DATE : 01/05/2016

Test Booklet Code

W

Aakash

Medical | IIT-JEE | Foundations

(Divisions of Aakash Educational Services Pvt. Ltd.)

Regd. Office **: Aakash Tower, Plot No.-4, Sec-11, MLU, Dwarka, New Delhi-110075**
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Time : 3 hrs. **Max. Marks : 720**

Answers & Solutions

for

AIPMT-2016

Important Instructions :

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue / black** ball point pen only.
2. The test is of **3 hours** duration and Test Booklet contains **180** questions. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page/marking responses.
4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
5. **On completion of the test, the candidate must handover the Answer Sheet to the invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.**
6. The CODE for this Booklet is **W**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/ Answer Sheet.
8. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
9. Each candidate must show on demand his/her Admission Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. Cases where a candidate has not signed the Attendance Sheet the second time will be deemed not to have handed over Answer Sheet and dealt with as an unfair means case.
12. Use of Electronic/Manual Calculator is prohibited.
13. The candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

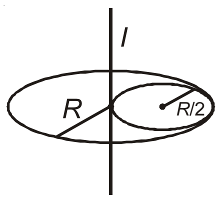
1. From a disc of radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the centre?

(1) $15MR^2/32$ (2) $13MR^2/32$

(3) $11MR^2/32$ (4) $9MR^2/32$

Answer (2)

Sol.



$I = I_{remain} + I_{(R/2)}$

$\Rightarrow \; I_{remain} = I - I_{(R/2)}$

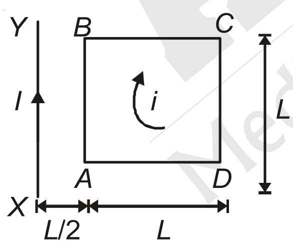
$$= \frac{MR^2}{2} - \left[\frac{\frac{M}{4}(R/2)^2}{2} + \frac{M}{4}\left(\frac{R}{2}\right)^2\right]$$

$$= \frac{MR^2}{2} - \left[\frac{MR^2}{32} + \frac{MR^2}{16}\right]$$

$$= \frac{MR^2}{2} - \left[\frac{MR^2 + 2MR^2}{32}\right]$$

$$= \frac{MR^2}{2} - \frac{3MR^2}{32} = \frac{16MR^2 - 3MR^2}{32} = \frac{13MR^2}{32}$$

2. A square loop $ABCD$ carrying a current i, is placed near and coplanar with a long straight conductor XY carrying a current I, the net foce on the loop will be



(1) $\frac{2\mu_0 Ii}{3\pi}$ (2) $\frac{\mu_0 Ii}{2\pi}$

(3) $\frac{2\mu_0 IiL}{3\pi}$ (4) $\frac{\mu_0 IiL}{2\pi}$

Answer (1)

Sol. $F_{Loop} = F_{BA} - F_{CD}$

$$= \frac{\mu_0 iIL}{2\pi}\left[\frac{1}{\frac{L}{2}} - \frac{1}{\frac{3L}{2}}\right] = \frac{2\mu_0 iI}{3\pi}$$

3. The magnetic susceptibility is negative for

(1) Diamagnetic material only

(2) Paramagnetic material only

(3) Ferromagnetic material only

(4) Paramagnetic and ferromagnetic materials

Answer (1)

Sol. Susceptibility of diamagnetic substance is negative

Susceptibility of para and ferromagnetic substance is positive

4. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of 15 ms^{-1}. Then, the frequency of sound that the observer hears in the echo reflected from the cliff is

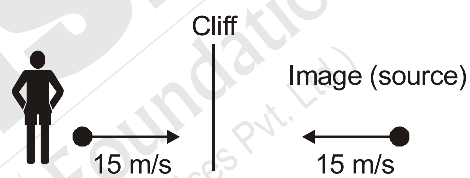
(Take velocity of sound in air = 330 ms^{-1})

(1) 765 Hz (2) 800 Hz

(3) 838 Hz (4) 885 Hz

Answer (3)

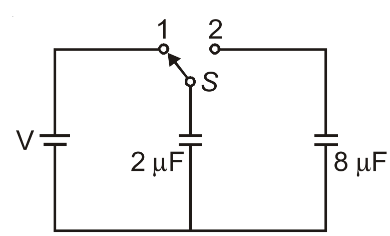
Sol.



$$f' = \left(\frac{v}{v - v_s}\right) f = \left(\frac{330}{330 - 15}\right) 800$$

$= 838$ Hz

5. A capacitor of 2 μF is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is



(1) 0% (2) 20%

(3) 75% (4) 80%

Answer (4)

Sol. Initial energy stored = $\frac{1}{2}(2\,\mu\text{F}) \times V^2$

Energy dissipated on connection across 8 μF

$$= \frac{1}{2}\frac{C_1 C_2}{C_1 + C_2} V^2$$

$$= \frac{1}{2} \times \frac{2\,\mu F \times 8\,\mu F}{10\,\mu F} \times V^2$$

$$= \frac{1}{2} \times (1.6\,\mu F)\,V^2$$

$$\%\ \text{loss of energy} = \frac{1.6}{2} \times 100 = 80\%$$

6. In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of

(1) $\sin^{-1}\left(\frac{1}{4}\right)$ (2) $\sin^{-1}\left(\frac{2}{3}\right)$

(3) $\sin^{-1}\left(\frac{1}{2}\right)$ (4) $\sin^{-1}\left(\frac{3}{4}\right)$

Answer (4)

Sol. 1st minimum

$a \sin\theta = n\lambda$

$n = 1$, $a\sin 30° = \lambda$

$\Rightarrow$ $a = 2\lambda$

1st secondary maximum

$$a \sin\theta_1 = \frac{3\lambda}{2}$$

$$\Rightarrow \sin\theta_1 = \frac{3\lambda}{2a} = \frac{3}{4}$$

$$\Rightarrow \theta = \sin^{-1}\frac{3}{4}$$

7. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J kg^{-2} and 6.0 ms^{-2} respectively? Take the radius of earth as 6400 km

(1) 2600 km (2) 1600 km

(3) 1400 km (4) 2000 km

Answer (1)

Sol. $V = -\frac{GM}{(R+h)}$ $\qquad g' = \frac{GM}{(R+h)^2}$

$$\Rightarrow \frac{|V|}{g'} = R + h$$

$$\Rightarrow \frac{5.4 \times 10^7}{6.0} = R + h$$

$\Rightarrow$ $9 \times 10^6 = R + h$

$\Rightarrow$ $h = (9 - 6.4) \times 10^6 = 2.6 \times 10^6 = 2600$ km

8. Out of the following options which one can be used to produce a propagating electromagnetic wave?

(1) A charge moving at constant velocity

(2) A stationary charge

(3) A chargeless particle

(4) An accelerating charge

Answer (4)

Sol. Accelerating charge produce electromagnetic wave.

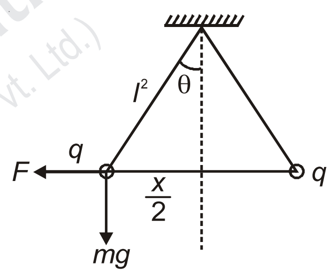
9. Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance $d(d << l)$ apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then v varies as a function of the distance x between the spheres, as

(1) $v \propto x^{\frac{1}{2}}$ (2) $v \propto x$

(3) $v \propto x^{-\frac{1}{2}}$ (4) $v \propto x^{-1}$

Answer (3)

Sol. $\frac{F}{mg} = \tan\theta$



$$\frac{Kq^2}{x^2 mg} = \frac{\frac{x}{2}}{\sqrt{l^2 - \frac{x^2}{4}}}$$

$$\frac{Kq^2}{x^2 mg} = \frac{x}{2l}$$

$q^2 \propto x^3$

$\Rightarrow$ $q \propto x^{3/2}$

$$\Rightarrow \frac{dq}{dt} \propto \frac{d(x^{3/2})}{dx}\frac{dx}{dt}$$

$$\Rightarrow \frac{dq}{dt} \propto x^{1/2} v$$

$$\Rightarrow v \propto \frac{1}{x^{\frac{1}{2}}}$$

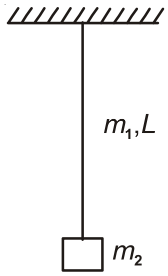
10. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2. The ratio λ_2/λ_1 is

(1) $\sqrt{\frac{m_1}{m_2}}$ (2) $\sqrt{\frac{m_1 + m_2}{m_2}}$

(3) $\sqrt{\frac{m_2}{m_1}}$ (4) $\sqrt{\frac{m_1 + m_2}{m_1}}$

Answer (2)

Sol. $\lambda = \frac{v}{f}$ $\quad \left(v = \sqrt{\frac{T}{\mu}}\right)$



$\frac{\lambda_2}{\lambda_1} = \frac{v_2}{v_1}$

$= \sqrt{\frac{T_2}{T_1}}$

$= \sqrt{\frac{(m_1 + m_2)}{m_2}}$

11. A refrigerator works between 4°C and 30°C. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is [Take 1 cal = 4.2 joules)

(1) 2.365 W (2) 23.65 W

(3) 236.5 W (4) 2365 W

Answer (3)

Sol. T_2 = 4°C = 277 K

T_1 = 303 K

Q_2 = 600 cal

$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$

$\Rightarrow \frac{Q_2 + W}{Q_2} = \frac{T_1}{T_2}$

W = 236.5 W

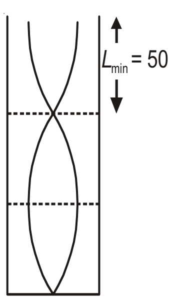
12. An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tuning fork is

(1) 66.7 cm (2) 100 cm

(3) 150 cm (4) 200 cm

Answer (3)

Sol.

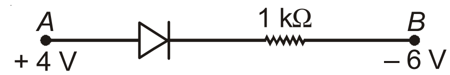


L_{min} = 50 cm

So other lengths for resonance are $3L_{min}$, $5L_{min}$, $7L_{min}$, etc.

$\Rightarrow$ 150 cm, 250 cm, 350 cm, etc.

