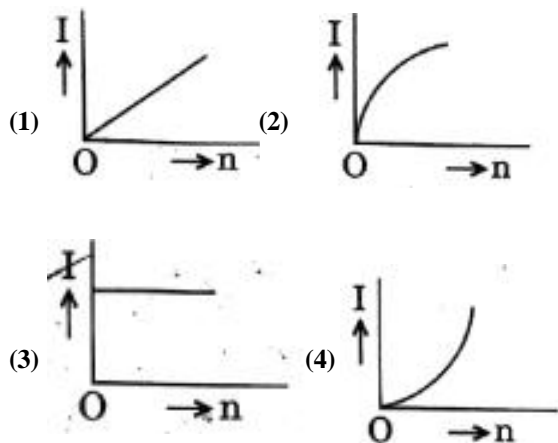


**Part - A (Physics)**

91. A battery consists of a variable number  $n$  of identical cells (having internal resistance  $r$  each) which are connected in series. The terminals of the battery are short-circuited and the current  $I$  is measured. Which of the graphs show the correct relationships between  $I$  and  $n$ ?



Ans: [3]

92. A carbon resistor of  $(45 \pm 4.7) k\Omega$  is to be marked with rings of different colours for its identification. The colour code sequence will be

- (1) Yellow - Violet - Orange - Silver
- (2) Yellow - Green - Violet - Gold
- (3) Violet - Yellow - Orange - Gold
- (4) Green - Orange - Violet - Gold

Ans: [1]

3. A set of  $n$  equal resistors of value  $R$  each are connected in series to a battery of emf  $E$  and internal resistance  $R$ . The current drawn is  $I$ . Now, the  $n$  resistors are connected in parallel to the same battery. Then the current drawn from battery becomes  $10 I$ . The value of  $n$  is

- (1) 11
- (2) 20
- (3) 10
- (4) 9

Ans: [3]

4. An em wave is propagating in a medium with a velocity  $\vec{v} = v\hat{i}$ . The instantaneous oscillating electric field of this em wave is along  $+y$  axis. Then the direction of oscillating magnetic field of the em wave will be along

- (1)  $+z$  direction
- (2)  $-y$  direction
- (3)  $-z$  direction
- (4)  $-x$  direction

Ans: [1]

95. The magnetic potential energy stored in a certain inductor is 25 mJ. when the current in the inductor is 60 mA. This inductor is inductance .

- (1) 138.88 H
- (2) 1.389 H
- (3) 0.138 H
- (4) 13.89 H

Ans: [4]

96. The refractive index of the material of a prism is  $\sqrt{2}$  and the angle of the prism is  $30^\circ$ . One of the two refracting surfaces of the prism is made a mirror inwards., by silver coating. A beam of monochromatic light entering the prism from other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is

- (1)  $45^\circ$
- (2)  $30^\circ$
- (3)  $60^\circ$
- (4) zero

Ans: [1]

97. An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm. If the object is displaced through a distance of 20 cm towards the mirror, the displacement of the image will

- (1) 36 cm away from the mirror
- (2) 30 cm towards the mirror
- (3) 30 cm away from the mirror
- (4) 36 cm towards the mirror

Ans: [1]

98. An electron of mass  $m$  with an initial velocity  $\vec{v} = V_0 \hat{i}$  ( $V_0 > 0$ ) enters an electric field  $\vec{E} = -E_0 \hat{i}$  ( $E_0 = \text{constant} > 0$ ) at  $t = 0$ . If  $\lambda_0$  is its de-Broglie wavelength initially, then its de-Broglie wavelength at time  $t$  is

- (1)  $\lambda_0 \left( 1 + \frac{eE_0}{mV_0} t \right)$
- (2)  $\lambda_0 t$
- (3)  $\frac{\lambda_0}{\left( 1 + \frac{eE_0}{mV_0} t \right)}$
- (4)  $\lambda_0$

Ans: [3]

99. When the light of frequency  $2\nu_0$  (where  $\nu_0$  is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is  $\nu_1$ . When the frequency of the incident radiation is increased to  $5\nu_0$ , the maximum velocity of electrons emitted from the same plate is  $\nu_2$ . The ratio of  $\nu_1$  to  $\nu_2$  is

- (1) 1 : 4
- (2) 4 : 1
- (3) 1 : 2
- (4) 2 : 1

Ans: [3]



100. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is

- (1) 1 : -1                      (2) 2 : -1  
(3) 1 : 1                        (4) 1 : -2

**Ans: [1]**

101. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is

- (1) 10                              (2) 30  
(3) 20                              (4) 15

**Ans: [3]**

102. Unpolarised light is incident from air on a plane surface of a material of refractive index  $\mu$ . At a particular angle of incidence  $i$ . It is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation?

