

DATE : 01/05/2016



Test Booklet Code

Z

# Aakash

Medical | IIT-JEE | Foundations

(Divisions of Aakash Educational Services Pvt. Ltd.)

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Time : 3 hrs.

## Answers & Solutions

Max. Marks : 720

for

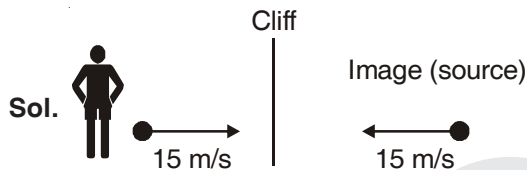
## AIPMT-2016

### 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/markings 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 **Z**. 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. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of  $15 \text{ ms}^{-1}$ . Then, the frequency of sound that the observer hears in the echo reflected from the cliff is (Take velocity of sound in air =  $330 \text{ ms}^{-1}$ )
- (1) 838 Hz
  - (2) 885 Hz
  - (3) 765 Hz
  - (4) 800 Hz

**Answer (1)**



$$f' = \left( \frac{v}{v - v_s} \right) f = \left( \frac{330}{330 - 15} \right) 800 = 838 \text{ Hz}$$

2. Out of the following options which one can be used to produce a propagating electromagnetic wave?
- (1) A chargeless particle
  - (2) An accelerating charge
  - (3) A charge moving at constant velocity
  - (4) A stationary charge

**Answer (2)**

**Sol.** Accelerating charge produce electromagnetic wave.

3. An inductor 20 mH, a capacitor 50  $\mu\text{F}$  and a resistor 40  $\Omega$  are connected in series across a source of emf  $V = 10\sin 340t$ . The power loss in A.C. circuit is
- (1) 0.76 W
  - (2) 0.89 W
  - (3) 0.51 W
  - (4) 0.67 W

**Answer (3)**

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

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

$$40 \left[ \frac{1}{40^2 + \left( 340 \times 20 \times 10^{-3} - \frac{1}{340 \times 50 \times 10^{-6}} \right)^2} \right]$$

$$= \frac{100}{2} \times 40 \frac{1}{1600 + [6.8 - 58.8]^2} = \frac{2000}{1600 + 2704} \approx 0.46 \text{ W} = 0.51 \text{ W}$$

4. 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  $\rightarrow$  a and d; B  $\rightarrow$  b and c; C  $\rightarrow$  b and d; D  $\rightarrow$  b and c
- (2) A  $\rightarrow$  c and d; B  $\rightarrow$  b and d; C  $\rightarrow$  b and c; D  $\rightarrow$  a and d
- (3) A  $\rightarrow$  b and c; B  $\rightarrow$  b and c; C  $\rightarrow$  b and d; D  $\rightarrow$  a and d
- (4) A  $\rightarrow$  a and c; B  $\rightarrow$  a and d; C  $\rightarrow$  a and b; D  $\rightarrow$  c and d

**Answer (3)**

**Sol.** A  $\rightarrow$  b and c; B  $\rightarrow$  b and c; C  $\rightarrow$  b and d; D  $\rightarrow$  a and d

5. Coefficient of linear expansion of brass and steel rods are  $\alpha_1$  and  $\alpha_2$ . 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)  $\alpha_1 l_1 = \alpha_2 l_2$
- (3)  $\alpha_1 l_2 = \alpha_2 l_1$
- (4)  $\alpha_1 l_2^2 = \alpha_2 l_1^2$

**Answer (2)**

**Sol.**  $l_2 - l_1 = l_2 - l_1$

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

$$l_2 \alpha_2 = l_1 \alpha_1$$

6. At what height from the surface of earth the gravitation potential and the value of  $g$  are  $-5.4 \times 10^7 \text{ J kg}^{-2}$  and  $6.0 \text{ ms}^{-2}$  respectively? Take the radius of earth as 6400 km
- (1) 1400 km
  - (2) 2000 km
  - (3) 2600 km
  - (4) 1600 km

**Answer (3)**

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

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

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

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

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

7. 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  $3.4 \times 10^5 \text{ J/kg}$  and  $g = 10 \text{ N/kg}$ ]

- (1) 136 km  
 (2) 68 km  
 (3) 34 km  
 (4) 544 km

**Answer (1)**

$$\text{Sol. } \frac{mgh}{4} = mL_f$$

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

8. In a diffraction pattern due to a single slit of width  $a$ , the first minimum is observed at an angle  $30^\circ$  when light of wavelength  $5000 \text{ \AA}$  is incident on the slit. The first secondary maximum is observed at an angle of

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

**Answer (2)**

**Sol.** 1<sup>st</sup> minimum

$$a \sin \theta = n\lambda$$

$$n = 1, a \sin 30^\circ = \lambda$$

$$\Rightarrow a = 2\lambda$$

1<sup>st</sup> secondary maximum

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

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

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

9. 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) 3 : 4                      (2) 3 : 2  
 (3) 5 : 1                      (4) 5 : 4

**Answer (2)**

**Sol.** Potentiometer  $E \propto l$

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

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

10. 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  $8 \times 10^{-4} \text{ J}$  by the end of the second revolution after the beginning of the motion?

- (1)  $0.18 \text{ m/s}^2$                       (2)  $0.2 \text{ m/s}^2$   
 (3)  $0.1 \text{ m/s}^2$                       (4)  $0.15 \text{ m/s}^2$

**Answer (3)**

**Sol.**  $m = 0.01 \text{ kg}$

$$r = 6.4 \text{ cm}$$

$$\frac{1}{2}mv^2 = 8 \times 10^{-4} \text{ J}$$

$$v^2 = \frac{16 \times 10^{-4}}{0.01} = 16 \times 10^{-2}$$

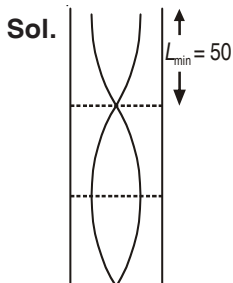
$$\text{Speed } v^2 = 2a_t s$$

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

$$\Rightarrow a_t = \frac{v^2}{8\pi r} = \frac{16 \times 10^{-2}}{8 \times 3.14 \times 6.4 \times 10^{-2}} = 0.1 \text{ m/s}^2$$

11. 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) 150 cm                      (2) 200 cm  
(3) 66.7 cm                      (4) 100 cm

**Answer (1)**

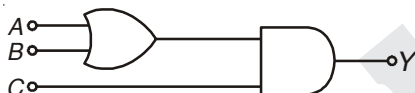


$$L_{\min} = 50 \text{ cm}$$

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

$$\Rightarrow 150 \text{ cm, } 250 \text{ cm, } 350 \text{ cm, etc.}$$

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



- (1)  $A = 1, B = 1, C = 0$   
(2)  $A = 1, B = 0, C = 1$   
(3)  $A = 0, B = 1, C = 0$   
(4)  $A = 1, B = 0, C = 0$

**Answer (2)**

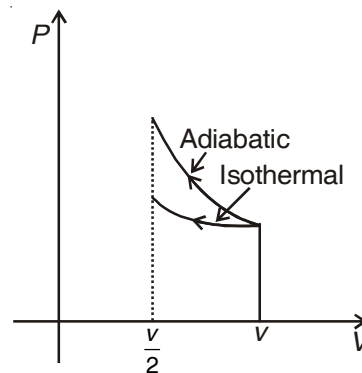


To get  $Y = 1$ ,  $C$  should be 1.

