தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு
முன்றாம் தவணைப் பரீட்சை - 2024
National Field Work Centre, Thondaimanaru
3ʳᵈ Term Examination - 2024

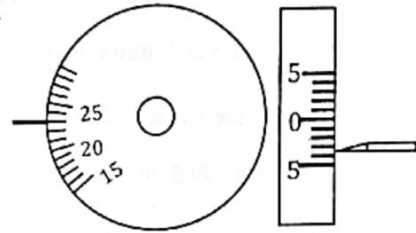| பௌதிகவியல் **Physics**	Three Hours	01	E	I
	Gr. 12 (2024)			

01) If v − velocity, F −force, t − time in $\alpha = \frac{F}{v^2} \sin\beta t$. What are the dimensions of $\frac{\alpha}{\beta}$?

    (1) $ML^{-1}T^{-1}$ (2) $ML^{-1}T$ (3) MLT (4) $M^{-1}L^{-1}T^{-1}$ (5) MLT^{-1}

02) Circular scale of spherometer consists of 50 divisions. If main scale moves 1mm distance during two complete turns of circular scale, what is the reading in shown instance?

    (1) 3.23mm   (2) 4.23mm   (3) 2.23mm

    (4) 2.27mm   (5) 3.77mm

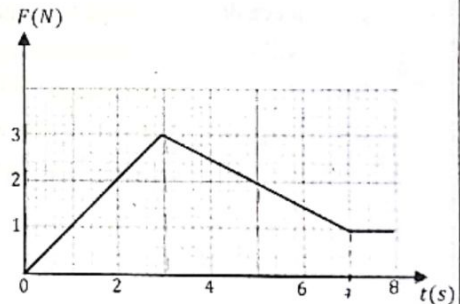03) Consider the following statements regarding laser beam.

    A - Laser beams can be generated in different frequencies

    B - A laser medium, pumping machine and resonator are important for laser production.

    C - Four level laser system is more efficient than three level laser system.

    Which of the above statements is / are true?

    (1) B Only   (2) C only   (3) A, C only   (4) B, C only   (5) A, B, C all

04) Diagram shows the variation of force (F) with time (t) acting on an object of mass $5kg$. If the velocity of object when $t = 0$ is $+1ms^{-1}$, what is its speed during $t = 7s$?

    (1) $2.0ms^{-1}$ (2) $2.5ms^{-1}$ (3) $3.5ms^{-1}$

    (4) $12.5ms^{-1}$ (5) $15ms^{-1}$

05) Diagram shows the displacement(s) versus time (t) graph drawn for the displacement measured from the moment when two vehicles A, B moving in a straight path pass a particular point P. consider the following statements.
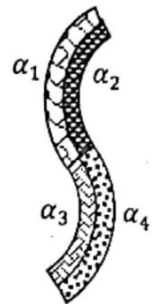
    A - Acceleration of B is higher than that of A

    B - At time $t = t_3$, A and B meet together for the second time.

    C - After time $t = t_3$, velocities of A and B are opposite to one another

    Which of the above statements is / are true?

    (1) A Only   (2) B Only   (3) A, C Only   (4) B, C Only   (5) A, B, C all
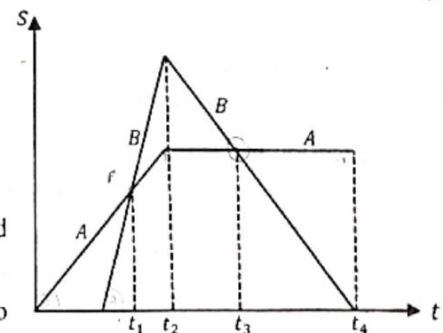
06) Diagram shows a composite bar made using four different metal pieces taking 'S' shape when heated up to 90°C. Their coefficients of linear expansions are mentioned. If it returns to straight 'I' shape when allowed to cool down to room temperature, the correct relationship between coefficients of expansion according to this is,

