G.C.E. (Advanced Level) Examination - August 2008
PHYSICS - I
Two hours

Important :
- ✵ This question paper includes **60** questions in **07** pages.
- ✵ Enter your **Index Number** in the space provided on the answer sheet.
- ✵ **Answer all the questions.**
- ✵ Instructions are given on the back of the answer sheet. Follow them carefully.
- ✵ In each of the questions **1** to **60**, pick one of the alternatives (1), (2), (3), (4), (5) which is **correct or most appropriate** and mark your response on the answer sheet **in accordance with the instructions given therein.**

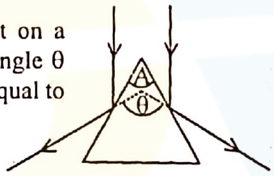
Use of calculators is not allowed.

$(g = 10 N kg^{-1})$

01. Dimensions of kilowatt-hour is
(1) $[M][L]^2[T]^{-2}$ (2) $[M][L][T]^{-1}$ (3) $[M][L]^2[T]^{-3}$
(4) $[T]$ (5) $[T]^{-1}$

02. Consider the following statements made regarding the action force and the reaction force.
(A) They are equal in magnitude.
(B) They act on the same object.
(C) They are opposite in direction to each other.
Of the above statements,
(1) only (A) is true. (2) only (A) and (B) are true
(3) only (A) and (C) are true (4) only (B) and (C) are true.
(5) All (A), (B) and (C) are true.

03. A parallel beam of light is incident on a prism as shown in the figure. The angle θ between the two reflected beams is equal to



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

04. When the tension in a guitar string is doubled without changing its length the frequency of a give tone will
(1) increase by a factor of 2.
(2) decrease by a factor of 2.
(3) increase by a factor of $\sqrt{2}$
(4) decrease by a factor of $\sqrt{2}$
(5) be the same.

05. A mass attached to one end of a vertical spring whose other end is fixed to a ceiling, is made to execute simple harmonic motion with amplitude a and maximum speed v. When the amplitude of the motion is increased to $2a$, the maximum speed will become.

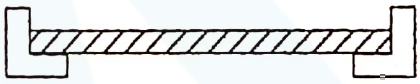
(1)4υ (2)2υ (3)υ (4) $\frac{\upsilon}{2}$ (5)$\frac{\upsilon}{4}$

06. Two ideal gases A and B having same value for the ratio of principal specific heat capacities are kept at the same tempera ture. Mass of a molecule of gas A is four times the mass of a molecule of gas B.
The ratio $\frac{\text{velocity of sound in gas A}}{\text{velocity of sound in gas B}}$ is equal to

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

07. A box of mass 5kg is placed on a horizontal surface. The coefficient of static friction between the box and the surface is 0.3. If a horizontal force of 10N is applied to the box, the magnitude of the frictional force acting on the box will be
(1)1.5 N (2) 3 N (3) 4.5 N (4)10 N (5) 15 N

08. A steel (Young' s modulus = E, linear expansivity = α) beam of cross sectional area A is clamped between two concrete sup ports as shown in the figure. When the temperature of the beam rises by ΔT, the force that must be exerted by the concrete supports to each end of the beam, in order to keep the beam without expanding is given by



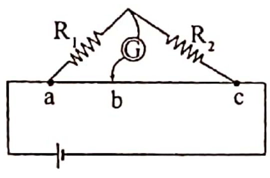
(1) $AE\alpha\Delta T$ (2) $\frac{AE}{\alpha\Delta T}$ (3) $\frac{AE\alpha}{\Delta T}$
(4) $\frac{AE\Delta T}{\alpha}$ (5) $E\alpha\Delta T$

09. The two lowest values of the resistance that can be obtained by combining four 1Ω resistors are

(1)0.25 Ω and 1.0Ω (2) 0.25 Ω and 1.33Ω
(3)1 Ω and 2Ω (4)1.2 Ω and 2.66 Ω
(5)1.33 Ω and 2.5 Ω

10. A galvanometer having an internal resistance of 200Ω produces full-scale deflection when a current of 5mA passes through it. In order to use this galvanometer as an ammeter which gives a full-scale deflection for 10A, the approximate value of the external resistance needed, and the way in which it should be connected with the galvanometer are
(1) 0.2 Ω, in series. (2) 0.2 Ω, in parallel.
(3) 2.0 Ω, in parallel. (4) 0.1 Ω, in series.
(5) 0.1 Ω, in parallel.

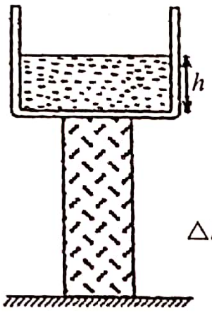
11. In the circuit shown ac is a uniform resistive wire of length lm. When the galvanometer reading is zero, the distance from point a to point b is 20 cm.
The ratio $\frac{R_1}{R_2}$ is



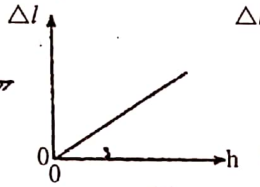
(1)5 (2)4 (3) $\frac{1}{4}$ (4) $\frac{1}{5}$ (5) $\frac{1}{10}$

12. A heating element draws a current of 10 A when connected to 240V powre source. The wattage of the element is
(1)2.4 w (2)24 w (3)240 w (4)2.4 kw (5) 24 kw

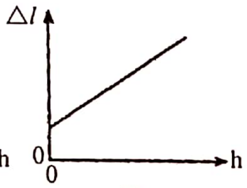
13. Blue and red light falling on a certain photocathode produce photoelectrons. Which of the following statements is true?
(1) Maximum kinetic energy of the emitted photoelectrons is higher for blue light.
(2) Stopping potential is higher for red light.
(3) Work function of the material of the photocathode is higher for blue light.
(4) Number of emitting photoelectrons is **always** higher for blue light.
(5) Stopping potential is same for both colours.

14. 

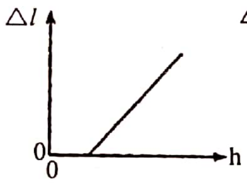
A water tank is constructed on a steel pillar of original length l_0 and water is filled up to a height h as shown in figure. The variation of the compression (Δl) of the pillar from its original length with the height of water level h is best represented by



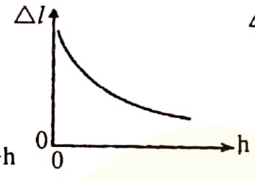
(1)



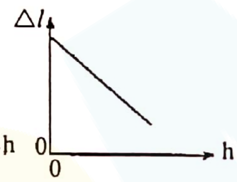
(2)



(3)



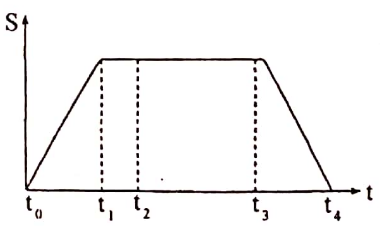
(4)



(5)

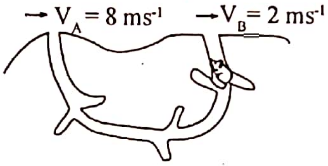
15. A blood vessel of length 0.1m has a radius of 1.0×10^{-3} m. Blood of viscosity 3.0×10^{-3} Pa s flows through the vessel at a rate of $1.0 \times 10^{-7} m^3 s^{-1}$. The pressure difference between the two ends of the vessel is (take $\pi = 3$)
(1) 80 Pa (2) 8 Pa (3) 0.8 Pa (4) 0.5 Pa (5) 0.1 Pa

16. Figure shows displacement (s) versus time (t) curve for a motion of a particle. Consider the following statements made about its motion.
(A) During the time period t_0 - t_1 the particle moves at a constant acceleration and during t_2 - t_3, it moves at a constant velocity.
(B) Particle comes to rest at time t_4.
(C) During the time period t_0 - t_4, the total distance travelled by the particle is equal to the area under the s - t curve.
Of the above statements,



(1) only (A) is true (2)only (A) and (B) are true.
(3)only (B) and (C) are true. (4)all (A), (B) and (C) are true.
(5) all (A), (B) and (C) are **false.**

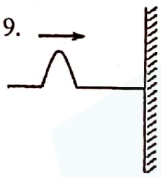
17. Figure shows a burrow of some animals living underground. The animals maintain the shapes of two entrances A and B to the burrow different from each other and because of this, air (density 1.3 kgm-3) blows past the openings at different speeds of $8 ms^{-1}$ and $2 ms^{-1}$ as shown in the figure. If the openings are at the same level, the difference in air pressure between the openings and the direction of the air-movement in the burrow are,



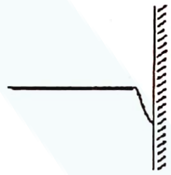
(1) 78 Pa and from B to A.
(2) 78 Pa and from A to B.
(3) 39 Pa and from B to A.
(4) 39 Pa and from A to B.
(5) 3.9 Pa and from B to A.

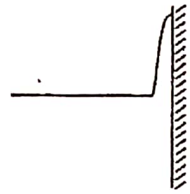
18. Both nodes and antinodes of a standing wave of period T have zero vertical displacements at time t_0. This will happen next at time.

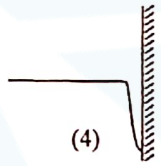
(1) $t_0 + \frac{T}{4}$ (2) $t_0 + \frac{T}{2}$ (3) $t_0 + \frac{3T}{4}$ (4) $t_0 + T$ (5) $t_0 + \frac{3T}{2}$

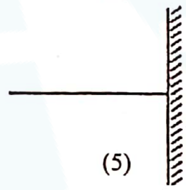
19. 
A symmetrical pulse shown in the figure is moving along a string towards a rigid boundary. Which of the following figures correctly shows the resultant pulse at the instant when exactly half of the pulse is reflected from the rigid boundary?


(1)


(2)


(3)


(4)

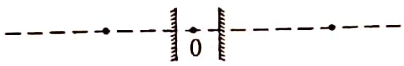

(5)

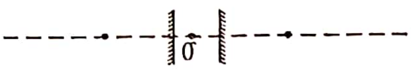
20. A box rests on the floor of an elevator. If the magnitudes of the minimum force required to slide the box on the floor when the elevator is stationary, accelerating upward, and accelerating downward are F_1, F_2 and F_3 respectively, then
(1) $F_2 > F_1 > F_3$ (2) $F_1 > F_2 > F_3$ (3) $F_3 > F_2 > F_1$
(4) $F_1 > F_3 > F_2$ (5) $F_1 = F_2 = F_3$

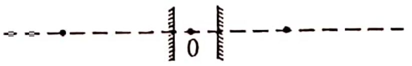
21. The far point of a near sighted eye is 50cm, in front of the eye. To see clearly objects at infinity a lens is worn 2 cm in front of the eye. The lens should be a
(1) converging lens with a focal length of 50 cm.
(2) converging lens with a focal length of 48 cm.
(3) diverging lens with a focal length of 52 cm.
(4) diverging lens with a focal length of 50 cm.
(5) diverging lens with a focal length of 48 cm.

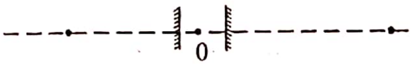
22. A point object O is placed between two parallel plane mirrors. which of the following diagrams shows the location of the second image formed by each mirror?

(1) 

(2) 

(3) 

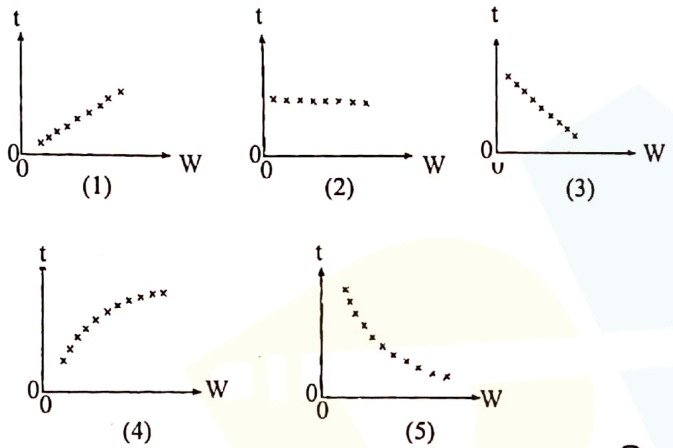
(4) 

(5) 

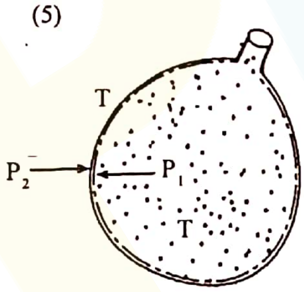
23. The planet Mars subtends as angle of 8.0×10^{-5} rad at an unaided eye. When Mars is viewed using an astronomical telescope in normal adjustment it subtends an angle of 2.4×10^{-3} rad at the eye. If the focal length of the eyepiece is 0.03m, the focal length of the objective is

(1) 0.001m (2) 0.01m (3) 0.5m (4) 0.9m (5) 1.0m

24. A set of identical kettles are fitted with heating coils of different wattages. If the kettles are used to boil same amount of water, which of the following curves best represents the variation of the time (t) that is required to raise the temperature of water up to its boiling point, with wattage (W) of the coils.



