SULIT

SP015
Physics 1
Semester I
Session 2023/2024
2 hours

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Fizik 1
Semester I
Sesi 2023/2024
2 jam

KOLEJ MATRIKULASI KELANTAN
KELANTAN MATRICULATION COLLEGE

UJIAN PRA-PSPM 1 (SET 1)
PRE-PSPM 1 TEST (SET 1)

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU.
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Kertas soalan ini mengandungi **12** halaman bercetak.
This question paper consists of 12 printed pages.

LIST OF SELECTED CONSTANT VALUE

SENARAI NILAI PEMALAR TERPILIH

Speed of light in vacuum *Laju cahaya dalam vakum*	c	=	3.00×10^{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	=	8.85×10^{-12} F m^{-1}
Electron charge magnitude *Magnitud cas elektron*	e	=	1.60×10^{-19} C
Planck constant *Pemalar Planck*	h	=	6.63×10^{-34} J s
Electron mass *Jisim elektron*	m_e	= =	9.11×10^{-31} kg 5.49×10^{-4} u
Neutron mass *Jisim neutron*	m_n	= =	1.674×10^{-27} kg 1.008665 u
Proton mass *Jisim proton*	m_p	= =	1.672×10^{-27} kg 1.007277 u
Hydrogen mass *Jisim hidrogen*	m_H	= =	1.673×10^{-27} kg 1.007825 u
Deuteron mass *Jisim deuteron*	m_d	= =	3.34×10^{-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	=	6.02×10^{23} mol^{-1}
Boltzmann constant *Pemalar Boltzmann*	k	=	1.38×10^{-23} J K^{-1}
Free-fall acceleration *Pecutan jatuh bebas*	g	=	9.81 m s^{-2}
Atomic mass unit *Unit jisim atom*	1 u	= =	1.66×10^{-27} kg 931.5 MeV/c^2

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

LIST OF SELECTED FORMULAE

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. $P_{av} = \frac{\Delta W}{\Delta t}$
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. $\omega = \omega_\circ + \alpha t$
22. $\theta = \omega_\circ t + \frac{1}{2}\alpha t^2$
23. $\theta = \frac{1}{2}(\omega_\circ + \omega)t$
24. $\omega^2 = \omega_\circ^{\,2} + 2\alpha\theta$
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. $I_{ring} = MR^2$
30. $I_{\text{rod}} = \frac{1}{12}ML^2$
31. $\sum\tau = I\alpha$
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. $K = \frac{1}{2}m\omega^2\left(A^2 - y^2\right)$

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

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

54. $\varepsilon = \frac{\Delta L}{L_\circ}$

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. $\Delta L = \alpha L_\circ \Delta T$

60. $\Delta A = \beta A_\circ \Delta T$

61. $\Delta V = \gamma V_\circ \Delta T$

62. $\beta = 2\alpha$

63. $\gamma = 3\alpha$

64. $n = \frac{m}{M} = \frac{N}{N_A}$

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

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

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

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

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

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

71. $\Delta U = Q - W$

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

73. $W = \int PdV = P\left(V_f - V_i\right)$

74. $W = \int PdV = 0$

1 Determine the S.I unit of impulse using dimensional analysis.

[2 *marks*]

2 (a) The maximum power of a jet engine is capable to accelerate the plane at 2.0 m s^{-2}. The length of the runaway is 0.85 km.

(i) Calculate the maximum velocity at take off.

(ii) How long does the plane on the run away?