13. Consider the junction diode as ideal. The value of current flowing through AB is



(1) 0 A (2) 10^{-2} A

(3) 10^{-1} A (4) 10^{-3} A

Answer (2)

Sol. $V_A - V_B = IR$

$\Rightarrow 4 + 6 = 10^3 I$

$\Rightarrow I = \frac{10}{10^3} = 10^{-2} A$

14. The charge flowing through a resistance R varies with time t as $Q = at - bt^2$, where a and b are positive constants. The total heat produced in R is

(1) $\frac{a^3R}{6b}$

(2) $\frac{a^3R}{3b}$

(3) $\frac{a^3R}{2b}$

(4) $\frac{a^3R}{b}$

Answer (1)

Sol. $Q = at - bt^2$

$I = \frac{dQ}{dt} = a - 2bt$

Current will exist till $t = \frac{a}{2b}$

$P = \int_0^t I^2 R\,dt = \int_0^{\frac{a}{2b}} (a - 2bt)^2 R\,dt$

$= \int_0^{\frac{a}{2b}} (a^2 + 4b^2t^2 - 4abt) R\,dt$

$= \left[a^2t + 4b^2\frac{t^3}{3} - 4ab\frac{t^2}{2}\right]_0^{\frac{a}{2b}} R = \frac{a^3R}{6b}$

15. A black body is at a temperature of 5760 K. The energy of radiation emitted by the body at wavelength 250 nm is U_1, at wavelength 500 nm is U_2 and that at 1000 nm is U_3. Wien's constant, $b = 2.88 \times 10^6$ nmK. Which of the following is **correct**?

(1) $U_1 = 0$ (2) $U_3 = 0$

(3) $U_1 > U_2$ (4) $U_2 > U_1$

Answer (4)

Sol. $T_1 = 5760\ \text{K}$, $\lambda_m T = 2.88 \times 10^6\ \text{nmK}$

$$\lambda_m = \frac{2.88 \times 10^6\ \text{nmK}}{5760\ \text{K}} = 500\ \text{nm}$$

λ_m = Wavelength corresponding to maximum energy $U_2 > U_1$

16. Coefficient of linear expansion of brass and steel rods are α_1 and α_2. Lengths of brass and steel rods are l_1 and l_2 respectively. If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good?

(1) $\alpha_1 l_2 = \alpha_2 l_1$ (2) $\alpha_1 l_2^2 = \alpha_2 l_1^2$

(3) $\alpha_1^2 l_2 = \alpha_2^2 l_1$ (4) $\alpha_1 l_1 = \alpha_2 l_2$

Answer (4)

Sol. $l_2' - l_1' = l_2 - l_1$

$\Rightarrow l_2(1 + \alpha_2 \Delta t) - l_1(1 + \alpha_1 \Delta t) = l_2 - l_1$

$l_2 \alpha_2 = l_1 \alpha_1$

17. A *npn* transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800 Ω is connected in the collector circuit and the voltage drop across it is 0.8 V. If the current amplification factor is 0.96 and the input resistance of the circuit is 192 Ω, the voltage gain and the power gain of the amplifier will respectively be

(1) 4, 3.84 (2) 3.69, 3.84

(3) 4, 4 (4) 4, 3.69

Answer (1)

Sol. $R_L = 800\ \Omega, V_L = 0.8\ \text{V}$ $\Rightarrow I_C = \dfrac{V_L}{R_L} = 1\text{mA}$

$R_i = 192\ \Omega$

$$\text{Current amplification} = \frac{\text{Output current}}{\text{Input current}} = \frac{I_C}{I_B} = 0.96$$

$$\Rightarrow I_B = \frac{1\ \text{mA}}{0.96}$$

$$A_v = \frac{V_L}{V_{in}} = \frac{V_L}{I_B R_i} = 4$$

$$A_p = \frac{I_C^2 R_L}{I_B^2 R_i} = 3.84$$

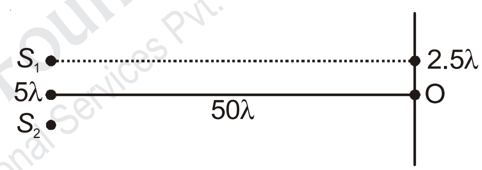
18. The intensity at the maximum in a Young's double slit experiment is I_0. Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance $D = 10\ d$?

(1) I_0 (2) $\dfrac{I_0}{4}$

(3) $\dfrac{3}{4} I_0$ (4) $\dfrac{I_0}{2}$

Answer (4)

Sol. $I_{\text{max}} = I_0$



$$\text{Path diff} = \frac{dy_n}{D} = \frac{d \times \frac{d}{2}}{10d} = \frac{d}{20} = \frac{\lambda}{4}$$

Phase diff = 90°

$$I = I_0 \cos^2 \frac{\phi}{2} = \frac{I_0}{2}$$

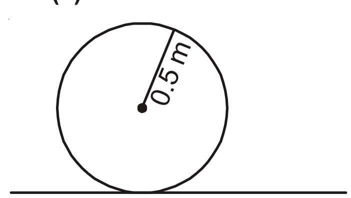
19. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2}. Its net acceleration in ms^{-2} at the end of 2.0 s is approximately

(1) 8.0 (2) 7.0

(3) 6.0 (4) 3.0

Answer (1)

Sol.



Angular acceleration α = 2 rad s^{-2}

Angular speed $\omega = \alpha t = 4$ rad s^{-1}

$a_c = r\omega^2 = 0.5 \times 16 = 8$ m/s^2

$a_t = \alpha r = 1$ rad/s

$a = \sqrt{a_c^2 + a_t^2} = \sqrt{8^2 + 1^2} \approx 8$ m/s^2

20. An electron of mass m and a photon have same energy E. The ratio of de-Broglie wavelengths associated with them is (c being velocity of light)

(1) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ (2) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(3) $c(2mE)^{\frac{1}{2}}$ (4) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

Answer (1)

Sol. $\lambda_e = \frac{h}{\sqrt{2mE}}, \lambda_p = \frac{hc}{E}, \ E = \frac{hc}{\lambda_p}$

$\frac{\lambda_e}{\lambda_p} = \frac{h}{\sqrt{2mE}}\frac{E}{hc}$

$= \frac{1}{c}\sqrt{\frac{E}{2m}}$

21. A disk and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first?

(1) Disk

(2) Sphere

(3) Both reach at the same time

(4) Depends on their masses

Answer (2)

Sol. $a_{\text{sphere}} > a_{\text{disc}}$,

Acceleration $(a) = \frac{g\sin\theta}{1 + K^2/r^2}$, independent of mass and radius.

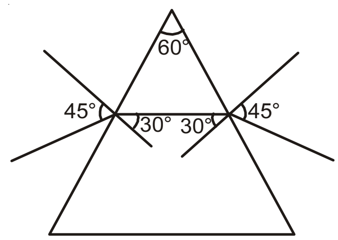
22. The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are

(1) $45°; \frac{1}{\sqrt{2}}$ (2) $30°; \sqrt{2}$

(3) $45°; \sqrt{2}$ (4) $30°; \frac{1}{\sqrt{2}}$

Answer (2)

Sol.



Ray pass symmetrically through prism

$\delta_{\min} = (i + e) - A = 30°$

$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} = \sqrt{2}$

23. When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on m as

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

(3) $\frac{1}{m^2}$ (4) m

Answer (1)

Sol. Initial kinetic energy = potential energy at closest approach

$\frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\varepsilon_0 r_0}$

$\Rightarrow r_0 \propto \frac{1}{m}$

24. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8×10^{-4} J by the end of the second revolution after the beginning of the motion?

(1) 0.1 m/s^2 (2) 0.15 m/s^2

(3) 0.18 m/s^2 (4) 0.2 m/s^2

Answer (1)

Sol. $m = 0.01$ kg

$r = 6.4$ cm

$\frac{1}{2}mv^2 = 8\times10^{-4}$ J

$v^2 = \frac{16\times10^{-4}}{0.01} = 16\times10^{-2}$

Speed $v^2 = 2a_t s$

$v^2 = 2a_t 4\pi r$

$$\Rightarrow \quad a_t = \frac{v^2}{8\pi r} = \frac{16\times10^{-2}}{8\times3.14\times6.4\times10^{-2}}$$

$$= 0.1 \text{ m/s}^2$$

25. The molecules of a given mass of a gas have r.m.s. velocity of 200 ms^{-1} at 27°C and 1.0×10^5 Nm^{-2} pressure. When the temperature and pressure of the gas are respectively, 127°C and 0.05×10^5 Nm^{-2}, the r.m.s. velocity of its molecules in ms^{-1} is

(1) $100\sqrt{2}$ (2) $\frac{400}{\sqrt{3}}$

(3) $\frac{100\sqrt{2}}{3}$ (4) $\frac{100}{3}$

Answer (2)

Sol. $v_{rms} = 200$ ms^{-1}, $T_1 = 300$ K, $P_1 = 10^5$ Nm^{-2}

$v_{rms} = \sqrt{\frac{3RT}{M}}$ $T_2 = 400$ K, $P_2 = 0.05 \times 10^5$ N/m^2

$$\Rightarrow \quad \frac{V_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$$

$$\Rightarrow \quad v_2 = \sqrt{\frac{400}{300}} \times 200 \text{ ms}^{-1} = \frac{400}{\sqrt{3}} \text{ ms}^{-1}$$

26. A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B' at radial distances $\frac{a}{2}$ and $2a$ respectively, from the axis of the wire is

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

(3) 1 (4) 4

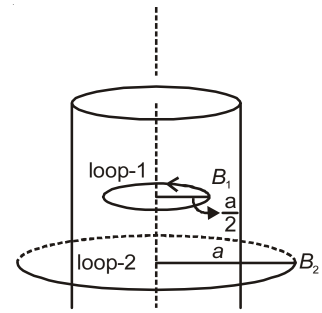
Answer (3)

Sol. Using Ampere circuital law

Loop-1

$$B_1 2\pi \frac{a}{2} = \mu_0 \frac{I}{\pi a^2} \times \frac{\pi a^2}{4}$$

$$B_1 = \frac{\mu_0 I}{4\pi a} \qquad \ldots(1)$$



Loop-2

$B_2.2\pi 2a = \mu_0 I$

$$\Rightarrow \quad B_2 = \frac{\mu_0 I}{4\pi a} \qquad \ldots(2)$$

$$\frac{B_1}{B_2} = 1$$

27. A particle moves so that its position vector is given by $\vec{r} = \cos\omega t\ \hat{x} + \sin\omega t\ \hat{y}$, where ω is a constant. Which of the following is true?

