CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	PHYSICS IN ENGINEERING AND TECHNOLOGY
COURSE CODE	:	DAK13003
PROGRAMME CODE	:	DAK
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS
		2.THIS FINAL EXAMINATION IS CONDUCTED VIA **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 **EIGHT (8)** PAGES

Q1 (a) State the Newton's Second and Third Law in words and their applications in real life.

(4 marks)

(b) A group of students takes a tour to UTHM sports complex. There are two routes to go to the sports complex from college. The first route is 13 km drive to the north, followed by a 8 km to the 70° east of north. The second one is a10 km drive to the bearing of 40°, followed by another 9 km to the north. Sketch all the vectors along with the label for both routes in a x-y axes.

(4 marks)

(c) A 60 N force is applied horizontally to a 13000 g block which is initially at rest. The block moved to a distance of 500 cm at the speed of 6 ms^{-1}.

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

(2 marks)

(ii) Calculate the coefficient of kinetic friction of the block.

(6 marks)

(d) A 800 kg car is moving at 30 ms^{-1} at a height of 10 m above the bottom of a hill when it runs out of gasoline as in **Figure Q1 (d)**. The car coasts down the hill and then continues coasting up the other side until it returns to rest. Neglecting the frictional force and the air resistance, calculate the highest position that the car can reach when it continues coasting up to the other side of the hill.

(4 marks)

Q2 (a) A U-tube is initially filled with water and the other side of tube is filled with oil. If the height of oil is 10 cm and the height of the water is 4 cm, determine the density of oil. Given the density of water is 1000 kg/m^3.

(4 marks)

(b) A 5000 g ball with the volume of 0.4 m^3 is totally submerged in a water tank. Given the density of water is 1000 kg/m^3.

(i) Define the term buoyant force in fluid statics.

(1 mark)

(ii) Calculate the net force acted on the ball when it is fully submerged.

(5 marks)

(c) A 5000 kg spherical object that is completely submerged in a pool of water is suspended from a scale. Calculate the radius of the sphere if the scale reads 40 N.

(6 marks)

(d) A hydraulic lift with two different platforms sizes can raise a car weighing 5000 kg. The diameter and weight of the smaller sized platform is 25 cm and 1000 kg, respectively. Calculate the diameter of the opposite platform if 200 N of force is required to lift the car.

(4 marks)

Q3 (a) Show the diagram that indicates the correlation between stress, strain and elasticity.

(2 marks)

(b) (i) A circular cord has a diameter of 2.5 mm and a length of 60 m. A 2 kg load causes it to extend 5.0 cm more. Calculate the Young's modulus of the cord's material.

(4 marks)

(ii) A 15 m steel wire with the cross-sectional area of 0.04 cm^2 is hung from a support. If a mass of 20 kg is hung at its end, calculate the final length of the wire. (Given the Young modulus for steel = 210 GPa)

(6 marks)

(c) (i) The bottom part of the women's outer shoes has created stress due to heel lifting. The heel radius of a women's shoe is 0.80cm. If each pair of the heel supports 40% of a lady weighing 500N, determine the stress on each heel.

(4 marks)

(ii) One end of a steel rod with the radius of 19.5 mm is held in a holder. A 6.5 kN of force is then applied perpendicularly to the end face (uniformly across the area) at the other end. Determine the stress on the rod.

(4 marks)

Q4 (a) The ideal gas law shows the relationship between pressure, temperature, and moles.

(i) State the **three (3)** principles of gas laws.

(3 marks)

(ii) The volume of a gas at 0°C is 4.00 L. Compute the final temperature required to change the volume to 50.0 mL.

(5 marks)

(iii) A space shuttle carrying a balloon has landed at a space station above a distant planet. The temperature inside the space station is precisely controlled at 24°C and a pressure of 745 mmHg. The balloon with a volume of 425 mL from the space station was taken into a section where the temperature is -95°C and the pressure is 0.115 atm. Predict the balloon's final volume in milliliters if n (the amount of substance) remains constant in the section.

(5 marks)

(b) (i) An inspector uses a steel measuring tape that is exactly 60 m at a cold temperature of 19 °C. Estimate the length of the tape on a hot summer day when the temperature is 37 °C. ($\alpha_{steel} = 1.2\times10^{-5}\,K^{-1}$)

(4 marks)

(ii) At 27°C, the stainless-steel rivet with a diameter of 15.010 mm could not fit through a 15.000 mm diameter hole in a compartment of a machine. Estimate a temperature difference (ΔT) should be applied to the rivet so that the rivet could fit in the hole. Given the expansion coefficient for stainless steel, ($\alpha_{stainless}$) is 17×10^{-6} /°C.

(3 marks)

Q5 (a) (i) Determine the amount of heat energy needed to heat 0.4 kg of aluminium by 8°C. Given specific heat capacity of aluminium is 910 J kg^{-1} K^{-1}.

(3 marks)

(ii) Calculate the specific heat capacity of a material if 98 000 J of heat energy is given off when a 12 kg block of the material cools by 50°C.

(3 marks)

(b) External heat is applied on a glass window with the dimension of 2.0 m x 1.5 m with 3.2 m of thickness. If the temperature of the inner and the outer surface of the window is 20°C and 14 °C respectively, calculate the rate of heat flowing through the window. Given the thermal conductivity of glass, k is equal to 2×10^{-4} kcal/s/m/□.

