

77. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by

- (1) Only daughters
- ✓(2) Both sons and daughters
- (3) Only grandchildren
- (4) Only sons

78. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA?

- ✓(1) AGGUAUCGCAU
- (2) UCCAUAGCGUA
- (3) ACCUAUGCGAU
- (4) UGGTUTCGCAT

79. Match the items given in Column I with those in Column II and select the correct option given below :

Column I	Column II
a. Proliferative Phase	i. Breakdown of endometrial lining
b. Secretory Phase	ii. Follicular Phase
c. Menstruation	iii. Luteal Phase

- |      | a         | b   | c        |
|------|-----------|-----|----------|
| (1)  | iii       | ii  | <u>i</u> |
| (2)  | iii       | i   | ii       |
| ✓(3) | <u>ii</u> | iii | <u>i</u> |
| (4)  | i         | iii | ii       |

80. According to Hugo de Vries, the mechanism of evolution is

- (1) Multiple step mutations
- (2) Minor mutations
- (3) Phenotypic variations
- (4) Saltation

81. All of the following are part of an operon except

- (1) an operator
- (2) a promoter
- ✓(3) an enhancer
- (4) structural genes

82. Which of the following events does not occur in rough endoplasmic reticulum?

- (1) Protein folding
- ✓(2) Phospholipid synthesis
- (3) Cleavage of signal peptide
- (4) Protein glycosylation

83. Which of these statements is incorrect?

- (1) Enzymes of TCA cycle are present in mitochondrial matrix.
- ✓(2) Oxidative phosphorylation takes place in outer mitochondrial membrane.
- (3) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms.
- (4) Glycolysis occurs in cytosol.

84. Select the incorrect match :

- (1) Lampbrush chromosomes – Diplotene bivalents
- (2) Polytene chromosomes – Oocytes of amphibians
- (3) Submetacentric chromosomes – L-shaped chromosomes
- (4) Allosomes – Sex chromosomes

85. Which of the following terms describe human dentition?

- (1) Thecodont, Diphyodont, Homodont
- (2) Pleurodont, Diphyodont, Heterodont
- (3) Pleurodont, Monophyodont, Homodont
- ✓(4) Thecodont, Diphyodont, Heterodont

86. Nissl bodies are mainly composed of

- (1) Proteins and lipids
- ✓(2) Free ribosomes and RER
- (3) Nucleic acids and SER
- (4) DNA and RNA

87. Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as

- ✓(1) Polysome
- (2) Nucleosome
- (3) Plastidome
- (4) Polyhedral bodies

88. Match the items given in Column I with those in Column II and select the **correct** option given below :

Column I		Column II	
a. Tricuspid valve	i.	Between left atrium and left ventricle	
b. Bicuspid valve	ii.	Between right ventricle and pulmonary artery	
c. Semilunar valve	iii.	Between right atrium and right ventricle	

	a	b	c
(1)	iii	i	<u>ii</u>
(2)	ii	i	iii
(3)	i	ii	iii
(4)	i	iii	<u>ii</u>

89. Match the items given in Column I with those in Column II and select the **correct** option given below :

Column I		Column II	
a. Tidal volume	i.	2500 - 3000 mL	
b. Inspiratory Reserve volume	ii.	1100 - 1200 mL	
c. Expiratory Reserve volume	iii.	500 - 550 mL	
d. Residual volume	iv.	1000 - 1100 mL	

	a	b	c	d
(1)	iii	ii	i	iv
(2)	<u>iv</u>	iii	ii	i
(3)	i	iv	ii	iii
(4)	<u>iii</u>	<u>i</u>	iv	ii

90. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively ?

- (1)  Inflammation of bronchioles; Decreased respiratory surface  
 (2)  Decreased respiratory surface; Inflammation of bronchioles  
 (3)  Increased respiratory surface; Inflammation of bronchioles  
 (4)  Increased number of bronchioles; Increased respiratory surface

91. The stage during which separation of the paired homologous chromosomes begins is

- (1) Pachytene  
 (2) Zygotene  
 (3) Diakinesis  
 (4) Diplotene

92. Which of the following is true for nucleolus ?

- (1) Larger nucleoli are present in dividing cells  
 (2) It is a site for active ribosomal RNA synthesis.  
 (3) It takes part in spindle formation.  
 (4) It is a membrane-bound structure.

