Surigao City Campus

Bachelor of Science in Electrical Engineering

SURIGAO STATE COLLEGE OF TECHNOLOGY

SSCT

"For Nation's Greater Heights"

I.8.19. problem-solving;

Troubleshooting

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BSEE - 1A

PHYSICS

80/90

MODULE 1

PART - A and Part - B

1. What is Heat?

- Heat is the energy transferred from one object to another by a temperature difference. When two objects with different temperatures are put together, energy is transferred.

2. What is temperature?

- Temperature is a physical quantity the represents heat and cold the source of the appearance of heat is the manifestation of the heat energy present in all matter, and the flow of energy when one body comes into contact with another is colder or hotter.

3. What are the three important scales of temperature?

- The three most common temperature scales are Fahrenheit, Celsius and Kelvin

4- Define Conduction

- The process by which heat or electricity is directly transmitted through a substance when there is a difference of temperature or of electrical potential between adjoining regions, without movement of the material

5- Define Convection

- The movement caused within a fluid by the tendency of hotter and therefore less dense material to rise, and colder, denser material to sink under the influence of gravity, which consequently results in transfer of heat.

6- Define Radiation.

- Radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium.

- Give examples for two good and two poor thermal conductors.

- Metals like copper and aluminum have good thermal conductivity while steel and bronze have the poorest.

EXERCISE PROBLEMS

1- Find the magnitude and direction of the resultant of two forces of 5N and 3N at an angle of 60°

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Given: $F_1 = 5N$

$F_2 = 3N$

$\theta = 60°$

Sol'n: $|\vec{R}| = \sqrt{F_1 + F_2 + 2 |\vec{F_1}||\vec{F_2}| \cos\theta}$

$= \sqrt{5^2 + 3^2 + 2 \cdot 5 \cdot 3 \cos 60°}$

$= \sqrt{25 + 9 + 30 \cos 60°}$

$R = 7N$

$\alpha = \tan^{-1}\left(\frac{F_2 \sin\theta}{F_1 + F_2 \cos\theta}\right)$

$= \tan^{-1}\left(\frac{3 \sin 60°}{5 + 3 \cos 60°}\right)$

$= 21°47$

2- Two forces of magnitude 4N and 2.5N acting at a point inclined at an angle of 40° to each other. Find their resultant.

Given: $F_1 = 4N$.

$F_2 = 2.5N$

$\theta = 40°$

Sol'n $|\vec{R}| = \sqrt{F_1 + F_2 + 2 |\vec{F}||\vec{F}| \cdot \cos\theta}$

$= \sqrt{4^2 + 2.5^2 + 2 \cdot 4 \cdot 2.5 \cos 40}$

$= \sqrt{9 + 16 + 24 \cos 30°}$

$R = 6.12951N$

$\alpha = \tan^{-1}\left(\frac{F_2 \sin\theta}{F_1 + F_2 \cos}\right)$

$= \tan^{-1}\left(\frac{2.5 \sin 40°}{4 + 2.5 \cos 40°}\right)$

$= 15°8°$

3. Find the resultant of two forces 3n an 4n acting on a particle in direction inclined at 30°

Given $F_1 = 3N$

$F_2 = 4N$

$\theta = 30°$

Sol'n $|\vec{R}| = \sqrt{F_1 + F_2 + 2 |\vec{F_1}||\vec{F_2}| \cos\theta}$

$= \sqrt{3^2 + 4^2 + 2 \cdot 3 \cdot 4 \cos 30°}$

$= \sqrt{9 + 16 + 24 \cos 30°}$

$R = 6.76643N$

$\alpha = \tan^{-1}\left(\frac{F_2 \sin\theta}{F_1 + F_2 \cos\theta}\right)$

$= \tan^{-1}\left(\frac{3 \sin 30°}{3 + 4 \cos 30°}\right)$

$= 17°19°$

5

4- Two forces of magnitude 4N and 3N respectively, act on a particle at right angles to each other. F

Given: $F_1 = 4N$

$F_2 = 3N$

$\theta = 90°$

Sol. $|\vec{R}| = \sqrt{F_1 + F_2 + 2 |\vec{F_1}||\vec{F_2}| \cos\theta}$

$= \sqrt{4^2 + 3^2 + 2 \cdot 4 \cdot 3 \cos 90°}$

$= \sqrt{16 + 9 + 24 \cos 90°}$

$R = 5N$

$\alpha = \tan^{-1}\left(\frac{F_2 \sin\theta}{F_1 + F_2 \cos}\right)$

$= \tan^{-1}\left(\frac{4 \sin 90°}{4 + 3 \cos 90}\right)$

$= 36°52°$

10

8- Define the coefficient of thermal conductivity of a material is defined as the quantity of heat conducted per second through a unit area of a slab of unit thickness when the temperature difference between its ends is 1k.