13. 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 or adiabatically will require the same amount of work  
(2) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas  
(3) Compressing the gas isothermally will require more work to be done  
(4) Compressing the gas through adiabatic process will require more work to be done

**Answer (4)**

**Sol.**

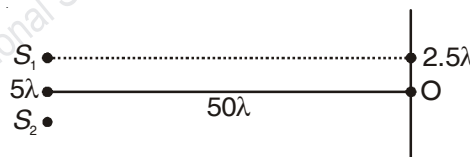


14. The intensity at the maximum in a Young's double slit experiment is  $I_0$ . Distance between two slits is  $d = 5\lambda$ , where  $\lambda$  is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance  $D = 10d$ ?

- (1)  $\frac{3}{4}I_0$                       (2)  $\frac{I_0}{2}$   
(3)  $I_0$                       (4)  $\frac{I_0}{4}$

**Answer (2)**

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



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

$$\text{Phase diff} = 90^\circ$$

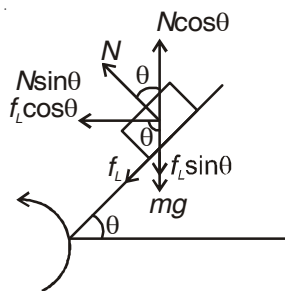
$$I = I_0 \cos^2 \frac{\phi}{2} = \frac{I_0}{2}$$

15. A car is negotiating a curved road of radius  $R$ . The road is banked at an angle  $\theta$ . The coefficient of friction between the tyres of the car and the road is  $\mu_s$ . The maximum safe velocity on this road is

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

**Answer (4)**

**Sol.**



**Vertical equilibrium**

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

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

**Horizontal equilibrium**

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

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

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

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

16. An electron of mass  $m$  and a photon have same energy  $E$ . The ratio of de-Broglie wavelengths associated with them is

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

( $c$  being velocity of light)

**Answer (3)**

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

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

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

17. 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)  $U_1 > U_2$   
 (2)  $U_2 > U_1$   
 (3)  $U_1 = 0$   
 (4)  $U_3 = 0$

**Answer (2)**

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

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

$\lambda_m$  = Wavelength corresponding to maximum energy  $U_2 > U_1$

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

- (1)  $0.25 \times 10^7 \text{ m}^{-1}$   
 (2)  $2.5 \times 10^7 \text{ m}^{-1}$   
 (3)  $0.025 \times 10^4 \text{ m}^{-1}$   
 (4)  $0.5 \times 10^7 \text{ m}^{-1}$

**Answer (1)**

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

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

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

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

19. A  $n p n$  transistor is connected in common emitter configuration in a given amplifier. A load resistance of  $800 \Omega$  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  $192 \Omega$ , the voltage gain and the power gain of the amplifier will respectively be

- (1) 4, 4  
 (2) 4, 3.69  
 (3) 4, 3.84  
 (4) 3.69, 3.84

**Answer (3)**

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

$R_i = 192 \Omega$

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

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

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

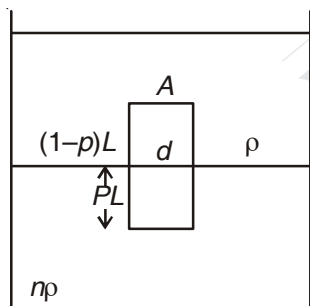
$A_p = \frac{I_C^2 R_L}{I_B^2 R_i} = 3.84$

20. Two non-mixing liquids of densities  $\rho$  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)  $\{2 + (n - 1)p\}\rho$
- (2)  $\{1 + (n - 1)p\}\rho$
- (3)  $\{1 + (n + 1)p\}\rho$
- (4)  $\{2 + (n + 1)p\}\rho$

**Answer (2)**

**Sol.**



Weight of cylinder =  $Th_1 + Th_2$

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

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

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

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

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

21. 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)  $\frac{3}{2}A + \frac{7}{3}B$

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

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

(4)  $3A + 7B$

**Answer (1)**

**Sol.**  $v = At + Bt^2$

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

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

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

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

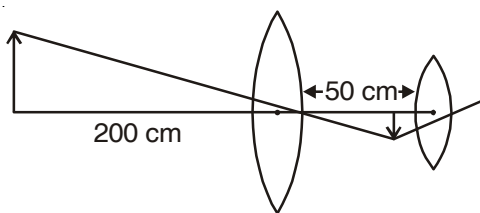
$= \frac{3}{2}A + \frac{7}{3}B$

22. 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) 50.0 cm
- (2) 54.0 cm
- (3) 37.3 cm
- (4) 46.0 cm

**Answer (2)**

**Sol.**



Objective

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

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

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

$v = 50$

For normal adjustment =  $L = v + f_e = 54 \text{ cm}$ .

23. 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 : 4                      (2) 1 :  $\sqrt{2}$   
(3) 1 : 2                      (4) 1 :  $2\sqrt{2}$

**Answer (4)**

**Sol.**  $v_e = \sqrt{2qR} = R\sqrt{\frac{8}{3}\pi G\rho}$

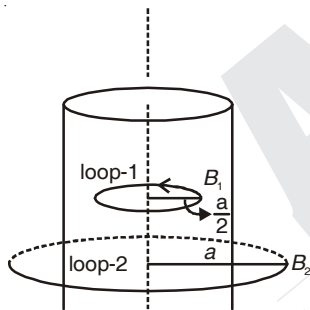
$$\Rightarrow \frac{v_e}{v_p} = \frac{R\sqrt{\rho}}{R_p\sqrt{\rho}} = \frac{1}{2\sqrt{2}}$$

24. 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) 1                              (2) 4  
(3)  $\frac{1}{4}$                               (4)  $\frac{1}{2}$

**Answer (1)**

**Sol.**



Using Ampere circuital law

**Loop-1**

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

$$B_1 = \frac{\mu_0 I}{4\pi a} \quad \dots(1)$$

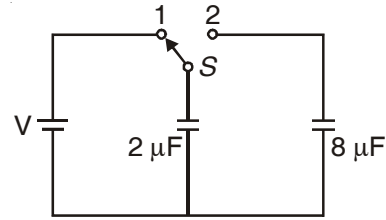
**Loop-2**

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

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

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

25. A capacitor of  $2 \mu\text{F}$  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) 75%                      (2) 80%  
(3) 0%                      (4) 20%

**Answer (2)**

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

Energy dissipated on connection across  $8 \mu\text{F}$

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

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

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

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

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

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

**Answer (2)**

**Sol.** Einstein P.E. equation

**Case-I**

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \quad \dots(1)$$

**Case-II**

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

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

Equation (1) – (2)

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

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

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

27. 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)  $45^\circ$  (2)  $180^\circ$   
(3)  $0^\circ$  (4)  $90^\circ$

**Answer (4)**

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

$$\Rightarrow \cos\theta = 0 \Rightarrow \theta = 90^\circ$$

28. A body of mass 1 kg begins to move under the action of a time dependent force  $F = (2t\hat{i} + 3t^2\hat{j})\text{N}$ ,

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)  $(2t^3 + 3t^4)\text{W}$   
(2)  $(2t^3 + 3t^6)\text{W}$   
(3)  $(2t^2 + 3t^2)\text{W}$   
(4)  $(2t^2 + 4t^4)\text{W}$

