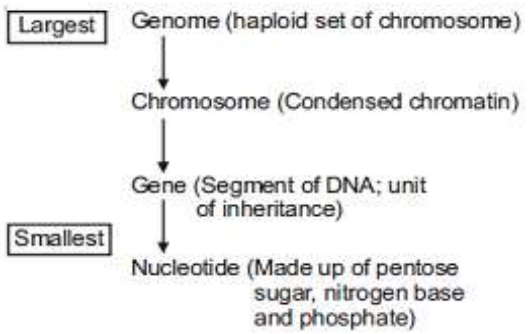
	(a)	(b)	(c)	(d)
(1)	(iii)	(iv)	(ii)	(i)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iii)	(iv)	(i)	(ii)
(4)	(iii)	(i)	(iv)	(ii)

116. Identify the correct order of organisation of genetic material from largest to smallest :
(1) Chromosome, genome, nucleotide, gene
(2) Chromosome, gene, genome, nucleotide
(3) Genome, chromosomes, nucleotide, gene
(4) Genome, chromosome, gene, nucleotide
Answer Key: (4)
Solution: Order of organisation of genetic material

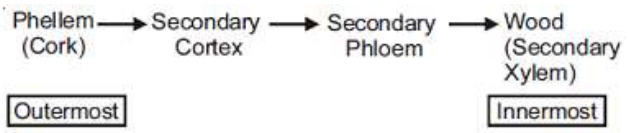


117. Which one of the following hormones though synthesis elsewhere, is stored and released by the master gland?
(1) Melanocyte stimulating hormone
(2) Antidiuretic hormone
(3) Luteinizing hormone
(4) Prolactin
Answer Key: (2)
Solution: Antidiuretic hormone is synthesized by the neurons of hypothalamus and stored in axon endings of posterior lobe of pituitary and released into the blood by posterior pituitary.

118. Read the different components from (a) to (d) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem:
(a) Secondary cortex
(b) Wood
(c) Secondary phloem
(d) Phellem
The correct order is :

(1) (d), (c), (a), (b)
(2) (c), (d), (b), (a)
(3) (a), (b), (d), (c)
(4) (d), (a), (c), (b)

Answer Key: (4)
Solution: Sequence of different components of woody dicot stem from outerside to inner side is:



119. Which of the following joints would allow no movement?
(1) Ball and Socket joint
(2) Fibrous joint
(3) Cartilaginous joint
(4) Synovial joint
Answer Key: (2)
Solution: Fibrous joint are immovable joints where two bones are connected with the help of fibrous connective tissue.

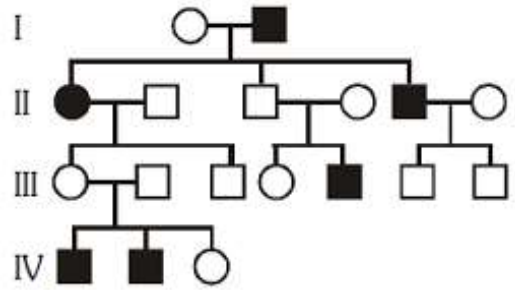
120. Which one of the following is not applicable to RNA?
(1) Chargaff's rule
(2) Complementary base pairing
(3) 5' phosphoryl and 3' hydroxyl ends
(4) Heterocyclic nitrogenous bases
Answer Key: (1)
Solution: Chargaff's rule is applicable only for DNA.

121. Doctors use stethoscope to hear the sound; produced during each cardiac cycle. The second sound is heard when:
(1) AV node receives signal from SA node
(2) AV valves open up
(3) Ventricular walls vibrate due to gushing of blood from atria
(4) Semilunar valves close down after the blood flows into vessels from ventricles

Answer Key: (4)
Solution: Second heart sound is 'DUP' which is produced during early ventricular diastole due to the sharp closure of semilunar valves.

122. During ecological succession:
(1) The changes lead to a community that is in near equilibrium with the environment and is called pioneer community
(2) The gradual and predictable change in species composition occurs in a given area
(3) The establishment of a new biotic community is very fast in its primary phase
(4) The number and types of animals remain constant
Answer Key: (2)
Solution: Ecological succession involves gradual and fairly predictable change in the species composition of a given area.

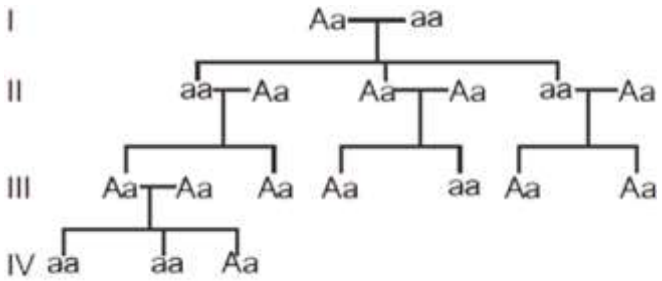
123. In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree.



(1) X-linked dominant
(2) Autosomal dominant
(3) X-linked recessive
(4) Autosomal recessive

Answer Key: (4)

Solution: The given pedigree represents inheritance of Autosomal recessive trait.



124. Balbiani rings are sites of :
(1) RNA and protein synthesis
(2) Lipid synthesis
(3) Nucleotide synthesis
(4) Polysaccharide synthesis

Answer Key: (1)

Solution: Balbiani rings are the large chromosome puff of polytene chromosomes. These are the sites of RNA and protein synthesis.

125. Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls :
(1) Asthma
(2) Pleurisy
(3) Emphysema
(4) Pneumonia

Answer Key: (3)

Solution: Emphysema is mainly due to cigarette smoking in which the walls of alveoli are damaged that leads to reduction in surface area for gaseous exchange.