9- Give the relation between pressure and kinetic energy of gas.

- Pressure is equal to 2/3 of ~~~~ mean kinetic energy per unit volume.

10- Define mean square velocity of molecules

- the root-mean-square speed is the measure of the speed of particles in a gas, defined as the square root of the average velocity-squared of the molecules in a gas.

1. Define Root mean Square velocity of molecules.

- the root mean-square speed is the measure of the speed of particles in a gas, defined as the square root of the average velocity-squared of the molecules in a gas.

13. Give the relation between two specific heats of a gas with universal gas constant.

- Specific heat at constant pressure is more than the specific heat and constant volume because the gas can expand for the first case, causing more absorption of heat as compared to other one. ---

13. State any two postulates of kinetic theory of gases.

- The particles in a gas are in constant, random motion. The combined volume of the particles is negligible

Define mean free path

- Mean free path is the average distance over which among particle travels before substantially changing its direction or energy, typically as a result of one or more successive collisions with other particles.

15. Define specific heat capacity of a solid.

- The term "specific heat" is short for "specific heat capacity". It is determined by the vibrations of the solid's atom of a solid. It determined by the vibrations of the solids atom or excitations of its electrons, and also by a variety of phase transitions.

16. Define specific heat capacity of a liquid.

- The specific heat capacity of a substance is heat capacity of a sample of the substance divided by the mass of the sample.

17. Define Specific heat capacity of a gas at constant pressure.

- Specific heat at constant pressure is defined as the quantity of heat required to raise the temperature of unit mass of gas by 1°C at constant pressure.

18. Define specific heat capacity of a gas at constant volume.

- The specific heat of gas at constant volume is defined as the quantity of heat required to raise the temperature of unit mass of the gas by 1 degree when it heated at constant volume.

19. Define ratio of specific heat capacities of gases.

- The heat capacity ratio, also known as the adiabatic index, the ratio of specific heats, or Laplace's coefficient, is the ratio of the heat capacity at constant pressure to heat capacity of the heat capacity at constant volume.

Part C

1. Give the rules and conventions followed while writing SI units.

- Abbrevations such as sec, cc, or mps are avoided and only standard unit symbols, prefix symbols, unit names, and prefix names are used.
Unit symbols are unaltered in the plural. Unit symbols are not followed by a period unless at the end of a sentence.

2- Derive expressions ~~for the~~ magnitude and direction of the resultant of two forces acting at a point with an acute angle between them.

- Let P and Q be two vectors acting simultaneously at a point and represented both in magnitude and direction by two adjacent sides OA and OD of a parallelogram OABD as show in figure.

3- Describe an experiment to verify the parallelogram law of forces.

- The law of parallelogram of forces states that, if two vectors acting on a particle at the same time be represented in magnitude and direction by two adjacent sides of parallelogram drawn from a point, their resultant vector is represented in magnitude and direction by the diagonal of the parallelogram drawn.

4- Describe an experiment to verify Lami's theorem

Experimental Verification of Triangle Law and Lami's theorem. Two smooth small pullys are fixed, one each at the top corners of a drawing board kept vertically on a wall as shown in figure. The pulleys should move freely without any friction. A light string is ~~made~~ to pass over both the pulleys

5- Describes an experiment to determine the mass of the given body using principle of moments.

- To determine mass of a given body using a metre scale by principle of moments. A metre scale, a broad heavy wedge with sharp edge, a weight box, a body of unknown mass or m= Ma/a which can be calculated.

EXERCISE PROBLEMS

1. Find the R.M.S velocity of hydrogen molecules at S.T.P., if the density of hydrogen is 0.0899 kg m^{-3} at S.T.P

Given: $M = 0.0899$ kg m^{-3}

$T = 273$ k

$P = 0.76 \times 13.6 \times 10^3 \times 9.8$

$R = \frac{P}{T}$

$= \sqrt{\frac{101,292.8}{273}}$

$= 371.03$ Jk^{-1} per gram mole

Sol'n: RMS = ?

