Question 1 (20 marks)

a) i) Give **THREE** examples of derived quantities and its S.I. unit. **[6 marks]**

ii) The density of vegetable oil is 0.93 gcm^{-3}. Determine its density in S.I. unit. **[3 marks]**

b) An airplane is heading towards east-north direction with a velocity of 434 ms^{-1} and continue heads to south with a velocity of 520 ms^{-1} as shown in Figure 1. Determine the magnitude of resultant velocity of the airplane. **[5 marks]**

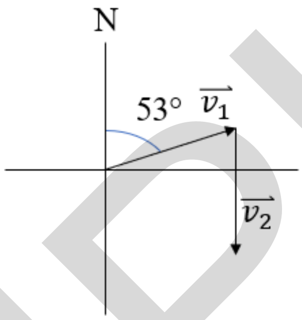


Figure 1

c) A skateboarder is skating horizontally from the top of a 0.54 m cliff with a speed of 0.85 ms^{-1}. Determine:

i) The horizontal and vertical velocity of the skateboarder when he skates horizontally. **[2 marks]**

ii) The time of flight of the skateboarder. **[2 marks]**

iv) The horizontal range between the skateboarder and cliff when he reaches the ground. **[2 marks]**

Question 2 (20 marks)

a) State **THREE** conditions for work done by a constant force to be zero. **[3 marks]**

b) Figure 2 shows a block A of mass, $m_A = 3.5$ kg placed on a rough, horizontal surface. One end of the block is connected to a string and go through a frictionless pulley to another block B of mass, $m_B = 4.0$ kg. The system is released from rest.

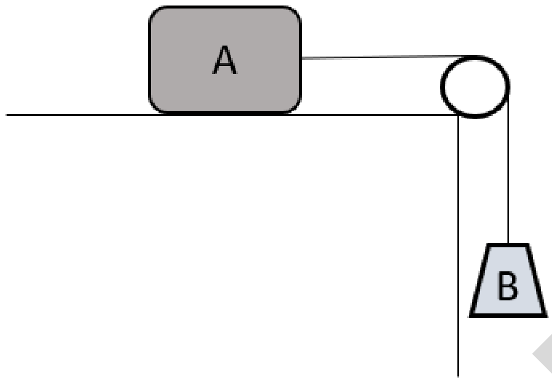


Figure 2

i) Sketch the free-body diagram (FBD) and label all the forces acting on the blocks. **[4 marks]**

ii) Calculate the coefficient of horizontal surface when the acceleration of both blocks is 0.8 ms^{-2}. **[6 marks]**

c) i) State **TWO** conditions for the system to be in static equilibrium. **[2 marks]**

ii) Three masses are attached to a 100 cm meter ruler, as shown in Figure 3. The mass of meter ruler is 0.13 kg and the masses of load hanging from the left side of pivot S are $m_1 = 60$ g and $m_2 = 75$ g. Calculate the mass of load m_3, if the system is in static equilibrium. **[5 marks]**

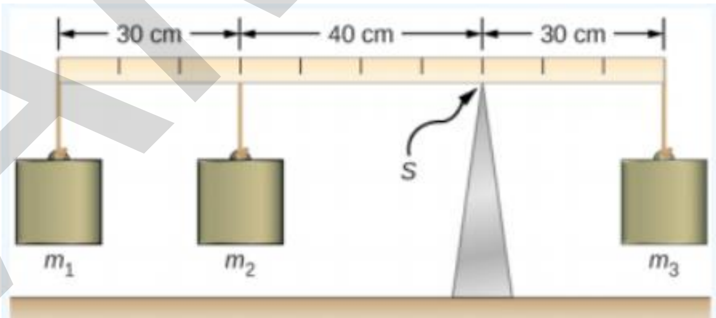


Figure 3

Question 3 (20 marks)

a) Briefly explain how buoyancy related to density. Give **ONE** example to support your answer. **[4 marks]**