(1) Velocity and acceleration both are perpendicular to $\vec{r}$

(2) Velocity and acceleration both are parallel to $\vec{r}$

(3) Velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin

(4) Velocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin

Answer (3)

Sol. $\vec{r} = \cos\omega t\ \hat{x} + \sin\omega t\ \hat{y}$,

$$\vec{v} = \frac{d\vec{r}}{dt} = -\omega \sin\omega t\ \hat{x} + \omega\cos\omega t\ \hat{y}$$

$\Rightarrow \vec{v}.\vec{r} = 0$

$$\vec{a} = -\omega^2 \cos\omega t\,\hat{x} - \omega^2 \sin\omega t\,\hat{y} = -\omega^2\vec{r}$$

28. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

(1) $\sqrt{gR}$

(2) $\sqrt{2gR}$

(3) $\sqrt{3gR}$

(4) $\sqrt{5gR}$

Answer (4)

Sol. $v_{\min} = \sqrt{5\,gR}$

29. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is

(1) 4λ (2) 5λ

(3) $\frac{5}{2}\lambda$ (4) 3λ

Answer (4)

Sol. Einstein P.E. equation

Case-I

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \qquad \ldots(1)$$

Case-II

$$e\frac{V}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$$

$$\Rightarrow \quad eV = \frac{4hc}{2\lambda} - \frac{4hc}{\lambda_0} \qquad \ldots(2)$$

Equation (1) – (2)

$$\frac{hc}{\lambda} - \frac{2hc}{\lambda} = -\frac{4hc}{\lambda_0} + \frac{hc}{\lambda_0}$$

$$-\frac{hc}{\lambda} = -\frac{3hc}{\lambda_0}$$

$$\Rightarrow \quad \lambda_0 = 3\lambda$$

30. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then

(1) Compressing the gas isothermally will require more work to be done

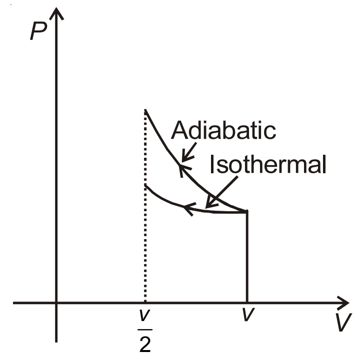
(2) Compressing the gas through adiabatic process will require more work to be done

(3) Compressing the gas isothermally or adiabatically will require the same amount of work

(4) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas

Answer (2)

Sol.



31. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is

(1) 5 : 1 (2) 5 : 4

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

Answer (4)

Sol. Potentiometer $E \propto l$

$$\Rightarrow \quad \frac{E_1 + E_2}{E_1 - E_2} = \frac{50}{10} = \frac{5}{1}$$

$$\Rightarrow \quad \frac{E_1}{E_2} = \frac{5+1}{5-1} = \frac{6}{4} = \frac{3}{2}$$

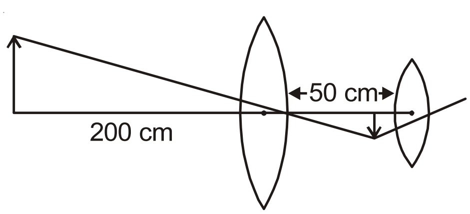
32. A astronomical telescope has objective and eyepiece of focal length 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance

(1) 37.3 cm (2) 46.0 cm

(3) 50.0 cm (4) 54.0 cm

Answer (4)

Sol.



Objective

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \quad \frac{1}{v} - \frac{1}{-200} = \frac{1}{40}$$

$$\frac{1}{v} = \frac{1}{40} - \frac{1}{200} = \frac{5-1}{200} = \frac{1}{50}$$

$v = 50$

For normal adjustment = $L = v + f_e = 54$ cm.

33. Two non-mixing liquids of densities ρ and $n\rho$ ($n > 1$) are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL ($p < 1$) in the denser liquid. The density d is equal to

(1) $\{1 + (n + 1)p\}\rho$

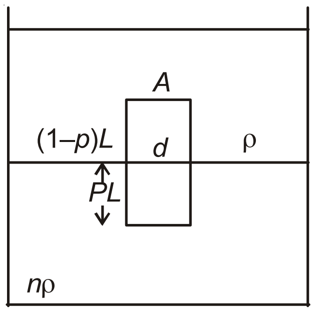
(2) $\{2 + (n + 1)p\}\rho$

(3) $\{2 + (n - 1)p\}\rho$

(4) $\{1 + (n - 1)p\}\rho$

Answer (4)

Sol.



Weight of cylinder = $Th_1 + Th_2$

$ALdg = (1 - P)\,LA\rho g + (PLA)\,n\rho g$

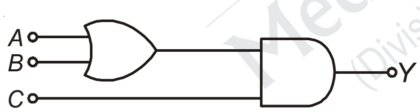
$\Rightarrow \quad d = (1 - P)\,\rho + Pn\rho$

$\Rightarrow \quad = \rho - P\rho + nP\rho$

$= \rho + (n - 1)P\rho$

$= \rho\,[1 + (n - 1)P]$

34. To get output 1 for the following circuit, the correct choice for the input is



(1) $A = 0,\ B = 1,\ C = 0$

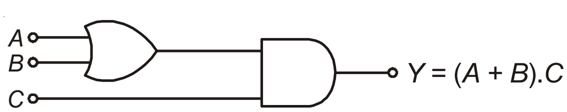
(2) $A = 1,\ B = 0,\ C = 0$

(3) $A = 1,\ B = 1,\ C = 0$

(4) $A = 1,\ B = 0,\ C = 1$

Answer (4)

Sol.



To get $Y = 1$, C should be 1.

35. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is

[Latent heat of ice is 3.4×10^5 J/kg and $g = 10$ N/kg]

(1) 34 km

(2) 544 km

(3) 136 km

(4) 68 km

Answer (3)

Sol. $\dfrac{mgh}{4} = mL_f$

$$\Rightarrow \quad h = \frac{4L_f}{g} = \frac{4 \times 3.4 \times 10^5}{10} = 136 \text{ km}$$

36. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is

(1) 1 : 2 (2) $1 : 2\sqrt{2}$

(3) 1 : 4 (4) $1 : \sqrt{2}$

Answer (2)

Sol. $v_e = \sqrt{2gR} = R\sqrt{\dfrac{8}{3}\pi G\rho}$

$$\Rightarrow \quad \frac{v_e}{v_p} = \frac{R\sqrt{\rho}}{R_p\sqrt{\rho}}$$

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

37. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

(1) 0° (2) 90°

(3) 45° (4) 180°

Answer (2)

Sol. $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$

$\Rightarrow \quad \cos\theta = 0 \Rightarrow \theta = 90°$

38. Given the value of Rydberg constant is 10^7 m^{-1}, the wave number of the last line of the Balmer series in hydrogen spectrum will be

(1) 0.025×10^4 m^{-1} (2) 0.5×10^7 m^{-1}

(3) 0.25×10^7 m^{-1} (4) 2.5×10^7 m^{-1}

Answer (3)

Sol. $R_H = 10^7 m^{-1}$

Last line $n_2 = \infty$, $n_1 = 2$

$$\lambda = \frac{1}{R_H\left(\frac{1}{4}-0\right)}$$

$$= \frac{4}{10^7} m = 0.25\times10^7 m^{-1}$$

39. A body of mass 1 kg begins to move under the action of a time dependent force $F = (2t\hat{i} + 3t^2\hat{j})N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t?

(1) $(2t^2 + 3t^2)$ W (2) $(2t^2 + 4t^4)$ W

(3) $(2t^3 + 3t^4)$ W (4) $(2t^3 + 3t^5)$ W

Answer (4)

Sol. $\vec{F} = \left(2t\hat{i} + 3t^2\hat{j}\right), \vec{a} = 2t\hat{i} + 3t^2\hat{j}$

$$v = \int_0^t a dt = t^2\hat{i} + t^3\hat{j}$$

$$P = \vec{F}\cdot\vec{v} = 2t\cdot t^2 + 3t^2\cdot t^3$$

$$= 2t^3 + 3t^5$$

40. An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf V = 10sin340t. The power loss in A.C. circuit is

(1) 0.51 W (2) 0.67 W

(3) 0.76 W (4) 0.89 W

Answer (1)

Sol. $L = \frac{20 \text{ mH}}{2}$ $C = 50\ \mu F$ $R = 40\ \Omega$

$$P_{av} = I_v^2 R = \left(\frac{E_v}{Z}\right)^2 R = \left(\frac{10}{\sqrt{2}}\right)^2$$

$$40\left[\frac{1}{40^2 + \left(340\times20\times10^{-3} - \frac{1}{340\times50\times10^{-6}}\right)}\right]$$

$$= \frac{100}{2}\times40\frac{1}{1600+[6.8-58.8]^2}$$

$$= \frac{2000}{1600+2704} \approx 0.46\text{ W} = 0.51\text{ W}$$

41. If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is

(1) $\frac{3}{2}A + 4B$ (2) $3A + 7B$

(3) $\frac{3}{2}A + \frac{7}{3}B$ (4) $\frac{A}{2} + \frac{B}{3}$

Answer (3)

Sol. $v = At + Bt^2$

$$\Rightarrow \frac{dx}{dt} = At + Bt^2$$

$$\Rightarrow dx = (At + Bt^2)dt$$

$$\Rightarrow x = \left[\frac{At^2}{2} + \frac{Bt^3}{3}\right]_1^2$$

$$= \frac{A}{2}(4-1) + \frac{B}{3}(8-1)$$

$$= \frac{3}{2}A + \frac{7}{3}B$$

42. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

(1) 4 H (2) 3 H

(3) 2 H (4) 1 H

Answer (4)

Sol. $N = 1000$, $I = 4$ A, $\phi = 4 \times 10^{-3}$

$$L = \frac{\phi N}{I} = \frac{4\times10^{-3}\times1000}{4} = 1\text{H}$$

43. A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C

(1) Current $I(t)$ lags voltage $V(t)$ by 90°

(2) Over a full cycle the capacitor C does not consume any energy from the voltage source

(3) Current $I(t)$ is in phase with voltage $V(t)$

(4) Current $I(t)$ leads voltage $V(t)$ by 180°

Answer (2)

Sol. Current leads voltage by phase $\frac{\pi}{2}(90°)$

Power consumed = 0.

