

## QUESTION & ANSWERS KEY FOR NEET 2026 VERSION-12

1. A 100-turn closely wound circular coil of radius 5 cm has a magnetic field of  $3.14 \times 10^{-3}$  T at its centre. The current flowing through the coil, and the magnitude of the magnetic moment of this coil are respectively:

(take  $\mu_0 = 4\pi \times 10^{-7}$  Tm A<sup>-1</sup>)

- (1) 2.5 A, 2 A m<sup>2</sup>                      (2) 2.5 A, 20 A m<sup>2</sup>  
(3) 2 A, 4 A m<sup>2</sup>                      (3) 2 A, 10 A m<sup>2</sup>

**Ans key: (1)**

**Sol:**  $B = \frac{\mu_0 ni}{2r}$   
 $i = \frac{B \times 2r}{\mu_0 n}$   
 $= \frac{3.14 \times 10^{-3} \times 2 \times 5 \times 10^{-2}}{4\pi \times 10^{-7} \times 100} = 2.5$  A

$M = niA = 100 \times 2.5 \times \pi \times (5 \times 10^{-2})^2$   
 $\approx 2$  A m<sup>2</sup>

2. Match List I with list II

| List I |                              | List II |                          |
|--------|------------------------------|---------|--------------------------|
| A      | $E = hv$                     | I.      | De Broglie wavelength    |
| B      | Diffraction and interference | II.     | Particle nature of light |
| C      | $\lambda = \frac{h}{p}$      | III.    | Wave nature of light     |
| D      | Compton effect               | IV.     | Energy of photon         |

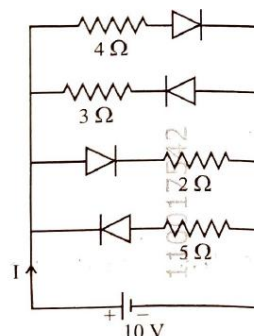
Choose the correct answer from the options given below

- (1) A – IV, B – III, C – I, D – II  
 (2) A – I, B – IV, C – II, D – II  
 (3) A – IV, B – I, C – II, D – III  
 (4) A – IV, B – III, C – II, D – I

**Ans key: (1)**

- Sol:** A.  $E = hv \rightarrow$  energy of photon (IV);  
 B. Diffraction/Interference  $\rightarrow$  wave nature (III);  
 C.  $\lambda = \frac{h}{p} \rightarrow$  de Broglie (I);  
 D. Compton effect  $\rightarrow$  particle nature (II).

3. The current  $I$  in the circuit shown below is: (All diodes are ideal and identical)



- (1)  $\frac{5}{3}$  A                                      (2)  $\frac{15}{2}$  A  
 (3)  $\frac{1}{3}$  A                                      (4)  $\frac{5}{9}$  A

**Ans key: (2)**

**Sol:**  $R_{\text{eff}} = \frac{4 \times 2}{4 + 2} = \frac{8}{6} = \frac{4}{3} \Omega$

(diodes in the 3 Ω branch and 5 Ω branch are reverse biased)

$i = \frac{V}{R_{\text{eff}}} = \frac{10}{\left(\frac{4}{3}\right)} = \frac{30}{4} = \frac{15}{2}$  A

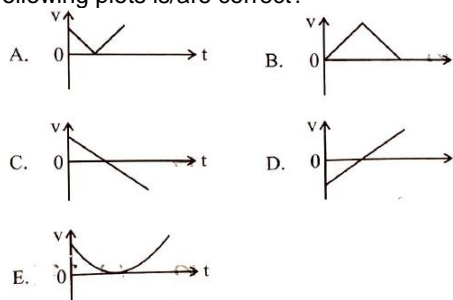
4. The speed of light in vacuum is taken as unity. If light takes 6 min 40 s to reach the earth from the sun, the distance between the Sun and the earth in new unit is

- (1)  $3 \times 10^8$                                       (2)  $3 \times 10^{10}$   
 (3) 400    (4) 500

**Ans key: (3)**

**Sol:**  $c = 1$  (new unit).  
 $t = 6 \text{ min } 40 \text{ s}$   
 $= 400 \text{ s}$ .  
 Distance =  $c \times t = 1 \times 400$   
 $= 400$  new units

5. The following plots show variation of velocity ( $v$ ) with time ( $t$ ), of a ball thrown vertically upward, and falling back. Which of the following plots is/are correct?



- (1) C only    (2) A and E only  
 (3) D only    (4) B only

**Ans key: (1)**

**Sol:** Take up as positive.  $v = u - gt$  - a straight line of constant negative slope, starts positive, crosses zero (at the top), then becomes negative during the fall. That is plot C.

6. In a vernier callipers, 20 VSD coincide with 16 MSD (each division of length 1 mm). The least count of the vernier callipers is  
 (1) 0.01 cm (2) 0.1 cm  
 (3) 0.02 cm (4) 0.2 cm

**Ans key: (3)**

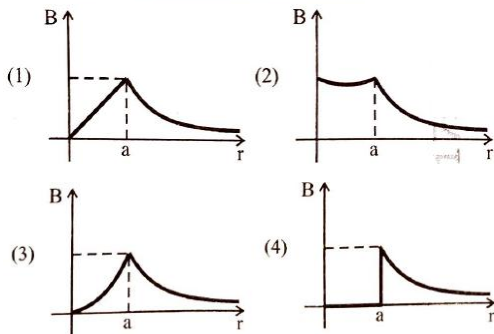
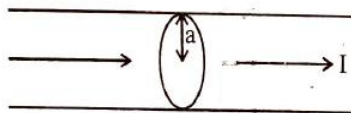
**Sol:** 20 VSD = 16 MSD  
 $\Rightarrow 1 \text{ VSD} = 0.8 \text{ MSD} = 0.8 \text{ mm}$ .  
 $\text{LC} = 1 \text{ MSD} - 1 \text{ VSD} = 1 - 0.8$   
 $= 0.2 \text{ mm} = 0.02 \text{ cm}$

7. An ac circuit contains a resistance of 1 k $\Omega$ , a capacitor of 0.1  $\mu\text{F}$  and an inductor of 1 mH connected in series. The resonance frequency of the circuit is approximately:  
 (1) 10.1 kHz (2) 20.7 kHz  
 (3) 15.9 kHz (4) 13.5 kHz

**Ans key: (3)**

**Sol:**  $f_r = \frac{1}{2\pi\sqrt{LC}}$   
 $= \frac{1}{2\pi\sqrt{1 \times 10^{-3} \times 0.1 \times 10^{-6}}}$   
 $= \frac{10^5}{2\pi} = 15.9 \text{ kHz}$

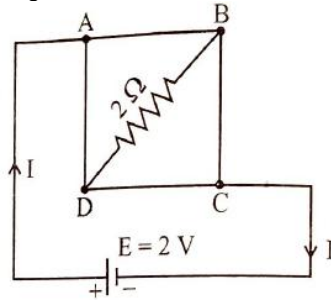
8. The figure given below shows a long straight solid wire of circular cross-section of radius 'a' carrying steady current I. The current I is uniformly distributed across its cross-section. The plot which correctly represents the variation of the magnetic field (B) with distance (r) from the axis of the conductor in the region is:



**Ans key: (1)**

**Sol:** Inside the wire ( $r < a$ ),  $B \propto r$   
 At the surface ( $r = a$ ), B is maximum  
 Outside the wire ( $r > a$ ),  $B \propto \frac{1}{r}$

9. A uniform metallic wire having resistance 4 $\Omega$  is bent to form a square loop (ABCD) (see figure). A resistance of 2 $\Omega$  is connected between points B and D and a battery of 2 V is connected across points A and C and shown in the figure. Now the value of current (I) is:



- (1) 2 A (2) 4 A  
 (3) 8 A (4) 4.5 A

**Ans key: (1)**

**Sol:** Balanced Wheatstone's bridge.  
 $\therefore R_{\text{eff}} = 1 \Omega$   
 $i = \frac{E}{R_{\text{eff}}} = \frac{2}{1} = 2 \text{ A}$

10. An unknown nucleus has a nuclear density of  $2.29 \times 10^{17} \text{ kg m}^{-3}$  and mass of  $19.926 \times 10^{-27} \text{ kg}$ . Its mass number A is approximately:  
 (Take  $R_0 = 1.2 \times 10^{-15} \text{ m}$ ,  $4\pi = 12.56$ )  
 (1) 12 (2) 19  
 (3) 20 (4) 16

**Ans key: (1)**

**Sol:**  $d = \frac{m}{V}$   
 $V = \frac{m}{d} = \frac{19.926 \times 10^{-27}}{2.29 \times 10^{17}}$   
 $= 8.7 \times 10^{-44} \text{ m}^3$   
 $V = \frac{4}{3} \pi R^3$   
 $R^3 = \frac{3V}{4\pi} = \frac{3 \times 8.7 \times 10^{-44}}{4 \times 3.14}$   
 $= 2.07 \times 10^{-44}$   
 $R = R_0 A^{1/3}$   
 $R^3 = R_0^3 A$   
 $A = \left(\frac{R}{R_0}\right)^3 = \frac{2.07 \times 10^{-44}}{(1.2 \times 10^{-15})^3}$   
 $= 1.197 \times 10$

11. A rectangular wire loop of sides 8 cm and 3 cm with a small cut, is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the plane of the loop. The emf developed across the cut, if the velocity of the loop is  $2 \text{ m s}^{-1}$ , in a direction normal to the shorter side of the loop, will be:
- (1)  $1.8 \times 10^{-4}$  volt      (2)  $1.2 \times 10^{-4}$  volt  
 (3)  $1.3 \times 10^{-4}$  volt      (4)  $4.8 \times 10^{-4}$  volt