(1) $\alpha_1 > \alpha_2, \alpha_3 = \alpha_4$ 　　(2) $\alpha_2 > \alpha_1, \alpha_3 > \alpha_4$ 　　(3) $\alpha_1 = \alpha_2, \alpha_3 < \alpha_4$

(4) $\alpha_1 > \alpha_2, \alpha_3 < \alpha_4$ 　　(5) $\alpha_1 > \alpha_2, \alpha_3 > \alpha_4$

07) Two prisms of refractive indices n_1, n_2 are kept in contact as shown in the diagram. n_1, n_2 are in relationship with wave length λ as follows, $n_1 = 1.2 + \frac{10.8 \times 10^4}{\lambda^2}$, $n_2 = 1.45 + \frac{1.8 \times 10^4}{\lambda^2}$. If the value of λ for a light ray incident angle to pass without refracting on BC is λ_0, which gives λ_0?
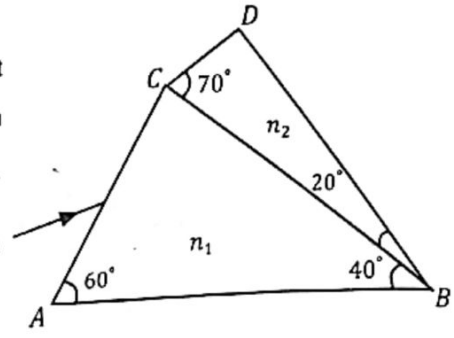
(1) $100 \ nm$ 　　(2) $200 \ nm$ 　　(3) $300 \ nm$ 　　(4) $500 \ nm$ 　　(5) $600 nm$

08) Figure shows a system of a metal piece attached to the external of a metal vessel floating on the water inside the beaker suddenly the metal piece falls off the vessel. Consider the following statements.
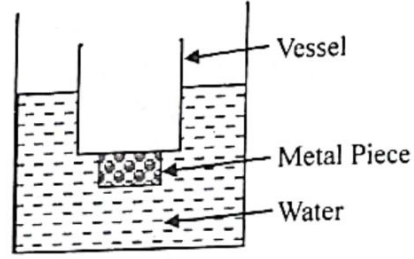
A - Since the volume of water displaced by the metal piece doesn't change the water level in the beaker will not change after the metal piece falls off.

B - When the metal piece in the beaker is put inside the vessel, the water of beaker increases.

C - Because of the volume of water displaced by the system is high when the metal part was attached to the vessel, the water level of the beaker decreases when it falls off.

From the above statements,

(1) Only B is correct 　　(2) Only A, B are correct 　　(3) Only B, C are correct

(4) All A, B, C are correct 　　(5) All A, B, C are incorrect

09) Figure shows a pump filled with liquid of density ρ. Respective heights are noted. Assume that atmospheric pressure is P_0. Considering the following statements.
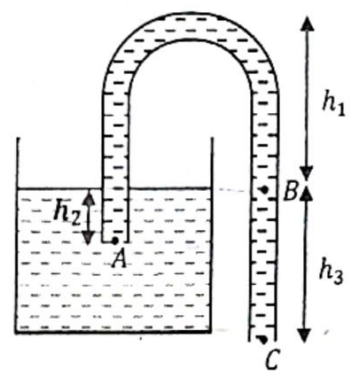
A - $h_3 > 0$ For pump to function.

B - Pressure at point Q is $P_0 - \rho g h_3$

C - Flow speed of liquid at point R is $\sqrt{2g(h_3 - h_2)}$

From above statements,

(1) Only A is correct 　　(2) Only B is correct

(3) Only A, B is correct 　　(4) All A, B, C are correct

(5) All A, B, C are incorrect

10) When the temperature of a liquid of small volume is measured by correct calibrated mercury in glass thermometer, its reading was 79.7°C . If the actual temperature of the liquid is 80°C , what is the reason for this difference?

A - Because mercury didn't expand uniformly with temperature.

B - Because the bulb of thermometer has gained small amount of heat from liquid.