**Answer (2)**

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

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

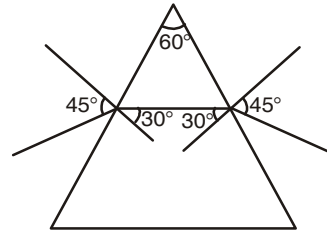
$$P = \vec{F} \cdot \vec{v} = 2t \cdot t^2 + 3t^2 \cdot t^3 = 2t^3 + 3t^5$$

29. The angle of incidence for a ray of light at a refracting surface of a prism is  $45^\circ$ . The angle of prism is  $60^\circ$ . 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)  $45^\circ; \sqrt{2}$  (2)  $30^\circ; \frac{1}{\sqrt{2}}$   
(3)  $45^\circ; \frac{1}{\sqrt{2}}$  (4)  $30^\circ; \sqrt{2}$

**Answer (4)**

**Sol.**



Ray pass symmetrically through prism

$$\delta_{\min} = (i + e) - A = 30^\circ$$

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

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

- (1) Velocity is perpendicular to  $\vec{r}$  and acceleration is directed towards the origin  
(2) Velocity is perpendicular to  $\vec{r}$  and acceleration is directed away from the origin  
(3) Velocity and acceleration both are perpendicular to  $\vec{r}$   
(4) Velocity and acceleration both are parallel to  $\vec{r}$

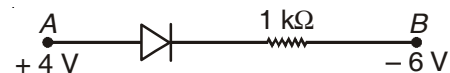
**Answer (1)**

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

$$\vec{v} = \frac{d\vec{r}}{dt} = -\omega \sin\omega t \hat{x} + \omega \cos\omega t \hat{y} \quad \left| \Rightarrow \vec{v} \cdot \vec{r} = 0 \right.$$

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

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



- (1)  $10^{-1}\text{A}$  (2)  $10^{-3}\text{A}$   
(3)  $0\text{A}$  (4)  $10^{-2}\text{A}$

**Answer (4)**

**Sol.**  $V_A - V_B = IR$

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

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

32. Two identical charged spheres suspended from a common point by two massless strings of lengths  $l$ , are initially at a distance  $d$  ( $d \ll l$ ) 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)  $v \propto x^{-1}$   
 (3)  $v \propto x^{\frac{1}{2}}$                         (4)  $v \propto x$

**Answer (1)**

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

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

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

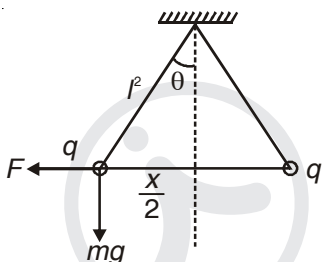
$$q^2 \propto x^3$$

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

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

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

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



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

- (1) Current  $I(t)$  is in phase with voltage  $V(t)$   
 (2) Current  $I(t)$  leads voltage  $V(t)$  by  $180^\circ$   
 (3) Current  $I(t)$  lags voltage  $V(t)$  by  $90^\circ$   
 (4) Over a full cycle the capacitor  $C$  does not consume any energy from the voltage source

**Answer (4)**

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

Power consumed = 0.

34. The magnetic susceptibility is negative for

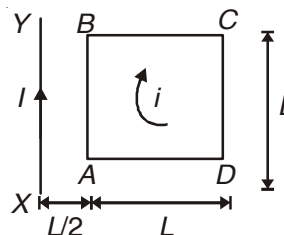
- (1) Ferromagnetic material only  
 (2) Paramagnetic and ferromagnetic materials  
 (3) Diamagnetic material only  
 (4) Paramagnetic material only

**Answer (3)**

**Sol.** Susceptibility of diamagnetic substance is negative

Susceptibility of para and ferromagnetic substance is positive

35. 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 force on the loop will be



(1)  $\frac{2\mu_0 i I L}{3\pi}$

(2)  $\frac{\mu_0 i I L}{2\pi}$

(3)  $\frac{2\mu_0 i I}{3\pi}$

(4)  $\frac{\mu_0 i I}{2\pi}$

**Answer (3)**

**Sol.**  $F_{\text{Loop}} = F_{BA} - F_{CD}$

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

$$= \frac{2\mu_0 i I}{3\pi}$$

36. 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  $\lambda_1$  is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is  $\lambda_2$ . The ratio  $\lambda_2/\lambda_1$  is

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

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

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

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

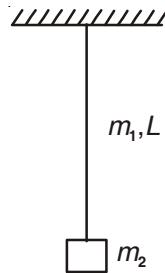
**Answer (4)**

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

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

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

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



37. When an  $\alpha$ -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)  $\frac{1}{m^2}$
- (2)  $m$
- (3)  $\frac{1}{m}$
- (4)  $\frac{1}{\sqrt{m}}$

**Answer (3)**

**Sol.** Initial kinetic energy = potential energy at closest approach

$$\frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\epsilon_0 r_0}$$

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

38. 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) Both reach at the same time
- (2) Depends on their masses
- (3) Disk
- (4) Sphere

**Answer (4)**

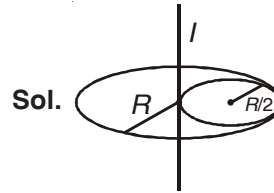
**Sol.**  $a_{\text{sphere}} > a_{\text{disc}}$

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

39. 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)  $11MR^2/32$
- (2)  $9MR^2/32$
- (3)  $15MR^2/32$
- (4)  $13MR^2/32$

**Answer (4)**



**Sol.**

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

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

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

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

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

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

40. 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  $4 \times 10^{-3}$  Wb. The self-inductance of the solenoid is

- (1) 2 H
- (2) 1 H
- (3) 4 H
- (4) 3 H

**Answer (2)**

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

$$L = \frac{\phi N}{I} = \frac{4 \times 10^{-3} \times 1000}{4} = 1 \text{ H}$$

41. 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)  $\sqrt{3gR}$
- (2)  $\sqrt{5gR}$
- (3)  $\sqrt{gR}$
- (4)  $\sqrt{2gR}$

**Answer (2)**

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

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

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

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

(3)  $100\sqrt{2}$

(4)  $\frac{400}{\sqrt{3}}$

**Answer (4)**

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

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

$$\Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$$

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

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

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

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

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

**Answer (3)**

**Sol.**  $Q = at - bt^2$

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

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

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

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

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

44. A refrigerator works between  $4^\circ\text{C}$  and  $30^\circ\text{C}$ . 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  $1 \text{ cal} = 4.2 \text{ joules}$ ]

(1) 236.5 W

(2) 2365 W

(3) 2.365 W

(4) 23.65 W

**Answer (1)**

**Sol.**  $T_2 = 4^\circ\text{C} = 277 \text{ K}$

$$T_1 = 303 \text{ K}$$

$$Q_2 = 600 \text{ cal}$$

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

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

$$W = 236.5 \text{ W}$$

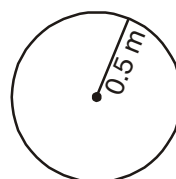
45. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of  $2.0 \text{ rad s}^{-2}$ . Its net acceleration in  $\text{ms}^{-2}$  at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

(1) 6.0

(2) 3.0

(3) 8.0

(4) 7.0

**Answer (3)**

**Sol.**

$$\text{Angular acceleration } \alpha = 2 \text{ rad s}^{-2}$$

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

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

$$a_t = \alpha r = 1 \text{ rad/s}$$

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



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

- (1) Inter membrane space
- (2) Antennae complex
- (3) Stroma
- (4) Lumen of thylakoids