25. Consider a rubber balloon filled with air. Inside and outside pressures of the balloon are P_1 and P_2 respectively, and temperatures on either side remain the same. Which of the following statements is true?



(1) $P_1 = P_2$ as the temperatures on either side remain the same.
(2) $P_1 > P_2$ due to higher mean speeds of air molecules inside the balloon.
(3) $P_1 > P_2$ due to higher mean kinetic energy of air molecules inside the balloon.
(4) $P_1 > P_2$ due to higher rate of collisions of air molecules inside with the wall of the balloon.
(5) $P_1 > P_2$ due to lower mean kinetic energy of air molecules inside the balloon.

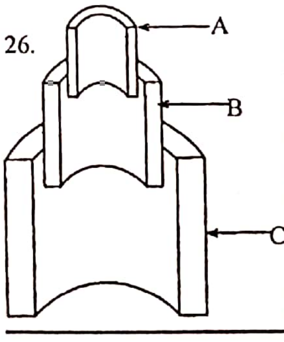
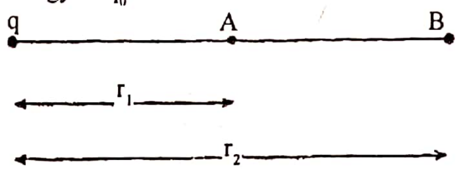
26. 

Figure shows a cross- sectional view of three hollow cylinders A, B and C made from different materials, lead, brass and steel. They barely fit one another at room temperature. If the cylinders are heated the cylinder C falls off, while cylinder A becomes tightly wedged to cylinder B.
If $\alpha_{lead} > \alpha_{brass} > \alpha_{steel}$, A, B and C cylinders are likely to be made of

	A	B	C
(1)	brass	lead	steel
(2)	steel	lead	brass
(3)	brass	steel	lead
(4)	steel	brass	lead
(5)	lead	brass	steel

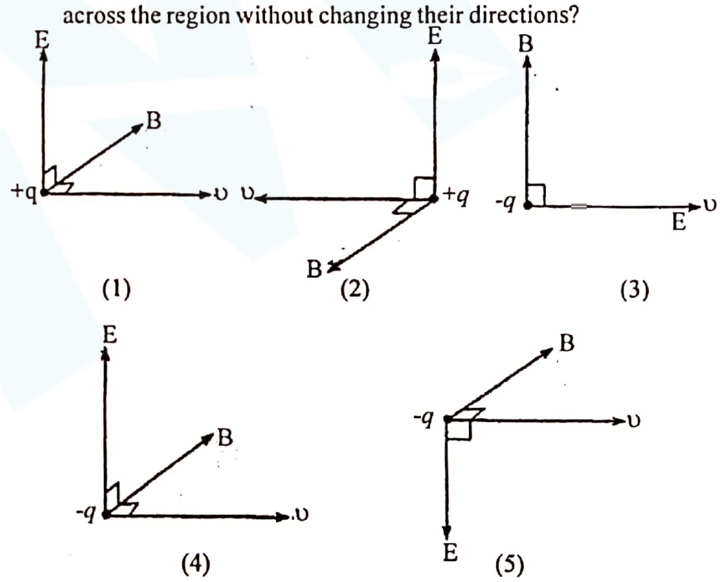
27. A point charge q_0 moves under the influence of the electric field created by another stationary point charge q. The change in the kinetic energy of q_0 when it moves from A to B is



(1) $\frac{qq_0}{4\pi\varepsilon_0}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$ (2) $\frac{qq_0}{4\pi\varepsilon_0}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$ (3) $\frac{qq_0}{4\pi\varepsilon_0}(r_1+r_2)$

(4) $\frac{qq_0}{4\pi\varepsilon_0}\left[\frac{1}{r_1^2}-\frac{1}{r_2^2}\right]$ (5) $\frac{q_0^2}{4\pi\varepsilon_0}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$

28. Diagrams below show situations where two charges +q and -q moving with a uniform velocity (υ) and separately entering five regions having a uniform electric field (E) and a uniform magnetic field (B). Vectors E and B are always perpendicular to each other, and the vector υ can be either perpendicular to E and b or parallel to E. Which of the following configurations may provide a possibility for charges to move across the region without changing their directions?



29. A spherical liquid drop has an electrical capacitance C_1 and another spherical drop made of the same liquid has a capacitance C_2. If these two liquid drops coalesce to form one spherical drop, the capacitance C of that drop is given by

(1) $C = C_1 + C_2$ (2) $C = \frac{C_1C_2}{C_1 + C_2}$ (3) $C = (C_1^3 + C_2^3)^{\frac{1}{3}}$

(4) $C = (C_1^2 + C_2^2)^{\frac{1}{2}}$ (5) $C = (C_1C_2)^{\frac{1}{2}}$

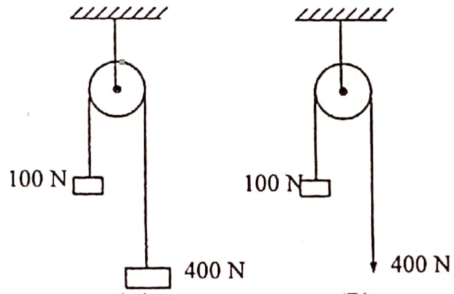
30. Two audio systems A and B produce sounds with intensity levels of 90dB and 95dB respectively. If the corresponding sound intensities are I_A and I_B respectively, the ratio of $\frac{I_B}{I_A}$ is equal to

(1) 500 (2) 100 (3) $\sqrt{50}$ (4) $\sqrt{10}$ (5) $\sqrt{5}$

31. When a ball of mass 0.1 kg is thrown vertically upward in a vacuum, it reaches a maximum height of 5.0m. When the ball is thrown upward with the same velocity in air it reaches a maximum height of 2.0m. The average resistive force exerted on the ball by the air is

(1) 1.5N (2) 1.25N (3) 1.0N
(4) 0.75N (5) 0.5 N

32. Figure (A) shows two blocks of weight 100N and 400N which are connected by a light string that passes over a frictionless pulley. Figure (B) shows a situation where the heavier block in the system is removed and the string is pulled by a downward force of 400N. The respective accelerations of the 100N block in the two situations are given by



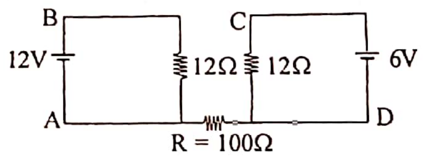
(A) (B)

(1) 0.6 m s^{-2} and 3m s^{-2}
(2) 6ms^{-2} and 6ms^{-2}
(3) 10ms^{-2} and 10ms^{-2}
(4) 6ms^{-2} and 40ms^{-2}
(5) 6ms^{-2} and 30ms^{-2}

33. Two voltmeters A and B having internal resistances 1500Ω and 13500Ω respectively are connected (a) in series, and (b) in parallel with an ideal battery of e. m. f 10V. Which of the following correctly indicates the voltages read by A and B?

	(a) when A and (B) are in series		(b) when A and B are parallel	
	reading of A (V)	reading of B (V)	reading of A (V)	reading of B (V)
(1)	10	10	10	10
(2)	1	9	10	10
(3)	10	10	9	10
(4)	9	10	1	9
(5)	1	9	9	10

34. In the circuit shown the batteries have negligible internal resistances. If V_A, V_B, V_C and V_D represent potentials at points A, B, C and D respectively of the circuit, then

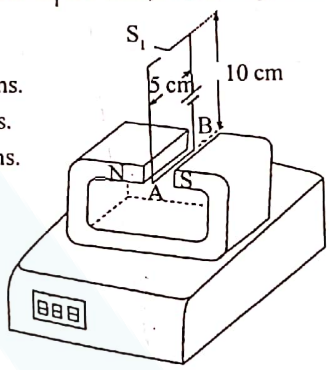


(1) $V_B - V_D = 18$ V
(2) $R_A \neq V_D$
(3) $V_B - V_C = \frac{6}{124}$V
(4) $V_A - V_C = -6$ V
(5) $V_A - V_D = 0$ only if R = 0

35. When a magnet is brought closer to three freely rotating discs A, B and C having same moment of inertia and same angular velocity, A is found to stop first followed by B, and C is found to rotate continuously. Which of the following is true?

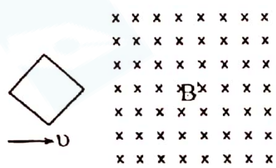
	Metal disc	Laminated metal disc	Plastic disc
(1)	C	A	B
(2)	C	B	A
(3)	A	B	C
(4)	B	A	C
(5)	B	C	A

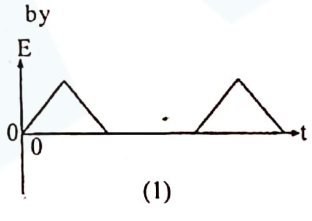
36. A magnet with magnetic flux density of 1.0 T between the poles is placed on an electronic balance. A rectangular wire loop of resistance 10Ω, which is connected to a 40V battery with zero internal resistance, is placed in between the poles of the magnet so that the side AB of the loop is completely inside the magnetic field and the plane of the loop is perpendicular to the magnetic field, as shown in the figure. The loop is firmly fixed to avoid any movement. When the switch S_1 is closed, the reading of the electronic balance.



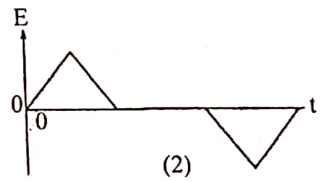
(1) will decrease by 200 grams.
(2) will decrease by 20 grams.
(3) will increase by 200 grams.
(4) will increase 20 grams.
(5) will not change.

37. A conducting wire loop bent in the shape of a parallelogram enters a uniform magnetic field with a constant speed as shown in the figure. The variation of the induced e.m.f (E) in the loop with time (t) is best represented by

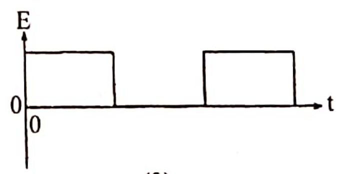




(1)



(2)



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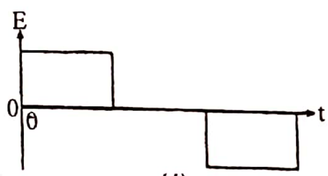
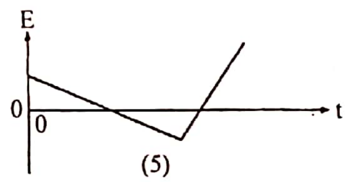


(4)



(5)

38. The temperature of a sunspot is 4000K while the surrounding solar surface is at 6000K. The ratio

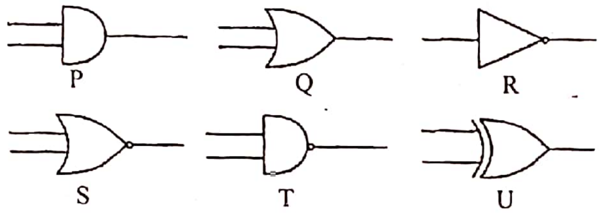
$$\frac{\text{The intensity of the sunspot}}{\text{The intensity of the surrounding solar surface}}$$

is (assume that the surface emissivity is the same throughout the sun's surface.)

(1) $\frac{2}{3}$ (2) $\frac{1}{2}$ (3) $\frac{4}{9}$ (4) $\frac{8}{27}$ (5) $\frac{16}{81}$

39. When an atom of a radioactive element emits a β^- Particle, it is transformed into an atom of a different element. A different element is formed in this manner because,
(1) the nucleus of the radioactive element emits a proton.
(2) the nucleus of the radioactive element gains a neutron.
(3) a proton in the nucleus of the radioactive element changes into a proton.
(4) a neutron in the nucleus of the radioactive element changes into a proton.
(5) the radioactive atom emits one of its electrons from an outer orbit.

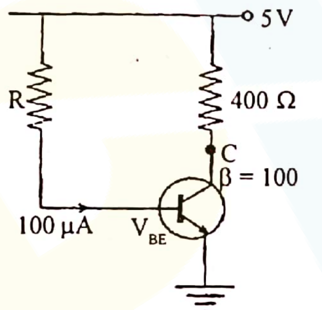
40. Which of the two gates shown can be combined to construct a circuit in order to obtain a binary output of 1 for input binary digit combinations of 00 and 11 only?