126. Which the following are most suitable indicator of SO_2 pollution in the environment ?
(1) Fungi
(2) Lichens
(3) Conifers

(4) Algae

Answer Key: (2)

Solution: Lichens do not grow in SO_2 polluted regions therefore they indicate SO_2 pollution in air. Phycobionts of lichen are sensitive to SO_2

127. Satellite DNA is important because it :

(1) Codes for enzymes needed for DNA replication

(2) Codes for proteins needed in cell cycle

(3) Shows high degree of polymorphism in population and also the same degree of polymorphism in an individual, which is heritable from parents to children

(4) Does not code for proteins and is same in all members of the population

Answer Key: (3)

Solution: Satellite DNA are the repetitive DNA which do not code for any protein. They show high degree of polymorphism and form basis of DNA fingerprinting.

Since DNA from every tissue from an individual show the same degree of polymorphism, they become very useful identification tool in forensic applications.

128. Industrial melanism is an example of:

(1) Neo Lamarckism

(2) Neo Darwinism

(3) Natural selection

(4) Mutation

Answer Key: (3)

Solution: Industrial melanism is an example of natural selection.

129. A column of water within xylem vessels of tall trees does not break under its weight because of :

(1) Positive root pressure

(2) Dissolved sugars in water

(3) Tensile strength of water

(4) Lignification of xylem vessels

Answer Key: (3)

Solution: The column of water within Xylem vessel of tall trees does not break under its weight due to high tensile strength of water. Tensile strength is the ability to resist pulling forces.

130. The introduction of t-DNA into plants involves:

(1) Allowing the plant roots to stand in water

(2) Infection of the plant by Agrobacterium tumefaciens

(3) Altering the pH of the soil, then heat shocking the plants

(4) Exposing the plants to cold for a brief period

Answer Key: (2)

Solution: When Agrobacterium tumifaciens infects the host plant, it will transfer a part of DNA called t-DNA without any human interference so called natural genetic engineer.

131. Pick up the wrong statement :

(1) Nuclear membrane is present in Monera

(2) Cell wall is absent in Animalia

(3) Protista have photosynthetic and heterotrophic modes of nutrition

(4) Some fungi are edible

Answer Key: (1)
Solution: The members of kingdom-Monera are prokaryotes they lack nuclear membrane.

132. In photosynthesis, the light-independent reactions take place at :
(1) Stromal matrix
(2) Thylakoid lumen
(3) Photosystem - I
(4) Photosystem-II
Answer Key: (1)
Solution: Light-independent reactions or Dark reactions occur in stroma/ stromal matrix. During these reactions carbon dioxide is reduced to carbohydrates.

133. Which of the following immunoglobulins does constitute the largest percentage in human milk?
(1) IgG
(2) IgD
(3) IgM
(4) IgA
Answer Key: (4)
Solution: IgA is present in external body secretion including colostrum and milk. They provide naturally acquired passive immunity to child.

134. Which of the following pairs is not correctly matched?

	Mode of eproduction	Example
(1)	Rhizome	Banana
(2)	Binary fission	Sargassum
(3)	Conidia	Penicillium
(4)	Offset	Water hyacinth

Answer Key: (4)

Solution:

Mode of Reproduction	**Example**
(1) Rhizome	Banana
(2) Binary fission	*Saecharomyces* (Yeast)
(3) Conidia	*Penicillium* (Ascomycetes)
(4) Offset	Water hyacinth

135. The UN conference of Parties on climate change in the year 2012 was held at :
(1) Warsaw
(2) Durban
(3) Doha

(4) Lima

Answer Key: (3)
Solution: The United Nations Climate change conferences are yearly conferences and are known as Conference of the Parties (COP).

Physics

136. In the spectrum of hydrogen, the ratio of the longest wavelength in the Lyman series to the longest wavelength in the Balmer series is:

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

Solution: (1)

$$\frac{1}{\lambda_1} = R_e\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$\frac{1}{\lambda_2} = R_e\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\frac{\lambda_1}{\lambda_2} = \frac{5}{27}$$

137. The energy of the em waves is of the order of 15 keV. To which part of the spectrum does it belong?

(1) γ-rays
(2) X-rays
(3) Infra-red rays
(4) Ultraviolet rays

Solution: (2)

Wavelength of the ray

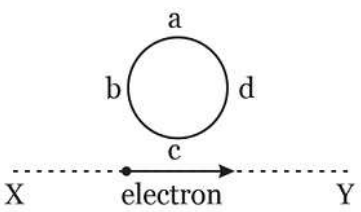
$$\lambda = \frac{hc}{E}$$

$$= 0.826\ \text{Å}$$

Since $\lambda < 100\ \text{Å}$

So it is X-ray

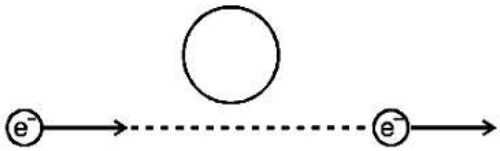
138. An electron moves on a straight line path XY as shown. The abcd is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil?



(1) No current induced

(2) abcd
(3) adcb
(4) The current will reverse its direction as the electron goes past the coil

Solution: (4)



When e^- comes closer the induced current will be anticlockwise

When e^- comes farther induced current will be clockwise.

