



Royal College – Colombo 07

Grade 13

Final Term Test -October 2024

Physics - I

$g = 10 \text{ N kg}^{-1}$

01	S	I
----	---	---

Time: 2 hours

❖ Answer all the questions.

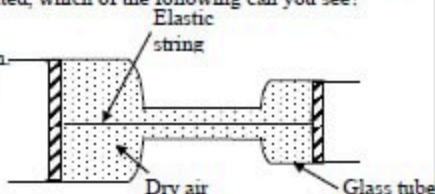
- 01) Choose the physical quantity with different dimensions from the physical quantities given below.
  - (1) Radioactive decay constant
  - (2) Angular velocity
  - (3) Half lifetime
  - (4) Frequency
  - (5) Radioactive activity
  
- 02) Which of the following principles illustrate conservation of energy ?
  - (1) Principle of moments
  - (2) Archimedes' Principle
  - (3) Pascal's Principle
  - (4) Bernoulli's Principle
  - (5) Principle of floatation
  
- 03) Choose the correct answer for the given physical quantity with correct dimensions from the answers given below.
  - (1) Moment of force -  $\text{ML}^2\text{T}^{-1}$
  - (2) Volume per unit length -  $\text{L}^3\text{T}^{-1}$
  - (3) Absolute humidity -  $\text{ML}^{-2}$
  - (4) Mechanical energy -  $\text{ML}^2\text{T}^{-1}$
  - (5) Rate of volume -  $\text{L}^3\text{T}^{-1}$
  
- 04) Consider the following statements made about vectors.
  - A) The vector triangle rule can be used to find the resultant of two vectors that are parallel to each other.
  - B) Two vectors can be considered equal when their magnitudes and directions are equal.
  - C) A vector with zero magnitude also has no direction.

Correct statement/s is/are,

  - (1) A only
  - (2) A and B only
  - (3) B and C only
  - (4) A and C only
  - (5) All of A, B and C
  
- 05) The main scale of a vernier caliper is divided into 1 mm divisions and the length of a vernier division is 9/5 mm. A measurement obtained from this instrument can be,
  - (1) 2.20 mm
  - (2) 5.70 mm
  - (3) 3.2 mm
  - (4) 7.1 mm
  - (5) 300.1 mm
  
- 06) Choose the image from the following answers which cannot be seen when observed through a convex lens at the mark " P " (diagrams are drawn to the scale).
  - (1) P
  - (2) b
  - (3) d
  - (4) d
  - (5) d

- 07) Two smooth pistons are placed inside a glass tube and they are connected to each other by an elastic string. As the air in the tube is slowly heated, which of the following can you see?

- (1) The pistons remain stationary.
- (2) The pistons start moving in the right direction.
- (3) The pistons start moving in the left direction.
- (4) The pistons move away from each other.
- (5) The pistons move towards each other.



- 08) Consider the following statements.

- (A) Use of a narrow measuring cylinder instead of a wide measuring cylinder to measure a small volume of liquid.
- (B) Using a calorimeter with blackened outer surface instead of a polished calorimeter in a cooling law experiment
- (C) measuring the prism angle by spectrometer using a monochromatic light source instead of a white light source .

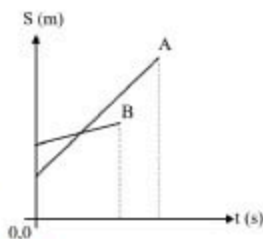
From the above, choose the answer that includes factors that affect the accuracy of the final result

- (1) A only
  - (2) B only
  - (3) C only
  - (4) A and B only
  - (5) All of A, B and C
- 09) A small block of plastic of density  $400 \text{ kg m}^{-3}$  is kept at rest in a liquid of density  $800 \text{ kg m}^{-3}$  at a depth of 1 m and released. Select the answer that includes the maximum height the block of plastic moves above the surface of the liquid when viscous forces are neglected?