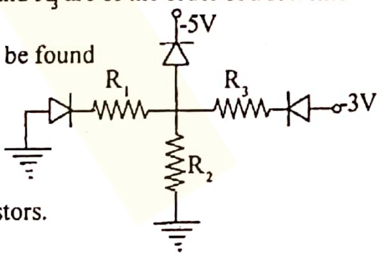
(1) P and R (2) P and Q (3) R and U
(4) S and R (5) T and Q

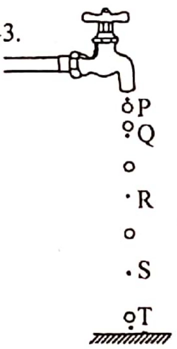
41. In the circuit shown base current to the transistor is 100μA, and $V_{BE} = 0.7V$. If the current gain of the transistor is 100, then the voltage at C is

(1) 0.1V (2) 1V
(3) 2V (4) 4V
(5) 5V



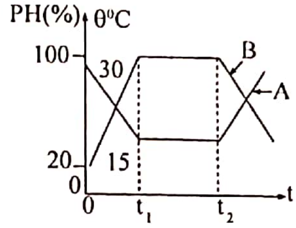
42. In the circuit shown R_1, R_2, and R_3 are of the order of a few kilo ohms.
An appreciable currents can be found
(1) only through R_1 and R_3
(2) only through R_2 and R_3
(3) only through R_1 and R_2
(4) through all R_1, R_2 and R_3
(5) through none of the resistors.

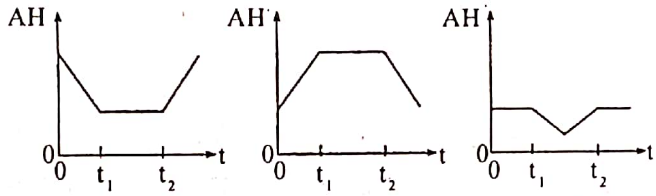


43. 

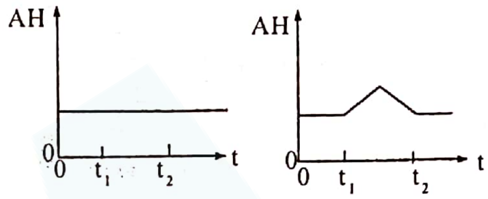
Water droplets drip at a constant rate from a tap as shown in the figure. The centre of gravity of the system of drops in the air is most likely to be found at
(1) P
(2) Q
(3) R
(4) S
(5) T

44. When the temperature (θ) of air inside a closed room is varied with time (t) according to the curve A shown in figure, its relative humidity (RH) is found to vary with time according to the curve (B). The corresponding variation of the absolute humidity (AH) of air inside the room with time (t) is correctly represented by



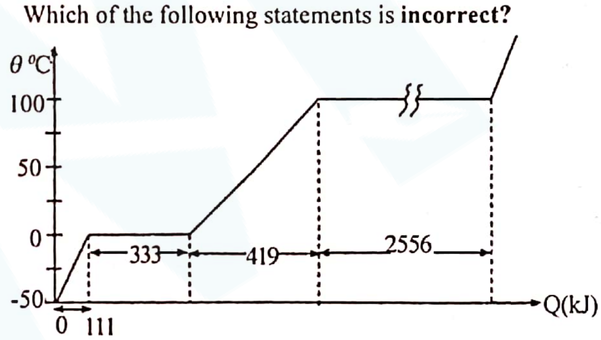


(1) (2) (3)



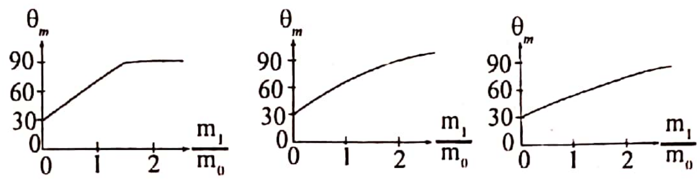
(4) (5)

45. The figure shows the amounts of heat, Q, (in kJ) absorbed by 1kg of ice under each of the states when it is heated from temperature - 50°C to 100°C.
Which of the following statements is **incorrect?**

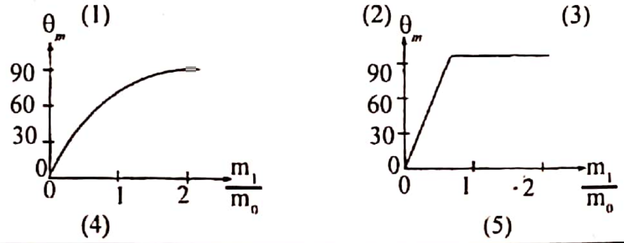


(1) Specific latent heat of fusion of ice is 333×10^3 J kg^{-1}.
(2) Specific latent heat of vaporization of water is 2256×10^3 J kg^{-1}
(3) Specific heat capacity of ice is 1110J kg^{-1} °C^{-1}
(4) Specific heat capacity of ice is less than that of water
(5) Specific heat capacity of water is 4190J kg^{-1} °C^{-1}

46. A vessel of negligible heat capacity contains water of mass m_0 at the room temperature of 30°C. when a mass m_1 of water at 100 °C is added to the vessel, the maximum temperature of the mixture becomes θ_m (neglect heat losses). The variation of θ_m with $\frac{m_1}{m_0}$ is best represented by

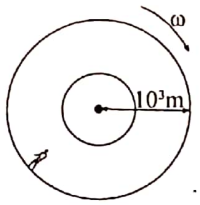


(1) (2) (3)



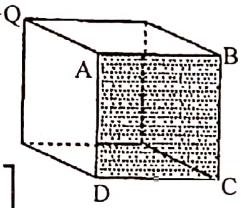
(4) (5)

47. Figure shows a space colony of radiue 10^3 m, rotating about its axis. At what angular speed (ω) must the space colony be rotated so that an astronaut standing on the floor of the colony experiences a push on his feet that equals his weight on the Earth?



(1) 0.1 rad s^{-1} (2) 1 rad s^{-1}
(3) 2 rad s^{-1} (4) 5 rad s^{-1}
(5) 10 rad s^{-1}

48. A point charge +Q is placed at one of the corners of a cube as shown in the figure. The electric flux through the surface ABCD of the cube due to the charge is



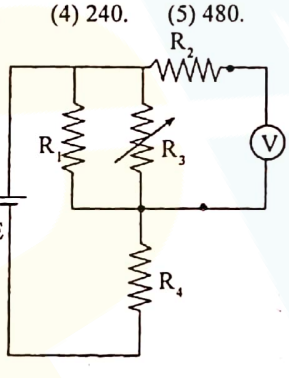
(1) $Q\left[\text{or } \frac{Q}{\varepsilon_0}\right]$ (2) $\frac{Q}{4}\left[\text{or } \frac{Q}{4\varepsilon_0}\right]$

(3) $\frac{Q}{6}\left[\text{or } \frac{Q}{6\varepsilon_0}\right]$ (4) $\frac{Q}{24}\left[\text{or } \frac{Q}{24\varepsilon_0}\right]$ (5) $\frac{Q}{36}\left[\text{or } \frac{Q}{36\varepsilon_0}\right]$

49. A radio is powered by six 1.5V batteries, connected in series, whose internal resistance can be neglected. A single battery can provide a charge of 9600°C. If the batteries treat the radio as a resistance of 270Ω at a certain sound level, the number of hours the radio can be operated at this sound level is

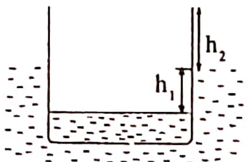
(1) 60. (2) 80. (3) 90. (4) 240. (5) 480.

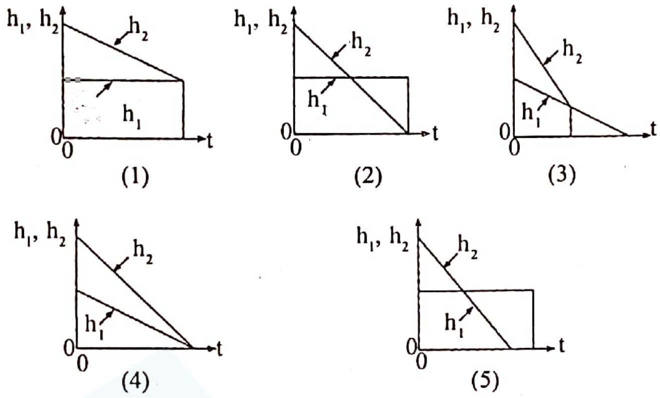
50. In the circuit shown E represents the e.m.f of a cell of negligible internal resistance. R_1, R_2 and R_4 are finite resistances. V is an ideal voltmeter connected across a variable resistance R_3. If the value of R_3 varies from zero to infinity, which of the following terms correctly predicts the readings of V when $R_3 = 0$ and $R_3 \to \infty$?



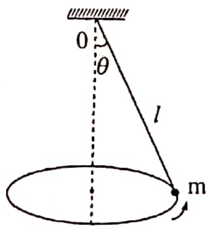
	When $R_3 = 0$	When $R_3 \to \infty$
(1)	0	$\left[R_4+\frac{R_1 R_2}{R_1 R_2}\right]E$
(2)	$\left[\frac{R_1}{R_1+R_4}\right]E$	$\left[\frac{R_4}{R_1+R_4}\right]E$
(3)	0	$\left[\frac{R_1}{R_1+R_4}\right]E$
(4)	$\left[\frac{R_1+R_2}{R_1+R_4}\right]E$	$\left[\frac{R_1}{R_1+R_4}\right]E$
(5)	0	$\left[R_1+\frac{R_4 R_2}{R_4+R_2}\right]E$

51. A thin walled cylindrical vessel is floating in a lake. At time t = 0, a small hole is made at the bottom of the vessel and water is allowed to flow into the vessel at a constant rate so that the vessel immerses with a constant velocity. If h_1 is the difference in heights of the water levels inside and outside the vessel and h_2 is the height of the brim above the outside water level at time t, which of the following curves best represents the variation of the heights h_1 and h_2 with time (t) until the vessel is fully immersed?





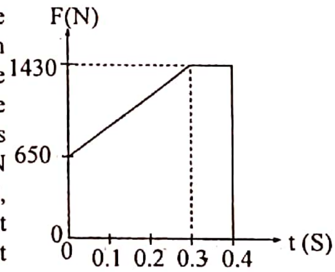
52. A small object of mass m is suspended by a string of length l, and is allowed to move in a horizontal circular path about the vertical axis passing through O, as shown in figure, If the air resistance can be neglected, the speed of the object will be given by



(1) $\sqrt{lg \sin\theta \tan\theta}$ (2) $\sqrt{lg \sin\theta \cos\theta}$ (3) $\sqrt{lg \tan\theta}$

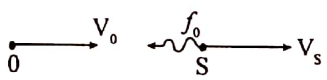
(4) $\sqrt{lg \sin\theta}$ (5) $\sqrt{lg \cos\theta}$

53. Figure shows the variation of the force (F) exerted by the floor on the feet with time (t) when a person jumps vertically upwards. The force (F) increases from a value which is equal to the person's normal weight of 650N to 1430 N in 0.3s, stays constant for 0.1s, and then drops to zero as the feet lose contact with the floor. At what speed did the person leave the floor?



(1) 1ms^{-1} (2) 1.5ms^{-1} (3) 2ms^{-1}
(4) 3ms^{-1} (5) 10ms^{-1}

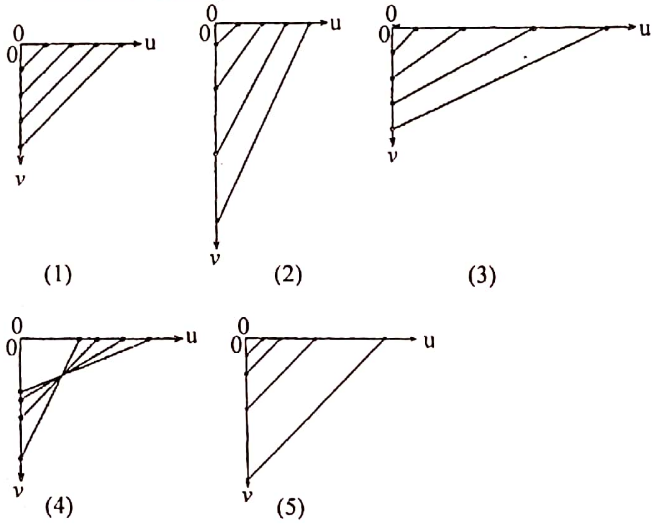
54. A source of sound (S), moving with velocity V_s, emits a sound wave of frequency f_0. An observer (O) moving with velocity V_0, as shown in the figure, determines the frequency of the sound as f'. which of the following statement is true?



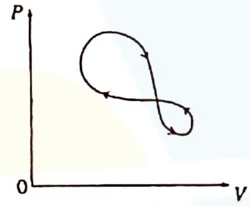
(1) If $V_s = 60$ ms^{-1} and $V_0 = 20$ ms^{-1} then $f' > f_0$
(2) If $V_s = 20$ ms^{-1} and $V_0 = 60$ ms^{-1} then $f' < f_0$
(3) If $V_s = -20$ ms^{-1} and $V_0 = -60$ms^{-1} then $f' > f_0$
(4) If $V_s = -60$ ms^{-1} and $V_0 = -20$ ms^{-1} then $f' > f_0$
(5) If $V_s = 60$ ms^{-1} and $V_0 = -20$ ms^{-1} then $f' > f_0$

55. For real images produced by a convex lens, values of object distance (u) and image distance (v) are marked on the u-axis and v

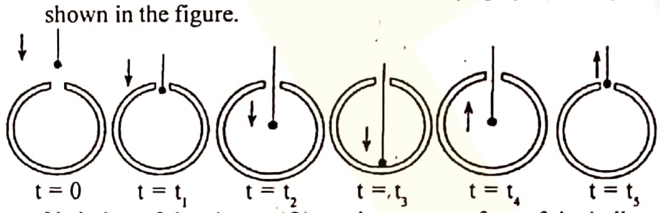
- axis respectively. Which of the following best represents the correct pattern when the corresponding u and v points are connected by straight lines?