93. Stomatal movement is **not** affected by

- (1) Temperature  
 (2) CO<sub>2</sub> concentration  
 (3) O<sub>2</sub> concentration  
 (4) Light

94. Which among the following is **not** a prokaryote ?

- (1) *Saccharomyces*  
 (2) *Oscillatoria*  
 (3) *Nostoc*  
 (4) *Mycobacterium*

95. Which of the following is **not** a product of light reaction of photosynthesis ?

- (1) ATP  
 (2) Oxygen  
 (3) NADPH  
 (4) NADH

96. Stomata in grass leaf are

- (1) Dumb-bell shaped  
 (2) Barrel shaped  
 (3) Rectangular  
 (4) Kidney shaped

97. The Golgi complex participates in

- (1) Fatty acid breakdown  
 (2) Activation of amino acid  
 (3) Respiration in bacteria  
 (4) Formation of secretory vesicles

98. The two functional groups characteristic of sugars are

- (1) hydroxyl and methyl  
 (2) carbonyl and hydroxyl  
 (3) carbonyl and phosphate  
 (4) carbonyl and methyl

99. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to

- (1) Co-667
- (2) Basmati
- (3) Lerma Rojo
- (4) Sharbati Sonora

100. Select the **correct** match :

- (1) Ribozyme - Nucleic acid
- (2) G. Mendel - Transformation
- (3) T.H. Morgan - Transduction
- (4)  $F_2 \times$  Recessive parent - Dihybrid cross

101. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes ?

- (1) Retrovirus
- (2) pBR 322
- (3)  $\lambda$  phage
- (4) Ti plasmid

102. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is

- (1) Indian Council of Medical Research (ICMR)
- (2) Genetic Engineering Appraisal Committee (GEAC)
- (3) Research Committee on Genetic Manipulation (RCGM)
- (4) Council for Scientific and Industrial Research (CSIR)

103. The correct order of steps in Polymerase Chain Reaction (PCR) is

- (1) Extension, Denaturation, Annealing
- (2) Denaturation, Annealing, Extension
- (3) Denaturation, Extension, Annealing
- (4) Annealing, Extension, Denaturation

104. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called

- (1) Bio-infringement
- (2) Bioexploitation
- (3) Biodegradation
- (4) Biopiracy

105. Winged pollen grains are present in

- (1) Mustard
- (2) Pinus
- (3) Mango
- (4) Cycas

106. After karyogamy followed by meiosis, spores are produced exogenously in

- (1) *Neurospora*
- (2) *Saccharomyces*
- (3) *Agaricus*
- (4) *Alternaria*

107. Which one is **wrongly** matched ?

- (1) Uniflagellate gametes - *Polysiphonia*
- (2) Unicellular organism - *Chlorella*
- (3) Gemma cups - *Marchantia*
- (4) Biflagellate zoospores - Brown algae

108. Match the items given in Column I with those in Column II and select the **correct** option given below :

	Column I	Column II
a.	Herbarium	i. It is a place having a collection of preserved plants and animals.
b.	Key	ii. A list that enumerates methodically all the species found in an area with brief description aiding identification.
c.	Museum	iii. Is a place where dried and pressed plant specimens mounted on sheets are kept.
d.	Catalogue	iv. A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

	a	b	c	d
(1)	i	iv	iii	ii
<input checked="" type="checkbox"/> (2)	iii	<input checked="" type="checkbox"/> iv	i	ii
(3)	ii	iv	iii	i
(4)	iii	ii	i	iv

109. What is the role of  $\text{NAD}^+$  in cellular respiration ?

- (1) It functions as an enzyme.
- (2) It is the final electron acceptor for anaerobic respiration. ✗
- (3) It is a nucleotide source for ATP synthesis. ✗
- (4) It functions as an electron carrier. ✓

110. Oxygen is **not** produced during photosynthesis by

- (1) Green sulphur bacteria ✓
- (2) *Chara*
- (3) *Cycas*
- (4) *Nostoc*

111. Double fertilization is

- (1) Fusion of two male gametes of a pollen tube with two different eggs
- (2) Syngamy and triple fusion ✓
- (3) Fusion of two male gametes with one egg
- (4) Fusion of one male gamete with two polar nuclei

112. In which of the following forms is iron absorbed by plants ?

- (1) Ferric
- (2) Both ferric and ferrous
- (3) Free element
- (4) Ferrous

113. Which of the following elements is responsible for maintaining turgor in cells ?

- (1) Magnesium
- (2) Calcium
- (3) Potassium ✓
- (4) Sodium

114. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other ?

