STATE BOARD OF TECHNICAL EDUCATION & TRAINING::AP, VIJAYAWADA

DIPLOMA IN MECHANICAL ENGINEERING

III SEMESTER

FUELS LABORATORY PRACTICE (M-309)

MANUAL (AS PER C-20 CURRICULUM)

INTRODUCTION

1.0 INTRODUCTION

The Curriculum of Technical Education should invariably provide for knowledge, attitudes and skills required by the technicians /technologists in the country. In this context the laboratory courses form a vital portion in the entire curriculum of technician education. The laboratory courses shall therefore be so designed and delivered that they help the students acquire attitudes and motor skills that are essential to function effectively as technicians/technologists.

The planning, organization and implementation of lab courses need a detailed description of tasks to be performed by the students. Well thought out instructional objectives to a large extent give these descriptions. The analysis of tasks (by identifying the activities the students are expected to do) help prepare the objectives meticulously. In other words the objectives would be clearer, when the task analysis is done to spell out the sub tasks for each objective.

A survey of the practices currently followed in the technical/technician education shows an urgent need to plug in gaps in instructional procedures. The reasons for these gaps are ambiguity in the minds of the teachers regarding tasks to be performed, levels of competency to be achieved by the students and the weightage to be allocated for each task. This aids in scientific design of instructional plan (optimizing the resources, budgeting the time & content).

The task analysis, teaching points and the structured scheme of evaluation are very important in focusing the instruction on specific skill of desired outcome and in evaluating the same. The Instruction and evaluation in Laboratory courses are different from that of cognitive lessons in the sense that adequate importance and hence weightage needs to be given for all three domains of learning viz. cognitive, psychomotor and affective. Since both training and evaluation of traits of affective domain are practically difficult, a few traits (called values) most relevant and essential to occupations/professions after the Course may be identified for the purpose. It is imperative to integrate these values during instruction and evaluation and also overtly notify the same to the students.

A technician, in addition to performing a skill needs to prepare a report of testing that includes the description of procedure, details of measurements made, reasoning based inferences and so on.,. The current practice of record writing has failed to achieve this purpose as most of the time students end up with making copies of available material.

Therefore, for sensitizing the need for the changes in laboratory instruction, the present hand book has been prepared to meet the above requirements. As such the hand book comprises four parts that intend to :

- Present task analysis, teaching points which can be used for effective design of instruction
- provide a scheme of evaluation with rationally allocated weightage to each significant skill component
- offer a set of questions designed at different levels of competencies for assessment enabling the teacher to set the question paper with balanced levels of competencies

- present pre set worksheets that cultivate the habit of systematic recording of observations and writing the technical report.

- Provide all important data related to particular laboratory activity at one point in the form of annexure

1.1. STRUCTURE OF THE BOOK

The hand book is presented in four parts viz., Laboratory sheets, Worksheet, Experimental Methodology and Annexure. The description of each part is given in the following sections

Part I. Laboratory Sheet

The information provided in this part is useful for the teacher for designing the instruction, planning & organization of the experiment and for scientific evaluation of the students. The major features of the Laboratory sheet are further explained below.

1. **Objective**

   It indicates the **Task** to be performed and completed by the student during the specified duration of time.

2. **Task Analysis**

It is the process of identifying the component activities (sub tasks) to be carried out by the student in order to achieve the stipulated objective. As the task analysis aim at fitting the instructional objectives into various classes of behaviour, it would help the teacher to determine any particular type of behaviour the student has learnt / failed to perform.

The task analysis would help the teacher in identifying the specific activities to be performed by the students. This could also be used as some kind of check list to compare with activities planned for the laboratory. Further it would give clue to the teacher to make students think originally & act independently. It includes both psychomotor learning and the related cognitive information and hence the task analysis is presented as Knowledge and skill parts.

A. Knowledge Part: That includes the cognitive aspects of the task.

B. Skill Part: That includes Psychomotor & Affective aspects of the task.

3. **Teaching Points:**

This includes the points based on the SKILL identified with suggested duration for each point and total duration which helps the teacher for the time and content budgeting during instruction.

4. **Need and Scope:**

The purpose, application and scope of the task to be performed are normally included in this sub section.

5. **Planning and Organisation:**

It lists actions to be taken to perform various activities and hence useful in planning the instruction and organizing the resources and equipment

6. Scheme of Valuation:

The information provided in this section helps the teacher to devise a tool for rational measurement assessment of the competencies accomplished by the student.

Part II. Work Sheet

It is designed for the student, where in the student enters his personal data of identification, details of the experiment, stepwise procedure, observations made during experiment, a sample calculation, free hand typical graph, graph from experimental data and inference with discussion.

Part III. Experimental Methodology

This section furnishes information with regard to standard procedure to conduct the experiment along with the description of equipment/apparatus and the basic theory/concept involved in the conduct of the experiment. Thus this section is very useful for both teacher and student as well to conduct the experiment systematically. Thus this section is presented in four sub section as described below:

- **Description**

  It gives the detailed description of apparatus / tools / equipment / materials to be used for the task.

- **Theory / Concept**

  It gives the concept of the task to be performed with formulae and units.

- **Procedure**

  It provides the idea of step wise procedure to perform the task.

- **Observation and Calculation**

  It includes sample observation, sample graph, sample calculation for reference

Part IV. Annexure

All important and useful information that may help in accomplishment of tasks like conversion tables for units, technical & scientific data like material properities, standard trend or characteristic curves (graphs) etc are compiled and presented at one place in this section.

1.2. WHO IS TO USE AND HOW TO USE.

The hand book is so designed that it can be beneficially used by different sections of the technical education viz., the teacher, the student, the examiner and the administrator convenient to individual's requirements. A few uses of this hand book each stakeholder could make is outlined in the following sections.

1. Teacher

A. The **laboratory sheet** is designed keeping the teacher in mind for the teacher has key responsibility of imparting the skills to the student and hence the information given in the lab sheets may be useful for planning & organizing the experimental set up and designing an effective instruction. Thus the teacher may

Plan and organize as per *section 4*,

Instruct the students as per *section 2***,**

Demonstrate each sub task as per *section1.B*.and

Evaluate the students as per *section 5***,** according to the level of competency.

Values: The values in a person are an important personality trait that needs to be nurtured in the learning environment. Further it is also a driving component in any individual to deliver the best and hence this component is also included in the evaluation. However only five key dimensions, that are important in the teaching-learning environment, are taken into consideration for nurturing and evaluation. A little information about these five dimensions is given below as a guideline for the teacher while assessing students.

1. Co-operation: It is the voluntary arrangement in which two or more students engage in a mutually beneficial exchange, instead of competition. Cooperation can happen where resources adequate for both students exist or are created by their interaction.

2. Co-ordination: It is the unification, integration, synchronization of the effect of group members so as provide unity of action in the pursuit of common goals. It is an integral element and required in each & every function and at each & every stage & therefore it cannot be separated.

3. Communication; Communication skill is the set of skills that enables a student to convey information so that it is received and understood.

4. Sharing: A part or portion belonging to, distributed to, contributed by, owed by a person or a group **Or** To participate in, use, enjoy or experience jointly or in turns.

s5. Leadership: Students with the following leadership qualities are almost always the ones that rise above the crowd.

1. Trustworthiness: This refers to integrity.

2. Inspiration: Guides, leads and inspiring others to want to participate in the process of moving towards the vision.

3. Self awareness: It is the individual awareness of him or her self – their abilities and the impact that they have on others.

4. Acceptance of responsibility: True leaders are accepting responsibility for all that comes their way and taking ownership and responsibilities for getting things back on track. Blaming, justifying and excuse making just is not in their responsibility.

B. The **Experimental methodology** is designed for both teacher and student. The teacher can refer the experimental methodology for the details of equipment/apparatus/ materials/tools, procedure to be followed, observations to be made, graphs to be drawn and calculations to be done for the task to be performed

2. Student

The Worksheet is designed keeping in view the needs, deficiencies and the adolescent characteristics of the student for student.

The students submit the filled in work sheet given by the teacher on the day of experiment after referring to experimental methodology and listening to instructions of teacher. The design of the worksheet is made user friendly and the contents are so logically sequenced that the student finds it easy to understand and develop the skill of recording and report writing skill. It also helps the student to actively participate in skill learning. More importantly the student gets immediate meaningful feedback of his performance since the competency wise assessment is done and that too on the same day.

3. Examiner

The examiner may find this hand book very useful as Laboratory sheets and Scheme of evaluation provides information with regard to various competencies (skills) the students is expected to acquire during the course of study and the relative weightages of each competency. This information helps him to design a well balance question paper/measurement tool for assessment.

COURSE CONTENT

EXPERIMENT : 01

DETERMINATION OF FLASH AND FIRE POINTS USING ABLE'S APPARATUS

OBJECTIVES: To determine the Flash and fire point of given sample oil/fuel by using ABLE'S APPARATUS.

APPARATUS

- Able's apparatus.
- Thermometer (0 – 110^{o}C).
- Energy regulator.

Specifications

1. TASK ANALYSIS

A. KNOWLEDGE

1	Component parts of Able's apparatus
2	Definition of fuel and lubricating oil.
3	Flash point and fire point
4	Thermometer, Advantages of stirring
5	Energy regulator(voltage controlled

B. SKILL

Category of skill	Sub task
1.Handling of apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the mark C. closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame

2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the spring loaded knob. F. Providing the test flame at the opening.
3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings

2. TEACHING POINTS

S.NO	Teaching points	Suggestive duration (min)
1	Theoretical concept of fuel and lubricating oil, Flash point and fire point	
2	Noting the flash point and fire point at different supply voltages	
3	Handling of apparatus	
4	Need and scope of experiment	
5	Precautions	
	Total	

A. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- Care should be taken while opening and closing the shutter
- Care should be taken while keeping the test flame at the opening
- Record the temperature rise without parallax error
- Proper measure should be taken while opening the lid of the cup in hot condition
- Ensure that proper functioning of thermometer for precise calibration
- Dispose hot used oil carefully

B. Safety precautions

- Wear apron, hand gloves and safety goggles
- Beware of loose clothing and hair during experiment
- Ensure sufficient availability of oil
- Keep readily the availability of fire extinguishing equipment

3. NEED AND SCOPE OF EXPERIMENT

It is necessary to know the Temperature of flash and fire point of fuels/oils so that fuels can be stored, transported in safe working conditions

4. PLANNIG AND ORGANISATION

ACTION	ACTIVITY
Check for	1. Availability of required range of thermometers 2. Availability of oil/fuel 3. Electrical wiring and connections 4. Proper functioning of energy regulator 5. Stirrer and shutter controlled mechanisms 6. Working of electrical heater
For design of Instructions	Read the teaching points carefully

5. SCHEME OF EVALUATION

Category of skill	Subtask	Weight age with competency level individually	Awarded
1.Handlingof apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the specified mark C. closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame	A B C D E F G Tot	
2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the Spring loaded knob. F. Providing the test flame at the opening.	A B C D E F Tot	

3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings	A B C Tot	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership		
		Total	

6. ASSESMENT QUESTIONS

1. Prepare Able's apparatus to determine flash and fire point of given sample oil.
2. Connect the heater to the energy regulator
3. Check the functioning of thermometer
4. Record the temperature for flash point
5. Record the temperature for fire point

7. VIVA QUESTIONS

1. What is flash point?
2. What is fire point?
3. Name the various parts of apparatus
4. Why flash and fire points of fuel are tested

EXPERIMENT : 02

DETERMINATION OF FLASH AND FIRE POINTS USING PENSKY MARTEN'S APPARATUS

OBJECTIVES: To determine the Flash and fire point of given sample oil / fuel by using PENSKY MARTENS FLASH POINT AND FIRE POINT APPARATUS.

APPARATUS

- Pensky marten's apparatus.
- Thermometer (0 – 110^{o}C).
- Energy regulator.

Specifications.

This apparatus is made as per IP-34,ASTM D-93 and IS 1448 (part I) 1270 (part II) and IS 1209 - 1953 Method B.

1.TASK ANALYSIS

A. KNOWLEDGE

1	Component parts of Pensky marten's apparatus
2	Definition of fuel and lubricating oil.
3	Flash point and fire point
4	Thermometer, Advantages of stirring
5	Energy regulator(voltage controlled

B. SKILL

Category of skill	Sub task
1.Handling of apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the mark C. closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame
2.Manipulation of	A. switching on the power supply

apparatus	B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the spring loaded knob. F. Providing the test flame at the opening.
3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings D.

2. TEACHING POINTS:

S.NO	Teaching points	Suggestive duration (min)
1	Theoretical concept of fuel and lubricating oil, Flash point and fire point	
2	Noting the flash point and fire point at different supply voltages	
3	Handling of apparatus	
4	Need and scope of experiment	
5	Precautions	
	Total	

D. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- Care should be taken while opening and closing the shutter
- Care should be taken while keeping the test flame at the opening
- Record the temperature rise without parallax error
- Proper measure should be taken while opening the lid of the cup in hot condition
- Ensure that proper functioning of thermometer for precise calibration
- Dispose hot used oil carefully

E. Safety precautions

- Wear apron, hand gloves and safety goggles
- Beware of loose clothing and hair during experiment
- Ensure sufficient availability of oil
- Keep readily the availability of fire extinguishing equipment

3. NEED AND SCOPE OF EXPERIMENT

It is necessary to know the Temperature of flash and fire point of fuels/oils so that fuels can be stored, transported in safe working conditions

4. PLANNIG AND ORGANISATION

ACTION	ACTIVITY
Check for	1. Availability of required range of thermometers 2. Availability of oil/fuel 3. Electrical wiring and connections 4. Proper functioning of energy regulator 5. Stirrer and shutter controlled mechanisms 6. Working of electrical heater
For design of Instructions	Read the teaching points carefully

5. SCHEME OF EVALUATION

Category of skill	Subtask	Weight age with competency level individually	Awarded
1.Handlingof apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the specified mark C. closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame	A B C D E F G Tot 5	
2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the Spring loaded knob. F. Providing the test flame at the opening.	A B C D E F Tot 10	

3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings	A B C Tot 30	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	**05**	
		Total	

6. ASSESMENT QUESTIONS

1. Prepare Pensky-marten's apparatus to determine flash and fire point of given sample oil.
2. Connect the heater to the energy regulator
3. Check the functioning of thermometer
4. Record the temperature for flash point
5. Record the temperature for fire point

7. VIVA QUESTIONS

1. What is flash point?
2. What is fire point?
3. Name the various parts of apparatus
4. Why flash and fire points of fuel are tested

EXPERIMENT : 03

DETERMINATION OF FLASH AND FIRE POINTS USING CLEVELAND APPARATUS

OBJECTIVES: To determine the Flash and fire point of given sample oil/fuel by using CLEVELAND'S FLASH POINT AND FIRE POINT APPARATUS.

APPARATUS

- Cleveland's apparatus.
- Thermometer (0 – 100^{o}C).
- Energy regulator

1. TASK ANALYSIS

A. KNOWLEDGE

1	Component parts of Cleveland's apparatus
2	Definition of fuel and lubricating oil.
3	Flash point and fire point
4	Thermometer, Advantages of stirring
5	Energy regulator(voltage controlled)

B. SKILL

Category of skill	Sub task
1.Handling of apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the mark C. Checking the stirrer mechanism D. Fixing the thermometer in appropriate provision E. Making the arrangement for test flame
2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Observing the temperature rise E. Providing the test flame at the opening.
3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings

2. TEACHING POINTS:

S.NO	Teaching points	Suggestive duration (min)
1	Theoretical concept of fuel and lubricating oil, Flash point and fire point	
2	Noting the flash point and fire point at different supply voltages	
3	Handling of apparatus	
4	Need and scope of experiment	
5	Precautions	
	Total	

F. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- Care should be taken while keeping the test flame at the opening
- Record the temperature rise without parallax error
- Proper measure should be taken while opening the lid of the cup in hot condition
- Ensure that proper functioning of thermometer for precise calibration
- Dispose hot used oil carefully

G. Safety precautions

- Wear apron, hand gloves and safety goggles
- Beware of loose clothing and hair during experiment
- Ensure sufficient availability of oil
- Keep readily the availability of fire extinguishing equipment

3. NEED AND SCOPE OF EXPERIMENT

It is necessary to know the Temperature of flash and fire point of fuels/oils so that fuels can be stored, transported in safe working conditions

4. PLANNIG AND ORGANISATION

ACTION	ACTIVITY
Check for	1. Availability of required range of thermometers 2. Availability of oil/fuel 3. Electrical wiring and connections 4. Proper functioning of energy regulator 6. Working of electrical heater
For design of Instructions	Read the teaching points carefully

5. SCHEME OF EVALUATION

Category of skill	Subtask	Weight age with competency level individually	Awarded
1.Handlingof apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the specified mark C. Fixing the thermometer in appropriate provision D. Making the arrangement for test flame	A 1 B 1 C 2 D 1 Tot 5	
2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Observing the temperature ris D. Providing the test flame at the opening.	A 2 B 2 C 4 D 2 Tot 10	
3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings	A 14 B 14 C 2 Tot 30	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	**5**	
		Total	

6. ASSESMENT QUESTIONS

1. Prepare cleveland's apparatus to determine flash and fire point of given sample oil.
2. Connect the heater to the energy regulator
3. Check the functioning of thermometer
4. Record the temperature for flash point
5. Record the temperature for fire point

7. VIVA QUESTIONS

1. What is flash point?
2. What is fire point?
3. Name the various parts of apparatus
4. Why flash and fire points of fuel are tested

EXPERIMENT : 04

DETERMINATION OF VISCOSITY OF GIVEN OIL USING REDWOOD VISCOMETER-I

OBJECTIVE: To perform the viscosity test of a given sample of oil on Redwood viscometer-I and determine the
Following at different temperatures
1. Kinematic viscosity 2. Dynamic viscosity

APPARATUS:
1. Redwood viscometer-I 2 Electrical heater 3.Thermometers-2 Nos 4.Stop watch
5. 50 ml measuring flask . 6. Glass jar and oil 7.Weighing machine

TASK ANALYSIS:

A) KNOWLEDGE:
1) Viscosity
2) Kinematic viscosity
3) Dynamic Viscosity
4) Effect of temperature on Viscosity
5) Electrical heater
6) Thermometers
7) Stop watch
8) Weighing machine

B) SKILL:

Category of Skill	Sub Task
Handling of apparatus/tools/material	• Choosing the appropriate instrument • Leveling the viscometer • Fixing the power supply • Cleaning the oil cup. • Placing the ball valve • Filling the water and oil
Manipulation of apparatus	• Weighing the graduate glass flask • Heating the bath • Stirring the water • Starting the stop watch
Precise Operations/Activities	• Stopping the stop watch • Noting down the time for collecting 50 ml of oil • Weighing the glass flask with 50 ml oF oil • Calculating the Kinematic viscosity • Calculating the density of oil • Calculating the Dynamic viscosity of oil • Repeating the process • Drawing the graph Viscosity Vs Temperature.

TEACHING POINTS:

S. No	Teaching Point	Time allocation (15 mins Suggestive)
1	Define Density, Viscosity, Dynamic Viscosity and Kinematic Viscosity	04
2	List the part of Red Wood Viscometer-I	02
3	Show the placing of ball vale, stirrer, thermometer and filling of water and oil	02
4	Explain the procedure of conducting the Experiment	04
5	Explain the calculations	03

A) PROCEDURAL PRECAUTIONS:

- The oil cup thoroughly dried
- The orifice should be well cleaned to avoid choking and ensure free flow
- Ensure proper setting of the ball valve to avoid leakage
- The oil should be filled in the container up to the indicated mark
- Fix the thermometers properly and see that they do not slip or obstruct the stirrer
- Stir the water continuously so that the temperature of the oil and water are equal.
- Always take the readings at a stable temperature.
- Note down the time without any error

B) SAFETY PRECAUTIONS:

- Wear shoe and apron.
- Don't wear loose cloths.