**Ans key: (1)**

**Sol:**  $B = 0.3 \text{ T}$ ,  
 $V = 0.02 \text{ m s}^{-1}$   
 $l = 0.03 \text{ m}$   
 $e = BlV$   
 $= 0.3 \times 0.02 \times 0.03$   
 $= 1.8 \times 10^{-4} \text{ V}$

12. A galvanometer of resistance  $100 \Omega$  gives full scale deflection for a current of 1 mA. It is converted into an ammeter of range 0 – 10 A. The shunt required is:
- (1)  $0.01 \Omega$       (2)  $0.10 \Omega$   
 (3)  $0.001 \Omega$       (4)  $1.0 \Omega$

**Ans key: (1)**

**Sol:**  $S = \frac{I_g G}{I - I_g}$   
 $= \frac{1 \times 10^{-3} \times 100}{10 - 0.001} = 0.01 \Omega$

13. In Young's double slit experiment, using monochromatic light of wavelength  $\lambda$ , the intensity of light at a point on the screen where the path difference is  $\lambda$ , is K units. The intensity of light at a point where the path difference is  $\frac{\lambda}{3}$  will be
- (1)  $\frac{K}{4}$       (2) K  
 (3)  $\frac{K}{2}$       (4) 2 K

**Ans key: (1)**

**Sol:**  $I = I_0 \cos^2 \phi$   
**Case 1:**  $\phi = \frac{2\pi}{\lambda} \times \lambda = 2\pi$   
 $K = I_0 \cos^2 2\pi$   
 $K = I_0$   
**Case 2:**  $\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{3} = \frac{2\pi}{3}$   
 $I = I_0 \cos^2 \frac{2\pi}{3}$   
 $I = \frac{I_0}{4} = \frac{K}{4}$

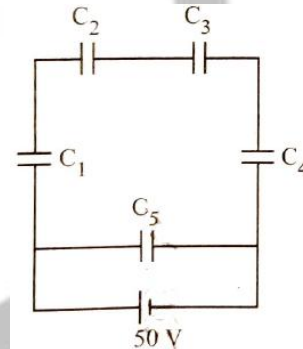
14. The magnitude and direction of the acceleration produced in a body of mass 5 kg when two mutually perpendicular forces 8 N and 6 N act on it, are respectively:

- (1)  $2 \text{ m s}^{-2}$ ;  $\tan^{-1}\left(\frac{3}{4}\right)$  with 6 N force  
 (2)  $2 \text{ m s}^{-2}$ ;  $\tan^{-1}\left(\frac{4}{3}\right)$  with 8 N force  
 (3)  $2 \text{ m s}^{-2}$ ;  $\tan^{-1}\left(\frac{3}{4}\right)$  with 8 N force  
 (4)  $20 \text{ m s}^{-2}$ ;  $\tan^{-1}\left(\frac{4}{3}\right)$  with 8 N force

**Ans key: (3)**

**Sol:** Net force on 5 kg, two perpendicular forces 8 N & 6 N  
 $F = \sqrt{8^2 + 6^2} = 10 \text{ N}$   
 $a = \frac{F}{m} = 2 \text{ m s}^{-2}$   
 Direction:  $\tan \theta = \frac{6}{8} = \frac{3}{4}$  with the 8 N force.

15. Five capacitors of capacitances  $C_1 = C_2 = C_3 = C_4 = 10 \mu\text{F}$  and  $C_5 = 2.5 \mu\text{F}$  are connected as shown, along with a battery of 50 V



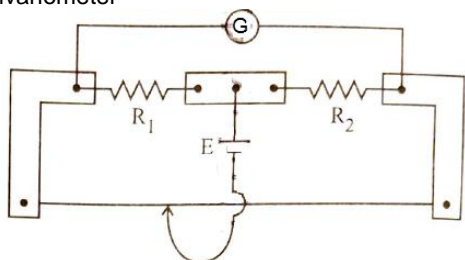
The equivalent capacitance and the charges on each capacitor respectively are

(1)  $5 \mu\text{F}$ ,  $125 \mu\text{C}$  on all capacitors  
 (2)  $5 \mu\text{F}$ ,  $250 \mu\text{C}$  on all capacitors  
 (3)  $4 \mu\text{F}$ ,  $250 \mu\text{C}$  on  $C_1$  to  $C_4$  and  $125 \mu\text{C}$  on  $C_5$   
 (4)  $5 \mu\text{F}$ ,  $125 \mu\text{C}$  on  $C_1$  to  $C_4$  and  $25 \mu\text{C}$  on  $C_5$

**Ans key: (1)**

**Sol:**  $C_{1234} = \frac{10}{4} = 2.5 \mu\text{F}$   
 $C_{1234}$  is in parallel with  $C_5$   
 $C_{\text{eff}} = 2.5 + 2.5 = 5 \mu\text{F}$   
 $Q_{\text{tot}} = C_{\text{eff}} \times V$   
 $= 5 \times 50 = 250 \mu\text{C}$   
 $Q_5 = \frac{250 \times 2.5}{2.5 + 2.5} = 125 \mu\text{C}$   
 $\therefore Q_1 = Q_2 = Q_3 = Q_4 = 250 - 125$   
 $= 125 \mu\text{C}$

16. In a metre bridge experiment (see figure), the positions of the cell, E, and galvanometer G, are interchanged. We shall observe in the galvanometer



- (1) Only the right-sided deflection
- (2) Only the left-sided deflection
- (3) There will be no deflection irrespective of the position of the jockey
- (4) Both right-sided and left sided deflection and at balance point, no deflection

**Ans key: (4)**

**Sol:** Metre-bridge with cell & galvanometer interchanged Wheatstone-bridge balance condition is unchanged on swapping the cell and galvanometer.

17. The power of a crane, which lifts a mass of 1000 kg to a height of 20 m in 10 s is: ( $g = 9.8 \text{ m s}^{-2}$ )
- (1) 19.6 W
  - (2) 39.2 W
  - (3) 39.2 kW
  - (4) 19.6 kW

**Ans key: (4)**

**Sol:** Power of crane

$$P = \frac{mgh}{t}$$

$$= \frac{1000 \times 9.8 \times 20}{10} = 19600 \text{ W}$$

$$= 19.6 \text{ kW}$$

18. Match List I with list II

| List I |                 | List II |   |
|--------|-----------------|---------|---|
| A      | Young's Modulus | I.      | $\frac{\Delta d}{\Delta L} \left( \frac{L}{d} \right)$  |
| B      | Compressibility | II.     | $\frac{FL}{A(\Delta L)}$                                |
| C      | Bulk Modulus    | III.    | $-\frac{1}{\Delta P} \left( \frac{\Delta V}{V} \right)$ |
| D      | Poisson's Ratio | IV.     | $-P \left( \frac{V}{\Delta V} \right)$                  |

Choose the correct answer from the options given below

- (1) A – I, B – IV, C – III, D – II
- (2) A – IV, B – I, C – II, D – III
- (3) A – III, B – II, C – I, D – IV
- (4) A – II, B – III, C – IV, D – I

**Ans key: (4)**

**Sol:** Match elastic moduli with formulas

- A. Young's modulus  $\rightarrow$  II.  $\frac{FL}{A(\Delta L)}$
- B. Compressibility  $\rightarrow$  III.  $-\frac{1}{\Delta P} \left( \frac{\Delta V}{V} \right)$
- C. Bulk modulus  $\rightarrow$  IV.  $-P \left( \frac{V}{\Delta V} \right)$
- D. Poisson's ratio  $\rightarrow$  I.  $\frac{\Delta d}{\Delta L} \left( \frac{L}{d} \right)$

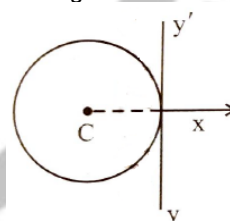
19. In a concave lens, a ray of light emanating from the object parallel to the principal axis of the lens after refraction:

- (1) emerges parallel to principal axis
- (2) appears to diverge from the first principal focus.
- (3) passes through  $2F$ , which is the radius of curvature of the lens.
- (4) passes through the second principal focus.

**Ans key: (2)**

**Sol:** Concave lens, parallel ray after refraction. A diverging lens makes parallel rays appear to diverge from the focal point on the object side

20. A thin wire of length 'L' and linear mass density 'm' is bent into a circular ring (in x-y plane) with centre 'C' as shown in figure. The moment of inertia of the ring about an axis  $yy'$  will be



- (1)  $\frac{3 mL^3}{8\pi^2}$
- (2)  $\frac{3 mL^3}{8\pi}$
- (3)  $\frac{3 mL^2}{8\pi^2}$
- (4)  $\frac{3 mL^2}{8\pi}$

**Ans key: (1)**

**Sol:**  $\ell = 2\pi r \Rightarrow r = \frac{\ell}{2\pi}$

$$I_{yy'} = \frac{Mr^2}{2} + Mr^2$$

$$= \frac{3 M\ell^2}{2 \cdot 4\pi^2} = \frac{3M\ell^2}{8\pi^2}$$

$$M = m \times \ell$$

$$\therefore I_{yy'} = \frac{3m\ell^3}{8\pi^2}$$

21. Each side of a metallic cube of mass 5.580 kg is measured to be 9.0 cm. Keeping the significant figure in view, the density of the material of the cube can be best expressed as  $X \times 10^3 \text{ kg m}^{-3}$ , where the value of X is
- (1) 7.654 (2) 7.7  
 (3) 7.65 (4) 7.6

Ans key: (2)