C - Because the bulb of thermometer also expands a bit.

From above statements,

(1) A is true   (2) C is true   (3) A, B are true

(4) B, C are true   (5) All A, B, C are true

11) Consider the following statements regarding compound microscope and astronomical telescope.

A - The distance between lenses in a compound microscope in normal adjustment is larger than its state during infinity adjustment.

B - Angular magnification of astronomical telescope during normal adjustment is larger than that in its abnormal adjustment

C - Eyepiece acts as a simple magnifying lens in both compound microscope and astronomical telescope.

From the above statements,

(1) B is correct   (2) C is correct   (3) A, B is correct

(4) A, B, C are correct   (5) A, B, C are incorrect

12) An object of mass $10kg$ moves along the curved smooth path AB from A at rest and then moves along the horizontal rough path BD ,as shown in the figure. The coefficient of dynamic friction between the object and floor is 0.1.It collides joins and moves with the spring of spring constant $2 \times 10^4 Nm^{-1}$ at point C and rests momently. The maximum compression that could occur in the spring neglecting the energy lost during collision is,

(1) 0.1m   (2) 0.2m   (3) 0.3m   (4) 0.35m   (5) 0.4m
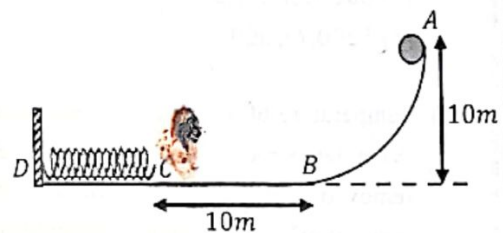
13) Two stationary sound sources S_1, S_2 generate sound waves of frequency $165Hz$. Figure shows a car moving towards S_1 with a speed of $20ms^{-1}$ between them. What is the beat frequency heard by the observer in the car if the speed of sound in our is $330ms^{-1}$

(1) $10Hz$ (2) $20Hz$ (3) $25Hz$ (4) $30Hz$ (5) $35Hz$

14) A stretched string is vibrating at its fundamental frequency. If it is made to vibrate at fundamental vibration after increasing its Tension by 69% and reducing its length by 35% What is the ratio between final, initial fundamental frequencies,

(1) $2:1$ (2) $1:2$ (3) $1:3$ (4) $3:1$ (5) $2:3$

15) A biconvex lens of focal length $30cm$ is divided into two equal part and made into two Plane convex lenses namely A and B. They are placed together as shown in the diagram and the interspace is filled with water. If the image of a point object placed on its principal axis at $40cm$ from the optical center of this compound lens forms at infinity, what is the total length of the water lens?
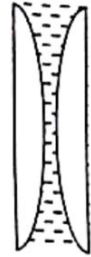
(1) $30\ cm$ (2) $40\ cm$ (3) $80cm$ (4) $100\ cm$ (5) $120\ cm$

16) Three particles each of mass m are attached in a equilateral triangular shape by three identical springs as shown in the figure and are placed on a smooth horizontal table. Length of one spring when unstretched is l. Now, the table is rotated with angular velocity ω about the center of mass of the system. If the distance between any two masses becomes $2l$ at this instance, the spring constant of one spring is given by,
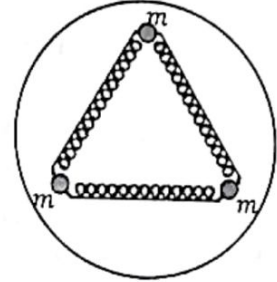
(1) $2m\omega^2$ (2) $\frac{2}{\sqrt{3}}m\omega^2$ (3) $\frac{2}{3}m\omega^2$