NEED

- Viscosity of an oil is an impotent property of liquids based on which flow of liquid depends. The lubricating oils
  are used to reduce the friction, heat, and wear between mechanical components that are in contact with each other.
- The viscosity of oil influences the ease of handling, transportation and nature of storage.
- The combustion of the fuel oils are depends upon the viscosity. High viscosity fuel oil cannot be properly
  High viscosity fluids cause undue friction and reduce its fluidity.
- The lubricating oils are used in bearings for reducing the friction between the internal sliding surfaces of the **bearings** components and reduce or prevent metal-to-metal contact of the rolling elements with their raceways. Proper **lubrication** reduces wear and prevents corrosion, ensuring long service lives for **bearings**.
  the viscosity of lubricating oil determines the bearing friction, heat generation and fluidity under the conditions of load and speed.

Scope

Investigation of new oils that are used as a lubricating oils and alternative fuels for I.C Engines

SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
1. Handling of apparatus	A) Choosing the appropriate instrument B) Leveling the viscometer C) Fixing the power supply D) Cleaning the oil cup E) Placing the ball valve F) Filling the water and oil	A B C D E F T 1 1 1 1 1 1 6	6
2. Manipulation of apparatus	A) Weighing the graduated glass flask B) Heating the bath C) Stirring the water. D) Starting the stop watch	A B C D T 4 3 5 3 15	15
3. Precise Operations/ Activities	A) Stopping the stop watch B) Noting down the time for collecting 50CC oil C) Calculating the kinematic viscosity of oil D) Calculating the density of oil E) Calculating the dynamic	A B C D E F G T 2 2 5 5 2 3 5 24	24

<table>
<tr><td></td><td>viscosity of oil
F) Repeating the process
G) Drawing the graphs
.</td><td></td><td></td></tr>
<tr><td>4. Values</td><td>A) Co Operation
B) Co- Ordination
C) Communication
D) Sharing
E) Leadership</td><td><table><tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>T</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>5</td></tr></table></td><td>5</td></tr>
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VII) ASSESSMENT QUESTIONS:

1. Which oil is tested and what is the application of oil?(lower order)
2. How do you measure the weight of oil and weight of the flask?
3. What instrument is used to measure the temperature?
4. What instrument is used to measure the time?
5. Why stirring is done in viscometer?
6. What is the Redwood viscometer constant?
7. What is the relation between kinematic viscosity, density and dynamic viscosity
8. Draw the graph between Temp vs Redwood seconds
9. Draw the graph between Temp and kinematic viscosity
10. Draw the graph between Temp and Dynamic viscosity
11. What type of curve obtained between Temp and kinematic viscosity

VIVA QUESTIOINS:

1. What is Viscosity?
2. What are different types of viscosity explain them and write the units?
3. What are factors effecting viscosity?
4. Mention some applications where viscosity is considered?
5. Relation between density and viscosity?
6. What is the effect of temperature on viscosity of the liquids?
7. Why is the viscosity of temperature of liquid decreases with temperature?
8. Mention different types of oils used in lubricating purposes?
9. How does SAE grade differ in lubricants oils used summer and winter?
10. Properties of good lubricant?
11. How viscosity does effects lubricants?
12. What is the temperature range for Redwood – I viscometer?

EXPERIMENT : 05

DETERMINATION OF VISCOSITY OF GIVEN OIL USING REDWOOD VISCOMETER-II

OBJECTIVE: To perform the viscosity test of a given sample of oil on Redwood viscometer-II and determine the
Following at different temperatures
1. Kinematic viscosity 2. Dynamic viscosity

APPARATUS:
1. Redwood viscometer-II 2. Electrical heater 3.Thermometers-2 Nos 4.Stop watch
5. 50 ml measuring flask 6. Glass jar and oil 7.Weighing machine

TASK ANALYSIS:

C) KNOWLEDGE:
9) Viscosity
10) Kinematic viscosity
11) Dynamic Viscosity
12) Effect of temperature on Viscosity
13) Electrical heater
14) Thermometers
15) Stop watch
16) Weighing machine

D) SKILL:

Category of Skill	Sub Task
Handling of apparatus/tools/material	• Choosing the appropriate instrument • Leveling the viscometer • Fixing the power supply • Cleaning the oil cup. • Placing the ball valve • Filling the water and oil
Manipulation of apparatus	• Weighing the graduate glass flask • Heating the bath • Stirring the water • Starting the stop watch
Precise Operations/Activities	• Stopping the stop watch • Noting down the time for collecting 50 ml of oil • Weighing the glass flask with 50 ml oF oil • Calculating the Kinematic viscosity • Calculating the density of oil • Calculating the Dynamic viscosity of oil • Repeating the process • Drawing the graph Viscosity Vs Temperature.

TEACHING POINTS:

S. No	Teaching Point	Time allocation (15 mins Suggestive)
1	Define Density, Viscosity, Dynamic Viscosity and Kinematic Viscosity	04
2	List the part of Red Wood Viscometer-I	02
3	Show the placing of ball vale, stirrer, thermometer and filling of water and oil	02
4	Explain the procedure of conducting the Experiment	04
5	Explain the calculations	03

B) PROCEDURAL PRECAUTIONS:

- The oil cup thoroughly dried
- The orifice should be well cleaned to avoid choking and ensure free flow
- Ensure proper setting of the ball valve to avoid leakage
- The oil should be filled in the container up to the indicated mark
- Fix the thermometers properly and see that they do not slip or obstruct the stirrer
- Stir the water continuously so that the temperature of the oil and water are equal.
- Always take the readings at a stable temperature.
- Note down the time without any error

B) SAFETY PRECAUTIONS:

- Wear shoe and apron.
- Don't wear loose cloths.

NEED

- Viscosity of an oil is an impotent property of liquids based on which flow of liquid depends. The lubricating oils
  are used to reduce the friction, heat, and wear between mechanical components that are in contact with each other.
- The viscosity of oil influences the ease of handling, transportation and nature of storage.
- The combustion of the fuel oils are depends upon the viscosity. High viscosity fuel oil cannot be properly
  Atomized leading to incomplete combustion and loss of fuel. The Maximum viscosity for easy atomization in
  Conventional burners are 25 centistokes. In case of diesel fuels, too low viscosity causes excessive leakage at
  Injection pistons while too high viscosity produces coarse droplets leading to incomplete combustion.
- High viscosity fluids cause undue friction and reduce its fluidity.
- The lubricating oils are used in bearings for reducing the friction between the internal sliding surfaces of the **bearings** components and reduce or prevent metal-to-metal contact of the rolling elements with their raceways. Proper **lubrication** reduces wear and prevents corrosion, ensuring long service lives for **bearings**.
  the viscosity of lubricating oil determines the bearing friction, heat generation and fluidity under the conditions of load and speed.

Scope

Investigation of new oils that are used as a lubricating oils and alternative fuels for I.C Engines

SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
1. Handling of apparatus	A) Choosing the appropriate instrument B) Leveling the viscometer C) Fixing the power supply D) Cleaning the oil cup E) Placing the ball valve F) Filling the water and oil	A B C D E F T 1 1 1 1 1 1 6	6
2. Manipulation of apparatus	A) Weighing the graduated glass flask B) Heating the bath C) Stirring the water. D) Starting the stop watch	A B C D T 4 3 5 3 15	15

3. Precise Operations/ Activities	A) Stopping the stop watch B) Noting down the time for collecting 50CC oil C) Calculating the kinematic viscosity of oil D) Calculating the density of oil E) Calculating the dynamic viscosity of oil F) Repeating the process G) Drawing the graphs	<table><tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>T</td></tr><tr><td>2</td><td>2</td><td>5</td><td>5</td><td>2</td><td>3</td><td>5</td><td>24</td></tr></table>	24
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	<table><tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>T</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>5</td></tr></table>	5

VII) ASSESSMENT QUESTIONS:

1. Which oil is tested and what is the application of oil?(lower order)
2. How do you measure the weight of oil and weight of the flask?
3. What instrument is used to measure the temperature?
4. What instrument is used to measure the time?
5. Why stirring is done in viscometer?
6. What is the Redwood viscometer constant?
7. What is the relation between kinematic viscosity, density and dynamic viscosity
8. Draw the graph between Temp vs Redwood seconds
9. Draw the graph between Temp and kinematic viscosity
10. Draw the graph between Temp and Dynamic viscosity
11. What type of curve obtained between Temp and kinematic viscosity

VIVA QUESTIOINS:

1. What is Viscosity?
2. What are different types of viscosity explain them and write the units?
3. What are factors effecting viscosity?
4. Mention some applications where viscosity is considered?
5. Relation between density and viscosity?
6. What is the effect of temperature on viscosity of the liquids?
7. Why is the viscosity of temperature of liquid decreases with temperature?
8. Mention different types of oils used in lubricating purposes?
9. How does SAE grade differ in lubricants oils used summer and winter?
10. Selection of viscometers based on grading or viscosity of oil?
11. Properties of good lubricant?
12. How viscosity does effects lubricants?
13. What is the temperature range for Redwood – II viscometer?

EXPERIMENT : 06

DETERMINATION OF VISCOSITY OF GIVEN OIL USING SAYBOLT VISCOMETER

OBJECTIVES: To determine the viscosity of given sample oil/fuel by using Saybolt Apparatus.

APPARATUS:

1. Saybolt Apparatus.
2. Thermometer (0 – 110^{o}C).
3. Auto Transformer

Specifications:

1. TASK ANALYSIS

A. KNOWLEDGE

1	choose the appropriate apparatus
2	Cleaning the cup thoroughly with a dry cloth
3	Pouring the given oil upto the mark
4	Pouring the water upto the end of the level mark
5	Fixing the bob in centre of the oil cup
6	Fixing the thermometers in respective positions
7	Fixing the current, slowly increasing the voltage,
8	Observing the raising temperatures of oil and water.
9	Stirring the water continuously in water bath
10	Observing the required temperature reached or not,
11	placing the 50ml conical flask, exactly below the cup,
12	keeping stopwatch in ready condition and removing the bob,
13	Noting time for collecting the 50 ml oil in a given flask.

B. SKILL

1. Cleaning the cup thoroughly with drycloth
2. Fixing the bob exactly centre of the position in a cup
3. Fixing the current and maintaining the required voltage
4. Stirring continuously in a water bath with stirrer
5. Collecting exactly 50ml oil
6. Noting time with stopwatch.

Category of skill	Sub task
1.Handling of apparatus	A. Choosing the appropriate instrument B. Cleaning the oil cup C. Placing the bob D. Pouring the water and oil E. Fixing the power supply
2.Manipulation of apparatus	A. Heating the water bath B. Stirring the water C. Placing the flask in exact position D. Noting the time in stopwatch E. Noting the required temperature
3.Precise operation/activity	A. Noting the temperature of oil B. Noting the time for collecting 60C.C. C. Calculating the viscosity D. Draw the graph Viscosity Vs Temperature

2. TEACHING POINTS:

S.NO	Teaching points	Suggestive duration (min)
1	Define Density, Viscosity, Dynamic Viscosity and Kinematic Viscosity	2
2	Describing the Abels apparatus	3
3	Show the placing of bob, stirrer, thermometer and filling of water and oil	1
4	Explain the procedure of conducting the Experiment	5
5	Explain the calculations	4
	Total	15

H. Procedural precautions.

- Maintaing the water in a water bath
- Maintaing the oil in a oil cup
- Stirring the water in waterbath
- Fixing the proper connections to autotransformer
- Placing the bob in centre of the oil cup.
- Collecting the exact 50ml of oil

I. Safety precautions

- Maintaining the proper connections and insulations
- Wearing proper apron, shoe.

3. NEED AND SCOPE OF EXPERIMENT:

It is necessary to determine viscosity of given oil so that it can be used in different machining purpose

4. PLANNIG AND ORGANISATION

ACTION	ACTIVITY
Check for	1. Availability of required range of thermometers 2. Availability of oil/fuel 3. Electrical wiring and connections 4. Proper functioning of energy regulator 5. Stirrer and shutter controlled mechanisms 6. Working of electrical heater
For design of Instructions	Read the teaching points carefully

5. SCHEME OF EVALUATION

Category of skill	Subtask	Weightage with competency level individually	Awarded
1.Handlingof apparatus	A. Choosing the appropriate instrument B. Cleaning the oil cup C. Placing the bob D. Poring the water and oil E. Fixing the power supply	A 1 B 1 C 1 D 1 E 1 Tot 5	**5**
2.Manipulation of apparatus	A. Heating the water bath B. Stirring the water C. Placing the flask in exact position D. Noting the time in stopwatch E. Noting the required temperature	A 2 B 2 C 5 D 3 E 3 Tot 15	**15**
3.Precise operation/activity	A. Noting the temperature of oil B. Noting the time for collecting 60C.C. C. Calculating the viscosity D. Draw the graph Viscosity Vs Temperature	A 3 B 5 C 12 D 5 Tot 25	**25**
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	A 1 B 1 C 1 D 1 E 1 Tot 5	**05**
		Total	**50**

6. ASSESMENT QUESTIONS

1. Define viscosity.
2. Define kinematic viscosity
3. Define dynamic viscosity
4. What is the density
5. what are the different types of lubricants?
6. Mention the properties of lubricants
7. Differentiate between cutting fluids and lubricants

7. VIVA QUESTIONS

1. What are the units of kinematic viscosity
2. Mention the lubricants used in IC engines.
3. What will happen viscosity as temperature increases.
4. Give example semi solid lubricants.

EXPERIMENT : 07

DETERMINATION OF CALORIFIC VALUE OF GIVEN GASSEOUS FUEL USING JUNKER'S GAS CALORIMETER

OBJECTIVES: To determine the Calorific value of given gaseous fuel using Junker's Gas Calorimeter.

APPARATUS:

1. Junker's Gas Calorimeter.
2. Thermometers

Specifications:

TASK ANALYSIS:

Experiment:

To conduct the test on Junker's gas Calorimeter to determine the calorific value of the given gaseous fuel**..**

S.No	List the skill first, as you think of them
1	Choosing the appropriate instrument
2	Filling the governor with water and tighten over flow nut
3	Placing the three thermometers into the rubber corks.
4	Inserting burner into its support rod in the bottom of the calorimeter and fix knob tightly.
5	Connecting the calorimeter, the flow meter and the pressure governor using rubber tubing provided.
6	Turning water regulator knob on calorimeter to ON position. Allowing water to flow through the calorimeter from overhead tank/ tap.
7	Connecting gas supply line to governor inlet. Remove burner from calorimeter then open governor outlet tap. Allow gas to pass through the burner.
8	Lighting up the burner by holding a lighted match stick near the mesh at the top.
9	Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non-luminous flame. Fixing the lighted burner back into position.
10	Adjusting water regulator on calorimeter to get a temperature difference of 12^0C to $15\ ^0$ C between the inlet water & outlet water as indicated by the respective thermometers at the top of the calorimeter.
11	Allowing 20 to 30 min for outlet water temperature to become steady.
12	Measuring the water flow rate with the help of measuring jar. Simultaneously, note the flow meter reading.
13	Noting down the inlet &outlet water temperatures.
14	Repeating the test with same volume of gas 3 or 4 times and take average temperatures of inlet and outlet water.
15	Calculating the calorific value of given fuel

Activity 2: Classify the above listed skills as below in the following format

S.No	Category	List the skill first, as you think of them
1	Handling of apparatus/tools/material	Choosing the appropriate instrument
2		Filling the governer with water
3		Placing the three thermometers into the rubber corks.
4		Inserting burner into its support rod in the bottom of the calorimeter and fix knob tightly
5		Connecting the calorimeter, the flow meter and the pressure governor using rubber tubing provided.
6		Turning water regulator knob on calorimeter to ON position. Allow water to flow through the calorimeter from overhead tank/ tap.
7		Connecting gas supply line to governor inlet. Remove burner from calorimeter then open governor outlet tap. Allow gas to pass through the burner.
8	Manipulation of tools/equipment	Lighting up the burner by holding a lighted match stick near the mesh at the top.
9		Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non-luminous flame. Fixing the lighted burner back into position.
10		Adjusting water regulator on calorimeter to get a temperature difference of 12^0C to $15\ ^0$ C between the inlet water & outlet water as indicated by the respective thermometers at the top of the calorimeter.
11		Measuring the water flow rate with the help of measuring jar. Simultaneously, note the flow meter reading.
12		Allowing 20 to 30 min for outlet water temperature to become steady.
13	Precise operations	Noting down the inlet &outlet water temperatures.
14		Repeating the test with same volume of gas 3 or 4 times and take average temperatures of inlet and outlet water.
15		Calculating the calorific value of given fuel

C. Teaching Points

S. No	Teaching Point	Time allotted in minutes
1	Define Fuel, Different types of fuels with examples, Explain concept of Calorific vale	03
2	Explain pats of Junker's gas Calorimeter	03
3	Explain the procedure of conducting the Experiment	05
4	Explain the calculations	04
	Total time (≤15 minutes)	

SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
1. Handling of apparatus	A) Choosing the appropriate instrument B) Filling the governor with water C) Placing the three thermometers into the rubber corks D) Inserting burner into its support rod in the bottom of the calorimeter and fix knob tightly E) Connecting the calorimeter, the flow meter and the pressure governor using rubber tubing provided. F) Turning water regulator knob on calorimeter to ON position. Allow water to flow through the calorimeter from overhead tank/ tap. G) Connecting gas supply line to governor inlet. Remove burner from calorimeter then open governor outlet tap. Allow gas to pass through the burner.	A: , B: , T: 05	05
2. Manipulation of apparatus	A) Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fixing the lighted burner back into position. B) Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fixing the lighted burner back into position. C) Adjusting water regulator on calorimeter to get a temperature difference of 12^0C to 15 ^{0} C between the inlet water & outlet water as indicated by the respective thermometers at the top of the calorimeter. D) Measuring the water flow rate with the help of measuring jar. Simultaneously, note the flow meter reading. E) Allowing 20 to 30 min for outlet water temperature to become steady.	A: , B: , C: , T: 15	15
3. Precise Operations Activities	A) Noting down the inlet &outlet water temperatures. B) Repeating the test with same volume of gas 3 or 4 times and take average temperatures of inlet and outlet water. C) Calculating the calorific value of given fuel	A: , B: , C: , T: 25	25
4. Values	F) Co Operation G) Co- Ordination H) Communication I) Sharing J) Leadership		05

EXPERIMENT : 08

DETERMINATION OF CARBON RESIDUE OF GIVEN FUEL USING CONRADSON'S APPARATUS

OBJECTIVES: To determine the carbon residue by using conradson's Apparatus.