**Answer (4)**

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

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

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

**Answer (3)**

**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.

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

- (1) Aldosterone - Atrial Natriuretic Factor
- (2) Relaxin - Inhibin
- (3) Parathormone - Calcitonin
- (4) Insulin - Glucagon

**Answer (2)**

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

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

- (1) Hepatic Vein
- (2) Hepatic Portal Vein
- (3) Renal Vein
- (4) Dorsal Aorta

**Answer (1)**

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

58. 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), (c) and (d) are correct
  - (2) (a), (b) and (c) are correct
  - (3) (a) and (d) are correct
  - (4) (b) and (d) are correct

**Answer (2)**

**Sol.** Sickle cell anaemia is autosomal recessive gene disorder.

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

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

**Answer (2)**

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

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

- (1) Viviparity
- (2) Warm blooded nature
- (3) Ossified endoskeleton
- (4) Breathing using lungs

**Answer (1)**

**Sol.** Mammals are viviparous while birds are oviparous.

61. Emerson's enhancement effect and Red drop have been instrumental in the discovery of
- (1) Photophosphorylation and cyclic electron transport
  - (2) Oxidative phosphorylation
  - (3) Photophosphorylation and non-cyclic electron transport
  - (4) Two photosystems operating simultaneously

**Answer (4)**

**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.

62. In which of the following all three are macronutrients?
- (1) Molybdenum, magnesium, manganese
  - (2) Nitrogen, nickel, phosphorus
  - (3) Boron, zinc, manganese
  - (4) Iron, copper, molybdenum

**Answer (2)**

**Sol.** None of the option is correct w.r.t. question statement. The option (1) seems to be more appropriate.

63. Changes in GnRH pulse frequency in females is controlled by circulating levels of
- (1) Progesterone only
  - (2) Progesterone and inhibin
  - (3) Estrogen and progesterone
  - (4) Estrogen and inhibin

**Answer (3)**

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

64. The coconut water from tender coconut represents
- (1) Free nuclear proembryo
  - (2) Free nuclear endosperm
  - (3) Endocarp
  - (4) Fleshy mesocarp

**Answer (2)**

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

65. Which of the following guards the opening of hepatopancreatic duct into the duodenum?
- (1) Pyloric sphincter
  - (2) Sphincter of Oddi
  - (3) Semilunar valve
  - (4) Ileocaecal valve

**Answer (2)**

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

66. Which one of the following is the starter codon?
- (1) UAA
  - (2) UAG
  - (3) AUG
  - (4) UGA

**Answer (3)**

**Sol.** AUG is the start codon.

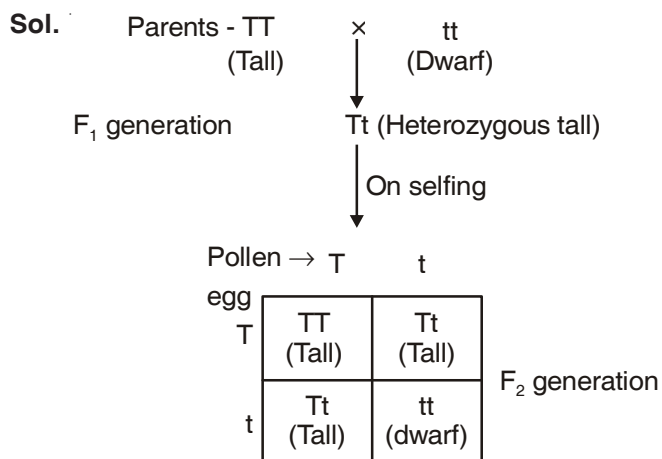
UAA, UAG and UGA are stop codons.

67. Spindle fibres attach on to:
- (1) Centromere of the chromosome
  - (2) Kinetosome of the chromosome
  - (3) Telomere of the chromosome
  - (4) Kinetochore of the chromosome

**Answer (4)**

**Sol.** Spindle fibres attach to kinetochores of chromosomes.

68. 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) 3 : 1 :: Tall : Dwarf
  - (2) 3 : 1 :: Dwarf : Tall
  - (3) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf
  - (4) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf

**Answer (3)**

Phenotypic ratio = 3 : 1 [Tall : Dwarf]

Genotypic ratio ⇒

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

69. A typical fat molecule is made up of
- (1) One glycerol and one fatty acid molecule
  - (2) Three glycerol and three fatty acid molecules
  - (3) Three glycerol molecules and one fatty acid molecule
  - (4) One glycerol and three fatty acid molecules

**Answer (4)**

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

70. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called
- (1) Strip farming
  - (2) Shifting agriculture
  - (3) Ley farming
  - (4) Contour farming

**Answer (3)**

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

71. Which of the following is **not** a stem modification?
- (1) Tendrils of cucumber
  - (2) Flattened structures of *Opuntia*
  - (3) Pitcher of *Nepenthes*
  - (4) Thorns of citrus

**Answer (3)**

**Sol.** Pitcher of *Nepenthes* is modified leaf.

72. Which of the following features is not present in *Periplaneta americana*?
- (1) Exoskeleton composed of N-acetylglucosamine
  - (2) Metamerically segmented body
  - (3) Schizocoelom as body cavity
  - (4) Indeterminate and radial cleavage during embryonic development

**Answer (4)**

**Sol.** Cockroach has determinate cleavage during embryonic development.

73. Name the chronic respiratory disorder caused mainly by cigarette smoking
- (1) Respiratory acidosis
  - (2) Respiratory alkalosis
  - (3) Emphysema
  - (4) Asthma

**Answer (3)**

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

74. Which one of the following statements is **not** true?
- (1) Pollen grains of many species cause severe allergies
  - (2) Stored pollen in liquid nitrogen can be used in the crop breeding programmes
  - (3) Tapetum helps in the dehiscence of anther
  - (4) Exine of pollen grains is made up of sporopollenin

**Answer (3)**

**Sol.** Tapetum provides nourishment to developing pollen grain.

75. Which of the following is required as inducer(s) for the expression of Lac operon?
- (1) Lactose
  - (2) Lactose and Galactose
  - (3) Glucose
  - (4) Galactose

**Answer (1)**

**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.

76. Mitochondria and chloroplast are
- semi-autonomous organelles
  - formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

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

- (a) is true but (b) is false
- Both (a) and (b) are false
- Both (a) and (b) are correct
- (b) is true but (a) is false

**Answer (1)**

**Sol.** Mitochondria and chloroplast are semi-autonomous organelles which contains DNA, RNA, ribosomes (70S) etc.

77. It is much easier for a small animal to run uphill than for a large animal, because
- Small animals have a lower  $O_2$  requirement
  - The efficiency of muscles in large animals is less than in the small animals
  - It is easier to carry a small body weight
  - Smaller animals have a higher metabolic rate

**Answer (4)**

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

78. Seed formation without fertilization in flowering plants involves the process of
- Somatic hybridization
  - Apomixis
  - Sporulation
  - Budding

**Answer (2)**

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

79. The avena curvature is used for bioassay of
- |         |              |
|---------|--------------|
| (1) IAA | (2) Ethylene |
| (3) ABA | (4) $GA_3$   |

**Answer (1)**

**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.

80. 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) CAM   | (2) Nitrogen fixer |
| (3) $C_3$ | (4) $C_4$          |

