

Department of Physics
 The Open University of Sri Lanka
 Bachelor of Science Degree Program
 Level 3
 PHU3300- General and Thermal Physics
 Final Examination – 2025



Duration - two hours (2 hrs.)

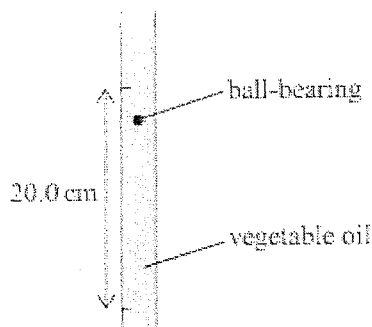
Date : 12.12.2025

Time 9.30 am - 11.30 am

ANSWER FOUR QUESTIONS ONLY

1. A. (i) What is mean of the coefficient of Viscosity of a Fluid ? Explain the temperature effect on it. (5 marks)
- (ii) Derive an expression for the terminal velocity of a ball when it is falling through the liquid. (4 marks)
- (iii) Explain the experimental method to determine the Coefficient of viscosity of oil. (6 marks)

B. A student measured the viscosity of vegetable oil using the falling ball method. After determining the ball bearing's diameter, he dropped it into a measuring cylinder filled with vegetable oil, as seen in the figure.



After attaining the terminal velocity, the student calculated how long it took the ball bearing to fall 20.0 cm.

- (i) Give another measurement needed to determine the viscosity of the oil. (2 marks)
 - (ii) Which instruments should be used to measure the above two parameters? (2 marks)
 - (iii) The student drops a ball-bearing with the diameter of 1.24 mm. The time taken to fall 20.0 cm was 1.3 s. Calculate the viscosity of the oil. (6 marks)
- Density of steel = 2900 kg m^{-3} , Density of oil = 900 kg m^{-3}

2. A. Define and write down an expression for the following physical parameters of Gravitational Field
- Gravitational field intensity of a point on the earth surface.
 - Gravitational potential of a point on the earth surface **(4 marks)**
- B. Describe why the gravitational potential values at all points on Earth are negative **(2marks)**
- A satellite of mass 6.50×10^3 kg is initially at the surface of the Earth. The satellite is launched into a circular orbit of radius 4.22×10^7 m. Calculate the change in gravitational potential energy of the satellite. Mass of Earth = 5.98×10^{24} kg, radius of Earth = 6.37×10^6 m **(6 marks)**
- C. (i) What is a Geostationary satellite ? Explain the advantages of Geostationary satellites. **(4 marks)**
- (ii) Derive an expression for the radius of the Geostationary Satellite around the earth. **(4 marks)**
- The geostationary orbit of a satellite around the earth is at about 36000 km from the earth's surface. Find the weight of 120 kg of equipment placed in the geostationary satellite. The radius of the earth is 6400 km and $g = 9.8 \text{ ms}^{-2}$ at the surface of the earth. **(5 marks)**
3. A (i) Explain the property of Surface tension of a liquid and define the Coefficient of Surface tension of liquid. **(4 marks)**
- (ii) Find the work done when the water drop of radius 1 mm is breaking into 1000 drops. Given the surface tension of water is $72 \times 10^{-3} \text{ N/m}$ **(5 marks)**
- (iii) Write down the expression for the excess pressure in a soap bubble. **(2 marks)**
- Two soap bubbles-one of radius 3 cm and other of radius 4 cm each, coalesce in vacuum isothermal condition. Calculate the radius of the bubble formed? **(6 marks)**
- B.(i) Write down an expression for the rise of liquid in a capillary tube. **(2 marks)**
- (ii) Water rises to a height of 9 cm in a certain capillary tube. In the same tube the level of mercury surface is lower by 3 cm. Compute the ratio of surface tension of water and mercury. Density of mercury $13.6 \times 10^3 \text{ kg m}^{-3}$. Angle of contact of water is zero and that for mercury is 135° . **(6 marks)**
4. A. An electrical heater is placed in an insulated container holding 100 g of ice at a temperature of -14°C . The heater supplies energy at a rate of 98 joules per second.
- (i) After an interval of 30 s, all the ice has reached a temperature of 0°C . Calculate the specific heat capacity of ice. **(5 marks)**
- (ii) Show that when the heater is turned on for an additional 500 seconds, the water's final temperature will be about 40°C .
 specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$
 specific latent heat of fusion of water = $3.3 \times 10^5 \text{ J kg}^{-1}$ **(6 marks)**

B. State **four** assumptions made in the molecular kinetic theory model of an ideal gas. (4 marks)

A sample of air has a density of 1.24 kg m^{-3} at a pressure of $1.01 \times 10^5 \text{ Pa}$ and a temperature of 300 K . The Boltzmann constant $= 1.38 \times 10^{-23} \text{ J K}^{-1}$

(i) Calculate the mean kinetic energy of an air molecule under these conditions. (5 marks)

(ii) Calculate the mean square speed for the air molecules. (5 marks)

5. A. Explain

(i) Hooke's law of Elasticity and difference between the plasticity and elasticity properties. (5 marks)

(ii) Prove that the work done per unit volume in stretching a wire is equal to $\frac{1}{2} (\text{Stress} \times \text{Strain})$ (5 marks)

(iii) Calculate the work done in stretching a wire of cross section area 1 mm^2 and length 2 m if the increase in length of the wire is 0.1 mm and the young's modulus of the material of the wire is $2 \times 10^{11} \text{ N m}^{-2}$. (6 marks)

B. Define shear modulus of a material. (3 marks)

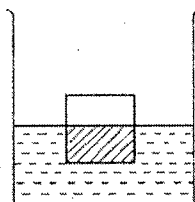
A square lead slab of side 50 cm and thickness 5.0 cm is subjected to a shearing force (on its narrow face) of magnitude $9.0 \times 10^4 \text{ N}$. The lower edge is riveted to the floor. How much is the upper edge displaced if the shear modulus of lead is $5.6 \times 10^9 \text{ Pa}$? (6 marks)

6. A. Explain Bernoulli's theorem and write down the assumptions made when applying Bernoulli's theorem for a fluid? (4 marks)

An aircraft is in level flight at constant speed and each of its wings has an area of 25 m^2 . If the speed of the air is 180 km/h over the lower wing and 234 km/h over the upper wing surface, determine the mass of the aircraft. (Take air density to be 1 kg/m^3 , $g = 9.8 \text{ m/s}^2$). (6 marks)

B. Explain the Archimedes Principle of hydrostatic. (5 marks)

An ice cube of mass 50 g floats on the surface of a strong brine solution of volume 200 cm^3 inside a measuring cylinder.



Calculate the level of the liquid in the measuring cylinder under the following situations .

(i) before ice melts

(ii) after all ice melts

(Density of ice and brine solution are 0.9 g cm^3 and 1.1 g cm^3 respectively.) (10 marks)