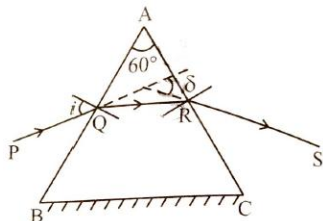
Sol:  $m = 5.580 \text{ kg}$   
 $a = 0.09 \text{ m}$   
 Volume =  $(0.09)^3 = 0.000729$   
 $= 7.29 \times 10^{-4} \text{ m}^3$   
 $\rho = \frac{m}{V} = \frac{5.580}{7.29 \times 10^{-4}} = \frac{5.580}{0.729 \times 10^{-3}}$   
 $= 7.654 \times 10^3$   
 The answer should be rounded off to two significant figures  
 $\therefore \rho = 7.7 \times 10^3 \text{ kg m}^{-3}$

22. For a travelling harmonic wave  $y(x, t) = 2.0 \cos 2\pi (10t - 0.0080x + 0.35)$ , where x and y are in cm and t in s. The phase difference between oscillatory motion of two points separated by a distance of 0.5 m is:
- (1)  $8\pi \text{ rad}$  (2)  $0.08\pi \text{ rad}$   
 (3)  $0.008\pi \text{ rad}$  (4)  $0.8\pi \text{ rad}$

Ans key: (4)

Sol:  $\Delta\phi = \frac{2\pi}{\lambda} \Delta x = \frac{2\pi}{\frac{2\pi \times 10^{-2}}{2\pi \times 0.008}} \times 0.5$   
 $= 2\pi \times 0.008 \times 10^{+2} \times 0.5$   
 $= 0.8\pi \text{ rad}$

23. A ray of monochromatic light is passing through an equilateral prism (ABC) as shown in the figure. The refracted ray (QR) is parallel to its base (BC) and the angle of incidence (i) is  $50^\circ$ . Then the angle of deviation ( $\delta$ ) is

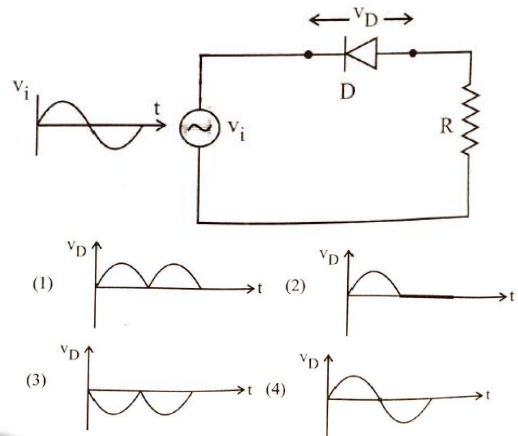


- (1)  $40^\circ$  (2)  $45^\circ$   
 (3)  $55^\circ$  (4)  $35^\circ$

Ans key: (1)

Sol:  $i_1 = i_2 = i$   
 $d = i_1 + i_2 - A$   
 $= 2i - A$   
 $= 2 \times 50 - 60$   
 $= 100 - 60 = 40^\circ$

24. In the circuit shown below, the voltage appearing across the diode D will be of the form

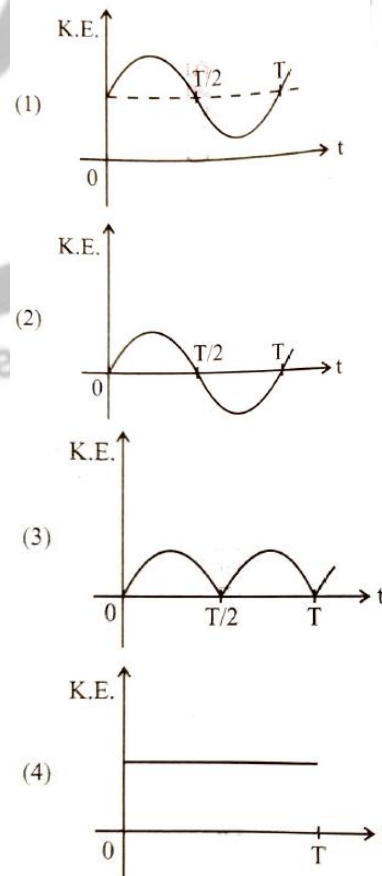


Ans key: (2)

Sol:



25. For a simple pendulum, having time period T, The variation of kinetic energy (K.E) with time (t) is represented by



**Ans key: (3)**

**Sol:** Kinetic energy can never be negative

26. A resistor is connected to a battery of 12 V emf and internal resistance 2  $\Omega$ . If the current in the circuit is 0.6 A, the terminal voltage of the battery is:
- (1) 10 V (2) 10.8 V  
(3) 12 V (4) 1.2 V

**Ans key: (2)**

**Sol:** Terminal voltage  
 $V = E - Ir = 12 - 0.6 \times 2 = 10.8 \text{ V}$

27. The amount of work done to raise a mass 'm' from the surface of the earth to a height equal to the radius of the earth 'R', will be
- (1) 2 mg R (2) mg R  
(3)  $mg \frac{R}{4}$  (4)  $mg \frac{R}{2}$

**Ans key: (4)**

**Sol:**  $W = \Delta U = \left( \frac{-GMm}{2R} \right) - \left( \frac{-GMm}{R} \right)$   
 $= \frac{GMm}{(2R)} = mg \frac{R}{2}$

28. An electric heater supplies heat to a system at a rate of 100 W. If the system performs work at a rate of 75 J s<sup>-1</sup>, then the rate at which internal energy increases will be
- (1) 125 W (2) 100 W  
(3) 25 W (4) 75 W

**Ans key: (3)**

**Sol:** First law of thermodynamics  
 $\frac{dU}{dt} = \frac{dQ}{dt} - \frac{dW}{dt}$   
 $= 100 - 75 = 25 \text{ W}$

29. A room heater is rated 400 W, 220 V. If the supply voltage drops to 200 V, What will be the power consumed (approximately)?
- (1) 121 W (2) 331 W  
(3) 200 W (4) 400 W

**Ans key: (2)**

**Sol:**  $R = \frac{V^2}{P} = \frac{220^2}{400} = 121 \Omega$   
Power consumed  $P = \frac{200^2}{121} \approx 331 \text{ W}$

30. When a ruler falls vertically, 5 different persons catch it with different reaction times. ( $g = 9.8 \text{ m s}^{-2}$ )
- A. Person A has reaction time of 0.20 s

- B. Person B has reaction time of 0.22 s  
C. Person C has reaction time of 0.18 s  
D. Person D has reaction time of 0.19 s  
E. Person E has reaction time of 0.21 s

What is the correct order of the distance travelled by the ruler for each person?

- (1)  $C > D > A > B > E$  (2)  $C > D > A > E > B$   
(3)  $B > E > A > C > D$  (4)  $B > E > A > D > C$

**Ans key: (4)**

**Sol:**  $d = \frac{1}{2}gt^2$

$d \propto t^2$ . Therefore person with the longest reaction time will let the ruler fall the greatest distance.

31. Consider two uncharged capacitors of equal capacitance 200 pF. One of them is charged by a 100 V supply and disconnected. Now this capacitor is connected to the uncharged capacitor. The amount of electrostatic energy lost in the process is
- (1)  $1.0 \times 10^{-6} \text{ J}$  (2)  $0.5 \times 10^{-6} \text{ J}$   
(3) 0.5 J (4) 1.0 J

**Ans key: (2)**

**Sol:**  $\Delta u = \frac{1}{2} \frac{C_1 C_2}{C_1 + C_2} (V_1 - V_2)^2$   
 $= \frac{1}{2} \times \frac{200 \times 200 \times 10^{-24}}{(200 + 200) \times 10^{-12}} (100 - 0)^2$   
 $= \frac{1}{2} \times 100 \times 10^{-10} \times 100^2$   
 $= 0.5 \times 10^{-6} \text{ J}$

32. Savitha, a XI standard student, while conducting an experiment to determine the effective length of a simple pendulum L, notes down the data of time taken to complete 30 oscillations as 60 s and hence calculates the length of the simple pendulum as (take  $\pi^2 = 9.8$ , and  $g = 9.8 \text{ m s}^{-2}$ )
- (1) 2 m (2) 0.75 m  
(3) 1.5 m (4) 1 m

**Ans key: (4)**

**Sol:** Number of oscillations in 1 s,  $\frac{30}{60} = \frac{1}{2} \text{ Hz}$

$T = 2 \text{ s}$

$T = 2\pi \sqrt{\frac{\ell}{g}}$

$\ell = \frac{T^2 g}{4\pi^2} = \frac{2^2 \times 9.8}{4 \times 9.8} = 1 \text{ m}$

33. The peak value of an alternating current is 5 A and frequency is 60 Hz. How long will the current, starting from zero, take to reach the peak value?

- (1)  $\frac{1}{240}$  s                      (2)  $\frac{1}{30}$  s  
 (3)  $\frac{1}{120}$  s                      (4)  $\frac{1}{60}$  s

**Ans key: (1)**

**Sol:**  $T = \frac{1}{f} = \frac{1}{60}$  s  
 $t = \frac{T}{4} = \frac{1}{4 \times 60} = \frac{1}{240}$  s

**34.** In interference and diffraction, the light energy is redistributed. If it reduces in one region, producing a dark fringe. It increases in another region, producing a bright fringe.

- A. As there is no gain or loss of energy, these phenomena are consistent with the principle of conservation of energy.  
 B. Diffraction and interference are characteristics exhibited only by light waves.