**Answer (4)**

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

81. Which is the National Aquatic Animal of India?
- Blue whale
  - Sea-horse
  - Gangetic shark
  - River dolphin

**Answer (4)**

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

82. Which of the following is **not** a feature of the plasmids?
- Transferable
  - Single-stranded
  - Independent replication
  - Circular structure

**Answer (2)**

**Sol.** Plasmid is extrachromosomal, double stranded circular DNA.

83. The amino acid Tryptophan is the precursor for the synthesis of
- Estrogen and Progesterone
  - Cortisol and Cortisone
  - Melatonin and Serotonin
  - Thyroxine and Triiodothyronine

**Answer (3)**

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

84. Joint Forest Management Concept was introduced in India during
- (1) 1980s                      (2) 1990s  
 (3) 1960s                      (4) 1970s

**Answer (1)**

**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.

85. Water soluble pigments found in plant cell vacuoles are
- (1) Carotenoids                (2) Anthocyanins  
 (3) Xanthophylls              (4) Chlorophylls

**Answer (2)**

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

86. Which one of the following is a characteristic feature of cropland ecosystem?
- (1) Absence of weeds  
 (2) Ecological succession  
 (3) Absence of soil organisms  
 (4) Least genetic diversity

**Answer (4)**

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

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

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

**Answer (3)**

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

88. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the
- (1) Methanogens  
 (2) Eubacteria  
 (3) Halophiles  
 (4) Thermoacidophiles

**Answer (1)**

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

89. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain
- (1) Gamma globulin  
 (2) Attenuated pathogens  
 (3) Activated pathogens  
 (4) Harvested antibodies

**Answer (2)**

**Sol.** Oral polio vaccine consists of attenuated pathogen.

90. 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  $N/K$  equals zero  
 (2) When death rate is greater than birth rate  
 (3) When  $N/K$  is exactly one  
 (4) When  $N$  nears the carrying capacity of the habitat

**Answer (3)**

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

91. Which one of the following statements is wrong?

- (1) Uracil is a pyrimidine
- (2) Glycine is a sulphur containing amino acid
- (3) Sucrose is a disaccharide
- (4) Cellulose is a polysaccharide

**Answer (2)**

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

92. The taq polymerase enzyme is obtained from

- (1) *Bacillus subtilis*
- (2) *Pseudomonas putida*
- (3) *Thermus aquaticus*
- (4) *Thiobacillus ferrooxidans*

**Answer (3)**

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

93. Gause's principle of competitive exclusion states that

- (1) No two species can occupy the same niche indefinitely for the same limiting resources
- (2) Larger organisms exclude smaller ones through competition
- (3) More abundant species will exclude the less abundant species through competition
- (4) Competition for the same resources excludes species having different food preferences

**Answer (1)**

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

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

- (1) Phylloclades
- (2) Scales
- (3) Cladodes
- (4) Phyllodes

**Answer (1)**

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

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

- |            |          |
|------------|----------|
| (1) Stem   | (2) Root |
| (3) Flower | (4) Leaf |

**Answer (2)**

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

96. Fertilization in humans is practically feasible only if

- (1) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the cervix
- (2) The sperms are transported into cervix within 48 hrs of release of ovum in uterus
- (3) The sperms are transported into vagina just after the release of ovum in fallopian tube
- (4) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the fallopian tube

**Answer (4)**

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

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

- (1) Mutations inactivate the cell control
- (2) Mutations inhibit production of telomerase
- (3) Mutations in proto-oncogenes accelerate the cell cycle
- (4) Mutations destroy telomerase inhibitor

**Answer (2)**

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

98. Which of the following structures is homologous to the wing of a bird?

- (1) Hind limb of Rabbit
- (2) Flipper of Whale
- (3) Dorsal fin of a Shark
- (4) Wing of a Moth

**Answer (2)**

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

99. 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(iv), b(i), c(ii), d(iii)	(2) a(iv), b(iii), c(i), d(ii)
(3) a(ii), b(i), c(iv), d(iii)	(4) a(ii), b(iii), c(iv), d(i)

**Answer (4)**

<b>Sol.</b> 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.

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

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

**Answer (2)**

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

101. Select the **incorrect** statement :

- (1) LH and FSH decrease gradually during the follicular phase
- (2) LH triggers secretion of androgens from the Leydig cells
- (3) FSH stimulates the sertoli cells which help in spermiogenesis
- (4) LH triggers ovulation in ovary

**Answer (1)**

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

102. Which of the following is a restriction endonuclease?

- (1) DNase I
- (2) RNase
- (3) Hind II
- (4) Protease

**Answer (3)**

**Sol.** Hind II is a restriction endonuclease.

103. Microtubules are the constituents of

- (1) Centrioles, Spindle fibres and Chromatin
- (2) Centrosome, Nucleosome and Centrioles
- (3) Cilia, Flagella and Peroxisomes
- (4) Spindle fibres, Centrioles and Cilia

**Answer (4)**

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

104. Select the correct statement

- (1) *Sequoia* is one of the tallest trees
- (2) The leaves of gymnosperms are not well adapted to extremes of climate
- (3) Gymnosperms are both homosporous and heterosporous
- (4) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms

**Answer (1)**

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

105. 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) Auto-immune disease
- (2) Active immunity
- (3) Allergic response
- (4) Graft rejection

**Answer (1)**

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

106. 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 linked and present on the same chromosome
- (2) Both of the characters are controlled by more than one gene
- (3) The two genes are located on two different chromosomes
- (4) Chromosomes failed to separate during meiosis

**Answer (1)**

**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.

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

- (1) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil
- (2) Some reptiles have also been reported as pollinators in some plant species
- (3) 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
- (4) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers

**Answer (3)**

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

108. Asthma may be attributed to

- (1) Inflammation of the trachea
- (2) Accumulation of fluid in the lungs
- (3) Bacterial infection of the lungs
- (4) Allergic reaction of the mast cells in the lungs

**Answer (4)**

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

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

- (1) It can be used for detection of Down syndrome.
- (2) It can be used for detection of Cleft palate.
- (3) It is usually done when a woman is between 14 - 16 weeks pregnant.
- (4) It is used for prenatal sex determination.

**Answer (2)**

**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.

110. Specialised epidermal cells surrounding the guard cells are called

- (1) Bulliform cells
- (2) Lenticels
- (3) Complementary cells
- (4) Subsidiary cells

**Answer (4)**

**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**.

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

- (1) Habitat loss and fragmentation
- (2) Co-extinctions
- (3) Over-exploitation
- (4) Alien species invasion

**Answer (1)**

**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".

112. Analogous structures are a result of

- (1) Shared ancestry
- (2) Stabilizing selection
- (3) Divergent evolution
- (4) Convergent evolution

**Answer (4)**

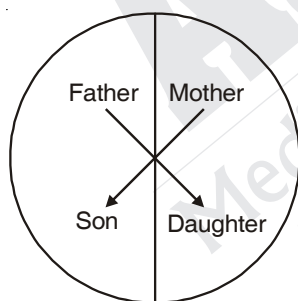
**Sol.** Analogous structures are a result of convergent evolution.