(1) Reflected light is polarised with its electric vector perpendicular to the plane of incidence

(2)  $i = \sin^{-1}\left(\frac{1}{\mu}\right)$

(3) Reflected light is polarised with its electric vector parallel to the plane of incidence

(4)  $i = \tan^{-1}\left(\frac{1}{\mu}\right)$

**Ans: [1]**

103. In Young's double slit experiment the separation  $d$  between the slits is 2 mm, the wavelength  $\lambda$  of the light used is  $5896 \text{ \AA}$  and distance  $D$  between the screen and slits is 100 cm. It is found that the angular width of the fringes is  $0.20^\circ$ . To increase the fringe angular width to  $0.21^\circ$  (with same  $\lambda$  and  $D$ ) the separation between the slits needs be changed to

- (1) 1.9 mm                      (2) 2.1 mm  
(3) 1.8 mm                      (4) 1.7 mm

**Ans: [1]**

104. An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of

- (1) large focal length and small diameter  
(2) large focal length and large diameter  
(3) small focal length and large diameter  
(4) small focal length and small diameter.

**Ans: [2]**

105. An inductor 20 mH, a capacitor  $100 \mu\text{F}$  and a resistor  $50 \Omega$  are connected in series across a source of emf,

$$V = 10 \sin 314 t .$$

- The power loss in the circuit is  
(1) 0.43 W                      (2) 2.74 W  
(3) 0.79 W                      (4) 1.13 W

**Ans: [3]**

16. A metallic rod of mass per unit length  $0.5 \text{ kg m}^{-1}$  is lying horizontally on a smooth inclined plane which makes an angle of  $30^\circ$  with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing in the rod to keep it stationary is

- (1) 5.98 A                        (2) 14.76 A  
(3) 7.14 A                        (4) 11.32 A

**Ans: [4]**

107. Current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is

- (1)  $25 \Omega$                         (2)  $250 \Omega$   
(3)  $40 \Omega$                         (4)  $500 \Omega$

**Ans: [2]**

108. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from

- (1) the magnetic field  
(2) the lattice structure of the material of the rod  
(3) the current source  
(4) the induced electric field due to the change magnetic field.

**Ans: [4]**

109. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston room temperature of  $27^\circ\text{C}$  two successive resonances are produced at 20 cm and 74 cm column length. If the frequency of the tuning is 320 Hz, the velocity of sound in air at  $27^\circ\text{C}$

- (1) 339 m/s                      (2) 350 m/s  
(3) 330 m/s                      (4) 300 m/s

**Ans: [1]**

110. An electron falls from rest through a vertically distance  $h$  in a uniform and vertically upward directed electric field  $E$ . The direction of electric field is now reversed, keeping its magnitude same. A proton is allowed to fall from rest, in it through the same vertical distance  $h$ . The time fall of the electron, in comparison to the time of fall of the proton is

- (1) 5 times greater                      (2) 10 times greater  
 (3) smaller                                (4) equal

**Ans: [3]**

111. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is  $20 \text{ m/s}^2$  at a distance of 5 m from the mean position. The time period of oscillation is

- (1)  $f$  s                                        (2) 2 s  
 (3)  $2f$  s                                      (4)  $1f$  s

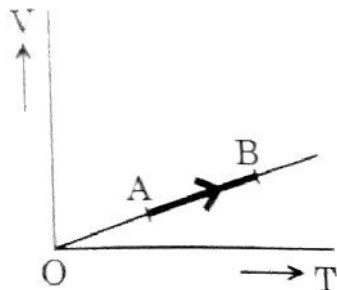
**Ans: [1]**

112. The electrostatic force between the metal plates of an isolated parallel plate capacitor  $C$  having a charge  $Q$  and area  $A$  is

- (1) linearly proportional to the distance between the plates  
 (2) proportional to the square root of the distance between the plates  
 (3) independent of the distance between the plates  
 (4) inversely proportional to the distance between the plates

**Ans: [3]**

113. The volume ( $V$ ) of a monatomic gas varies with its temperature ( $T$ ), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B is



- (1)  $2/3$                                         (2)  $1/3$   
 (3)  $2/5$                                       (4)  $2/7$

**Ans: [3]**

114. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is

- (1) 20%                                        (2) 6.25%  
 (3) 26.8%                                    (4) 12.5%

**Ans: [3]**

115. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere ?