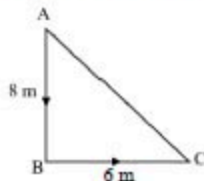
- (1) 1 m
- (2) 1.4 m
- (3) 1.5 m
- (4) 1.7 m
- (5) 2 m

- 10) Following figure shows the displacement time graph for two children A and B which shows how they walked to their home. Which of the following statements is false?

- (1) B is ahead of A at the beginning of the motion.
- (2) B has passed by child A shortly after the start of the motion.
- (3) Child A walks home before B.
- (4) The Velocity of A relative to B is positive.
- (5) If the two lines were parallel, neither child could ever pass the other.



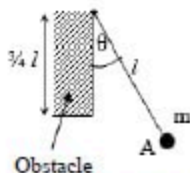
- 11) In a conserved force field, the work done to move 8 m distance from A to B and 6 m distance from B to C are 40 J and 30 J respectively, then the amount of work to be done to move from A to C is,



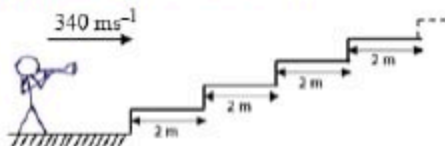
- (1) 70 J
- (2) 14 J
- (3) 50 J
- (4) 10 J
- (5) 0 J

- 12) A simple pendulum of length  $l$  and mass  $m$  is oscillating and collides with an obstacle as shown in the figure. If the oscillation starts from A, then the time taken to return to A is, (Note that the angles of oscillation are very small.)

- (1)  $2\pi\sqrt{\frac{l}{g}}$       (2)  $\frac{3\pi}{2}\sqrt{\frac{l}{g}}$   
 (3)  $\frac{3\pi}{4}\sqrt{\frac{l}{g}}$       (4)  $\frac{\pi}{2}\sqrt{\frac{l}{g}}$       (5)  $\pi\sqrt{\frac{3l}{g}}$



- 13) A child near a staircase blows the horn at once. The frequency of the echoes that the child can detect when the wave is reflected from the staircase is,



- (1) 170 Hz      (2)  $\frac{1}{170}$  Hz      (3) 340 Hz      (4)  $\frac{1}{85}$  Hz      (5) 85 Hz

- 14) Which of the following statements is most true if a telescope is placed at normal adjustment as compared to non-normal adjustment,

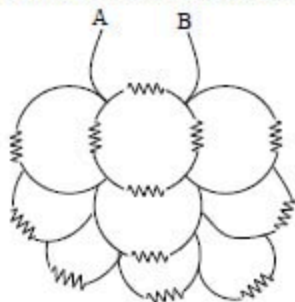
- (1) Low angular magnification is obtained, and eye fatigue is minimized.  
 (2) Low angle magnification is obtained, and eye fatigue is maximized.  
 (3) Greater angular magnification is obtained, and eye fatigue is minimized.  
 (4) Greater angular magnification is obtained, and eye fatigue is maximized.  
 (5) No change in angular magnification and no change in eye fatigue.

- 15) Choose the answer that shows the correct relationship between X, Y and Z when the Q factor (RBE factor) for a certain radiation is taken as X, the effective dose is Y and the absorbed radiation dose is Z.

- (1)  $X = YZ$       (2)  $X = \frac{Y}{Z}$       (3)  $X = \frac{Z}{Y}$       (4)  $X = 2YZ$       (5)  $X = Y^2Z$

- 16) The value of all resistances in the circuit shown in figure is R. Equivalent resistance between A and B is,

- (1) R      (2)  $\frac{3R}{2}$   
 (3)  $\frac{5R}{7}$       (4)  $\frac{4R}{7}$   
 (5)  $\frac{7R}{3}$





- 17) The windscreen of a car is smooth and inclined at  $30^\circ$  from the horizontal. The acceleration with which the car must travel to keep a small object on it stationary relative to the car is,

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



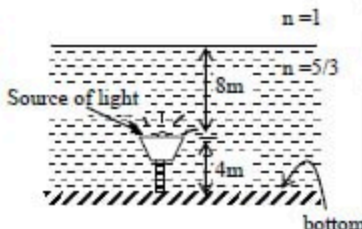
- 18) Consider the following statements regarding the production of X-rays.