Choose the correct answer from the options given below:

- (1) A is true, but B is false  
 (2) A is true and B is also true  
 (3) A is false and B true  
 (4) Both A and B are false

**Ans key: (1)**

**Sol:** A is true, but B is false

**35.** A box of mass 15 kg is kept on the floor of a stationary trolley. The coefficient of static friction between the box and the trolley is 0.12. Keeping the box in stationary state over the trolley, the maximum acceleration with which the trolley can be moved horizontally in  $\text{m s}^{-2}$  is ( $g = 10 \text{ m s}^{-2}$ )

- (1) 1.5                              (2) 1.8  
 (3) 2.1                              (4) 1.2

**Ans key: (4)**

**Sol:**  $a = \mu_s \times g$   
 $= 0.12 \times 10 = 1.2 \text{ m s}^{-2}$

**36.** The sum of kinetic energy and potential energy of a simple pendulum bob is 0.02 joule. The speed of the simple pendulum bob at equilibrium position is approximately: (consider mass of the bob = 20 g)

- (1)  $1.41 \text{ m s}^{-1}$                       (2)  $14.1 \text{ m s}^{-1}$   
 (3)  $0.2 \text{ m s}^{-1}$                       (4)  $2.0 \text{ m s}^{-1}$

**Ans key: (1)**

**Sol:**  $TE = 0.02 \text{ J}$   
 $\frac{1}{2}KA^2 = 0.02$

$$\frac{1}{2}m\omega^2A^2 = 0.02$$

$$A^2\omega^2 = \frac{0.04}{m}$$

$$V_{\max} = A\omega = \sqrt{\frac{0.04}{0.02}} = 1.41 \text{ m s}^{-1}$$

**37.** Four statements are given (A is mass number):

- A. The volume of a nucleus is proportional to  $A^{1/3}$   
 B. The volume of a nucleus is proportional to A.  
 C. The difference in mass of an atom and its nucleus is called the mass defect.  
 D. The difference in mass of a nucleus and its constituents is called the mass defect.

Choose the correct answer from the options given below:

- (1) B and D are true, but A and C are false  
 (2) A and D are true, but B and C are false  
 (3) A and C are true, but B and D are false  
 (4) B and C are true, but A and D are false

**Ans key: (1)**

**Sol:** B and D are true, but A and C are false

**38.** The angular speed of a flywheel is increased from 600 rpm to 1200 rpm in 10 s. The number of revolutions completed by the flywheel during this time is:

- (1) 600                              (2) 900  
 (3) 300                              (4) 150

**Ans key: (4)**

**Sol:**  $\omega_0 = 600 \times \frac{2\pi}{60} = 20\pi \text{ rad s}^{-1}$

$$\omega = 1200 \times \frac{2\pi}{60} = 40\pi \text{ rad s}^{-1}$$

$$\alpha = \frac{\omega - \omega_0}{t} = \frac{40\pi - 20\pi}{10} = 2\pi \text{ rad s}^{-2}$$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$= 20\pi \times 10 + \frac{1}{2} \times 2\pi \times 10^2$$

$$= 200\pi + 100\pi = 300\pi$$

$$Q = 2\pi n$$

$$n = \frac{\theta}{2\pi} = \frac{300\pi}{2\pi} = 150$$

**39.** A submarine is designed to withstand an absolute pressure of 100 atm. How deep can it go below the water surface?

(Consider the density of water =  $1000 \text{ kg m}^{-3}$ ,  $1 \text{ atm} = 1 \times 10^5 \text{ Pa}$  and gravitational acceleration  $g = 10 \text{ m s}^{-2}$ )

- (1) 9900 m                              (2) 99 m  
 (3) 9000 m                              (4) 990 m

**Ans key: (4)**

**Sol:**  $P = 100 \times 10^5 = 10^7 \text{ Pa}$

$$P = P_0 + h\rho g$$

$$h\rho g = P - P_0$$

$$h = \frac{P - P_0}{\rho g} = \frac{10^7 - 10^5}{10^3 \times 10}$$

$$= \frac{99 \times 10^5}{10^4} = 990 \text{ m}$$

40. Match List I with list II

| List I<br>Electromagnetic<br>wave |                | List II<br>Production |   |
|-----------------------------------|----------------|-----------------------|---|
| A                                 | Microwave      | I.                    | Electrons in atoms emit light when they move from a higher energy level to a lower energy level |
| B                                 | Visible light  | II.                   | Radioactive decay of nucleus  |
| C                                 | Gamma rays     | III.                  | Vibration of atoms and molecules  |
| D                                 | Infra-red rays | IV.                   | Klystron valve or magnetron valve   |

Choose the correct answer from the options given below

- (1) A – III, B – I, C – II, D – IV  
(2) A – III, B – IV, C – I, D – II  
(3) A – IV, B – III, C – II, D – I  
(4) A – IV, B – I, C – II, D – III

**Ans key: (4)**

**Sol:** A-IV, B-I, C-II, D-III

41. Which of the following statements are correct?

- A. Inside a conductor, the electrostatic field is zero  
B. Electric field at the surface of a charged conductor does not depend on its surface charge density.  
C. The interior of a charged conductor can have no excess charge in the static situation.  
D. At the surface of a charged conductor, the electrostatic field must be normal to the surface at every point

Choose the correct answer from the options given below

- (1) C, D and E only      (2) A, B and D only  
(3) A, C and D only      (4) A, C and E only

**Ans key: (3)**

**Sol:** A, C and D only

42. For a metal of work function 6.6 eV, which of the following wavelengths of incident radiation does not give rise to the photoelectric effect?

- (Take Planck's constant as  $6.6 \times 10^{-34} \text{ J s}$ )  
(1) 200 nm      (2) 150 nm  
(3) 100 nm      (4) 50 nm

**Ans key: (1)**

**Sol:**  $\lambda = \frac{hc}{\phi_0}$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8 \times 10^9}{6.6 \times 1.6 \times 10^{-19}}$$

$$= 1.87 \times 10^2 = 187 \text{ nm}$$

Photoelectric effect fails for  $\lambda > 187 \text{ nm}$

43. In the first excited state of hydrogen atom, the energy of its electron is  $-3.4 \text{ eV}$ . The radial distance of the electron from the hydrogen nucleus in this case is approximately:

(take  $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$ ,  $e = 1.6 \times 10^{-19} \text{ C}$ )

$$\text{and } \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

- (1)  $2.1 \times 10^{-8} \text{ m}$       (2)  $2.1 \times 10^{-11} \text{ m}$   
(3)  $2.1 \times 10^{-9} \text{ m}$       (4)  $2.1 \times 10^{-10} \text{ m}$

**Ans key: (4)**

**Sol:**  $r_n = n^2 r_0$  ( $r_0 \rightarrow$  Bohr radius)

$$r_2 = 2^2 \times 0.53 \text{ \AA} \\ = 2.12 \times 10^{-10} \text{ m}$$

44. Two statements are given below:

- A. When the forward bias voltage across a p-n junction diode increases above a certain threshold voltage, the diode current increases significantly.  
B. This current is called reverse saturation current.

Choose the correct answer from the options given below

- (1) Both statements A and B are false  
(2) Statement A is true, but statement B is false  
(3) Both statements A and B are true  
(4) Statement A is false, but statement B is true

**Ans key: (2)**

**Sol:** Statement A is true, but Statement B is false

45. A flask contains argon and chlorine in the ratio of 2:1 by mass. The temperature of the mixture is  $27^\circ\text{C}$ . The ratio of root mean square speed of the molecules of the two gases

$$\left( \frac{V_{\text{rms}}^{\text{Ar}}}{V_{\text{rms}}^{\text{Cl}}} \right) \text{ is}$$

(atomic mass of argon = 40.0 u and molecular mass of chlorine = 70.0 u)

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- (1)  $\frac{\sqrt{7}}{2}$  (2)  $\frac{7}{2}$   
 (3)  $\frac{7}{4}$  (4)  $\frac{2}{\sqrt{7}}$

**Ans key: (1)**

**Sol:**  $V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{rms} \propto \frac{1}{\sqrt{M}}$

$\frac{V_{rms}^{Ar}}{V_{rms}^{Cl}} = \sqrt{\frac{M_{Cl}}{M_{Ar}}} = \sqrt{\frac{70}{40}} = \frac{\sqrt{7}}{2}$

46. Match List I with List II:

|   | List I   |     | List II  |
|---|--|-----|--|
| A | $\text{H}_3\text{C}-\text{CH}-\text{CH}_3$<br>   | I.  | (i) oleum;<br>(ii) NaOH, Δ<br>(iii) H <sup>+</sup>   |
| B | $\text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{CH}_2\text{OH}$                                       | II. | (i) O <sub>2</sub> ;<br>(ii) H <sub>2</sub> O/H <sup>+</sup>                                 |
| C | $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \rightarrow$<br>$\text{CH}_3-\text{CH}-\text{CH}_3$<br> <br>OH | III | (i) CH <sub>3</sub> OH,<br>H <sup>+</sup> ;<br>(ii) H <sub>2</sub> ,<br>catalyst             |
| D |  | IV  | (i) conc.<br>H <sub>2</sub> SO <sub>4</sub> ,<br>Δ;<br>(ii) H <sup>+</sup> /H <sub>2</sub> O |

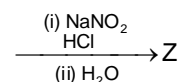
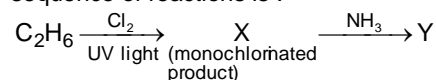
Choose the correct answer from the options given below:

- (1) A-I, B-III, C-IV, D-II  
 (2) A-II, B-IV, C-III, D-I  
 (3) A-II, B-III, C-I, D-IV  
 (4) A-II, B-III, C-IV, D-I

**Ans key: (4)**

**Sol:** A-II, B-III, C-IV, D-I

47. The major product Z formed in the following sequence of reactions is :

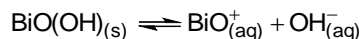


- (1)  $\text{C}_2\text{H}_5-\text{N}=\text{N}-\text{OH}$   
 (2)  $\text{C}_2\text{H}_5\text{OH}$   
 (3)  $\text{C}_2\text{H}_5\text{NO}_2$   
 (4)  $\text{C}_2\text{H}_5\text{NH}_2$

**Ans key: (2)**

**Sol:**  $\text{C}_2\text{H}_6 \rightarrow \text{C}_2\text{H}_5\text{Cl} \rightarrow \text{C}_2\text{H}_5\text{NH}_2 \rightarrow$   
 (diazotisation of 1° aliphatic amine)  $\rightarrow$   
 $\text{C}_2\text{H}_5\text{OH}$  (with  $\text{N}_2\uparrow$ ).