b) i) An anchor is released into the ocean to a depth of 300 m. Calculate the pressure of the anchor at this level. Give the answer in both pascals and atmosphere. The density of seawater is 1030 kgm^{-3}. **[4 marks]**

ii) A hydraulic lift at a car repair shop is filled with oil with density of 900 kgm^{-3}. To lift the car up, 735.05 N of compressed air force is used to push down a 6.0 cm diameter piston. Determine the mass of the car when the car rests on another piston that has a 25 cm diameter piston. **[6 marks]**

c) Figure 4 shows a uniform cord that has a mass of 0.40 kg. The cord passes over a pulley and supports a 2.0 kg of a static block. Determine the length of the cord when the speed of a pulse travelling along it is 17.14 ms^{-1}. **[6 marks]**

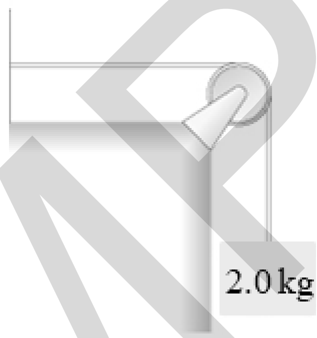


Figure 4

Question 4 (20 marks)

a) Given two-point charges $Q_1 = 2$ µC and $Q_2 = -3$ µC are separated at a distance 10.0 cm and $Q_3 = 2$ µC is placed at point P which is at the mid-point between these two charges.

i) Sketch the diagram to show the direction of electrostatic forces on point P due to these charges. **[2 marks]**

ii) Determine the magnitude and direction of the electrostatic force strength at P due to the other two charges. **[5 marks]**

b) You are given three capacitors of capacitance, 2 μF.

i) Show with diagrams how would you arrange all three capacitors to obtain the minimum and maximum effective capacitance. **[2 marks]**

Minimum effective capacitance	Maximum effective capacitance

ii) Calculate the value of the minimum and maximum effective capacitances in question b (ii). **[4 marks]**

Minimum effective capacitance	Maximum effective capacitance

c) Figure 5 shows a network of capacitors connected to a point A and B. Determine the capacitance value of capacitor *C* if the effective capacitance of this circuit is equivalent to 1 μF. **[7 marks]**

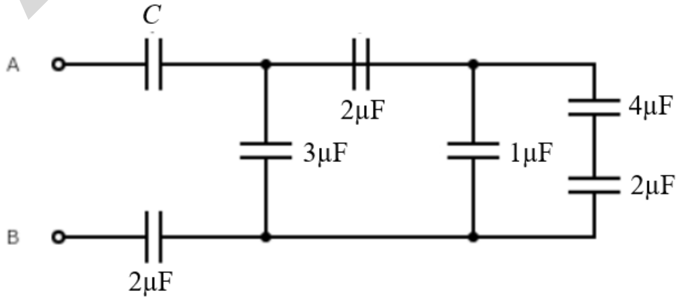
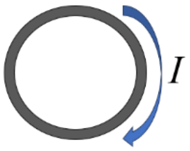
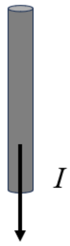


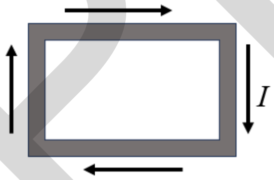
Figure 5

Question 5 (20 marks)

a) Determine the direction of magnetic field lines for the following diagrams.