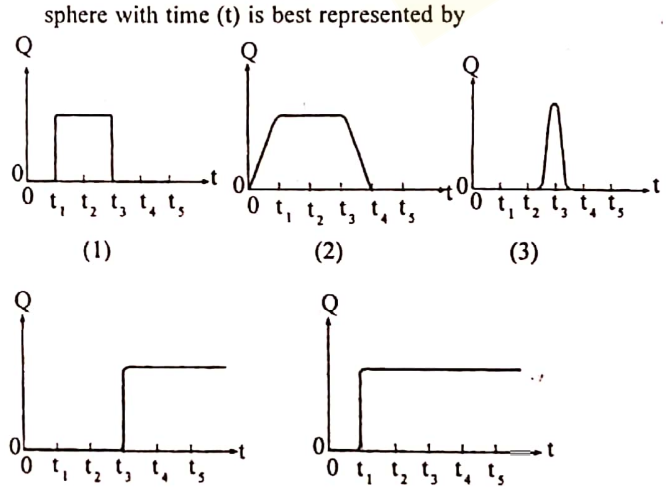
56. An ideal gas undergoes a cyclic process as shown in the figure. Consider the following statements.
(A) Over a complete cycle a net work is done by the gas.
(B) Over a complete cycle a net heat goes out of the gas.
(C) The temperature of the gas remains unchanged throughout the cycle.
Of the above statements,
(1) only (A) is true
(2) only (B) is true
(3) only (A) and (B) are true
(4) only (B) and (C) are true
(5) all (A), (B) and (C) are true



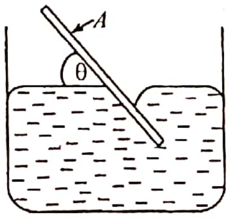
57. A small metal ball, suspended by a insulating thread and carrying a charge q is inserted gradually into an uncharged, conducting hollow sphere through a small hole until it touches the bottom and then in is removed in the same manner. Positions of the metal ball different times t = 0, t_1, t_2, t_3, t_4 and t_5 are shown in the figure.



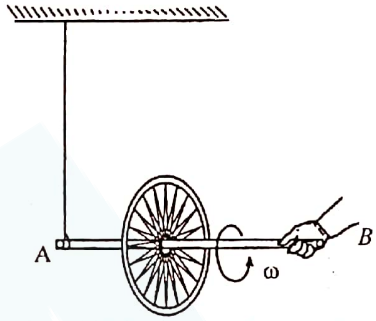
Variation of the charge (Q) on the outer surface of the hollow sphere with time (t) is best represented by



58. Figure shows a glass plate A dipped in a liquid. If the glass plate makes an angle θ with the horizontal, the angle of contact of the liquid with glass is
(1) 0
(2) θ
(3) 90° - θ
(4) 180° - θ
(5) 90° + θ

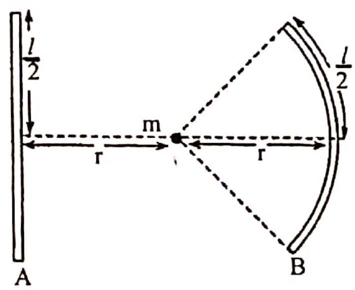


59. The figure shows a bicycle wheel, which is rotating with large angular velocity ω about the axle AB, hung from a string connected to the end A and holding from end B. If it is released from end B,



(1) the end B will fall down and the axle AB becomes vertical.
(2) the direction of AB remains unchanged.
(3) the axle will rotate about the vertical axis through A, while AB remains approximately horizontal.
(4) the end B will fall down and the wheel will start to oscillate like a pendulum.
(5) the end B will move upward first and then fall down and will start to oscillate like a pendulum.

60. A is uniform metal rod of length l and mass M. The rod B is formed by bending another rod, which is identical to A, to form an arc of a circle of radius r. A point mass m has been placed in between A and B as shown in the figure.
If F_A is the magnitude of the gravitational force on m by A, and F_B is the magnitude of the gravitational force on m by B, then



(1) $F_A = F_B = \frac{GMm}{r^2}$
(2) $F_B < F_A = \frac{GMm}{r^2}$
(3) $F_A < F_B = \frac{GMm}{r^2}$
(4) $F_A < F_B < \frac{GMm}{r^2}$
(5) $F_B < F_A < \frac{GMm}{r^2}$

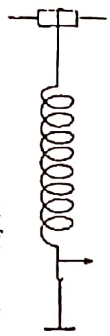
G.C.E. (Advanced Level) Examination - August 2008

PHYSICS - II

Three hours

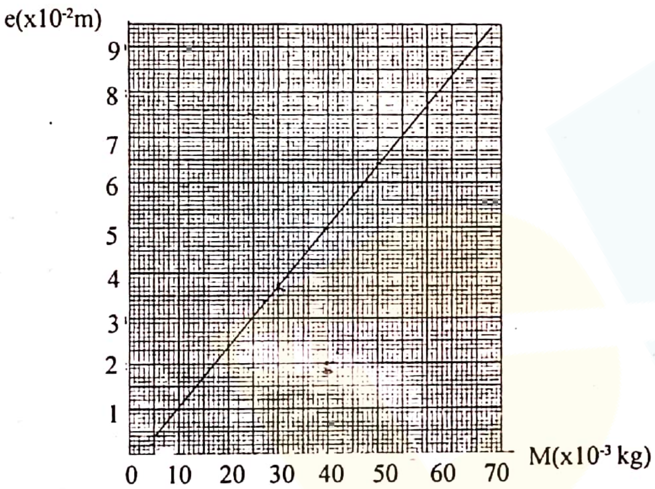
Answer all four questions. **PART A - Structured Essay** $[g = 10\ \mathrm{N\,kg^{-1}}]$

01. Figure shows a spring whose upper end is firmly clamped to a rigid stand, and a light pointer attached to its lower end. You are to determine the spring constant (k) of the spring. A set of standard weights and a metre ruler are provided.



(a) Draw the metre ruler on the figure at its correct poition in order to measure the extension (e) of the spring.

(b) The extension (e) versus load (M) graph for such a spring is shown below.



(i) Determine the spring constant k of the spring in k gm^{-1}.

....

....

....

(ii) Clearly indicate on the graph the two points which you have used to determine k.

(c) The spring with a load M attached is set in vertical oscillations by giving a small displacement. The period (T) of the oscillations is given by

$$T = 2\pi\sqrt{\frac{M + \frac{m}{3}}{kg}}$$ where m is the mass of the spring.

(i) Rearrange the above expression in the **most suitable** manner to draw a graph in order to determine the acceleration due to gravity (g) and mass (m) of the spring.

....

....

(ii) What additional instrument do you need to take measurements in this experiment?

....

(iii) What quantities would you extract from the graph to determine g and m?

To determine g : ....

To determine m : ....

(d) If the percentage error of M values is 1%, how many oscillations would you need to take in order to match the percentage error of T also to 1%? (Fractional error of T is $\frac{2\Delta T}{T}$, and error in time measurement is 0.1s. Take T = 2s).

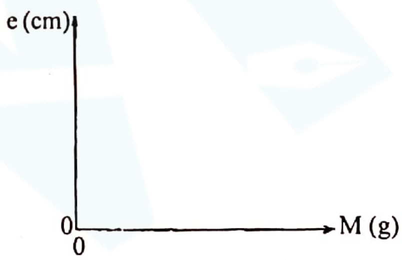
....

....

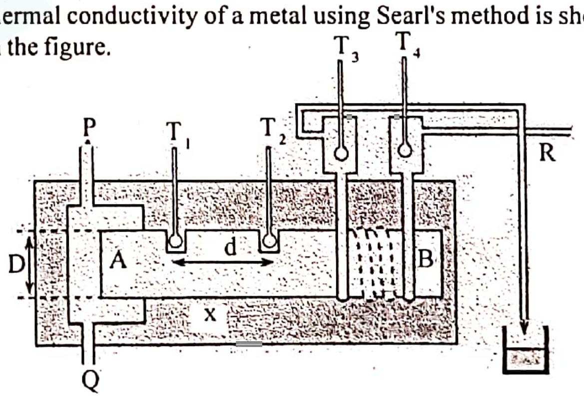
....

....

(e) A student used a brand new spring whose turns are **pressed against each other** to draw the graph mentioned in (b) above. On the Figure given below, sketch the shape of the graph that you would expect in this situation.



02. A part of an experimental setup that is used to determine the thermal conductivity of a metal using Searl's method is shown in the figure.



(a) Draw a figure of the apparatus that you need to connect to tube R, in the **appropriate place** of the space in front of R. Clearly show haw you would connect the apparatus to R.

(b) What additional instruments are essential in order to perform this experiment?

....

....

(c) End A of the metal bar is heated using steam. Give **two** reasons as to why it is better to send steam through tube P rather than sending through tube Q.

(i) ....

(ii) ....

(d) How do you observe whether the system has reached the steady state?

....

....

(e) How do you achieve a good thermal contact between thermometers T_1, T_2 and the metal bar?

....

....

(f) You are provided with the following set of date related to this experiment.

Reading of the thermometer	T_1 (θ_1)	= 75.0°C
Reading of the thermometer	T_2 (θ_2)	= 61.0 °C
Reading of the thermometer	T_3 (θ_3)	= 37.0 °C
Reading of the thermometer	T_4 (θ_4)	= 28.0 °C
Mass of water collected in 3.0 minutes (M)		= 0.4kg
Cross sectional area of the metal rod (A)		= 1.2×10^{-3} m^2
Distance between the thermometers T_1 and T_2 (d)		= 0.08 m
Specific heat capacity of water (s)		= 4200J kg^{-1} K^{-1}

Calculate the thermal conductivity of metal.

....

....

....

(g) Space X is filled with a good thermal insulator such as polystyrene to reduce the heat loss from the metal bar. Thermal conductivity of air is 0.025Wm^{-1}K^{-1} and that of polystyrene is 0.08 Wm^{-1} K^{-1} which implies that air is a good thermal insulator than polystyrene. Explain why it is still better to fill the space X with polystyrene rather than having air.

....

....

03. (a) Two monochromatic rays of light with angles of incidence $\theta_1(>\theta_C)$ and θ_2 $(<\theta_C)$, where θ_C is the critical angle of glass, are falling on a glass-air interface as shown in figure 1. Complete the paths of the rays.

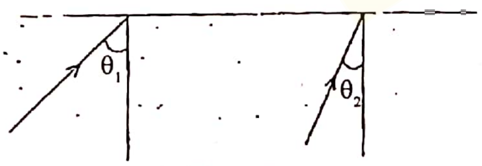


Figure 1

(b) You are asked to determine the critical angle of glass by the method of total internal reflection. A prism is placed on a whits sheet of paper, in such a way that a vertical pin (M) is in contact with face AC of the prism as shown in figure 2. The boundaries of the faces of the prism are drawn on the paper.

(i) In this experiment the pin M has to be placed in contact with face AC. State the reason for this.

....

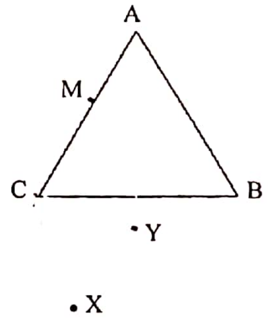


Figure 2

(ii) When you move your eye from B to C while looking through face BC towards AB what change of the image of the pin M do you expect to observe?

....

....

(iii) How do you detect path of the relevant emergent ray experimentally using two other pins? The locations of the two pins are marked as X and Y in the figure 2.

....

....

(iv) Write down the remaining steps in the order that you would follow to construct ray diagram.
Use figure 2 also to illustrate the steps in the construction of the ray diagram.

....

....

....

....

....

....

(v) What measurement would you take from the ray diagram? Also clearly indicate it on the ray diagram.

....

(c) You are asked to modify and repeat this experiment to determine the critical angle for glass - water interface by forming a thin layer of water on the surface AB as shown in figure 3.

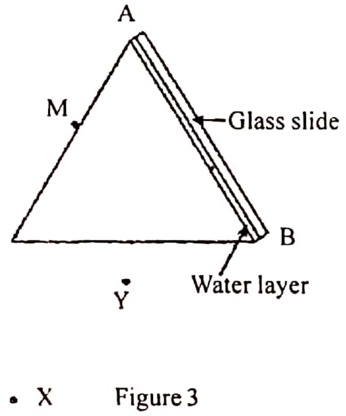


Figure 3

(i) Where would be the new location of the image of pin M relative to the image obtained in part (b) above.