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$= \sqrt{\frac{3(371.03)(273)}{0.0899}}$

$= \sqrt{\frac{303,873.57}{0.0899}}$

$= \sqrt{3,380,128.69}$

$= 1,838.5124$ ms^{-1}

2. At atmospheric pressure, the density of Nitrogen Gas is 1.25 kgm^{-3}. Find the R.M.S velocity of Nitrogen molecules

Given: $M = 1.25$ kg m^{-3}

$T = 273$ k

$P = 0.76 \times 13.6 \times 10^{-3} \times 9.8$

$R = \frac{P}{T}$

$= \sqrt{\frac{101,292.8}{273}}$

$= 371.03$ Jk^{-1} per gram mole

Sol'n: RMS = ?

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$= \sqrt{\frac{3(371.03)(273)}{1.25}}$

$= \sqrt{\frac{303,873.57}{1.25}}$

$= \sqrt{243,098.85}$

$= 493.05$ ms^{-1}

3. The density of carbon dioxide gas at S.T.P is 1.977 kg m^{-3}. Find the R.M.S velocity of carbon dioxide molecules.

Given: $M = 1.977$ kg m^{-3}

$T = 273$ k

$P = 0.76 \times 13.6 \times 10^3 \times 9.8$

$R = \frac{P}{T}$

$= \sqrt{\frac{101.292.8}{273}}$

$= 371.03$ JK^{-1} per gram mole

Sol'n RMS = ?

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$= \sqrt{\frac{3(371.03)(273)}{1.977}}$

$= \sqrt{\frac{303,873.57}{1.977}}$

$= \sqrt{153,704.38}$

$= 392.05$ ms^{-1}

4. Calculate R.M.S velocity of air molecules at N.T.P. if the density of air is 1.29 kg m^{-3}

Given: $M = 1.29$ kg m^{-3}

$T = 273$ k

$P = 0.76 \times 13.6 \times 10^3 \times 9.8$

$R = \frac{P}{T}$

$= \sqrt{\frac{101,292.8}{273}}$

$= 371.03$ JK^{-1} per gram mole

Soln RMS = ?

$V_{RMS} = \sqrt{\frac{3RT}{M}}$

$= \sqrt{\frac{3(371.03)(273)}{1.29}}$

$= \sqrt{\frac{303,873.57}{1.29}}$

$= \sqrt{235,560.90}$

$= 485.3461$ $m s^{-1}$

5. The density of Helium Gas at S.T.P is 0.1786 kg m^{-3}. Calculate the R.M.S velocity of Helium molecules.

Given: $M = 0.1786$ kg m^{-3}

$T = 273$k

$P = 0.76 \times 13.6 \times 10^3 \times 9.8$

$R = \frac{P}{T}$

$= \sqrt{\frac{101,292.8}{273}}$

$= 371.03$ JK^{-1} per gram mole

Soln RMS = ?

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$= \sqrt{\frac{3(371.03)(273)}{0.1786}}$

$= \sqrt{\frac{303,873.57}{0.1786}}$

$= \sqrt{1,701,419.76}$

$= 1,304.3848$ ms^{-1}

MODULE 2

50/60

PART - A ans PART B

1 Define stress

- Stress is a physical quantity that expresses the internal forces that neighboring particles a continuous material exert on each other, while strain is the measure of the deformation of the material.

2 Define strain.

- An object or medium under stress becom deformed. The quantity that scribes thes deformation is called strain.

3. Which is more elastic, rubber or steel and why?

- The strain produce in rubber is much larger compared to that steel. This means that steel has a larger value of Young's modules of elasticity and hence, steel has more elasticity than rubber.

4. What is elastic limit and plastic limit?

- Elastic limit refers to the maximum value of stress of force for which a material shows elastic behaviours. Plastic limit is defined as the water moisture content at which a thread of soil with 3.2 m diameters begin to crumble.

5. Define elastic body and plastic body.

Force within the elastic limit is called an elastic body elasticity. That does not regain its original shape and size after the removal of deforming force is called a plastic body.