- (1) *Hydrilla*
- (2) *Viola*
- (3) Banana
- (4) *Yucca* ✓

115. Pollen grains can be stored for several years in liquid nitrogen having a temperature of

- (1)  $-120^{\circ}\text{C}$
- (2)  $-160^{\circ}\text{C}$
- (3)  $-196^{\circ}\text{C}$  ✓
- (4)  $-80^{\circ}\text{C}$

116. Niche is

- (1) all the biological factors in the organism environment
- (2) the functional role played by the organism where it lives ✓
- (3) the range of temperature that the organism needs to live
- (4) the physical space where an organism lives

117. Which of the following is a secondary pollutant ?

- (1) CO
- (2)  $\text{O}_3$  ✓
- (3)  $\text{SO}_2$
- (4)  $\text{CO}_2$

118. World Ozone Day is celebrated on

- (1) 5<sup>th</sup> June
- (2) 22<sup>nd</sup> April
- (3) 16<sup>th</sup> September
- (4) 21<sup>st</sup> April

119. In stratosphere, which of the following element acts as a catalyst in degradation of ozone and release of molecular oxygen ?

- (1) Carbon
- (2) Oxygen
- (3) Fe
- (4) Cl ✓

120. What type of ecological pyramid would be obtained with the following data ?

Secondary consumer : 120 g

Primary consumer : 60 g

Primary producer : 10 g

- (1) Inverted pyramid of biomass ✓
- (2) Upright pyramid of biomass
- (3) Upright pyramid of numbers
- (4) Pyramid of energy

121. Natality refers to

- (1) Death rate
- (2) Number of individuals entering a habitat
- (3) Number of individuals leaving the habitat
- (4) Birth rate ✓

122. Which of the following has proved helpful in preserving pollen as fossils ?

- (1) Pollenkitt
- (2) Sporopollenin
- (3) Oil content
- (4) Cellulosic intine

123. Which of the following pairs is *wrongly* matched ?

- (1) Starch synthesis in pea : Multiple alleles
- (2) T.H. Morgan : Linkage
- (3) XO type sex Determination : Grasshopper
- (4) ABO blood grouping : Co-dominance

124. Select the *correct* match :

- (1) Alec Jeffreys - *Streptococcus pneumoniae*
- (2) Francois Jacob and Jacques Monod - *Lac operon*
- (3) Matthew Meselson and F. Stahl - *Pisum sativum*
- (4) Alfred Hershey and Martha Chase - TMV

125. Which of the following flowers only once in its life-time ?

- (1) Bamboo species
- (2) Papaya
- (3) Mango
- (4) Jackfruit

126. Select the *correct* statement :

- (1) Franklin Stahl coined the term "linkage".
- (2) Transduction was discovered by S. Altman.
- (3) Spliceosomes take part in translation.
- (4) Punnett square was developed by a British scientist.

127. Offsets are produced by

- (1) Meiotic divisions
- (2) Parthenogenesis
- (3) Parthenocarpy
- (4) Mitotic divisions

128. The experimental proof for semiconservative replication of DNA was first shown in a

- (1) Fungus
- (2) Virus
- (3) Plant
- (4) Bacterium

129. Select the *wrong* statement :

- (1) Cell wall is present in members of Fungi and Plantae.
- (2) Mitochondria are the powerhouse of the cell in all kingdoms except Monera.
- (3) Pseudopodia are locomotory and feeding structures in Sporozoans.
- (4) Mushrooms belong to Basidiomycetes.

130. Casparian strips occur in

- (1) Epidermis
- (2) Endodermis
- (3) Cortex
- (4) Pericycle

131. Which of the following statements is *correct* ?

- (1) Ovules are not enclosed by ovary wall in gymnosperms.
- (2) Stems are usually unbranched in both *Cycas* and *Cedrus*.
- (3) Horsetails are gymnosperms.
- (4) *Selaginella* is heterosporous, while *Salvinia* is homosporous.

