KOLEJ MATRIKULASI SELANGOR
PHYSICS PRE-PSPM
SESSION 2022/2023
TOTAL MARKS: 80 M
TIME: 2 HOURS

80

Name	
Practicum	

Instructions:

1. Answer **ALL** the questions.

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*	$k = \frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^9$ 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}

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. $W = Fs\cos\theta$

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. $P = Fv = Fv\ cos\ \theta$

16. $v = r\omega$

17. $a_t = r\alpha$

18. $a_c = \frac{v^2}{r} = r\omega^2$

19. $\omega = \omega_o + \alpha t$

20. $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

21. $\omega^2 = \omega_o^2 + 2\alpha\theta$

22. $\tau = rF\sin\theta$

23. $I = \sum mr^2$

24. $I_{solid\ sphere} = \frac{2}{5}MR^2$

25. $I_{solid\ cylinder/disc} = \frac{1}{2}MR^2$

26. $I_{ring} = MR^2$

27. $I_{rod} = \frac{1}{12}ML^2$

28. $\sum\tau = I\alpha$

29. $L = I\omega$

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

31. $F_c = \frac{mv^2}{r} = mv\omega = \mathrm{mr}\omega^2$

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

33. $s = r\theta$

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

35. $v = \omega A \cos \omega t =$

$\pm\omega\sqrt{A^2 - x^2}$

36. $a = -\omega^2 A \cos \omega t =$

$-\omega^2 y$

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

38. $U = \frac{1}{2}m\omega^2 x^2$

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

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

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

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

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

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

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

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

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

50. $\beta = 2\alpha$

51. $\gamma = 3\alpha$

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

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

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

55. $pV = nRT$

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

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

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

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

60. $\mu = \frac{m}{l}$

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

62. $v = f\lambda$

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

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

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

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

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

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

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

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

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

Questions

1) Determine the dimension of momentum.

[2 *marks*]

2) a) A car moving at 18 m s^{-1} and decelerates at 2.5 m s^{-2} as it approaches a stop sign.

i) How long does it take the car to come to a complete stop?

ii) What distance does the car travel as it is breaking?

b)

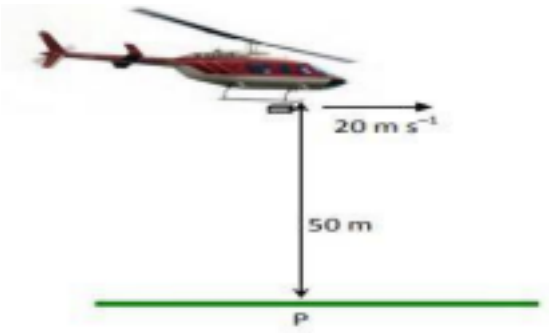

FIGURE 1

FIGURE 1 shows a helicopter is travelling horizontally at 20 m s^{-1} at a height of 50 m above a point P on horizontal ground when it releases a package.

i) How long will it take the package to reach the ground?

ii) How far from P will the package land?

iii) Calculate the speed of the package when it reaches the ground.

[10 *marks*]

3) a) A nett force of 6.0 N acts on a body of mass 18 kg for one minute. If the final velocity is 50.0 m s^{-1}, calculate the initial velocity of the body.

b) Ball A of mass 400 g and velocity 4 m s^{-1}collides with ball B of mass 600 g and velocity 6 m s^{-1}. After collision, A and B will move together. Determine the final velocity of both balls if A and B moves in the opposite direction initially.

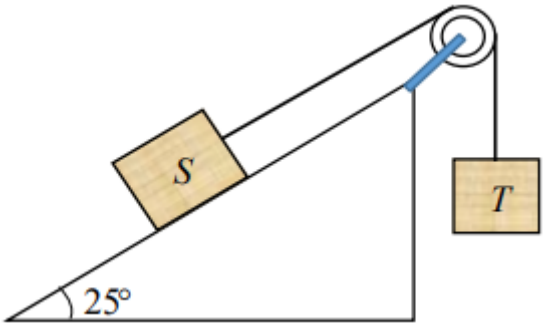

FIGURE 2

c) **FIGURE 2** shows a smooth inclined plane making an angle of 25° with the horizontal has a pulley at its top. A 30 kg block *S* on the plane is connected to a freely hanging 20 kg block *T* by a cord passing over the frictionless pulley.

i) Sketch a free-body diagram of block S and T.

ii) Determine the acceleration of the blocks and tension in the string.

iii) Determine the distance of the block *T* will fall in 2 s starting from rest.

