SP015
Physics 1
Semester I
Session 2023/2024
2 hours

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MATRIKULASI
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PROGRAM DRAW A QUESTION (DAQ)
SET A

MODEL PAPER SEMESTER I
PHYSICS UNIT

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

INSTRUCTIONS TO CANDIDATE:

The question paper consists of 8 questions.

Answer **all** questions.

The use of electronic calculator is permitted.

QUESTION	MARKS
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

LIST OF SELECTED CONSTANT VALUES
SENARAI NILAI PEMALAR TERPILIH

Speed of light in vacuum *Laju cahaya dalam vakum*	c	$= 3.00 \times 10^{8}$ m s^{-1}
Permeability of free space *Ketelapan ruang bebas*	μ_o	$= 4\pi \times 10^{-7}$ H m^{-1}
Permittivity of free space *Ketelusan ruang bebas*	ε_o	$= 8.85 \times 10^{-12}$ F m^{-1}
Electron charge magnitude *Magnitud cas elektron*	e	$= 1.60 \times 10^{-19}$ C
Planck constant *Pemalar Planck*	h	$= 6.63 \times 10^{-34}$ J s
Electron mass *Jisim elektron*	m_e	$= 9.11 \times 10^{-31}$ kg $= 5.49 \times 10^{-4}$ u
Neutron mass *Jisim neutron*	m_n	$= 1.674 \times 10^{-27}$ kg $= 1.008665$ u
Proton mass *Jisim proton*	m_p	$= 1.672 \times 10^{-27}$ kg $= 1.007277$ u
Deuteron mass *Jisim deuteron*	m_d	$= 3.34 \times 10^{-27}$ kg $= 2.014102$ u
Molar gas constant *Pemalar gas molar*	R	$= 8.31$ J K^{-1} mol^{-1}
Avogadro constant *Pemalar Avogadro*	N_A	$= 6.02 \times 10^{23}$ mol^{-1}
Boltzmann constant *Pemalar Boltzmann*	k	$= 1.38 \times 10^{-23}$ J K^{-1}
Free-fall acceleration *Pecutan jatuh bebas*	g	$= 9.81$ m s^{-2}

LIST OF SELECTED CONSTANT VALUES
SENARAI NILAI PEMALAR TERPILIH

Atomic mass unit *Unit jisim atom*	1 u	$= 1.66 \times 10^{-27}$ kg $= 931.5 \frac{\text{MeV}}{\text{c}^2}$
Electron volt *Elektron volt*	1 eV	$= 1.6 \times 10^{-19}$ J
Constant of proportionality for Coulomb's law *Pemalar hukum Coulomb*	$k = \frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^{9}$ N m^2 C^{-2}
Atmospheric pressure *Tekanan atmosfera*	1 atm	$= 1.013 \times 10^{5}$ Pa
Density of water *Ketumpatan air*	ρ_w	$= 1000$ kg m^{-3}

LIST OF SELECTED FORMULAE
SENARAI RUMUS TERPILIH

1. $v = u + at$
2. $s = ut + \frac{1}{2}at^2$
3. $v^2 = u^2 + 2as$
4. $s = \frac{1}{2}(u + v)t$
5. $p = mv$
6. $J = F\Delta t$
7. $J = \Delta p = mv - mu$
8. $f = \mu N$
9. $W = \vec{F} \cdot \vec{s} = Fs\cos\theta$
10. $K = \frac{1}{2}mv^2$
11. $U = mgh$
12. $U_s = \frac{1}{2}kx^2 = \frac{1}{2}Fx$
13. $W = \Delta K$
14. $P_{av} = \dfrac{\Delta W}{\Delta t}$
15. $P = \vec{F} \cdot \vec{v} = Fv\cos\theta$
16. $a_c = \frac{v^2}{r} = r\omega^2 = v\omega$
17. $F_c = \frac{mv^2}{r} = mr\omega^2 = mv\omega$
18. $s = r\theta$
19. $v = r\omega$
20. $a_t = r\alpha$
21. $\omega = \omega_o + \alpha t$
22. $\theta = \omega_o t + \dfrac{1}{2}\alpha t^2$
23. $\theta = \frac{1}{2}(\omega_o + \omega)t$
24. $\omega^2 = \omega_o^{\,2} + 2\alpha\theta$
25. $\tau = rF\sin\theta$
26. $I = \sum mr^2$
27. $I_{\text{solid sphere}} = \dfrac{2}{5}MR^2$
28. $I_{\text{solid cylinder/disc}} = \dfrac{1}{2}MR^2$
29. $I_{\text{ring}} = MR^2$
30. $I_{\text{rod}} = \dfrac{1}{12}ML^2$
31. $\sum\tau = I\alpha$

