SP015

PHYSICS

SEMESTER I

SESSION 2022/2023

NAME :..

CLASS :..

MATRIC NO : ....

UNIT FIZIK

KOLEJ MATRIKULASI LABUAN

PHYSICS ATTACK

2 HOURS

DO NOT OPEN THE QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO

Instructions to candidate:

1. Answer all the questions.
2. You may use a non-programmable scientific calculator for your calculations.

QUESTION	TOTAL MARKS	MARKS
1	5	
2	11	
3	10	
4	10	
5	3	
6	23	
7	8	
8	10	
TOTAL	80	

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

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. $P_{\text{av}} = \frac{\Delta W}{\Delta t}$
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. $\theta = \omega_o t + \frac{1}{2}\alpha t^2$
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. $I_{\text{solid sphere}} = \frac{2}{5}MR^2$
28. $I_{\text{solid cylinder/disc}} = \frac{1}{2}MR^2$
29. $I_{\text{ring}} = MR^2$
30. $I_{\text{rod}} = \frac{1}{12}ML^2$
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. $n = \dfrac{m}{M} = \dfrac{N}{N_A}$

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

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

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

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

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

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. **(a)** Check the dimensional homogeneity and provide the unit for the following formula:

$$Ft = mv - mu$$

Where F is the force acting on an object, t is the time taken, m is the mass of the object, v is the final velocity and u is the initial velocity of the object.

[3 marks]

(b) A force of 10 N acts at the origin in a direction of 40^0 above the positive x-axis. A second force of 8 N acts at the origin in the direction of the negative y-axis. Find the magnitude of horizontal component and vertical component of the resultant force.

[2 marks]

2. **(a) FIGURE 1** shows a pathway of a bus. The bus is moving from A to B at velocity 8 ms^{-2} for 2s, then from B to C at velocity 5 ms^{-2} for 4s, and finally from C to D at velocity 9 ms^{-2} for 3s. Calculate

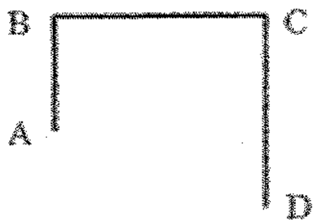


FIGURE 1

i. the distance of each pathway passed by the bus
ii. the displacement of the bus
iii. the average speed of the bus
iv. the average velocity of the bus

[5 marks]

(b) In **FIGURE 2**, a ball is thrown leftward from the left edge of the roof, at height h above the ground. The ball hits the ground 1.50 s later at a distance, d = 25.0 m from the building and at an angle, = 60^0 with the horizontal.

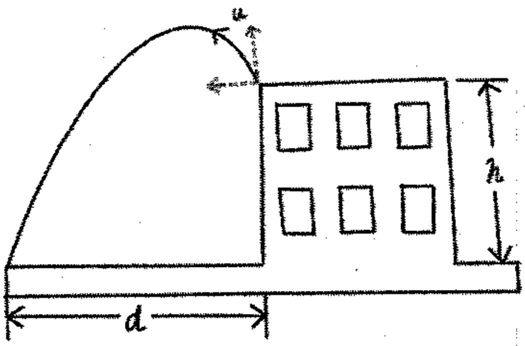


FIGURE 2

i. Find h.
ii. What are the magnitude and angle relative to the horizontal of the velocity at which the ball is thrown?

[6 marks]

3. **(a)** A tennis ball of mass 0.080 kg hits a wall at a speed of 32 m s^{-1} and rebounds at a speed of 22 m s^{-1}. With the aid of a diagram,

i. calculate the change in momentum of the ball
ii. determine the average force on the ball, if the impact between the ball and the wall last for 0.15 s.