[4 marks]

i) 	ii) 

iii) 	iv) 

b) A wire carrying current of 15 A in y-direction is placed in a uniform magnetic field of 0.10 T, as shown in Figure 6. If the magnetic field region is 5.0 cm long:

i) Determine the magnitude and direction of magnetic force, F_B. **[3 marks]**

ii) State one way in which the magnitude of the force acting on the wire could be increased. Briefly explain your answer. **[3 marks]**

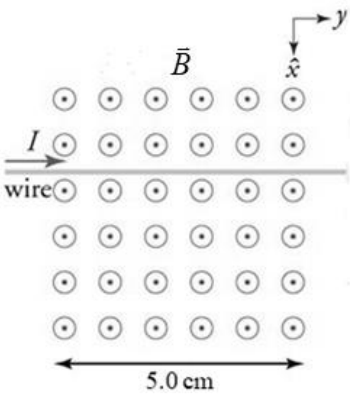


Figure 6

c) i) State **THREE** characteristics of image formed by plane mirror. **[3 marks]**

ii) With the aid of diagrams, state the law of reflection of light and refraction of light. **[4 marks]**

d) A 4.00 cm tall of spherical ball is placed by a distance of 45.5 cm from a convex lens having a focal length of a 13.5 cm. Determine the image distance of the object. **[3 marks]**

-END OF QUESTIONS-

Appendix

List of constant and formula

List of constants

Gravitational constant, $G = 6.67 \times 10^{-11}$ Nm^2kg^{-2}

Avogadro's number, $N_A = 6.02 \times 10^{23}$ mol

Gas constant, $R = 8.314$ $Jmol^{-1}K^{-1}$

Boltzmann's constant, $k = 1.38 \times 10^{-23}$ JK^{-1}

Acceleration due to gravity, $g = 9.80$ ms^{-1}

Atomic mass unit, $(1u) = 1.66 \times 10^{-27}$ kg

Speed of sound in air (dry) = 343 ms^{-1}

Density of air = 1.29 kgm^{-3}

Density of water = 1.0×10^3 kgm^{-3}

Specific heat of water = 4186 $Jkg^{-1}{}^{\circ}C^{-1}$

1 rev = 2π

List of formula

$$v = v_0 + at$$

$$v^2 = {v_0}^2 + 2a(x - x_0)$$

$$y = y_0 + v_0 t + \frac{1}{2}at^2$$

$$\underline{v} = \frac{v + v_0}{2}$$

$$d = vt$$

$$F = ma$$

$$W = Fd\ cos\theta$$

$$F_{fr} = \mu_k F_N$$

$$F_{fr} \leq \mu_s F_N$$

$$F = -kx$$

$$K = \frac{1}{2}mv^2$$

$$U = mgh$$

$$U_s = \frac{1}{2}kx^2$$

$$E = K + U$$

$$P = Fv$$

$$p = mv$$

$$a_R = \frac{v^2}{r}$$

$$v = R\omega$$

$$a = R\alpha$$

$$a = \omega^2 R$$

$$s = R\theta$$

$$F = \frac{\Delta p}{\Delta t}$$

$$m_A v_A + m_B v_B = m_A {v_A}' + m_B {v_B}'$$

$$x_{CM} = \frac{m_A x_A + m_B x_B}{m_A + m_B}$$

$$\tau = R_\perp F = RF_\perp$$

$$\omega = \omega_0 + \alpha t$$

$$\omega^2 = {\omega_0}^2 + 2\alpha\theta$$

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

$$\underline{\omega} = \frac{\omega + \omega_0}{2}$$

$$I = \sum \quad I\alpha$$

$$L = I\omega$$

$$K = \frac{1}{2} I\omega^2$$

$$F = EA\left(\frac{\Delta L}{L_0}\right) = k\Delta L$$

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

$$\varepsilon = \frac{\Delta L}{L_0}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$B = \rho V g$$

$$P = P_0 + \rho g h$$

$$P = \frac{F}{A}$$

$$A_1 v_1 = A_2 v_2$$

$$P_1 + \rho g h_1 + \frac{1}{2}\rho {v_1}^2 = P_1 + \rho g h_1 + \frac{1}{2}\rho {v_1}^2$$