(4) $\frac{1}{\sqrt{3}}m\omega^2$ (5) $\frac{1}{3}m\omega^2$

17) The fundamental frequency of particles vibrating in one end closed tube A is $100Hz$. If this tube is cut into two equal pieces B, C, what are the first overtone frequencies created in B and C
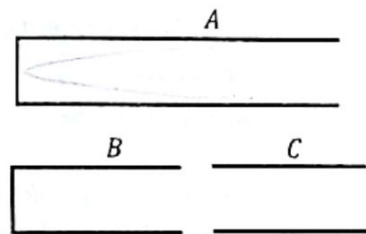
(1) $400Hz, 200Hz$ (2) $200Hz, 400Hz$

(3) $600Hz, 800Hz$ (4) $800Hz, 600Hz$

(5) $1200Hz, 800Hz$

18) Temperature of air inside a closed room of volume $1m^3$ is $30°C$ and its relative humanity is 80%. When temperature of the air becomes $20°C$, room gets Saturated and 50% of the condensed water is removed. If the temperature of air is increased again till $30°C$, What is the relative humidity of the room now? (The absolute humidities of saturated vapor at $30°C, 20°C$ are $30 \times 10^{-6}kgm^{-3}, 18 \times 10^{-6}kgm^{-3}$ respectively)

(1) 60% (2) 70% (3) 72% (4) 74% (5) 78%

19) When heat is supplied to water of mass M by a heating coil from time $t = 0$, the time taken to raise the temperature by $\Delta\theta$ is $t = t_1$. Water boils at time $t = t_2$. Mass m vaporizes at time $t = t_3$. The ratio between the specific heat capacity of water and the latent heat of vaporization is,

(1) $\frac{mt_1}{Mt_2\Delta\theta}$ (2) $\frac{m(t_3-t_2)}{Mt_1\Delta\theta}$ (3) $\frac{Mt_1}{m(t_3-t_2)\Delta\theta}$ (4) $\frac{mt_1}{M(t_3-t_2)\Delta\theta}$ (5) $\frac{mt_1}{M(t_3-t_1)\Delta\theta}$

20) Figure shows that a square portion has been removed from a uniform circular disc of radius R. The distance of center of gravity of remaining part from center O is, ($assume\ \pi = 3$)
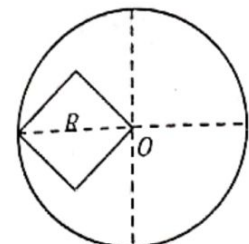
(1) $\frac{R}{2}$ (2) $\frac{R}{4}$ (3) $\frac{R}{8}$ (4) $\frac{R}{10}$ (5) $\frac{R}{12}$

21) Figure shows two oscillating systems A, B each attached with identical masses. All springs are identical. If A and B are performing small oscillations horizontally, what is the ratio between their oscillating frequencies.
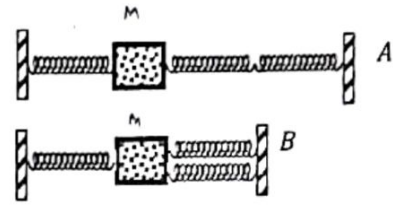

(1) $\sqrt{\frac{2}{3}}$ (2) $\frac{1}{\sqrt{3}}$ (3) $\frac{\sqrt{2}}{3}$ (4) $\frac{1}{\sqrt{2}}$ (5) $\sqrt{3}$

22) A person with eye defect uses a spectacle with $+2D$ to read a book at $25cm$ from the eye. After a period of time, he had to keep the book at $30cm$ from the eye to read using the same spectacles. What is the focal length of the lens required to read the book distance $25cm$?

(1) 27.5cm   (2) 33.3cm   (3) 37.5cm   (4) 40cm   (5) 50cm

23) The diagram shows the variation of horizontal force P acting on an object kept on a horizontal rough plane with time t. The limiting frictional force that could act on the object is F_L. The best graph representing the variation of the frictional force F acting on this object with time t.