6. What are the three moduli of elasticity?

- Young's modulus, Rigidity modulus and Bulk modulus are the three types of modulus of elasticity

7. Define (i) linear strain (ii) bulk strain (iii) shearing strain

- Linear strain of a deformed body is defined as the ratio of the change in length of the body due to deformation to its original length in the direction of the force. Bulk strain is the response of an object or medium to bulk stress. Shear strain is measured as a change in angle between lines that were originally perpendicular.

8. Write the statement of Hooke's Law.

- Hooke's Law states the applied force F equals a constant k times the displacement or change in length x, or F = kx.

9. Define module of elasticity.

- An elastic modulus is the unit of measurement of an object's or substance's resistance to being deformed elastically when a stress is applied to it.

10. Define (i) Young's modulus (ii) Bulk modulus and (iii) Rigidity modulus.

- The Young's modulus (E) is a property of the material that tells us how easily it can stretch and deform and is defined as the ratio of tensile stress (σ) to tensile strain (ε). The bulk modulus of a substance is a measure of how resistant to compression that substance re- Shear Modulus (Modulus of Rigidity) is the elasticity coefficient for shearing or torsion force.

11. Define Poisson's Ratio

- The ratio of the proportional decrease in lateral measurement to the proportional increase in length in a sample of material that is elastically stretched.

12. What is uniform bending of a beam?

- Uniform bending, every element of the beam is bent with the same radius of curvature.

13. What is non-uniform bending of beam?

- At non. uniform bending is the case where the cross-section is not only bent but also sheared.

14. Define coefficient of viscosity.

- the degree to which a fluid resists flow under an applied force, expressed as the ratio of the shearing stress to the velocity gradient

15. Derive the dimensional formula and the SI unit for the coefficient of viscosity.

- SI unit of coefficient of viscosity is Newton per second square metre (N-s/m2) N-s/m2).

16. What is stream line motion?

- If a particle is moving with the fluid in a smooth, and predictable way from moment to moment, it is stream line motion.

17. What is turbulent motion?

- Turbulence or turbulent flow is fluid motion characterized by chaotic changes in pressure and flow velocity.

18. What is Reynolds number?

- The reynolds number helps predict flow patterns in different fluid flow situations.

19. What is critical velocity?

- the greatest velocity with which fluid can flow through a given conduit without becoming turbulent.

20. What is terminal velocity?

- the constant speed that a freely falling object eventually reaches when the resistance of the medium through which it is falling prevents further acceleration.

21. Write the applicant of viscosity.

- the oil used as a lubricant for heavy machinery parts should have high viscous coefficient.

22. Derive the SI unit and the dimensional formula of surface tension

- Derivation - Or, T= [M1 L1 T-2] x M1 T-2. therefore, surface tension is deminsionally represented as M1-T2

23. What is the effect of surface tension on the surface area of liquids?

- Surface tension is the tendency of liquid surfaces at rest to shrink into the minimum surface area possible.

24. the droplet of rain is spherical. Why?

- Rain drops start to form in a roughly spherical structure due to the surface tension of water. This surface tension is the "skin" of a body of water that makes the molecules stick together.

25. How do insects run on the surface of water?

- Water striders are small insects that are adaptes for life on top of still water, using surface tension to their advantage so they can "walk on water"

26. Define surface tension of a liquid.

- Surface tension is the tendency of liquid surfaces at rest to shrink into the minimum surface area possible.

27. Define angle of contact

- the contact angle is the angle, conventionally measured through the liquid, where a liquid-vapor interface meets a solid surface

28 Write any two applications of capillarity

- the rise of kerosene in the wick in a lantern.
- Sucking of ink by the blotting paper.

29. What are uniform bending of beams?

- the beam is loaded uniformly on its both ends, the bend beam form an arc of a circle. the elevation is produced in the beams.

30. what are non-uniform bending of beams?

- the bending is not uniform throughout the beam and the bending of the beam is called non uniform bending.

31. Explain young's modulus.

- Young's modulus is a measure of the ability of a material to withstand changes in length when under lengthwise tension or compression.

32. Explain Bulk modulus.

- the bulk modulus of a substance is a measure of how resistant to compression that substance is.

33. Explain Rigidity modulus.

- Shear modulus also known as Modulus of rigidity is the measure of the rigidity of the body, given by the ratio of ~~shear~~ stress to shear strain.