- A) To increase the penetration of X-rays, the current flowing through the cathode filament must be increased.  
 B) The intensity of the X-rays depends on the number of electrons passing from the cathode to the anode.  
 C) X-rays can cause the photoelectric effect, and they are charged.  
 Correct statement/s is/are

- (1) A only (2) B only (3) C only  
 (4) A and B only (5) All of A, B and C

- 19) A light source that emits light only in the upward direction is placed and operated in a liquid as shown in the figure. Now which answer correctly shows the radius of the dark spot formed at the bottom?

- (1) 15 m (2) 12 m (3) 9 m  
 (4) 6 m (5) 4 m



- 20) Two objects A and B of masses 4 kg and 7 kg respectively are placed on a horizontal smooth plane. An object A moving with a velocity of  $2 \text{ ms}^{-1}$  makes an elastic collision with B which is at rest.



- X) After the collision, A is at rest and B is moving in the right direction with a velocity of  $2 \text{ ms}^{-1}$ .  
 Y) After the collision, objects A and B make motions according to Newton's first law.  
 Z) The total momentum of the system after the collision is  $8 \text{ kgms}^{-1}$

Which of the above statements is true?

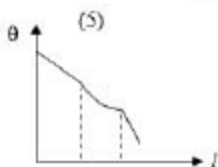
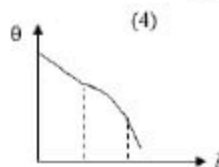
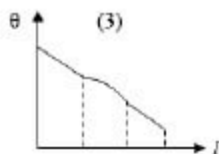
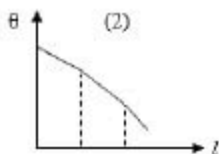
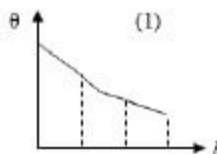
- (1) X only (2) Y only (3) Z only  
 (4) Y and Z only (5) All of X, Y and Z

- 21) Two light springs of spring constants  $k_1$  and  $k_2$  are fixed in series with each other and a mass  $m$  is suspended by the compound spring as shown in the figure. When the mass  $m$  is displaced slightly vertically downwards and released, the amplitude of the simple harmonic motion of  $m$  at point X is,

- (1)  $\frac{mg}{k_1} - \frac{Ak_2}{(k_1 + k_2)}$  (2)  $\frac{mg}{k_1} + \frac{Ak_2}{(k_1 + k_2)}$  (3)  $\frac{k_1 A}{(k_1 + k_2)}$  (4)  $\frac{k_2 A}{(k_1 + k_2)}$  (5)  $\frac{mg}{k_1} + \frac{Ak_2}{k_1}$

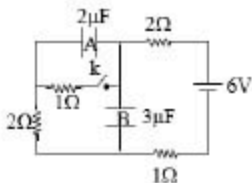


- 22) A well thermally insulated rod made of a material of thermal conductivity  $k$  is shown in the figure. The graph of variation of temperature with distance from A to B is

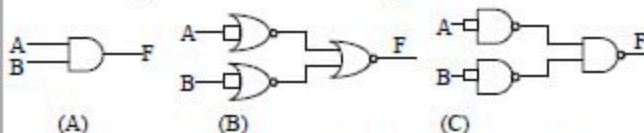
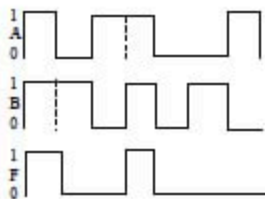


- 23) In the following circuit, when the key  $k$  is closed and when the key  $k$  is opened, the charges stored in the two capacitors A and B are