132. Pneumatophores occur in

- (1) Halophytes
- (2) Submerged hydrophytes.
- (3) Carnivorous plants
- (4) Free-floating hydrophytes

133. Sweet potato is a modified

- (1) Stem
- (2) Rhizome
- (3) Tap root
- (4) Adventitious root

134. Secondary xylem and phloem in dicot stem are produced by

- (1) Apical meristems
- (2) Axillary meristems
- (3) Phellogen
- (4) Vascular cambium

135. Plants having little or no secondary growth are

- (1) Grasses
- (2) Cycads
- (3) Conifers
- (4) Deciduous angiosperms

$$E \propto A^2$$

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

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

$$\frac{P_1}{T_1^4} = \frac{P_2}{T_2^4}$$

$$\frac{P}{T^4} = \frac{nP}{(4/3 T)^4}$$

$$P = \frac{nP}{(4/3)^4}$$

$$1 = \frac{n}{(4/3)^4}$$

$$n = (4/3)^4 = \frac{256}{81}$$

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

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

$$A l_1 = 3 A l_2$$

$$l_2 = l_1 / 3$$

138. A sample of 0.1 g of water at  $100^\circ\text{C}$  and normal pressure ( $1.013 \times 10^5 \text{ Nm}^{-2}$ ) requires 54 cal of heat energy to convert to steam at  $100^\circ\text{C}$ . If the volume of the steam produced is 167.1 cc, the change in internal energy of the sample, is

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

$$E = \Delta U + P \Delta V$$

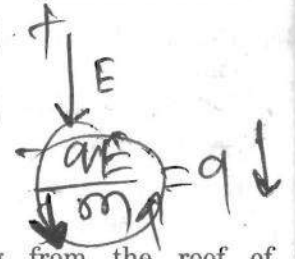
$$\Delta U = 54 \times 4.2 + (167.1 \times 10^{-6}) \times 1.013 \times 10^5$$

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

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

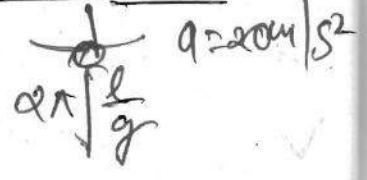
140. An electron falls from rest through a vertical distance h in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance h. The time of fall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

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



141. 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)  $2\pi \text{ s}$
- (2) 1 s
- (3) 2 s
- (4)  $\pi \text{ s}$

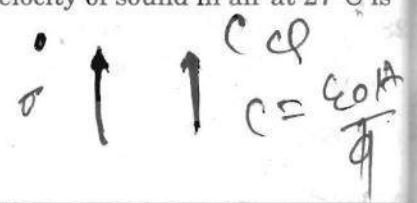


142. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is

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

143. 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. At room temperature of  $27^\circ\text{C}$  two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at  $27^\circ\text{C}$  is

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



$$226.8 - 170.3 = 56.5$$

$$\Delta E = \frac{108}{216} \times 226.8$$

$$167 \times 10^{-3} \times 1.013 \times 10^5 \times 0.3$$

$$17034$$

$$\frac{102 \times 167}{214}$$

$$17034$$

144. 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) 1 : -2
- (3) 2 : -1
- (4) 1 : -1

$\text{KE} = -KE$

145. 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  $v_1$ . When the frequency of the incident radiation is increased to  $5\nu_0$ , the maximum velocity of electrons emitted from the same plate is  $v_2$ . The ratio of  $v_1$  to  $v_2$  is

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

$2h\nu_0 - h\nu_0 = \frac{1}{2}mv_1^2$   
 $4h\nu_0 - h\nu_0 = \frac{1}{2}mv_2^2$

146. 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) 20
- (2) 15
- (3) 30
- (4) 10

$\frac{180}{600} = \left(\frac{1}{2}\right)^{t/10} \Rightarrow \left(\frac{1}{2}\right)^{t/10} = \left(\frac{1}{2}\right)^{1.5}$