113. Which of the following most appropriately describes haemophilia?

- (1) Chromosomal disorder
- (2) Dominant gene disorder
- (3) Recessive gene disorder
- (4) X-linked recessive gene disorder

**Answer (4)**

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



114. Cotyledon of maize grain is called

- (1) Coleoptile
- (2) Scutellum
- (3) Plumule
- (4) Coleorhiza

**Answer (2)**

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

115. The term ecosystem was coined by

- (1) E. Haeckel
- (2) E. Warming
- (3) E.P. Odum
- (4) A.G. Tansley

**Answer (4)**

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

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

- (1) Parapodia
- (2) Jointed appendages
- (3) Chitinous exoskeleton
- (4) Metameric segmentation

**Answer (1)**

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

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

- (1) Lysosomes
- (2) Nuclei
- (3) Mitochondria
- (4) Chloroplasts

**Answer (1)**

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

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

- (1) Chromosome movement
- (2) Synapsis
- (3) Spindle fibres
- (4) Disappearance of nucleolus

**Answer (2)**

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

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

- (1) An increased production of fish due to biodegradable nutrients
- (2) Death of fish due to lack of oxygen
- (3) Drying of the river very soon due to algal bloom
- (4) Increased population of aquatic food web organisms

**Answer (2)**

**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.

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

- (1) Restriction enzymes
- (2) DNA-DNA hybridization
- (3) Polymerase chain reaction
- (4) Zinc finger analysis

**Answer (4)**

**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.

121. In meiosis crossing over is initiated at

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

**Answer (3)**

**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

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

- (1) Eubacteria are also called false bacteria
- (2) Phycomycetes are also called algal fungi
- (3) Cyanobacteria are also called blue-green algae
- (4) Golden algae are also called desmids

**Answer (1)**

**Sol.** Eubacteria are true bacteria.

123. Blood pressure in the pulmonary artery is

- (1) More than that in the pulmonary vein
- (2) Less than that in the venae cavae
- (3) Same as that in the aorta
- (4) More than that in the carotid

**Answer (1)**

**Sol.** Blood pressure in different blood vessels:

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

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

- (1) They causes infections
- (2) Their RNA is of high molecular weight
- (3) They lack a protein coat
- (4) They are smaller than viruses

**Answer (2)**

**Sol.** Viroids have RNA of low molecular weight.

125. Photosensitive compound in human eye is made up of

- (1) Opsin and Retinol
- (2) Transducin and Retinene
- (3) Guanosine and Retinol
- (4) Opsin and Retinal

**Answer (4)**

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

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

- |               |                   |
|---------------|-------------------|
| (1) Cellulose | (2) Hemicellulose |
| (3) Chitin    | (4) Peptidoglycan |

**Answer (3)**

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

127. 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.

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

- (1) Both (a) & (b) are correct
- (2) Both (a) & (b) are false
- (3) (a) is correct but (b) is false
- (4) (b) is correct but (a) is false

**Answer (1)**

**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.

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

- (1) Fungi
- (2) Animalia
- (3) Monera
- (4) Protista

**Answer (4)**

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

129. Tricarpellary, syncarpous gynoecium is found in flowers of

- (1) Fabaceae
- (2) Poaceae
- (3) Liliaceae
- (4) Solanaceae

**Answer (3)**

**Sol.** Liliaceae represents G(3).

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

- (1) Polypeptide
- (2) Okazaki fragment
- (3) Polysome
- (4) Polymer

**Answer (3)**

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

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

- (1) Peptic cells
- (2) Acidic cells
- (3) Gastrin secreting cells
- (4) Parietal cells

**Answer (4)**

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

132. Identify the correct statement on inhibin

- (1) Is produced by granulose cells in ovary and inhibits the secretion of LH
- (2) Is produced by nurse cells in testes and inhibits the secretion of LH
- (3) Inhibits the secretion of LH, FSH and Prolactin
- (4) Is produced by granulose cells in ovary and inhibits the secretion of FSH

**Answer (4)**

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

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

- (1) Vexillum
- (2) Corona
- (3) Carina
- (4) Pappus

**Answer (1)**

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

134. In bryophytes and pteridophytes, transport of male gametes requires:

- (1) Birds
- (2) Water
- (3) Wind
- (4) Insects

**Answer (2)**

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

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

- (1) Placenta
- (2) Thalamus or petal
- (3) Anther
- (4) Connective

**Answer (2)**

**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.

136. 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 equal amounts of benzene and toluene
- (2) Not enough information is given to make a prediction
- (3) The vapour will contain a higher percentage of benzene
- (4) The vapour will contain a higher percentage of toluene

**Answer (3)**

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

137. Match the compounds given in Column-I with the hybridisation and shape given in Column-II and mark the correct 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) (iv)	(iii)	(i)	(ii)
(2) (iv)	(i)	(ii)	(iii)
(3) (i)	(iii)	(iv)	(ii)
(4) (i)	(ii)	(iv)	(iii)

**Answer (3)**

**Sol.** Fact.

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

- (1) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain
- (2) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain
- (3) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain
- (4) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain

**Answer (2)**

**Sol.** Fact.

139. Fog is a colloidal solution of

- (1) Solid in gas
- (2) Gas in gas
- (3) Liquid in gas
- (4) Gas in liquid

**Answer (3)**

**Sol.** Fact.

140. 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)	(i)	(ii)	(iii)	(iv)
(2)	(iii)	(iv)	(v)	(i)
(3)	(iv)	(ii)	(iii)	(i)
(4)	(ii)	(iii)	(i)	(v)

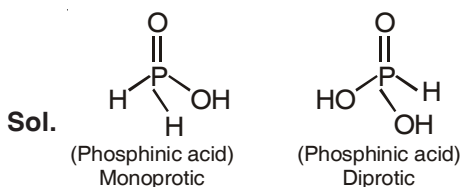
**Answer (3)**

**Sol.** Fact.

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

- (1) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid
- (2) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid
- (3) Both are diprotic acids
- (4) Both are triprotic acids

**Answer (1)**



142. 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.**  $\therefore \Delta G = \Delta H - T\Delta S$

For reaction to be spontaneous,  $\Delta G$  should be negative.

**Note :**  $\Delta G$  can be negative in option (3) also.

143. Which one of the following statements is corrected when  $\text{SO}_2$  is passed through acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  solution?

- (1)  $\text{SO}_2$  is reduced
- (2) Green  $\text{Cr}_2(\text{SO}_4)_3$  is formed
- (3) The solution turns blue
- (4) The solution is decolourized

**Answer (2)**

**Sol.** Fact

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

- (1) The sugar component in RNA is arabinose and the sugar component in DNA is ribose
- (2) The sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose
- (3) The sugar component in RNA is arabinose and the sugar component in DNA is 2'-deoxyribose
- (4) The sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose

**Answer (4)**

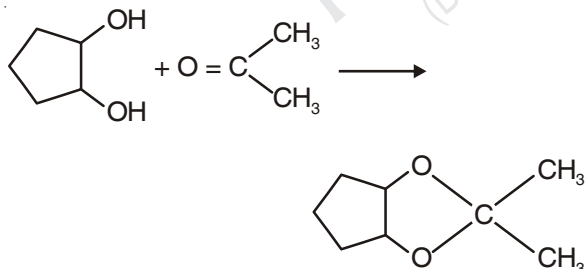
**Sol.** Fact.