34. Explain stream line motion.

- If a particle moving with the fluid in a smooth, and predictable way from moment to moment, it is stream line motion.

35. Explain turbulent motion

- Turbulence or turbulent flow is fluid motion characterized by chaotic ~~change~~ changes in pressure and flow velocity.

PART C

1. Explain three type of modulus

- Young's modulus. Within the elastic limit the ratio of stress by strain is called young's modulus of elasticity.
- Rigidity modulus: the ratio of shear stress to shear strain is called rigidity modulus.
- Bulk modulus: the ratio of volume stress to volume strain within the elastic limit is called bulk modulus.

2. Describe an experiment to determine the Young's modulus of the material of a bar by bending it uniformly.

- If the beam is loaded at both ends, the elevation produced will form an arc of a circle. this type of bending is called uniform bending. Two methods are used to measure Young's modulus of the bar in both uniform or non-uniform bending

MODULE 4

54/60

Part - A and Part - B

1. Define rigid body.

- Rigid body is a solid body in which deformation is zero or so small it can be neglected. the distance between any two given points on a rigid body remains constant in time regardless of external forces or moments exerted on it.

2. Define moment of inertia a particle

- The moment of inertia, otherwise known as the mass moment of inertia, of a rigid body is a quantity that determines the torque needed for a desired angular acceleration about a rotational axis.

3. Define moment of inertia of a rigid body.

- A measure of the resistance of a body to angular acceleration about a given axis that is equal to the sum of the products of each element of mass in the body and the square of the element's distance from the axis.

4. Define radius of gyration.

- Radius of gyration or gyradius of a body about the axis of rotation is defined as the radial distance to a point which would have a moment of inertia the same as the body's actual distribution of mass if the total mass of the body were concentrated there.

5. Define angular momentum.

- The quantity of rotation of a body, which is the product of its moment of inertia and its angular velocity.

6. State the law of conversation of angular momentum.

- The law of conversation of angular momentum states that when no external torque acts on an object, no change of angular momentum will occur.

7. State Newton's I Law of gravitation.

- Directly proportional to the product of their masses

8. State Newton's II Law of gravitation.

- Inversely proportional to the square of the distance between them.

9. What is a satellite?

- A satellite is an object that has been intentionally placed to orbit. These objects are called artificial satellites to distinguish them from natural satellites such as Earth's Moon.

10. Define escape velocity.

- The lowest velocity which a body must have in order to escape the gravitational attraction of a particular planet or other object.

11. Define orbital velocity.

- Orbital velocity is a velocity sufficient to cause a natural or artificial satellite to remain in orbit.

12- Give any two uses of artifical satellites.

- Communication- satellite television and phone calls
- Navigation - including the Global Positioning System (GPS).

13- Derive an expression for the moment of inertia of a rigid body about an axis.

- The formula for the moment of inertia is the "sum of the product of mass" of each particle with the "square of distance from the axis of the rotation

14- Explain Newton's Law of Gravitation.

- Newton's law of universal gravitation is usually stated as that every particle attracts every other particle in the universe with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

15- Explain escape velocity and orbital velocity

- Orbital velocity is the speed required to achieve orbit around a celestial body, such as a planet or a star, while escape velocity is the speed required to leave that orbit.

16- Write the uses of artificial satellites

- Communication - satellite television and phone calls.
- Navigation - including the Global Positioning system (GPS).
- Earth observation - including weather forecasting, tracking storms and pollution, spying and satellite photography.

PART- C

1- Derive an expression for the kinetic energy of a rigid body rotating about an axis.

- Rotational kinetic energy can be expressed as. Erotational = ½Iw2

E rotational = 1 2 Iw 2 where w is the angular momentum of inertia around the axis rotation. the mechanical work applied during rotation is the torque times the rotation angle: W= τθ W = τ θ .

2- Derive an expression for the angular momentum of a rigid body rotating about an axis.

- A rigid rotating body has angular momentum L= Iω L = Iw directed along the axis of rotation.

3- Obtain an expression for the acceleration due to gravity on the surface of the earth.

- it's value near the surface of the earth is 9.8 ms-2. therefore, the acceleration due to gravity (g) is given by = GM/R

4- Obtain an expression for the variation of acceleration due to gravity with altitude.

- h = altitude height of the object from the surface of the Earth. Hence acceleration due to gravity decreases with increase in altitude.

