الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا
كلية عمان البحرية الدولية
International Maritime College Oman

ACADEMIC YEAR 2023 – 2024

Program	Year	Semester	Paper
ME	2	2	MAIN

MODULE NAME:	**PHYSICS – II**		
MODULE CODE:	**MPHYS – II**	**EXAM DATE:**	**27/05/2024**
INSTRUCTOR's NAME:	**Jahanzeb Khan Bahadur**	**DURATION:**	**2 hrs**

Questions to be answered on:	**Allowed tools:**	**Number of pages**
✓ Space provided on the question paper	Pen, Pencil & Calculator	(Incl. cover page)**: 10**

Points of attention:

- For each question, the maximum earned points are mentioned between brackets at the end of each question.
- Write very clearly! Answers that are not readable are not marked and don't get points!
- Make sure your answers are written to the point.
- All answers should be written **in English.**
- Write all the answers in **blue or black pen only.**
- Use the **pencil** only for **diagrams & graphs.**
- Show all the calculation steps in the given space.
- When finished submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

STUDENT NAME:

STUDENT ID:

FINAL MARKS	
	40
	10

Number of answer scripts:……..…….

Invigilator:……..……..…..

Student's signature: ……

Time of receipt:……..….

Question 1 **[Total Marks: 06]**

The total length of the beam is 120 cm and it is pivoted at the center of mass. A load of 36 N is hanged at 36 cm from the left end of the beam and Newton meter (spring balance) is 53 cm away from the pivot (axis of rotation) on the other side of pivot.

a) Define the principle of moments? (1 mark)

b) Draw a labelled diagram of above situation for class – 1 type of lever. (2 marks)

c) Now replace the class I type with class 3 lever and redraw the figure for the situation given in the question above. (2 marks)

d) Calculate the force required to keep the beam horizontally balanced. (1 marks)

Question 2 **[Total Marks: 06]**

An oil tank has the rectangular base of 2.5 by 1.5 m. The depth of oil in the tank is 8m. The oil has density of 0.88 g/cm^3. Atmospheric pressure is 1.0 x10^5 Pa.

(a) Calculate the absolute pressure at the base of tank. (2 marks)

(b) Calculate the force exerted by the oil on the base of tank. (2 marks)

(c) Calculate the mass of the oil inside the tank. (2 marks)

Question 3 **[Total Marks: 08]**

(a) Distinguish between quantity of heat and temperature. (2 marks)

(b) Convert the given temperature 212 ^{o}F & -28 ^{o}F into Celsius and kelvin. (2 marks)

(c) Define coefficient of linear expansion. Write their mathematical relation and with the help of mathematical relation show that $L_2 = L_1(1 + \alpha \times \Delta T)$. (2 marks)

(d) The length of an aluminum rod is 3.5 m at 30^{o}C. If the rod is heated at a temperate of 65^{o}C, calculate the change in length of the rod after heating. (2 marks)

Question 4 **[Total Marks: 08]**

(a) State and explain Boyle's Law. Explain your answer with the help of a cylinder piston diagram and the graphical representation. (3 marks)

(b) The steam pressure in high pressure boilers is 6×10^7 N/m^2. Write this pressure according to SI unit of kN/m^2 and in bar. (2 marks)

(c) 0.5 m^3 of a perfect gas at a pressure of 0.95 bar and a temperature 17 °C is compressed to a volume of 0.125 m^3 and, the final pressure is 560 kN/m^2. Calculate the final temperature. (3 marks)

Question 5 **[Total Marks: 06]**

(a) Define specific heat and write its SI unit and the mathematical relation. (2 marks)

(b) In an experiment to find the specific heat of the lead, 0.4 kg of lead shot at a temperature of 80^{o}C is poured into an insulated calorimeter of mass 0.5 kg containing 0.45 kg of water at 18.5^{o}C. The resultant temperature of the mixture is 25.5^{o}C. Find the specific heat capacity of the lead. (4 marks)

Question 6 **[Total Marks: 06]**

Heat energy is transferred to 360 g of air is heated in furnace at constant pressure increasing the temperature from 44°C to 368°C. [$c_v = 0.718$ *and* $c_p = 1.005 \frac{kJ}{kgK}$]