[4 *marks*]

(b)

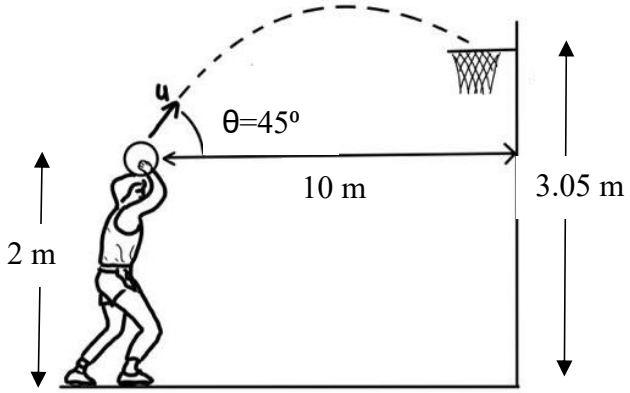

FIGURE 2

In **FIGURE 2**, 2.0 m tall basketball player tries to make a shoot into a basket from a distance of 10 m. if the basket post is 3.05 m high and he shoots the ball at a 45° angle. Calculate the

(i) initial speed that he must throw into the basketball so that it goes through into the basket.

(ii) time when the ball passes through the basket.

[6 *marks*]

3 (a)

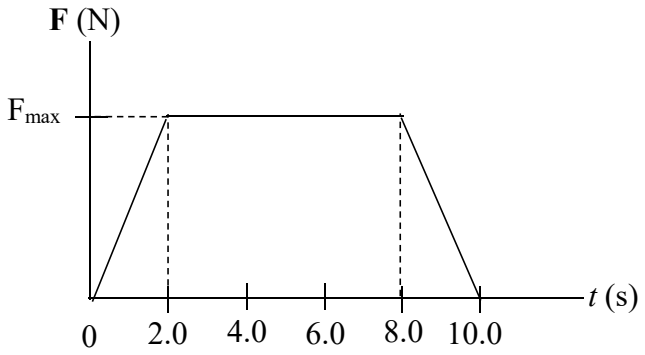

FIGURE 3.1

Initially a 40 kg object is moving in a straight line 6.2 m s^{-1} and during its journey forces are applied to it according to the force versus time graph in the **FIGURE 3.1**. Find the maximum force applied to the object if its final velocity is 7 m s^{-1}.

[2 *marks*]

(b)

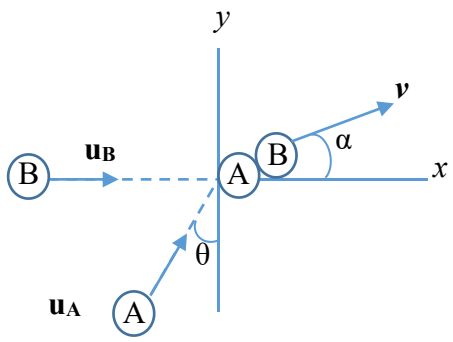

FIGURE 3.2

Suppose that the two identical putty balls collide obliquely as shown in **FIGURE 3.2** and stick together after collision. Determine the magnitude and direction of the velocity after impact. Take $u_A = u_B = 55$ m s^{-1} and $\theta = 20^o$.

[5 *marks*]

(c)

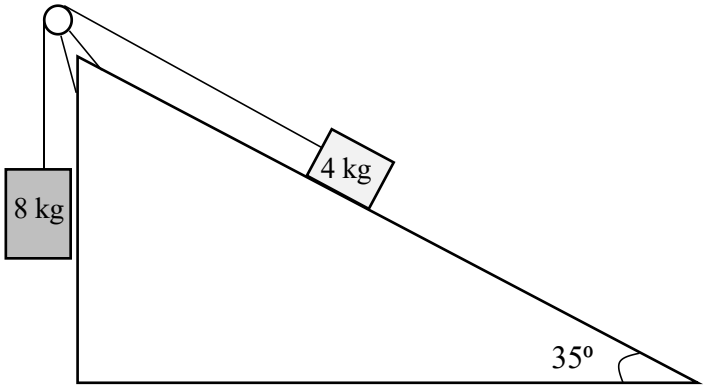

FIGURE 3.3

Two boxes of mass 8 kg and 4 kg are connected by a light string that passes over a frictionless pulley as shown in **FIGURE 3.3**. The 4 kg box lies on a rough inclined plane of angle 35º. If the coefficient of kinetic friction is 0.2, calculate the acceleration and tension of the system.