APPARATUS:

1. Conradson's Apparatus.
2. Weight balance

Specifications:

TASK ANALYSIS :

S.No	List the skill first, as you think of them
1	Choosing the appropriate instrument
2	Fixing the connections
3	Cleaning the porcelain or silica crucible
4	Weighing the porcelain or silica crucible
5	Weighing the crucible and sample of oil
6	Placing in wrought iron crucible
7	Placing the Chimney
8	Heating the wrought iron crucible
9	Heating 5 minutes slowly
10	Heating 15 minutes Strongly
11	Cooling the apparatus
12	Weighing the crucible with residue
13	Calculating the weight of residue
14	Calculating the percentage of residue

Activity 2: Classify the above listed skills as below in the following format

S.No	Category	Classified Skills
1	Handling of apparatus/tools/material	Choosing the appropriate instrument
2		Fixing the connections
3		Cleaning the porcelain or silica crucible
4	Manipulation of tools/equipment	Weighing the porcelain or silica crucible
5		Weighing the crucible and sample of oil
6		Placing in wrought iron crucible
7		Placing the Chimney
8	Precise operations	Heating the wrought iron crucible
9		Heating 5 minutes slowly
10		Heating 15 minutes Strongly
11		Cooling the apparatus
12		Weighing the crucible with residue
13		Calculating the weight of residue
14		Calculating the percentage of residue

C. Teaching Points

S. No	Teaching Point	Time allotted in minutes
1	Define Fuel, Solid fuel, liquid fuel, gaseous fuel	02
2	Explain the meaning of Residue	01
3	Show the parts of residue test apparatus	04
4	Explain the procedure of conducting the Experiment	05
5	Explain the calculations	03
	Total time (≤15 minutes)	

SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
1. Handling of apparatus	A) Choosing the appropriate instrument. B) Fixing the connections C) Cleaning the porcelain or silica crucible	A: , B: , T: 05	05
2. Manipulation of apparatus	A) Weighing the porcelain or silica crucible. B) Weighing the crucible and sample of oil C) Placing in wrought iron crucible D) Placing the Chimney	A: , B: , C: , T: 15	15
3. Precise Operations Activities	D) Heating the wrought iron crucible E) Heating 5 minutes slowly F) Heating 15 minutes Strongly G) Cooling the apparatus H) Weighing the crucible with residue I) Calculating the weight of residue J) Calculating the percentage of residue	A: , B: , C: , T:	25
4. Values	K) Co Operation L) Co- Ordination M) Communication N) Sharing O) Leadership		05

EXPERIMENT : 09

CALIBRATION OF PRESSURE GAUGE USING DEAD WEIGHT PRESSURE GAUGE TESTER

OBJECTIVES: To calibrate pressure gauge using dead weight pressure gauge tester

APPARATUS:

1. Dead weights pressure gauge tester
2. Weights

Specifications:

TASK ANALYSIS :

S.No	List the skill first, as you think of them
1	Choosing the appropriate instrument
2	Placing the apparatus on a firm flat table or platform to provide convenient operating height for the apparatus.
3	Placing a spirit level on the top of the loading head
4	Levelling the apparatus adjusting the levelling screws
5	Pouring the hydraulic oil through the hole on top of the priming-pump while rotating its handle in anti-clockwise direction until the handle is completely taken out
6	Rotating the priming-pump slowly in clockwise direction with its isolating valve open until oil starts coming out of pressure gauge adopter
7	Fitting the gauge in the adopter.
8	Rotating pressure-pump handle in clockwise direction till it stops
9	Rotating priming- pump handle in anti-clockwise direction until it is taken out, and add oil if required in to the priming-pump
10	Placing weights on the loading head up to the full capacity of the apparatus and see that a pressure gauge of capacity slightly higher than the total capacity of weights is fitted in the adopter
11	Opening the isolating valve and fix the priming-pump handle simultaneously unscrewing pressure-pump so that it is unscrewed completely
12	Screwing the priming-pump tightly and close the isolating valve.
13	Moving the pressure-pump handle clockwise to build up pressure in the system
14	Checking for any leaks at the pressure gauge fitting adopter etc
15	Building up the pressure to the full capacity of weights and rotate the weights gently by hand
16	Rotating the weights to minimize the friction between the hydraulic ram and its guide so that the loaded ram just floats on the oil surface
17	Rotating the handle of pressure-pump and open the isolating valve

18	Rotating the priming-pump handle in the anti-clockwise direction until the pressure comes to zero.
19	Removing the weights from the loading plat form and fit the pressure gauge to be tested in the pressure gauge adopter
20	Using the sealing washer in the joint to prevent leakage.
21	Selecting about ten points at equal intervals to reach the full capacity of the gauge
22	Selecting the corresponding weights from the set of weights supplied
23	Adding weights on the loading head step by step after priming and closing the isolating valve
24	operating the pressure-pump clockwise so that the loading platform remains lifted up to the red mark on the guide
25	Rotating the weights gently by hand and see that the platform remains moving in the red band range
26	Increasing the weights continuously and balancing the hydraulic ram in the red band range.
27	Comparing the pressure shown by the pressure gauge needle with the sum of pressure intensities marked on the weights at various selected points and make necessary adjustments in the pressure gauge mechanism

Activity 2: Classify the above listed skills as below in the following format

S.No	Category	Classified Skills
1	Handling of apparatus/tools/material	Choosing the appropriate instrument
2		Placing the apparatus on a firm flat table or platform to provide convenient operating height for the apparatus
3		Rotating the priming-pump slowly in clockwise direction with its isolating valve open until oil starts coming out of pressure gauge adopter
4		Fitting the gauge in the adopter
5		Rotating pressure-pump handle in clockwise direction till it stops
6		Rotating priming- pump handle in anti-clockwise direction until it is taken out, and add oil if required in to the priming-pump
7		Opening the isolating valve and fix the priming-pump handle simultaneously unscrewing pressure-pump so that it is unscrewed completely
8		Moving the pressure-pump handle clockwise to build up pressure in the system
9		Checking for any leaks at the pressure gauge fitting adopter etc
10		Rotating the handle of pressure-pump and open the isolating valve

11		Removing the weights from the loading plat form and fit the pressure gauge to be tested in the pressure gauge adopter
12		operating the pressure-pump clockwise so that the loading platform remains lifted up to the red mark on the guide
13		Rotating the weights gently by hand and see that the platform remains moving in the red band range
14		Increasing the weights continuously and balancing the hydraulic ram in the red band range.
15	Manipulation of tools/equipment	Placing a spirit level on the top of the loading head
16		Levelling the apparatus adjusting the levelling screws
17		Screwing the priming-pump tightly and close the isolating valve.
18		Rotating the weights to minimize the friction between the hydraulic ram and its guide so that the loaded ram just floats on the oil surface
19		Using the sealing washer in the joint to prevent leakage.
20	Precise operations	Pouring the hydraulic oil through the hole on top of the priming-pump while rotating its handle in anti-clockwise direction until the handle is completely taken out
21		Placing weights on the loading head up to the full capacity of the apparatus and see that a pressure gauge of capacity slightly higher than the total capacity of weights is fitted in the adopter
22		Building up the pressure to the full capacity of weights and rotate the weights gently by hand
23		Rotating the priming-pump handle in the anti-clockwise direction until the pressure comes to zero.
24		Selecting about ten points at equal intervals to reach the full capacity of the gauge
25		Selecting the corresponding weights from the set of weights supplied
26		Addding weights on the loading head step by step after priming and closing the isolating valve
27		Comparing the pressure shown by the pressure gauge needle with the sum of pressure intensities marked on the weights at various selected points and make necessary adjustments in the pressure gauge mechanism

C. Teaching Points

S. No	Teaching Point	Time allotted in minutes
1	Define Pressure and explain about the pressure gauge and importance of calibration of pressure gauge	03
2	Explain pats of dead Weight pressure gauge	04
3	Explain the procedure of conducting the Experiment	06
4	Explain the calculations	02
	Total time (≤15 minutes)	

SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
1. Handling of apparatus	A) Identifying the components required. B) Placing the apparatus on a firm flat table or platform to provide convenient operating height for the apparatus C) Rotating the priming-pump slowly in clockwise direction with its isolating valve open until oil starts coming out of pressure gauge adopter D) Fitting the gauge in the adopter E) Rotating pressure-pump handle in clockwise direction till it stops F) Rotating priming- pump handle in anti-clockwise direction until it is taken out, and add oil if required in to the priming-pump G) Opening the isolating valve and fix the priming-pump handle simultaneously unscrewing pressure-pump so that it is unscrewed completely H) Moving the pressure-pump handle clockwise to build up pressure in the system I) Checking for any leaks at the pressure gauge fitting adopter etc J) Rotating the handle of pressure-pump and open the isolating valve K) Removing the weights from the loading plat form and fit the pressure gauge to be tested in the pressure gauge adopter L) operating the pressure-pump clockwise so that the loading platform remains lifted up to the red mark on the guide M) Rotating the weights gently by hand and see that the platform remains moving in the red band range N) Increasing the weights continuously and balancing the hydraulic ram in the red band range.	**A** | **B** | **T** | | 05	05

2. Manipulation of apparatus	A) Placing a spirit level on the top of the loading head B) Levelling the apparatus adjusting the levelling screws C) Screwing the priming-pump tightly and close the isolating valve D) Rotating the weights to minimize the friction between the hydraulic ram and its guide so that the loaded ram just floats on the oil surface E) Using the sealing washer in the joint to prevent leakage.	<table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>15</td></tr></table>	15
3. Precise Operations Activities	A) Pouring the hydraulic oil through the hole on top of the priming-pump while rotating its handle in anti-clockwise direction until the handle is completely taken out B) Placing weights on the loading head up to the full capacity of the apparatus and see that a pressure gauge of capacity slightly higher than the total capacity of weights is fitted in the adopter C) Building up the pressure to the full capacity of weights and rotate the weights gently by hand D) Rotating the priming-pump handle in the anti-clockwise direction until the pressure comes to zero E) Selecting about ten points at equal intervals to reach the full capacity of the gauge F) Selecting the corresponding weights from the set of weights supplied G) Addding weights on the loading head step by step after priming and closing the isolating valve H) Comparing the pressure shown by the pressure gauge needle with the sum of pressure intensities marked on the weights at various selected points and make necessary adjustments in the pressure gauge mechanism	<table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>25</td></tr></table>	25
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	<table><tr><td></td></tr><tr><td></td></tr></table>	05

EXPERIMENT : 01

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING ABLE'S APPARATUS

WORK SHEET

Name of the student:		Date of Experiment
PIN	Branch:	
Institution:		Experiment No.

1. Title of the experiment:

2. Objective of the experiment:

3. Apparatus/tools required:

4. Procedure:

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

5. Observations

Sample oil	Flash point, ^{o}C	Fire point, ^{o}C

6. Result

7. Discussion on result

8. Deficiency/malfunctioning of the apparatus (if any)

Category of skill	Subtask	Weight age with competency level individually	Awarded
1. Handling of apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the specified mark C closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame	A B C D Tot	
2. Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the Spring loaded knob. F. Providing the test flame at the opening.	A B C D Tot	
3. Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings	A B C D E Tot	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership		
		Total	

EXPERIMENT : 02

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING PENSKY MARTENS APPARATUS
WORK SHEET

Name of the student:		Date of Experiment
PIN	Branch:	
Institution:		Experiment No.

1. Title of the experiment:

2. Objective of the experiment:

3. Apparatus/tools required:

4. Procedure:

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

5. Observations

Sample oil	Flash point, ^{o}C	Fire point, ^{o}C

6. Result.

7. Discussion on result.

8. Deficiency/malfunctioning of the apparatus (if any)

Category of skill	Subtask	Weight age with competency level individually	Awarded
1.Handlingof apparatus	A. Plug-in the apparatus to power supply B. Filling the oil/fuel into the cup up to the specified mark C closing the cup with closing lid supplied with apparatus D. Checking the shutter controlling spring loaded knob E. Checking the stirrer mechanism F. Fixing the thermometer in appropriate provision G. Making the arrangement for test flame	A B C D Tot	
2.Manipulation of apparatus	A. switching on the power supply B. Changing the voltage by rotating the knob of energy regulator C. Stirring the oil continuously. D. Observing the temperature rise E. opening the shutter by rotating the Spring loaded knob. F. Providing the test flame at the opening.	A B C D Tot	
3.Precise operation/activity	A. Recording the temperature for flash point B. Recording the temperature for fire point C. Change the voltage for another set of readings	A B C D E Tot	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership		
		Total	

EXPERIMENT : 03

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING CLEVELAND APPARATUS

WORK SHEET

Name of the student:		Date of Experiment
PIN	Branch:	
Institution:		Experiment No.

1. Title of the experiment:

2. Objective of the experiment:

3. Apparatus/tools required:

4. Procedure:

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

5. Observations.

Sample oil	Flash point, ^{o}C	Fire point, ^{o}C

6. Sample calculations.

7. Graph.

8. Result.

9. Discussion on result.

10. Deficiency / malfunctioning of the apparatus (if any)

11. Scheme of valuation:

Category of skill	Subtask	Weightage with competency level individually	Awarded
1.Handlingof apparatus	A. B. C. D.	A B C D Tot	
2.Manipulation of apparatus	A. B. C. D.	A B C D Tot	
3.Precise operation/activity	A. B. C. D. E.	A B C D E Tot	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership		
		Total	

EXPERIMENT : 04

DETERMINATION OF VISCOSITY OF THE GIVEN OIL USING REDWOOD

VISCOMETER - I

WORK SHEET

NAME OF THE STUDENT:	INSTITUTION:
PIN NUMBER:	DATE OF EXPERIMENT:
BRANCH:	EXPERIMENT NO:

1. Title of the experiment: VICSOSITY TSEST

2. Objective of the Experiment: To determine the Kinematic viscosity and Dynamic viscosity of a Given sample of oil at different temperatures by using Red Wood-I Viscometer

3. Apparatus/Tools Required Redwood viscometer-I, Stop watch, Thermometers-2, Measuring Flask, Glass jar and oil ,stop watch, weighing machine

4. Procedure:

1.
2.
3.
4.
5.
6.
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8.
9.
10.
11.
12.
13.
14.
15.

5. Observations:

Weight empty glass flask W_1= --------grams
Weight of oil + Weight of empty glass flask (W_2)=----------grams
Volume of the oil (V) =---------- ml
Weight of the oil (W)=(W_2-W_1) =---------- grams
Density of the oil at temperature (ρ) =(W/V) ------- grams/ml
grams /ml = grams/cc

Redwood-I viscometer constants: A and B are RedWood-I Viscometer constants which are based on the orifice and jet size of the viscometer for Redwood-I .The values are taken depends upon the time for collecting the 50 ml of oil. The values are tabulated

S.No	Time collecting 50 ml of oil (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

Kinematic viscosity of oil = (Ax t) –(B / t) cm^2/Sec

Dynamic viscosity of oil = Kinematic viscosity of oil X Density of oil

A= 0.00247

B=0.65

Kinematic viscosity of oil = (Ax t) –(B / t) in cm^2/Sec

Dynamic viscosity of oil =Kinematic viscosity of oil X Density of oil

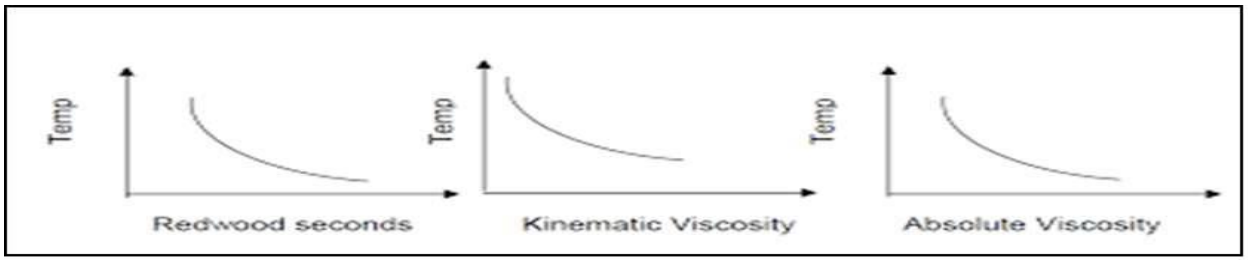
In dyne- sec/cm^2

6. Table:

Sl. No.	**Temperature of oil ^0C**	**Time for collecting 50ml of oil in sec (t)**	**Kinematic viscosity =(Ax t) –(B / t) cm^2/Sec**	**Density of oil gm/ml**	**Dynamic viscosity dyne-sec/cm 2**

7. GRAPHS:

1. Plot the graph between Temp (y-axis) and Redwood Seconds (x-axis)
2 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)
3 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)



8. Calculations:

Calculations at a particular temperature

A and B are Redwood-I instrument constants and this values taken depends upon the range of flow in seconds

S.No	Range of Flow (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

2. **Density of the oil (ρ) =(W/V) ----------**

3 . Dynamic viscosity of oil =Kinematic viscosity of oil X Density of the oil in

9. RESULTS AND DISCUSSIONS:

1. Kinematic viscosity of oil sample at a temperature---------- --------- is ----------
2. **Density of the given oil sample at a temperature----------** --------- **°C** is ---------- **grams/ml**
3. Dynamic viscosity of oil sample at a temperature---------- --------- is ----------

10. SCHEME OF EVALUATION:

Category of Skill	**SUB TASK**	**TOTAL MARKS (50)**	**TOTAL MARKS AWARDED**
1. Handling of apparatus	A) Choosing the appropriate instrument B) Levelling the viscometer C) Fixing the power supply D) Cleaning the oil cup E) Placing the ball valve F) Filling the water and oil	6	
2. Manipulation of apparatus	A) Weighing the graduated glass flask B) Heating the bath C) Stirring the water. D) Starting the stop watch	15	
3. Precise Operations/ Activities	A) Stopping the stop watch B) Noting down the time for collecting 50CC oil C) Calculating the kinematic viscosity of oil D) Calculating the density of oil E) Calculating the dynamic viscosity of oil F) Repeating the process G) Drawing the graphs	24	
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	5	

Signature of the student

EXPERIMENT : 05

DETERMINATION OF VISCOSITY OF THE GIVEN OIL USING REDWOOD

VISCOMETER - II

WORK SHEET

NAME OF THE STUDENT:	INSTITUTION:
PIN NUMBER:	DATE OF EXPERIMENT:
BRANCH:	EXPERIMENT NO:

1. Title of the experiment: VICSOSITY TSEST

2. Objective of the Experiment: To determine the Kinematic viscosity and Dynamic viscosity of a Given sample of oil at different temperatures by using Red Wood Viscometer –I

3. Apparatus/Tools Required Redwood viscometer-I, Stop watch, Thermometers-2, Measuring Flask, Glass jar and oil ,stop watch, weighing machine

4. Procedure:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.

5. Observations:

Weight empty glass flask W_1= --------- ------grams
Weight of oil + Weight of empty glass flask (W_2)=--------grams
Volume of the oil (V) =---------- ml
Weight of the oil (W)=(W_2-W_1) =---------- grams
Density of the oil at temperature (ρ) =(W/V) ------- grams/ml
grams /ml = grams/cc

Redwood-I viscometer constants: A and B are RedWood-I Viscometer constants which are based on the orifice and jet size of the viscometer for Redwood-I .The values are taken depends upon the time for collecting the 50 ml of oil. The values are tabulated

S.No	Time collecting 50 ml of oil (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

Kinematic viscosity of oil = (Ax t) –(B / t) cm^2/Sec

Dynamic viscosity of oil =Kinematic viscosity of oil) X Density of oil

In dyne- sec/cm^2

A= 0.00247

B=0.65

Kinematic viscosity of oil = (Ax t) –(B / t) in cm^2/Sec

6. Table:

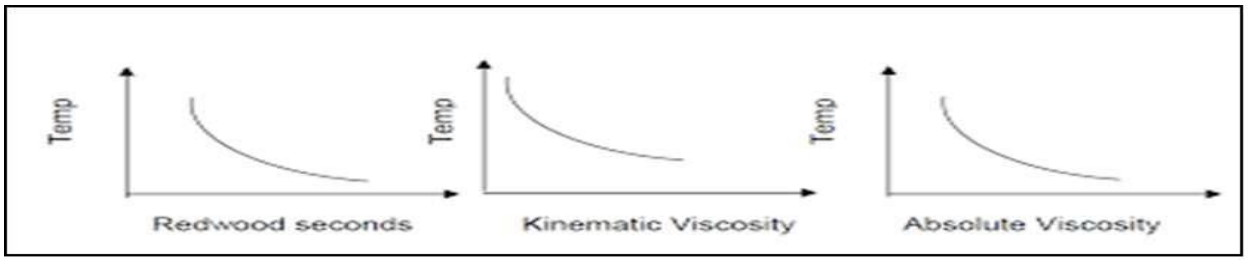
Sl. No.	**Temperature of oil ^0C**	**Time for collecting 50ml of oil in sec (t)**	**Kinematic viscosity =(Ax t) –(B / t) cm^2/Sec**	**Density of oil gm/ml**	**Dynamic viscosity dyne-sec/cm^2**

7. GRAPHS:

1.Plot the graph between Temp (y-axis) and Redwood Seconds (x-axis)

2 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)

3 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)



8. Calculations:

Calculations at a particular temperature

A and B are Redwood-I instrument constants and this values taken depends upon the range of flow in seconds

S.No	Range of Flow (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

3. **Density of the oil (ρ) =(W/V) ----------**

3 . Dynamic viscosity of oil = Kinematic viscosity of oil XDensity of the oil

9. RESULTS AND DISCUSSIONS:

4. Kinematic viscosity of oil sample at a temperature---------- --------- is ----------
5. **Density of the given oil sample at a temperature----------** --------- **^{o}C** is ---------- ---------- **grams/ml**
6. Dynamic viscosity of oil sample at a temperature---------- --------- is ----------

10.SCHEME OF EVALUATION:

Category of Skill	**SUB TASK**	**TOTAL MARKS (50)**	**TOTAL MARKS AWARDED**
1. Handling of apparatus	A) Choosing the appropriate instrument B) Levelling the viscometer C) Fixing the power supply D) Cleaning the oil cup E) Placing the ball valve F) Filling the water and oil	6	
2. Manipulation of apparatus	A) Weighing the graduated glass flask B) Heating the bath C) Stirring the water. D) Starting the stop watch	15	
3. Precise Operations/ Activities	A) Stopping the stop watch B) Noting down the time for collecting 50CC oil C) Calculating the kinematic viscosity of oil D) Calculating the density of oil E) Calculating the dynamic viscosity of oil F) Repeating the process G) Drawing the graphs .	24	
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	5	

EXPERIMENT : 06

DETERMINATION OF VISCOSITY OF THE GIVEN OIL USING SAYBOLT VISCOMETER

WORK SHEET

Name of the student:		Date of Experiment
PIN	Branch:	
Institution:		Experiment No.

