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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	PHYSICS FOR ENGINEERING TECHNOLOGY
COURSE CODE	:	DAK13003
PROGRAMME CODE	:	DAK
EXAMINATION DATE	:	JANUARY/FEBRUARY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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Q1 (a) Newton's laws of motion are three physical laws that provide relationships between forces acting on a body and the motion of the body.

(i) List three (3) Newton laws compiled by Sir Isaac Newton.
(3 marks)

(ii) Explain each Newton's law in **Q1(a)(i)**.
(6 marks)

(b) A traffic light weighing 200N is held from a vertical cable tied to two other cables fastened to support. The upper cables make angles of 40.0° west due north and 60.0° east due north.

(i) Draw a free-body diagram for the force acting on the block.
(1 mark)

(ii) Calculate the tension in each of the three cables.
(10 marks)

Q2 (a) When a car weighing 850 kg runs out of petrol, it travels at 50 m/s at a height of 8 m above the base of a slope. The vehicle coasts down the hill and then coasts up the opposite slope until it stops. Ignore air resistance and frictional forces.

(i) State the principle of conservation energy.
(2 marks)

(ii) Find the car's total energy at 8 meters above the hill's base in kJ.
(4 marks)

(iii) Determine the speed of the car at the bottom of the hill.
(4 marks)

(b) An automobile of mass 1000 kg moves up a rough road inclined at angle 30° east due to north. It is pulled along the road at a distance of 100 meters by a horizontal force with a magnitude of 2.5 kN. The vehicle and the road have a coefficient of kinetic friction of 0.300. After 20 minutes of travel, determine the car's power.
(10 mark)

Q3 (a) Density is the physical characteristic of matter. Any value of density of a substance relative to the density of the standard of water is called specific gravity, indicating the ability to float in water.

(i) Differentiate the fundamental phases of matter with appropriate labels and examples.

(6 marks)

(ii) **Figure Q3(a) (ii)** shows **four (4)** spheres, P, Q, R, and S, floating on the water surface. Arrange the following spheres in increasing density and justify your answer.

(4 marks)

(b) A hollow plastic sphere is held below the surface of a freshwater lake by a cord anchored to the bottom of the lake. The sphere has a volume and weight of 0.065 m^3 and 90 kg, respectively. Given $\rho_{water} = 1000$ kg/m^3, g = 9.81 ms^{-2}.

(i) Calculate the buoyant force exerted by the water on the sphere.

(3 marks)

(ii) Calculate the tension in the cord.

(3 marks)

(c) A dentist's chair moves patients up and down by applying Pascal's principle. When a patient sits on the chair, both the chair and the patient exert a downward force of 3000 N. The chair is attached to a large piston with an area of 1500 cm^2. To move the chair, a pump applies force to a small piston with an area of 100 cm^2.

(i) State Pascal's principle.

(1 mark)

(ii) Calculate the force that must be exerted on the small piston to lift the chair.

(3 marks)

Q4 The physical behavior of materials is studied based on the elasticity and elastic deformation.

(a) The stress-strain diagram provides a graphical measurement of the strength and elasticity of the material.

(i) Define the terms stress, strain, and elastic modulus.

(3 marks)

(ii) Draw and identify four (4) indications in the stress-strain diagram.

(4 marks)

(iii) A patient's leg was put into traction, stretching the femur from 0.530 m to 0.532 m. The femur has a diameter of 3.05 cm. Based on the knowledge that bone has Young's Modulus of $\sim 1.65 \times 10^{10}$ in tension. Determine the force needed to be used to stretch the femur.

(5 marks)

(b) Describe the principle of the elasticity of iron metal according to Young's modulus, shear modulus, and bulk modulus concepts.

(3 marks)

(c) A brass rod (diameter, d = 7 mm) is subjected to a tension of 5.0×10^3 N, then, the diameter changes by 4.2×10^{-4} cm. Given Young Modulus for brass, $Y_{brass} = 9.0 \times 10^{10}$ N/m^2.

(i) Calculate the longitudinal strain.

(2 marks)

(ii) Determine the Poisson's ratio for the brass rod.

(3 marks)

Q5 (a) Ideal gas law expressed the concept of gas expansion energy. A gas with a volume of 35 liters, at a temperature of 48 °C, and an unknown original pressure has its volume increased to 42 liters with temperature decreased to 28 °C. Determine the original pressure of a gas after the measurement of the pressure changed to 2.5 atm.

(3 marks)

(b) Thermal expansion is the tendency of matter to change in shape, volume, and area in response to a change in temperature. Thermal Energy is a type of internal energy contained within an object due to its temperature and state of matter.

(i) Point out three (3) types of thermal expansion.

(3 marks)

(ii) Elaborate the theory of internal thermal energy and conservation energy with some sketches to support your description.

(4 marks)

(c) Heat energy is required to change the state of a unit mass of material and heat transfer can be transferred in three ways: conduction, convection, and radiation.

(i) Define the means of specific heat capacity and latent heat.