139. The cylindrical tube of a spray pump has radius R, one end of which has n fine holes, each of radius r. If the speed of the liquid in the tube is V, the speed of the ejection of the liquid through the holes is :

(1) $\frac{V^2R}{nr}$
(2) $\frac{VR^2}{n^2r^2}$
(3) $\frac{VR^2}{nr^2}$
(4) $\frac{VR^2}{n^3r^2}$

Solution: (3)

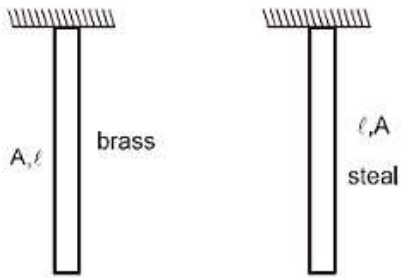
Volume inflow rate = volume anflow rate

$$\pi R^2 V = n\pi r^2 \quad \Rightarrow \quad v = \frac{\pi R^2 V}{n\pi r^2} = \frac{VR^2}{\mathrm{nr}^2}$$

140. The Young's modulus of steel is twice that of brass. Two wires of same length and of same area of cross section, one of steel and another of brass are suspended from the same roof. If we want the lower ends of the wires to be at the same level, then the weights added to the steel and brass wires must be in the ration of:

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

Solution: (3)



$$Y = \frac{W}{A} \cdot \frac{\ell}{\Delta\ell}$$

So $\Delta\ell = \frac{W\ell}{AY}$

$\Delta e_1 = \Delta e_2$ $\qquad \frac{w_1\ell}{AY_1} = \frac{w_2\ell}{AY_2}$

$$\frac{w_1}{w_2} = \frac{Y_1}{Y_2} = 2$$

141. A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f. E_0 and a resistance r_1. An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by:

(1) $\frac{LE_0 r}{(r+r_1)l}$

(2) $\frac{LE_0 r}{l\, r_1}$

(3) $\frac{E_0 r}{(r+r_1)} \cdot \frac{l}{L}$

(4) $\frac{E_0 l}{L}$

Solution: (3)

$K =$ potential gradient $= \left(\frac{E_0 r}{r+r_1}\right)\frac{1}{L}$

So $E = K\ell = \frac{E_0 r\ell}{(r+r_1)L}$

142. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be:

(1) $\frac{2\pi\beta}{\alpha}$

(2) $\frac{\beta^2}{\alpha^2}$

(3) $\frac{\alpha}{\beta}$

(4) $\frac{\beta^2}{\alpha}$

Solution: (1)

$$\omega^2 A = \alpha$$

$$\omega A = \beta$$

$$\Rightarrow \omega = \frac{\alpha}{\beta}$$

$$\Rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi\beta}{\alpha}$$

143. If vectors $\vec{A} = \cos\omega t\, i\hat{i} + \sin\omega t\, \hat{j}$ and $\vec{B} = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are functions of times, then the value of t at which they are orthogonal to each other is:

(1) $t = 0$
(2) $t = \frac{\pi}{4\omega}$
(3) $t = \frac{\pi}{2\omega}$
(4) $t = \frac{\pi}{\omega}$

Solution: (4)

$$\bar{A} = \cos wt\,\hat{i} + \sin wt\,\hat{j}$$

$$\bar{B} = \cos\frac{wt}{2}\,\hat{i} + \sin\frac{wt}{2}\,\hat{j}$$

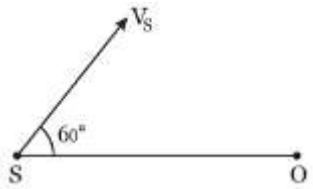
for $\vec{A}.\vec{B} = 0$

$$\bar{A}.\bar{B} = 0 = \cos wt.\cos\frac{wt}{2} + \sin wt.\sin\frac{wt}{2}$$

$$= \cos\left(wt - \frac{wt}{2}\right) = \cos\left(\frac{wt}{2}\right)$$

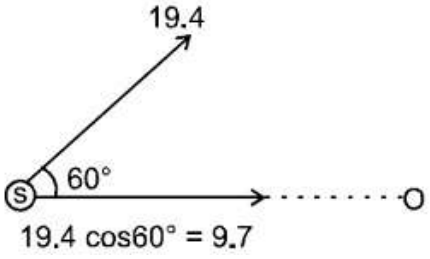
So $\frac{wt}{2} = \frac{\pi}{2} \quad \Rightarrow \quad t = \frac{\pi}{w}$

144. A source of sound S emitting waves of frequency 100 Hz and an observer O are located at some distance from each other. The source is moving with a speed of $19.4\ ms^{-1}$ at an angle of 60^o with the source observer line as shown in the figure. The observer is at rest. The apparent frequency observed by the observer (velocity of sound in air $330\ ms^{-1}$), is:



(1) 97 Hz
(2) 100 Hz
(3) 103 Hz
(4) 106 Hz

Solution: (3)



$$t^1 = f_0\left(\frac{v - v}{v - v_s}\right)$$

$$f^1 = 100\left(\frac{v - 0}{v - (+9.7)}\right)$$

$$f^1 = 100\frac{v}{v\left(1-\frac{9.7}{v}\right)}$$

$$f^1 = 100\left(1+\frac{3.7}{330}\right) = 103\text{Hz}$$

145. An automobile moves on a road with a speed of $54\ \text{km h}^{-1}$. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is $3\ \text{kg m}^2$. If the vehicle is brought to rest in 15s, the magnitude of average torque transmitted by its brakes to the wheel is:

(1) $2.86\ \text{kg m}^2\ \text{s}^{-2}$
(2) $6.66\ \text{kg m}^2\text{s}^{-2}$
(3) $8.58\ \text{kg m}^2\text{s}^{-2}$
(4) $10.86\ \text{kg m}^2\ \text{s}^{-2}$