1. Title of the experiment:

2. Objective of the experiment:

3. Apparatus/tools required:

4. Procedure:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

5. Observations

Sample oil	Temperature ^{o}C	Time, sec

6. Sample calculations.

7. Graph.

8. Result.

9. Discussion on result.

10. Defciency/malfunctioning of the apparatus (if any)

11. Scheme of valuation:

Category of skill	Subtask	Weightage with competency level individually	Awarded
1.Handlingof apparatus	A. Choosing the appropriate instrument B. Cleaning the oil cup C. Placing the bob D. Poring the water and oil E. Fixing the power supply	A B C D E Tot	
2.Manipulation of apparatus	A. Heating the water bath B. Stirring the water C. Placing the flask in exact position D. Noting the time in stopwatch E. Noting the required temperature	A B C D E Tot	
3.Precise operation/activity	A. Noting the temperature of oil B. Noting the time for collecting 60C.C. C. Calculating the viscosity D. Draw the graph Viscosity Vs Temperature	A B C D Tot	
4.Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	A B C D E Tot	
		Total	

EXPERIMENT : 07

MEASURMENT OF CALORIFIC VALUE OF GIVEN GASEOUS FUEL USING JUNKER'S GAS CALORIMETER

WORK SHEET

Name of the student:		Date of exp:
PIN:	Branch:	
Institution:		Exp no:

1. **TITLE OF EXPERIMENT:**
2. **OBJECTIVE OF THE EXPERIMENT:**
3. **EQUIPMENTS REQUIRED:**

S.No	Name	Quantity
1 2 3.		

4. **PROCEDURE:**

5. OBSERVATIONS:

Volume of water collected during the test period VW = _____ m^3 .

Specific weight of water γ = 1000 kg/m^3

Room temperature T = _____ ^{0} C

Volume of gas burnt at room temperature and pressure during the test period V_G = _____ m^3 .

Average water inlet temperature T_1= _____ ^{0} C

Average water outlet temperature T_2 = _____ ^{0} C

6. CALCULATIONS:

Calorific Value of given fuel =_____

7.SCHEME OF EVALUATION:

<table>
<tr><th>Category of Skill</th><th>SUB TASK</th><th>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</th><th>TOTAL (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A) Choosing the appropriate instrument
B) Filling the governor with water
C) Placing the three thermometers into the rubber corks
D) Inserting burner into its support rod in the bottom of the calorimeter and fix knob tightly
E) Connecting the calorimeter, the flow meter and the pressure governor using rubber tubing provided.
F) Turning water regulator knob on calorimeter to ON position. Allow water to flow through the calorimeter from overhead tank/ tap.
G) Connecting gas supply line to governor inlet. Remove burner from calorimeter then open governor outlet tap. Allow gas to pass through the burner.</td><td><table><tr><th>A</th><th>B</th><th>T</th></tr><tr><td></td><td></td><td>05</td></tr></table></td><td>05</td></tr>
<tr><td>2. Manipulation of apparatus</td><td>A) Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fixing the lighted burner back into position.
B) Adjusting the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fixing the lighted burner back into position.
C) Adjusting water regulator on calorimeter to get a temperature</td><td><table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>15</td></tr></table></td><td>15</td></tr>
</table>

	difference of 12^0C to 15 ^{0} C between the inlet water & outlet water as indicated by the respective thermometers at the top of the calorimeter. D) Measuring the water flow rate with the help of measuring jar. Simultaneously, note the flow meter reading. E) Allowing 20 to 30 min for outlet water temperature to become steady.		
3. Precise Operations Activities	A) Noting down the inlet &outlet water temperatures. B) Repeating the test with same volume of gas 3 or 4 times and take average temperatures of inlet and outlet water. C) Calculating the calorific value of given fuel	<table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>25</td></tr></table>	25
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	<table><tr><td></td></tr><tr><td></td></tr></table>	05

EXPERIMENT : 08

DETERMINATION OF CARBON RESIDUE OF GIVEN FUEL USING CONRADSON'S APPARATUS

WORK SHEET

Name of the student:		Date of exp:
PIN:	Branch:	
Institution:		Exp no:

1. **TITLE OF EXPERIMENT:**
2. **OBJECTIVE OF THE EXPERIMENT:**
3. **EQUIPMENTS REQUIRED:**

S.No	Name	Quantity
1 2 3.		

4. **PROCEDURE:**

5. OBSERVATIONS:

6. Weight of the crucible W_1 =*gms*

7. Weight of the crucible with oil W_2=*gms*

8. Weight of crucible with residue W_3 = *gms*

$$\textit{Percentage of Carbon Residue} = \frac{Weight\ of\ Residue}{Weight\ of\ sample}$$

$$=\frac{W3-W1}{W2-W1}X100$$

9. CALCULATIONS:

Percentage of Carbon Residue =_____

7.SCHEME OF EVALUATION:

Category of Skill	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	TOTAL (50)
5. Handling of apparatus	D) Choosing the appropriate instrument. E) Fixing the connections F) Cleaning the porcelain or silica crucible	A | B | T | | 05	05
6. Manipulation of apparatus	E) Weighing the porcelain or silica crucible. F) Weighing the crucible and sample of oil G) Placing in wrought iron crucible H) Placing the Chimney	A | B | C | T | | | 15	15
7. Precise Operations Activities	D) Heating the wrought iron crucible E) Heating 5 minutes slowly F) Heating 15 minutes Strongly G) Cooling the apparatus H) Weighing the crucible with residue I) Calculating the weight of residue J) Calculating the percentage of residue	A | B | C | T | | |	25
8. Values	F) Co Operation G) Co- Ordination H) Communication I) Sharing J) Leadership		05

EXPERIMENT : 09

CALIBRATION OF PRESSURE GAUGE USING DEAD WEIGHT PRESSURE GAUGE TESTER

WORK SHEET

Name of the student:		Date of exp:
PIN:	Branch:	
Institution:		Exp no:

1. **TITLE OF EXPERIMENT:**
2. **OBJECTIVE OF THE EXPERIMENT:**
3. **EQUIPMENTS REQUIRED:**

S.No	Name	Quantity
1		
2		
3		
4		
5		

4. **PROCEDURE:**

5. OBSERVATIONS:

Sl No	Actual pressure Based on weights Kg/cm^2	Pressure as per pressure gauge Kg/cm^2	Error	Correction	Percentage correction %
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

6. CALCULATIONS:

1. Draw the graph between pressure as read from pressure gauge on X-axis and the percentage correction on Y-axis.
2. Draw the graph between actual pressure based on weights on X-axis and the pressure as shown by gauge being tested/calibrated on Y-axis.

7. SCHEME OF EVALUATION:

<table>
<tr><th>Category of Skill</th><th>SUB TASK</th><th>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</th><th>TOTAL (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A) Identifying the components required.
B) Placing the apparatus on a firm flat table or platform to provide convenient operating height for the apparatus
C) Rotating the priming-pump slowly in clockwise direction with its isolating valve open until oil starts coming out of pressure gauge adopter
D) Fitting the gauge in the adopter
E) Rotating pressure-pump handle in clockwise direction till it stops
F) Rotating priming- pump handle in anti-clockwise direction until it is taken out, and add oil if required in to the priming-pump
G) Opening the isolating valve and fix the priming-pump handle simultaneously unscrewing pressure-pump so that it is unscrewed completely
H) Moving the pressure-pump handle clockwise to build up pressure in the system
I) Checking for any leaks at the pressure gauge fitting adopter etc
J) Rotating the handle of pressure-pump and open the isolating valve
K) Removing the weights from the loading plat form and fit the pressure gauge to be tested in the pressure gauge adopter
L) operating the pressure-pump clockwise so that the loading platform remains lifted up to the red mark on the guide
M) Rotating the weights gently by hand and see that the platform remains moving in the red band range
N) Increasing the weights continuously and balancing the hydraulic ram in the red band range.</td><td><table><tr><th>A</th><th>B</th><th>T</th></tr><tr><td></td><td></td><td>05</td></tr></table></td><td>05</td></tr>
<tr><td>2. Manipulation of apparatus</td><td>A) Placing a spirit level on the top of the loading head
B) Levelling the apparatus adjusting the levelling screws
C) Screwing the priming-pump tightly and close the isolating valve
D) Rotating the weights to minimize the friction between the hydraulic ram and its guide so that the loaded ram just floats on the oil surface
E) Using the sealing washer in the joint to prevent leakage.</td><td><table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>15</td></tr></table></td><td>15</td></tr>
</table>

3. Precise Operations Activities	A) Pouring the hydraulic oil through the hole on top of the priming-pump while rotating its handle in anti-clockwise direction until the handle is completely taken out B) Placing weights on the loading head up to the full capacity of the apparatus and see that a pressure gauge of capacity slightly higher than the total capacity of weights is fitted in the adopter C) Building up the pressure to the full capacity of weights and rotate the weights gently by hand D) Rotating the priming-pump handle in the anti-clockwise direction until the pressure comes to zero E) Selecting about ten points at equal intervals to reach the full capacity of the gauge F) Selecting the corresponding weights from the set of weights supplied G) Addding weights on the loading head step by step after priming and closing the isolating valve H) Comparing the pressure shown by the pressure gauge needle with the sum of pressure intensities marked on the weights at various selected points and make necessary adjustments in the pressure gauge mechanism	<table><tr><th>A</th><th>B</th><th>C</th><th>T</th></tr><tr><td></td><td></td><td></td><td>25</td></tr></table>	25
4. Values	A) Co Operation B) Co- Ordination C) Communication D) Sharing E) Leadership	<table><tr><td></td></tr><tr><td></td></tr></table>	05

EXPERIMENT : 01

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING ABLE'S APPARATUS

AIM

To determine the flash and fire point of the given sample of oil using Able's apparatus.

Apparatus

Able's apparatus,
Thermometer (0-110 ^{o}C).

Theory

This method determines flash and fire points of petroleum products and mixtures to ascertain whether they give off inflammable vapors below a certain temperature.

Flash Point:

It is the lowest temperatures of the oil at which application of test flame causes the vapor above the sample to ignite with a distinct flash inside the cup.

Fire point: It is the lowest temperature of the oil, at which, application of test flame causes burning for a period of about five seconds.

Description

1. Abel's apparatus mainly consists of an electrically operated heater provided with an energy regulator.
2. The heater and the regulator are arranged to a robust C.I. base, which is well insulated electrically.
3. An indicator lamp is provided by the side of the regulator, which indicates whether the heater is on or off.
4. Above the heater, a water bath is arranged. It has an inlet funnel for introducing water.
5. A thermometer point is arranged to the water bath to measure the temperature of water.
6. At the center of water bath a cylindrical air bath is provided in which ABEL'S cup is provided.
7. The ABEL'S cup is made of brass and is cylindrical in shape. Its diameter is 2" and depth is 2 ¼ ".
8. The cup has a pointer fixed to its inner surface and indicates the level up to which the sample has to be taken.
9. The cup can be closed securely with the help of lid. The lid is arranged with a stirrer, for oil stirring and a thermometer point to fix a thermometer for oil temperature measurement.
10. The cup also carries a slider. By operating the slider an opening can temporarily be made for introducing test flam into the cup.
11. The outer surface of water bath is well polished to reduce radiation heat losses. The unit is provided with terminals which can be connected to a 15 A power supply.

Procedure

1. Fill the water bath with pure water until it overflows at the spout.
2. Fix a thermometer to measure the temperature of the bath.
3. Place the bath in position so that it is seated correctly over the heater.
4. Take out the Abel's cup and clean it thoroughly.
5. Fill it with oil sample up to the arrow mark provided.
6. Fix a thermometer in the lid of cup to measure temperature of oil.
7. Operate the stirrer and ensure that the stirrer blades do not strike against the thermometer.
8. Check the slider for satisfactory operation.
9. Place the cup separately from the remaining apparatus.
10. Check the electrical circuit for satisfactory working.
11. Switch on the 15 A supply and adjust the energy regulator, so that steady and uniform heating is ensured.
12. Continue heating until the temperature of water bath is around 60^0C. Switch off the supply when this temperature has been reached.
13. Place the Abel's cup centrally in the air bath and ensure proper seating.
14. Stir the oil slowly, but continuously.
15. When the temperature of oil crosses 30^0C, put on a test flame.
16. Apply the test flam for every 1^0 raise in temperature.
17. The application of test flame should consume only a few seconds time.
18. Whenever test flame is applied, the slider is pulled open, and is again shut immediately after withdrawing the flame.
19. Record the temperature at which a momentary flash followed by a small hissing sound is obtained. This gives the Flash Point temperature.
20. Keep stirring and continue the test for Fire Point. Record the temperature at which the fuel catches fire and burns continuously on application of test flame which is called Fire Point.
21. Take out the cup, empty it, and cool it to the room temperature.
22. Cool the thermometer also to the room temperature.
23. Take a fresh sample of oils and repeat the procedure.
24. The test is repeated until successive results do not differ by 1- 2^0 C.
25. Record the lowest of the last three readings as the Flash Point and Fire Point of the oil.

Observations

Sample oil	Flash point, ^oC	Fire point, ^oC

Result

The flash point is observed at ^oC

The fire point is observed at ^oC

A. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- Care should be taken while opening and closing the shutter
- Care should be taken while keeping the test flame at the opening
- The bluish halo that some time surrounds the test flame should not be confused with true flash point.
- Record the temperature rise without parallax error
- Stir the oil bath continuously to maintain the uniform temperature of sample oil.
- Proper measure should be taken while opening the lid of the cup in hot condition
- Ensure that proper functioning of thermometer for precise calibration
- Dispose hot used oil carefully

B. Safety precautions

1. While heating water bath, Abel's cup should be taken out.
2. Oil should be stirred when temperature of oil is increasing.
3. Slider should not be kept in open position for more than few seconds.
4. Energy regulator should be adjusted so that water bath is heated slowly and uniformly.

EXPERIMENT : 02

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING PENSKY MARTENS APPARATUS

AIM

To determine the flash and fire point of the given sample of oil using Pensky Marten's apparatus by both open and closed cup methods.

Apparatus

Pensky Marten's apparatus,
Thermometer (0-110 ^{o}C).

Theory

This method determines the closed cup and open cup flash and fire points of petroleum products and mixtures to ascertain whether they give off inflammable vapors below a certain temperature.

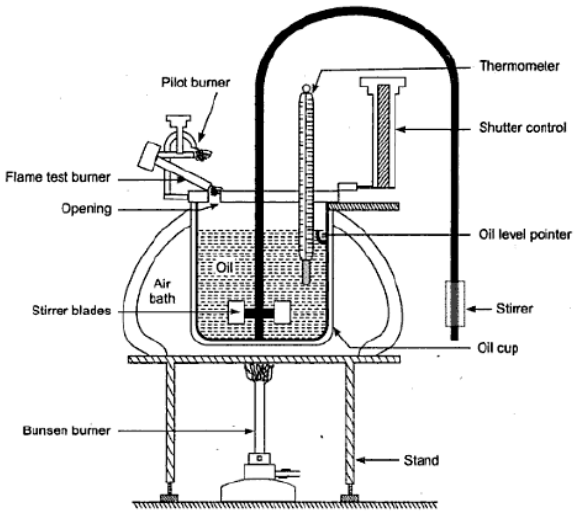
Flash Point:

It is the lowest temperatures of the oil at which application of test flame causes the vapor above the sample to ignite with a distinct flash inside the cup.

Fire point: It is the lowest temperature of the oil, at which, application of test flame causes burning for a period of about five seconds.

Description

The apparatus consists of a brass cup and cover fitted with shutter mechanism without shutter mechanism (open cup), test flame arrangement, hand stirrer (closed cup), thermometer socket, etc., heated with energy regulator, a thermometer socket made of copper.



Procedure

1. Clean the oil cup thoroughly and fill the oil cup with the sample oil to be tested up to the mark.
2. Insert the thermometer into the oil cup through a provision, which measures the rise of oil temperature.
3. Using the Energy regulator, control the power supply given to the heater and rate of heating
4. The oil is heated slowly when temperature of oil rises, it is checked for the flash point for every one degree rise in temperature.
5. After determining the flash point, the heating shall be further continued. The temperature at which time of flame application which causes burning for a period at least 5 seconds shall be recorded as the fire point.
6. Repeat the experiment 2 or 3 times with fresh sample of the same oil
7. Take the average value of flash and fire points.

Observations

Sample oil	Flash point, ^oC	Fire point, ^oC

Result

The flash point is observed at ^oC

The fire point is observed at ^oC

C. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- Care should be taken while opening and closing the shutter
- Care should be taken while keeping the test flame at the opening
- The bluish halo that some time surrounds the test flame should not be confused with true flash point.
- Record the temperature rise without parallax error
- Stir the oil bath continuously to maintain the uniform temperature of sample oil.
- Proper measure should be taken while opening the lid of the cup in hot condition
- Ensure that proper functioning of thermometer for precise calibration
- Dispose hot used oil carefully

D. Safety precautions

- Wear apron, hand gloves and safety goggles
- Beware of loose clothing and hair during experiment
- Ensure sufficient availability of oil
- Keep readily the availability of fire extinguishing equipment

EXPERIMENT : 03

DETERMINATION OF FLASH AND FIRE POINT OF GIVEN OIL USING CLEVELAND APPARATUS

AIM

To determine the flash and fire point of the given sample of oil using Cleveland's apparatus by open cup method.

Apparatus

Cleveland's apparatus
Thermometer (0-100 ^{o}C).

Theory

This method determines the closed cup and open cup flash and fire points of petroleum products and mixtures to ascertain whether they give off inflammable vapors below a certain temperature.