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

$i = \frac{eE_0 t}{m}$   
 $\lambda = \frac{h}{m(V_0 + \frac{eE_0 t}{m})}$

148. 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) 0.79 W
- (2) 1.13 W
- (3) 2.74 W
- (4) 0.43 W



149. 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) 7.14 A
- (2) 11.32 A
- (3) 14.76 A
- (4) 5.98 A

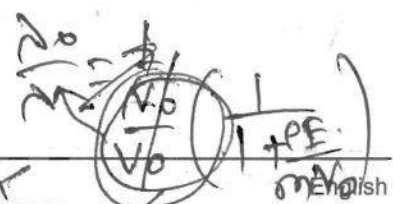
$aBL \sin \theta = mg$

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

151. 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) 40  $\Omega$
- (2) 500  $\Omega$
- (3) 250  $\Omega$
- (4) 25  $\Omega$



$v = v_0 + \left(\frac{eE_0}{m}\right)t$   
 $\lambda = \frac{h}{m\left(v_0 + \frac{eE_0}{m}t\right)}$

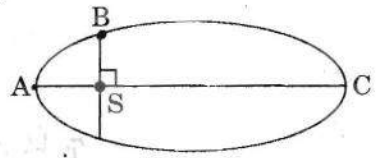
$$\frac{1}{2} M V^2$$

$$\frac{1}{2} M V^2 \quad \frac{1}{2} (2 M V^2) \quad \frac{1}{2} (2 M V^2)$$

152. 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  $\frac{K_t}{K_t + K_r}$  for the sphere is

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

153. The kinetic energies of a planet in an 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)  $K_A > K_B > K_C$

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

155. 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) Angular velocity
- ✓ (2) Angular momentum
- (3) Rotational kinetic energy
- (4) Moment of inertia

156. 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 parallel to the plane of incidence
- (2)  $i = \tan^{-1}\left(\frac{1}{\mu}\right)$
- (3)  $i = \sin^{-1}\left(\frac{1}{\mu}\right)$
- (4) Reflected light is polarised with its electric vector perpendicular to the plane of incidence

$$d = 2 \text{ mm}$$

157. In Young's double slit experiment the separation  $d$  between the slits is 2 mm, the wavelength  $\lambda$  of the light used is 5896 Å 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 to be changed to

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

$$\frac{0.21}{0.20} = \frac{d}{2}$$

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

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

$$1.9 \times 10^9 \quad \theta = \frac{0.40}{21} = \frac{40}{21} = \frac{80}{42} = \frac{40}{21} = 1.90$$



$\frac{1}{2}mv^2$      $\frac{1}{2}mv^2 \left( \frac{2}{5} + 1 \right)$      $\frac{1}{2}mv^2$      $\frac{1}{2} \frac{mv^2}{3}$

159. A carbon resistor of  $(47 \pm 4.7) \text{ k}\Omega$  is to be marked with rings of different colours for its identification. The colour code sequence will be
- (1) Violet - Yellow - Orange - Silver
  - (2) Green - Orange - Violet - Gold
  - (3) Yellow - Green - Violet - Gold
  - (4) Yellow - Violet - Orange - Silver

160. 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) 10
  - (2) 9
  - (3) 20
  - (4) 11