Solution: (2)

$$\omega_i = \frac{15}{0.45} = \frac{100}{3}\ \omega_f = 0$$

$$\omega_f = \omega_i + \alpha t$$

$$0 = \frac{100}{3} + (-\alpha)(15)$$

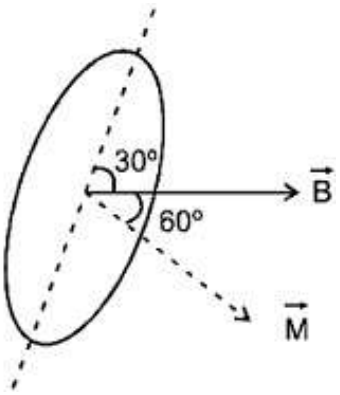
$$\alpha = \frac{100}{45}$$

$$\tau = (I)(\alpha) = 3 \times \frac{100}{45} = 6.66\ \text{N. M}$$

146. A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m^2. The coil carries a current of 2A. if the plane of the coil is inclined at an angle of 30^o with the direction of the field, the torque required to keep coil in stable equilibrium will be:

(1) 0.12 Nm
(2) 0.15 Nm
(3) 0.20 Nm
(4) 0.24 Nm

Solution: (3)



$\vec{\tau} = \vec{M} \times \bar{B} = MB\sin 60^o$

$= Ni\,AB\sin 60^o$

$50 \times 2 \times 0.12 \times 0.1 \times 0.2 \times \frac{\sqrt{3}}{2}$

$= 12\sqrt{3} \times 10^{-2}\,\text{Nm} = 0.20748\,\text{Nm}$

147. A parallel plate air capacitor has capacity 'C', distance of separation between plates is 'd' and potential difference 'V' is applied between the plates. Force of attraction between the plates of the parallel plate air capacitor is:

(1) $\frac{C^2V^2}{2\,d^2}$

(2) $\frac{C^2V^2}{2\,d}$

(3) $\frac{CV^2}{2d}$

(4) $\frac{CV^2}{d}$

Solution: (3)

Attraction between the plates

$F = \frac{q^2}{2A\varepsilon_0}$ where $q - CV$ and $C = \frac{\varepsilon_0 A}{d}$

$$F = \frac{C^2V^2}{2Cd} = \frac{CV^2}{2d}$$

148. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of a being twice that of B. Under such conditions, the density of A is found to be 1.5 times the density if B. The ratio of molecular weight of A and B is:

(1) $\frac{1}{2}$

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

(3) $\frac{3}{4}$

(4) 2

Solution: (3)

$$P_A = \frac{\rho_A M_A}{RT}, P_B = \frac{\rho_B M_B}{RT} = \frac{3}{2} \Rightarrow \frac{P_A}{P_B} = \frac{\rho_A}{\rho_B}\frac{M_A}{M_B} = 2\frac{M_A}{M_B} = \frac{3}{2}$$

So, $\frac{M_A}{M_B} = \frac{3}{4}$

149. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth. Then,

(1) The acceleration of S is always directed towards the centre of the earth

(2) The angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant

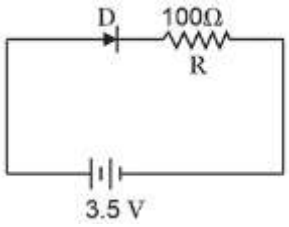
(3) The total mechanical energy of S varies periodically with time

(4) The linear momentum of S remains constant is magnitude

Solution: (1)

The gravitation force on the satellite will be aiming toward the centre of earth so acceleration of the satellite will also be aiming toward the centre of earth.

150. In the given figure, a diode D is connected to an external resistance $R = 100\ \Omega$ and an e.m.f. of 3.5 V. If the barrier potential developed across the diode is 0.5 V, the current in the circuit will be:



(1) 35 mA
(2) 30 mA
(3) 40 mA
(4) 20 mA

Solution: (2)

$$\text{Current} = \frac{(3.5 - 0.5)}{100}\text{A}$$

$$= \frac{3}{100}\text{A} = 30\ \text{mA}$$

151. A remote-sensing satellite of earth revolves in a circular orbit at a height of 0.25×10^6 m above the surface of earth. If earth's radius is 6.38×10^6 m and $g = 9.8\ \text{ms}^{-2}$, then the orbital speed of the satellite is:

(1) $6.67\ \text{km s}^{-1}$
(2) $7.76\ \text{km s}^{-1}$
(3) $8.56\ \text{km s}^{-1}$
(4) $9.13\ \text{km s}^{-1}$

Solution: (2)

$$V_0 = \sqrt{\frac{GM}{r}} = \sqrt{\frac{GM}{R^2}.\frac{R^2}{r}}$$

$$= \sqrt{\frac{9.8\times6.38\times6.38}{6.63\times10^6}} = \sqrt{60 \times 10^6}\ \text{m/sec}$$

$= 7.76$ km/sec

152. The position vector of a particle $\vec{R}$ as a function of time is given by:

$\bar{R} = 4\sin(2\pi t)\,\hat{i} + 4\cos(2\pi t)\hat{j}$

Where R is in meters, t is in seconds and $\hat{i}$ and $\hat{j}$ denote unit vectors along x- and y-directions, respectively. Which one of the following statements is wrong for the motion of particle?

(1) Patch of the particle is a circle of radius 4 meter

(2) Acceleration vector is along $-\bar{R}$

(3) Magnitude of acceleration vector is $\frac{v^2}{R}$, where v is the velocity of particle

(4) Magnitude of the velocity of particle is 8 meter/second

Solution: (4)

$x = 45\ m\ 2\pi t,$

$y = 4\cos(2\pi\, t)$

Squiring and adding

⇒ Circular motion

$V = \omega = (2\pi)(4) = 8\pi$

So , Ans is (4)

153. A string is stretched between fixed points separated by 75.0 cm. It is observed to have resonant frequencies of 420 Hz and 315 Hz. There are no other resonant frequency for this string is:

(1) 105 Hz

(2) 155 Hz

(3) 205 Hz

(4) 105 Hz

Solution: (1)

Two consecutive resonant frequencies for a string fixed at both ends will be

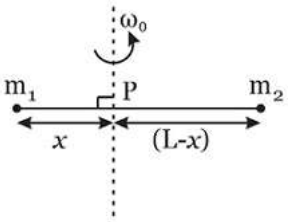
$\frac{nv}{2\ell}$ and $\frac{(n+1)v}{2\ell}$

$\Rightarrow \quad \frac{(n+1)v}{2\ell} - \frac{nv}{2\ell} = 420 - 315$

$\frac{v}{2\ell} = 105\ Hz$

Which is the minimum resonant frequency.