....

(ii) Draw the new emergent ray in figure 3 relative to X and Y and label it as $X'Y'$.

(d) Critical angles determined in part (b) and part (c) above are C_1 and C_2, respectively. Find an expression for the refractive index of water in terms of C_1 and C_2.

....

....

....

04. A moving coil galvanometer with coil resistance R_G produces full scale deflection when a current of I_0 is passed through it.

(a) Write down an expression for the voltage (V_0) appearing across the terminals of the galvanometer in terms of R_G and I_0 when it shows a full scale deflection.

....

(b) When a voltage (V_1) which is less than V_0 is appeared across the galvanometer it produces a deflection θ. If θ_m is the full scale deflection of the galvanometer, write-down an expression for V_1 in terms of θ, θ_m and V_0.

....

....

(c) This galvanometer is to be converted to a voltmeter giving full scale deflection for a voltage V_2 which is much larger than V_0. If you are provided with a resistor having the suitable value R_1 show by drawing a diagram how you would connect this resistor to the galvanometer.

(d) Write down an expression for R_1 in terms of V_2, I_0 and R_G.

....

....

(e) If $R_G = 20\ \Omega$ and $I_0 + 10$ mA find the value of the resistance R_1 necessary to convert this galvanometer to a voltmeter which gives a full scale deflection for 1V.

....

....

(f) Also calculate the values of resistances R_2 and R_3 that are necessary to convert this galvanometer to voltmeters which give full scale deflection for 10V and 50V respectively.

....

....

....

(g) Using the resistance values calculated in (*e*) and (*f*) and the galvanometer mentioned above, draw a circuit diagram of a multi-range voltmeter which can be used to measure voltages in three different ranges of 0 - 1V, 0 - 10V and 0 - 50V. Use a 3-way switch to select ranges.

(h) If this voltmeter is used in the 0-10V range to measure a voltage of the order of 5V appearing across a 2000 Ω resistor, would you expect to obtain the actual value? Explain your answer.

....

....

....

PART B - Essay

Answer four questions only $[g = 10\ N\ kg^{-1}]$

01.

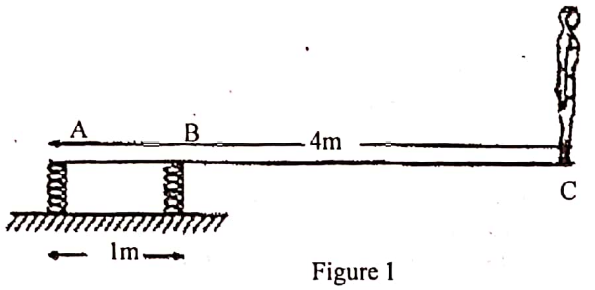


Figure 1

(a) A diver of mass 50kg is standing at the end (C) of a 4 m long horizontal diving board (AC) of negligible mass, mounted on two vertical springs, 1m apart, at A and B as shown in figure 1. Find the magnitude and direction of the forces acting on the board at A and B by springs.

(b) The diver performs a dive. Consider the motion of the centre of gravity (G) of the diver. Its path in indicated by a dotted line as shown in figure 2. The point G which is 4 m above the water surface at the beginning of the dive, enters the water surface at Y after completing the path in 2s. $XY = 2$ m. (Neglect air resistance.)

(i) Find the horizontal and vertical components of the initial velocity of G.

(ii) Calculate the maximum height reached by G from the water surface.

(iii) Calculate the following at the highest point of the path of the diver.

(1) The translational kinetic energy.

(2) The gravitational potential energy relative to the water surface.

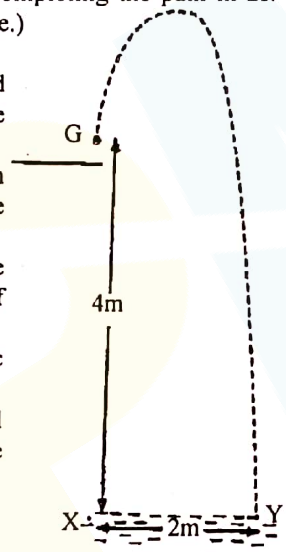
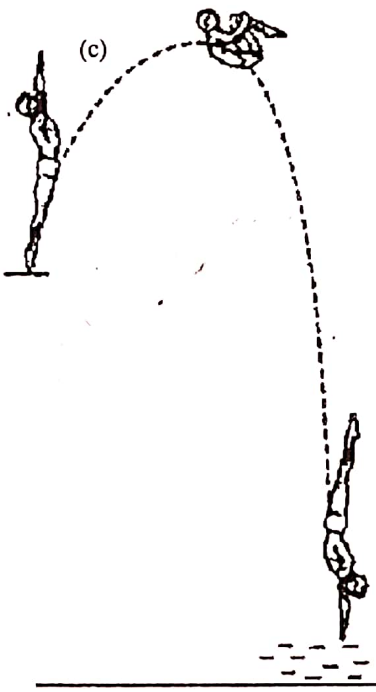


Figure 2

(c)



Diver also performs rotational motion about an axis (take as OP into the paper) passing through G. He controls his rotational motion by bending/ extending his body to change the moment of inertia of the body. During the first 0.25s and last 0.75s of the motion the diver maintains his body in fully extended Position and during the rest of the time period of 1 s he maintains his body in tucked position. See figure 3.

(Take $\pi = 3.0$) The diver rotates around OP at a rate of 0.5 revolutions per second during first 0.25s.

(i) find the angular speed (ω_1) of the diver during first 0.25s.

If the diver rotates $2\frac{1}{2}$ revolutions around OP during the total time period of 2s find.

(ii) the angular speed (ω_2) when the diver is in fully tucked position.

(iii) The moment of inertia of the diver about OP in the fully tucked position. The moment of inertia of the diver about OP in fully extended position is 20 kg m^2.

(iv) the rotational kinetic energy of the body when the diver is in fully extended position

02.

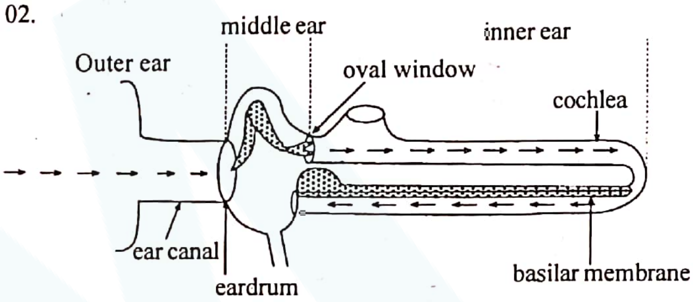


Figure 1

The ear converts the energy of sound waves into electrical energy. Therefore, the ear can be considered as a pressure transducer. The ear is divided into three parts, outer, middle and inner ear depending upon the role they play in response to incident sound. A crossectional view (simplified) of the ear is shown in figure 1.

The outer ear consists of an external auditory canal. It is open to atmosphere at one end and terminates at the eardrum at the other end. The auditory canal is 2.5 cm long, and the area of eardrum is $80mm^2$. The auditory canal is equivalent to an organ pipe closed at one end. The ear is the most sensitive to sounds of frequencies around 3000Hz. The minimum intensity of sound which the ear can detect is $10^{-12}Wm^{-2}$. Sound intensity level of 160dB may rupture the eardrum. The intensity (I) of a sound wave, expressed in terms of ist pressure amplitude (P_m), is given by $I = \frac{P_m^2}{2\upsilon\rho}$ where is υ the speed of sound in air and ρ is the density of air.

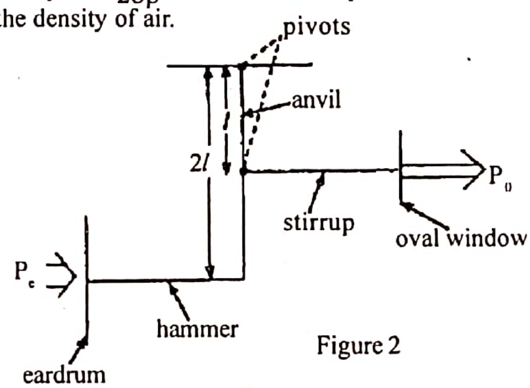


Figure 2

The important parts of middle ear are three small linked bones, called the hammer, the anvil and the stirrup, because of their respective shapes. These three bones function as a lever system. Its one arm, hammer, is coupled to the eardrum. Its other arm, stirrup, is coupled to the oval window (area 4 mm^2) of the inner ear. A schematic representation of the lever and piston action of the middle ear is shown in figure 2.

The inner ear consists of a small spiral shaped tube called cochlea, filled with a fluid. In the figure 1, the cochlea is shown in 'straightend' form.

The cochlea is divided lengthwise into three canals which are separated from each other by membranes. As the pressure wave passes along the first canal it causes transverse displacements of the basilar membrane which separates the second canal from the third canal. It has been found that the basilar membrane is made of thousands of parallel fibres which run across it. The fibres of the basilar membrane towards the base of the cochlea are short and stiff. They vibrate very rapidly and are sensitive to high notes. In contrast, the fibres of the basilar membrane towards the apex of the cochlea are long and more flexible. Therefore they vibrate more slowly and are sensitive to low notes. This is how the inner ear resolves frequencies.

(a) What is the reason for treating the ear as a pressure transducer?

(b) (i) Around what sound frequency does the ear most sensitive?

(ii) Considering the auditory canal to be an organ pipe closed at one end, calculate its fundamental resonant frequency (speed of sound in air is 330m s^{-1})
Hence justify your answer given is (b) (i).

(iii) When the auditory canal resonates, is the pressure variation of the standing wave at the eardrum maximum or minimum? Give the reason for your answer.

(c) (i) Consider sound waves with intensity 10^{-12} W m^{-2}. Determine the corresponding pressure amplitude of the sound waves. (density of air is 1.25kg m^{-3} ; Take $\sqrt{33} = 5.5$)

(ii) Using the answer obtained in (c) (i) above, determine the force (F_e) acting on the eardrum.

(iii) Considering the lever action of the three bones, determine the force (F_0) generated on the oval window. (Use the data given in fig. 2 for this calculation.)

(iv) Hence calculate the pressure amplitude (P_0) on the oval window. Determine the factor by which the pressure is amplified.

(d) (i) How much sound intensity level might rupture the eardrum?

(ii) What intensity of sound does this correspond to?

(e) 'Higher frequencies stimulate the base region while lower frequencies stimulate the apex region of the basilar membrane.' Considering the fibres in the basilar membrane as uniform strings under tension justify the above statement.

03. Poiseuille's equation can be written as $Q = \dfrac{\pi \Delta p . r^4}{8 \eta l}$
Identify each physical quantity in the above equation.

(a) Show that the above equation is dimensionally correct.

(b) Crude oil of viscosity 0.9 kg $m^{-1}s^{-1}$ and density 9.0×10^2kg m^{-3} has to be delivered from a harbour to a refinery, using a straight horizontal metal tube of internal radius 20cm and length 1 km, at an average speed of 1.0 ms^{-1}.

(i) Calculate the pressure difference that should be maintained across the tube.

(ii) What is the minimum power needed to deliver the oil through the pipe at the given rate? (Take $\pi = 3.0$)

(iii) At what radial distances the speed of oil in the tube has its maximum and minimum values? What is the value of the minimum speed?

(c) The internal radius of the metal tube is decreased by 10% due to deposits. What percentage the pressure difference across the tube should be increased in order to deliver oil at the same rate mentioned in (b) above? (Take $\frac{10}{9} = 1.11$)

(d) Two smaller tubes having similar radii and lengths are now fitted to the end of the metal tube mentioned in (b) above, and oil is delivered to two other refineries, instead of the refinery mentioned in (b). If the length of a smaller tube is also 1km, and the pressure differences across all the tubes are equal, find the radius of a smaller tube.

04. (a) If the mass and the radius of the earth are M and R respectively, write down an expression for the gravitational potential at a point P, which is at a distance h (h > R) from the centre of the earth, in terms of M, h and the universal gravitational constant G. Assume that the gravitational potential is zero at an infinite distance from the centre of the earth.

(b) Suppose a small object of mass m is projected vertically upward from the point P with speed υ_i.

(i) Write down an expression for the total mechanical energy of the object at its starting point?

(ii) Obtain an expression for the maximum height H the object travels from the centre of the earth, in terms of h, G, M and υ_i.

(iii) Find an expression for the escape velocity υ'_e of the object in this situation, in terms of G, M and h.

(c) If υ_0 is the speed required to keep the object in a circular orbit at a distance h from the centre of the earth, show that $\upsilon'_e = \sqrt{2}\upsilon_0$.

(d) If, $M = 6 \times 10^{24}$ kg and $R = 6400$km, calculate the escape velocity υ_e at the surface of the earth.
Take $G = 6 \times 10^{-11}$ m^3 $kg^{-1}s^{-2}$ and $\sqrt{2} = 1.4$.