When the switch $k$ is closed	When the switch $k$ is opened
(1) $A = 2 \mu\text{C}$ , $B = 0 \mu\text{C}$	$A = 0 \mu\text{C}$ , $B = 9 \mu\text{C}$
(2) $A = 0 \mu\text{C}$ , $B = 3 \mu\text{C}$	$A = 2 \mu\text{C}$ , $B = 3 \mu\text{C}$
(3) $A = 2 \mu\text{C}$ , $B = 9 \mu\text{C}$	$A = 0 \mu\text{C}$ , $B = 18 \mu\text{C}$
(4) $A = 4 \mu\text{C}$ , $B = 18 \mu\text{C}$	$A = 0 \mu\text{C}$ , $B = 0 \mu\text{C}$
(5) $A = 2 \mu\text{C}$ , $B = 9 \mu\text{C}$	$A = 12 \mu\text{C}$ , $B = 18 \mu\text{C}$



- 24) The output signal  $F$  corresponding to the input signals  $A$  and  $B$  is shown in the figure. Which of the following circuits can achieve this output?



- (1) A only  
(2) B only  
(3) C only  
(4) A and B only  
(5) A and C only

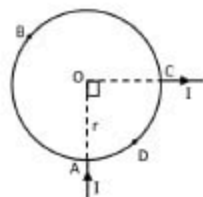
- 25)  ${}_{37}^{88}\text{X} + 2\alpha \longrightarrow {}_m^n\text{Y} + \beta^-$ . The values of  $m$  and  $n$  in this nuclear reaction can be,

	(1)	(2)	(3)	(4)	(5)
$m$	96	42	40	92	41
$n$	42	96	92	40	97

- 26) When the body of a healthy person who died by hanging was found, the temperature of the body was  $35^{\circ}\text{C}$ . After another 25 minutes the body temperature was  $33^{\circ}\text{C}$ . If the body temperature of a healthy living person is  $37^{\circ}\text{C}$  and the surrounding temperature is  $26^{\circ}\text{C}$ , the time elapsed from the death of the person when the body is found can be,

(1) 60 min      (2) 40 min      (3) 30 min      (4) 24 min      (5) 20 min

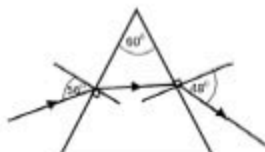
- 27) Figure shows a circular wire frame ABCD in which a current  $I$  is introduced at A and drawn at C. The cross-sectional area of segment ADC is twice the cross-sectional area of segment ABC. The net magnetic flux density at O due to current flow is,



(1)  $\frac{\mu_0 I}{56r}$       (2)  $\frac{3\mu_0 I}{28r}$       (3)  $\frac{3\mu_0 I}{56r}$   
 (4)  $\frac{\mu_0 I}{28r}$       (5) 0

- 28) If the minimum angle of deviation that can be formed by the prism given here is  $D$ , the most correct of the following answers,

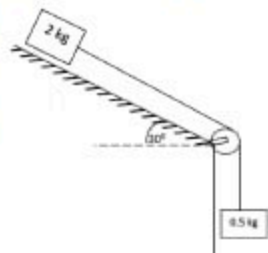
(1)  $D = 60^{\circ}$       (2)  $D > 60^{\circ}$       (3)  $D = 44^{\circ}$   
 (4)  $D < 44^{\circ}$       (5)  $D > 44^{\circ}$



- 29) Relative humidity of air in a container is 80%. The fraction of water vapor that condenses when its volume is halved at constant temperature is,

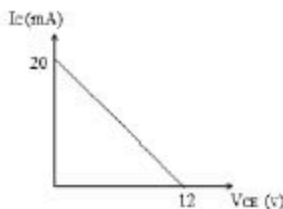
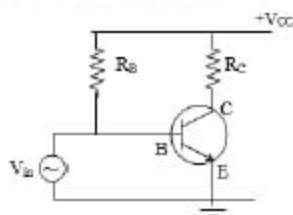
(1) 0.250      (2) 0.005      (3) 0.375      (4) 0.520      (5) 0.200

- 30) The pulley shown in the figure is smooth and the strings are light and inextensible. Coefficient of dynamic friction between the 2 kg mass and the inclined plane on which it is placed is  $\mu$ . If the system moves with constant velocity the value of  $\mu$  can be



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

- 31) Figure shows that the npn transistor is biased to operate according to the half-voltage law in common-emitter configuration.