154. Point masses m_1 and m_2 are placed at the opposite ends of rigid rod of length L, and negligible mass. The rod is to be set rotating about an axis perpendicular to it. The position of point P on this rod through which the axis should pass so that the work required to set the rod rotating with angular velocity ω_0 is minimum, is given by:



(1) $x = \frac{m_2 L}{m_1 + m_2}$

(2) $x = \frac{m_1 L}{m_1 + m_2}$

(3) $x = \frac{m_1}{m_2} L$

(4) $x = \frac{m_2}{m_1} L$

Solution: (1)

$$K.E. = \frac{1}{2} I \omega^2$$

I is min. about the centre of mass

So, $(m_1)(x) = (m_2)(L - x)$

$$x = \frac{m_2 L}{m_1 + m_2}$$

155. At the first minimum adjacent to the central maximum of a single-slit diffraction pattern, the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the midpoint of the slit is:

(1) $\frac{\pi}{8}$ radian

(2) $\frac{\pi}{4}$ radian

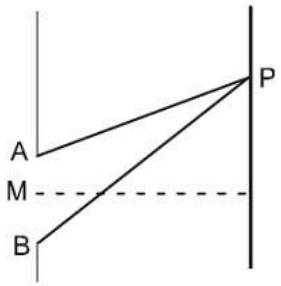
(3) $\frac{\pi}{2}$ radian

(4) π radian

Solution: (4)

For first minima

$$AP - BP = \lambda$$



$$AP - MP = \frac{\lambda}{2}$$

So phase difference $= \frac{2\pi}{\lambda} \times \frac{\lambda}{2} = \pi$

156. A force $\vec{F} = \alpha\hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\vec{r} = 2\hat{i} - 6\hat{j} - 12\hat{k}$. The value of α for which angular momentum about origin is conserved is:

(1) –
(2) – 1
(3) 2
(4) Zero

Solution: (2)

If $\vec{L} =$ constant then $\vec{\tau} = 0$

So $\vec{r} \times \vec{F} = 0 \Rightarrow \vec{F}$ should be parallel to $\vec{r}$ so coefficient should be in same ratio. So $\frac{\alpha}{2} = \frac{3}{-6} = \frac{6}{-12}$

So $\alpha = -1$

Ans (4)

157. Two particles A and B move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vectors $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for particles A and B for their collision is:

(1) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$
(2) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$
(3) $\vec{r}_1 \cdot \vec{v}_1 = \vec{r}_2 \cdot \vec{v}_2$
(4) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$

Solution: (2)

For two particles to collide, the direction of the relative velocity of one with respect to other should be directed towards the relative position of the other particle

i.e. $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|}$ → direction of relative position of 1 w.r.t..2.

& $\frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2| - \vec{v}_1}$ → direction of velocity of 2 w.r.t.1

So for collision of A & B

$$\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$$

158. A nucleus of uranium decays at rest into nuclei of thorium and helium. Then:

(1) The helium nucleus has less kinetic energy than the thorium nucleus
(2) The helium nucleus has more kinetic energy than the thorium nucleus
(3) The helium nucleus has less momentum then the thorium nucleus
(4) The helium nucleus has more momentum than the thorium nucleus

Solution: (2)

$$U \rightarrow Th + \alpha$$

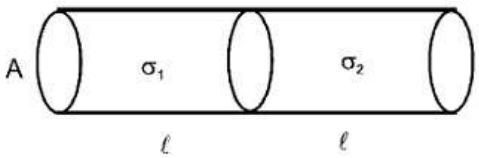
$$KE_{Th} = \frac{P^2}{2m_{Th}}, KE_{\alpha} = \frac{P^2}{2m_{\alpha}}$$

Since m_{α} is less so KE_{α} will be mone.

159. Two metal wires of identical dimensions are connected in series. If v_1 and v_2 are the conductivities of the metal wires respectively, the effective conductivity if the combination is:

(1) $\frac{\sigma_1 \sigma_2}{\sigma_1+\sigma_2}$
(2) $\frac{2\sigma_1 \sigma_2}{\sigma_1+\sigma_2}$
(3) $\frac{\sigma_1+\sigma_2}{2\sigma_1 \sigma_2}$
(4) $\frac{\sigma_1+\sigma_2}{\sigma_1 \sigma_2}$

Solution: (2)



$$R_{ec} = \frac{\ell}{\sigma_1 A} + \frac{\ell}{\sigma_1 A} = \frac{\ell_{eq}}{\sigma_{eq} A_{eq}}$$

$$\frac{2\ell}{\sigma_{eq} A} = \frac{\ell}{A}\left(\frac{\sigma_1 + \sigma_2}{\sigma_1 \sigma_2}\right)$$

$$\sigma_{eq} = \frac{2\sigma_1 \sigma_2}{\sigma_1 \sigma_2}$$

Ans. (2)

160. Light of wavelength 500 nm is incident on a metal with work function 2.258 eV. The de Broglie wavelength of the emitted electron is:

(1) $\leq 2.8 \times 10^{-12}$ m
(2) $< 2.8 \times 10^{-10}$ m
(3) $< 2.8 \times 10^{-9}$ m
(4) $\geq 2.8 \times 10^{-9}$ m

