SP015
Physics 1
Semester I
Session 2022/2023
2 hours

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Fizik 1
Semester I
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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.

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

Kertas soalan ini mengandungi **9** halaman bercetak.

*This question paper consists of **9** printed pages.*

LIST OF SELECTED CONSTANT VALUES

Speed of light in vacuum	c	=	3.00×10^{8} m s^{-1}
Permeability of free space	μ_o	=	$4\pi\times10^{-7}$ H m^{-1}
Permittivity of free space	ε_o	=	8.85×10^{-12} F m^{-1}
Electron charge magnitude	e	=	1.60×10^{-19} C
Planck constant	h	=	6.63×10^{-34} J s
Electron mass	m_e	=	9.11×10^{-31} kg
		=	5.49×10^{-4} u
Neutron mass	m_n	=	1.674×10^{-27} kg
		=	1.008665 u
Proton mass	m_p	=	1.672×10^{-27} kg
		=	1.007277 u
Deuteron mass	m_d	=	3.34×10^{-27} kg
		=	2.014102 u
Molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
Avogadro constant	N_A	=	6.02×10^{23} mol^{-1}
Boltzmann constant	k	=	1.38×10^{-23} J K^{-1}
Free-fall acceleration	g	=	9.81 m s^{-2}
Atomic mass unit	$1\ u$	=	1.66×10^{-27} kg
		=	931.5 MeV/c^2
Electron volt	$1\ eV$	=	1.6×10^{-19} J
Constant of proportionality for Coulomb's law	$k = \frac{1}{4\pi\pi_o}$	=	9.0x10^9 N m^2 C^{-2}
Atmospheric pressure	$1\ atm$	=	1.013×10^{5} Pa
Density of water	ρ_w	=	1000 kg m^{-3}

LIST OF SELECTED FORMULAE

1. $v = u + at$
2. $v^2 = u^2 + 2as$
3. $s = ut + \frac{1}{2}at^2$
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. $W = \vec{F} \bullet \vec{s} = Fs\cos\theta$
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. $P = \vec{F} \bullet \vec{v} = Fv\cos\theta$
16. $a_c = \frac{v^2}{r} = r\omega^2 = v\omega$
17. $F_c = \frac{mv^2}{r} = mv\omega = mr\omega^2$
18. $s = r\theta$
19. $v = r\omega$
20. $a_t = r\alpha$
21. $\omega = \omega_\circ + at$
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. $PV = \frac{1}{3} Nm{v_{\text{rms}}}^2$

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. $W = \int PdV = 0$

Answer **all** questions.

1 Newton's law of gravity states that the gravitational force, F between two masses, m_1 and m_2, separated by a distance r is given by $F = \frac{Gm_1m_2}{r^2}$. Determine the dimension of gravitational constant, G.

[2 *marks*]

2 (a) A boat with an initial speed of 30 m s^{-1}, decelerates at 3.5 m s^{-2} for 4.5 s before reaching a buoy. Calculate the speed of the boat when reaching the buoy.

[2 *marks*]

(b)

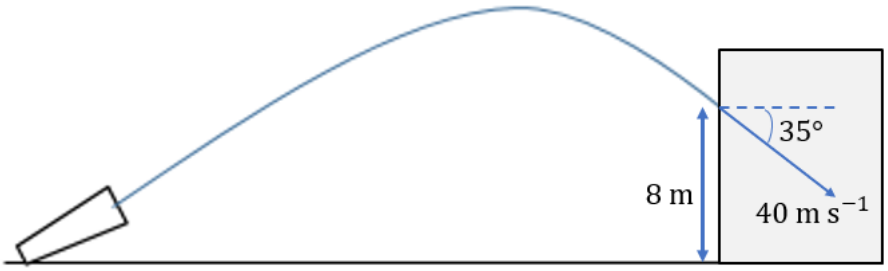

FIGURE 1

FIGURE 1 shows a stream of water hitting a wall at a height of 8 m with a velocity of 40 m s^{-1} at an angle of 35° below the horizontal. Determine the initial velocity of the water as it leaves the nozzle.

[8 *marks*]

3 (a)

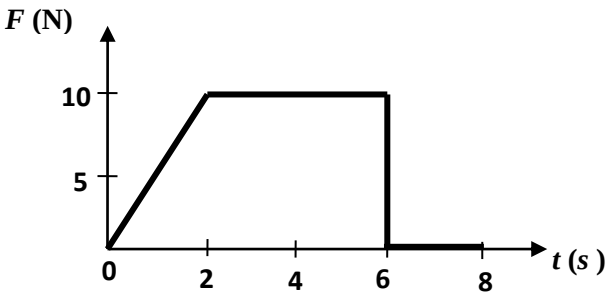

FIGURE 2

An object of mass 5.0 kg which is initially at rest is acted upon by a force F that varies with time t as shown in the **FIGURE 2**. Calculate the velocity of the object after 8.0 s.