48. In a qualitative analysis  $\text{Bi}^{3+}$  is detected by appearance of precipitate of  $\text{BiO}(\text{OH})_{(s)}$ . Calculated pH when the following equilibrium exists at 298 K:



$K = 4 \times 10^{-10}$

(Given :  $\log 2 = 0.3010$ )

- (1) 4.699 (2) 8.714  
 (3) 9.301 (4) 5.286

**Ans key: (3)**

**Sol:** pH when  $\text{BiO}(\text{OH})_{(s)} \rightarrow \text{BiO}^+ + \text{OH}^-$ ,  $K = 4 \times 10^{-10}$   
 $[\text{OH}^-] = \sqrt{K} = 2 \times 10^{-5}$   
 $\text{pOH} = 5 - \log 2 = 4.699$   
 $\text{pH} = 14 - 4.699 = 9.301$

49. When 1 dm<sup>3</sup> of CO<sub>2</sub> gas is passed over hot coke, the volume of gaseous mixture after complete reaction at STP becomes 1.4 dm<sup>3</sup>. The composition of the gaseous mixture at STP is :

- (1) 0.6 dm<sup>3</sup> of CO, 0.8 dm<sup>3</sup> of CO<sub>2</sub>  
 (2) 0.8 dm<sup>3</sup> of CO, 0.8 dm<sup>3</sup> of CO<sub>2</sub>  
 (3) 0.8 dm<sup>3</sup> of CO, 0.6 dm<sup>3</sup> of CO<sub>2</sub>  
 (4) 0.6 dm<sup>3</sup> of CO, 0.4 dm<sup>3</sup> of CO<sub>2</sub>

**Ans key: (3)**

**Sol:** CO<sub>2</sub> over hot coke: composition at STP  
 (1 dm<sup>3</sup> → 1.4 dm<sup>3</sup>)  
 $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$   
 Let x dm<sup>3</sup> react: volume becomes (1-x) +  
 $2x = 1 + x = 1.4 \text{ dm}^3$   
 $x = 0.4$ . CO<sub>2</sub>  
 left = 0.6 dm<sup>3</sup>, CO formed = 0.8 dm<sup>3</sup>

50. Match List I with List II:

|   | List I<br>(Quantum Numbers<br>'n' 'l') |   |     | List II<br>(Orbital) |
|---|--|---|-----|----------------------|
| A | 2                                      | 1 | I   | 3d                   |
| B | 4                                      | 0 | II  | 2p                   |
| C | 5                                      | 3 | III | 4s                   |
| D | 3                                      | 2 | IV  | 5f                   |

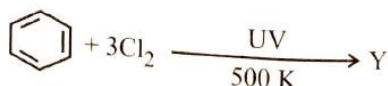
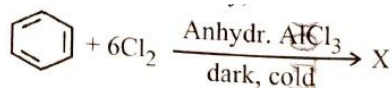
Choose the **correct** answer from the options given below:

- (1) A-II, B-III, C-IV, D-I  
 (2) A-I, B-II, C-III, D-IV  
 (3) A-IV, B-II, C-III, D-I  
 (4) A-II, B-III, C-I, D-IV

**Ans key: (1)**

Sol: A-II, B-III, C-IV, D-I

51. The number of chlorine atoms present in the organic products X and Y of the following reactions, respectively, are

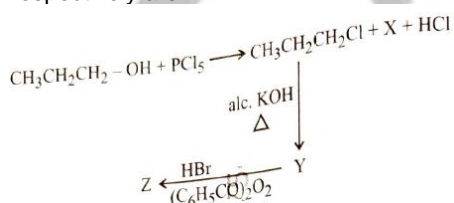


- (1) 3 and 6                      (2) 6 and 6  
(3) 6 and 3                      (4) 3 and 3

Ans key: (2)

Sol: X = C<sub>6</sub>Cl<sub>6</sub> (hexachlorobenzene, 6 Cl);  
Y = C<sub>6</sub>H<sub>6</sub>Cl<sub>6</sub> (BHC/lindane, 6 Cl).

52. In the following reaction sequence, X and Z respectively are :



- (1) X = POCl<sub>3</sub>; Z =  $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_3 \\ | \\ \text{Br} \end{array}$   
(2) X = H<sub>3</sub>PO<sub>3</sub>; Z = CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>-Br  
(3) X = H<sub>3</sub>PO<sub>3</sub>; Z =  $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_3 \\ | \\ \text{Br} \end{array}$   
(4) X = POCl<sub>3</sub>; Z = CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>-Br

Ans key: (4)

Sol: X = POCl<sub>3</sub> (from PCl<sub>5</sub>/alcohol). Propyl chloride + alc. KOH → propene (Y). Anti Markovnikov HBr/peroxide on propene → 1-bromopropane (Z = CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>Br).

53. Match List I with List II :

|    | List I                        |      | List II   |
|----|-------------------------------|------|---|
| A. | V <sub>2</sub> O <sub>5</sub> | I.   | Preparation of ammonia from N <sub>2</sub> / H <sub>2</sub> mixture |
| B. | Fe                            | II.  | Polymerisation of alkynes   |
| C. | PfCl <sub>2</sub>             | III. | Preparation of alkynes  |
| D. | Ni complex                    | IV   | Oxidation of ethyne to ethanal                                      |

Choose the **correct** answer from the options given below:

- (1) A-III, B-IV, C-I, D-II  
(2) A-II, B-I, C-IV, D-III  
(3) A-IV, B-I, C-III, D-II  
(4) A-III, B-I, C-IV, D-II

Ans key: (4)

Sol: A-III, B-I, C-IV, D-II

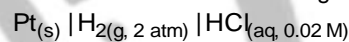
54. Identify the correct statement about ClF<sub>3</sub> from the following options :

- (1) It has a trigonal pyramidal geometry with two lone pairs on Cl atom.  
(2) It has T-shaped geometry with two lone pairs on Cl atom  
(3) It has a planar trigonal geometry with two lone pairs on Cl atom.  
(4) It has T-shaped geometry with three lone pairs on Cl atom

Ans key: (2)

Sol: Geometry of ClF<sub>3</sub> sp<sup>3</sup>d hybridisation, 3 bond pairs + 2 lone pairs ⇒ T-shaped with two lone pairs on Cl.

55. Calculate emf of the half cell given below:



$$E^0_{\text{H}_2/\text{H}^+} = 0 \text{ V}$$

$$\left( \text{Given: } \frac{2.303RT}{F} = 0.059, \log 2 = 0.3010 \right)$$

- (1) 0.109 V                      (2) 0.035 V  
(3) -0.035 V                      (4) 0.109 V

Ans key: (1)

Sol: EMF of Pt|H<sub>2</sub>(2 atm)|HCl(0.02 M);  
E° = 0 V,  
E = 0 - (0.059/2) log([H<sup>+</sup>]<sup>2</sup>/pH)  
= -0.02955 × log((0.02)<sup>2</sup>/2)  
= -0.02955 × log(2 × 10<sup>-4</sup>)  
= -0.02955 × (-3.699) ≈ +0.109 V

56. Match List I with List II:

|    | List I<br>(Order of reaction) |      | List II<br>(Unit of rate constant)               |
|----|-------------------------------|------|--|
| A. | Zero order                    | I.   | mol <sup>-1</sup> Ls <sup>-1</sup>               |
| B. | First order                   | II.  | mol <sup>-2</sup> L <sup>2</sup> s <sup>-1</sup> |
| C. | Second order                  | III. | S <sup>-1</sup>                                  |
| D. | Third order                   | IV   | Mol L <sup>-1</sup> s <sup>-1</sup>              |

Choose the **correct** answer from the options given below:

- (1) A-IV, B-III, C-II, D-I  
(2) A-I, B-II, C-III, D-IV  
(3) A-IV, B-III, C-I, D-II  
(4) A-IV, B-II, C-I, D-III

Ans key: (3)

**Sol:** A-IV, B-III, C-I, D-II

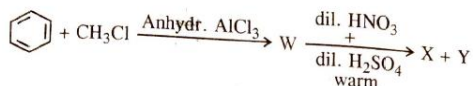
57. The calculated 'spin-only' magnetic moment of  $Ti^{2+}(3d^2)$  is :
- (1) 2.84 BM (2) 5.92 BM  
(3) 4.90 BM (4) 3.87 BM

**Ans key: (1)**

**Sol:** Spin-only  $\mu$  of  $Ti^{2+}$  ( $3d^2$ )

$$n = 2 \Rightarrow \mu = \sqrt{2 \times 4} = \sqrt{8} \approx 2.84 \text{ BM}$$

58. Two products X and Y are formed in the following reaction sequence.



The suitable method that can be used for the separation of products X and Y is:

- (1) Continuous extraction  
(2) Differential extraction  
(3) Fractional distillation  
(4) Sublimation

**Ans key: (3)**

**Sol:** Separation of ortho- and para-nitrochlorobenzene (X, Y) from  $C_6H_6 + CH_3Cl/AlCl_3$  then  $HNO_3/H_2SO_4$ . Toluene  $\rightarrow$  o- and p-nitrotoluene; well-known separation by fractional distillation of liquid o-isomer from solid p-isomer (different b.p./m.p.).