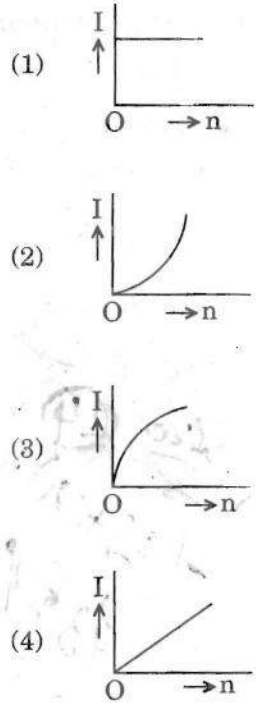
$$R + R(n) = \frac{E}{I}$$

$$R + nR = \frac{E}{I}$$

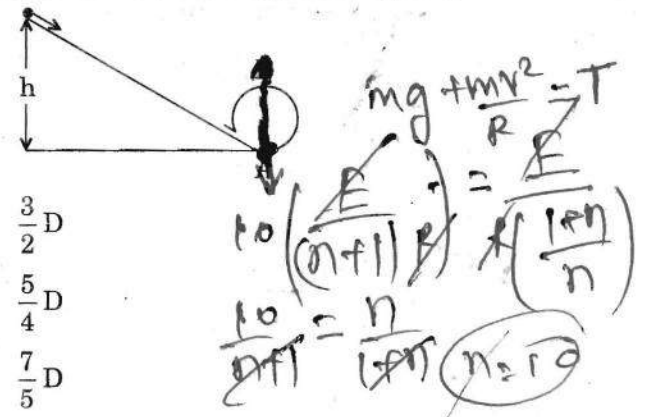
$$R(1+n) = \frac{E}{I}$$

$$R = \frac{E}{I(1+n)}$$

161. 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 shows the correct relationship between I and n?



162. A body initially at rest and sliding along a 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)  $\frac{3}{2}D$
- (2)  $\frac{5}{4}D$
- (3)  $\frac{7}{5}D$
- (4) D

163. 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  $\omega$  about their own symmetry axes. The amounts of work (W) required to bring them to rest, would satisfy the relation

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

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

$$I_{\text{sphere}} = \frac{2}{5} MR^2$$

$$I_{\text{disk}} = \frac{1}{2} MR^2$$

$$I_{\text{ring}} = MR^2$$

164. Which one of the following statements is incorrect?
- (1) Rolling friction, is smaller than sliding friction.
  - (2) Coefficient of sliding friction has dimensions of length.
  - (3) Frictional force opposes the relative motion.
  - (4) Limiting value of static friction is directly proportional to normal reaction.

165. 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) 0.5
  - (2) 0.4
  - (3) 0.8
  - (4) 0.25

$$mv = 4mV_1$$

$$v = 4V_1$$

$$e = \frac{v_2 - v_1}{u_2 - u_1}$$

$$0 = \frac{v_2 - 0}{0 - v}$$

$$0 = \frac{v_2}{-v}$$

$$v_2 = -v$$

English  
 $v_2 = v_1$   
 $0 = v_2$

166. 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) -x direction
- (3) -y direction
- (4) +z direction

167. 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 the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is

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

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

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

$$\frac{1}{15} = \frac{1}{v} + \left(-\frac{4}{40}\right)$$

$$\frac{1}{v} = \frac{11}{15} + \frac{1}{40}$$

169. 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 be

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

Handwritten calculations for Q169:

$$\frac{1}{15} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{1}{15} = \frac{1}{40} + \frac{1}{v}$$

$$\frac{1}{v} = \frac{40-15}{15 \times 40} = \frac{25}{600}$$

$$v = \frac{600}{25} = 24 \text{ cm}$$

When object is displaced 20 cm towards the mirror,  $u = 20$  cm.

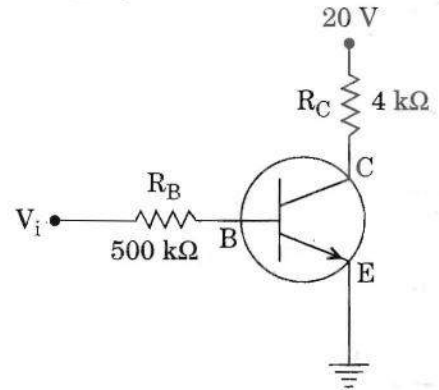
$$\frac{1}{15} = \frac{1}{20} + \frac{1}{v'}$$

$$\frac{1}{v'} = \frac{20-15}{15 \times 20} = \frac{5}{300}$$

$$v' = \frac{300}{5} = 60 \text{ cm}$$

Displacement of image =  $60 - 24 = 36$  cm away from the mirror.