44. Match the corresponding entries of column-1 with column-2. [Where m is the magnification produced by the mirror]

Column-1	Column-2
(A) $m = -2$	(a) Convex mirror
(B) $m = -\frac{1}{2}$	(b) Concave mirror
(C) $m = +2$	(c) Real image
(D) $m = +\frac{1}{2}$	(d) Virtual image

(1) A → b and c; B → b and c; C → b and d; D → a and d

(2) A → a and c; B → a and d; C → a and b; D → c and d

(3) A → a and d; B → b and c; C → b and d; D → b and c

(4) A → c and d; B → b and d; C → b and c ; D → a and d

Answer (1)

Sol. A → b and c; B → b and c; C → b and d; D → a and d

45. A car is negotiating a curved road of radius R. The road is banked at an angle θ. The coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is

(1) $\sqrt{gR^2 \frac{\mu_s + \tan\theta}{1-\mu_s \tan\theta}}$

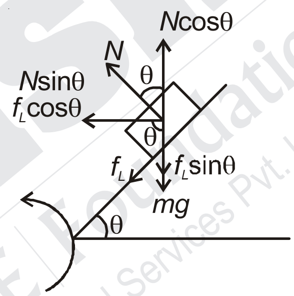
(2) $\sqrt{gR \frac{\mu_s + \tan\theta}{1-\mu_s \tan\theta}}$

(3) $\sqrt{\frac{g}{R} \frac{\mu_s + \tan\theta}{1-\mu_s \tan\theta}}$

(4) $\sqrt{\frac{g}{R^2} \frac{\mu_s + \tan\theta}{1-\mu_s \tan\theta}}$

Answer (2)

Sol.



Vertical equilibrium

$N\cos\theta = mg + f_L \sin\theta$

$\Rightarrow mg = N\cos\theta - f_L \sin\theta$ ...(1)

Horizontal equilirbium

$N\sin\theta + f_L\cos\theta = \frac{mv^2}{R}$ ...(2)

$\frac{Eqn(2)}{Eqn(1)} \quad \frac{v^2}{Rg} = \frac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s \sin\theta}$

$\Rightarrow v = \sqrt{Rg\frac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s \sin\theta}}$

$= \sqrt{Rg\frac{\tan\theta + \mu_s}{1 - \mu_s \tan\theta}}$

46. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false?

(1) The H – C – H bond angle in CH_4, the H – N – H bond angle in NH_3, and the H – O – H bond angle in H_2O are all greater than 90°

(2) The H – O – H bond angle in H_2O is larger than the H – C – H bond angle in CH_4

(3) The H – O – H bond angle in H_2O is smaller than the H – N – H bond angle in NH_3

(4) The H – C – H bond angle in CH_4 is larger than the H – N – H bond angle in NH_3

Answer (2)

Sol. Molecules **Bond angle**

$CH_4 \longrightarrow 109.5°$

$NH_3 \longrightarrow 107.5°$

$H_2O \longrightarrow 104.45°$

47. In the reaction

$$H-C\equiv CH \xrightarrow[\text{(2) } CH_3CH_2Br]{\text{(1) } NaNH_2/\text{liq. } NH_3} X \xrightarrow[\text{(2) } CH_3CH_2Br]{\text{(1) } NaNH_2/\text{liq. } NH_3} Y$$

X and Y are

(1) X = 1-Butyne; Y = 3-Hexyne

(2) X = 2-Butyne; Y = 3-Hexyne

(3) X = 2-Butyne; Y = 2-Hexyne

(4) X = 1-Butyne; Y = 2-Hexyne

Answer (1)

Sol. $$H-C\equiv CH \xrightarrow[\text{(2) } CH_3CH_2Br]{\text{(1) } NaNH_2/\text{liq. } NH_3} \underset{\text{(1–Butyne(X))}}{H-C\equiv C-CH_2-CH_3}$$

$$\xrightarrow[\text{(2) } CH_3CH_2Br]{\text{(1) } NaNH_2/\text{liq. } NH_3} \underset{\text{(3-Hexyne(Y))}}{CH_3-CH_2-C\equiv C-CH_2-CH_3}$$

48. Among the following, the correct order of acidity is

(1) $HClO_3 < HClO_4 < HClO_2 < HClO$

(2) $HClO < HClO_2 < HClO_3 < HClO_4$

(3) $HClO_2 < HClO < HClO_3 < HClO_4$

(4) $HClO_4 < HClO_2 < HClO < HClO_3$

Answer (2)

Sol. $$\xrightarrow[\text{Acidic – strength}]{\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}}$$

49. The rate of a first-order reaction is 0.04 mol l^{-1} s^{-1} at 10 seconds and 0.03 mol l^{-1} s^{-1} at 20 seconds after initiation of the reaction. The half-life period of the reaction is

(1) 24.1 s (2) 34.1 s

(3) 44.1 s (4) 54.1 s

Answer (1)

Sol. $$K = \frac{2.303}{10}\times \log\frac{0.04}{0.03}$$

$$= \frac{2.303\times 0.124}{10}$$

$$\therefore\ t_{1/2} = \frac{2.303\times 0.301\times 10}{2.303\times 0.124}$$

$$= 24.27 \text{ s}$$

$$\therefore\ t_{1/2} \approx 24.1 \text{ s}$$

50. Which one of the following characteristics is associated with adsorption?

(1) ΔG is negative but ΔH and ΔS are positive

(2) ΔG, ΔH and ΔS all are negative

(3) ΔG and ΔH are negative but ΔS is positive

(4) ΔG and ΔS are negative but ΔH is positive

Answer (2)

Sol. Adsorption is a spontaneous process with release in energy and decreases the randomness of adsorbed substance

$\therefore$ ΔG, ΔH & ΔS all are negative.

51. In which of the following options, the order of arrangement does **not** agree with the variation of property indicated against it?

(1) $Al^{3+} < Mg^{2+} < Na^+ < F^-$ (increasing ionic size)

(2) B < C < N < O (increasing first ionisation enthalpy)

(3) I < Br < Cl < F (increasing electron gain enthalpy)

(4) Li < Na < K < Rb (increasing metallic radius)

Answer (2 & 3)

Sol. For option (2) :

The correct order for 1st ionisation energy is B < C < O < N.

For option (3) :

The correct order for magnitude of electron gain enthalpy is I < Br < F < Cl

52. Which of the following statements is false?

(1) Mg^{2+} ions form a complex with ATP

(2) Ca^{2+} ions are important in blood clotting

(3) Ca^{2+} ions are not important in maintaining the regular beating of the heart

(4) Mg^{2+} ions are important in the green parts of plants

Answer (3)

Sol. Fact.

53. Which of the following statements about hydrogen is **incorrect?**

(1) Hydrogen has three isotopes of which tritium is the most common

(2) Hydrogen never acts as cation in ionic salts

(3) Hydronium ion, H_3O^+ exists freely in solution

(4) Dihydrogen does not act as a reducing agent

Answer (1 & 4)

Sol. Fact.

54. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is

(1) A carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol

(2) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration

(3) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation

(4) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism

Answer (4)

Sol. Fact.

55. MY and NY_3, two nearly insoluble salts, have the same K_{SP} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3?

(1) The molar sulubilities of MY and NY_3 in water are identical

(2) The molar solubility of MY in water is less than that of NY_3

(3) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water

(4) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities

Answer (2)

Sol. For MY,

$K_{SP} = S^2$

$\therefore \quad S = (6.2 \times 10^{-13})^{1/2}$

For, NY_3,

$K_{SP} = 27\ S^4$

$$\therefore \quad S = \left(\frac{6.2\times10^{-13}}{27}\right)^{1/4}$$

56. In a protein molecule, various amino acids are linked together by

(1) α-glycosidic bond

(2) β-glycosidic bond

(3) Peptide bond

(4) Dative bond

Answer (3)

Sol. Fact.

57. Natural rubber has

(1) All cis-configuration

(2) All trans-configuration

(3) Alternate cis - and trans-configuration

(4) Random cis - and trans-configuration

Answer (1)

Sol. Fact.

58. Match items of **Column I** with the items of **Column II** and assign the correct code :

	Column I		Column II
(a)	Cyanide process	(i)	Ultrapure Ge
(b)	Froth floatation process	(ii)	Dressing of ZnS
(c)	Electrolytic reduction	(iii)	Extraction of Al
(d)	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

Code :

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

Answer (1)

Sol. Fact.

59. Which one of the following statements is corrected when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?

(1) The solution turns blue

(2) The solution is decolourized

(3) SO_2 is reduced

(4) Green $Cr_2(SO_4)_3$ is formed

Answer (4)

Sol. Fact.

60. The electronic configurations of Eu (Atomic no. 63), Gd (Atomic No. 64) and Tb (Atomic No 65) are

(1) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

(2) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5f^1$ and $[Xe]4f^9 6s^2$

(3) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

(4) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

Answer (4)

Sol. Fact.

61. Two electrons occupying the same orbital are distinguished by

(1) Principal quantum number

(2) Magnetic quantum number

(3) Azimuthal quantum number

(4) Spin quantum number

Answer (4)

Sol. Fact.

62. When copper is heated with conc. HNO_3, it produces

(1) $Cu(NO_3)_2$ and NO_2

(2) $Cu(NO_3)_2$ and NO

(3) $Cu(NO_3)_2$, NO and NO_2

(4) $Cu(NO_3)_2$ and N_2O

Answer (1)

Sol. $$\underset{\text{(Conc.)}}{Cu + 4HNO_3} \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

63. Which of the following reagents would distinguish cis-cyclopenta-1, 2-diol from the trans-isomer?

(1) Acetone

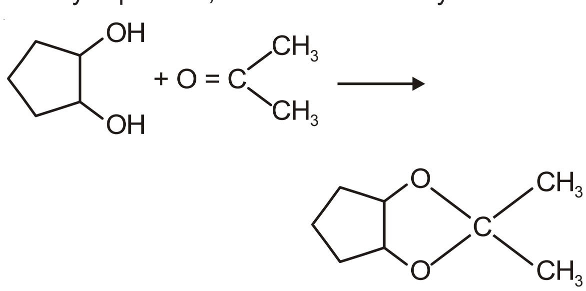
(2) Ozone

(3) MnO_2

(4) Aluminium isopropoxide

Answer (1)

Sol. cis-cylopenta-1, 2-diol can form cyclic ketal whereas tran-cyclopenta-1, 2-diol can't form cyclic ketal.



64. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is

(1) $\Delta H < 0$ and $\Delta S = 0$ (2) $\Delta H > 0$ and $\Delta S < 0$

(3) $\Delta H < 0$ and $\Delta S > 0$ (4) $\Delta H < 0$ and $\Delta S < 0$

Answer (1 & 3)

Sol. $\because$ $\Delta G = \Delta H - T\Delta S$

For reaction to be spontaneous, ΔG should be negative.

Note : ΔG can be negative in option (1) also.

65. Lithium has a bcc structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculate the edge length of a unit cell of Lithium metal ($N_A = 6.02 \times 10^{23}$ mol^{-1})

(1) 154 pm (2) 352 pm

(3) 527 pm (4) 264 pm

Answer (2)

Sol. $$0.53\ g/cm^3 \ \frac{2\times 6.94\ (g/mol)}{a^3 \times 6.02\times 10^{23}\ mol^{-1}}$$

On solving, a = 352 pm

66. Which one of the following orders is **correct** for the bond dissociation enthalpy of halogen molecules?

(1) $I_2 > Br_2 > Cl_2 > F_2$ (2) $Cl_2 > Br_2 > F_2 > I_2$

(3) $Br_2 > I_2 > F_2 > Cl_2$ (4) $F_2 > Cl_2 > Br_2 > I_2$

Answer (2)

Sol. Fact.

67. Which of the following is an analgesic?

(1) Novalgin (2) Penicillin

(3) Streptomycin (4) Chloromycetin

Answer (1)

Sol. Fact.

68. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

(1) $\frac{1}{8}$ (2) $\frac{1}{4}$

(3) $\frac{3}{8}$ (4) $\frac{1}{2}$

Answer (1)

Sol. $$\frac{n_{O_2}}{n_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$\Rightarrow \frac{n_{O_2}}{0.5} = \sqrt{\frac{2}{32}}$$

$$\therefore\ n_{O_2} = \frac{1}{8}$$

69. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be

(1) Faster (2) Slower

(3) Unchanged (4) Doubled

Answer (2)

Sol. $HNO_3 + H_2SO_4 \rightleftharpoons NO_2^+ + HSO_4^- + H_2O$

$\therefore$ Addition of $KHSO_4$ will decrease the NO_2^+ concentration.

70. Predict the **correct** order among the following

(1) lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

(2) lone pair - lone pair > bond pair - bond pair > lone pair - bond pair

(3) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair

(4) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair

Answer (1)

Sol. Fact.

71. The product obtained as a result of a reaction of nitrogen with CaC_2 is

(1) $Ca(CN)_2$ (2) $CaCN$

(3) $CaCN_3$ (4) Ca_2CN

Answer (1)

Sol. Option (1) should be $CaCN_2$ instead of $Ca(CN)_2$

$N_2 + CaC_2 \xrightarrow{\Delta} CaCN_2 + C$

72. Consider the following liquid-vapour equilibrium.

Liquid $\rightleftharpoons$ Vapour

Which of the following relations is correct?

(1) $\frac{d\ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$ (2) $\frac{d\ln P}{dT} = \frac{-\Delta H_v}{RT}$

(3) $\frac{d\ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$ (4) $\frac{d\ln P}{dT} = \frac{\Delta H_v}{RT^2}$

Answer (4)

Sol. Fact.

73. Match the compounds given in Column-I with the hybridisation and shape given in Column-II and mark the corect option.

Column-I	**Column-II**
(a) X_3F_6	(i) Distorted octahedral
(b) XeO_3	(ii) Square planar
(c) $XeOF_4$	(iii) Pyramidal
(d) XeF_4	(iv) Square pyramidal

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

Answer (1)

Sol. Fact.

74. Which of the following has longest C – O bond length? (Free C – O bond length CO is 1.128 Å)

(1) $Ni(CO)_4$ (2) $[Co(CO)_4]^{\ominus}$

(3) $[Fe(CO)_4]^{2-}$ (4) $[Mn(CO)_6]^+$

Answer (3)

Sol. Due to increase in –ve charge on metal atom bond length of C – O bond increases.

75. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 298 K is

(1) 10^{-14} atm (2) 10^{-12} atm

(3) 10^{-10} atm (4) 10^{-4} atm

Answer (1)

Sol. $2H^+ + 2e^- \rightarrow H_2(g)$

$$E = E^o - \frac{0.0591}{2} \times \log \frac{P_{H_2}}{[H^+]^2}$$

$$= 0 - \frac{0.0591}{2} \times \log \frac{P_{H_2}}{(10^{-7})^2}$$

$\therefore$ For potential of H_2 electrode to be zero, P_{H_2} should be 10^{-14} i.e., $\log \frac{10^{-14}}{10^{-14}} = 0$

76. The addition of a catalyst during a chemical reaction alters which of the following quantities?

(1) Entropy (2) Internal energy

(3) Enthalpy (4) Activation energy

Answer (4)

Sol. Catalyst decreases the activation energy and thus increases the rate of reaction.

77. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in AB is

(1) 6

(2) 4

(3) 8

(4) 2

Answer (1)

Sol. $\dfrac{r_{(+)}}{r_{(-)}} = \dfrac{0.98\times10^{-10}}{1.81\times10^{-10}} = 0.54$

i.e., Ionic solid has octahedral geometry, thus co-ordination number of each ion in AB is 6.

78. Which is the **correct** statement for the given acids?

(1) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid

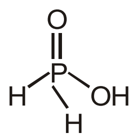
(2) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid

(3) Both are triprotic acids

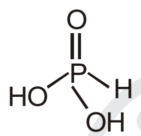
(4) Both are diprotic acids

Answer (2)

Sol.



(Phosphinic acid)
Monoprotic



(Phosphonic acid)
Diprotic

79. Fog is a colloidal solution of

(1) Liquid in gas (2) Gas in liquid

(3) Solid in gas (4) Gas in gas

Answer (1)

Sol. Fact.

80. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, Vapour Pressure Data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)

(1) The vapour will contain a higher percentage of benzene

(2) The vapour will contain a higher percentage of toluene

(3) The vapour will contain equal amounts of benzene and toluene

(4) Not enough information is given to make a prediction

Answer (1)

Sol. The component having higher vapour pressure will have higher percentage in vapour phase.

81. The **correct** statement regarding the comparison of staggered and eclipsed conformations of ethane is

(1) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain

(2) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain

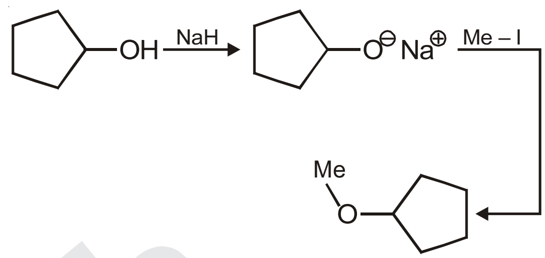
(3) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain

(4) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain

Answer (4)

Sol. Fact.

82. The reaction



can be classified as

(1) Williamson ether synthesis reaction

(2) Alcohol formation reaction

(3) Dehydration reaction

(4) Williamson alcohol synthesis reaction

Answer (1)

Sol. Fact.

83. The product formed by the reaction of an aldehyde with a primary amine is

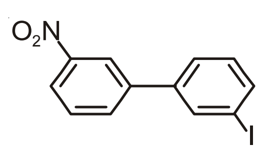
(1) Schiff base (2) Ketone

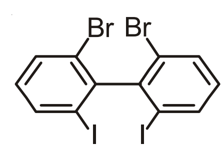
(3) Carboxylic acid (4) Aromatic acid

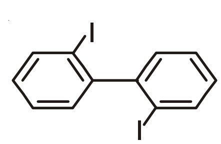
Answer (1)

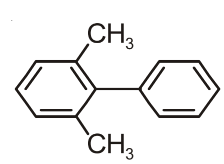
Sol. $R-\overset{\overset{\displaystyle O}{\|}}{C}-H + R'NH_2 \longrightarrow \underset{\text{schiff base}}{R-\overset{\overset{\displaystyle H}{|}}{C}=N-R'} + H_2O$

84. Which of the following biphenyl is optically active?

(1) 

(2) 

(3) 

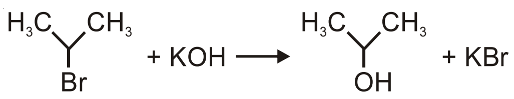
(4) 

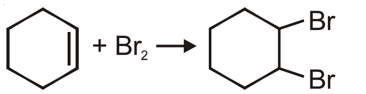
Answer (2)

Sol. Due to steric hindrance, arising due to presence of bulkier groups at ortho-positions of benzene rings, the biphenyl system becomes non-planar *i.e.*, optically active.

85. For the following reactions :

(a) $CH_3CH_2CH_2Br + KOH \rightarrow$
$CH_3CH = CH_2 + KBr + H_2O$

(b) 

(c) 

Which of the following statements is correct?

(1) (a) and (b) are elimination reactions and (c) is addition reaction

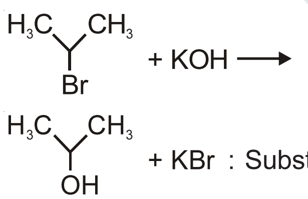
(2) (a) is elimination, (b) is substitution and (c) is addition reaction

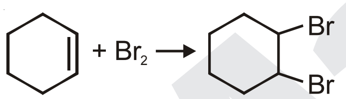
(3) (a) is elimination, (b) and (c) are substitution reactions

(4) (a) is substitution, (b) and (c) are addition reactions

Answer (2)

Sol. (a) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$: Elimination reaction

(b)  : Substitution reaction

(c)  : Addition reaction

86. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If K_b = 0.52, the boiling point of this solution will be

(1) 101°C (2) 100°C

(3) 102°C (4) 103°C

Answer (1)

Sol. $\because \dfrac{P_A^0 - P_S}{P_S} = \dfrac{n_B}{n_A}$

$$\Rightarrow \frac{760-732}{732} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\Rightarrow \frac{28}{732} = \frac{6.5 \times 18}{M_B \times 100}$$

$\therefore$ M_B = 30.6

$$\therefore \Delta T_b = 0.52 \times \frac{6.5 \times 1000}{30.6 \times 100}$$

= 1.10

$\therefore$ Boiling point = 100 + 1.1

= 101.1°C

$\approx$ 101°C

87. The **correct** statement regarding RNA and DNA, respectively is

(1) The sugar component in RNA is arabinose and the sugar component in DNA is 2′-deoxyribose

(2) The sugar component in RNA is ribose and the sugar component in DNA is 2′-deoxyribose

(3) The sugar component in RNA is arabinose and the sugar component in DNA is ribose

(4) The sugar component in RNA is 2′-deoxyribose and the sugar component in DNA is arabinose

Answer (2)

Sol. Fact.