LIST OF SELECTED FORMULAE
SENARAI RUMUS TERPILIH

32. $L = I\omega$

33. $y = A\sin\omega t$

34. $v = \omega A\cos\omega t = \pm\omega\sqrt{A^2 - y^2}$

35. $a = -\omega^2 A\ \sin\omega t = -\omega^2 y$

36. $K = \frac{1}{2}m\omega^2(A^2 - y^2)$

37. $U = \frac{1}{2}m\omega^2 y^2$

38. $E = \frac{1}{2}m\omega^2 A^2$

39. $\omega = \frac{2\pi}{T} = 2\pi f$

40. $T = 2\pi\sqrt{\frac{l}{g}}$

41. $T = 2\pi\sqrt{\frac{m}{k}}$

42. $k = \frac{2\pi}{\lambda}$

43. $v = f\lambda$

44. $y(x,t) = A\sin(\omega t \pm kx)$

45. $v_y = A\omega\cos\ (\omega t \pm kx)$

46. $y = 2A\cos kx\sin\omega t$

47. $f_n = \frac{nv}{2L}$

48. $f_n = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$

49. $f_n = \frac{nv}{4L}$

50. $v = \sqrt{\frac{T}{\mu}}$

51. $\mu = \frac{m}{L}$

52. $f_a = \left(\frac{v \pm v_o}{v \mp v_s}\right) f$

53. $\sigma = \frac{F}{A}$

54. $\varepsilon = \frac{\Delta L}{L_o}$

55. $Y = \frac{\sigma}{\varepsilon}$

56. $U = \frac{1}{2}F\Delta L$

57. $\frac{U}{V} = \frac{1}{2}\sigma\varepsilon$

58. $\frac{Q}{t} = -kA\left(\frac{\Delta T}{L}\right)$

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

60. $\Delta A = \beta A_o \Delta T$

61. $\Delta V = \gamma V_o \Delta T$

62. $\beta = 2\alpha$

LIST OF SELECTED FORMULAE
SENARAI RUMUS TERPILIH

63. $\gamma = 3\alpha$

64. $n = \dfrac{m}{M} = \dfrac{N}{N_{\mathrm{A}}}$

65. $v_{rms} = \sqrt{\langle v^2 \rangle}$

66. $v_{\mathrm{rms}} = \sqrt{\dfrac{3kT}{m}} = \sqrt{\dfrac{3RT}{M}}$

67. $PV = \frac{1}{3} N m {v_{rms}}^2$

68. $P = \frac{1}{3} \rho {v_{rms}}^2$

69. $K_{\mathrm{tr}} = \dfrac{3}{2}\left(\dfrac{R}{N_{\mathrm{A}}}\right)T = \dfrac{3}{2}kT$

70. $U = \dfrac{1}{2} fNkT = \dfrac{1}{2} fnRT$

71. $\Delta U = Q - W$

72. $W = nRT \ln \frac{V_f}{V_i} = nRT \ln \frac{P_i}{P_f}$

73. $W = \int P dV = P(V_f - V_i)$

74. $W = \int P dV = 0$

1. Two forces F_1 and F_2 acted upon a box resting on a floor. $F_1 = 20$ N acted horizontally to the left while $F_2 = 25$ N acted upwards. Determine the magnitude of the net force experienced by the box.

[2 marks]

2. (a) A truck moving from rest on a straight road and accelerates at a rate of 1.50 m s^{-2} until it reaches a velocity of 24.0 m s^{-1}. Then the truck travels till 180 m at constant velocity before the brakes are applied. The truck was stopped after 6.50 s.

(i) How long were the truck travels before it stopped?

(ii) Calculate the average velocity of the truck from rest until before the brakes are applied.

[5 marks]

(b) An athlete throws a shot at an angle 35° with the horizontal and the shot lands at a distance of 17.5 m. Calculate

(i) the initial speed of the shot.

(ii) the maximum height of the shot.

[5 marks]

3. (a) A net force of 8.5 N acts on a body of mass 4.5 kg for half minute. If the final velocity is 25 m s^{-1}, calculate the magnitude of the initial velocity of the body.

[2 marks]

(b) Two identical objects moving at 7.5 m s^{-1}, collide and sticked together as shown in **FIGURE 1**. Find the magnitude and the direction of the final velocity of both objects after the collision.

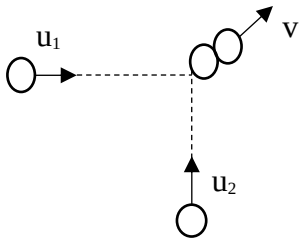

FIGURE 1

[4 marks]

(c) **FIGURE 2** shows a smooth inclined plane making an angle of 30° with the horizontal has a pulley at its top. A 35 kg block A, on the plane is connected to a freely hanging 22 kg block B by a string passing over the frictionless pulley.

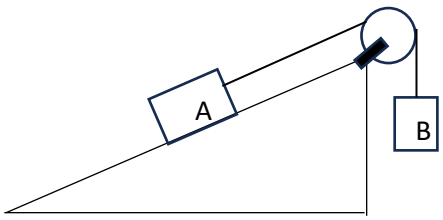

FIGURE 2

(i) Sketch a free body diagram of block A and B.

(ii) Determine the acceleration of the blocks.

(iii) Determine the tension in the string.