The graph shows how  $I_C$  varies with  $V_{CE}$  (load line) according to the circuit. If the current gain is 100, then the answer that  $V_{CE}$ ,  $R_C$  and  $I_B$  are correctly specified is,

- (1) 6 V, 600  $\Omega$ , 0.2 mA (2) 12 V, 600  $\Omega$ , 0.1 mA  
(3) 12 V, 300  $\Omega$ , 0.2 mA (4) 6 V, 300  $\Omega$ , 0.1 mA  
(5) 6 V, 600  $\Omega$ , 0.1 mA

- 32) Following is some of the statements made regarding photoelectric effect.

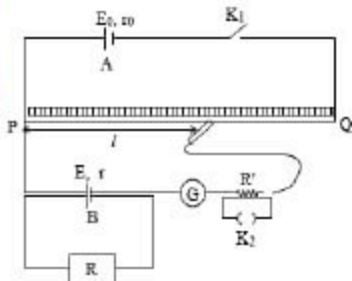
- (A) Regardless of the frequency of the incident radiation, when the radiation intensity exceeds a certain value, the photoelectric effect occurs.  
(B) The work function depends only on the type of metal.  
(C) The stopping potential of a photo metal increases as the frequency of incident photons increases.

Which of the above statements is true?

- (1) A only (2) B only (3) C only  
(4) B and C only (5) A and C only

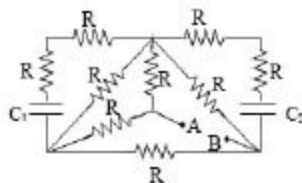
- 33) This circuit shows the circuit arrangement for the experiment to find the internal resistance( $r$ ) of cell B. For which of the following events can the balance length  $l$  remain the same even if the value of the resistance box  $R$  is changed?

- (1) The electromotive force of cell B is less than the electromotive force of cell A.  
(2)  $K_2$  plug key is opened.  
(3)  $K_1$  plug key is closed.  
(4) The internal resistance of cell A is negligible.  
(5) The internal resistance of cell B is negligible.



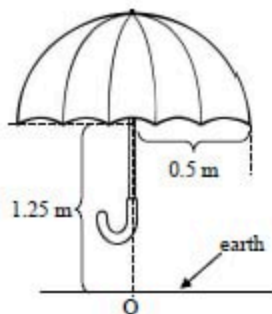
- 34) A potential difference of 6v is provided between A and B. The capacitances of  $C_1$  and  $C_2$  are  $2\mu F$  and  $6\mu F$  respectively. If the energy stored in  $C_2$  is,

- (1) 18  $\mu J$  (2) 24  $\mu J$   
(3) 27  $\mu J$  (4) 30  $\mu J$   
(5) 36  $\mu J$



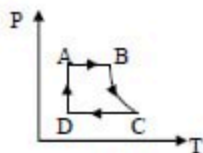
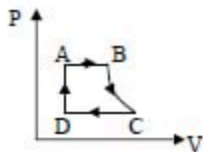
- 35) An umbrella raised on a rainy day is held by the handle and rotated with a velocity of  $2 \text{ rad s}^{-1}$ . The radius of the frame of the umbrella is 0.5 m. The umbrella frame has a height of 1.25 m from the ground level. When a drop of water thrown from the frame of umbrella, it hits the ground, the distance from point O which is vertically down to the center of umbrella to that point is,

- (1) 0.25 m (2)  $\sqrt{0.5}$  m (3) 0.5 m  
(4) 1.5 m (5)  $\sqrt{1.5}$  m

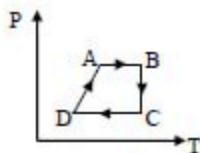




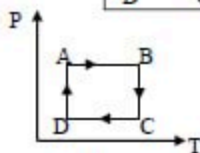
- 36) A pressure ( $P$ ) - volume ( $V$ ) curve of a constant mass of air is shown in the figure. The corresponding graph showing the variation of pressure ( $P$ ) versus absolute temperature ( $T$ ) is,



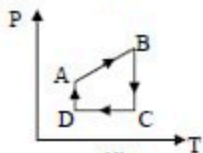
(1)