(1)   (2)   (3)

(4)   (5)
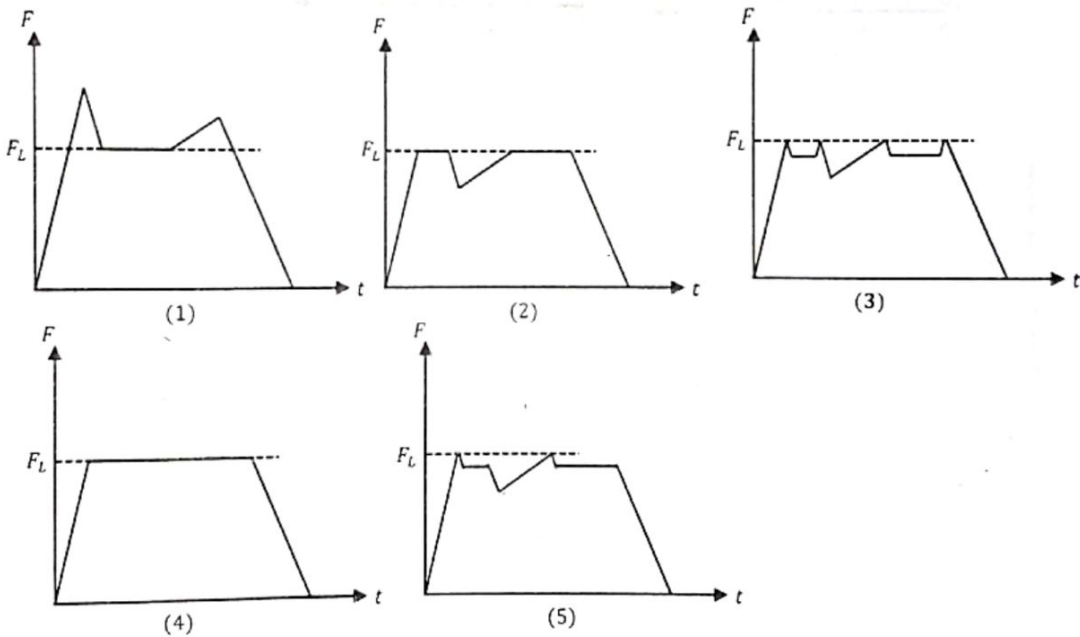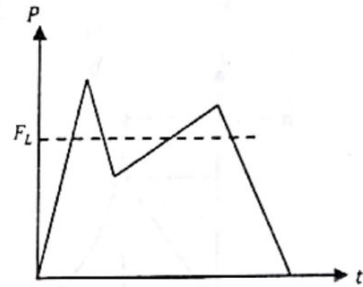
24) A load of weight W is at rest on a light bar AB of length L at distance a from A. Rod AB is horizontal. If the wedge on A and pulleys are smooth. What is the reaction at A ?

(1) $W\left(\frac{L-a}{L+a}\right)$ (2) $W\left(\frac{L+a}{L-a}\right)$ (3) $W\left(\frac{L-2a}{L+a}\right)$