5- Derive an expression for the escape velocity from the surface of the earth.

- Escape velocity of Earth = 11.2 km/s.

6 Derive an expression for the orbital velocity of a satellite.

- The expression for orbital velocity is $\sqrt{g(R+h)} = \sqrt{gr}$.

EXERCISE PROBLEMS

1- Find the escape velocity at the surface of the moon, given that the radius of moon is 2×10^6 m and acceleration due to gravity on the surface of moon is $1.69 ms^{-2}$.

Given: $R = 2 \times 10^6$ km

$g = 1.69 ms^{-2}$

Soln: $V_0 = \sqrt{2gR}$

$= \sqrt{2(1.69)(2,000,000)}$

$= \sqrt{6,760,000}$

$= 2.600$ km per second

2. A satellite is revolving in circular orbit at a height of 500 km from the surface of the earth. Calculate the ~~orbi~~ orbital velocity. The radius of the earth is 6400 km and $g = 9.8 ms^{-2}$.

Given: $g = 9.8 ms^{-2}$

$R = 6400 \times 10^{-3}$ km

$h = 182 \times 10^3$ km

Soln: $V_0 = \sqrt{\frac{gR^2}{(R+h)}}$

$= \sqrt{\frac{9.8(6,400,000)^2}{6582 \times 10^3}}$

$= \sqrt{\frac{9.8(40,960,000,000,000)}{6,582,000}}$

$= \sqrt{\frac{401,408,000,000,000}{6,582,000}}$

$= \sqrt{60,985,718.60}$

$= 7,810.933$ kms^{-1}

3: Distinguish between stream line and turbulent motion.

- In stream line motion the liquid must flow with a velocity less than critical velocity of the liquid. Turbulent motion of a liquid is disorderly type of motion in which the liquid flows into eddies and motion of the particles of the liquid becomes irregular at different points.

4: Describe an experiment to determine the comparison of coefficient of viscosity of two viscous liquid by capillary flow method.

- Viscosity have units of (N/m2)s or Pa-s. Flow is proportional to pressure difference and inversely proportional resistance Q=P2-P1R. For laminar flow in a tube, Poiseuille law for resistance states that R= 8nl/πr4.
Poiseuille's law for flow in a tube is Q= (P2-P1)πr4/8nl.

5. Describe stroke's method of determining the coefficient of viscosity: ~~of a transparent~~ high viscous liquid.

Viscosity Experiment to Determine the Coefficient of viscosity
Aim: Determine the viscosity coefficient of a given viscous liquid by ~~kon~~ measuring the terminal velocity of a given ______ spherical organism (by stokes method)

6. Derive an expression for the surface tension of a liquid in the case of the capillary rise.

- The phenomenon of rise or fall of a liquid in a capillary tube is called capillarity. T= r(h+r3) ~~@~~ pg 2cos θ. For capillary r3 can be neglected h= 2T cos rpg.