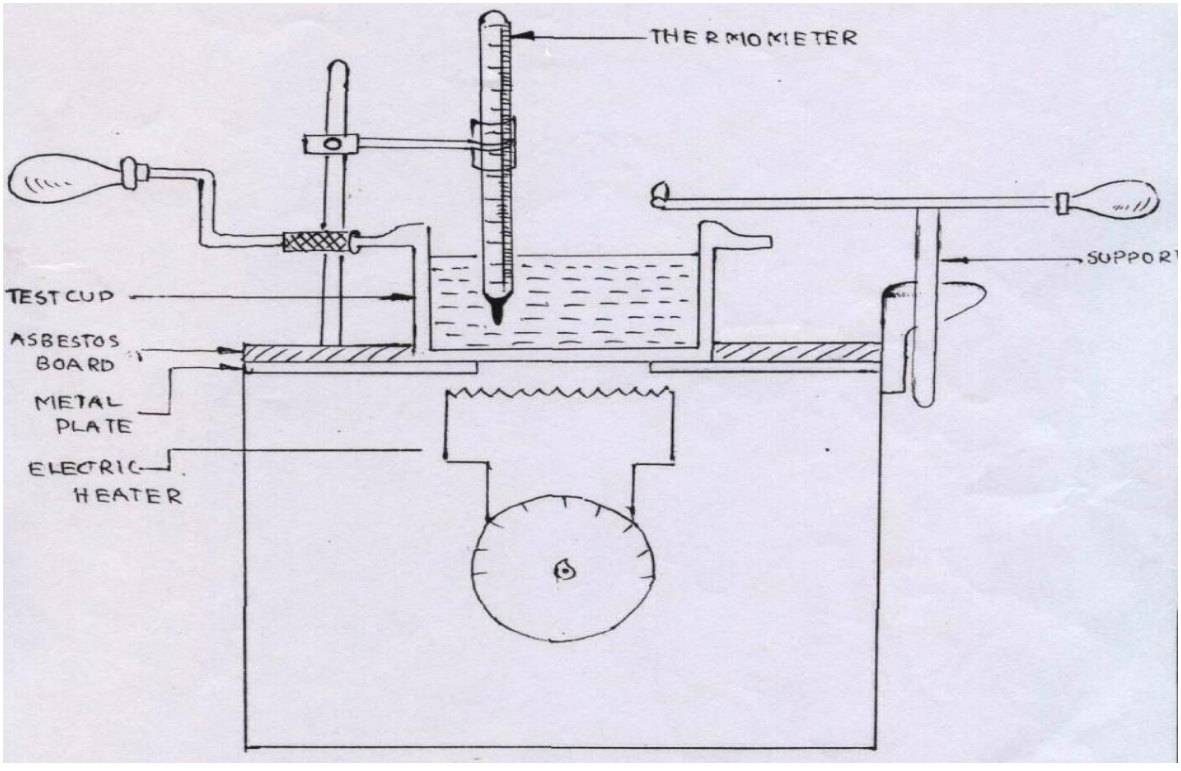
Flash Point:

It is the lowest temperatures of the oil at which application of test flame causes the vapor above the sample to ignite with a distinct flash inside the cup.

Fire point: It is the lowest temperature of the oil, at which, application of test flame causes burning for a period of about five seconds.

Description

The apparatus consists of a brass cup,
test flame arrangement, thermometer socket, etc., heated with energy regulator, a thermometer socket made of copper.



Procedure

1. Clean the oil cup thoroughly and fill the oil cup with the sample oil up to the level of groove marked in it.
2. Place the cup in the groove provided on the asbestos sheet.
3. Fix the thermometer in the fixture,so that the bulb should not touch the bottom.
4. Switch on,the power supply and adjust the regulator so that slow and steady heating may be obtained.
5. When the temperature of oil is about 5 to 10^0C below the expected flash temperature start introduction of a test flame.
6. Apply the test flame at every 0.5^{o}C to 1^0C rise in temperature.
7. Record the minimum temperature at which a distinct flash is obtained on the given sample of oil.
8. Continue heating and apply test flame on the surface of the oil and record the minimum temperature at which the oil burns with continuous flame on the surface for a minimum of 5 seconds and record it as fire point temperature.
9. Repeat the experiment 2 or 3 times with fresh sample of the same oil
10. Take the average value of flash and fire points.

Observations.

Sample oil	Flash point, ^{o}C	Fire point, ^{o}C

Result

The flash point is observed at ^{o}C

The fire point is observed at ^{o}C

A. Procedural precautions.

- Ensure that electrical wiring should be tightly connected.
- Avoid thermometer mercury bulb contacting with body of the cup
- The heating should be slow and steady
- Record the temperature rise without parallax error
- After every trial the cup should be cooled to room temperature

B. Safety precautions

- Wear apron, hand gloves and safety goggles
- Beware of loose clothing and hair during experiment
- Ensure sufficient availability of oil
- Keep readily the availability of fire extinguishing equipment

EXPERIMENT : 04

DETERMINTION OF VISCOCITY OF GIVEN OIL USING REDWOOD VISCOMETER-I

DESCRIPTION: To determine the viscosity (Kinematic and dynamic viscosity) of the given sample of oil by using Red Wood Viscometer-I.

THEORY : - Redwood viscometer apparatus mainly consist of

1. Redwood viscometer 2.Measuring devices 3.Heating device

1. **Redwood viscometer**: Redwood viscometer consists of metal cylindrical oil cup with an axially placed orifice at center of the bottom. The orifice having a concave depression from inside to facilitate a ball with stiff wire or rod to act as valve to start or stop oil flow. The oil cup is surrounded by water bath with electrical heating device and loosely fitted sleeve, which has a board flange at the top and vanes are provided for stirring the bath. Two thermo meters are provided in the oil cup and water bath for measuring the temperature of water bath and oil under test. This total set up supported by tripod with leveling screws.

2.Measuring Devices:

In Redwood viscometer there three measuring devices are used. 1. Thermometers 2. Small graduated glass flask 3.stop watch. There are two thermometers are used for measuring the temperature of oil and water bath. Small graduated glass flask is used to measure the 50 ml of oil flow against time. Stop watch is used to measure the time taken for collecting 50 ml of the given oil in seconds . The time in seconds is called “seconds REDWOOD- I” N and is a measure of viscosity .These seconds are converted into stokes of kinematic viscosity. Weighing machine is used to measure the weight of empty small graduated flask and to measure the weight of the small graduated flask

3.Heating Device: Electrical heater used as a heating device and it used to heat the water in the water bath.

Red wood viscometer-I is used to measure the Low viscosity oils Whose Redwood seconds (t) are between 34 to 100 seconds. It has an orifice diameter of 1.62 mm with a length of jet of 10 mm. Redwood viscometers will not effective when the time if the flow time for collecting the 50 ml of oil is less than the 30 seconds.

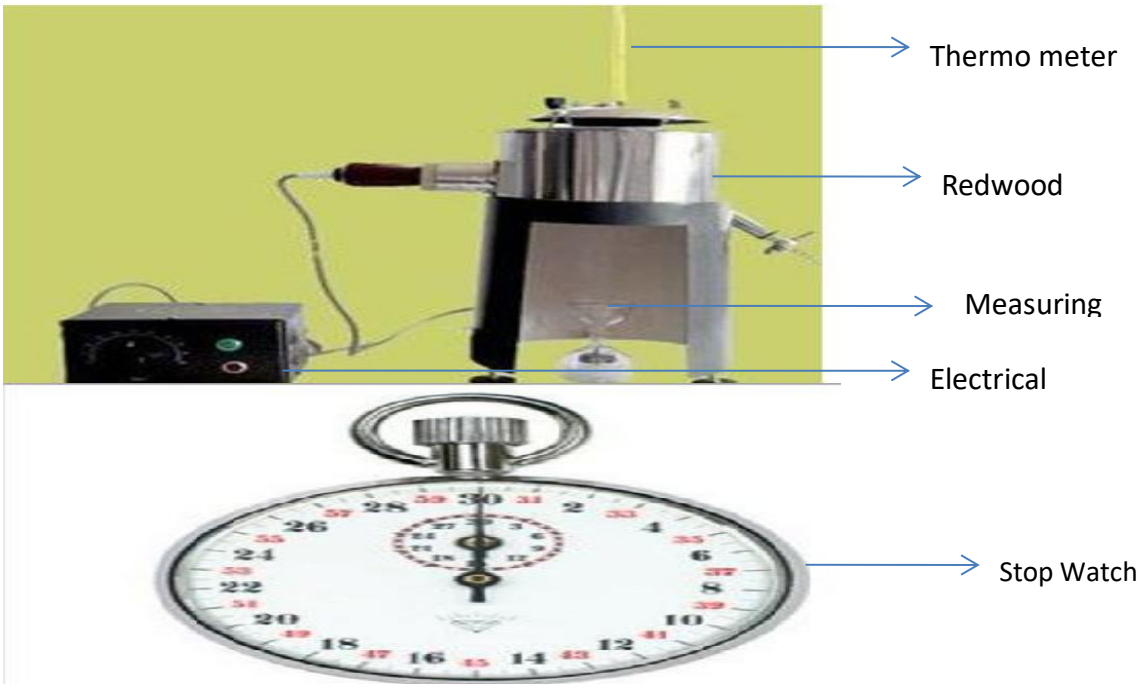


Fig 1. REDWOOD VISCOMETER-I APPARATUS

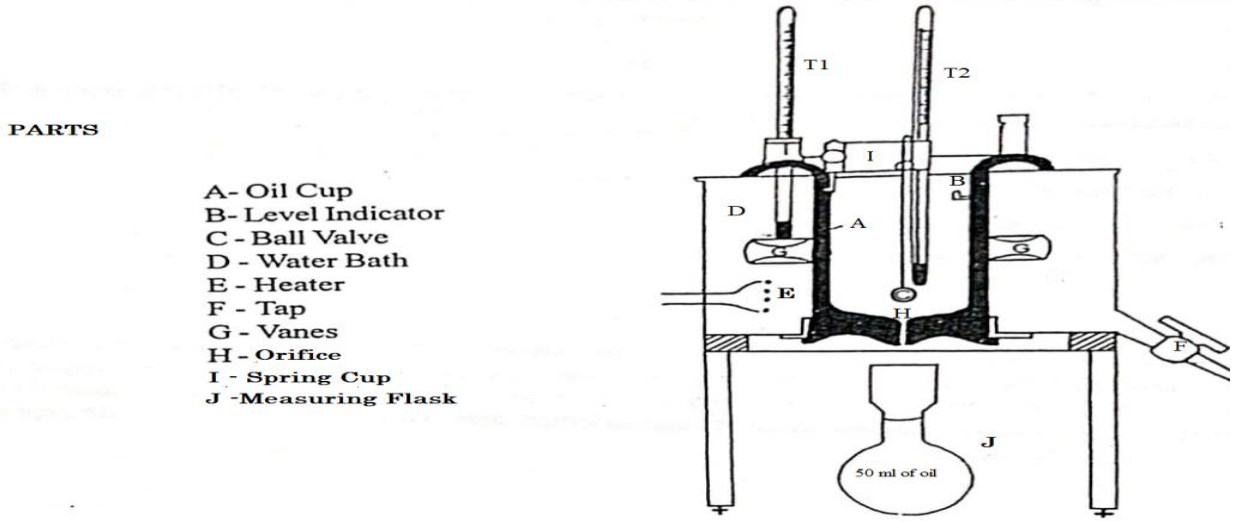


Fig 2. REDWOOD VISCOMETER-I WITH PARTS

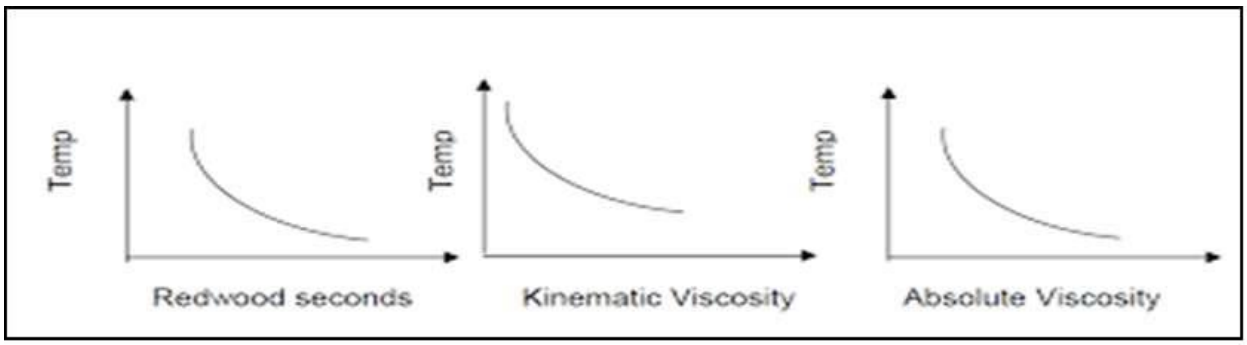
PROCEDURE:-

1. Take the Redwood viscometer apparatus setup.
2. Clean the oil cup with a suitable solvent thoroughly, for example, Carbon tetrachloride and dry it using Soft tissue paper or some similar material which will not leave any stuff
3. Keep the water bath with oil cup on the tripod stand
4. Level the viscometer with help of leveling screws.
5. Examine the orifice and ensure that it is clean and not obstructed
6. Close the orifice of oil cup with needle stick properly
7. Fill the Oil cup with oil whose viscosity is measured up to the mark
8. The oil cup is closed with cover plate
9. Filln the water bath with water up to the marked level
10. Insert the thermometer in the provisions intended for water bath temperature measurement
11. Insert the thermometer in the provisions intended for oil cup to measure the oil temperature.
12. Take the clean graduated glass flask and place it just below the oil jet
13. Connect the power supply card to the power source and switch on the power supply
14. Heat the water bath and stirring to impart the heat to the oil in the cup till the temperatures of oil and water are equal.
15. After attaining the equilibrium temperature switch off the power supply.
16. Open the orifice by lifting the ball valve and simultaneously start a stop watch
17. Wait till the oil level touches the 50 ml mark, then stop the stop watch
18 Note down the time taken for the collection of 50 ml of oil in seconds
19. Repeat the process for various temperatures using same oil by finding the time taken for the collection of 50 ml oil each time and tabulated the readings by repeating the steps from 13 to 18

PRECAUTIONS:-

- The oil cup thoroughly dried
- The orifice should be well cleaned to avoid choking and ensure free flow
- Ensure proper setting of the ball valve to avoid leakage
- The oil should be filled in the container up to the indicated mark
- Fix the thermometers properly and see that they do not slip or obstruct the stirrer
- Stir the water continuously so that the temperature of the oil and water are equal.
- Always take the readings at a stable temperature.
- Note down the time without any error

MOEL GRAPHS :



OBSERVATIONS:

Weight empty glass flask W_1= --------- ----------grams
Weight of oil + Weight of empty glass flask (W_2)=---------- grams
Volume of the oil (V) =---------- ml
Weight of the oil (W)=(W_2-W_1) =---------- grams
Density of the oil at temperature (ρ) =(W/V) ---------- grams/ml
grams /ml = grams/cc

Redwood-I viscometer constants: A and B are RedWood-1 Viscometer constants which are based on the orifice and jet size of the viscometer for Redwood-I .The values are taken depends upon the time for collecting the 50 ml of oil. The values are tabulated

S.No	Time collecting 50 ml of oil (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

Kinematic viscosity of oil ( ) = (Ax t) –(B / t) cm^2/Sec

Dynamic viscosity of oil (Kinematic viscosity of oil X Density of oil

TABLE:

Sl. No.	**Temperature of oil ^0C**	**Time for collecting 50ml of oil in sec (t)**	**Kinematic viscosity =(Ax t) –(B / t) cm^2/Sec**	**Density of oil**	**Dynamic viscosity**

GRAPHS: 1.Plot the graph between Temp (y-axis) and Redwood Seconds (x-axis)
2 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)
3 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)

Calculations:

Calculations at a particular temperature

1. **Kinematic viscosity of oil = (Ax t) –(B / t) cm^2/Sec**

A and B are Redwood-I instrument constants and this values taken depends upon the range of flow in sconds

S.No	Range of Flow (t in seconds)	A	B
1	t = 34 to 100	0.0026	1.72
2	More than 100	0.00247	0.5

4. **Density of the oil (ρ) =(W/V) ---------- grams/ml**

3 . Dynamic viscosity of oil IS _____

5. Kinematic viscosity of oil in **cm^2/Sec is** _____

RESULT:

7. Kinematic viscosity of oil sample at a temperature---------- --------- ^oC is ---------- **cm^3/Sec**
8. **Density of the given oil sample at a temperature----------** --------- ^oC is ---------- **grams/ml**
9. Dynamic viscosity of oil sample at a temperature---------- --------- ^oC is ---------- **dyne- sec/cm^2**

EXPERIMENT : 05

DETERMINTION OF VISCOCITY OF GIVEN OIL USING REDWOOD VISCOMETER-II

DESCRIPTION: To determine the viscosity (Kinematic and dynamic viscosity) of the given sample of oil by using Red Wood Viscometer-II .

THEORY : - Redwood viscometer apparatus mainly consist of

1. Redwood viscometer 2.Measuring devices 3.Heating device

1. **Redwood viscometer**: Redwood viscometer consists of metal cylindrical oil cup with an axially placed orifice at center of the bottom. The orifice having a concave depression from inside to facilitate a ball with stiff wire or rod to act as valve to start or stop oil flow. The oil cup is surrounded by water bath with electrical heating device and loosely fitted sleeve, which has a board flange at the top and vanes are provided for stirring the bath. Two thermo meters are provided in the oil cup and water bath for measuring the temperature of water bath and oil under test. This total set up supported by tripod with leveling screws.

2.Measuring Devices:

In Redwood viscometer there three measuring devices are used. 1. Thermometers 2. Small graduated glass flask 3.stop watch.4.Weighing machine There are two thermometers are used for measuring the temperature of oil and water bath. Small graduated glass flask is used to measure the 50 ml of oil flow against time. Stop watch is used to measure the time taken for collecting 50 ml of the given oil in seconds . The time in seconds is called “seconds REDWOOD- I” N and is a measure of viscosity .These seconds are converted into stokes of kinematic viscosity. Weighing machine is used to measure the weight of empty small graduated flask and to measure the weight of the small graduated flask

3.Heating Device: Electrical heater used as a heating device and it used to heat the water in the water bath.

Red wood viscometer-II is used to measure the High viscosity oils Whose Redwood seconds (t) are between 34 to 100 seconds. It has an orifice diameter of 3.8 mm with a length of jet of 50 mm. When an oil of unknown viscosity is given it must always be tested with REDWOOD-I viscometer .If the viscosity exceeds 2000 seconds redwood-I then REDWOOD-II be used.