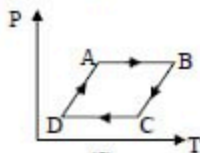
(2)



(3)



(4)



(5)

- 37) A drop of mercury of radius  $R$  falling on the ground at a height  $H$  above the ground is separated into  $n$  number of small droplets. Density of mercury is  $\rho$ . Also assuming no loss of energy in the form of sound energy or thermal energy, the surface tension  $T$  for mercury can be expressed as,

(1)  $\frac{\rho g H R}{4[n^{\frac{1}{3}} - 1]}$

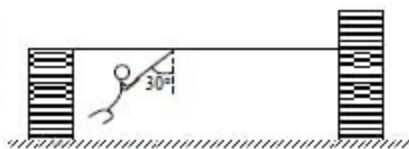
(2)  $\frac{2\rho g H R}{3[n^{\frac{1}{3}} - 1]}$

(3)  $\frac{\rho g H R}{3[n^{\frac{2}{3}} - 1]}$

(4)  $\frac{2\rho g H R}{4[n^{\frac{1}{3}} + 1]}$

(5)  $\frac{\rho g H R}{3[n^{\frac{1}{3}} - 1]}$

- 38) A man is accelerating along a string stretched horizontally between two tall buildings. What is the forward acceleration of the man when the man is inclined at an angle of  $30^\circ$  to the vertical?



(1)  $\sqrt{3} g$

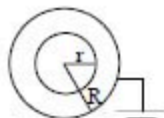
(2)  $2\sqrt{3} g$

(3)  $\frac{g}{\sqrt{3}}$

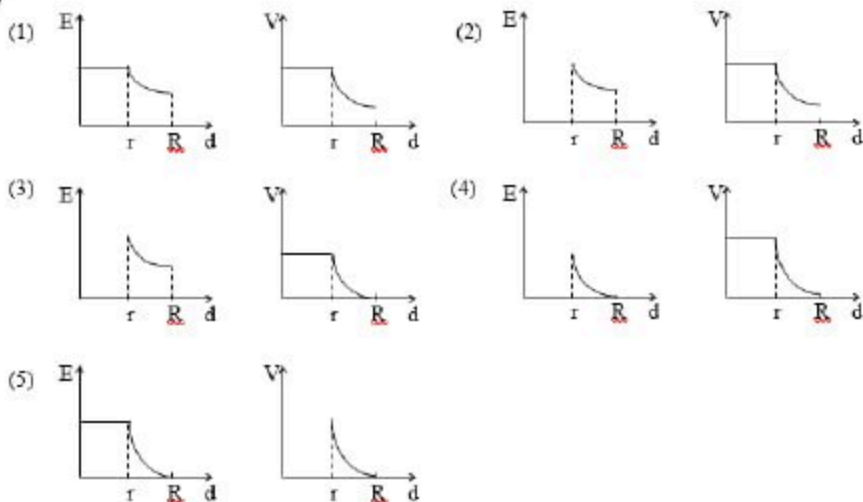
(4)  $\frac{g}{2\sqrt{3}}$

(5)  $g$

- 39) Figure shows two monocentric hollow conducting spheres of radii  $r$  and  $R$  ( $R > r$ ) and the outer sphere is grounded. Choose the answer that correctly shows the variation of electric field intensity ( $E$ ) and potential ( $V$ ) with distance ( $d$ ) from the center when the inner sphere is given a charge of  $+Q$ .







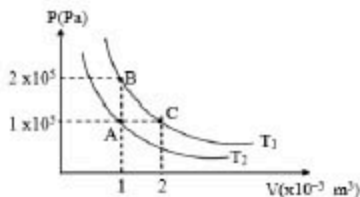
40) Consider the following statements.

- A) The surface tension of a liquid increases with temperature.
- B) Liquids tend to minimize their surface area.
- C) The potential energy of liquid molecules at the surface of a liquid is greater than the potential energy of liquid molecules inside the liquid.