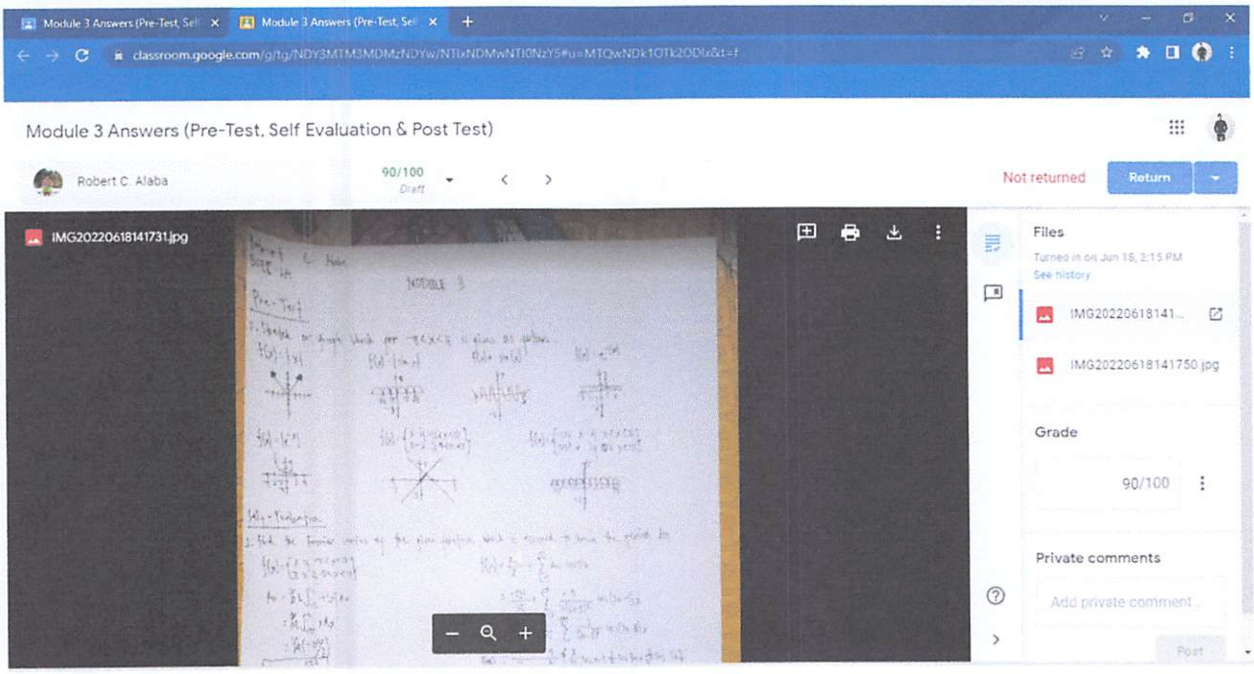
7: Describe an experiment to determine the surface tension of water by capillary rise method.

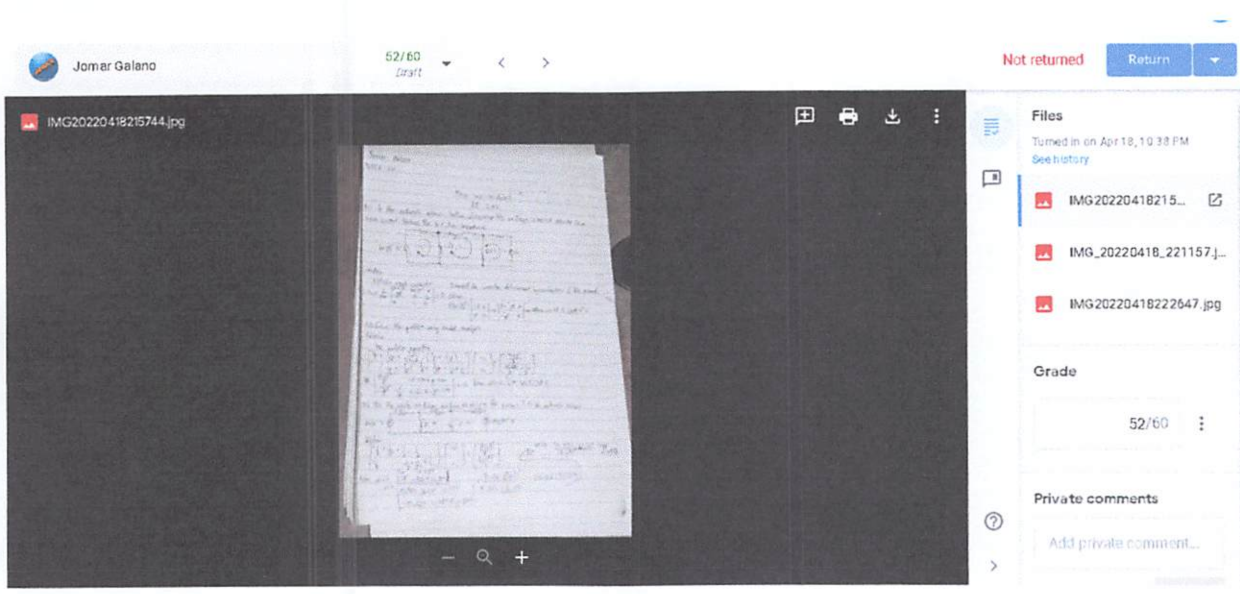
- to determine surface tension of water by experiment, capillary tube method is used. In this method, $T = (\rho r g h)/2$ relation is used.

8- List the various application of capillary.

- Food additives
- Herbicide
- Animal Nutrition
- Detergents

Problem Solving





Physics- Worded Problems