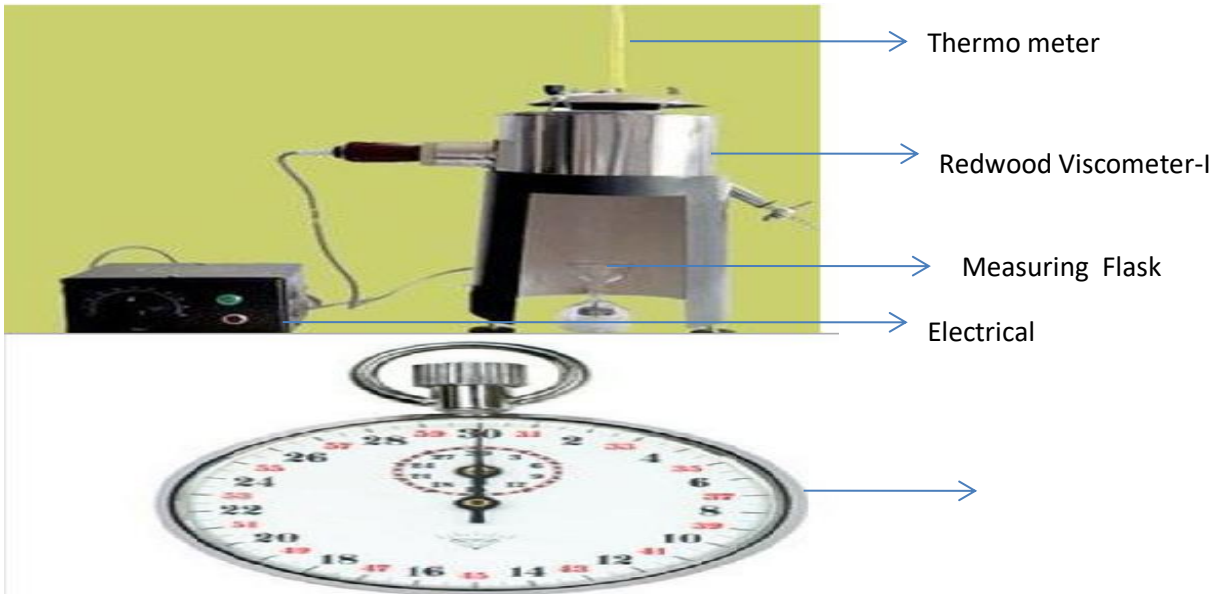


Fig 1. REDWOOD VISCOMETER-I APPARATUS

PARTS

A- Oil Cup
B- Level Indicator
C - Ball Valve
D - Water Bath
E - Heater
F - Tap
G - Vanes
H - Orifice
I - Spring Cup
J -Measuring Flask

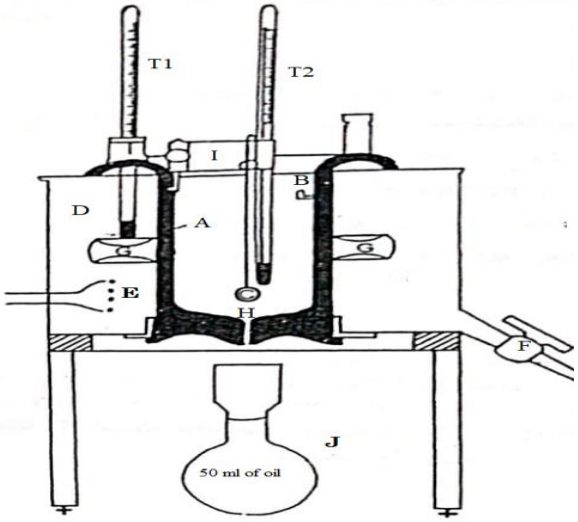


Fig 2. REDWOOD VISCOMETER-I WITH PARTS

PROCEDURE:-

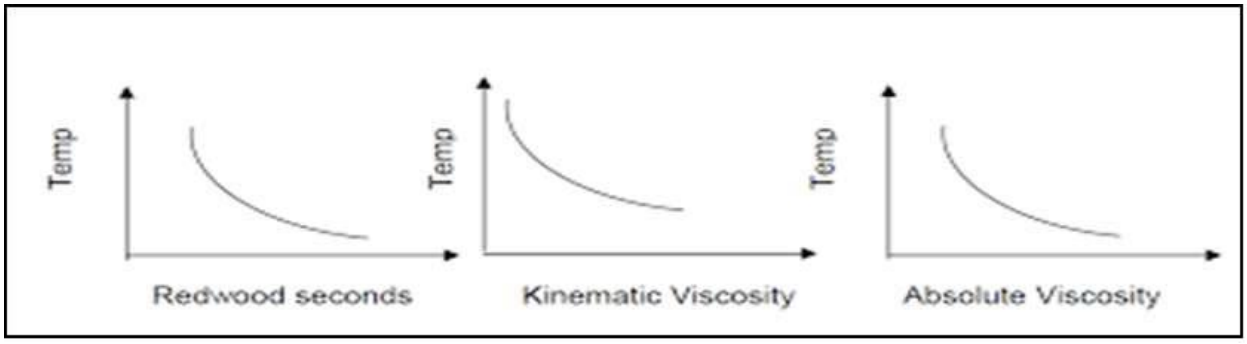
1. Take the Redwood viscometer apparatus setup.
2. Clean the oil cup with a suitable solvent thoroughly, for example, Carbon tetrachloride and dry it using Soft tissue paper or some similar material which will not leave any stuff
3. Keep the water bath with oil cup on the tripod stand
4. Level the viscometer with help of leveling screws.
5. Examine the orifice and ensure that it is clean and not obstructed
6. Close the orifice of oil cup with needle stick properly
7. Fill the Oil cup with oil whose viscosity is measured up to the mark
8. The oil cup is closed with cover plate
9. Filln the water bath with water up to the marked level
10. Insert the thermometer in the provisions intended for water bath temperature measurement
11. Insert the thermometer in the provisions intended for oil cup to measure the oil temperature.
12. Take the clean graduated glass flask and place it just below the oil jet
13. Connect the power supply card to the power source and switch on the power supply
14. Heat the water bath and stirring to impart the heat to the oil in the cup till the temperatures of oil and water are equal.
15. After attaining the equilibrium temperature switch off the power supply.

16. Open the orifice by lifting the ball valve and simultaneously start a stop watch
17. Wait till the oil level touches the 50 ml mark, then stop the stop watch
18. Note down the time taken for the collection of 50 ml of oil in seconds
19. Repeat the process for various temperatures using same oil by finding the time taken for the collection of 50 ml oil each time and tabulated the readings by repeating the steps from 13 to 18

PRECAUTIONS:-

1. The oil cup thoroughly dried
2. The orifice should be well cleaned to avoid choking and ensure free flow
3. Ensure proper setting of the ball valve to avoid leakage
4. The oil should be filled in the container up to the indicated mark
5. Fix the thermometers properly and see that they do not slip or obstruct the stirrer
6. Stir the water continuously so that the temperature of the oil and water are equal.
7. Always take the readings at a stable temperature.
8. Note down the time without any error

MOEL GRAPHS:



OBSERVATIONS:

Weight empty glass flask W_1= --------- ----------grams
Weight of oil + Weight of empty glass flask (W_2)=---------- grams
Volume of the oil (V) =---------- ml
Weight of the oil (W)=(W_2-W_1) =---------- grams
Density of the oil at temperature (ρ) =(W/V) ---------- grams/ml
grams /ml = grams/cc

Redwood-II Instrument constants: A and B are Redwood-II Viscometer constants which are based on the orifice and jet size of the viscometer for Redwood-II . The values are

A= 0.00247
B=0.65

Kinematic viscosity of oil = (Ax t) –(B / t) in cm^2/Sec

Dynamic viscosity of oil = Kinematic viscosity of oil X Density of oil

TABLE:

Sl. No.	Temperature of oil ^{0}C	Time for collecting 50ml of oil in sec (t)	Kinematic viscosity =(Ax t) –(B / t) cm^2/Sec	Density of oil	Dynamic viscosity

GRAPHS: 1.Plot the graph between Temp (y-axis) and Redwood Seconds (x-axis)
2 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)
3 .Plot the graph between Temp (y-axis) and Kinematic viscosity (x-axis)

Calculations:

Calculations at a particular temperature

1. **Kinematic viscosity of oil = (Ax t) –(B / t) cm^2/Sec**

   A and B are Redwood-II instrument constants
   A= 0.00247
   B=0.65

2. **Density of the oil (ρ) =(W/V) ---------- grams/ml**

   W= Weight of the oil in grams

   V= Volume of the oil in ml

3. **Dynamic viscosity of oil IS** _____

3. Kinematic viscosity of oil in **cm^2/Sec IS** _____-

RESULT:

10. Kinematic viscosity of oil sample at a temperature---------- --------- **^{o}C** is ---------- ---------- **cm^3/Sec**
11. **Density of the given oil sample at a temperature----------** --------- **^{o}C** is ---------- ---------- **grams/ml**
12. Dynamic viscosity of oil sample at a temperature---------- --------- **^{o}C** is ---------- ---------- **dyne- sec/cm^2**

EXPERIMENT : 06

DETERMINATION OF VISCOSITY OF THE GIVEN OIL USING SAYBOLT VISCOMETER

Aim: To determine the viscosity in Saybolt viscometer of the given sample of oil and to plot the variation of kinematic and dynamic viscosity with temperature.

Instruments:

- Saybolt viscometer,
- Stop watch,
- Thermometer (0-110^{0}C),
- Measuring flask (50 c.c)

Theory:

The viscosity of given oil is determined as the time of flow in seconds. The viscosity of a fluid indicates the resistance offered to shear under laminar condition. Dynamic viscosity of a fluid is the tangential force on unit area of either of two parallel planes at unit distance apart when the space between the plates is filled with the fluid and one of the plate's moves relative to the other with unit velocity in its own plane. The unit of dynamic viscosity is dyne-sec/cm^2. Kinematic viscosity of a fluid is equal to the ratio of the dynamic viscosity and density of the fluid. The unit of kinematic viscosity is cm^2 sec.

Description:

Saybolt viscometer consists of a water bath and oil bath, both provided with two thermometers inside them. There is a bob, which is located at center of oil bath to flow of oil through the orifice. A heater with regulator is fixed for heating purpose.

Procedure

1. Clean the oil cup with a suitable solvent thoroughly and dry it using dry cloth.
2. Keep the cork in its position so as to keep the orifice closed.
3. The water is taken into the water bath and the oil whose viscosity is to be determined is taken into the oil cup up to the mark.
4. Before switch on the electric supply, at room temperature note down the time taken in Saybolt seconds for a collection of 60 c.c. of oil with a stop watch.
5. Heat the bath and continuously stir it taking care to see that heating of the bath is done in a careful and controlled manner.
6. When the desired temperature is reached, place the cleaned 60 c.c. flask below the orifice in position.
7. Remove the bob and simultaneously start a stopwatch. Note the time of collection of oil up to the 60 c.c. Mark.
8. During the collection of oil don't stir the bath.
9. Repeat the process at various temperatures.

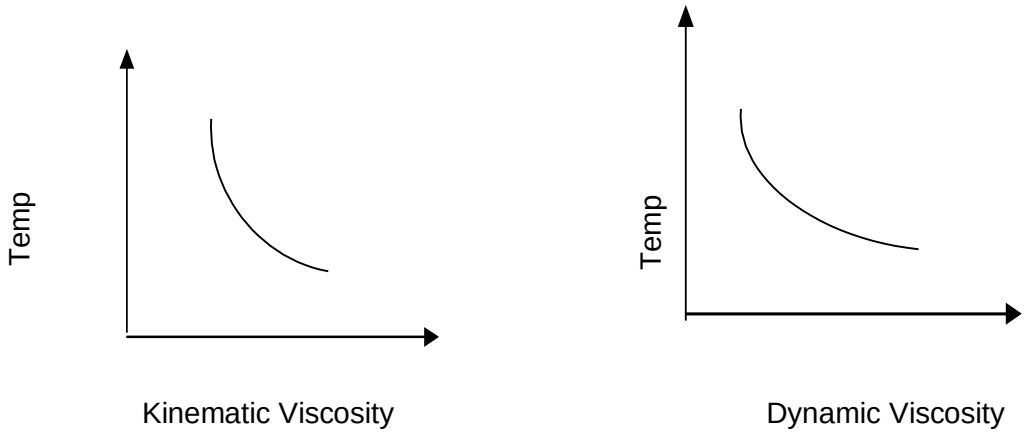
Observations:

Sl No.	Oil temperature in ^0c	Time for collecting 50cc of oil in sec	Kinematic viscosity $\upsilon = 0.226t - 195/t$ Centi stokes	Density gm/sec	Absolute viscosity dyne-sec/cm^2

Graphs to Be Drawn

1. Kinematic Viscosity vs. temperature
2. Dynamic Viscosity vs. temperature

Model Graphs:

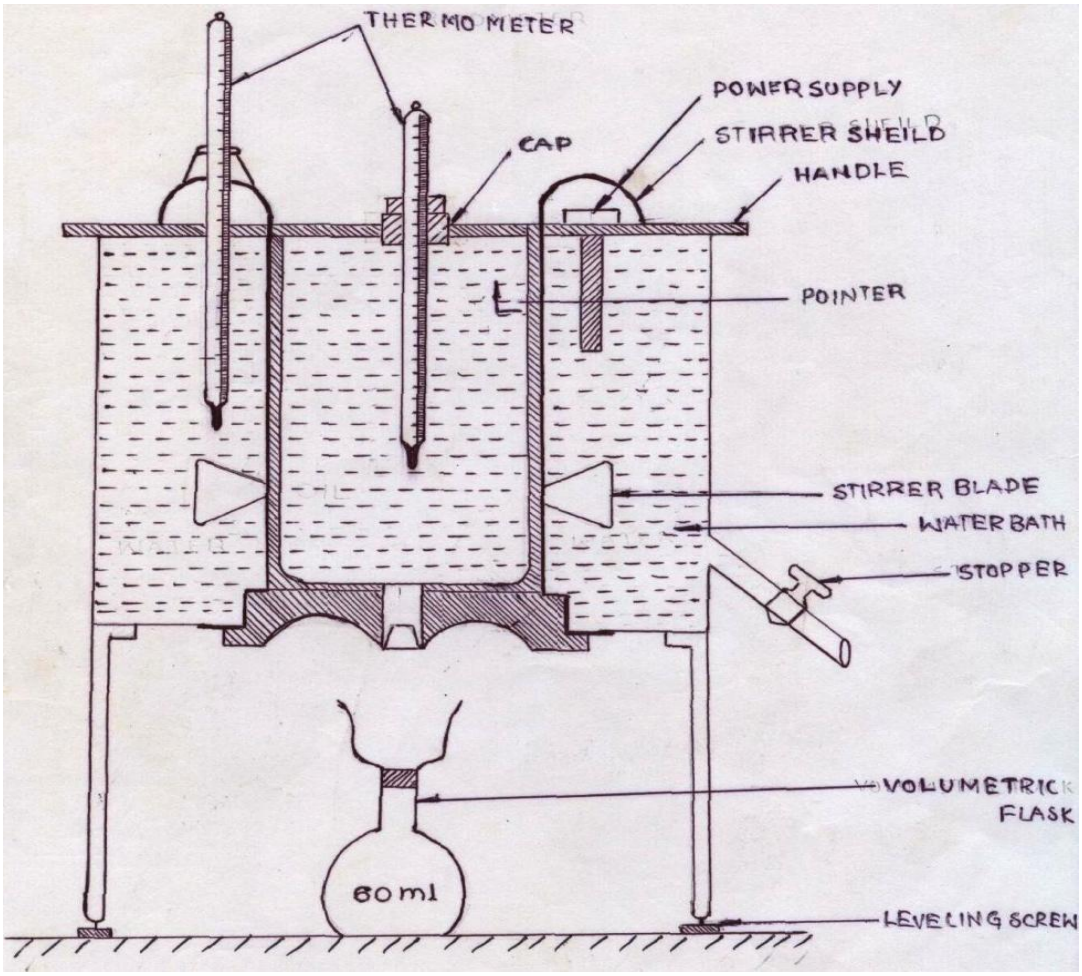


Precautions:

1. Stir the water continuously so that the temperature of the oil and water are equal.
2. Before collecting the oil at a temperature, check whether the oil is up to the level.
3. Always take the readings at a stable temperature.
4. Ensure proper setting of the bob to avoid leakage.

Result:

Variation of Absolute viscosity and Kinematic viscosity with temperature, were observed and found to be decreasing with temperature.



SAYBOLT VISCOMETER

EXPERIMENT : 07

DETERMINATION OF CALORIFIC VALUE OF GASSEOUS FUEL USING JUNKER'S GAS CALORIMETER

AIM

To conduct the test on Junker's gas Calorimeter to determine the calorific value of the given gaseous fuel.

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APPARATUS REQUIRED

1. Calorimeter
2. Main calorimeter body
3. Three thermometers
4. Gas flow meter
5. Main gas flow meter body
6. Inlet / outlet nozzles
7. Union net with washer for thermometers
8. Pressure governor
9. Pressure governor body
10. Balancing beam arrangement
11. Counter balance tube
12. Inlet and outlet union nuts with washers and
13. *Jars 2000 ml & 50 ml*

THEORY

Calorific value, also called heating value, is defined as the quantity of heat liberated by the complete combustion of unit quantity of fuel. Calorific values of gasses are measured in terms of volumes, their calorific values are expressed as calories/cubic centimeter in CGS system of units, kilo calories/cubic meter ($Kcal/m^3$) in MKS system of units and British Thermal Units/cubic feet ($B.T.U./ft^3$) in FPS system of units. However, the volume of gasses varies with temperature and pressure. Therefore, volume at normal temperature and pressure are considered.

The apparatus used for determining the calorific value is called calorimeter. It operates on the principle that heat liberated from a known quantity of fuel burnt in an atmosphere of pure oxygen in the sealed and thoroughly insulated chamber of calorimeter can be completely utilized for raising the temperature of the calorimeter and a known quantity of water in the calorimeter. By considering that the heat absorbed by the calorimeter and water and the heat given out by the fuel are equal the calorific value of the fuel can bedetermined.

PROCEDURE

1. Pour water into the governor till water starts overflowing through the overflow passage.
2. Replace and tighten the over flow nut.
3. Insert three thermometers provided with calorimeter into the rubber corks.
4. Insert rubber corks with thermometers into their places in calorimeter.
5. Insert burner into its support rod in the bottom of the calorimeter and turn the knurled knob so that the burner is fixed tightly. The burner must go into the center of the calorimeter body.
6. Connect the calorimeter, the flow meter and the pressure governor as shown in figure using rubber tubing provided. Do not connect gas supply line. Take care to see that the water regulator of calorimeter is in OFF position.
7. Turn water regulator knob on calorimeter to ON position. Allow water to flow through the calorimeter from overhead tank/ tap. Allow water to flow for 3 to 4 min into laboratory sink, through the calorimeter.
8. Ensure that outlet tap of governor is closed. Connect gas supply line to governor inlet. Remove burner from calorimeter then open governor outlet tap. Allow gas to pass through the burner.
9. Light up the burner by holding a lighted match stick near the mesh at the top.
10. Adjust the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fix the lighted burner back into position.
11. Adjust water regulator on calorimeter to get a temperature difference of 12^0C to 15 ^{0} C between the inlet water & outlet water as indicated by the respective thermometers at the top of the calorimeter.
12. Allow 20 to 30 min for outlet water temperature to become steady.
13. Measure the water flow rate with the help of measuring jar. Simultaneously, note the flow meter reading.
14. Note down the inlet &outlet water temperatures.
15. Repeat the test with same volume of gas 3 or 4 times and take average temperatures of inlet and outlet water.

OBSERVATIONS

Volume of water collected during the test period VW = _____ m^3 .

Specific weight of water γ = 1000 kg/m^3

Room temperature T = _____ ^{0} C

Volume of gas burnt at room temperature and pressure during the test period V_G = _____ m3 .

Average water inlet temperature T_1= _____ ^{0} C

Average water outlet temperature T_2 = _____ ^{0} C

Sl.No.	Volume of water collected during the test period V_w m^3	Volume of gas burnt during the test period V_G m^3	Water inlet temp $T_1{}^oC$	Water outlet temp $T_2{}^oC$	CV Kcal/m^3

CALCULATIONS

The formula to be used to calculate the calorific value to the test gas is as follows

$$CV = \frac{V_w}{V_G} X (T_2 - T_1) X 1000 \quad Kcal/m^3$$

Where

C.V = calorific value of gas in K cal/m3
V_G= volume of gas in liters consume during test period
V_w= volume of water in liters passed during test period
T_1 = Inlet water temperature in^0C
T_2 = outlet water temperature in^0C

PRECAUTIONS

1. Test reading are to be taken only after steady condition are reached
2. Formation of steam should not be allowed. If there is formation of steam, then increase the flow of water or reduce the gas flow rate
3. Water flow rate should be steady.
4. The inner float of the pressure governor should not be removed since the outlet pressure may vary when refitted.