(4 marks)

(c) The change of energy with temperature from solid to liquid and to gas was observed to involve a few stages of heat gain (energy input).

(i) State the definition of latent heat along with **two (2)** examples based on your understanding.

(4 marks)

(ii) A block of ice kept at 0°C inside a styrofoam cooler container during a picnic. Calculate the heat energy per second that passes through the walls of the container when 500 g of ice melts in 6 hours. Given the heat of fusion of ice is 3.33 x 10^5 J/kg.

(6 marks)

-END OF QUESTIONS-

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SEMESTER/SESSION	: I/2022/2023	PROGRAMME CODE: DAK	
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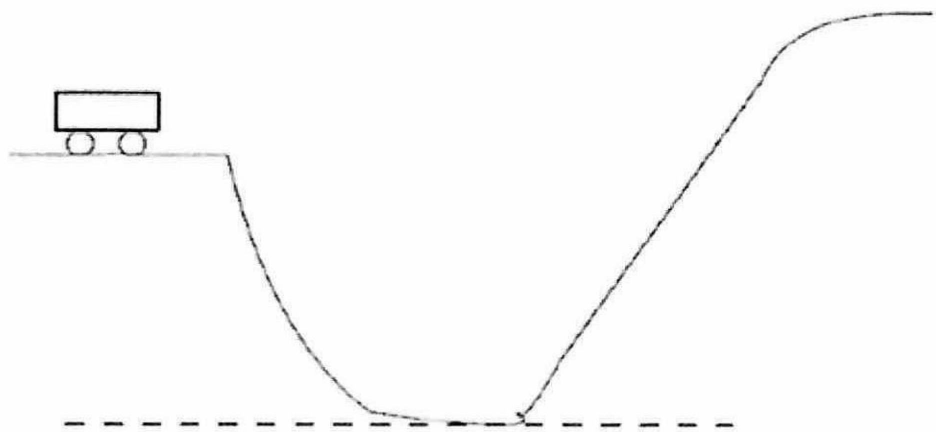

Figure Q1 (d)

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LIST OF FORMULA

g = 9.81 m/s2

PE = mgh

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

$F_b = V_b g \rho_f$

$W = KE_f - KE_i$

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

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

The volume of sphere = $V = \frac{4}{3}\pi r^2$

$\Delta L = L_o \alpha \Delta T$

$Q = mc\Delta T$

$Q = mL$

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

$$Y = \frac{FL}{A\Delta L}$$

$$\frac{Q}{t} = \frac{kA\Delta T}{d}$$

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Temperature	$T(\text{K}) = T(°\text{C}) + 273.15$ $\Delta T(\text{K}) = \Delta T(°\text{C})$	$T(\text{R}) = T(°\text{F}) + 459.67 = 1.8T(\text{K})$ $T(°\text{F}) = 1.8\,T(°\text{C}) + 32$ $\Delta T(°\text{F}) = \Delta T(\text{R}) = 1.8\,\Delta T(\text{K})$
Thermal conductivity	1 W/m·°C = 1 W/m·K	1 W/m·°C = 0.57782 Btu/h·ft·°F
Velocity	1 m/s = 3.60 km/h	1 m/s = 3.2808 ft/s = 2.237 mi/h 1 mi/h = 1.46667 ft/s 1 mi/h = 1.6093 km/h
Volume	1 m^3 = 1000 L = 10^6 cm^3 (cc)	1 m^3 = 6.1024 × 10^4 in^3 = 35.315 ft^3 = 264.17 gal (U.S.) 1 U.S. gallon = 231 in^3 = 3.7854 L 1 fl ounce = 29.5735 cm^3 = 0.0295735 L 1 U.S. gallon = 128 fl ounces
Volume flow rate	1 m^3/s = 60,000 L/min = 10^6 cm^3/s	1 m^3/s = 15,850 gal/min (gpm) = 35.315 ft^3/s = 2118.9 ft^3/min (cfm)

†Mechanical horsepower. The electrical horsepower is taken to be exactly 746 W.

Some Physical Constants

Universal gas constant	R_u = 8.31447 kJ/kmol·K = 8.31447 kPa·m^3/kmol·K = 0.0831447 bar·m^3/kmol·K = 82.05 L·atm/kmol·K = 1.9858 Btu/lbmol·R = 1545.37 ft·lbf/lbmol·R = 10.73 psia·ft^3/lbmol·R
Standard acceleration of gravity	g = 9.80665 m/s^2 = 32.174 ft/s^2
Standard atmospheric pressure	1 atm = 101.325 kPa = 1.01325 bar = 14.696 psia = 760 mm Hg (0°C) = 29.9213 in Hg (32°F) = 10.3323 m H_2O (4°C)
Stefan–Boltzmann constant	σ = 5.6704 × 10^{-8} W/m^2·K^4 = 0.1714 × 10^{-8} Btu/h·ft^2·R^4
Boltzmann's constant	k = 1.380650 × 10^{-23} J/K
Speed of light in vacuum	c_o = 2.9979 × 10^8 m/s = 9.836 × 10^8 ft/s
Speed of sound in dry air at 0°C and 1 atm	c = 331.36 m/s = 1089 ft/s
Heat of fusion of water at 1 atm	h_{if} = 333.7 kJ/kg = 143.5 Btu/lbm
Enthalpy of vaporization of water at 1 atm	h_{fg} = 2256.5 kJ/kg = 970.12 Btu/lbm