Of the above statements, the correct statement/s is /are

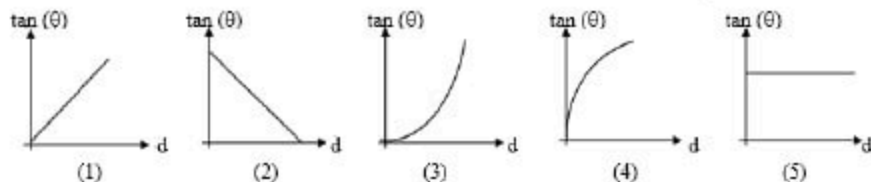
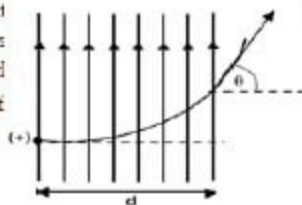
- (1) A only
- (2) B only
- (3) C only
- (4) B and C only
- (5) A and C only

41) Pressure (P)-Volume (V) curves of a given mass of a gas at two temperatures  $T_1$  and  $T_2$  are shown in figure. T is absolute temperature. Choose the false statement from the following statements.

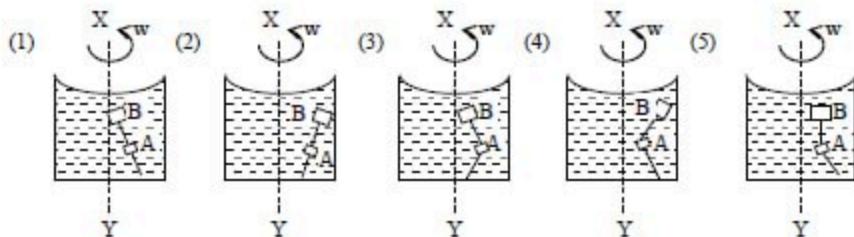
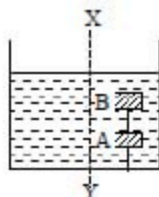


- (1) The temperature  $T_1$  is twice the temperature  $T_2$ .
- (2)  $PV/T$  is constant at all points in both graphs.
- (3) As the gas expands from B to C, there is no transfer of energy from the surroundings to the gas as shown by curve BC.
- (4) As the gas changes from A to B along the vertical line AB, no work is done by the gas.
- (5) The work done to move the gas horizontally from state A to state C is 100 J.

- 42) A positive (+) charge projected perpendicular to a uniform electric field spread over a width  $d$  moves with a deflection and travels a parabolic path as shown in the figure. It exits the field with angle  $\theta$  with direction perpendicular to the field. The graph  $t$  best represents the variation of  $\tan(\theta)$  with  $d$ ,



- 43) A small object A with a density greater than the density of water and an object B with a density less than the density of water are balanced by a light inelastic string slightly apart from the center of the bottom of a vessel containing water as shown in the diagram. Which diagram shows the exact position of A and B along the string when the system moves with constant angular velocity about the vertical axis XY?

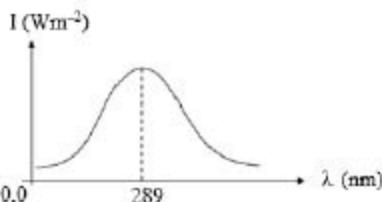


- 44) The statements are given for Field Effect Transistor (FET) and Bipolar Junction Transistor (BJT). Select the correct answer from the following statements.

	Bipolar Junction Transistor (BJT)	Field Effect Transistor (FET)
(1)	There are two p - n junctions.	There are two p - n junctions.
(2)	Both p - n junctions are forward biased during biasing.	One p - n junction is present, reverse biasing works during biasing.
(3)	One p - n junction is forward biased and the other p - n junction is reverse biased.	One p - n junction is present, reverse biasing works during biasing.
(4)	Current and voltage can be amplified.	Cannot be used as an amplifier circuit.
(5)	One p - n junction is forward biased and the other is reverse biased.	One p - n junction is present, and it is forward biased.

- 45) The curve shows how the intensity of radiation varies with wavelength at a given temperature. What is the total intensity of radiation emission of the object at this temperature?