RESULT

The calorific value gaseous fuel is _____ Kcal/m^3 .

EXPERIMENT : 08

DETERMINATION OF CARBON RESIDUE OF GIVEN FUEL

USING CONRADSON'S APPARATUS

Aim

To conduct the test on Carbon Residue (Conrodson) Apparatus to determine the carbon residue of the given sample of lubricating oil / Fuel.

Apparatus

1. Carbon residue (Conradson) apparatus
2. Analytical balance with Weight box.

Theory

Most of the lubricant oils are containing high percentage of carbon in combined form and fuels containing less percentage of carbon in combined form. On heating, they decompose depositing a certain amount of carbon. The deposition of such carbon in machine is intolerable, particularly in internal combustion engines and air compressors. A good lubricant should deposit least amount of the carbon in use.

Procedure

1. The weighed porcelain or silica crucible with approximately 2 grams of sample is placed in the center of skid morecrucible.
2. The skid more crucible is provided with lid, having a small tube type opening for the escape of volatilematter.
3. The combination is then placed in a wrought iron crucible covered with chimney shaped iron hood.
4. The wrought iron crucible is heated slowly till flame appears. Slow heating continues for 5 minutesmore.
5. Finally, strong heating is done for about 15 minutes till vapors of all volatile matter are burnt completely.
6. Apparatus is then allowed to cool and weight of residue left isdetermined.
7. The result is expressed as percentage of the original weight of oiltaken.

Observations:

i. Weight of the crucible W_1 =*gms*

ii. Weight of the crucible with oil W_2=*gms*

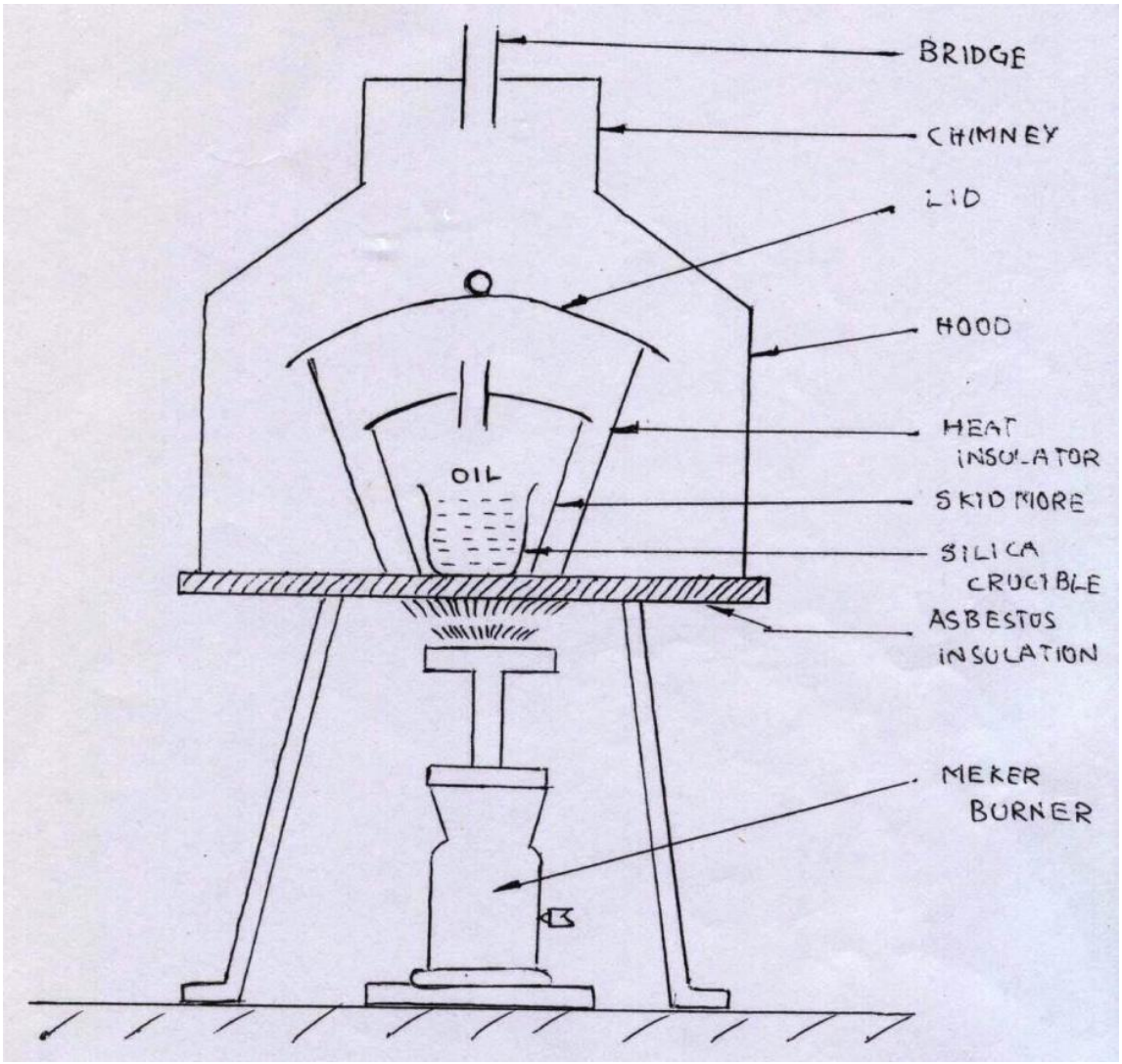
iii. Weight of crucible with residue W_3 =*gms*

$$\textit{Percentage of Carbon Residue} = \frac{Weight\ of\ Residue}{Weight\ of\ sample}$$

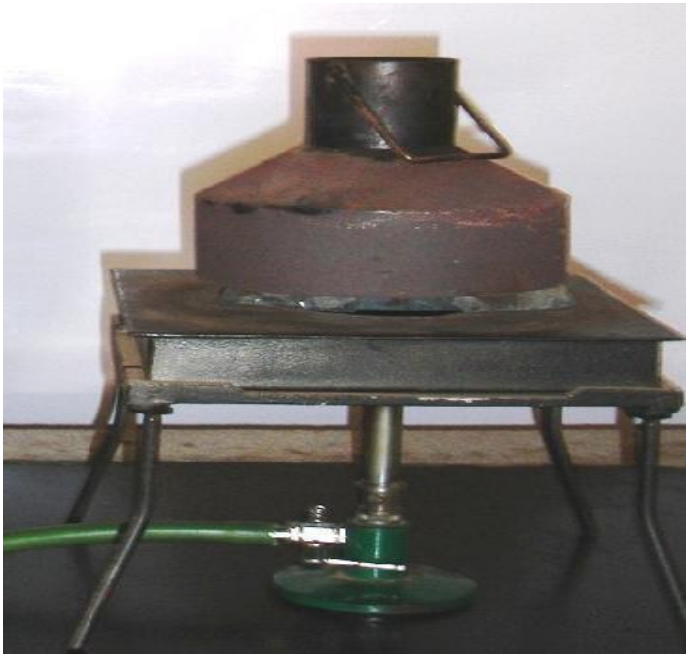
$$= \frac{W3 - W1}{W2 - W1} X100$$

Result:

The percentage of carbon present in given sample oflubricatingoilis_____%



CARBON RESIDUE (CONRADSON) APPARATUS



CARBON RESIDUE (CONRADSON) TEST

EXPERIMENT : 09

CALIBRATION OF PRESSURE GAUGE USING DEAD WEIGHT PRESSURE GAUGE TESTER

AIM

To conduct the test on Dead weight pressure Gauge to calibrate the given pressure gauge and to draw its calibration curves.

APPARATUS REQUIRED

1. One dead weight pressure gauge testing cum calibration machine
2. A set of standardized weights to reach the maximum capacity of the gauge being tested
3. two pressure gauge adopters
4. two spanners and one needle puller

THEORY

Pressure intensity is defined as force per unit area and its measurement is quite commonplace in most mechanical applications and accouterments. Pressure due to ambience is called atmospheric pressure and pressure measured over and above the atmospheric pressure is called gauge pressure. If pressure is measured with respect to absolute vacuum it is called absolute pressure. Obviously absolute pressure is the sum of atmospheric pressure and gauge pressure. The gadget used for pressure measurement is called pressure gauge. Broadly they are two types, manometers and mechanical gauges. Manometers are liquid columns, usually of mercury, wherein pressure is measured in terms of height of liquid column. This does not pose any calibration problems as it involves measurement of height only. On the other hand mechanical gauges such as bourdon gauge, diaphragm gauge, bellows gauge etc., must be calibrated before use. Besides, in the course of their usage due to loss of mechanical properties they lose their accuracy and required to be re-calibrated at regular intervals. A number of methods exist for their calibration and dead weight method using standard weights is one of them.

DESCRIPTION OF APPARATUS

The apparatus consists of a priming-pump, a pressure-pump, an isolating valve, a loading head with hydraulic ram and two pressure gauge adopters, all assembled to a common base plate with leveling screws. The priming-pump is used to develop small initial pressure to begin with the test. It also serves as a reservoir of hydraulic liquid required for testing. The isolating valve isolates the priming-pump from rest of the hydraulic system after a small initial pressure has been built up in the system. A thrust ball bearing is used in the pressure-pump operating mechanism to minimize the effort required to operate it. The loading head houses a precision ground and lapped hydraulic ram to facilitate movement without friction in its guide. The ram carries a loading platform on top of which standardized weights can be placed. The pressure developed due to self- weight of loading ram and loading platform is marked on the platform itself. Each of the standardized weights is also marked with the additional pressure that it builds up when placed on the loading platform. Two pressure gauge adopters are provided with the unit. When testing an already calibrated gauge, one adopter must be closed with a dead plug, and when comparing or calibrating a new gauge both adopters must be used simultaneously. A needle puller is proved for pulling out the pressure gauge needles during calibration and testing.

PROCEDURE

1. The apparatus should be set up on a firm flat table or platform to provide convenient operating height for the apparatus. Place a spirit level on the top of the loading head and level the apparatus adjusting the leveling screws.
2. Pour hydraulic oil through the hole on top of the priming-pump while rotating its handle in anti-clockwise direction until the handle is completely taken out.
3. Now rotate the priming-pump slowly in clockwise direction with its isolating valve open until oil starts coming out of pressure gauge adopter. Fit the gauge in the adopter.
4. Rotate pressure-pump handle in clockwise direction till it stops. Rotate priming- pump handle in anti-clockwise direction until it is taken out, and add oil if required in to the priming-pump.
5. Place weights on the loading head up to the full capacity of the apparatus and see that a pressure gauge of capacity slightly higher than the total capacity of weights is fitted in the adopter.
6. Open the isolating valve and fix the priming-pump handle simultaneously unscrewing pressure-pump so that it is unscrewed completely.
7. Screw in the priming-pump tightly and close the isolating valve. Then move the pressure-pump handle clockwise to build up pressure in the system.
8. Check for any leaks at the pressure gauge fitting adopter etc.
9. Build up pressure to the full capacity of weights and rotate the weights gently by hand. It is necessary to rotate the weights to minimize the friction between the hydraulic ram and its guide so that the loaded ram just floats on the oil surface.
10. Rotate the handle of pressure-pump and open the isolating valve. Also rotate the priming-pump handle in the anti-clockwise direction until the pressure comes to zero.
11. Repeat this process 5 to 10 times to completely let out air in the system.
12. Remove the weights from the loading plat form and fit the pressure gauge to be tested in the pressure gauge adopter. A sealing washer should be used in the joint to prevent leakage.
13. Select about ten points at equal intervals to reach the full capacity of the gauge. Select the corresponding weights from the set of weights supplied.
14. After priming and closing the isolating valve for priming-pump add weights on the loading head step by step and operate the pressure-pump clockwise so that the loading platform remains lifted up to the red mark on the guide.
15. Rotate the weights gently by hand and see that the platform remains moving in the red band range.
16. Similarly go on increasing the weights and balancing the hydraulic ram in the red band range.
17. Compare the pressure shown by the pressure gauge needle with the sum of pressure intensities marked on the weights at various selected points and make necessary adjustments in the pressure gauge mechanism

OBSERVATIONS

The observed valued are recorded in tabular form as following

Sl No	Actual pressure Based on weights Kg/cm^2	Pressure as per pressure gauge Kg/cm^2	Error	Correction	Percentage correction %
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

GRAPHS: The observed data as recorded in the above table is presented in the following two graphs:

- A graph drawn between pressure as read from pressure gauge on X-axis and the percentage correction on Y-axis.
- A graph drawn between actual pressure based on weights on X-axis and the pressure as shown by gauge being tested/calibrated on Y-axis.

PRECAUTIONS

1. Keep the apparatus along with the weights clean and tidy. The loading head is the most delicate and sensitive part of the apparatus and therefore care should be taken in its handling. The weights should be placed very gently over it, and removed one by one carefully.
2. The oil inlet of the priming-pump should be kept covered with the plug to prevent foreign matter like dust from entering into it.
3. If the needle of the pressure gauge is to be removed, it should be done with the help of needle puller only, and not by force to avoid damage to the gauge spindle.

RESULT

The given pressure gauge has been calibrated using dead weight pressure gauge and calibration curves have been drawn

Length Units

Millimeters	Centimeters	Meters	Kilometers	Inches	Feet	Yards	Miles
mm	cm	m	km	in	ft	yd	mi
1	0.1	0.001	0.000001	0.03937	0.003281	0.001094	6.21e-07
10	1	0.01	0.00001	0.393701	0.032808	0.010936	0.000006
1000	100	1	0.001	39.37008	3.28084	1.093613	0.000621
1000000	100000	1000	1	39370.08	3280.84	1093.613	0.621371
25.4	2.54	0.0254	0.000025	1	0.083333	0.027778	0.000016
304.8	30.48	0.3048	0.000305	12	1	0.333333	0.000189
914.4	91.44	0.9144	0.000914	36	3	1	0.000568
1609344	160934.4	1609.344	1.609344	63360	5280	1760	1

Area Units

Millimeter square	Centimeter square	Meter square	Inch square	Foot square	Yard square
mm^2	cm^2	m^2	in^2	ft^2	yd^2
1	0.01	0.000001	0.00155	0.000011	0.000001
100	1	0.0001	0.155	0.001076	0.00012
1000000	10000	1	1550.003	10.76391	1.19599
645.16	6.4516	0.000645	1	0.006944	0.000772
92903	929.0304	0.092903	144	1	0.111111
836127	8361.274	0.836127	1296	9	1

Volume Units

Centimeter cube	Meter cube	Liter	Inch cube	Foot cube	US gallons	Imperial gallons	US barrel (oil)
cm^3	m^3	ltr	in^3	ft^3	US gal	Imp. gal	US brl
1	0.000001	0.001	0.061024	0.000035	0.000264	0.00022	0.000006
1000000	1	1000	61024	35	264	220	6.29
1000	0.001	1	61	0.035	0.264201	0.22	0.00629
16.4	0.000016	0.016387	1	0.000579	0.004329	0.003605	0.000103
28317	0.028317	28.31685	1728	1	7.481333	6.229712	0.178127
3785	0.003785	3.79	231	0.13	1	0.832701	0.02381
4545	0.004545	4.55	277	0.16	1.20	1	0.028593
158970	0.15897	159	9701	6	42	35	1

Mass Units

Grams	Kilograms	Metric tonnes	Short ton	Long ton	Pounds	Ounces
g	kg	tonne	shton	Lton	lb	oz
1	0.001	0.000001	0.000001	9.84e-07	0.002205	0.035273
1000	1	0.001	0.001102	0.000984	2.204586	35.27337
1000000	1000	1	1.102293	0.984252	2204.586	35273.37
907200	907.2	0.9072	1	0.892913	2000	32000
1016000	1016	1.016	1.119929	1	2239.859	35837.74
453.6	0.4536	0.000454	0.0005	0.000446	1	16
28	0.02835	0.000028	0.000031	0.000028	0.0625	1

Density Units

Gram/milliliter	Kilogram/meter cube	Pound/foot cube	Pound/inch cube
g/ml	kg/m^3	lb/ft^3	lb/in^3
1	1000	62.42197	0.036127
0.001	1	0.062422	0.000036
0.01602	16.02	1	0.000579
27.68	27680	1727.84	1

Volumetric Liquid Flow Units

Liter/second	Liter/minute	Meter cube/hour	Foot cube/minute	Foot cube/hour	US gallons/minute	US barrels (oil)/day
L/sec	L/min	M^3/hr	ft^3/min	ft^3/hr	gal/min	US brl/d
1	60	3.6	2.119093	127.1197	15.85037	543.4783
0.016666	1	0.06	0.035317	2.118577	0.264162	9.057609
0.277778	16.6667	1	0.588637	35.31102	4.40288	150.9661
0.4719	28.31513	1.69884	1	60	7.479791	256.4674
0.007867	0.472015	0.02832	0.01667	1	0.124689	4.275326
0.06309	3.785551	0.227124	0.133694	8.019983	1	34.28804
0.00184	0.110404	0.006624	0.003899	0.2339	0.029165	1

Volumetric Gas Flow Units

Normal meter cube/hour	Standard cubic feet/hour	Standard cubic feet/minute
Nm^3/hr	scfh	scfm
1	35.31073	0.588582
0.02832	1	0.016669
1.699	59.99294	1

Mass Flow Units

Kilogram/hour	Pound/hour	Kilogram/second	Ton/hour
kg/h	lb/hour	kg/s	t/h
1	2.204586	0.000278	0.001
0.4536	1	0.000126	0.000454
3600	7936.508	1	3.6
1000	2204.586	0.277778	1

high Pressure Units

Bar	Pound/square inch	Kilopascal	Megapascal	Kilogram force/ centimeter square	Millimeter of mercury	Atmospheres
bar	psi	kPa	MPa	kgf/cm^2	mm Hg	atm
1	14.50326	100	0.1	1.01968	750.0188	0.987167
0.06895	1	6.895	0.006895	0.070307	51.71379	0.068065
0.01	0.1450	1	0.001	0.01020	7.5002	0.00987
10	145.03	1000	1	10.197	7500.2	9.8717
0.9807	14.22335	98.07	0.09807	1	735.5434	0.968115
0.001333	0.019337	0.13333	0.000133	0.00136	1	0.001316
1.013	14.69181	101.3	0.1013	1.032936	759.769	1

Low Pressure Units

Meter of water	Foot of water	Centimeter of mercury	Inches of mercury	Inches of water	Pascal
mH_2O	ftH_2O	cmHg	inHg	inH_2O	Pa
1	3.280696	7.356339	2.896043	39.36572	9806
0.304813	1	2.242311	0.882753	11.9992	2989
0.135937	0.445969	1	0.39368	5.351265	1333
0.345299	1.13282	2.540135	1	13.59293	3386
0.025403	0.083339	0.186872	0.073568	1	249.1
0.000102	0.000335	0.00075	0.000295	0.004014	1

Speed Units

Meter/second	Meter/minute	Kilometer/hour	Foot/second	Foot/minute	Miles/hour
m/s	m/min	km/h	ft/s	ft/min	mi/h
1	59.988	3.599712	3.28084	196.8504	2.237136
0.01667	1	0.060007	0.054692	3.281496	0.037293
0.2778	16.66467	1	0.911417	54.68504	0.621477
0.3048	18.28434	1.097192	1	60	0.681879
0.00508	0.304739	0.018287	0.016667	1	0.011365
0.447	26.81464	1.609071	1.466535	87.99213	1

Torque Units

Newton meter	Kilogram force meter	Foot pound	Inch pound
Nm	kgfm	ftlb	inlb
1	0.101972	0.737561	8.850732
9.80665	1	7.233003	86.79603
1.35582	0.138255	1	12
0.112985	0.011521	0.083333	1

Dynamic Viscosity Units

Centipoise*	Poise	Pound/foot·second
cp	poise	lb/(ft·s)
1	0.01	0.000672
100	1	0.067197
1488.16	14.8816	1

Kinematic Viscosity Units

Centistoke*	Stoke	Foot square/second	meter square/second
cs	St	ft^2/s	m^2/s
1	0.01	0.000011	0.000001
100	1	0.001076	0.0001
92903	929.03	1	0.092903
1000000	10000	10.76392	1

*note: centistokes x specific gravity = centipoise

Temperature Conversion Formulas

Degree Celsius (°C)	(°F - 32) x 5/9
	(K - 273.15)
Degree Fahrenheit (°F)	(°C x 9/5) + 32
	(1.8 x K) - 459.67
Kelvin (K)	(°C + 273.15)
	(°F + 459.67) ÷ 1.8

M-309, FUELS LABORATORY PRACTICE

ASSESSMENT AND VIVA QUESTIONS

EXPERIMENT NO.1, 2 and 3: FLASH AND FIRE POINTS TESTS:

(a) By using Cleveland's Flash and fire point apparatus

LO:

1. Identify the components of clelveland's apparatus and tools required for conducting experiment.
2. Clean the oil cup and take the given oil sample at the level of grooved mark in it.Fix the thermometer in fixture in order that the bulb of thermometer should not touch the bottom of oil cup.
3. Maintaining the uniform temperature of oil.