88. The **correct** statement regarding the basicity of arylamines is

(1) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π electron system

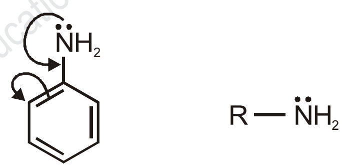
(2) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π electron system

(3) Arylamines are generally more basic than alkylamines because of aryl group

(4) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is *sp*-hybridized

Answer (1)

Sol.



Arylamine (less basic) Alkyl amine (more basic)

89. Which one given below is a non-reducing sugar?

(1) Maltose (2) Lactose

(3) Glucose (4) Sucrose

Answer (4)

Sol. Sucrose is non-reducing sugar because reducing parts of glucose and fructose are involved in glycosidic linkage.

90. The pair of electron in the given carbanion, $CH_3C \equiv C^{\ominus}$ is present in which of the following orbitals?

(1) 2*p* (2) sp^3

(3) sp^2 (4) *sp*

Answer (4)

Sol. Fact.

91. Gause's principle of competitive exclusion states that

(1) More abundant species will exclude the less abundant species through competition

(2) Competition for the same resources excludes species having different food preferences

(3) No two species can occupy the same niche indefinitely for the same limiting resources

(4) Larger organisms exclude smaller ones through competition

Answer (3)

Sol. Gause's principle of competitive exclusion states that no two species can occupy the same niche indefinitely for the same limiting resources.

92. The two polypeptides of human insulin are linked together by

(1) Hydrogen bonds (2) Phosphodiester bond

(3) Covalent bond (4) Disulphide bridges

Answer (4)

Sol. Mature insulin has two polypeptide chains (A and B) which are linked together by disulphide linkages (bridges).

93. The coconut water from tender coconut represents

(1) Endocarp

(2) Fleshy mesocarp

(3) Free nuclear proembryo

(4) Free nuclear endosperm

Answer (4)

Sol. Coconut milk represents free nuclear endosperm where the division of PEN is not followed by cytokinesis.

94. Which of the following statements is **wrong** for viroids?

(1) They lack a protein coat

(2) They are smaller than viruses

(3) They causes infections

(4) Their RNA is of high molecular weight

Answer (4)

Sol. Viroids have RNA of low molecular weight.

95. Which of the following features is not present in the Phylum-Arthropoda?

(1) Chitinous exoskeleton

(2) Metameric segmentation

(3) Parapodia

(4) Jointed appendages

Answer (3)

Sol. Parapodia are present in aquatic annelids like *Nereis* and helps in swimming.

96. Which of the following most appropriately describes haemophilia?

(1) Recessive gene disorder

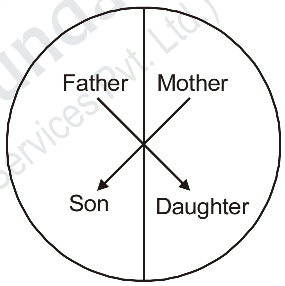
(2) X-linked recessive gene disorder

(3) Chromosomal disorder

(4) Dominant gene disorder

Answer (2)

Sol. Haemophilia is X-linked recessive gene disorder. It is a blood clotting disorder and shows criss-cross inheritance.



97. Emerson's enhancement effect and Red drop have been instrumental in the discovery of

(1) Photophosphorylation and non-cyclic electron transport

(2) Two photosystems operating simultaneously

(3) Photophosphorylation and cyclic electron transport

(4) Oxidative phosphorylation

Answer (2)

Sol. Emerson performed photosynthetic experiment on *chlorella*. He provided monochromatic light of more than 680 nm and observed decrease in rate of photosynthesis known as red drop.

Later he provided synchronised light of 680 nm and 700 nm and observed increase in rate of photosynthesis, known as enhancement effect.

This experiment led to discovery of two photosystems. - PS II and PS I.

98. In which of the following all three are macronutrients?

(1) Boron, zinc, manganese

(2) Iron, copper, molybdenum

(3) Molybdenum, magnesium, manganese

(4) Nitrogen, nickel, phosphorus

Answer (4)

Sol. None of the option is correct w.r.t. question statement. The option (4) seems to be more appropriate.

99. Name the chronic respiratory disorder caused mainly by cigarette smoking

(1) Emphysema (2) Asthma

(3) Respiratory acidosis (4) Respiratory alkalosis

Answer (1)

Sol. Emphysema is characterised by inflation of alveoli which is mainly due to chronic cigarette smoking.

100. A system of rotating crops with legume or grass pasture to imporve soil structure and fertility is called

(1) Ley farming (2) Contour farming

(3) Strip farming (4) Shifting agriculture

Answer (1)

Sol. The growing of granes or legumes in rotation with grain or tilled crops as a soil conservation measure.

101. Mitochondria and chloroplast are

(a) semi-autonomous organelles

(b) formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

Which one of the following options is **correct**?

(1) Both (a) and (b) are correct

(2) (b) is true but (a) is false

(3) (a) is true but (b) is false

(4) Both (a) and (b) are false

Answer (3)

Sol. Mitochondria and chloroplast are semi-autonomous organelles which contains DNA, RNA, ribosomes (705) etc.

102. In context of amniocentesis, which of the following statement is incorrect?

(1) It is usually done when a woman is between 14 - 16 weeks pregnant.

(2) It is used for prenatal sex determination.

(3) It can be used for detection of Down syndrome.

(4) It can be used for detection of Cleft palate.

Answer (4)

Sol. Cleft palate is a developmental abnormality and can be detected by sonography.

Amniocentesis is a foetal sex determination test and is banned in India for sex determination to legally check increasing female foeticides.

103. In a chloroplast the highest number of protons are found in

(1) Stroma

(2) Lumen of thylakoids

(3) Inter membrane space

(4) Antennae complex

Answer (2)

Sol. Proton concentration is higher in the lumen of thylakoid due to photolysis of water, H^+ pumping and NADP reductase activity in stroma.

104. Photosensitive compound in human eye is made up of

(1) Guanosine and Retinol

(2) Opsin and Retinal

(3) Opsin and Retinol

(4) Transducin and Retinene

Answer (2)

Sol. Photosensitive pigment rhodopsin in human eye is made up of opsin protein and retinal [aldehyde form of vitamin A (Retinol)]

105. Spindle fibres attach on to

(1) Telomere of the chromosome

(2) Kinetochore of the chromosome

(3) Centromere of the chromosome

(4) Kinetosome of the chromosome

Answer (2)

Sol. Spindle fibres attach to kinetochores of chromosomes

106. Which is the National Aquatic Animal of India?

(1) Gangetic shark (2) River dolphin

(3) Blue whale (4) Sea-horse

Answer (2)

Sol. River Dolphin is the national aquatic animal of India. This mammal can only survive in pure and fresh water.

107. Which of the following is required as inducer(s) for the expression of Lac operon?

(1) Glucose

(2) Galactose

(3) Lactose

(4) Lactose and Galactose

Answer (3)

Sol. *Lac* operon is an inducible operon. Lactose is the substrate for the enzyme beta-galactosidase and it also regulates switching on and off of the operon. Hence, it is termed as inducer.

108. Which of the following pairs of hormones are **not** antagonistic (having opposite effects) to each other?

(1) Parathormone - Calcitonin

(2) Insulin - Glucagon

(3) Aldosterone - Atrial Natriuretic Factor

(4) Relaxin - Inhibin

Answer (4)

Sol. Relaxin relaxes the pubic symphysis during parturition while inhibin decreases the secretion of FSH from anterior pituitary.

109. Microtubules are the constituents of

(1) Cilia, Flagella and Peroxisomes

(2) Spindle fibres, Centrioles and Cilia

(3) Centrioles, Spindle fibres and Chromatin

(4) Centrosome, Nucleosome and Centrioles

Answer (2)

Sol. Microtubules are structures present in cilia, flagella, centrioles and spindle fibres.

110. A complex of ribosomes attached to a single strand of RNA is known

(1) Polysome (2) Polymer

(3) Polypeptide (4) Okazaki fragment

Answer (1)

Sol. In prokaryotes, several ribosomes may attach to single mRNA and form a chain called polyribosomes or polysomes.

111. Fertilization in humans is practically feasible only if

(1) The sperms are transported into vagina just after the release of ovum in fallopian tube

(2) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the fallopian tube

(3) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the cervix

(4) The sperms are transported into cervix within 48 hrs of release of ovum in uterus

Answer (2)

Sol. Fertilization in human is practically feasible only if the sperms and ovum are transported simultaneously at ampullary-isthmic junction.

112. Asthma may be attributed to

(1) Bacterial infection of the lungs

(2) Allergic reaction of the mast cells in the lungs

(3) Inflammation of the trachea

(4) Accumulation of fluid in the lungs

Answer (2)

Sol. Asthma is an allergic reaction characterised by spasm of bronchi muscles because of effect of histamine released by mast cells.

113. The avena curvature is used for bioassay of

(1) ABA (2) GA_3

(3) IAA (4) Ethylene

Answer (3)

Sol. Bioassay - It is a quantitative and qualitative test used to determine the nature and function of a biochemical by using living material e.g., *Avena* curvature test used as bioassay for auxins.

114. The standard petal of a papilionaceous corolla is also called

(1) Carina (2) Pappus

(3) Vexillum (4) Corona

Answer (3)

Sol. The standard petal of a papilionaceous corolla is also called vexillum.

115. Tricarpellary, syncarpous gynoecium is found in flowers of

(1) Liliaceae (2) Solanaceae

(3) Fabaceae (4) Poaceae

Answer (1)

Sol. Liliaceae represents $\underline{G}(2)$.

116. One of the major components of cell wall of most fungi is

(1) Chitin (2) Peptidoglycan

(3) Cellulose (4) Hemicellulose

Answer (1)

Sol. Cell wall of most fungi is made up of chitin.

117. Select the **incorrect** statement :

(1) FSH stimulates the sertoli cells which help in spermiogenesis

(2) LH triggers ovulation in ovary

(3) LH and FSH decrease gradually during the follicular phase

(4) LH triggers secretion of androgens from the Leydig cells

Answer (3)

Sol. In follicular phase of menstrual cycle, LH and FSH increase gradually.