Solution: (4)

$$KE_{max} = \frac{hc}{\lambda} - \Psi$$

$$KE_{max} = \frac{1240}{500} - 2.82$$

$$KE_{max} = 2.48 - 2.28 = 0.2 \text{ eV}$$

$$\lambda_{min} = \frac{h}{\sqrt{2m(KE)_{max}}} = \frac{\frac{20}{3} \times 10^{-34}}{\sqrt{2 \times 9 \times 10^{-31} \times 0.2 \times 1.6 \times 10^{-19}}}$$

$$\lambda_{min} = \frac{25}{9} \times 10^{-9} = 2.80 \times 10^{-9} \text{ nm}$$

So $\lambda \geq 2.8 \times 10^{-9}$ m

Ans. (4)

161. 4.0 g of a gas occupies 22.4 liters at NTP. The specific heat capacity of the gas at constant volume is $5.0 \text{ JK}^{-1} \text{ mol}^{-1}$. If the speed of sound in this gas at NTP is 952 ms^{-1}, then the heat capacity at constant pressure is

(Take gas constant $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$)

(1) $8.5 \text{ JK}^{-1} \text{ mol}^{-1}$
(2) $8.0 \text{ JK}^{-1} \text{ mol}^{-1}$
(3) $7.5 \text{ JK}^{-1} \text{ mol}^{-1}$
(4) $7.0 \text{ JK}^{-1} \text{ mol}^{-1}$

Solution: (2)

No. of mole of gas = 1 so molar mass = 4g/mole

$$V = \sqrt{\frac{\gamma RT}{m}} \Rightarrow 952 \times 952 = \frac{\gamma \times 3.3 \times 273}{4 \times 10^{-3}} \Rightarrow \gamma = 1.6 = \frac{16}{10} = \frac{8}{5}$$

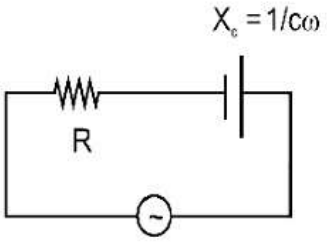
162. A series R-C circuit is connected to an alternating voltage source. Consider two situations:

i. When capacitor is air filled.
ii. When capacitor is mica filled.

Current through resistor is i and voltage across capacitor is V then:

(1) $V_a = V_b$
(2) $V_a < V_b$
(3) $V_a > V_b$
(4) $i_a > i_b$

Solution: (3)



$$i = \frac{v}{\sqrt{R^2 + \left(\frac{1}{c\omega}\right)^2}}$$

$$V_C = \frac{v}{\sqrt{R^2 + \left(\frac{1}{c\omega}\right)^2}} \times \left(\frac{1}{c\omega}\right)$$

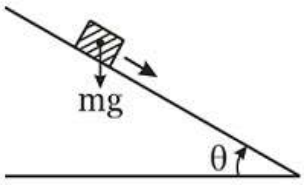
$$V_C = \frac{V}{\sqrt{(Rc\omega)^2 + 1}}$$

If we fill a di-electric material

$$C \uparrow \Rightarrow V_C \downarrow$$

Ans is (3)

163. A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30^o, the box starts to slip and slides 4.0 m down the plank in 4.0 s. The coefficients of static and kinetic friction between the box and the plank will be, respectively:



(1) 0.4 and 0.3
(2) 0.6 and 0.6
(3) 0.6 and 0.5
(4) 0.5 and 0.6

Solution: (3)

$$\mu_s = \tan 30^o = \frac{1}{\sqrt{3}} = 0.5$$

$$\mu_s = 0.57 = 0.6$$

$$S = ut + \frac{1}{2}at^2$$

$$4 = \frac{1}{2}a(4)^2 \Rightarrow a = \frac{1}{2} = 0.5$$

$$a = g\sin\theta - \mu_k(g)\cos\theta$$

$$\Rightarrow \mu_K = \frac{0.9}{\sqrt{3}} = 0.5$$

164. Two stones of masses ma and 2 m are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ and the lighter one in radius r. the tangential speed of lighter stone is n times that of the value of heavier stone when they experience same centripetal forces. The value of n is:

(1) 1
(2) 2
(3) 3
(4) 4

Solution: (2)

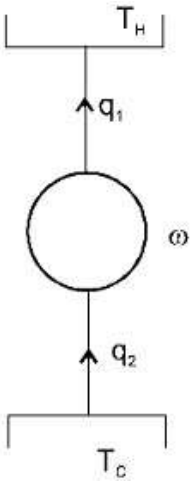
$$F_C = \frac{mv_1^2}{r} = \frac{2mv_2^2}{\left(\frac{r}{2}\right)} = \frac{4mv_2^2}{r}$$

So $V_1 = 2V_2$

165. The coefficient of performance of a refrigerator is 5. If the temperature inside freezer is -20^oC, the temperature of the surrounding to which is rejects heat is:

(1) 21^oC
(2) 31^oC
(3) 41^oC
(4) 11^oC

Solution: (2)



$$cop = \frac{q_1}{w} = \frac{q_2}{q_1 - q_2} = \frac{T_c}{T_H - T_C} = 5$$

$$T_C = 5T_H - 5T_c$$

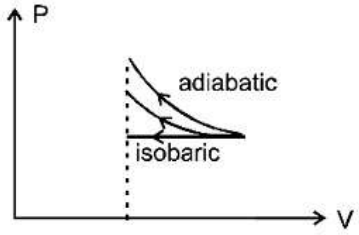
$$6T_c = 5T_H$$

$$T_H = \frac{6}{5} \times 253k = 303.6k = 30.6^oC = 31^oC$$

166. An ideal gas is compressed to half its initial volume by means of several processes. Which of the process results in the maximum work done on the gas?