[6 *marks*]

4 (a)

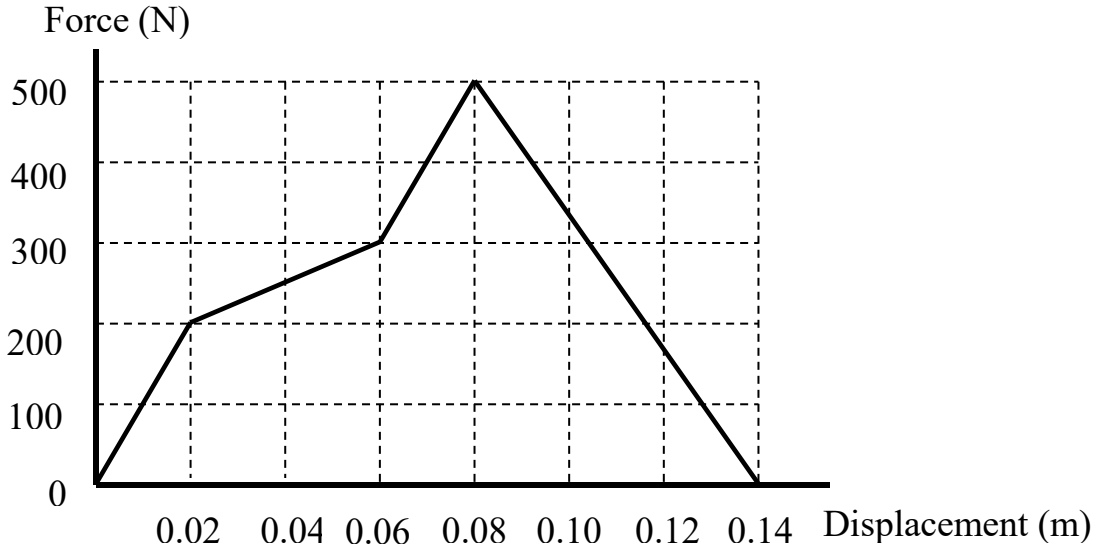

FIGURE 4.1

FIGURE 4.1 shows a force-displacement graph for an object is being pushed along a certain distance. Calculate the work done from the graph.

[2 *marks*]

(b)

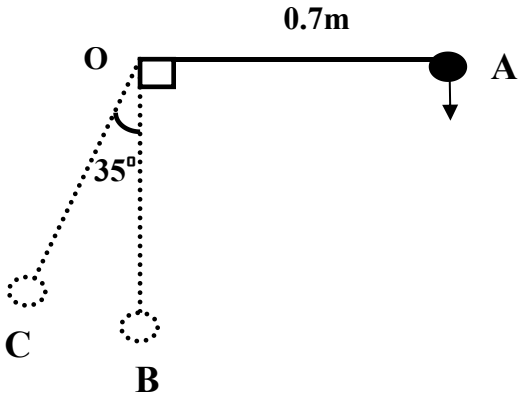

FIGURE 4.2

FIGURE 4.2 shows a pendulum of length 0.7 m with a bob of mass 0.14 kg is released from rest at A. Calculate the

(i) speed of the bob at B.

(ii) potential energy of the bob at C.

[4 *marks*]

(c) A 65 kg man climbs up a staircase of total height 342 m in 30 minutes. Calculate the average power.

[2 *marks*]

5 (a) An object of mass *m,* 0.2 kg is tied to a string and whirled in horizontal circle of radius R, 0.5 m at a constant speed of 5 m s^{-1} . Calculate the

(i) acceleration of the object.

(ii) tension in the string.