[13 *marks*]

4)

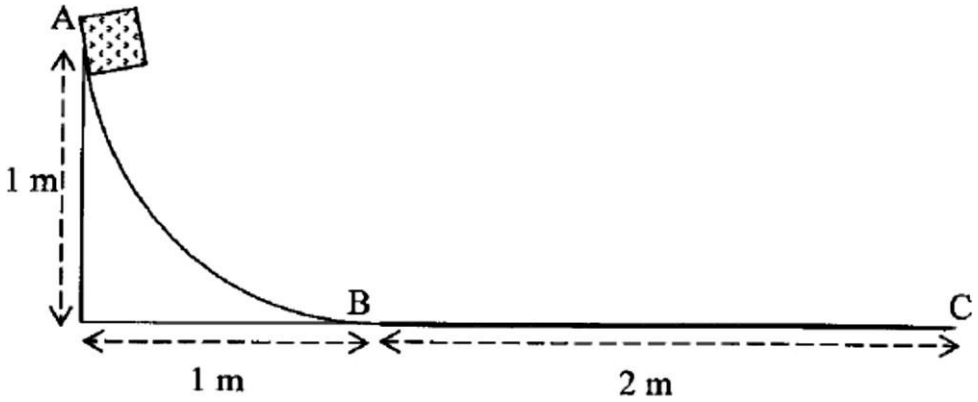

FIGURE 3

FIGURE 3 shows 0.3 kg object released from A, slides down the track and reaches point B. From point B it slides on a level surface a distance of 2 m to point C, where it comes to a rest. Track AB is frictionless while track BC is rough.

a) What is the speed of the block at B?

b) Calculate the work done against the frictional force.

c) Determine the coefficient of kinetic friction. [8 *marks*]

5) **FIGURE 4** shows a 200 *g* bob attached to an 80 *cm* string forming a conical pendulum. The bob rotates horizontally with speed *v*.

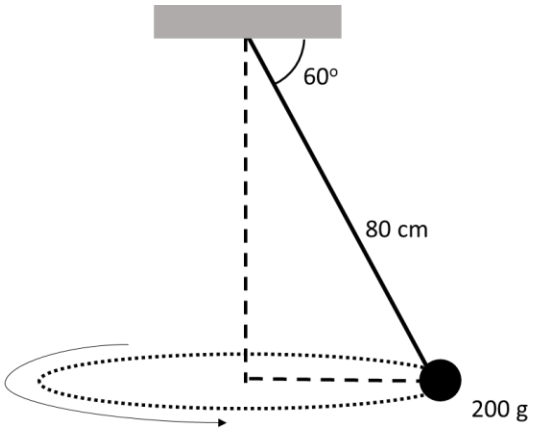

FIGURE 4

a) Sketch a free body diagram of the bob.

b) Determine *v*.

[5 *marks*]

6) a) A 0.7 kg block on one end of a spring oscillates with 5 cycles per second. If the amplitude of oscillation is 0.15 m,

i) Calculate the speed of the block when it passes the equilibrium position.

ii) Calculate the speed of the block when it at 0.10 m from the equilibrium position.

iii) Determine the total energy of the system.

iv) Write an equation for the oscillation by assuming that at t = 0 s, y = 0.

[8 *marks*]

b) The following equation represents a wave motion

$$y = 0.5\sin(215t + \frac{x}{0.17})$$

Where y and x are in meter, t in second.

i) Calculate the wavelength.

ii) Calculate the speed of wave.

iii) State the direction of wave propagation.

[4 *marks*]

c) A 2 m taut string is plucked at its centre producing vibrations with fundamental frequency of 50 Hz

i) Draw the stationary wave formed for fundamental tone, first overtone, and second overtone.

ii) Calculate the frequency of first overtone and forth overtone.

[5 *marks*]

c) A train moves at constant speed 20 m s^{-1} towards a train station and a loud sound signal of frequency 2.0 kHz is produced by a whistle.
(Given the speed of sound is 340 ms^{-1})

i) What is the apparent frequency of sound received by a stationary observer standing on the station platform?

ii) When the train passes the station at the same speed, what is the apparent frequency of sound received by the stationary observer?

