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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

COURSE NAME : PHYSICS FOR ENGINEERING TECHNOLOGY

COURSE CODE : BNP 12603

PROGRAMME CODE : BNC

EXAMINATION DATE : JULY 2022

DURATION : 3 HOURS

INSTRUCTION : 1. ANSWER ALL QUESTIONS

2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.

3. STUDENT ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) Define derived quantity and list out **THREE (3)** examples of derived quantity (5 marks)
- (b) The density of iron is 7.86 g/cm^3 under standard conditions. Convert the density of iron to kg/m^3 . (2 marks)
- (c) The mass of Earth is $5.98 \times 10^{24} \text{ kg}$. Express the mass of earth in megagrams. (2 marks)
- (d) You are working at a tropical resort and are settling up a treasure hunt activity for the guest. You've been given a map and told to follow its direction to bury a "treasure" at specific location. You don't want to waste time walking around the island because you want to finish early and go surfing. The direction are to walk 5.00 km headed 60° north of east and then 7.00 km headed 40° north of due west. Consider where should you head and how far must you walk to get the job done quickly?
- (i) Sketch the direction that you should bury the "treasure". (2 marks)
- (ii) Find the direction that you head and calculate the magnitude of distance that you walk by using the vector component method. (14 marks)
- Q2** (a) **Figure Q2(a)** shows two blocks $m_1 = 8\text{kg}$ on the inclined plane ($\theta_1 = 53^\circ$) and $m_2 = 5\text{kg}$ on the horizontal plane, are connected by a massless cord over a frictionless pulley. A constant force $F = 50\text{N}$ acts on m_2 in a direction, making $\theta_2 = 37^\circ$ with the horizontal axis. The coefficient of kinetic friction between both blocks and surfaces are same and equal to 0.2.
- (i) Draw the free body diagram of both blocks. (6 marks)
- (ii) Find the acceleration of the block m_2 . (8 marks)
- (b) Determine the mass of the picture hanging from a steel nail as shown in **Figure Q2(b)**. The nail bends only $1.8\mu\text{m}$, and the *Shear Modulus* is $80 \times 10^9 \text{ N/m}^2$. (6 marks)
- (c) A block of mass 0.5 kg slides down a smooth curved surface and falls through a vertical height of 2.5m to reach a horizontal surface at B as shown in **Figure Q2(c)**. Calculate :
- (i) The energy of the block at point A. (2 marks)
- (ii) The speed of the block at point B. (3 marks)

Q3 (a) A steel bar 5 cm long is welded end-to-end to a copper bar 10 cm long. Both bars are insulated perfectly on their sides. Each bar has a square cross section, 1 cm on a side. The free end of the steel bar is in contact with steam at 100 °C, while the free end of the copper bar is maintained at 0 °C by placing it in contact with ice. Given: $\kappa_{steel} = 45.4 \text{ Wm}^{-1}\text{K}^{-1}$ and $\kappa_{copper} = 401 \text{ Wm}^{-1}\text{K}^{-1}$

(i) Explain the heat conduction mechanism involved in the above situation. (3 marks)

(ii) Calculate the temperature at the junction of the two bars. (6 marks)

(iii) Find the total rate of heat flow. (4 marks)

(b) An electronic circuit element made of 20 mg of silicon. It is found that the electric current through it adds energy at the rate of 8 mW @ mJ/s. By assuming the design does not allow any heat transfer out of the element, calculate the rate where the temperature change in one second.

Given: *Specific heat capacity of silicon is 705 J/kg.K* (4 marks)

(c) A clothesline accidentally untied one of its end, holds it taut and wiggles the other end up and down sinusoidally with frequency 2 Hz and amplitude 0.07 m. The wave speed, v is 10 m/s. By assuming at time 0 the end has zero displacement and is moving in the $\pm y$ -direction after sometimes.

(i) Find the angular frequency and wave number. (4 marks)

(ii) Write a full wave function describing the situation. (4 marks)

Q4 (a) Water enters a house through an inlet 3 cm diameter pipe at an absolute pressure of $4 \times 10^5 \text{ Pa}$ (~ 4 atm). A 1.5 cm diameter pipe leads to the second floor bathroom 5 m above. Assuming the flow speed at the inlet pipe is 2 m/s, calculate the following inside the bathroom pipe.

(i) flow speed. (4 marks)

(ii) pressure. (6 marks)

(iii) volume flow rate. (4 marks)

- (b) Given below is the dataset taken from linear expansion experiment of three different type of solid rods as a function of temperature.

Type 1		Type 2		Type 3	
ΔL	ΔT	ΔL	ΔT	ΔL	ΔT
0.03	20	0.02	30.4	0.07	24.1
0.09	25	0.04	39.9	0.09	26
0.13	30	0.05	49.9	0.12	30.5
0.18	35	0.08	60.3	0.15	34.1
0.24	40	0.09	70.3	0.20	40.7
0.30	45	0.11	79.9	0.22	44.3
0.35	50	0.12	90.5	0.26	49.7
0.41	57	0.15	98.9	0.28	52.7
0.46	59.8			0.35	62.8
0.50	64			0.38	66.8
0.55	70			0.39	69.1
0.60	75			0.42	72.9
0.67	80			0.45	76.8
0.71	85			0.47	80.1
0.77	90			0.51	84.9
0.82	95			0.55	89.6
0.86	99.8			0.56	92.8
				0.60	98.6

Assuming each rod has a body length, L_0 of 600 cm.

- (i) Identify dependent and independent variable and state the correlation between them. (2 marks)
- (ii) Determine the linear expansion coefficient, α for each type of solid. (9 marks)

– END OF QUESTIONS –

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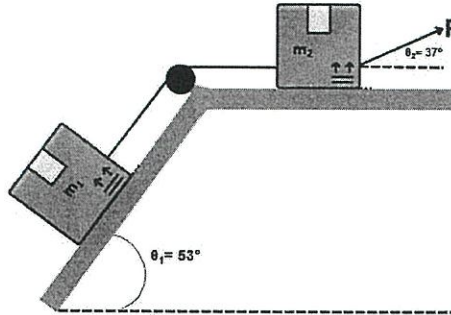


Figure Q2(a)

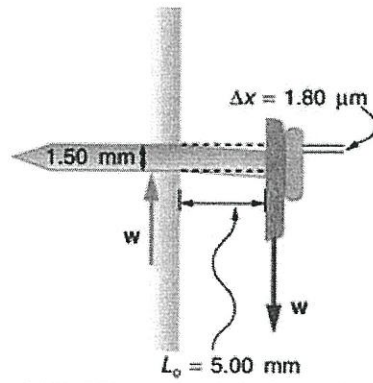


Figure Q2(b)

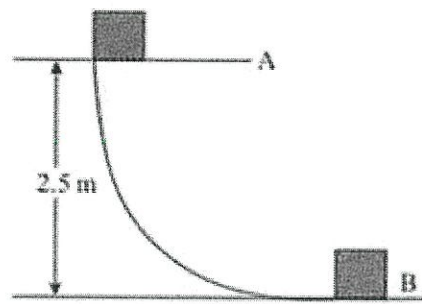


Figure Q2(c)