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

- (1)  $\text{MnO}_2$
- (2) Aluminium isopropoxide
- (3) Acetone
- (4) Ozone

**Answer (3)**

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



146. 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 rapidly equilibrates with its corresponding enol and this process is known as carbonylation

(2) 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

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

(4) 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

**Answer (2)**

**Sol.** Fact

147. At  $100^\circ\text{C}$  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)  $102^\circ\text{C}$
- (2)  $103^\circ\text{C}$
- (3)  $101^\circ\text{C}$
- (4)  $100^\circ\text{C}$

**Answer (3)**

$$\text{Sol.} \therefore \frac{P_A^0 - P_S}{P_S} = \frac{n_B}{n_A}$$

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

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

$$\therefore M_B = 30.6$$

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

$$= 1.10$$

$$\therefore \text{Boiling point} = 100 + 1.1$$

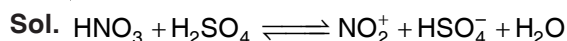
$$= 101.1^\circ\text{C}$$

$$\approx 101^\circ\text{C}$$

148. Consider the nitration of benzene using mixed conc.  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . If a large amount of  $\text{KHSO}_4$  is added to the mixture, the rate of nitration will be

- (1) Unchanged
- (2) Doubled
- (3) Faster
- (4) Slower

**Answer (4)**



$\therefore$  Addition of  $\text{KHSO}_4$  will decrease the  $\text{NO}_2^+$  concentration.

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

- (1)  $10^{-10}$  atm                      (2)  $10^{-4}$  atm  
(3)  $10^{-14}$  atm                      (4)  $10^{-12}$  atm

**Answer (3)**

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

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

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

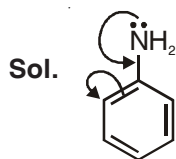
$\therefore$  For potential of  $H_2$  electrode to be zero,  $P_{H_2}$

should be  $10^{-14}$  i.e.,  $\log \frac{10^{-14}}{10^{-14}} = 0$

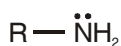
150. The **correct** statement regarding the basicity of arylamines is :

- (1) Arylamines are generally more basic than alkylamines because of aryl group  
(2) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is *sp*-hybridized  
(3) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring  $\pi$  electron system  
(4) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring  $\pi$  electron system

**Answer (3)**



Arylamine  
(less basic)



Alkyl amine  
(more basic)

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

- (1) Peptide bond                      (2) Dative bond  
(3)  $\alpha$ -glycosidic bond              (4)  $\beta$ -glycosidic bond

**Answer (1)**

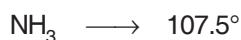
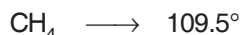
**Sol.** Fact.

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

- (1) The H – O – H bond angle in  $H_2O$  is smaller than the H – N – H bond angle in  $NH_3$   
(2) The H – C – H bond angle in  $CH_4$  is larger than the H – N – H bond angle in  $NH_3$   
(3) 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  $90^\circ$   
(4) The H – O – H bond angle in  $H_2O$  is larger than the H – C – H bond angle in  $CH_4$

**Answer (4)**

**Sol. Molecules      Bond angle**



153. Which of the following statements is false?

- (1)  $Ca^{2+}$  ions are not important in maintaining the regular beating of the heart  
(2)  $Mg^{2+}$  ions are important in the green parts of plants  
(3)  $Mg^{2+}$  ions form a complex with ATP  
(4)  $Ca^{2+}$  ions are important in blood clotting

**Answer (1)**

**Sol.** Fact.

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

- (1)  $Br_2 > I_2 > F_2 > Cl_2$       (2)  $F_2 > Cl_2 > Br_2 > I_2$   
(3)  $I_2 > Br_2 > Cl_2 > F_2$       (4)  $Cl_2 > Br_2 > F_2 > I_2$

**Answer (4)**

**Sol.** Fact

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

- (1) 44.1 s                                      (2) 54.1 s  
(3) 24.1 s                                      (4) 34.1 s

**Answer (3)**

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

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

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

$$= 24.27 \text{ s}$$

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

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

- (1) Glucose                      (2) Sucrose  
(3) Maltose                      (4) Lactose

**Answer (2)**

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

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

- (1)  $\Delta G$  and  $\Delta H$  are negative but  $\Delta S$  is positive  
(2)  $\Delta G$  and  $\Delta S$  are negative but  $\Delta H$  is positive  
(3)  $\Delta G$  is negative but  $\Delta H$  and  $\Delta S$  are positive  
(4)  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  all are negative

**Answer (4)**

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

$\therefore \Delta G$ ,  $\Delta H$  &  $\Delta S$  all are negative.

158. Two electrons occupying the same orbital are distinguished by

- (1) Azimuthal quantum number  
(2) Spin quantum number  
(3) Principal quantum number  
(4) Magnetic quantum number

**Answer (2)**

**Sol.** Fact

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

- (1) 527 pm                      (2) 264 pm  
(3) 154 pm                      (4) 352 pm

**Answer (4)**

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

On solving,  $a = 352 \text{ pm}$

160. The pair of electron in the given carbanion,  $\text{CH}_3\text{C} \equiv \text{C}^\ominus$  is present in which of the following orbitals?

- (1)  $sp^2$                               (2)  $sp$   
(3)  $2p$                                 (4)  $sp^3$

**Answer (2)**

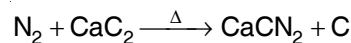
**Sol.** Fact

161. The product obtained as a result of a reaction of nitrogen with  $\text{CaC}_2$  is

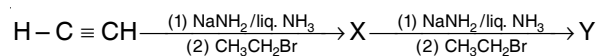
- (1)  $\text{CaCN}_3$                       (2)  $\text{Ca}_2\text{CN}$   
(3)  $\text{Ca}(\text{CN})_2$                 (4)  $\text{CaCN}$

**Answer (3)**

**Sol.** Option (3) should be  $\text{CaCN}_2$  instead of  $\text{Ca}(\text{CN})_2$



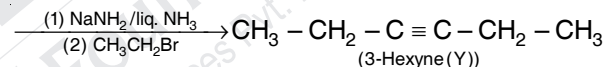
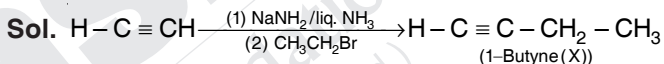
162. In the reaction



X and Y are

- (1) X = 2-Butyne; Y = 2-Hexyne  
(2) X = 1-Butyne; Y = 2-Hexyne  
(3) X = 1-Butyne; Y = 3-Hexyne  
(4) X = 2-Butyne; Y = 3-Hexyne

**Answer (3)**



163. MY and  $\text{NY}_3$ , two nearly insoluble salts, have the same  $K_{\text{SP}}$  values of  $6.2 \times 10^{-13}$  at room temperature. Which statement would be true in regard to MY and  $\text{NY}_3$ ?