[2 *marks*]

(b)

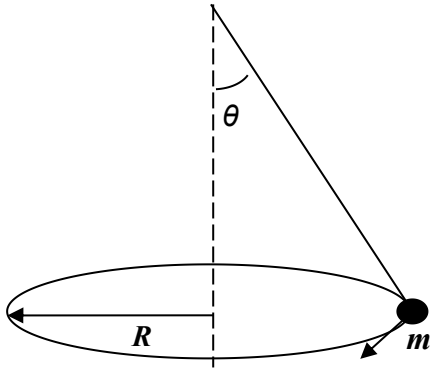

FIGURE 5.1

Calculate the angle, θ when the speed of the object is 3 m s^{-1} and moves at constant speed, then make a conical pendulum with radius *R*, 40 cm as shown in **FIGURE 5.1**.

[3 *marks*]

6 (a) An object undergoes a simple harmonic motion according to equation

$$y = 4\sin 1.2t$$

where *y* is in centimetre and *t* is in seconds. At *t* = 3 s, determine the

(i) displacement,

(ii) velocity and

(iii) acceleration of the object.

[5 *marks*]

(b) A block of mass 250 g is attached to a horizontal helix spring of spring constant 50 N m^{-1}. The block is pulled 6.0 cm horizontally from equilibrium position and then released to oscillate in simple harmonic motion.
Determine the

(i) frequency of the oscillation.

(ii) total energy of the system.

[4 *marks*]

(c) Two progressive waves in a long string are given by

$$y_1 = 0.04\sin\left(20t - \frac{x}{2}\right)$$

$$y_2 = 0.04\sin\left(20t + \frac{x}{2}\right)$$

where y_1, y_2 and x are in meters and t in seconds.

(i) Determine the expression for the new wave when both waves are superimposed.

(ii) Calculate the wavelength of the progressive waves.

[4 *marks*]

(d) A wire fixed at both ends has tension 100 N and vibrating at its second overtone. Length and mass of the wire are 2.5 m and 5.0 g respectively.

(i) Determine the wavelength of the string at second overtone vibration.

(ii) Calculate the speed of the wave on the string.

(iii) Calculate the frequency of the sound produced.

[6 *marks*]

(e) A boy standing at a bus stop when the fire engine with velocity 46 m s^{-1} emitting siren with frequency 550 Hz pass through him. If speed of sound in air is 340 m s^{-1}, calculate the frequency heard by the boy when it is

(i) approaching him.

(ii) moving away from him.

[4 *marks*]

7 (a) A 55 m^2 composite wall of a building consists of brick and concrete with the thickness of 12.0 cm and 24.0 cm respectively. The temperature of the outside surface of the brick and concrete is 40 ^oC and 20 ^oC respectively. Given coefficient of the thermal conductivity of brick and concrete are 0.6 W m^{-1} $^oC^{-1}$ and 0.8 W m^{-1} $^oC^{-1}$ respectively.

(i) Determine the temperature of the interface between the brick and the concrete.

(ii) How much heat flows through the concrete in 1 hour?

[5 *marks*]

(b) A steel tank is completely filled with 3.0 m^3 of glycerine at 32 ^oC. The tank is then cooled to 18 ^oC. The coefficients of linear and volume thermal expansion for steel and glycerine are $1.1 \times 10^{-4}\ K^{-1}$ and $4.84 \times 10^{-4}\ K^{-1}$ respectively. Calculate the additional volume of glycerine can be filled into the tank.

[3 *marks*]

8 (a) A closed cylinder contains 0.2 mole of nitrogen gas. What is the internal energy, U of the system if the root mean square velocity of nitrogen molecules is 600 m s^{-1}. Molar mass of nitrogen = 28 g mol^{-1}.

[4 *marks*]

(b) Calculate the pressure exerted by hydrogen if the density of hydrogen is 0.1 kg m^{-3} and rms speed of hydrogen molecule at that pressure is 1.85 km s^{-1}.

[2 *marks*]

(c) Two moles of monoatomic gas argon expand isothermally at 295 K, from an initial volume of $V_i = 0.025\ m^3$ to a final volume of $V_f = 0.050\ m^3$. Assuming that argon is an ideal gas. Calculate the heat transferred during the expansion. Is heat absorbed or released by the system.

[5 *marks*]

END OF QUESTIONS PAPER