(4) $W\left(\frac{L-a}{L+2a}\right)$ (5) $W\left(\frac{L+a}{L-2a}\right)$
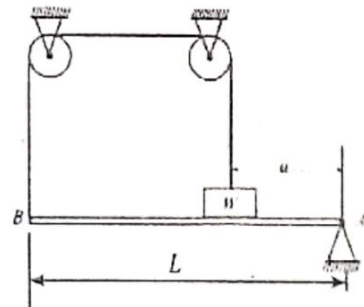
25) Figure shows the path of a light ray travelling from glass to air. If the critical angle between glass air interface is c, the graph denoting the variation of deviation angle d of the ray with incident angle i correctly is,
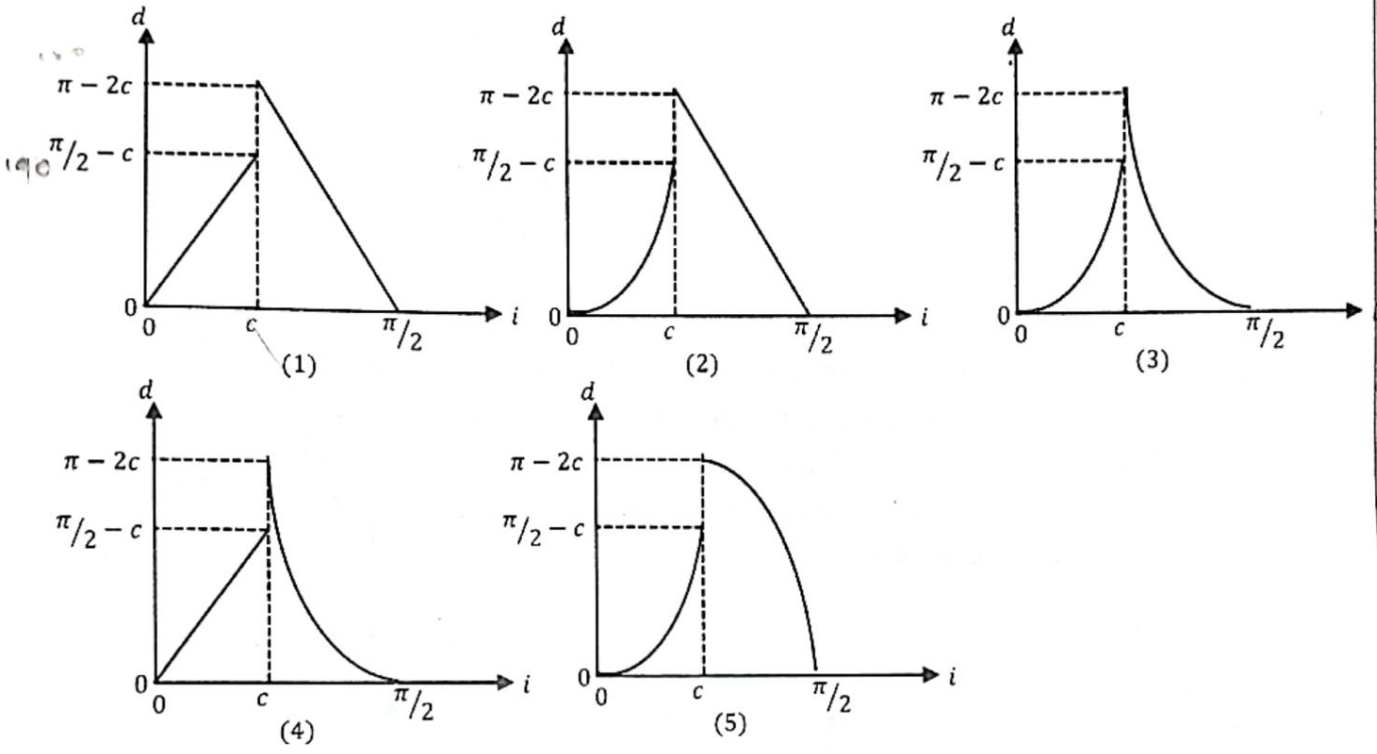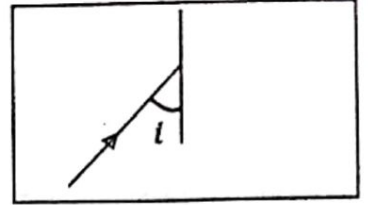
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FWC

வௌதிகவியல் Physics	Gr. 12 (2024)	01	E	II(B)

Part - B
Essay

➢ **Answer any two questions.**

01) (a) It is common that curvy roods are built with inward inclination to reduce dangers during travelling in vehicles. Figure 1 shows a car of mass m moving in a circular path of radius r in such a curve road with an inclination of θ with horizontal. The coefficient of friction between path and wheels of car is μ.
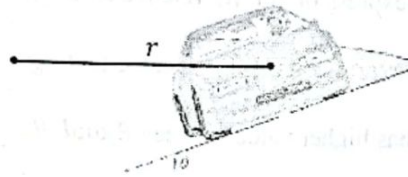

Figure (1)