[7 marks]

4. (a) A winch lifts a 150 kg crate 3.0 m upwards with an acceleration of 0.50 ms^{-2} .

(i) Calculate work done by the winch.

(ii) Determine work done by gravity.

(iii) Find total work done on the lift.

[6 marks]

(b) A 7500 W engine is propelling a boat at 12 km h^{-1}. How much force is water resistance exerting on the speedboat?

[2 marks]

5. A swing ball game moving in a circular motion at a radius of 0.6 m. If the ball completes one full circle in 1.7 s.

(i) Calculate the centripetal acceleration of the ball.

(ii) If a new 900 g swing ball is used and completes the same circle in 2 minutes, calculate the centripetal force of the circular motion.

[5 marks]

6. (a) An object is executing a simple harmonic motion with an amplitude of 25 cm and a maximum acceleration of 12.5 m s^{-2}. Calculate

(i) the period of the motion.

(ii) the speed of the object when it is at a distance of 10 cm from the amplitude.

[4 Marks]

(b) A progressive wave propagates towards negative-x direction with a velocity of 8 m s^{-1}. The amplitude and wavelength are 20 mm and 40 cm respectively.

(i) Calculate the frequency of the wave.

(ii) Write the displacement equation of the wave.

(iii) Calculate the vibrational speed of a particle at position x =15 cm at t = 0.3 s.

[8 Marks]

(c) F**IGURE 3** shows a loudspeaker emitting sound wave of 547 Hz in front of an open pipe of length, l. The air column resonates at its third harmonics.

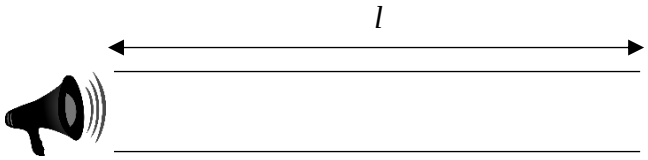

FIGURE 3

(i) Determine the length of the pipe, l.

(ii) Calculate the wavelength of the sound wave in the air column.

(iii) Calculate its first overtone frequency.

(speed of sound in air = 343 m s^{-1})

[7 Marks]

(d) A siren of a fire engine emits a sound of frequency 1000 Hz. The fire engine moves at constant speed of 70 km h^{-1} passes a stationary pedestrian at a red light traffic light. Calculate the frequency heard by the pedestrian as the fire engine

(i) is approaching him.

(ii) is moving away from him.

(speed of sound in air = 343 m s^{-1})

[4 Marks]

7. (a) A load of 5 kg hangs from a steel wire with a length of 4.50 m and cross-sectional area of 1.20 mm^2. The Young's modulus of steel is 190 GPa. Calculate

(i) the stress.

(ii) the strain energy per volume in the wire.

[3 Marks]

(b)

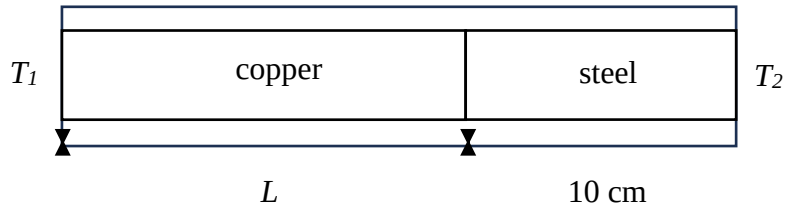

FIGURE 4

FIGURE 4 shows two insulated plates, one made of copper and the other of steel, each with an area of 50.0 cm^2 and joined together at their ends. The steel rod has a length of 10 cm, while the copper rod has a length of L. At the steady state, the temperatures at the ends of copper and steel are T_1 = 100 °C and T_2 = 0 °C and temperature at the joint is 60 °C. Given the thermal conductivity for both plates are k_{copper} = 380 W m^{-1} K^{-1} and k_{steel} = 46 W m^{-1} K^{-1}.

(i) Calculate the temperature gradient of the steel rod.

(ii) Determine L.

[4 Marks]

(c) A sheet of aluminium has an initial area of 550 cm^2 when the temperature is 10°C. If the linear expansion coefficient for aluminium is 2.3×10^{-5} $°C^{-1}$, what is the final temperature when the area of the sheet becomes 600 cm^2?

[1 Marks]

8. (a) The RMS speed of helium at STP is 2.5 km s^{-1}. Determine the density of helium at STP. [Given: The pressure at STP is 1.01 x 10^5 Pa]

[2 Marks]

(b) A 0.2 mol of monoatomic gas, fills in a container. If the temperature of the gas in the container is 310 K, calculate the

(i) average kinetic energy of the gas.

(ii) internal energy of the gas.

[4 Marks]

(c) A 0.5 mol gas is compressed at a constant temperature of 200K from 7 L to 4 L.

(i) State the type of thermodynamic process.

(ii) Calculate the work done on the gas.

(iii) Calculate the heat transferred during this process.

[Given: 1 atm = 1.013 x 10^5 Pa, 1 L = 0.001 m^3]

[5 Marks]

END OF QUESTION PAPER