(e) The mean temperature of the surface of the earth is 280K. Calculate the root mean square speeds (υ_{rms}) for H_2 and O_2 molecules at this temperature.
Boltzmann constant = k = 1.4×10^{-23} J K^{-1}
Mass of a H_2 molecule = $m_{H_2} = 3 \times 10^{-27}$ kg
Mass of a O_2 molecule = $m_{O_2} = 16 \times m_{H_2}$

(f) For a given temperature gas molecules have a range of speeds from very fast to very slow. To retain a given gas in atmosphere the condition, $6\upsilon_{rms} < \upsilon_e$, must be satisfied for that particular gas. Using the results obtained in (e) above, explain why oxygen gas exists in the earth's atmosphere but not hydrogen gas.

05. **Answer either part (A) or part (B) only.**

(A) Figure 1 shows a circuit diagram of a Wheatstone bridge.

V_0 is the voltage supplied to the bridge and a galvanometer can be connected across AB if needed.

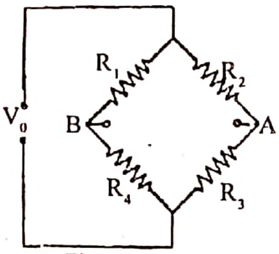


Figure 1

(a) Show that when the bridge is balanced $= \dfrac{R_1}{R_4} = \dfrac{R_2}{R_3}$

(b) Suppose $R_1 = R_2 = R_3 = R_4 = R$. The bridge is now made unbalanced by introducing a small resistance r into the R_3 arm so that $R_3 = R + r$. Show that under this condition a voltage of $\dfrac{Vr}{4R + 2r}$ will appear across AB (Note that when $R >>> r$ the above expression reduces to $\dfrac{Vr}{4R}$).

(c) The resistance of the R_2 arm is now reduced to $R - r$ while keeping R_3 arm at $R + r$. Show that by doing this change, the voltage across AB in (b) above can be doubled. (Assume $R >>> r$)

(d) Such increases or decreases of resistance occur, for example, when metal strips are subjected to elongations or contractions by the applications of external forces. If the volume and the resistivity of a metal strip do not change when elongated, show that its resistance increases.

(e) An accelerometer is constructed to measure accelerations of objects by fastening vertically an insulating rectangular rod XY to the upper-inner surface of a box and attaching a mass M firmly to the other end as shown in figure 2.

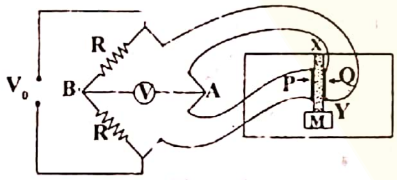


Figure 2

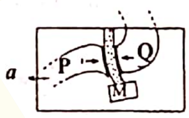


Figure 3

Two metal strips P and Q of resistance R are also fixed to either side of the rod. The ends of the strips are connected to two arms of a Wheatstone bridge as shown. When the box is placed on an accelerating object the rod and the strips bend as shown is figure 3.

(i) When the rod bends due to acceleration what would happen to the lengths of the strips P and Q.

(ii) If $V_0 = 5V$ and the magnitude of the fractional changes in resistance of the strips are same, and is equal to $\dfrac{1}{100}$.

find the voltage generated across a voltmeter connected between A and B.

(iii) How would you calibrate such an accelerometer?

(B) (a) Show by drawing a circuit diagram how you would construct a NAND gate using a NOT gate and an 2-input AND gate.

(b) Considering voltages, prove that the circuit shown in figure 1 operates as an AND gate. (Assume that the voltage across a forward bias diode is 0.7 V.)

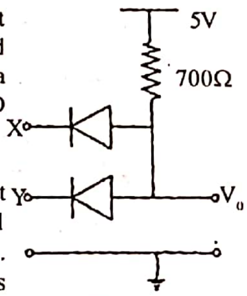


Figure 1

(c) Figure 2 shows a circuit diagram of a transistor circuit whose input B can be connected either to 5V or 0V. (Assume that when forward biased V_{BE} of the transistor is 0.7V.)

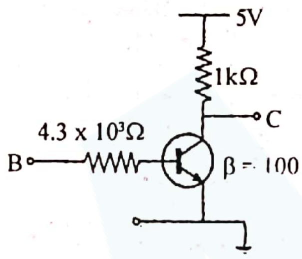


Figure 2

(i) If the current gain (β) of the transistor is 100 show that it is operating in the saturation mode when the input voltage is 5 V.

(ii) Considering voltages, prove that it operates as a NOT gate.

(d) The circuit in figure 3 is constructed by connecting the two circuits given in figure 1 and 2 together.

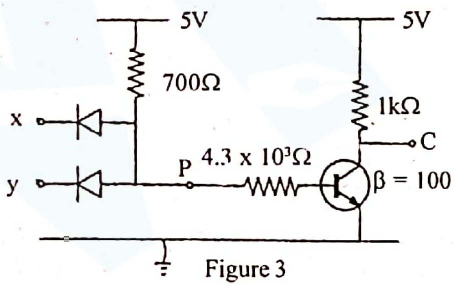


Figure 3

(i) Considering the logic levels at P, show that the circuit shown in figure 3 operates as a NAND gate (Note : This type of Diode Transistor Logic (DTL) gates are no longer in use and they are now replaced with TTL gates.)

(ii) When X = Y = 5V, what is the current through the base-emitter junction of the transistor?

(e) Logic gates can be used to construct a circuit to operate an electric lamp in a room in the following manner. In this case the lamp is to be operated from two switches; switch A at the front door and switch B at the back door to the room. The lamp is to be lit when the switch A is ON and the switch is OFF or when the switch A is OFF and the switch B is ON. The lamps is to be OFF it both switches are OFF or ON. Using the same symbols A and B to represent corresponding logic variables of the switches.

(i) write down a logic expression for the output (F) of the circuit which satisfies the above requirements.

(ii) draw a logic circuit using gates which performs the above function.

06. **Answer either part (A) or part (B) only.**

(A) Figure shows a hot-air balloon inflated with ambient air at atmospheric pressure of 10^5 Pa and temperature of 27 °C. The inner volume of the balloon is 830 m^3. Treat air to be an ideal gas in all your calculations.

(a) (i) Determine the mass (m_1) of air inside the balloon at the above temperature. Hence calculate the density of air at 27 °C. (Take gas constant R = 8.3JK^{-1} mol^{-1}, the molar mass of air is 30g mol^{-1})

(Take $\frac{1}{83} = 0.012$)

(ii) To lift- off the air inside the balloon should be heated. Modern hot-air balloons heat the air by burning propane. The propane is stored in compressed liquid form, in light weight cylinders positioned in the balloon's basket. If the temperature of air inside the balloon is raised to T K, write down an expression for the mass (m_2) of air remaining inside the balloon at this temperature in terms of T. The pressure of the heated air remains the same as that of the atmospheric pressure.

(b) Calculate the upthrust acting on the balloon due to air (27 °C) outside. Neglect the volumes of the material of the balloon and all other contents including occupants.

(c) (i) If the total mass of the balloon excluding that of the hot air inside is 246 kg, determine the value of temperature T to which the air inside the balloon should be raised for the balloon to just lift-off the ground.
Hence determine the value of m_2.

(ii) Assuming that the heat released by burning propane is absorbed only by the air inside the balloon during the lift-off, estimate the heat supplied in this process. Take the mean temperature of air leaving the balloon to be $\frac{300 + T}{2}$ K (The specific heat capacity C_p of air at constant pressure is 10^3 Jkg^{-1} K^{-1}).

(iii) If the amount of heat liberated when 1 kg of propane is completely burned is 87.5 MJ kg^{-1}, determine the mass of propane consumed in this process.

(B) One of the methods of measuring blood volume in human body is based on the measurement of the activity of a radioactive element added to the blood. In this method, a blood sample of known volume is removed from the body and a predetermined amount of radioactive element is added to it. This sample is then injected back into the human body. After a certain period, which is sufficient for the uniform distribution of radioactive material in the blood volume, a second blood sample is drawn and the radioactivity is measured. Blood volume can be calculated from the observed reduction of the activity.

A commonly used radioactive element in this procedure is ^{51}Cr, which has following properties.
Atomic number = 24; Half life = 28 d (28 days);
Specific activity (i.e. activity per unit mass)
= 3.5×10^{15} Bq g^{-1}; Molar mass = 51 g mol^{-1}.

You are also given the following constant and equations:

Avogadro Number = 6×10^{23} mol^{-1} ; $T_{\frac{1}{2}} = \frac{0.7}{\lambda}$; $A(t) = \lambda N(t)$

where $T_{\frac{1}{2}}$ = Half life ; λ = Decay constant ; $N(t)$ = Number of radioactive nuclei present at time t $A(t)$ = Activity at time t

(a) Write down the number of protons and number of neutrons in a ^{51}Cr nucleus.

(b) Find the value of decay constant of ^{51}Cr in units of d^{-1} (per day)

(c) In a test to determine the blood volume of a patient of mass 70kg, a blood sample of 10 m ℓ was drawn from the patient and ^{51}Cr was added to it. If the activity inside the patient must be limited to the value 6.0×10^4 Bq per kg of body mass after injecting the ^{51}Cr added blood sample, calculate the maximum possible mass of ^{51}Cr that can be added to 10m blood sample.

(d) A mass of 1.53×10^{-10} g of ^{51}Cr was added to the 10 m blood sample. Calculate the number of ^{51}Cr nuclei added to the sample and the activity of the sample in Bq.
(Take 1 day = 9×10^4 s for your calculations.)

(e) 10 m blood sample as described in part (d) is injected back to the patient. After a sufficient time has elapsed another 10m sample was drawn from the patient and the measured activity of that sample was found to be 1000Bq. Assuming the ^{51}Cr added to the blood sample is uniformly distributed in the patient's blood volume and neglecting the number of decayed ^{51}Cr nuclei during this time period, calculate the volume of blood in the patient's body.

(f) If the decay of ^{51}Cr is **not neglected,** will the calculated blood volume in (*e*) be slightly greater than or less than the actual value of blood volume? Explain your answer.

(g) Find the time required for the activity of ^{51}Cr inside the patinet to become $\frac{1}{64}$ of the initial value.

(h) Explain why a radioactive element with a half-life of 10 s is not suitable for this procedure.

G.C.E. (Advanced Level) Examination - August 2008

PHYSICS - I

Provisional Scheme of Marking

2008 - Answers

01	1	21	5	41	2
02	3	22	3	42	3, 4
03	4	23	4	43	3
04	3	24	5	44	4
05	2	25	4	45	3
06	2	26	3	46	2, 3
07	4	27	2	47	1
08	1	28	5	48	4
09	1, 2, 3, 4, 5	29	3	49	2
10	5	30	4	50	3
11	3	31	1	51	2
12	4	32	5	52	1
13	1	33	2	53	4
14	2	34	4	54	4
15	1	35	3	55	4
16	5	36	2	56	1
17	3	37	2	57	5
18	2	38	5	58	4
19	5	39	4	59	3
20	1	40	1, 2, 3, 4, 5	60	4

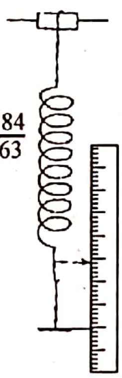
G.C.E. (Advanced Level) Examination - August 2008

PHYSICS - II

Provisional Scheme of Marking

A - PART

01.(a) Rular should be placed just by the side of the pointer. The zero mark or the top edge of the ruler should be just at the pointer. 01



(b) (i) Gradient of the graph $= \dfrac{(9.3 - 0.9) \times 10^{-2}}{(72 - 9) \times 10^{-3}} = \dfrac{84}{63}$

$K = \dfrac{1}{\text{Gradient}}$

$K = \dfrac{63}{84}$

$K = 0.75 \text{ kgm}^{-1}$ 01

(ii) When indicating two points on the graph;
the lower point should be ≤ 20.0 (M)
(6.0.0.5), (9.0,0.9), (12.0,1.3), (15.0,1.7), (18.0,2.1)

upper point should have one of the following sets of coordinates.
upper point should be ≥ 60 (M)
(60.0,7.7), (63.0,8.1), (66.0,8.5), (69.0,8.9),(72.0,0.93)

(c) (i) $T^2 = 4\pi^2 \left(\dfrac{M + m/3}{kg}\right)$

$T^2 = \left(\dfrac{4\pi^2}{kg}\right) M + \dfrac{4\pi^2 m}{kg\, 3}$ 01

$y = m\ x + c$

(ii) Stop watch 01

(iii) g : From the gradeint 01
m : From the intercept
OR the gradeint and intarcept
OR the gradeint and a coordinate of a point
\- 01

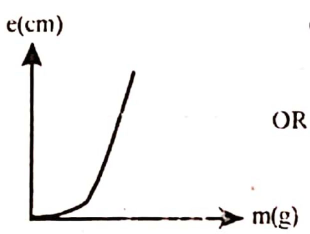
(d) n - the number of vibrations.
T_1 - measured total time
T_1 - nT

$\dfrac{2\triangle T}{T} = \dfrac{2 \times 0.1}{n \times 2}$ 01

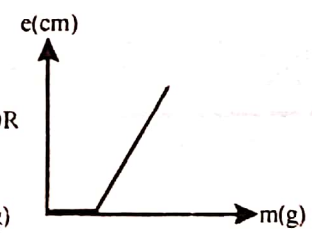
$= 0.01$ (1%)

n = 10 OR (n = 5) 01

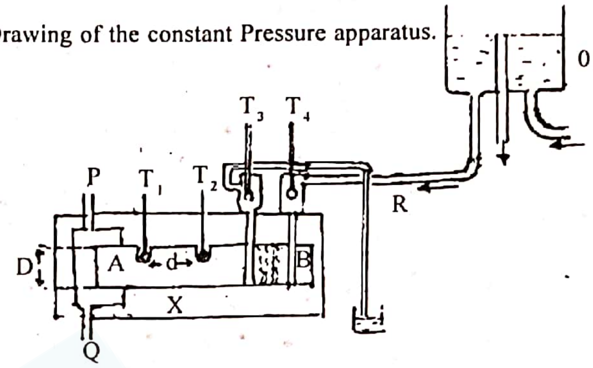
(e)



OR



02.(a) Drawing of the constant Pressure apparatus. 01



(b) (i) Steam generator
(ii) Eelectroinc /chemical / triple beam / four beam balance
(iii) Stop watch
(iv) Vernier caliper
(v) Meter ruler

All correet 02
Any three 01

(c) (i) In order to make sure that the end (A) of the metel bar reaches 100 °C OR
In order to incrase the contact time between steam and the end (A) OR
To fill the steam containter with steam so that the end (A) of the metel bar reaches 100 °C.