[3 marks]

(b)

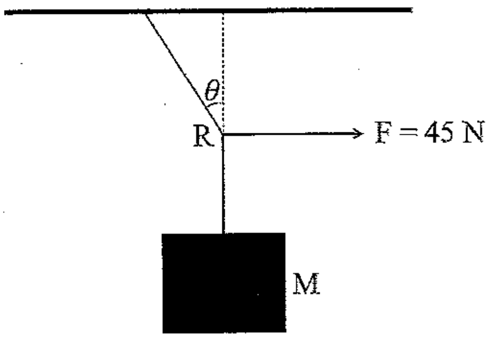


FIGURE 3

i. A mass M of 5 kg is suspended by a rope with negligible mass of length 2 m from the ceiling as shown in **FIGURE 3**. A force of 45 N in the horizontal direction is applied at the midpoint R of the rope, as shown. What is the angle, θ the rope makes with the vertical in equilibrium?

[3 marks]

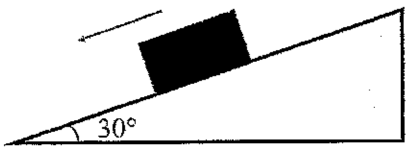


FIGURE 4

ii. A parcel of mass 2.0 kg is placed on a rough inclined plane as shown in **FIGURE 4**. It is released from rest and accelerates at a constant rate of 4.0 m s^{-2}. Determine the coefficient of kinetic friction for the parcel.

[4 marks]

4.

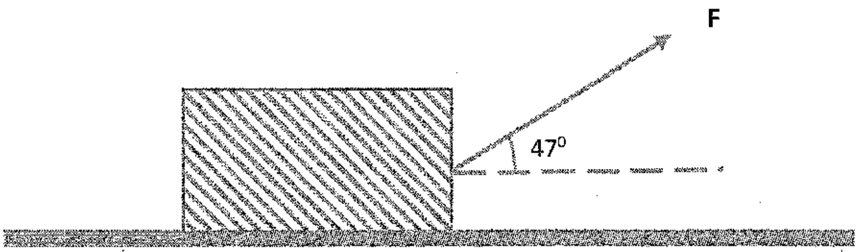


FIGURE 5

(a) **FIGURE 5** shows a block of mass 60 kg pulled by a constant force, F = 200N on a rough surface at an angle of 47° to the horizontal. The frictional force between the block and the surface is 70N. If the block moves 50 m horizontally, determine the net work done on the block.

[5 marks]

(b)

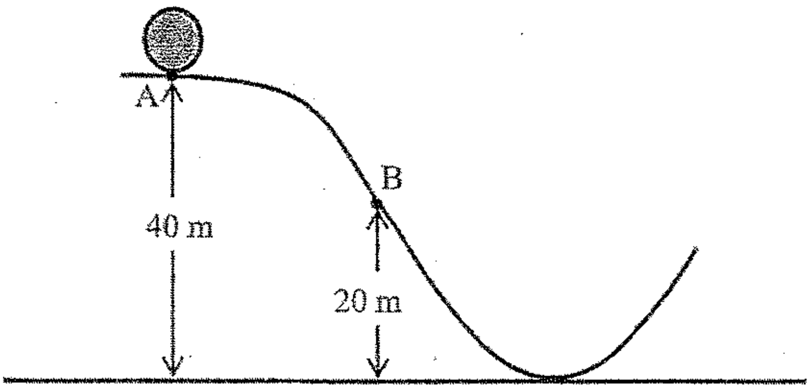


FIGURE 6

A sphere of mass 4 kg initially at rest slides along a smooth and curvy surface as shown in **FIGURE 6**. Calculate

(i) the potential energy of the sphere at point A.

(ii) the speed of the sphere as it passes point B.

[5 marks]

5. A 0.2 kg ball, attached to the end of a string, is rotated in a horizontal circle of radius 1.5 m on a frictionless table surface. The string will snap when the tension exceeds 50 N. What is the maximum speed of the ball?

[3 marks]

6.