(a) Calculate the amount of heat energy transferred. (2 marks)

(b) Calculate the increase in internal energy. (2 marks)

(c) Calculate the total amount of work done. (2 marks)

FORMUALE SHEET

$\tau = F \times d \times \sin\theta$	$Celisus = \frac{5}{9} \times (TF - 32)$
$Fahrenheit = \frac{9}{5} \times TC + 32$	$kelvin = TC + 32$
$Q = m \times c \times \Delta T$	$\Delta L = \alpha_L \times L_1 \times \Delta T$ $L_2 - L_1 = \alpha \times L_1 \times \Delta T$
$\Delta V = \beta \times V_1 \times \Delta T$ $V_2 - V_1 = \beta \times V_1 \times \Delta T$	$\Delta A = \alpha_A \times A_1 \times \Delta T$ $A_2 - A_1 = \alpha_A \times A_1 \times \Delta T$
$Q = W + \Delta U$ $Q = P \times \Delta V + \Delta U$	$Q_v = m \times C_v \times \Delta T$ $\Delta U = m \times C_v \times \Delta T$
$Q_v = m \times C_v \times \Delta T$	$Q_p = m \times C_p \times \Delta T$
$\frac{P_1}{T_1} = \frac{P_2}{T_2}$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Appendix

Table 1: THERMAL EXPANSION COEFFIECNT OF DIFFERENT MATERIALS:

	Material	Coefficient of linear expansion α_L (1/°C)	Coefficient of area expansion α_A (1/°C)	Coefficent of volumetric expansion β (1/°C)
SOLIDS	Aluminum	25×10^{-6}	50×10^{-6}	75×10^{-6}
	Brass	19×10^{-6}	38×10^{-6}	56×10^{-6}
	Copper	17×10^{-6}	34×10^{-6}	51×10^{-6}
	Gold	14×10^{-6}	28×10^{-6}	42×10^{-6}
	Iron or Steel	12×10^{-6}	24×10^{-6}	35×10^{-6}
	Lead	29×10^{-6}	58×10^{-6}	87×10^{-6}
	Silver	18×10^{-6}	36×10^{-6}	54×10^{-6}
	Glass (ordinary)	9×10^{-6}	18×10^{-6}	27×10^{-6}
	Glass (Pyrex®)	3×10^{-6}	6×10^{-6}	9×10^{-6}
LIQUIDS	Ethyl alcohol			1100×10^{-6}
	Petrol			950×10^{-6}
	Glycerin			500×10^{-6}
	Mercury			180×10^{-6}
	Water			210×10^{-6}
GASES	Air and most other gases at atmospheric pressure			3400×10^{-6}

Table 2: SPECIFIC HEAT, LATENT HEAT OF FUSION AND VAPORIZATION FOR DIFFERENT SUBSTANCES:

Substance	***Specific Heat in (J/kg ºC)***	***Specific Heat in (kJ/kg ºC)***
Copper	*390*	*0.390*
Aluminum	900	*0.900*
Brass	*394*	*0.394*
Concrete, granite, Glass	840	*0.840*
Gold	129	*0.129*
Iron, steel	452	*0.452*
Lead	128	*0.128*
Silver	235	*0.235*
Ice (-50°C to 0°C)	*2040*	*2.040*
water	*4200*	*4.200*
Benzene	1740	*0.174*
Glycerin	2410	*0.241*
Mercury	139	*0.139*
Substance	***Latent Heat of fusion in (J/kg ºC)***	***Latent Heat of fusion in (kJ/kg ºC)***
Ice/Water	*335000*	*335*
Mercury	*11800*	11.8
Lead	*24500*	24.5
Aluminum	*380000*	380
Silver	*88300*	88.3
Gold	*64500*	64.5
Copper	*134000*	134
Tungsten	*184000*	184
Uranium	*84000*	84
Wood	1700	1.7
Substance	***Latent Heat of steam in (J/kg ºC)***	***Latent Heat of steam in in (kJ/kg ºC)***
Water	*2256700*	*2256.7*
Mercury	*270000*	272
Lead	*871000*	871
Aluminum	*11400000*	11400
Silver	*2336000*	2336
Gold	1578000	1578
Copper	5069000	5069
Tungsten	4810000	4810