- (1) The salts MY and  $\text{NY}_3$  are more soluble in 0.5 M KY than in pure water  
(2) The addition of the salt of KY to solution of MY and  $\text{NY}_3$  will have no effect on their solubilities  
(3) The molar solubilities of MY and  $\text{NY}_3$  in water are identical  
(4) The molar solubility of MY in water is less than that of  $\text{NY}_3$

**Answer (4)**

**Sol.** For MY,

$$K_{\text{SP}} = S^2$$

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

For,  $\text{NY}_3$ ,

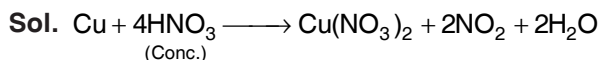
$$K_{\text{SP}} = 27 S^4$$

$$\therefore S = \left( \frac{6.2 \times 10^{-13}}{27} \right)^{1/4}$$

164. When copper is heated with conc.  $\text{HNO}_3$ , it produces

- (1)  $\text{Cu}(\text{NO}_3)_2$ , NO and  $\text{NO}_2$
- (2)  $\text{Cu}(\text{NO}_3)_2$  and  $\text{N}_2\text{O}$
- (3)  $\text{Cu}(\text{NO}_3)_2$  and  $\text{NO}_2$
- (4)  $\text{Cu}(\text{NO}_3)_2$  and NO

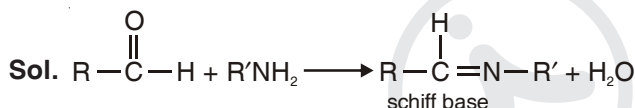
**Answer (3)**



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

- (1) Carboxylic acid
- (2) Aromatic acid
- (3) Schiff base
- (4) Ketone

**Answer (3)**



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

- (1) Enthalpy
- (2) Activation energy
- (3) Entropy
- (4) Internal energy

**Answer (2)**

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

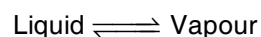
167. Predict the **correct** order among the following

- (1) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair
- (2) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair
- (3) lone pair - lone pair > lone pair - bond pair > bond pair - bond pair
- (4) lone pair - lone pair > bond pair - bond pair > lone pair - bond pair

**Answer (3)**

**Sol.** Fact

168. Consider the following liquid-vapour equilibrium.



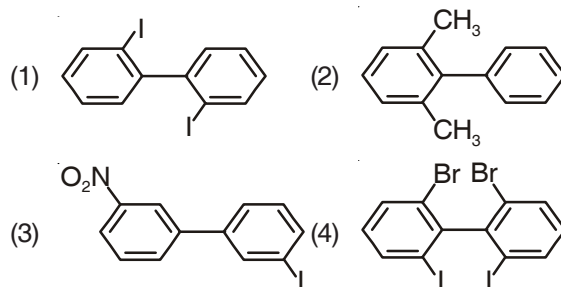
Which of the following relations is correct?

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

**Answer (2)**

**Sol.** Fact.

169. Which of the following biphenyl is optically active?



**Answer (4)**

**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.

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

- (1) Hydronium ion,  $\text{H}_3\text{O}^+$  exists freely in solution
- (2) Dihydrogen does not act as a reducing agent
- (3) Hydrogen has three isotopes of which tritium is the most common
- (4) Hydrogen never acts as cation in ionic salts

**Answer (2 & 3)**

**Sol.** Fact.

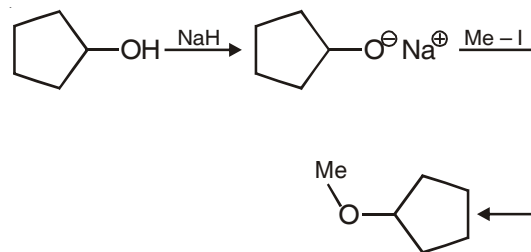
171. The electronic configurations of Eu (Atomic no. 63), Gd (Atomic No. 64) and Tb (Atomic No 65) are :

- (1)  $[\text{Xe}]4f^6 5d^1 6s^2$ ,  $[\text{Xe}]4f^7 5d^1 6s^2$  and  $[\text{Xe}]4f^6 5d^1 6s^2$
- (2)  $[\text{Xe}]4f^7 6s^2$ ,  $[\text{Xe}]4f^7 5d^1 6s^2$  and  $[\text{Xe}]4f^6 6s^2$
- (3)  $[\text{Xe}]4f^7 6s^2$ ,  $[\text{Xe}]4f^6 6s^2$  and  $[\text{Xe}]4f^6 5d^1 6s^2$
- (4)  $[\text{Xe}]4f^6 5d^1 6s^2$ ,  $[\text{Xe}]4f^7 5f^1$  and  $[\text{Xe}]4f^6 6s^2$

**Answer (2)**

**Sol.** Fact

172. The reaction



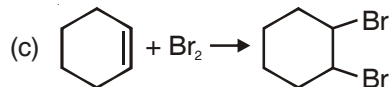
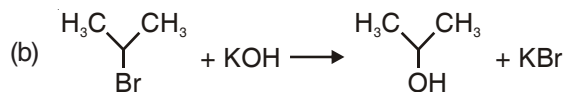
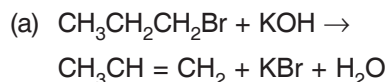
can be classified as

- (1) Dehydration reaction
- (2) Williamson alcohol synthesis reaction
- (3) Williamson ether synthesis reaction
- (4) Alcohol formation reaction

**Answer (3)**

**Sol.** Fact

173. For the following reactions :

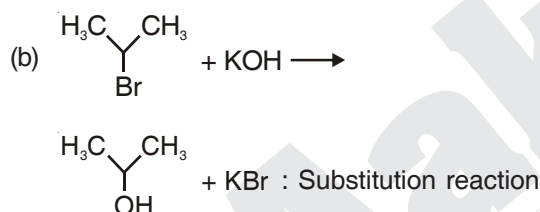


Which of the following statements is correct?

- (1) (a) is elimination, (b) and (c) are substitution reactions
- (2) (a) is substitution, (b) and (c) are addition reactions
- (3) (a) and (b) are elimination reactions and (c) is addition reaction
- (4) (a) is elimination, (b) is substitution and (c) is addition reaction

**Answer (4)**

**Sol.** (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{KOH} \rightarrow \text{CH}_3\text{CH} = \text{CH}_2 + \text{KBr} + \text{H}_2\text{O}$  : Elimination reaction



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

- (1)  $\text{I} < \text{Br} < \text{Cl} < \text{F}$  (increasing electron gain enthalpy)
- (2)  $\text{Li} < \text{Na} < \text{K} < \text{Rb}$  (increasing metallic radius)
- (3)  $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$  (increasing ionic size)
- (4)  $\text{B} < \text{C} < \text{N} < \text{O}$  (increasing first ionisation enthalpy)

**Answer (1 & 4)**

**Sol. For option (1) :**

The correct order for magnitude of electron gain enthalpy is  $\text{I} < \text{Br} < \text{F} < \text{Cl}$

**For option (4) :**

The correct order for 1st ionisation energy is  $\text{B} < \text{C} < \text{O} < \text{N}$ .

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

**Answer (3)**

**Sol.**  $\frac{n_{\text{O}_2}}{n_{\text{H}_2}} = \sqrt{\frac{M_{\text{H}_2}}{M_{\text{O}_2}}}$

$$\Rightarrow \frac{n_{\text{O}_2}}{0.5} = \sqrt{\frac{2}{32}}$$

$$\therefore n_{\text{O}_2} = \frac{1}{8}$$

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

- (1)  $\text{HClO}_2 < \text{HClO} < \text{HClO}_3 < \text{HClO}_4$
- (2)  $\text{HClO}_4 < \text{HClO}_2 < \text{HClO} < \text{HClO}_3$
- (3)  $\text{HClO}_3 < \text{HClO}_4 < \text{HClO}_2 < \text{HClO}$
- (4)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$

**Answer (4)**

**Sol.**  $\xrightarrow{\text{Acidic - strength}} \text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$

177. Which of the following is an analgesic?

- (1) Streptomycin
- (2) Chloromycetin
- (3) Novalgin
- (4) Penicillin

**Answer (3)**

**Sol. Fact**

178. Natural rubber has

- (1) Alternate cis - and trans-configuration
- (2) Random cis - and trans-configuration
- (3) All cis-configuration
- (4) All trans-configuration

**Answer (3)**

**Sol. Fact**