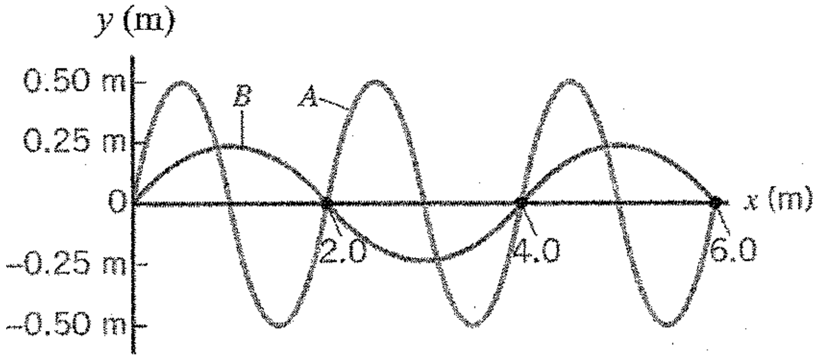


FIGURE 7

(a) **FIGURE 7** shows a graph of two waves traveling to the right at the same speed, $12\ m\ s^{-1}$. Determine:

(i) the wavelength of each wave.

(ii) the frequency of each wave.

(iii) the maximum speed for a particle attached to each wave.

[12 marks]

(b) A $60.0\ cm$ guitar string under a tension of $50.0\ N$ has a mass per unit length of $0.100\ g\ cm^{-1}$. Determine the highest resonance frequency of the string that can be heard by a person able to hear frequencies of up to $20\ 000\ Hz$.

[5 marks]

(c) When a metal pipe is cut into two pieces, the lowest resonance frequency in one piece is $256\ Hz$ and that for the other is $440\ Hz$. Determine:

(i) the length of original pipe.

(ii) the fundamental frequency would have been produced by the original length of pipe.

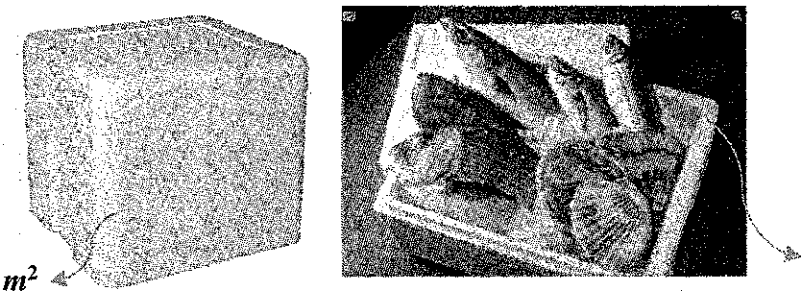
(Speed of sound in air = $343\ m\ s^{-1}$)

[6 marks]

7. **(a)** A thin, light wire 75. Cm long having a circular cross-section 0.55 mm in diameter has a 25 kg weight attached to it, causing it to stretch by 1.10 mm. Calculate the stress in this wire.

[3 marks]

30 ^oC



0.8 m^2 0 ^oC

FIGURE 8

(b) The Styrofoam box in **FIGURE 8** is used to keep fish cold at a picnic. The total wall area (including the lid) is 0.8 m^2, and the wall thickness is 2.0 cm. The box is filled with ice and some fish, keeping the inner surface at 0 ^oC. What is the amount of heat flowing into the box every minute if the temperature of the outside surface is 30 ^oC?

($k_{ice} = 0.010\ W.m^{-1}.K^{-1}$)

[5 marks]

8. **(a)** The pressure and volume of a monoatomic ideal gas is 1.0×10^5 Pa and 40 litres, respectively, when its temperature is 273 K.
   i. Calculate the number of moles in the gas
   ii. Determine the total internal energy of the gas

[4 marks]

(b) An ideal gas is kept in a container in the initial state at a temperature of 27 °C, a volume of 30 dm^3 and a pressure of 0.2 MPa. The gas goes through the following processes:

(AB) → Isobaric expansion to 80 dm^3

(BC) → Isovolumetric cooling to – 73 °C

(CD) → Isothermal compression to 60 dm^3

i. Calculate the temperature after process (AB)
ii. Calculate the pressure at the end of processes (BC) and (CD)
iii. Determine the work done in process (CD)
iv. Sketch the pressure against volume graph for all three processes

[6 marks]

END OF QUESTION PAPER