Wien displacement constant =  $2.89 \times 10^{-3} \text{ mK}$   
 Stefan constant =  $5.67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^{-4}$

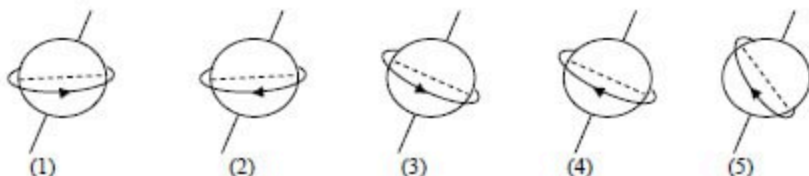


- (1)  $5.67 \times 10^7 \text{ Wm}^{-2}$  (2)  $56.7 \times 10^7 \text{ Wm}^{-2}$   
 (3)  $5.67 \times 10^9 \text{ Wm}^{-2}$  (4)  $56.7 \times 10^8 \text{ Wm}^{-2}$   
 (5)  $5.67 \times 10^8 \text{ Wm}^{-2}$
- 46) A small object of mass  $m$  is suspended from one end of a light elastic string of considerable elasticity and is suspended at the other end. The unstretched length of the string is  $l$  and the elastic spring constant is  $k$ . If the mass  $m$  moves on the vertical plane, the velocity  $u$  must be given at the lowest point so that it barely reaches the top position is correctly expressed as,

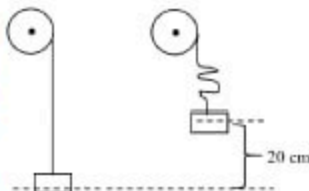


- (1)  $u = \sqrt{4gl - \frac{mg^2}{2k}}$  (2)  $u = \sqrt{\frac{mg^2}{2k} - 2gl}$   
 (3)  $u = \sqrt{2gl + \frac{mg^2}{k}}$  (4)  $u = \sqrt{2gl + \frac{mg^2}{2k}}$   
 (5)  $u = \sqrt{4gl + \frac{mg^2}{k}}$

- 47) The answer that best represents the trajectory and direction of a geostationary satellite orbiting the Earth is,

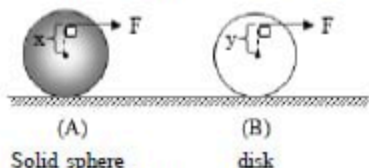


- 48) A string is fixed to a point of a cylinder of mass  $10 \text{ kg}$  and radius  $20 \text{ cm}$ , and it is wrapped several times around the cylinder. A mass of  $5 \text{ kg}$  is tied to the other end of the inextensible string. The cylinder is mounted so that it can rotate about a horizontal axis which goes through its axis. When a mass of  $5 \text{ kg}$  is suddenly lifted and released from a height of  $20 \text{ cm}$ , the total kinetic energy of the system after the string is stretched, (moment of inertia of a solid cylinder of mass  $m$  and radius  $r$  is  $\frac{1}{2}mr^2$ )



- (1)  $3 \text{ J}$  (2)  $5 \text{ J}$  (3)  $6 \text{ J}$  (4)  $15 \text{ J}$  (5)  $20 \text{ J}$

- 49) A uniform disk and uniform solid sphere of mass  $M$  and radius  $R$  are placed on a rough surface and equal forces  $F$  are applied as shown in the figure. Both objects are rolling without slipping.



Consider the following statements.

- A) When  $x = 2/5R$  the frictional force on the sphere is zero and when  $y = R$  the frictional force on the disc is in the forward direction.
- B) When  $y = R/2$  the frictional force on the disc is zero and when  $X = 2/5R$  the frictional force on the sphere is in the backward direction.
- C) When  $x = 2/5R$  the frictional force on the sphere is zero and when  $y = R/2$  the frictional force on the disk is zero.

The correct statement/s is/are

- (1) A only                      (2) B only                      (3) C only
- (4) A and C only            (5) A and B only
- 50) A closed loop of wire enters a uniform magnetic field as shown in the figure. The graph of induced emf ( $E$ ) with time ( $t$ ) is,