(1) Isothermal
(2) Adiabatic
(3) Isobaric
(4) Isochoric

Solution: (2)

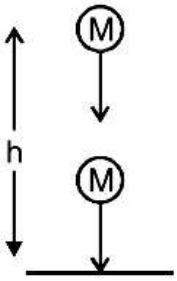


Since area under the curve is max for adiabatic process so work done on the gas will be max for adiabatic process.

167. A ball is thrown vertically downwards from a height of 20 m with an initial velocity v_0. It collides with the ground, loses 50 percent of its energy in collision and rebounds to the same height. The initial velocity v_0 is: (Take $g = 10\ ms^{-2}$)

(1) $10\ ms^{-1}$
(2) $14\ ms^{-1}$
(3) $20\ ms^{-1}$
(4) $28\ ms^{-1}$

Solution: (3)



$$\frac{KE_f}{KE_i} = \frac{1}{2}$$

$$\frac{V_f}{V_i} = \frac{1}{\sqrt{2}}$$

$$\frac{\sqrt{2gh}}{\sqrt{V_0^2 + 2gh}} = \frac{1}{\sqrt{2}}$$

$V_0 = 20$ m/sec

168. On a frictionless surfaces, a block of mass M moving at speed v collides elastically with another block of same mass M which is initially at rest. After collision the first block moves at an angle θ to its initial direction and has a speed $\frac{v}{3}$. The second block's speed after the collision is:

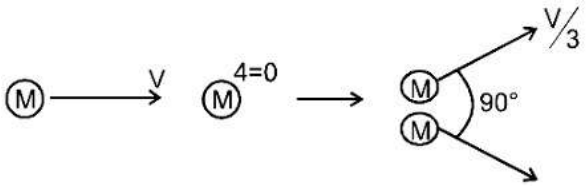
(1) $\frac{\sqrt{3}}{2}v$

(2) $\frac{2\sqrt{2}}{3}v$

(3) $\frac{3}{4}v$

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

Solution: (2)



$\vec{P_i} = \vec{P_f}$

$\Rightarrow |P_i| = |P_f| \Rightarrow \sqrt{\left(m\frac{V}{3}\right)^2 + (mV_2)^2}$

$V_2 = \frac{2\sqrt{2}}{3}V$

169. If potential (in volts) in a region is expressed as $V(x, y, z) = 6xy - y + 2yz$, the electric field (in N/C) at point (1, 1, 0) is:

(1) $-\left(6\hat{i} + 9\hat{j} + \hat{k}\right)$

(2) $-\left(3\hat{i} + 5\hat{j} + 3\hat{k}\right)$

(3) $-\left(6\hat{i} + 5\hat{j} + 2\hat{k}\right)$

(4) $-\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$

Solution: (3)

$V = 6xy - y + 24z$

$\bar{E} = \left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j}\frac{\partial V}{\partial z}\hat{k}\right)$

$\bar{E} = \left[(6y)\hat{i} + (6x - 1 + 2z)\hat{j} + (2y)\hat{k}\right]$

$\bar{E} = -\left(6\hat{i} + 5\hat{j} + 2\hat{k}\right)$
$(1, 1, 0)$

170. Two slits in Young's experiment have widths in the ratio 1 : 25. The ratio of intensity at the maxima and minima in the interference pattern, $\frac{I_{max}}{I_{min}}$ is:

(1) $\frac{4}{9}$

(2) $\frac{9}{4}$

(3) $\frac{121}{49}$

(4) $\frac{49}{121}$

Solution: (2)

$$\frac{I_1}{I_2} = \frac{25}{1} \Rightarrow \frac{A_1}{A_2} = \frac{5}{1}$$

$$\frac{A_{max}}{A_{min}} = \frac{5+1}{5-1} = \frac{6}{4} = \frac{3}{2}$$

$$\frac{I_{max}}{I_{min}} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

171. The heart of a man pumps 5 litres of blood through the arteries per minute at a pressure of 150 mm of mercury. If the density of mercury be 13.6×10^3 kg/m^3 and $g = 10$ m/s^2 then the power of heart in watt is:

(1) 1.50

(2) 1.70

(3) 2.35

(4) 3.0

Solution: (2)

Power $= \vec{F} . \vec{V} = PA\vec{V} = \rho gh\, AV$

$$= 13.6 \times 10^3 \times 10 \times 150 \times 10^{-3} \times 0.5 \times 10^{-3} / 60 \text{ watt}$$

$$= \frac{102}{60} \text{ watt} = 1.70 \text{ watt.}$$

172. A proton and an alpha particle both enter a region of uniform magnetic field B, moving at right angles to the field B. if the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is 1 MeV, the energy acquired by the alpha particle will be:

(1) 1 MeV

(2) 4 MeV

(3) 0.5 MeV

(4) 1.5 MeV

Solution: (1)

$$R = \frac{mV}{qB} = \frac{\sqrt{2m(kE)}}{qB}$$

Since R is same so $\mathrm{KE} \propto \frac{q^2}{m}$

So KE of α particle will be $\frac{(2)^2}{4} = \text{same} = 1\ \mathrm{MeV}$

Ans. is (1)

173. The input signal given to a CE amplifier having a voltage gain of 150 is $V_i = 2\cos\left(15t + \frac{\pi}{3}\right)$. The corresponding output signal will be:

(1) $300\cos\left(15t + \frac{4\pi}{3}\right)$
(2) $300\cos\left(15t + \frac{\pi}{3}\right)$
(3) $75\cos\left(15t + \frac{2\pi}{3}\right)$
(4) $2\cos\left(15t + \frac{5\pi}{6}\right)$

Solution: (1)

CE amplifier causes phase difference of $\pi(= 180^o)$ so $V_{out} = 300\cos\left(15t + \frac{\pi}{3} + \pi\right)$