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

$$\omega = \sqrt{\frac{k}{m}}$$

$$a = \omega^2 A$$

$$v = \omega A$$

$$v = \lambda f$$

$$v = \frac{\omega}{k}$$

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

$$v = \sqrt{\frac{F_T}{\mu}}$$

$$v = \sqrt{\frac{E}{\rho}}$$

$$v = \sqrt{\frac{B}{\rho}}$$

$$\Delta l = \alpha l_0 \Delta T$$

$$\Delta V = \beta V_0 \Delta T$$

$$\frac{F}{A} = \alpha E \Delta T$$

$$PV = nRT$$

$$PV = NkT$$

$$v_{rms} = \sqrt{\frac{3kT}{m}}$$

$$Q = mc\Delta T$$

$$Q = mL$$

$$S = \frac{\Delta Q}{T}$$

$$W = p\Delta V$$

$$\gamma = \frac{useful\ work\ done}{energy\ input}$$

$$\left(\sum F\right)_R = ma_R = m\frac{v^2}{r}$$

$$a_R = \frac{v^2}{r}$$

$$v = \frac{2\pi r}{T}$$

$$T = \frac{1}{f}$$

$$F = k\frac{Q_1Q_2}{r^2}$$

$$k = 8.99 \times 10^9 N.m^2/C^2$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{r^2}$$

$$E = \frac{F}{q} = k\frac{Q}{r^2}$$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

$$V_{ba} = \Delta V = V_b - V_a = \frac{U_b - U_a}{q} = -\frac{W_{ba}}{q}$$

$$V_{ba} = -Ed$$

$$V_b - V_a = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{r_b} - \frac{Q}{r_a}\right)$$

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$$

$$U = QV = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{r_{12}}$$

$$e = 1.6 \times 10^{-19}\ \mathbf{C}$$

$$Q = CV$$

$$E = \frac{Q}{\varepsilon_0 A}$$

$$V_{ba} = \frac{Qd}{\varepsilon_0 A}$$

$$C = \frac{Q}{V} = \varepsilon_0 \frac{A}{d}$$

$$C_{eq} = C_1 + C_2 + C_3 \ (parallel)$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \ (series)$$

$$U = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$$

$$u = energy\ density = \frac{1}{2}\varepsilon_0 E^2$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$V = IR$$

$$P = \frac{QV}{t} = IV = I^2R = \frac{V^2}{R}$$

$$V_{ab} = \xi - Ir$$

$$V = V_1 + V_2 + V_3 = IR_1 + IR_2 + IR_3$$

$$R_{eq} = R_1 + R_2 + R_3$$

$$I = \frac{V}{R_{eq}}$$

$$I = I_1 + I_2 + I_3$$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$V_c = \frac{Q}{C}$$

$$\tau\ (time\ constant) = RC$$

$$\xi = IR + \frac{Q}{C}$$

$$V_c = \xi(1 - e^{-\frac{t}{RC}})$$

$$Q = C\xi(1 - e^{-\frac{t}{RC}})$$

$$Q_{max} = C\xi$$

$$I = \frac{dQ}{dt} = \frac{\xi}{R}e^{-\frac{t}{RC}}$$

$$Q = Q_0 e^{-\frac{t}{RC}} = C\xi e^{-\frac{t}{RC}}$$

$$I = -\frac{dQ}{dt} = \frac{Q_0}{RC}e^{-\frac{t}{RC}} = I_0 e^{-\frac{t}{RC}}$$

$$F = IlBsin\theta$$

$$F = qvBsin\theta$$

$$\mu_0 = 4\pi \times 10^{-7} T.\frac{m}{A}$$

$$B_1 = \frac{\mu_0}{2\pi}\frac{I_1}{d}$$

$$F_1 = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d} l_2$$

$$n = \frac{c}{v}$$

$$f = \frac{r}{2}$$

$$\frac{1}{d_0} + \frac{1}{d_i} = \frac{1}{f}$$

$$m = \frac{h_i}{h_0} = -\frac{d_i}{d_0}$$