59. A bulb is rated at 150 watt, converting 8% energy into light. If energy of one photon is  $4.42 \times 10^{-19}$  J, how many photons are emitted by the bulb per second ?
- (1)  $1.35 \times 10^{19}$  (2)  $4.06 \times 10^{19}$   
(3)  $2.71 \times 10^{19}$  (4)  $27.2 \times 10^{19}$

**Ans key: (3)**

**Sol:** Photons per second from a 150 W bulb (8% efficient), each photon  $4.42 \times 10^{-19}$  J  
Useful power = 12W  
 $n = 12 / 4.42 \times 10^{-19} \approx 2.71 \times 10^{19}$

60. In a test tube containing a salt, a few drops of dilute  $H_2SO_4$  was added, which gave colourless vapours having the smell of vinegar. The vapours turned the blue litmus paper red. Identify the **correct** anion from the following :
- (1) Acetate,  $CH_3COO^-$   
(2) Carbonate,  $CO_3^{2-}$   
(3) Sulphate,  $SO_4^{2-}$   
(4) Sulphide,  $S^{2-}$

**Ans key: (1)**

**Sol:** Salt giving colourless vinegar-smelling vapours with dil.  $H_2SO_4$  that turn blue

litmus red "Vinegar smell" + acidic gas (turns blue litmus red) acetate salt liberating  $CH_3COOH$ .

61. Select the reagents that reduce nitriles to primary amines :
- A. (i)  $LiAlH_4$ ; (ii)  $H_2O$   
B.  $Sn + HCl$   
C.  $H_2, Ni$   
D.  $Na(Hg)/C_2H_5OH$   
E.  $Br_2/aq. NaOH$
- Choose the **correct** answer from the options given below:
- (1) A, B and C only  
(2) A, C and D only  
(3) A, D and E only  
(4) B, D and E only

**Ans key: (2)**

**Sol:** Reagents that reduce nitriles to primary amines  $LiAlH_4/H_2O$  (A),  $H_2/Ni$  (C),  $Na(Hg)/C_2H_5OH$  (D) all reduce  $R-CN \rightarrow R-CH_2-NH_2$ .

62. Identify the **incorrect** statement from the following :
- (1) Carbon has the ability to form  $p\pi-p\pi$  multiple bond with itself.  
(2)  $ECl_3$  (E = B and Al) is a monomer when E = B and a dimer when E = Al.  
(3) Oxygen exhibits only -2 oxidation state.  
(4) The order of catenation property of Group 14 elements is  $C \gg Si > Ge \approx Sn$

**Ans key: (3)**

**Sol:** Oxygen shows -2 commonly but also -1,  $-1/2$ , +2 — so saying "only -2" is incorrect

63. Although +3 oxidation state is most common in lanthanoids, cerium still shows +4 oxidation state because:
- (1) Its nearest inert gas is Radon  
(2) After losing one more electron, it acquires  $4f^{14}$  electronic configuration.  
(3) Its atomic number is 61.  
(4) After losing one more electron, it acquires  $4f^0$  electronic configuration.

**Ans key: (4)**

**Sol:**  $Ce^{4+}$  has  $[Xe]4f^0$  — extra stability of empty 4f shell after losing one more electron.

64. During Lassaigne's test. the elements present in an organic compound are converted from :
- (1) Covalent form to covalent form  
(2) ionic form to ionic form  
(3) covalent form to covalent form  
(4) ionic form to covalent form

**Ans key: (3)**

**Sol:** Covalent organic elements (N, S, X) are converted to ionic form ( $\text{CN}^-$ ,  $\text{S}^{2-}$ ,  $\text{X}^-$ ) by fusion with Na.

65. The number of hydrogen atoms present in 5.4 g of urea is :

(Given : Molar mass of urea:  $60 \text{ g mol}^{-1}$ ,  $N_A : 6.022 \times 10^{23} \text{ particles mol}^{-1}$ )

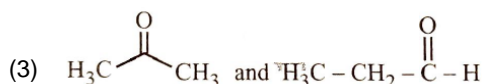
- (1)  $2.168 \times 10^{23}$  (2)  $2.168 \times 10^{22}$   
(3)  $1.084 \times 10^{22}$  (4)  $1.084 \times 10^{23}$

**Ans key: (1)**

**Sol:** H atoms in 5.4 g urea ( $\text{NH}_2\text{CONH}_2$ ,  $M = 60$ )  
moles =  $5.4/60 = 0.09$ ;  
H atoms =  $0.09 \times 4 \times 6.022 \times 10^{23}$   
=  $2.168 \times 10^{23}$

66. The pair of molecules that are metamers among the following is :

- (1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$  and  $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$   
(2)  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$  and  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$



- (4)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$  and  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$

**Ans key: (2)**

**Sol:** Metamers: same functional group (ether) with different alkyl groups on either side of O.  $\text{CH}_3\text{-O-CH}_2\text{CH}_2\text{CH}_3$  and  $\text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3$  are ether metamers.

67. Identify the **incorrect** statement from the following:

- (1)  $\text{P}(\text{C}_2\text{H}_5)_3$  and  $\text{As}(\text{C}_6\text{H}_5)_3$  form  $d\pi-d\pi$  bond with transition metals.  
(2) Nitrogen can form  $d\pi-p\pi$  bond with oxygen.  
(3) Nitrogen can form  $p\pi-p\pi$  multiple bonds with itself.  
(4) Phosphorus, arsenic and antimony show catenation property

**Ans key: (2)**

**Sol:** N cannot form  $p\pi-d\pi$  multiple bonds (no d-orbitals)

68. Phenolphthalein is used as an indicator for the titration of sodium hydroxide solution against a standard solution of oxalic acid. The colour change that is observed at an alkaline pH close to the equivalence point during this titration is :

- (1) pinkish red to yellow  
(2) yellow to pinkish red  
(3) colourless to pink  
(4) pink to colourless

**Ans key: (4)**

**Sol:** Oxalic acid is the primary standard solution and is taken in the burette. NaOH solution is taken in the conical flask. Using phenolphthalein as the indicator, the medium is alkaline before the equivalence point and acidic after the equivalence point. Hence, the colour change at the end point is from pink to colourless.

Reasoning: Standard solutions are preferred in the burette for accuracy.

Why not NaOH in burette: NaOH absorbs atmospheric  $\text{CO}_2$ , changing its concentration, and also reacts with glass to clog the burette.

Colour change: Phenolphthalein is pink in alkaline medium (NaOH in flask) and colourless in acidic medium. As oxalic acid is added from the burette, the base neutralises. At the end point, the solution turns acidic, so the colour changes from pink to colourless.

69. Match List I with List II :

|    | List I                 |      | List II                        |
|----|------------------------|------|--------------------------------|
| A. | $\text{C}_2\text{H}_4$ | I.   | $3\sigma$ bonds, $2\pi$ bonds  |
| B. | $\text{C}_2\text{H}_2$ | II.  | $3\sigma$ bonds, one lone pair |
| C. | $\text{CH}_4$          | III. | $4\sigma$ bonds                |
| D. | $\text{NH}_3$          | IV.  | $5\sigma$ bonds, $1\pi$ bond   |

Choose the **correct** answer from the options given below :

- (1) A-IV, B-I, C-III, D-II  
(2) A-III, B-IV, C-II, D-I  
(3) A-I, B-II, C-IV, D-III  
(4) A-II, B-III, C-I, D-IV

**Ans key: (1)**

**Sol:** A-IV, B-I, C-III, D-II

70. At a certain temperature, T(K), during a process 500 J is absorbed by the system and work of 200 J is done by the system. Then change in internal energy of the system is :

- (1) 700 J (2) 300 J  
(3) 400 J (4) 500 J

**Ans key: (2)**

**Sol:**  $\Delta U$  when  $q = +500\text{J}$  absorbed and work done by the system = 200 J

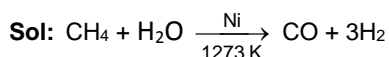
$$\Delta U = q - w$$

$$= 500 - 200 = +300 \text{ J}$$

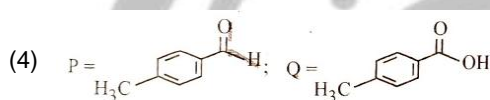
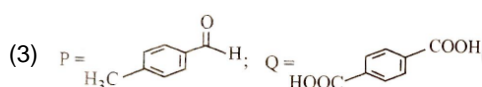
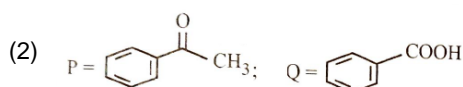
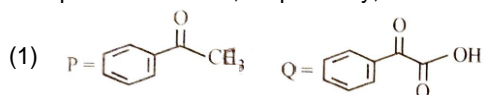
71. Methane reacts with steam at 1273 K in the presence of nickel catalyst to form:

- (1) CO and  $\text{H}_2$  (2) CO and  $\text{H}_2\text{O}$   
(3)  $\text{CO}_2$  and  $\text{H}_2\text{O}$  (4)  $\text{CO}_2$  and  $\text{H}_2$

**Ans key: (1)**



72. Compound P ( $\text{C}_8\text{H}_8\text{O}$ ) gives a red orange precipitate with 2,4-DNP reagent and it does not reduce Fehling's reagent. On drastic oxidation with chromic acid, P gives an aromatic product Q that produces effervescence on treating with aq.  $\text{NaHCO}_3$ . Compounds P and Q, respectively, are :



**Ans key: (2)**

**Sol:**  $\text{C}_8\text{H}_8\text{O}$  compound P giving red-orange precipitate with 2,4-DNP, no Fehling's, drastic chromic acid  $\rightarrow$  aromatic Q that effervesces with  $\text{NaHCO}_3$  P = ketone (positive 2,4-DNP, negative Fehling) = acetophenone ( $\text{C}_6\text{H}_5\text{COCH}_3$ ); oxidation gives benzoic acid ( $\text{C}_6\text{H}_5\text{COOH}$ ) — Q.