(Given :

Mass of oxygen molecule ( $m$ )  $2.76 \times 10^{-26} \text{ kg}$

Boltzmann's constant  $k_B = 1.38 \times 10^{-23} \text{ J K}^{-1}$ )

- (1)  $8.360 \times 10^4 \text{ K}$                         (2)  $5.016 \times 10^4 \text{ K}$   
 (3)  $2.508 \times 10^4 \text{ K}$                         (4)  $1.254 \times 10^4 \text{ K}$

**Ans: [1]**

116. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm; the length of the open organ pipe is

- (1) 8 cm                                        (2) 12.5 cm  
 (3) 13.2 cm                                    (4) 16 cm

**Ans: [3]**

117. Two wires are made of the same material have the same volume. the first wire cross-sectional area  $a$  and the second wire cross-sectional area  $3A$ . If the length of the wire is increased by  $\Delta l$  on applying a force  $F$  for how much force is needed to stretch the same wire by the same amount ?

- (1)  $6F$                                         (2)  $4F$   
 (3)  $9F$                                         (4)  $F$

**Ans: [3]**

118. a sample of 0.1 g of water at  $100^\circ\text{C}$  and no pressure ( $1.013 \times 10^5 \text{ Nm}^{-2}$ ) requires 54 heat energy to convert to steam at  $100^\circ\text{C}$ . If volume of the steam produced is 167.1 cm change in internal energy of the sample, is

- (1) 208.7 J                                    (2) 42.2 J  
 (3) 104.3 J                                    (4) 84.5 J

**Ans: [1]**

119. The power radiated by a black body is  $P$  at wavelength  $\lambda_0$  radiates maximum energy at wavelength  $\lambda_0$ . If the temperature of the black body is changed so that it radiates maximum energy wavelength  $\frac{3}{4}\lambda_0$ , the power radiated by becomes  $nP$ . The value of  $n$  is

- (1)  $\frac{4}{3}$                       (2)  $\frac{256}{81}$   
 (3)  $\frac{3}{4}$                       (4)  $\frac{81}{5256}$

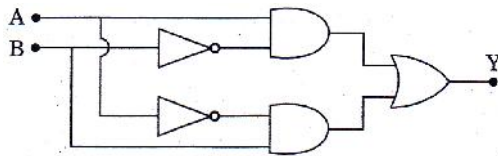
Ans: [2]

120. A small sphere of radius 'r' falls from rest in a viscous liquid. As a result, heat is produced to overcome viscous force. The rate of production of heat when the sphere attains its terminal velocity is proportional to

- (1)  $r^2$                       (2)  $r^5$   
 (3)  $r^3$                       (4)  $r^4$

Ans: [2]

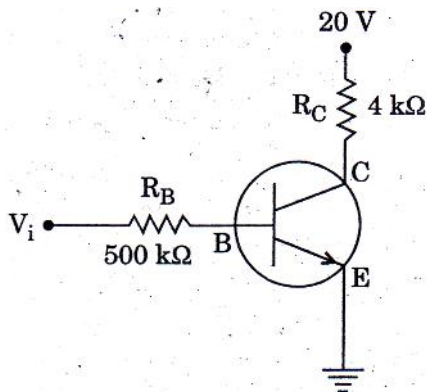
121. In the combination of the following gates the output  $Y$  can be written in terms of inputs  $A$  and  $B$  as



- (1)  $A \cdot \bar{B} + \bar{A} \cdot B$                       (2)  $\overline{A \cdot B} + A \cdot B$   
 (3)  $\overline{A \cdot B}$                       (4)  $\overline{A + B}$

Ans: [1]

122. In the circuit shown in the figure, the input voltage  $V_i$  is 20 V,  $V_{BE} = 0$  and  $V_{CE} = 0$ . The values of  $I_B$ ,  $I_C$  and  $\beta$  are given by



(1)  $I_B = 25 \mu A, I_C = 5 mA, \beta = 200$

(2)  $I_B = 20 \mu A, I_C = 5 mA, \beta = 250$

(3)  $I_B = 40 \mu A, I_C = 10 mA, \beta = 250$

(4)  $I_B = 40 \mu A, I_C = 5 mA, \beta = 125$

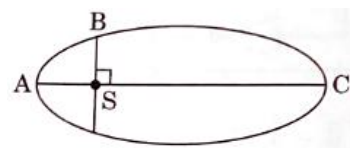
Ans: [4]

123. In a p-n junction diode, change in temperature due to heating

- (1) affects only forward resistance  
 (2) does not affect resistance of p-n junction  
 (3) affects only reverse resistance  
 (4) affects the overall  $V - I$  characteristics of p-n junction

Ans: [4]

124. The kinetic energies of a planet in all elliptical orbit about the Sun, at positions A, B and C are  $K_A, K_B$  and  $K_C$ , respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then



- (1)  $K_A > K_B > K_C$                       (2)  $K_B > K_A > K_C$   
 (3)  $K_B < K_A < K_C$                       (4)  $K_B > K_A > K_C$

Ans: [1]

125. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy ( $K_t$ ) as well as rotational kinetic energy ( $K_r$ ) simultaneously. The ratio  $K_t : (K_t + K_r)$  for the sphere is

- (1) 5 : 7                      (2) 10 : 7  
 (3) 7 : 10                      (4) 2 : 5

Ans: [1]

126. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is **not** correct?