(i) If the maximum speed of the car to avoid slipping upwards along the plane is V_m, mark the forces acting on the car considering that fig 2 is similar to fig 1 and copying fig 2 in your answer sheet.
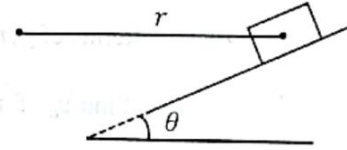(Assume that total normal reaction and frictional force for 4 tires are R and F respectively)

Figure (2)

(ii) Obtain an expression for the reaction force (R) acting on car's tires,

    1)   In terms of m, g, μ, θ

    2)   In terms of m, V_m, r, μ, θ

(iii) Obtain an expression for V_m in terms of r, g, μ, θ from the conclusion arrived in part (ii)

(b) Deduce the minimum speed V_m' of the car to avoid slipping downwards along the plane.
(You can deduce your answer from part a (iii) or should give sufficient explanations)

(c) Figure 3 shows a car of mass m moving in a circular path of radius r having O as the center with speed v on a rough horizontal path. Here G is the center of gravity of the car. $2a$ is the distance between two wheels. Reactions exerted by road on wheels inside (I) and outside(E) of the road are R_i and R_e respectively and frictional forces in I and E are F_i and F_e.

CamScanner

Figure (3)
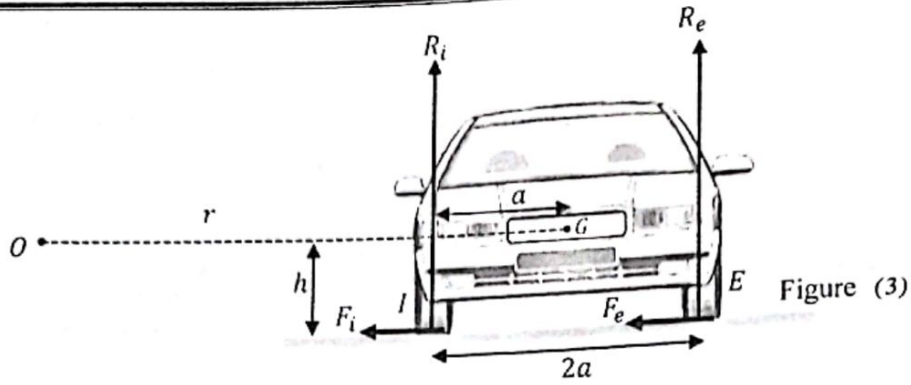
(i) Obtain an expression for $F_i + F_e$ in terms of m, v, r

(ii) Give an expression for $R_i + R_e$ in terms of m, g

(iii) Give $F_i + F_e$ in terms of h, R_i, R_e by considering the moment about G. Her h is the vertical height from land to G

(iv) (1) Find an expression for R_i relative to m, g, v, h, r, a

   (2) Find an expression for R_e relative to m, g, v, h, r, a

   (3) Which has higher value between R_i and R_e

   (4) Using the above conclusions regarding R_i and R_e find the maximum speed v_o that should be possessed by the car to move in a correct circular path and find v_o in terms of g, r, a, h

   (5) Find v_o if $r = 8m, a = 0.75m, h = 0.6m, g = 10ms^{-2}$

   (6) What can you say about the motion of the car at the instance where $v > v_o$

   (7) What are the modifications that can be done in the structure of the car to travel on the above circular path with the velocity greater than v_o?

02) This question is about waves and wave properties.

(a) The diagram below shows three wave fronts incident on a boundary between medium I and medium R. Wave front CD is shown crossing the boundary. Wave front EF is incomplete.
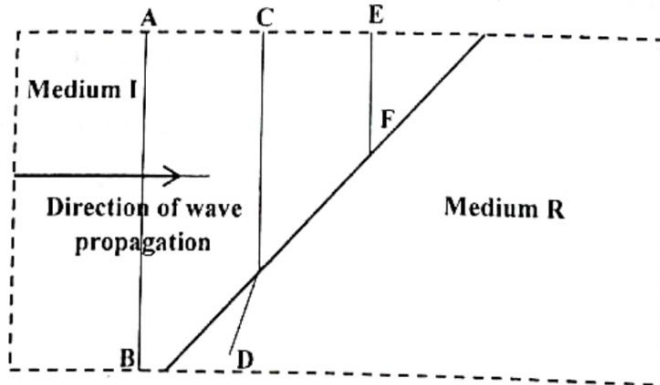

(i) Copy the above diagram in your answer sheet, and draw a line to complete the wave front EF.