(2 marks)

(ii) About 0.3 g piece of copper is heated and fashioned into a bracelet. Determine the change in copper temperature when the amount of energy transferred by heat to the copper is 66.3 kJ. Given specific heat of copper is 390.0 J/g°C.

(3 marks)

(iii) The insulated copper can mass, 20 g filled with 50 ml of water both at a temperature of 84 °C. A block of copper of mass 47 g at a temperature of 990 °C is lowered into the water as shown in **Figure Q5(c)(iii)**. As a result, the temperature of the can and its contents reached 100 °C and some of the water turned to steam. Calculate the mass of steam required by using the latent heat of vaporization to form steam. Assume no heat is lost to the surroundings.

(5 marks)

-END OF QUESTIONS-

APPENDIX A

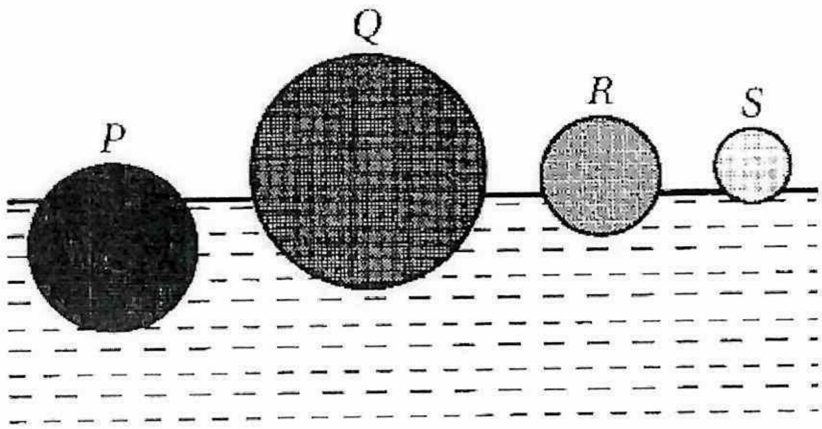

Figure Q3(a)(ii): Different spheres (P, Q, R, and S) float in the water

Specific heat capacity of copper = 390 J kg^{-1} °C^{-1}

Specific heat capacity of water = 4200 J kg^{-1} °C^{-1}

Specific latent heat of vaporization of water = 2.3×10^6 J kg^{-1} °C^{-1}

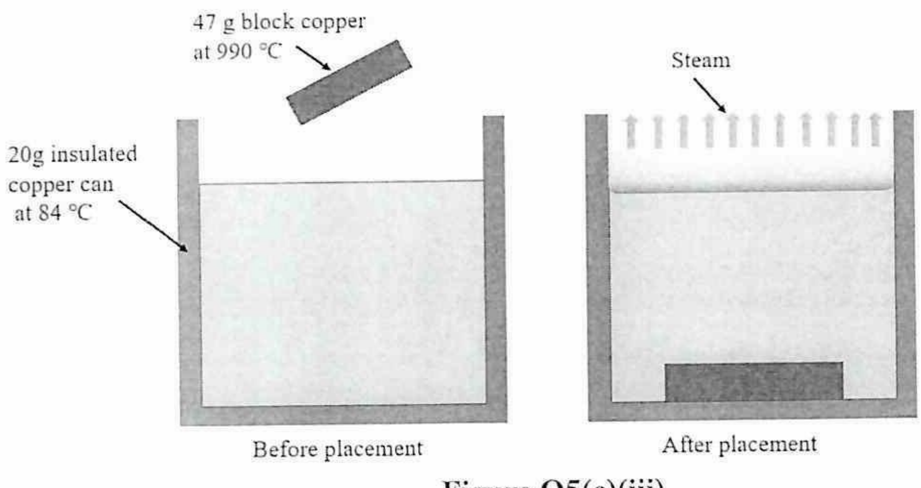

Figure Q5(c)(iii)

APPENDIX B

LIST OF FORMULA

Gravity velocity, g = 9.81 m/s^2

$$Stress, \sigma = \frac{F}{A}$$

$$Strain, \varepsilon = \frac{\Delta L}{l}$$

PE = mgh

KE = $\frac{1}{2} mv^2$

$$SG_{substance} = \frac{\rho_{substance}}{\rho_{reference}}$$

$F_b = V_b g \rho_f$

$$PV = nRT$$

$$\frac{n_1(P_1 V_1)}{T_1} = \frac{n_2(P_2 V_2)}{T_2}$$

W = $KE_f - KE_i$

$$F = -k\Delta x$$

$$Q = mc\Delta T$$

$$\Delta L = L_o \alpha \Delta T ; L = L_o(1 + \alpha \Delta T)$$

$$Y = \frac{F.L}{A.\Delta L}$$

$$B = \frac{P.V}{\Delta V}$$

$$\mu = \frac{\varepsilon_t}{\varepsilon_l}$$

$$\Delta A = A_o \beta \Delta T ; A = A_o(1 + \beta \Delta T)$$

$$\Delta V = V_o \gamma \Delta T ; V = V_o(1 + \gamma \Delta T)$$

$$S = \frac{F.L}{A.\Delta X}$$

$$L_f = \frac{Q}{m}$$

$$L_v = \frac{Q}{m}$$