[6 *marks*]

7)

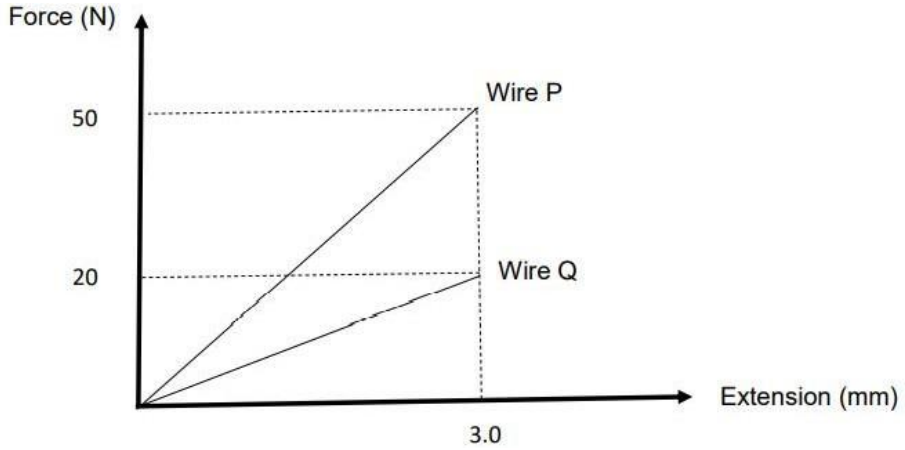

FIGURE 5

a) **FIGURE 5** shows the force-extension graphs of two wires P and Q of the same material. Both wires have the same length of 1.5 m but different diameters. The diameter of wire P is 0.58 mm. Calculate the diameter of wire Q.

[3 *marks*]

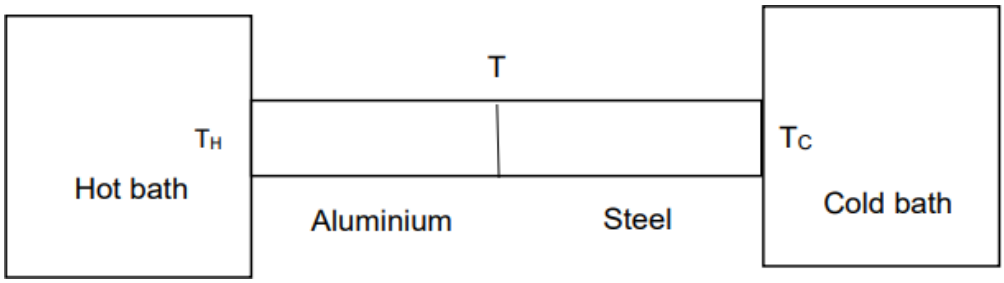

FIGURE 6

b) i) An aluminium bar is welded to a steel bar of the same dimension. The other end of the aluminium bar is placed in a hot bath of temperature T_H while the end of the steel bar is placed in a cold bath of temperature T_C as shown in **FIGURE 6**. The system is in steady state and is properly insulated. Determine the temperature T at the interface of the aluminium-steel bar in terms of T_H, T_C, k_A (thermal conductivity of aluminium) and k_S (thermal conductivity of steel).

ii) At 25°C, the length of the steel bed of a suspension bridge is 150 m. The coefficient of linear expansion of steel is $12\times10^{-6}\ °C^{-1}$. If the extreme temperatures to which it is exposed are −5°C and 40°C, determine the maximum linear contraction and maximum linear expansion.

[5 *marks*]

8) a) A tank is filled with 150 m^3 of air at pressure 25 kPa and temperature $15^{o}C$. The tank is then sealed to prevent the air leakage. After that the tank is heated until its pressure becomes 45 kPa.

i) Calculate the final temperature by assuming the volume is constant.

ii) If the temperature is maintained at $75^{o}C$ and the gas expand until the pressure becomes 10 kPa, calculate the final volume.

[5 *marks*]

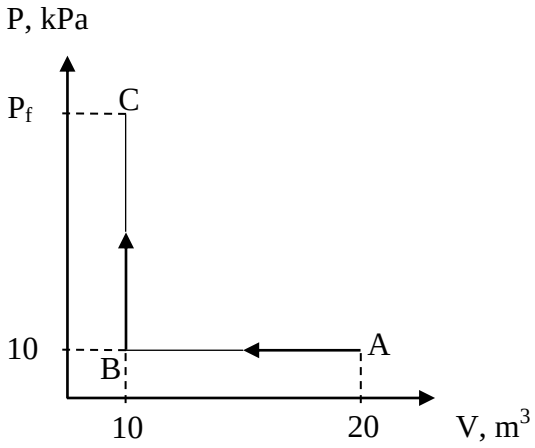

FIGURE 7

b) **FIGURE 7** shows an ideal gas which is compressed from a volume $20m^3$ to $10m^3$ at constant pressure of 10 kPa. Heat is then supplied to the system at constant volume while pressure and temperature is let to change until the system finally reaches the initial temperature at C. Calculate

i) The total work done in the above process.

ii) The final value of pressure, P_f.

[6 *marks*]