73. A solution of copper sulphate is electrolysed for 10 minutes with a current of 1.5 amperes. The mass of copper deposited at cathode is : (Given : Molar mass of  $\text{Cu} = 63 \text{ g mol}^{-1}$ ;  $1 \text{ F} = 96487 \text{ C mol}^{-1}$ )

- (1) 2.4036 g (2) 1.7018 g  
(3) 0.5876 g (4) 0.2938 g

**Ans key: (4)**

**Sol:** Cu deposited at cathode by 1.5 A for 10 min ( $M_{\text{Cu}} = 63$ )  
 $Q = 1.5 \times 600 = 900 \text{ C}$ ;  
eq. wt =  $63/2 = 31.5$ ;  
 $w = 31.5 \times 900/96487 = 0.2938 \text{ g}$

74. The functional group that can be identified through phthalein dye test is :

- (1) Phenolic (2) Alcohol  
(3) aldehydes (4) Carboxylic acid

**Ans key: (1)**

**Sol:** Functional group identified by phthalein dye test Phthalein dye (made by fusing phenol with phthalic anhydride) tests for phenolic OH.

75. The correct statement with regard to the secondary structure of DNA/RNA is :

- (1) DNA possesses a single strand helix structure and contains uracil as one of the four bases.  
(2) RNA possesses a single strand helix structure and contains thymine as one of the four bases.  
(3) DNA possesses a double strand helix structure and contains thymine as one of the four bases.  
(4) RNA possesses a double strand helix structure and contains uracil as one of the four bases.

**Ans key: (3)**

**Sol:** DNA = double helix; bases A, T, G, C (thymine, not uracil).

76. Identify the correct statements:

- A. The molality of 2.5 g of ethanoic acid (Molar mass :  $60 \text{ g mol}^{-1}$ ) in 75 g of benzene solution is 0.556 m.  
B. The molality of a solution containing 5 g of NaOH (molar mass :  $40 \text{ g mol}^{-1}$ ) in 450 mL of solution is 0.278 M at 298 K.  
C. Aquatic species are more comfortable in cold water.  
D. The solubility of gas increases with decrease in pressure.  
E. For a binary mixture of A and B, the number of moles of A and B are  $n_A$  and  $n_B$  respectively. The mole fraction of B will be

$$x_B = \frac{n_B}{n_A + n_B}$$

Choose the **correct** answer from the options given below:

- (1) A and C only (2) A, B and C only  
(3) A, D and E only (4) A and B only

**Ans key: (2)**

**Sol:** A. Molality of 2.5 g ethanoic acid ( $M=60$ ) in 75 g benzene =  $(2.5/60)/0.075 \approx 0.556 \text{ m}$  — TRUE.

B. Molarity =  $\frac{5}{40 \times 0.45} = 0.278 \text{ M}$  -TRUE

C. Aquatic species are more comfortable in cold water (higher dissolved  $\text{O}_2$ ) — TRUE.

77. Mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law due to :

- (1) formation of hydrogen bonding between acetone and chloroform.  
(2) increase in escaping tendency of molecules of each component.

- (3) stronger intermolecular forces between chloroform molecules than those between chloroform and acetone molecules.  
 (4) repulsive forces.

**Ans key: (1)**

**Sol:** Chloroform + acetone — negative deviation from Raoult's law H-bonding between  $\text{Cl}_3\text{CH}$  and  $\text{O}=\text{C}(\text{CH}_3)_2$  lowers escaping tendency  $\Rightarrow$  negative deviation.

78. At 298 K, a certain buffer solution contains equal concentrations of  $\text{X}^-$  and  $\text{HX}$ ,  $K_b$  for  $\text{X}^-$  is  $10^{-10}$ . What is the pH of this buffer solution ?  
 (1) 2 (2) 10  
 (3) 4 (4) 6

**Ans key: (3)**

**Sol:** pH of buffer with  $[\text{X}^-] = [\text{HX}]$ ,  $K_b$  for  $\text{X}^- = 10^{-10}$   
 $K_a = K_w/K_b = 10^{-14}/10^{-10} = 10^{-4}$   
 $\text{p}K_a = 4$ . Buffer with equal [salt]/[acid]:  $\text{pH} = \text{p}K_a = 4$ .

79. Identify the **incorrect** statement from the following :  
 (1) The IUPAC name of the element with atomic number 107 is Unnilseptium.  
 (2) The largest and the smallest species among Mg,  $\text{Mg}^{2+}$ , Al and  $\text{Al}^{3+}$  are Al and  $\text{Mg}^{2+}$ , respectively.  
 (3) The similarity in behaviour of Li with Mg is referred to as 'diagonal relationship'.  
 (4) The oxidation state and covalency of Al in  $[\text{AlCl}(\text{H}_2\text{O})_5]^{2+}$  are 3 and 6 respectively.

**Ans key: (2)**

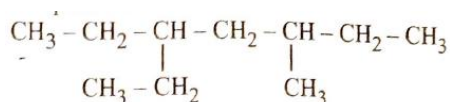
**Sol:** Largest and smallest among Mg,  $\text{Mg}^{2+}$ , Al,  $\text{Al}^{3+}$  are Al and  $\text{Mg}^{2+}$  — largest is Mg, but smallest cation is  $\text{Al}^{3+}$ ,

80. The correct order of increasing metallic character of Na, Be, P, Mg and Si is :  
 (1)  $\text{P} < \text{Si} < \text{Be} < \text{Mg} < \text{Na}$   
 (2)  $\text{Be} < \text{Si} < \text{P} < \text{Mg} < \text{Na}$   
 (3)  $\text{P} < \text{Si} < \text{Na} < \text{Mg} < \text{Be}$   
 (4)  $\text{P} < \text{Mg} < \text{Be} < \text{Si} < \text{Na}$

**Ans key: (1)**

**Sol:**  $\text{P} < \text{Si} < \text{Be} < \text{Mg} < \text{Na}$

81. The correct IUPAC name of the following compound is :



- (1) 2,4-diethylhexane  
 (2) 3,5-diethylhexane  
 (3) 3-ethyl-5-methylheptane  
 (4) 3-methyl-5-ethylheptane

**Ans key: (3)**

**Sol:** 3-ethyl-5-methylheptane

82. Match List I with List II:

|    | List I<br>Complex/ion                     |      | List II<br>(shape/geometry) |
|----|---|------|-----------------------------|
| A. | $[\text{Pt}(\text{Cl}_2)(\text{NH}_3)_2]$ | I.   | Octahedral                  |
| B. | $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$   | II.  | Trigonal bipyramidal        |
| C. | $[\text{NiCl}_4]^{2-}$                    | III. | Square planar               |
| D. | $[\text{Fe}(\text{CO})_5]$                | IV.  | Tetrahedral                 |

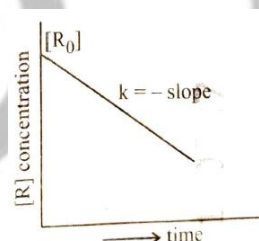
Choose the **correct answer** from the options given below :

- (1) A-I, B-III, C-IV, D-II  
 (2) A-III, B-IV, C-I, D-II  
 (3) A-IV, B-I, C-III, D-II  
 (4) A-III, B-I, C-IV, D-II

**Ans key: (4)**

**Sol:** A-III, B-I, C-IV, D-II

83. For a certain reaction  $\text{R} \rightarrow \text{Product}$ , the plot of concentration  $[\text{R}]$  vs time has a negative slope as shown. The order of reaction is :



- (1) 0 (2) 1 (3) 2 (4) 2.5

**Ans key: (1)**

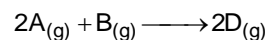
**Sol:** Order from  $[\text{R}]$  vs  $t$  with negative slope  $k = \text{rate constant} \Rightarrow$  zero order.

84. Which one of the following is an ambidentate ligand ?  
 (1) Ethylenediamine tetraacetate ion  
 (2) Oxalate  
 (3) Ethane-1,2-diamine  
 (4) Thiocyanate

**Ans key: (4)**

**Sol:** Thiocyanate

85. Consider the following reaction :



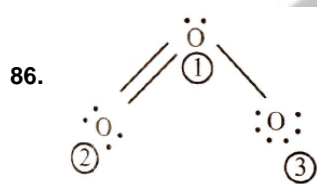
$\Delta U^\ominus = -10 \text{ kJ mol}^{-1}$  and  $\Delta S^\ominus = -44 \text{ JK}^{-1}$  at 298 K.

Identify the **correct** option with  $\Delta G^\ominus$  for the reaction and spontaneity of the reaction at 298 K. (Given :  $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$ )

- (1)  $-1.635 \text{ kJ mol}^{-1}$ , spontaneous
- (2)  $+0.63568 \text{ kJ mol}^{-1}$ , non-spontaneous
- (3)  $-0.63568 \text{ kJ mol}^{-1}$ , spontaneous
- (4)  $+1.635 \text{ kJ mol}^{-1}$ , non-spontaneous

**Ans key: (2)**

**Sol:**  $\Delta G^\ominus$  at 298 K for  $2A(g) + B(g) \rightarrow 2D(g)$ ;  
 $\Delta U^\ominus = -10 \text{ kJ/mol}$ ,  $\Delta S^\ominus = -44 \text{ J/K}\cdot\text{mol}$   
 $\Delta n_g = 2 - 3 = -1$ ;  $\Delta H^\ominus = \Delta U^\ominus + \Delta n_g \cdot RT = -10 \text{ 000} + (-1)(8.314)(298) = -12 \text{ 478 J} \approx -12.478 \text{ kJ}$ .  
 $\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus = -12.478 - 298(-0.044) = -12.478 + 13.112 = +0.634 \text{ kJ/mol}$  non-spontaneous.