(ii) Explain in which medium, I or R, the wave has the higher speed.

(iii) What is the direction and distance an eye defect person must move the eye piece to see the image of the cell at normal adjustment without wearing lenses? (Assume that the position of the object is not changed)

(iv) If a person with eye defects adjust the eye piece abnormally without wearing lenses. What is the distance between these lenses? (Assume that the position of the object is not changed)

04) (a) (i) Write the first law of thermodynamics in its usual symbols and identify the components

(ii) Give arguments for internal energy of a gaseous system depend only on temperature.

(b) (i) Give conditions for the following thermodynamic processes and write the thermodynamically equations for each process

(1) Isothermal process

(2) Adiabatic process

(3) Is volumetric process

(ii) Identify the quick and slow processes among the processes given in question b(i) above and explain reasons why they are considered as such.

➤ **Assume that all gases have ideal behavior when answering questions c, d**

(c) Variation of mean kinetic energy(E) of a certain mass of gas with pressure(p) during a thermodynamic process from R to S is given in the figure.
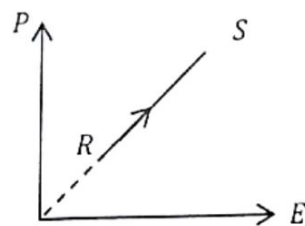
(i) Draw the graph for variation of absolute temperature with pressure of gas (P) giving appropriate explanation.

(ii) Draw graph for variation of volume(V) with pressure of gas(P) using the conclusion derived from question $(C)(i)$ above.

(iii) Identify the process RS from the graph drawn in question $(C)(ii)$ above

(d) The following graphs denote the variation of volume (V) with pressure(P) of three trapped, separate gaseous systems
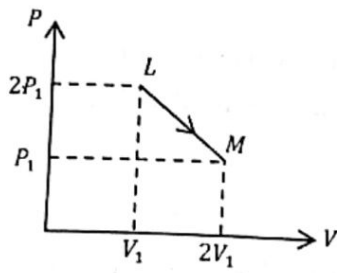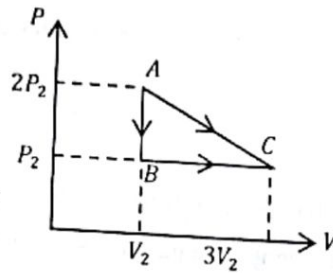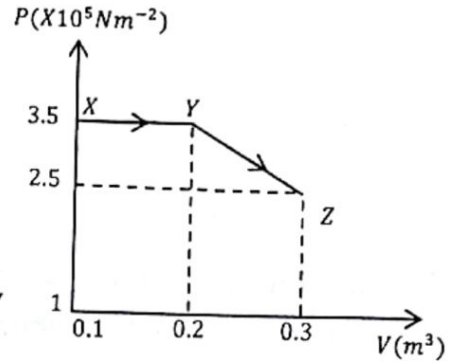

Figure (1)

Figure (2)

Figure (3)

(i) Find the internal energy during thermodynamic process LM in terms of P_1, V_1.

(ii) Obtain the heat energy given to the gaseous system during thermodynamic process LM in terms of P_1, V_1.

(iii) Obtain expressions for the works done during the processes AB, BC, CA in thermodynamic process $ABCA$ in terms of P_2, V_2 and find the heat transferred during the total process $ABCA$ in terms of P_2, V_2.

(iv) If the change in internal energy of the gas during process XYZ in figure (3) $30 kJ$, find the heat supplied to the system.