118. In meiosis crossing over is initiated at

(1) Pachytene (2) Leptotene

(3) Zygotene (4) Diplotene

Answer (1)

Sol. Leptotene - Condensation of chromatin

Zygotene - Synapsis of homologous chromosomes

Pachytene - Crossing over

Diplotene - Dissolution of synaptonemal complex and appearance of chiasmata

Diakinesis - Terminalisation of chiasmata

119. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of

(1) 1 : 2 : 1 : : Tall homozygous : Tall heterozygous : Dwarf

(2) 1 : 2 : 1 : : Tall heterozygous : Tall homozygous : Dwarf

(3) 3 : 1 : : Tall : Dwarf

(4) 3 : 1 : : Dwarf : Tall

Answer (1)

Sol. Parents - TT (Tall) × tt (Dwarf)

↓

F_1 generation Tt (Heterozygous tall)

↓ On selfing

egg \ Pollen →	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (dwarf)

F_2 generation

Phenotypic ratio = 3 : 1 [Tall : Dwarf]

Genotypic ratio ⇒

1 : 2 : 1 [Homozygous tall : Heterozygous tall : Dwarf]

120. Which of the following is the most important cause of animals and plants being driven to extinction?

(1) Over-exploitation

(2) Alien species invasion

(3) Habitat loss and fragmentation

(4) Co-extinctions

Answer (3)

Sol. There are four major causes of biodiversity loss in which most important cause driving animals and plants to extinction is "habitat loss and fragmentation".

121. Which one of the following is a characteristic feature of cropland ecosystem?

(1) Absence of soil organisms

(2) Least genetic diversity

(3) Absence of weeds

(4) Ecological succession

Answer (2)

Sol. Cropland ecosystem is largest anthropogenic ecosystem characterised by less diversity and high productivity.

122. Changes in GnRH pulse frequency in females is controlled by circulating levels of

(1) Estrogen and progesterone

(2) Estrogen and inhibin

(3) Progesterone only

(4) Progesterone and inhibin

Answer (1)

High level of estrogen and progesterone gives negative feedback to hypothalamus for the release of GnRH.

123. Which of the following is **not** a feature of the plasmids?

(1) Independent replication

(2) Circular structure

(3) Transferable

(4) Single-stranded

Answer (4)

Sol. Plasmid is extrachromosomal, double stranded circular DNA.

124. Which of the following features is not present in *Periplaneta americana*?

(1) Schizocoelom as body cavity

(2) Indeterminate and radial cleavage during embryonic development

(3) Exoskeleton composed of N-acetylglucosamine

(4) Metamerically segmented body

Answer (2)

Sol. Cockroach has determinate cleavage during embryonic development.

125. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to

(1) Allergic response (2) Graft rejection

(3) Auto-immune disease (4) Active immunity

Answer (3)

Sol. In autoimmune diseases, the immune cells are unable to distinguish between self cells and non-self cells and attack self cells.

126. Match the terms in **Column I** with their description in **Column II** and choose the correct option

Column I	Column II
(a) Dominance	(i) Many genes govern a single character
(b) Codominance	(ii) In a heterozygous organism only one allele expresses itself
(c) Pleiotropy	(iii) In a heterozygous organism both alleles express themselves fully
(d) Polygenic inheritance	(iv) A single gene influences many characters

(1) a(ii), b(i), c(iv), d(iii)

(2) a(ii), b(iii), c(iv), d(i)

(3) a(iv), b(i), c(ii), d(iii)

(4) a(iv), b(iii), c(i), d(ii)

Answer (2)

Sol.

Dominance	-	Expression of only one allele in heterozygous organism.
Codominance	-	Side by side full expression of both alleles. F_1 resembles both parents.
Pleiotropy	-	Single gene can exhibit multiple phenotypic expression *e.g.*, Phenyl ketonuria.
Polygenic inheritance	-	Many genes govern a single character *e.g.*, Human skin colour.

127. Joint Forest Management Concept was introduced in India during

(1) 1960s (2) 1970s

(3) 1980s (4) 1990s

Answer (3)

Sol. Joint Forest Management Concept was introduced in India during 1980s by the Government of India to work closely with the local communities for protecting and managing forests.

128. Pick out the **correct** statements :

(a) Haemophilia is a sex-linked recessive disease.

(b) Down's syndrome is due to aneuploidy.

(c) Phenylketonuria is an autosomal recessive gene disorder.

(d) Sickle cell anaemia is an X-linked recessive gene disorder.

(1) (a) and (d) are correct

(2) (b) and (d) are correct

(3) (a), (c) and (d) are correct

(4) (a), (b) and (c) are correct

Answer (4)

Sol. Sickle cell anaemia is autosomal recessive gene disorder.

129. Which one of the following statements is **wrong**?

(1) Cyanobacteria are also called blue-green algae

(2) Golden algae are also called desmids

(3) Eubacteria are also called false bacteria

(4) Phycomycetes are also called algal fungi

Answer (3)

Sol. Eubacteria are true bacteria.

130. Proximal end of the filament of stamen is attached to the

(1) Anther (2) Connective

(3) Placenta (4) Thalamus or petal

Answer (4)

Sol. A typical stamen consist of anther and filament.

The proximal end of filament is attached to thalamus or petal of the flower where as distal and bears anther.

131. Which of the following approaches does **not** give the defined action of contraceptive?

(1)	Barrier methods	Prevent fertilization
(2)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilizing capacity of sperms
(3)	Hormonal contraceptives	Prevent/retard entry of sperms, prevent ovulation and fertilization
(4)	Vasectomy	Prevents spermatogenesis

Answer (4)

Sol. Vasectomy blocks the gamete transport and does not affect spermatogenesis.

132. The taq polymerase enzyme is obtained from

(1) *Thermus aquaticus*

(2) *Thiobacillus ferroxidans*

(3) *Bacillus subtilis*

(4) *Pseudomonas putida*

Answer (1)

Sol. Taq polymerase is thermostable DNA polymerase obtained from *Thermus aquaticus*.

133. Identify the correct statement on inhibin

(1) Inhibits the secretion of LH, FSH and Prolactin

(2) Is produced by granulose cells in ovary and inhibits the secretion of FSH

(3) Is produced by granulose cells in ovary and inhibits the secretion of LH

(4) Is produced by nurse cells in testes and inhibits the secretion of LH

Answer (2)

Sol. Inhibin is produced by granulosa cells in ovary and has direct effect on the secretion of FSH.

134. Which part of the tobacco plant is infected by *Meloidogyne incognita?*

(1) Flower (2) Leaf

(3) Stem (4) Root

Answer (4)

Sol. *Meloidogyne incognita* cause root knot disease in tobacco plant.

135. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain

(1) Activated pathogens

(2) Harvested antibodies

(3) Gamma globulin

(4) Attenuated pathogens

Answer (4)

Sol. Oral polio vaccine consists of attenuated pathogen.

136. Which one of the following cell organelles is enclosed by a single membrane?

(1) Mitochondria (2) Chloroplasts

(3) Lysosomes (4) Nuclei

Answer (3)

Sol. Nuclei, mitochondria and chloroplasts are double membrane bound organelles. Lysosomes are single membrane bound organelle.

137. Lack of relaxation between successive stimuli in sustained muscle contraction is known as

(1) Spasm

(2) Fatigue

(3) Tetanus

(4) Tonus

Answer (3)

Sol. Sustained muscle contraction due to repeated stimulus is known as tetanus.

138. Which of the following is **not** a stem modification?

(1) Pitcher of *Nepenthes*

(2) Thorns of citrus

(3) Tendrils of cucumber

(4) Flattened structures of *Opuntia*

Answer (1)

Sol. Pitcher of *Nepenthes* is modified leaf.

139. Water soluble pigments found in plant cell vacuoles are

(1) Xanthophylls (2) Chlorophylls

(3) Carotenoids (4) Anthocyanins

Answer (4)

Sol. Anthocyanin are water soluble vacuolar pigments that may appear red, purple or blue depending on pH.

140. Select the correct statement

(1) Gymnosperms are both homosporous and heterosporous

(2) *Salvinia, Ginkgo* and *Pinus* all are gymnosperms

(3) *Sequoia* is one of the tallest trees

(4) The leaves of gymnosperms are not well adapted to extremes of climate

Answer (3)

Sol. *Sequoia* is one of the tallest tree species, known as red wood tree.

141. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?

(1) Polymerase chain reaction

(2) Zinc finger analysis

(3) Restriction enzymes

(4) DNA-DNA hybridization

Answer (2)

Sol. A zinc finger is a small protein structural motif that characterised by the co-ordination of one or more Zn ions in order to stabilise the folds.

142. Which type of tissue **correctly** matches with its location?

	Tissue	**Location**
(1)	Smooth muscle	Wall of intestine
(2)	Areolar tissue	Tendons
(3)	Transitional epithelium	Tip of nose
(4)	Cuboidal epithelium	Lining of stomach

Answer (1)

Sol. Columnar epithelium is present in the lining of stomach.

- Tendon is dense connective tissue and connects muscle to bone.
- Tip of nose consists of elastic cartilage.

143. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant?

(1) C_3

(2) C_4

(3) CAM

(4) Nitrogen fixer

Answer (2)

Sol. C_4 plants are special, they tolerate higher temperatures, they lack photorespiration and have greater productivity of biomass.

144. Which of the following structures is homologus to the wing of a bird?

(1) Dorsal fin of a Shark

(2) Wing of a Moth

(3) Hind limb of Rabbit

(4) Flipper of Whale

Answer (4)

Sol. Wings of bird and flipper of whale are modified fore limbs but wings help in flying and flippers help in swimming.

145. Which of the following characteristic features always holds true for the corresponding group of animals?

(1)	Cartilaginous endoskeleton	Chondrichthyes
(2)	Viviparous	Mammalia
(3)	Possess a mouth with an upper and a lower jaw	Chordata
(4)	3-chambered heart with one incompletely divided ventricle	Reptilia

Answer (1)

Sol. Reptiles have 3-chambered heart except crocodiles. Mammals are viviparous except prototherian mammals; chordates have jaws except protochordates and cyclostomes.

146. Which of the following statements is not true for cancer cells in relation to mutations?

(1) Mutations in proto-oncogenes accelerate the cell cycle

(2) Mutations destroy telomerase inhibitor

(3) Mutations inactivate the cell control

(4) Mutations inhibit production of telomerase

Answer (4)

Sol. Cancerous cells have high telomerase activity. Telomerase inhibitors are used in cancer treatment.