MO:

1. Apply the test flame at every $0.5^{o}C$ and $1^{0}C$ rise of temperature.
2. Adjust the regulator to obtain slow and steady heating of oil.

HO:

1. Identify and record the minimum temperature at which distinct flash point is obtained on the given sample of oil surface.
2. Identify and record the minimum temperature at which the oil burns continuously for 5 sec. (Fire point) on the surface of the given sample of oil.

Viva questions:

1. Define flash point.
2. Define fire point.
3. Why we need to measure the flash and fire points of given oil sample.
4. State the industrial applications of oils where the data of flash and fire points are used.
5. How much temperature difference is observed between flash and fire points of given sample.

(b) By using Pensky marten flash and fire point apparatus

LO:

1. Identify the components of Pensky Marten closed cup apparatus and tools required for conducting the flash and fire point experiment.
2. Clean the oil cup and take the given oil sample at the level of grooved mark in it.Fix the thermometer in fixture in order that the bulb of thermometer should not touch the bottom of oil cup
3. Maintaining the uniform temperature of oil.

MO:

1. Apply the test flame at every $0.5^{o}C$ and $1^{0}C$ rise of temperature.
2. Adjust the regulator to obtain slow and steady heating of oil

HO:

1. Identify and record the minimum temperature at which distinct flash point is obtained on the given sample of oil surface.
2. Identify and record the minimum temperature at which the oil burns continuously (Fire point) for 5 sec. on the surface of the given sample of oil.

Viva questions:

1. State the functions of lubricating oils.
2. Define flash point.
3. Define fire point.
4. What is the purpose of finding the flash and fire points of given oil sample.
5. State the industrial applications of oils where the data of flash and fire points is used.
6. How much temperature difference observed between flash and fire points of given sample.
7. State the advantages of closed cup apparatus over open cup apparatus.

(c) By using Able's Flash and fire point apparatus

LO:

1. Identify the components of Able's apparatus and tools required for conducting experiment.
2. Clean the oil cup and take the given oil sample at the level of grooved mark in it.Fix the thermometer in fixture in order that the bulb of thermometer should not touch the bottom of oil cup.
3. Maintaining the uniform temperature of oil.

MO:

1. Apply the test flame at every $0.5^{o}C$ and $1^{0}C$ rise of temperature.
2. Adjust the regulator to obtain slow and steady heating of oil.

HO:

1. Identify and record the minimum temperature at which distinct flash point is obtained on the given sample of oil surface.
2. Identify and record the minimum temperature at which the oil burns continuously for 5 sec. (Fire point) on the surface of the given sample of oil.

Viva questions:

1. Define flash point.
2. Define fire point.
3. Why we need to measure the flash and fire points of given oil sample.
4. State the industrial applications of oils where the data of flash and fire points are used.
5. How much temperature difference is observed between flash and fire points of given sample.

EXPERIMENT NO. 4, 5 and 6

VISCOSITY MEASUREMENT TESTS:

(a) By using Redwood Viscometer - I

LO:

1. Identify the different components of redwood viscometer and identify the tools required for conducting experiment.
2. Cleaning the oil cup with suitable solvent and drying with tissue paper.
3. Keep the ball valve in position so as to keep the orifice closed before filling with given oil
4. Maintain uniform temperature of water in water bath.
5. Write the equation to determine the viscosity of given oil using Redwood viscometer – I

MO:

1. Leveling of viscometer with the help of leveling screws.
2. Determine the diameter of orifice using vernier caliper
3. Record the time taken to collect the 50 cc of oil at different temperatures.
4. Calculate the density of given oil.

HO:

1. Determine the Dynamic viscosity of given oil at different temperatures. Draw the graph Dynamic viscosity vs temperature and discuss the variation of dynamic viscosity with temperature.
2. Determine the kinematic viscosity of given oil at different temperatures. Draw the graph, kinematic viscosity Vs temperature and discuss the variation of kinematic viscosity with temperature.

Viva questions:

1. Define viscosity
2. State the relationship between dynamic viscosity and kinematic viscosity.
3. Mention the units of Dynamic viscosity
4. Mention the units of kinematic viscosity.
5. How do you calculate the density of given oil.
6. How the viscosity varies with temperature for liquids.
7. How the viscosity varies with temperature for gases.
8. State the application fields of lubricant oils in which viscosity property is mainly considered.

By using Redwood Viscometer - II

LO:

1. Identify the different components of redwood viscometer-II and identify the tools required for conducting experiment.
2. Cleaning the oil cup with suitable solvent and drying with tissue paper.
3. Keep the ball valve in position so as to keep the orifice closed before filling with given oil
4. Maintain uniform temperature of water in water bath.
5. Write the equation to determine the viscosity of given oil using Redwood viscometer – II

MO:

1. Leveling of viscometer with the help of leveling screws.
2. Determine the diameter of orifice using vernier caliper
3. Record the time taken to collect the 50 cc of oil at different temperatures.
4. Calculate the density of given oil.

HO:

1. Determine the Dynamic viscosity of given oil at different temperatures. Draw the graph, Dynamic viscosity Vs temperature and discuss the variation of dynamic viscosity with temperature.
2. Determine the kinematic viscosity of given oil at different temperatures. Draw the graph, kinematic viscosity Vs temperature and discuss the variation of kinematic viscosity with temperature.

Viva questions:

1. Define viscosity
2. State the relationship between dynamic viscosity and kinematic viscosity.
3. Mention the units of Dynamic viscosity
4. Mention the units of kinematic viscosity.
5. How do you calculate the density of given oil.
6. State the need of strirring while doing the experiment.
7. What is the effect of temperature on viscosity for liquids.
8. State the application fields of lubricant oils in which viscosity property is mainly considered.
9. Mention the situations at which Redwood – I and Redwood – II viscometers are used to measure the viscosity.

(c) By using Saybolt viscometer:

LO:

1. Identify the different components of Saybolt viscometer and identify the tools required for conducting experiment.
2. Cleaning the oil cup with suitable solvent and drying with tissue paper.
3. Keep the ball valve in position so as to keep the orifice closed before filling with given oil
4. Maintain uniform temperature of water in water bath.
5. Write the equation to determine the viscosity of given oil using Sayboltviscometer

MO:

1. Leveling of viscometer with the help of leveling screws.
2. Determine the diameter of orifice using vernier caliper
3. Record the time taken to collect the 50 cc of oil at different temperatures.
4. Calculate the density of given oil.

HO:

1. Determine the Dynamic viscosity of given oil at different temperatures. Draw the graph, Dynamic viscosity Vs temperature and discuss the variation of dynamic viscosity with temperature.
2. Determine the kinematic viscosity of given oil at different temperatures. Draw the graph, kinematic viscosity Vs temperature and discussthe variation of kinematic viscosity with temperature.

Viva questions:

1. state the purpose of lubricant oils
2. give few examples for lubricant oils
3. Define viscosity
4. State the relationship between dynamic viscosity and kinematic viscosity.
5. Mention the units of Dynamic viscosity
6. Mention the units of kinematic viscosity.
7. How do you calculate the density of given oil.
8. How the temperature of oil will affect the viscosity property.
9. State the application fields of lubricant oils in which viscosity property is mainly considered.

EXPERIMENT NO.7

CALORIFIC VALUE TEST BY USING JUNKER'S GAS CALORIMETER

LO:

16. Identify the components of Junker's gas calorimeter and tools used for conducting experiment.
17. Write the formula used for calculation of calorific value of fuel using Junker's gas calorimeter
18. Pour water into the governor till water starts overflowing through the overflow passage. Replace and tighten the over flow nut. Insert three thermometers into the rubber corks. Insert rubber corks with thermometer. Insert burner into its support rod in the bottom of the calorimeter and fix knob tightly. The burner must go into the center of the calorimeter body.
19. Connect the calorimeter, the flow meter and the pressure governor using rubber tubing provided while the water regulator of calorimeter is in OFF position.
20. Turn water regulator knob on calorimeter to ON position. Allow water to flow through the calorimeter from overhead tank/ tap. Allow water to flow for 3 to 4 min into laboratory sink, through the calorimeter.

MO:

1. Light up the burner by holding a lighted match stick near the mesh at the top. Adjust the air regulator sleeve at the bottom of the burner to get a blue, non- luminous flame. Fix the lighted burner back into position.
2. Measure the water flow rate with the help of measuring jar.

HO:

1. Determine the calorific value of given gaseous fuel.

Viva questions:

1. Define Higher calorific value
2. Define lower calorific value
3. What is formula for calculation of calorific value of fuel.
4. Mention the different types of calorimeters.
5. Name the calorimeter used to measure the calorific value of solid and liquid fuels.
6. Name the calorimeter used to measure the calorific value of gaseous fuels.
7. What are the advantages, disadvantages of solid, liquid & gaseous fuels?
8. What are the properties required for a good fuel? 8.

EXPERIMENT NO.8

CARBON RESIDUE TEST BY USING CONRADSON APPARATUS

LO:

1. Take approx. 2 gsof sample of oil and place it in the center of the skidmore crucible.
2. State formula to calculate the weight of carbon residue.

MO:

1. Measure the weight of given sample of oil. Place it in the center of skidmore crucible. Place skidmore crucible with lid l, having a small tube type opening for the escape of volatile matter.

HO:

1. Heat the wrought iron crucible slowly, till the flame appears and slow heating is continuous for 5 min. Heat the wrought iron crucible strongly for about 15 min. till the vapours of all volatile matter are burnt completely.
2. Calculate the percentage of carbon residue in the given sample of oil.

Viva questions:

1. Define fuel.
2. State the types of fuels and give examples for each type
3. Differentiate between fuel and lubricating oils.
4. What do you understand by carbon residue.
5. How do you calculate the % of carbon residue.
6. What is the need finding the carbon residue of given sample.
7. Is this equipment suitable for measuring the carbon residue of gaseous fuels.

EXPERIMENT NO.9: CALIBRATION OF PRESSURE GAUGE TEST:

LO:

1. Detach the piston from the cylinder. Measure the internal diameter of the cylinder and calculate the cross sectional area.

MO:

1. Adjust the oil level in the open cylinder until the cylinder is filled upto the edge and reinsert the piston into the cylinder of the pressure gauge.
2. State the formula to calculate the percentage of error for given pressure gauge.

HO:

1. Record the increase of gauge pressure by adjusting mass in five steps of increment 0.5 kg. Record the decrease of gauge pressure by reducing the mass in five steps back to zero reading. Calculate the average pressure for each step.
2. Draw the graph percentage error Vs standard gauge pressure and average gauge pressure Vs standard gauge pressure.

Viva questions:

1. Define pressure.
2. Mention the units of pressure.
3. Define absolute pressure, gauge pressure, and vacuum pressures
4. State the relationship among gauge pressure, vacuum pressure and absolute pressure.
5. Define the term calibration
6. State advantages and disadvantages of bourdon pressure gauge.

MODEL PAPER FOR UNIT TEST – I …… 60 MARKS

1. (a)Fix the thermometer in fixture in order that the bulb of thermometer should not touch the bottom of oil cup using Cleveland's flash and fire point apparatus. 6M
   (b) Calculate the density of given oil sample using Redwood viscometer – I 20M
   (c)By using Saybolt viscometer, Determine the Dynamic viscosity of given oil at different temperatures. Draw the graph, Dynamic viscosity Vs temperature and discuss the variation of dynamic viscosity of oil with temperature. 28 M
   (d) Viva-Questions 6 M
2. (a)Maintain the uniform temperature of oil bath to find out flash and fire points using Pensky marten apparatus. 6M
   (b) Record the time taken to collect the 50 cc of oil at different temperatures while calculating the viscosity by using redwood viscometer - II. 20M
   (c) By using Redwood Viscometer – I, determine the kinematic viscosity of given oil at different temperatures. Draw the graph, kinematic viscosity Vs temperature and discuss the variation of kinematic viscosity with temperature. 28M
   (d) Viva-Questions 6 M

3. (a)Write the equation to determine the viscosity of given oil using Redwood viscometer–I. 6M
   (b)Adjust the regulator to obtain slow and steady heating of oil to find out flash and fire point of given sample using Cleveland's apparatus. 20M
   (c) By using Redwood Viscometer – II, determine the Dynamic viscosity of given oil at different temperatures. Draw the graph, Dynamic viscosity Vs temperature and discuss. 28M
   (d) Viva-Questions 6 M

4. (a)Write the equation to determine the viscosity of given oil using Redwood viscometer–II. 6M
   (b) Determine the diameter of orifice of sayboltviscometer using vernier caliper. 20M
   (C) Identify and record the flash point and the minimum temperature at which the oil burns continuously for 5 sec (fire point) on the surface of the given sample of oil using pensky marten's apparatus 28M
   (d) Viva-Questions 6 M

5. (a) Write the equation to determine the viscosity of given oil using saybolt viscometer. 6M
   (b) Determine the diameter of orifice of redwood viscometer-I using vernier caliper. 20M
   (c) Identify and record the flash point and the minimum temperature at which the oil burns continuously for 5 sec.(fire point) on the surface of the given sample of oil using Cleveland's open cup apparatus. 28M
   (d) Viva-Questions 6 M
6 (a) Connect the calorimeter, the flow meter and the pressure governor using rubber tubing provided while the water regulator of calorimeter is in OFF position. 6M
   (b) Determine the diameter of orifice of redwood viscometer-II using vernier caliper. 20M
   (c) Identify and record the flash point and the minimum temperature at which the oil burns continuously for 5 sec.(fire point) on the surface of the given sample of oil using Able's open cup apparatus 28M
   (d) Viva-Questions 6 M

MODEL PAPER FOR UNIT TEST – II ….. 60 Marks

1. (a) Measure the internal diameter of the cylinder and calculate the cross sectional area of piston of the calibration of pressure gauge apparatus.
   6M

   (b)Measure the weight of given sample of oil. Place it in the center of skidmore crucible. Place skidmore crucible with lid l, having a small tube type opening for the escape of volatile matter.
   20M

   (c) Determine the calorific value of given sample of fuel using junker's gas calorimeter.
   28M

   (d) Viva-Questions 6 M

2. (a)Identify the components of Junker's gas calorimeter and tools used for conducting experiment. 6M

   (b) State the formula to calculate the percentage of error for given pressure gauge.
   20M

   (c)Calculate the percentage of carbon residue in the given sample of oil.
   28M

   (d) Viva-Questions 6 M

3. (a) State formula to calculate the weight of carbon residue.
   6M

   (b) Write the formula used for calculation of calorific value of fuel using Junker's gas calorimeter. 20M

   (c) Draw the graph percentage error Vs standard gauge pressure and average gauge pressure Vs standard gauge pressure by calibrating the given pressure gauge.
   28M

   (d) Viva-Questions 6 M

MODEL PAPER FOR PRACTICAL END EXAMINATION
… 60 MARKS

1. (a) Clean the oil cup and take the given oil sample at the level of grooved mark. Fix the thermometer in fixture in order that the bulb of thermometer should not touch the bottom of oil cup using Cleveland's flash and fire point apparatus. 6M
   (b) Write the formula used for calculation of calorific value of fuel using junker's gas calorimeter 20M
   (c) Identify and record the minimum temperature at which the oil burns continuously for 5 sec (fire point) on the surface of the given sample of oil using Cleveland's open cup apparatus. 28M
   (d) Viva-Questions 6 M

2. (a) Write the equation to determine the viscosity of given oil using Redwood viscometer–I 6M
   (b) State the formula to calculate the percentage of error used in calibration of pressure gauge. 20M
   (c) Identify and record the minimum temperature at which the oil burns continuously for 5 sec (fire point) on the surface of the given sample of oil using pensky marten's apparatus. 28M
   (d) Viva-Questions 6 M

3. (a) State formula to calculate the weight of carbon residue. 6 M
   (b) Measure the water flow rate with the help of measuring jar while doing the experiment with junker's gas claorimeter. 20M
   (c) Identify and record the minimum temperature at which the oil burns continuously for 5 sec (fire point) on the surface of the given sample of oil using Able's apparatus 28M
   (d) Viva-Questions 6 M

4. (a) Maintain the uniform temperature of oil bath to find out flash and fire points using Pensky marten apparatus. 6M

   (b) Measure the weight of given sample of oil. Place it in the center of skidmore crucible. Place skidmore crucible with lid I, having a small tube type opening for the escape of volatile matter. 20M
   (c) By using Redwood Viscometer – II, determine the Dynamic viscosity of given oil at different temperatures. Draw the graph, Dynamic viscosity Vs temperature and discuss. 28 M
   (d) Viva-Questions 6 M

5. (a)Write the equation to determine the viscosity of given oil using Redwood viscometer–II. 6M
   (b) Determine the diameter of orifice of saybolt diameter using vernier caliper. 20M
   (c)By using Redwood Viscometer – I, determine the absolute viscosity of given oil at different temperatures. Draw the graph, absolute viscosity Vs temperature and discuss the effect of temperature on absolute viscosity. 28M
   (d) Viva-Questions 6 M

6. (a) Write the equation to determine the viscosity of given oil using redwood viscometer. 6M

(b) Determine the diameter of orifice of redwood viscometer-I using vernier caliper. 20M

(c)By using Saybolt viscometer, Determine the Dynamic viscosity of given oil at different temperatures. Draw the graph , Dynamic viscosity Vs temperature and discuss the effect of temperature on dynamic viscocity of oil. 28M

(d) Viva-Questions 6 M

7. (a) Measure the internal diameter of the cylinder and calculate the cross sectional area of the calibration of pressure gauge apparatus. 6M

(bAdjust the regulator to obtain slow and steady heating of oil to find out flash and fire point of given sample using Cleveland's apparatus. 20M

(c) Determine the calorific value of given gaseous fuel using Junker's gas calorimeter. 28 M

(d) Viva-Questions 6 M

8. (a)Identify the components of junker's gas calorimeter and tools used for measurement of calorific value of fuel. 6M

(b)Record the time taken to collect the 50 cc of oil at different temperatures while calculating the viscosity by using redwood viscometer - II. 20 M

(c)Calculate the percentage of carbon residue in the given sample of oil. 28M

(d) Viva-Questions 6 M

9. (a) State formula to calculate the weight of carbon residue. 6M

(b) Calculate the density of given oil sample using Redwood viscometer – I 20M

(c) Draw the graph percentage error Vs standard gauge pressure and average gauge pressure Vs standard gauge pressure by calibrating the given pressure gauge. 28M

(d) Viva-Questions 6 M