170. 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

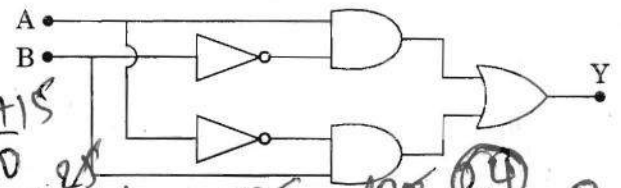


- (1)  $I_B = 40 \mu\text{A}$ ,  $I_C = 10 \text{ mA}$ ,  $\beta = 250$
- (2)  $I_B = 40 \mu\text{A}$ ,  $I_C = 5 \text{ mA}$ ,  $\beta = 125$
- (3)  $I_B = 20 \mu\text{A}$ ,  $I_C = 5 \text{ mA}$ ,  $\beta = 250$
- (4)  $I_B = 25 \mu\text{A}$ ,  $I_C = 5 \text{ mA}$ ,  $\beta = 200$

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

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

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



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

Handwritten logic derivation for Q172:

$$Y = (A \cdot B) + (A + B) \cdot (A \cdot \bar{B})$$

$$Y = A \cdot B + A \cdot A \cdot \bar{B} + B \cdot A \cdot \bar{B}$$

$$Y = A \cdot B + A \cdot \bar{B} + A \cdot B \cdot \bar{B}$$

$$Y = A \cdot B + A \cdot \bar{B} + 0$$

$$Y = A \cdot B + A \cdot \bar{B}$$

Handwritten rough work at the bottom of the page:

$$2y - 6 + 2y = 9 + 16$$

$$2y - 2y = 9 - 16$$

$$0 = -7$$

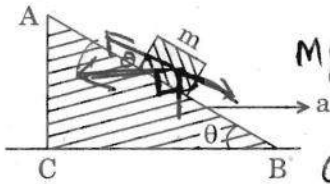
$$60 - 24 = 36$$

173. A toy car with charge  $q$  moves on a frictionless horizontal plane surface under the influence of a uniform electric field  $E$ . Due to the force  $qE$ , 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) 2 m/s, 4 m/s
- (2) 1.5 m/s, 3 m/s
- (3) 1 m/s, 3.5 m/s
- (4) 1 m/s, 3 m/s

$$s = \frac{1}{2} \left( \frac{aR}{m} \right) t^2$$

174. 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



$$mg \sin \theta = mg \cos \theta$$

$$a = \frac{mg \sin \theta}{mg} \tan \theta$$

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

175. 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) 0.521 cm
- (2) 0.529 cm
- (3) 0.053 cm
- (4) 0.525 cm

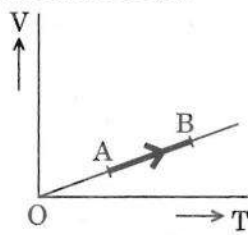
176. The moment of the force,  $\vec{F} = 4\hat{i} + 5\hat{j} - 6\hat{k}$  at  $(2, 0, -3)$ , about the point  $(2, -2, -2)$ , is given by

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

$$\vec{r} = (2-2)\hat{i} + (0+2)\hat{j} + (-3+2)\hat{k} = 2\hat{j} - \hat{k}$$

$$\vec{M} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 2 & -1 \\ 4 & 5 & -6 \end{vmatrix} = \hat{i}(12-6) - \hat{j}(6-4) - \hat{k}(20-8) = 6\hat{i} - 2\hat{j} - 12\hat{k}$$

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

$$V^2 = 0^2 + 2gS$$

$$S = \frac{6 \times 2 + 2 \times 6}{3} = \frac{24 + 12}{3} = 12$$

$$v = u + at$$

$$6 = 0 + a(1)$$

$$a = 6 \text{ m/s}^2$$

178. 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) 13.2 cm
- (2) 16 cm
- (3) 12.5 cm
- (4) 8 cm

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

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

$$\eta = \frac{100 - 100}{273 + 373} = \frac{0}{646} = 0\%$$

180. 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) =  $2.76 \times 10^{-26}$  kg Boltzmann's constant  $k_B = 1.38 \times 10^{-23}$  J K<sup>-1</sup>)

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

$$\frac{1}{2} m v_{rms}^2 = \frac{3}{2} k_B T$$

$$v_{rms}^2 = \frac{3 k_B T}{m}$$

$$v_{rms} = \sqrt{\frac{3 \times 1.38 \times 10^{-23} \times T}{2.76 \times 10^{-26}}}$$

$$2y + 2x = 6 \quad 4 \quad 5 \quad -6$$

$$2x + 6 - 2y$$

$$(-6 - (-15))\hat{i} + (-12 - (-4))\hat{j} + (-10 - 4)\hat{k}$$

$$9\hat{i} - 8\hat{j} - 14\hat{k}$$