(ii) To avoid the blocking of the steam in the inlet tube OR
The condensed water will leave the outlet Q with out blocking the incoming flow of steam.
Any one 01

(d) By observing that the thermometer readings are steady OR
By observing that the thermometer readings donot change with time 01

(e) By adding mercury into the holes which contain Thermometers. 01

(f) $\dfrac{Mc(\theta_3 - \theta_4)}{\Delta t} = \dfrac{KA(\theta_1 - \theta_2)}{d}$

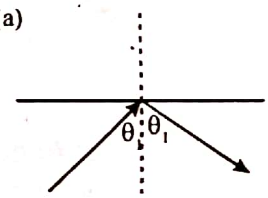
$\dfrac{400 \times 10^{-3} \times 4200 \times (37 - 28)}{3 \times 60} = \dfrac{k \times 12 \times 10^{-4} \times (75 - 61)}{8 \times 10^{-2}}$

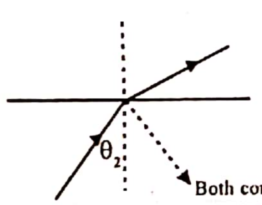
L.H.S 01
R.H.S 01

$k = 400 \text{ wm}^{-1}\text{k}^{-1}$ 01

(g) Heat loss due to convection is higher from air OR
Heat will be lost due to convection currents. 01

03. (a)





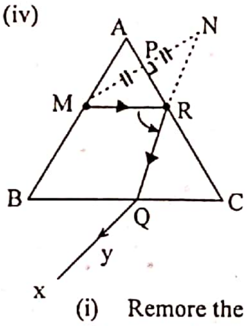
Both correct 01

(b) (i) To avoid the refraction from face AC 01

(ii) The image should disappear at a certion location of the eye 01

(iii) Place the pins so that they are apparently collinear with the image of *M* when the image just disappears.

(iv)

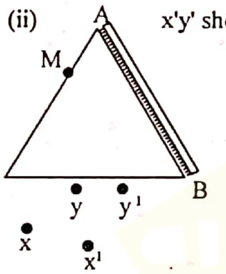


(i) Remore the prism
(ii) Draw the line XY to meet BC at Q
(iii) Draw a line perpendicular to AB from Pin M and mark N such that MP = PN
(iv) Join the line NQ which intersects AB at R
(v) Join MR

(v) The angle MRO (2 x critical angle) 01

(C) (i) No change OR at the same location 01

(ii) x'y' should be on the right hand side of xy



(d) $_an_g = \frac{1}{\sin c_1}$ $\quad _wn_g = \frac{1}{\sin c_2}$ (OR $n_g \sin c_1 = 1$, $n_g \sin c_2 = n_w$)

$$_an_g = \frac{_an_g}{_wn_g} = \frac{\sin c_2}{\sin c_1}$$

04. (a) $V_0 = I_0 R_G$ 01

(b) $V_1 = \frac{V_0}{\theta_m}\theta$ 01

(c)

01

01

(d) $V_2 = I_0R_G + I_0R_1$

$R_1 = \frac{V_2 - I_0R_G}{I_0}$ 01

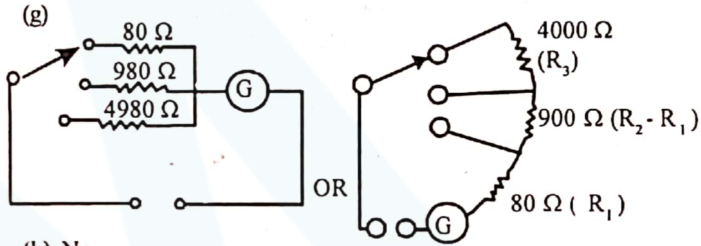
(e) $R_1 = \frac{1 - 10 \times 10^{-3} \times 20}{10 \times 10^{-3}}$ 01

$R_1 = 80\ \Omega$ 01

(f) $R_2 = 980\ \Omega$

$R_3 = 4980\ \Omega$

(g)

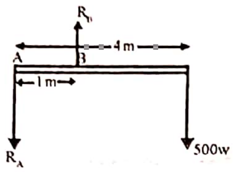


(h) No

voltaye across the 2000Ω will be reduced as part of the current will divert through the galvonometer. OR The effective value of the 2000Ω resister will be reduced as the internal resistance of the Galvonometar will appear in parallel with the 2000Ω resistor OR this connection will affect the current in the 2000Ω resistor.

PART - B

01.(a)



moments about B

G_B $R_A \times 1 - 500 \times 3 = 0$

$R_A = 1500N \downarrow$ (downward) 01

$\uparrow Y = 0$

$R_B - R_A - 500 = 0$

$R_B = R_A + 500$

$R_B = 2000N \uparrow$ (upward) 01

Both directions correct 02

(b) U_x - horizontal component
U_y - Vertical component of the initial velocity.

(i) Applying $\uparrow$ $h = ut + \frac{1}{2} gt^2$

$-4 = u_y 2 - \frac{1}{2} \times 10 \times 4$ 01

$u_y = 8 \text{ ms}^{-1}$ 01

Applying $\rightarrow$ $S = ut$

$2 = u_x \times 2$

$u_x = 1 \text{ms}^{-1}$ 01

(ii) Applying $\uparrow$ $v^2 = u^2 + 2as$

$0 = 64 - 2 \times 10 \times h$ 01

$h = 3.2$ m

Maximum height from the water Surface

$= 4 + 3.2$m

$= 7.2$ m 01

(iii) (1) Kinetic Energy $= \frac{1}{2} mV^2$

$= \frac{1}{2} \times 50 \times 1$

$= 25J$ 01

(2) Potential energy $= mgh$

$= 50 \times 10 \times 7.2$

$= 3600J$ 01

(c) (i) Angular Velocity ω_1 $= 2\pi f$

$= 2 \times 3 \times 0.5 \text{ rads}^{-1}$

$= 3.0 \text{ rads}^{-1}$ 01

(ii) Angular Velocity ω_2;

Total period in fully tucked position = 1.0s

$\omega_2 = 2\pi f$

$= 2 \times 3 \times 2$ 01

$= 12 \text{ rads}^{-1}$ 01

(12.5 - 12.6)

(iii) $I_1\omega_1 = I_2\omega_2$

$20 \times 3.0 = I_2 \times 12$ (or $20 \times 0.5 = I_2 \times 2$)

$I_2 = 5\text{kgm}^2$ (4.7 - 5.1) 01

(iv) Rotational kinetic energy in fully

extended position $= \frac{1}{2} I_1\omega_1^2$

$= \frac{1}{2} \times 20 \times 9$

$= 90$ J 01

(90 - 99)

02. (a) Because the ear converts the energy of sound wave into electrical energy. 01

(b) (i) 3000H_z 01

(ii) $f = v/\lambda$, $\lambda = 4l$

$f = \frac{V}{4l}$

$f = \frac{330}{4 \times 2.5 \times 10^{-2}}$ 01

f = 3300 H2 01

(iii) Pressure Variation is maximum at the ear drum.

(A displaccement node - at a closed end) Corresponds fo a Pressure antionode) 01

(C) (i) $I = \frac{P_m^2}{2\upsilon\rho}$

$P_m = \sqrt{2 I \upsilon \rho}$

$P_m = \sqrt{2 \times 10^{-12} \times 330 \times 1.25}$ 01

$P_m = 2.75 \times 10^{-5}$ Pa 01

$(2.7 - 2.9) \times 10^{-5}$ Pa

(ii) $F_e = (2.75 \times 10^{-5}) \times 80 \times 10^{-6}$

$F_e = 2.2 \times 10^{-9}$ N

$(2.2 - 2.3) \times 10^{-9}$ N 01

(iii) Taking moments, $F_0 = 2 \times (2.2 \times 10^{-9})$ 01

$F_0 = 4.4 \times 10^{-9}$ N 01

$(4.4 - 4.6) \times 10^{-9}$ N

(iv) $P_o = \frac{4.4 \times 10^{-9}}{4 \times 10^{-6}}$

$P_0 = 1.1 \times 10^{-3}$ Pa 01

$(1.1 - 1.2) \times 10^{-3}$ Pa

Factor of amplification $= \frac{1.14 \times 10^{-3}}{2.75 \times 10^{-5}}$

$= 40$ 01

(40 - 41)

(d) (i) 160dB 01

(ii) $160 = 10\log I / 10^{-12}$

$I = 10^4 \text{ Wm}^{-2}$ 01

(c) $V = \sqrt{T/m}$ and $f = v/\lambda$

For stiff strings, tension is high OR T is high.

Therefore velocity of transverse waves υ is large For Short strings wavelegth λ is small. 01

Both will contribute to high resonant frequencies Similarly for flexible and long strings is υ small but λ is large. 01

there fore these strings respond to low frequencies.

03. Poiseuille's equation $\frac{Q}{t} = \frac{\pi r^4 \Delta P}{8\eta l}$

Q/t	=	Rate of volume flow of liquid (flow of liquid volume per second / Per unit time)
ΔP	=	Pressure difference across the tube.
l	=	length of the tube (or $\Delta P/l$ - Pressure gradient)
r	=	Internal radius of the tube
η	=	Viscosity of the liquid. all correct 01

(a) $$\frac{[M]\ [L]^4}{[T]^2\ [L]} \quad \frac{1}{\frac{[M]}{[L]\ [T]}} \quad \frac{1}{[L]} = \frac{[L]^3}{[T]}$$

(correct L. H. S) 01

If L . H. S is correct and the simplification is correct of get R. H. S. 01

(b) (i) $\frac{Q}{t}$ = speed x area

$$V \times \pi r^2 = \frac{\pi \Delta P r^4}{8\eta l}$$

$$1 \times \pi (20 \times 10^{-2})^2 = \frac{\pi \Delta P (20 \times 10^{-2})^4}{8 \times 0.9 \times 1000}$$ L. H. S. -01 R. H. S. -01

$\Delta P = 1.8 \times 10^5\ Nm^{-2}$ (Pa) 01

(ii) Power $= \Delta P . A \times V$

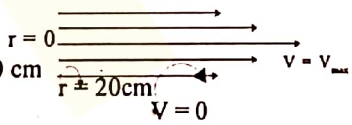
$= (18 \times 10^4) \times \pi (20 \times 10^{-2})^2 \times (1.0)$ 01

$= 2.16 \times 10^4 w$ 01

$(2.1 - 2.3) \times 10^4$ W

(iii) Maximum speed at r = 0

Minimum speed at r = 20 cm



Minimum speed V = 0 01

- 02

(c) Q . l and η are same

$$\Delta P_1 r_1^4 = \Delta P_2 r_2^4$$

$$\Delta P_1 r_1^4 = \Delta P_2 \left(\frac{90}{100} r_1\right)^4$$ 01

$$\Delta P_1 = \left(\frac{9}{10}\right)^4 \Delta P_2$$

$$\Delta P_2 = \left(\frac{10}{9}\right)^4 \Delta P_1$$

$$\Delta P_2 = 1.11^4 \Delta P_1$$

Percentage increase $= \frac{1.11^4 \Delta P_1 - \Delta P_1}{\Delta P_1} \times 100\%$

$= (1.\ 11^4 - 1) \times 100\ \%$

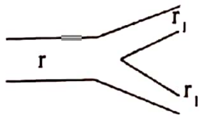
$= 0.518 \times 100\%$

$= 51.8\ \%\ (52\ \%)$ 01

$\{ (51.5 - 52.5)\ \% \}$

(d) Rate of flow $Q = Q_1 + Q_2$

ΔP, η and r are same for all tubes



$\therefore\ r^4 = r_1^4 + r_2^4 = 2r_1^4$ 01

$$r_1 = \frac{r}{\sqrt[4]{2}} = \frac{20 \times 10^{-2}}{\sqrt[4]{2}} = 1.68 \times 10^{-1} m$$ 01