174. If dimensions of critical velocity v_c of a liquid flowing through a tube are expressed as $[\eta^x \rho^y r^z]$, where η, ρ and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by:

(1) $1, 1, 1$
(2) $1, -1, -1$
(3) $-1, -1, 1$
(4) $-1, -1, -1$

Solution: (2)

$V_c = \eta^x \rho^y r^z$

Critical velocity is given by $V_c = \frac{R\eta}{2\rho r}$

So, $x = 1$

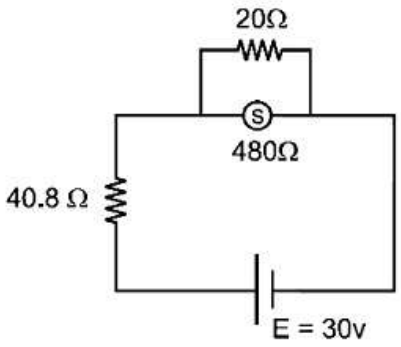
$y = -1$

$z = -1$

175. A circuit contains an ammeter, a battery of 30 v and a resistance 40.8 ohm all connected in series. If the ammeter has coil of resistance 480 ohm and a shunt of 20 ohm, the reading in the ammeter will be:

(1) 1 A
(2) 0.5 A
(3) 0.25 A
(4) 2 A

Solution: (2)



Resistance of ammeter $= \frac{480\times20}{480+20} = 19.2\Omega$

$$i = \frac{30}{40.8 + 19.2} = 0.5\ A$$

Ans. is (2)

176. Water rises to a height 'h' in capillary tube. If the length of capillary tube above the surface of water is made less than 'h', then:

(1) Water does not rise at all
(2) Water rises upto the tip of capillary tube and then starts overflowing like a fountain
(3) Water rises upto the top of capillary tube and stays there without overflowing
(4) Water rises upto a point a little below the top and stays there

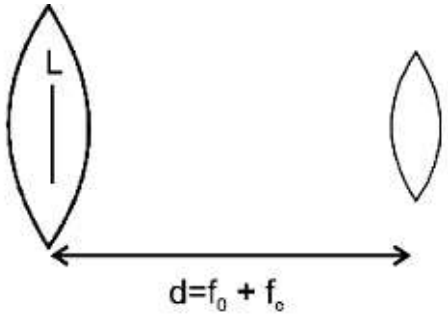
Solution: (3)

Water will not overflow but will change its radius of curvature.

177. In an astronomical telescope in normal adjustment a straight black line of the length L is drawn on inside part of objective lens. The eye-piece forms a real image of this line. The length of this image is I. The magnification of the telescope is:

(1) $\frac{L}{I}$
(2) $\frac{L}{I} + 1$
(3) $\frac{L}{I} - 1$
(4) $\frac{L+I}{L-I}$

Solution: (1)



Magnification by eyepiece

$$m = \frac{f}{f+u}$$

$$-\frac{I}{L} = \frac{f_e}{f_e + (-(f_0 + f_e)}$$

$$\Rightarrow \quad \frac{I}{L} = \frac{f_e}{f_0}$$

$$m.p. = \frac{f_0}{f_e} = \frac{L}{I}$$

178. The value of coefficient of volume expansion of glycerin is $5 \times 10^{-4} K^{-1}$. The fractional change in the density of glycerin for a rise of 40^oC in its temperature is:

(1) 0.010
(2) 0.015
(3) 0.020
(4) 0.025

Solution: (3)

$$\rho = \rho_0(1 - \gamma \Delta t)$$

$$\frac{\Delta \rho}{\rho_0} = \gamma \Delta T = (5 \times 10^{-4})(40) = 0.02$$

Ans. is (3)

179. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is:

(h = Planck's constant, c= speed of light)

(1) $\frac{hc}{3\lambda}$
(2) $\frac{hc}{2\lambda}$
(3) $\frac{hc}{\lambda}$
(4) $\frac{2hc}{\lambda}$

Solution: (2)

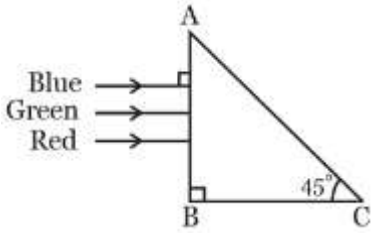
$$k_1 = \frac{hc}{\lambda} - \psi$$

$$k_2 = 3k_1 = \frac{2hc}{\lambda} - \psi = \frac{3hc}{\lambda} - 3\psi$$

So $2\psi = \frac{hc}{\lambda}$

So $\psi = \frac{hc}{2\lambda}$

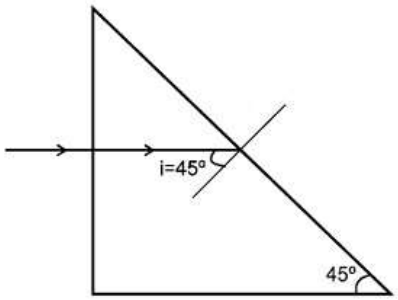
180. A beam of light consisting of red, green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red, green and blue wavelengths are 1.39,1.44 and 1.47 respectively.



The prism will:

(1) Separate the red colour part from the green and blue colours
(2) Separate the blue colour part from the red and green colours
(3) Separate all the three colours from one another
(4) Not separate the three colours at all

Solution: (1)



For TIR $I > I_c$ so $\text{Sin } i > \sin I_c$

$$\text{Sin } 45^o > \frac{1}{\mu} \Rightarrow \mu\sqrt{2} \Rightarrow \mu = 1.414$$

Since μ of green and violet are greater than 1.414 so they will total internal refrected. But red colour will be vetracted.

So Ans. is (1)