[3 *marks*]

(b)

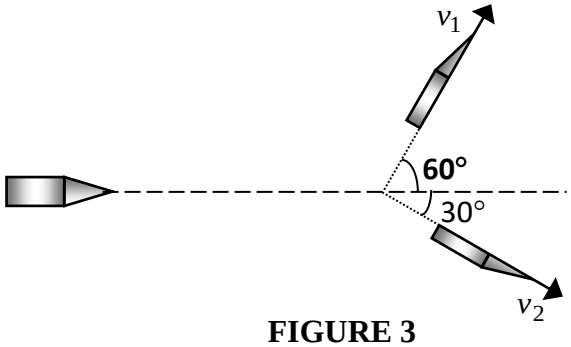

FIGURE 3

A homemade rocket is moving at a speed of 45 m s^{-1}. The rocket breaks into two pieces of equal mass which fly off with velocities, v_1 and v_2, as shown in **FIGURE 3**. Determine the value of v_1, and v_2. (Neglect the effect of gravity)

[6 *marks*]

(c) A load of 4000 kg is lifted vertically by a cable attached to a crane. The cable can support a maximum tension of 5.5×10^4 N. Calculate the tension in the cable when

(i) the load is lifted vertically at constant speed of 3.0 m s^{-1}

(ii) the load is lowered down at constant acceleration of 1.5 m s^{-2}

[4 *marks*]

4 (a) The brakes of a truck cause it to slow down by applying an opposite force of 3×10^{-8} N to the truck over a distance of 850 m. Calculate the work done by the force on the truck.

[2 *marks*]

(b)

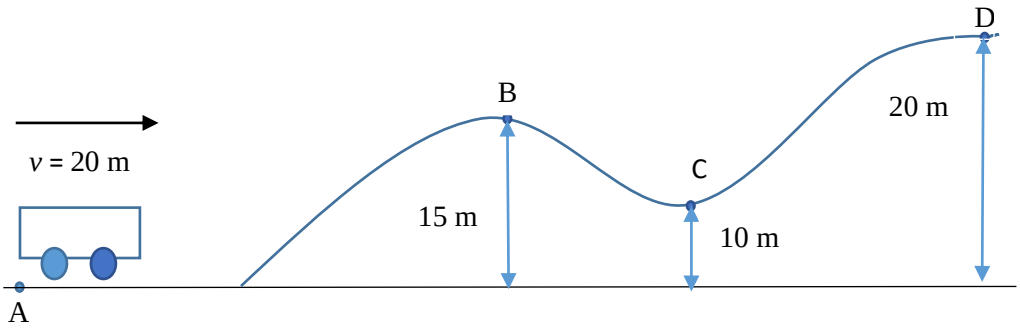

FIGURE 4

FIGURE 4 shows a cart is moving to the right passes point A at a speed of 20 m s^{-1}. By neglecting frictional effect,

(i) calculate the speed of the cart when it arrives at point B.

(ii) will the cart reach point D? Show your answer by calculation.

[6 *marks*]

5 A conical pendulum has a small bob of mass 0.20 kg attached to it by a string of length of 0.8 m. The bob rotates in a horizontal circle and the string makes an angle of 30°. Calculate

(a) the linear speed of the bob.

[4 *marks*]

(b) the tension in the string.

[1 *marks*]

6 (a) A body of mass 2.0 kg moves in simple harmonic motion. The displacement *y* from the equilibrium position at time *t* is given by

$$y = 6.0 \sin 2(\pi t)$$

where *y* is in centimetres and *t* is in seconds. Determine

(i) the amplitude and period of the SHM.

(ii) the magnitude of maximum acceleration of the motion.

(iii) the kinetic and potential energies of the body at time *t* = 5 s.

[9 *marks*]

(b) In an experiment of simple harmonic motion, a vibrating mass-spring system makes 20 oscillations in 10 seconds. If the constant of the spring is 100 N m^{-1}, calculate the weight of the object attached to the spring.

[4 *marks*]

(c) A copper wire of mass 200 g and length 2.5 m has one of its ends fixed to a wall and the other end is forced to vibrate transversely with a frequency of 100 Hz. If the tension of the wire is 125 N, calculate

(i) the speed **and** wavelength of the progressive wave produced.

(ii) the number of harmonics for stationary wave produced.

[7 *marks*]

(d) A train moving at a constant speed is passing a stationary man on a platform and whistle its horn at a frequency of 500 Hz. If the frequency heard by the man on the platform is 450 Hz, what is the speed of the train?
(Given the speed of sound in air is 340 m s^{-1})

[3 *marks*]

7 (a) A support cable on a bridge has an area of cross-section of 0.0085 m^2 and a length of 35 m. It is made of high tensile steel of Young's modulus 2.8×10^{11} Pa. The tension in the cable is 720 kN. Calculate the

(i) extension of the cable.

(ii) energy stored in the cable.

[4 *marks*]

(b) A 1.300 m long composite rod consists of a 0.800 m length of aluminium joined end to end to a 0.500 m length of brass. The free end of the aluminium section is maintained at 150.0°C and the free end of the brass piece is maintained at 20.0°C. No heat is lost through the sides of the rod. At steady state, Calculate the

(i) temperature of the point where the two metal are joined.

(ii) temperature gradient across brass section.

(Given k of aluminium is 205 W $m^{-1}°C^{-1}$ and k of brass is 109 W $m^{-1}°C^{-1}$)

[4 *marks*]

8 (a) A root mean square velocity of a helium gas is 1350 m s^{-1}. The pressure and volume of the gas are each doubled while the number of moles of the gas kept constant. Calculate the

(i) new root mean square velocity of the gas.

(ii) new temperature of the gas if the molar mass of helium gas is 4 g mol^{-1}.

[5 *marks*]

(b) A 0.5 mole monoatomic ideal gas is filled in a 0.5 m^3 container at 303 K and pressure of 2.52 kPa. The gas is isothermally compressed to a volume of 0.3 m^3 and pressure of 4.20 kPa. Then the gas expands isobarically to its original volume and the final temperature of the gas is 505 K. Calculate the

(i) total work done in the processes.

(ii) change in the internal energy of the gas for isobaric process.

[6 *marks*]

END OF QUESTIONS PAPER