04. (a) Gravitational Potential $= Ep = \frac{-GM}{h}$ (01 mark negative Sign)

(b) (i) Total mechanical energy of the object $E = \frac{1}{2} m v_i^2 - \frac{GMm}{h}$ 01

(ii) From the conservation of energy

$$\frac{1}{2} m v_i^2 - \frac{GMm}{h} = \frac{-GMm}{H}$$ 01

$$H = \frac{2hGM}{(2GM - hv_i^2)}$$ 01

(iii) When $V_i = V_e'$ $H \to \infty$

$2GM - hv_e'^2 = o$

$$v_e' = \sqrt{\frac{2GM}{h}}$$ 01

(c) $$\frac{mv_0^2}{h} = \frac{GMm}{h^2}$$ 01

$$v_o = \sqrt{\frac{GM}{h}}$$ 01

$$v_e' = \sqrt{2}\ v_o$$

(d) Escape velocity for the earth

$$v_e = \sqrt{\frac{2GM}{R}}$$

$$= \sqrt{\frac{2 \times 6 \times 10^{-11} \times 6 \times 10^{24}}{6400 \times 10^3}}$$

$$v_e = \frac{3}{4} \times \sqrt{2} \times 10^4$$

$$v_e = 0.75 \times 1.4 \times 10^4$$

$v_e = 1.05 \times 10^4\ ms^{-1}$ 01

[(10500 - 10607) ms^{-1}]

(e) $V_{rms} = \sqrt{\frac{3kT}{m}}$ $\qquad \left[\frac{1}{2}mV_{rms}^{2} = \frac{3}{2}kT\right]$

Therefore $(V_{rms})H_2 = \sqrt{\frac{3 \times 1.4 \times 10^{-23} \times 280}{3 \times 10^{-27}}}$

$= 14 \times \sqrt{2} \times 100$

$= 1960\ ms^{-1}$ 01

$[(1960 - 2000)\ ms^{-1}]$

$(V_{rms})O_2 = \sqrt{\frac{3kT}{16m_{H2}}}$

$(V_{rms})O_2 = \frac{(V_{rms})H_2}{4}$

$= \frac{1960}{4}$

$= 490\ ms^{-1}$ 01

$[(490 - 500)\ ms^{-1}]$

(f) For H_2 gas. $(6\ V_{rms}) = 6 \times 1960 = 11760\ ms^{-1}$

$[(11760 - 12000)\ ms^{-1}]$

O_2 gas $(6\ V_{rms}) = 6 \times 490 = 2940\ ms^{-1}$

$[(2940 - 3000)\ ms^{-1}]$ 01

Therefore the condition $6V_{rms} < Ve$ is satisfied only for O_2 gas
OR the condition $6\ V_{rms} > Ve$ is not satisfied for H_2 gas 01

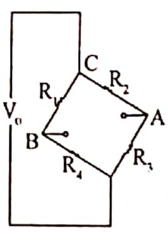
05. (A) (a) Let I_1 be the current through the branch R_1, R_4 and I_2 be the current through the branch R_2 R_3 when the brige is balanced

$I_1 R_1 = I_2 R_2$ —① 02

$I_1 R_4 = I_2 R_3$ —② 02

① /② $\frac{R_1}{R_4} = \frac{R_2}{R_3}$

(b) When all the resistances are equal except R_3 which is $R + r$



$V_A = \frac{R + r}{R + R + r} V_0(v)$ 01

OR $\left[V_c - V_A = \frac{R}{R + R + r} V_0(v)\right]$

$V_B = \frac{1}{2} V_0(v)$ 01

OR $\left[V_c - V_B = \frac{1}{2} V_0(v)\right]$ 01

$\therefore V_{AB} = \left[\frac{R + r}{2R + r} - \frac{1}{2}\right] V_0(v)$ OR $V_A - V_B = \left[\frac{1}{2} - \frac{R}{2R + r}\right] V_0(v)$

$V_{AB} = \frac{V_0(v)\, r}{4R + 2r}$

(c) $R_3 = R + r$ and $R_2 = R - r$

$V_A = \frac{(R + r)}{2R} V_0(V)$ OR $V_c - V_A = \frac{(R - r)}{2R} V_0(V)$

$V_B = \frac{1}{2} V_0(V)$ OR $V_c - V_B = \frac{1}{2} V_0(V)$

$\therefore V_{AB} = \left[\frac{R + r}{2R} - \frac{1}{2}\right] V_0(V)$ OR $V_A - V_B = \left[\frac{1}{2} - \frac{R + r}{2R}\right] V_0(V)$

$V_{AB} = \frac{V_0(V) r}{2R}$

(d) For the metal strip $R = \rho\, \ell / A$ 01 $(V = \ell A)$

$R = \rho\, \ell^2 / V$ $(A = V/\ell)$

If the volume of the strip remains unchaged when L is increased, its area of cross - section should decrease. Therefore R should increase. 01

(e) (i) length of the strip P will increase 01

length of the strip Q will decrease 01

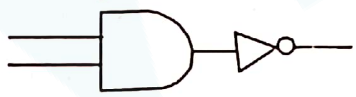
(ii) $r/R = 1/100$

Voltage qenerated aceoss AB $= 5/100 \times 2$ 01

$= 25$ mV OR $(2.5 \times 10^{-2}$ V) 01

(iii) Connect a voltmeter and measure voltages across AB For several known accelerations. Calibrate the voltmetar scale with acceleration values 01

05. (B) (a)



01

(b) When x is grounded ($V_x = 0V$), the diode is forward baised and V_0 becomes 0.7V whether the voltage at y is O or 5V.

When Y is grounded (Vy = oV), the diode is forward baised and V_0 becomes 0 7V whether the voltage at X is O or 5V.

When X and Y bare both at 5V, both diodes are not foward biased and V_0 becomes 5V. 01

x	y	V_o
0	0	0
0	1	0
1	0	0
1	1	1

01

(c) (i) When B is connected to 5V, the base current I_B is given by the equ.

$V_{AB} = I_B R_B + V_{BE}$

$5 = 4.3 \times 10^3\ I_B + 0.7$ 01

$I_B = 1$ mA $(10^{-3}$A) 01

If it is oprating in the saturation mode

$\beta\, I_B > I_C$ 01

$\beta I_B = 100 \times 10^{-3}$

$= 0.1$A 01

The maximum current that can flow through the collector circuit.

$I_C = \frac{5}{10^3}$

$= 5 \times 10^{-3}$ A (5mA) 01

$\beta I_B > I_C$ and the transistor operates in the Saturation mode.

(ii) When the voltage at the input B is 5V (logic 1)

the output voltage at C is 0.1v (OR 0V) (logic 0)

and

when the Input vottage is 0 the transistor does not conduct and voltage at C becomes 5V. 01

the circuit operates as a NOT gate.

B	C
1	0
0	1

(d) (i) When the logic level of p is 0, the x and y in puts should have the logiclevels of x = 0, y = 0 , or x = 1 y = o or x = o , y = 1 when p = o on the hand C = 1

when the logic levelof P is l, the x and y inputs Should have the logic levels of x = 1, y = 1 and in that case C should be O 01

Thuth table for the NAND gate 01

x	y	c
0	0	1
0	1	1
1	0	1
1	1	0

x	y	p	c
0	0		1
0	1	0	1
1	0		1
1	1	1	0

(ii) When x = y = 5V current through the Base Emitter Junction (I_B) is given by the equation.

$5 = (700 + 4.3 \times 10^{+3})\, I_B + 0.7$

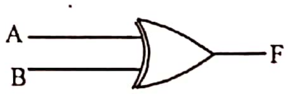
$I_B = 8.6 \times 10^{-4}$ A 01

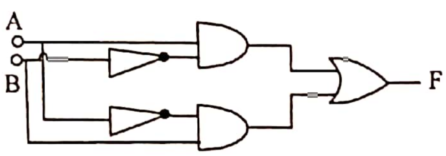
(e) (i)

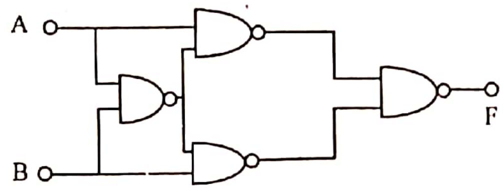
A	B	F
0	0	0
0	1	1
1	0	1
1	1	0

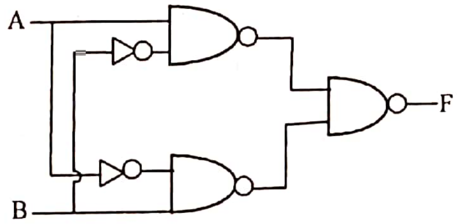
$F = A\bar{B} + \bar{A}B$ 01

(ii)









06. (A) (a) (i) Appying $PV = \frac{m}{M} RT$ OR $PV = nRT$ 01

$10^5 \times 830 = \frac{m_1}{30 \times 10^{-3}} \times 8.3 \times 300$ 01

$m_1 = 10^3$ kg [(996 - 1000) kg] 01

Density of air at 300k = $\left(\frac{m_1}{V}\right)$

$= \frac{10^3}{830}$

$= 1.2$ kgm^{-3} 01

(1.2 - 1.202kgm^{-3})

(ii) PV = nR T

$10^5 \times 830 = \frac{m_2}{30 \times 10^{-3}} \times 8.3 \times T$

$m_2 = \frac{3 \times 10^5}{T}$ 01

(b) Upthrust on the balloon (u) $= \rho Vg$

$= 1.2 \times 830 \times 10$ 01

u $= 9960$ N 01

(9960 - 10000N)

(c) (i) For the balloon of Just lift off the ground.

$m_2 g + mg = u$

$\frac{3 \times 10^5}{T} + 2460 = 996 \times 10$

$\frac{T}{3 \times 10^5} = 7500$

$T = \frac{3 \times 10^5}{7500}$

T = 400 k (127°C) 01

(397k - 400k)

$m_2 = \frac{3 \times 10^5}{400}$

$m_2 = 750$kg 01

(750kg - 755kg)

(ii) Heat absorbed by the air remaining inside the balloon

$= m C_p \theta$

$= 750 \times 10^3 \times 100$ 01

$= 75 \times 10^6$ J

Heat ahsorbed by the removed form the balloon

$= 250 \times 10^3 \times 50$ 01

$= 125 \times 10^5$

heat supplied $= (750 + 125)\ 10^5$ J 01

$= 875 \times 10^5$ J

$= 8.75 \times 10^7$ J 01

$= (8.4 - 8.9)$

(iii) Mass of Propane used $= \dfrac{8.75 \times 10^7}{8.75 \times 10^6}$

$= 1$ kg 01

[(0.9 - 1.1)kg

06. (B) (a) Number of protons $= 24$ 01

Number of neutrons $= 51 - 24$

$= 27$ 01

(b) $t_{\frac{1}{2}} = \dfrac{0.7}{\lambda}$

$\lambda = \dfrac{0.7}{t_{\frac{1}{2}}}$

$= \dfrac{0.7}{28} d^{-1}$

$= 0.025 d^{-1}$ 01

(c) Maximum allowed activity inside the patient

$= (6.0 \times 10^4) \times 70$ 01

$= 4.2 \times 10^6$ Bq

Maximum possible mass of ^{51}Cr that can be added to 10ml blood sample.

$= \dfrac{4.2 \times 10^6}{3.5 \times 10^{15}}$

$= 1.2 \times 10^{-9}$g 01

$(1.2 \times 10^{-12}$kg)

(d) Number of ^{51}Cr nuclei atoms added to the sample

$= N_o = \dfrac{6.0 \times 10^{23} \times 1.53 \times 10^{-10}}{51}$

$= 1.8 \times 10^{12}$ 01

Activity of the sample $= \lambda N_0$

$= \left[\dfrac{0.025}{9 \times 10^4}\right] \times (1.8 \times 10^{12})$ 01

$= 5.0 \times 10^5$Bq 01

(5. 3 - 5.4)

(e) Initial activity / Final activity = Blood Volume / 10ml

OR

Blood volume $= \dfrac{5.0 \times 10^5}{1000} \times 10ml$ 01

$= 5000$ ml 01

(5000 - 5400)ml

(f) The calculated value of blood volume in (e) will be Silightly greater than the actual value. 01

In Calculating the blood volume it has been assumed that the total number of ^{51}Cr atoms has not changed. But to get the correct answer a higher value for the activity than the measured value has to be substituted in (e) above.

OR

The measured activity substituted in (e) above is smaller than the actual value. that has to be used in the calculation. 01

(g) Time required $= 6 \times$ half life OR $6 \times t_{\frac{1}{2}}$

$= 6 \times 28$ days 01

$= 168$ days 01

(h) Most of the atoms would decay before mixing up with the blood volume in the body OR half $(t\frac{1}{2})$ life is too short. 01