- (1) Walking on the ground would become more difficult  
 (2) Time period of a simple pendulum on the Earth would decrease  
 (3) Raindrops will fall faster  
 (4) 'g' on the Earth will not change

**Ans: [4]**

127. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?

- (1) Moment of inertia      (2) Rotational kinetic energy  
 (3) Angular velocity      (4) Angular momentum

**Ans: [4]**

128. The moment of the force,  $\vec{F} = 4\hat{i} + 5\hat{j} - 6\hat{k}$  at  $(2, 0, -3)$ , about the point  $(2, -2, -2)$ , is given by

- (1)  $-4\hat{i} - \hat{j} - 8\hat{k}$       (2)  $-7\hat{i} - 8\hat{j} - 4\hat{k}$   
 (3)  $-8\hat{i} - 4\hat{j} - 7\hat{k}$       (4)  $-7\hat{i} - 4\hat{j} - 8\hat{k}$

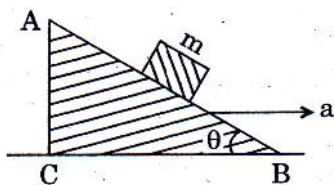
**Ans: [4]**

129. A toy car with charge  $q$  moves on a frictionless horizontal plane surface under the influence of a uniform electric field  $\vec{E}$ . Due to the force  $q\vec{E}$ , its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed. The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively

- (1) 1 m/s, 3 m/s      (2) 1 m/s, 3.5 m/s  
 (3) 2 m/s, 4 m/s      (4) 1.5 m/s, 3 m/s

**Ans: [1]**

130. A block of mass  $m$  is placed on a smooth inclined wedge ABC of inclination  $\theta$  as shown in the figure. The wedge is given an acceleration 'a' towards the right. The relation between  $a$  and  $\theta$  for the block to remain stationary on the wedge is



- (1)  $a = \frac{g}{\sin \theta}$       (2)  $g = g \cos \theta$

- (3)  $a = \frac{g}{\operatorname{cosec} \theta}$       (4)  $a = g \tan \theta$

**Ans: [4]**

131. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of -0.004 cm, the correct diameter of the ball is

- (1) 0.525 cm      (2) 0.053 cm  
 (3) 0.521 cm      (4) 0.529 cm

**Ans: [4]**

132. Three objects, A : (a solid sphere), B : (a thin circular disk) and C (a circular ring), each have the same mass  $M$  and radius  $R$ . They all spin with the same angular speed  $S$  about their own symmetry axes. The amounts of work ( $W$ ) requires to bring them to rest, would satisfy the relation

- (1)  $W_A > W_B > W_C$       (2)  $W_B > W_A > W_C$   
 (3)  $W_C > W_B > W_A$       (4)  $W_A > W_C > W_B$

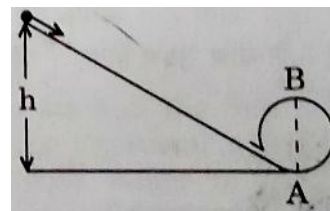
**Ans: [3]**

133. A moving block having mass  $m$ , collides with another stationary block having mass  $4m$ . The lighter block comes to rest after collision. When the initial velocity of the lighter block is  $v$ , then the value of coefficient of restitution ( $e$ ) will be

- (1) 0.25      (2) 0.8  
 (3) 0.5      (4) 0.4

**Ans: [1]**

134. A body initially at rest and sliding along frictionless track from a height  $h$  (as shown in the figure) just completes a vertical circle of diameter  $AB = D$ . The height  $h$  is equal to



- (1)  $D$       (2)  $\frac{7}{5}D$



(3)  $\frac{3}{2}D$

(4)  $\frac{5}{4}D$

**Ans: [4]****135.** Which one of the following statements is **incorrect**?

- (1) Limiting value of static friction is directly proportional to normal reaction
- (2) Frictional force opposes the relative motion
- (3) Rolling friction is smaller than sliding friction
- (4) Coefficient of sliding friction has dimensions of length

**Ans: [4]**