147. The amino acid Tryptophan is the precursor for the synthesis of

(1) Melatonin and Serotonin

(2) Thyroxine and Triiodothyronine

(3) Estrogen and Progesterone

(4) Cortisol and Cortisone

Answer (1)

Sol. Melatonin and serotonin are derivatives of tryptophan amino acid while thyroxine and tri-iodothyronine are tyrosine amino acid derivatives.

148. Following are the two statements regarding the origin of life

(a) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.

(b) The first autotrophic organisms were the chemoautotrophs that never released oxygen.

On the above statements which one of the following options is **correct**?

(1) (a) is correct but (b) is false

(2) (b) is correct but (a) is false

(3) Both (a) & (b) are correct

(4) Both (a) & (b) are false

Answer (3)

Sol. The earliest organisms that appeared on earth were anaerobic chemoheterotrophs.

Chemoautotrophs were the first autotrophic organisms unable to perform photolysis of water and never released oxygen.

149. Reduction in pH of blood will

(1) Reduce the rate of heart beat

(2) Reduce the blood supply to the brain

(3) Decrease the affinity of hemoglobin with oxygen

(4) Release bicarbonate ions by the liver

Answer (3)

Sol. Reduction in pH of blood favours the dissociation of oxyhemoglobin.

150. Analogous structures are a result of

(1) Divergent evolution

(2) Convergent evolution

(3) Shared ancestry

(4) Stabilizing selection

Answer (2)

Sol. Analogous structures are a result of convergent evolution.

151. Which of the following is a restriction endonuclease?

(1) Hind II (2) Protease

(3) DNase I (4) RNase

Answer (1)

Sol. Hind II is a restriction endonuclease.

152. The term ecosystem was coined by

(1) E.P. Odum (2) A.G. Tansley

(3) E. Haeckel (4) E. Warming

Answer (2)

Sol. The term ecosystem was coined by A.G. Tansley.

153. Which one of the following statements is wrong?

(1) Sucrose is a disaccharide

(2) Cellulose is a polysaccharide

(3) Uracil is a pyrimidine

(4) Glycine is a sulphur containing amino acid

Answer (4)

Sol. Glycine is simplest amino acid in which 'R' is replaced by H(Hydrogen).

154. In bryophytes and pteridophytes, transport of male gametes requires

(1) Wind (2) Insects

(3) Birds (4) Water

Answer (4)

Sol. In several simple plants like algae, bryophytes and pteridophytes, water is the medium through which male gamete transfer takes place.

155. When does the growth rate of a population following the logistic model equal zero? The logistic model is given as dN/dt = rN(1-N/K)

(1) When N/K is exactly one

(2) When N nears the carrying capacity of the habitat

(3) When N/K equals zero

(4) When death rate is greater than birth rate

Answer (1)

Sol. In logistic growth model population growth equation is described as

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where N = population density at time t

r = Intrinsic rate of natural increase

K = carrying capacity

when $\frac{N}{K} = 1$ then $\frac{K-N}{K} = 0$

therefore $\frac{dN}{dt} = 0$

156. Which one of the following statements is **not** true?

(1) Tapetum helps in the dehiscence of anther

(2) Exine of pollen grains is made up of sporopollenin

(3) Pollen grains of many species cause severe allergies

(4) Stored pollen in liquid nitrogen can be used in the crop breeding programmes

Answer (1)

Sol. Tapetum provides nourishment to developing pollen grain.

157. Which of the following would appear as the pioneer organisms on bare rocks?

(1) Lichens (2) Liverworts

(3) Mosses (4) Green algae

Answer (1)

Sol. Pioneer species are the species that invade a bare area.

In primary succession on rocks these are lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.

158. Which one of the following is the starter codon?

(1) AUG (2) UGA

(3) UAA (4) UAG

Answer (1)

Sol. AUG is the start codon.

UAA, UAG and UGA are stop codons.

159. Which one of the following characteristics is **not** shared by birds and mammals?

(1) Ossified endoskeleton

(2) Breathing using lungs

(3) Viviparity

(4) Warm blooded nature

Answer (3)

Sol. Mammals are viviparous while birds are oviparous.

160. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature?

(1) Biological names can be written in any language

(2) The first word in a biological name represents the genus name and the second is a specific epithet

(3) The names are written in Latin and are italicised

(4) When written by hand, the names are to be underlined

Answer (1)

Sol. Biological names originate from latin language and printed in italics.

161. Blood pressure in the pulmonary artery is

(1) Same as that in the aorta

(2) More than that in the carotid

(3) More than that in the pulmonary vein

(4) Less than that in the venae cavae

Answer (3)

Sol. Blood pressure in different blood vessels:

Artery > Arteriole > Capillary > Venule > Vein (Vena cava)

162. Cotyledon of maize gain is called

(1) Plumule (2) Coleorhiza

(3) Coleoptile (4) Scutellum

Answer (4)

Sol. Large, shield shaped cotyledon of grass family is called scutellum.

163. In the stomach, gastric acid is secreted by the

(1) Gastrin secreting cells

(2) Parietal cells

(3) Peptic cells

(4) Acidic cells

Answer (2)

Sol. In stomach, gastric acid (HCl) is secreted by parietal cells of gastric gland

164. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers

(1) Nitrous oxide (2) Ozone

(3) Ammonia (4) Methane

Answer (2)

Sol. Ozone is found in the upper part of the atmosphere called stratosphere and it acts as a shield absorbing ultraviolet radiation from sun and so its depletion can lead to incidence of skin cancers.

165. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom

(1) Animalia (2) Monera

(3) Protista (4) Fungi

Answer (2)

Sol. All single celled eukaryotes like chrysophytes [diatoms and desmids], Euglenoids [*Euglena*], Dinoflagellates and slime moulds are included in kingdom -Protista.

166. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options :

(1) Both processes cannot happen simultaneously

(2) Both processes can happen together because the diffusion coefficient of water and CO_2 is different

(3) The above processes happen only during night time

(4) One process occurs during day time, and the other at night

Answer (2)

Sol. Diffusion of water vapour and CO_2 are independent process. Their diffusion depends on the difference in their partial pressure.

167. In mammals, which blood vessel would normally carry largest amount of urea?

(1) Renal Vein (2) Dorsal Aorta

(3) Hepatic Vein (4) Hepatic Portal Vein

Answer (3)

Sol. Urea is synthesized in liver. So maximum amount of urea is present in hepatic vein and minimum in renal vein.

168. Seed formation without fertilization in flowering plants involves the process of

(1) Sporulation

(2) Budding

(3) Somatic hybridization

(4) Apomixis

Answer (4)

Sol. Apomixis is a special mechanism to produce seeds without fertilisation.

169. Which of the following is wrongly matched in the given table?

	Microbe	Product	Application
(1)	*Trichoderma polysporum*	Cyclosporin A	immunosuppressive drug
(2)	*Monascus purpureus*	Statins	lowering of blood cholesterol
(3)	*Streptococcus*	Streptokinase	removal of clot from blood vessel
(4)	*Clostridium butylicum*	Lipase	removal of oil stains

Answer (4)

Sol. Butyric acid is produced by fermentive activity of *Clostridium butylicum*.

170. In a testcross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates

(1) The two genes are located on two different chromosomes

(2) Chromosomes failed to separate during meiosis

(3) The two genes are linked and present on the same chromosome

(4) Both of the characters are controlled by more than one gene

Answer (3)

Sol. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental or recombinant type.

171. It is much easier for a small animal to run uphill than for a large animal, because

(1) It is easier to carry a small body weight

(2) Smaller animals have a higher metabolic rate

(3) Small animals have a lower O_2 requirement

(4) The efficiency of muscles in large animals is less than in the small animals

Answer (2)

Sol. Basal metabolic rate is inversely proportional to body size. So smaller animals have a higher metabolic rate.

172. Which of the following is not a characteristic feature during mitosis in somatic cells?

(1) Spindle fibres

(2) Disappearance of nucleolus

(3) Chromosome movement

(4) Synapsis

Answer (4)

Sol. Synapsis is pairing of homologous chromosomes. It occurs during zygotene stage of meiosis.

173. Which of the following statements is **not correct**?

(1) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style

(2) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers

(3) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil

(4) Some reptiles have also been reported as pollinators in some plant species

Answer (1)

Sol. Pollen grains of different species are incompatible, so they fail to germinate.

174. Specialised epidermal cells surrounding the guard cells are called

(1) Complementary cells (2) Subsidiary cells

(3) Bulliform cells (4) Lenticels

Answer (2)

Sol. Few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called **stomatal apparatus**.

175. Which of the following guards the opening of hepatopancreatic duct into the duodenum?

(1) Semilunar valve (2) Ileocaecal valve

(3) Pyloric sphincter (4) Sphincter of Oddi

Answer (4)

Sol. Sphincter of Oddi guards the opening of hepatopancreatic duct into the duodenum.

176. Stems modified into flat green organs performing the functions of leaves are known as

(1) Cladodes (2) Phyllodes

(3) Phylloclades (4) Scales

Answer (3)

Sol. Phylloclades are modified stem, *i.e.*, green flat structure as in *Opuntia*.

177. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the

(1) Halophiles (2) Thermoacidophiles

(3) Methanogens (4) Eubacteria

Answer (3)

Sol. Methanogens are obligate anaerobic ancient and primitive bacteria. They are involved in methanogenesis.

178. A river with an inflow of domestic sewage rich in organic waste may result in

(1) Drying of the river very soon due to algal bloom

(2) Increased population of aquatic food web organisms

(3) An increased production of fish due to biodegradable nutrients

(4) Death of fish due to lack of oxygen

Answer (4)

Sol. A river with an inflow of domestic sewage rich in organic waste will reduce the dissolved oxygen (DO) and may result in death of fish due to lack of oxygen.

179. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in

(1) Aneuploidy (2) Polyploidy

(3) Somaclonal variation (4) Polyteny

Answer (2)

Sol. Polyploidy cells have a chromosome number that is more than double the haploid number.

180. A typical fat molecule is made up of

(1) Three glycerol molecules and one fatty acid molecule

(2) One glycerol and three fatty acid molecules

(3) One glycerol and one fatty acid molecule

(4) Three glycerol and three fatty acid molecules

Answer (2)

Sol. A typical fat molecule is triglyceride formed by esterification of one glycerol and three fatty acid molecules.

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