The correct formal charges on oxygen atoms numbered 2, 1 and 3 respectively are :

- (1)  $-1, 0, +1$
- (2)  $0, +1, -1$
- (3)  $0, 0, 0$
- (4)  $+1, 0, -1$

**Ans key: (2)**

**Sol:**  $0, +1, -1$

87. Given below are certain reactions. Identify the reaction for which  $K_p \neq K_c$

- (1)  $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$
- (2)  $\text{N}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)}$
- (3)  $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$
- (4)  $\text{H}_2\text{O}_{(g)} + \text{CO}_{(g)} \rightleftharpoons \text{H}_{2(g)} + \text{CO}_{2(g)}$

**Ans key: (3)**

**Sol:**  $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$ ,  $\Delta n_g \neq 0$

88. Given below is an expression for the rate constant of a first order reaction occurring at a certain T(K).

$$\ln k = 14.34 - \frac{1.25 \times 10^4}{T}$$

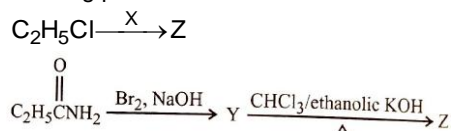
The energy of activation in  $\text{kcal mol}^{-1}$  for the reaction is :

- (Given :  $k$  in  $\text{s}^{-1}$ ,  $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$ )
- (1) 12.42
  - (2) 14.34
  - (3) 18.63
  - (4) 24.84

**Ans key: (4)**

**Sol:**  $E_a$  from  $\ln k = 14.34 - 1.25 \times 10^4 / T$  ( $k$  in  $\text{s}^{-1}$ ,  $R = 1.987 \text{ cal/mol}\cdot\text{K}$ )  
 Slope =  $-E_a/R \Rightarrow E_a = 1.25 \times 10^4 \times 1.987 \approx 24 \text{ 837 cal/mol} \approx 24.84 \text{ kcal/mol}$ .

89. The following two reactions give the same foul smelling product Z.



X and Z, respectively, are :

- (1) X = AgCN; Z =  $\text{C}_2\text{H}_5\text{CN}$
- (2) X = KCN; Z =  $\text{C}_2\text{H}_5\text{CN}$
- (3) X = KCN; Z =  $\text{C}_2\text{H}_5\text{NC}$
- (4) X = AgCN; Z =  $\text{C}_2\text{H}_5\text{NC}$

**Ans key: (4)**

**Sol:** Z = ethyl isocyanide ( $\text{C}_2\text{H}_5\text{NC}$ , foul carbonylamine smell). From  $\text{C}_2\text{H}_5\text{Cl}$ : needs alc. AgCN to give isocyanide.

90. Match List I with List II :

|    | List I (complex)                                   |      | List II (Type of isomerism) |
|----|--|------|-----------------------------|
| A. | $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$            | I.   | Optical                     |
| B. | $[\text{Co}(\text{en})_3]^{3+}$                    | II.  | Solvate                     |
| C. | $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$ | III. | Geometrical                 |
| D. | $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$     | IV.  | Linkage                     |

Choose the **correct** answer from the options given below:

- (1) A-III, B-I, C-II, D-IV
- (2) A-I, B-III, C-II, D-IV
- (3) A-III, B-I, C-IV, D-II
- (4) A-II, B-IV, C-III, D-I

**Ans key: (3)**

**Sol:** A-III, B-I, C-IV, D-II

91. "The Evil Quartet" of biodiversity loss includes which of the following?

- (1) **Over-exploitation;** Alien species invasions; Air pollution; Co-extinctions
- (2) **Habitat loss and fragmentation;** over-exploitation; Alien species invasions; Co-extinctions
- (3) **Habitat loss and fragmentation;** Air pollution; Water pollution; Co-extinctions
- (4) **Over-exploitation;** Alien species invasions; Soil pollution; Co-extinctions

**Ans key: 2**

**Sol:** Option (2) is the correct answer for 'The Evil Quartet' of biodiversity loss.

92. Which one of the following is the site for active ribosomal RNA synthesis?  
 (1) Nucleolus (2) Chromatin  
 (3) Centrosome (4) Kinetochore

**Ans key: 1**

**Sol:** Nucleolus is the site for active rRNA synthesis.

93. Match List I with List II:

| List I<br>(Phase of cell cycle) |                      | List II<br>(Activity) |  |
|---------------------------------|----------------------|-----------------------|--|
| A.                              | G <sub>1</sub> phase | I.                    | Actual cell division occurs  |
| B.                              | S phase              | II.                   | Cell is metabolically active and continuously grows but does not replicate its DNA |
| C.                              | G <sub>2</sub> phase | III.                  | Synthesis of DNA occurs and the amount of DNA per cell doubles                     |
| D.                              | M phase              | IV.                   | Proteins are synthesized while cell growth continues                               |

Choose the **correct** answer from the options given below:

- (1) A - II B - III C - IV D - I  
 (2) A - III B - IV C - I D - II  
 (3) A - I B - II C - III D - IV  
 (4) A - IV B - I C - II D - III

**Ans key: 1**

**Sol:** Both List I and List II are correctly matched in the option (1).

94. Match List I with List II:

| List I |                            | List II |  |
|--------|----------------------------|---------|--|
| A.     | Productivity               | I.      | Gross primary productivity minus respiration losses        |
| B.     | Net primary productivity   | II.     | Rate of formation of new organic matter by consumers       |
| C.     | Gross primary productivity | III.    | Rate of biomass production                                 |
| D.     | Secondary productivity     | IV.     | Rate of production of organic matter during photosynthesis |

Choose the **correct** answer from the options given below:

- (1) A - I B - II C - III D - IV  
 (2) A - III B - I C - IV D - II  
 (3) A - III B - I C - II D - IV  
 (4) A - I B - III C - IV D - II

**Ans key: 2**

**Sol:** Both List I and list II are correctly matched in the option (2).

95. Which of the following statements are correct?  
 A. The Amazon rainforest being cut and cleared for cultivation of soyabeans is an example of habitat loss.  
 B. Steller's sea cow and passenger pigeon became extinct due to over-exploitation by humans.  
 C. The Nile perch introduced into Lake Victoria in East Africa helped in population growth of cichlid fish in the lake.  
 D. Water hyacinth is an invasive species.  
 E. When a species becomes extinct, the plant and animal species associated with it are not affected.

Choose the **correct** answer from the options given below:

- (1) B, C and D only (2) A, B and D only  
 (3) A, B and E only (4) C, D and E only

**Ans key: 2**

**Sol:** Nile perch introduced into Lake Victoria caused the extinction of cichlid fish in the lake.

96. Identify the **correct** statements about biomolecules:

- A. Lipids are generally water soluble.  
 B. Proteins are polypeptides.  
 C. Polysaccharides are long chains of sugars.  
 D. Adenine and guanine are substituted pyrimidines.  
 E. Almost all enzymes are proteins.

Choose the **correct** answer from the options given below:

- (1) C, D and E only (2) B, C and E only  
 (3) B, D and E only (4) A, B and C only

**Ans key: 2**

**Sol:** Lipids are generally insoluble in water. Adenine and guanine are substituted purines.

97. How many ATP and NADPH molecules are required to make one molecule of glucose through the Calvin pathway?

- (1) 18 ATP and 12 NADPH  
 (2) 6 ATP and 12 NADPH  
 (3) 24 ATP and 18 NADPH  
 (4) 12 ATP and 18 NADPH

**Ans key: 1**

**Sol:** Option (1) is correct about Calvin pathway.

98. Which of the following statements are **not** true regarding restriction endonucleases?
- They are called molecular scissors.
  - These are the enzymes responsible for restricting the growth of bacteriophages in *E.coli*.
  - They cut the DNA only at the centre of the palindromic sites.
  - They remove nucleotides only from the ends of DNA fragments.
  - They recognise specific palindromic base-pair sequences.

Choose the answer from the options given below:

- A and B only                      (2) D and E only
- C and D only                      (4) A and E only

**Ans key: 3**

**Sol:** Restriction enzyme endonucleases cut DNA a little away from the centre of the palindrome sites. They remove from the specific positions within the DNA.

99. Match List I with List II:

| List I            | List II  |
|-------------------|--|
| A. Decomposition  | I. Accumulation of dark coloured amorphous colloidal substance         |
| B. Detritus       | II. Release of inorganic nutrients by the activity of microbes in soil |
| C. Mineralisation | III. Breaking down of complex organic matter into inorganic substances |
| D. Humification   | IV. Dead remains of plants and animals including fecal matter          |

Choose the **correct** answer from the options given below:

- A - I    B - II    C - III    D - IV
- A - IV    B - III    C - I    D - II
- A - III    B - IV    C - II    D - I
- A - III    B - II    C - I    D - IV

**Ans key: 3**

**Sol:** Both List I and List II are correctly matched in the option (3).

100. In which one of the following, the ovules are not enclosed by an ovary wall and remain exposed?

- Selaginella*                      (2) *Funaria*
- Pinus*                                (4) *Wolffia*

**Ans key: 3**

**Sol:** *Pinus* belongs to naked seeded plant group – gymnosperm.

101. Match List I with List II:

| List I<br>(Placentation) | List II<br>(Example) |
|--------------------------|----------------------|
| A. Marginal              | I. Mustard           |
| B. Axile                 | II. Pea              |
| C. Parietal              | III. Marigold        |
| D. Basal                 | IV. Lemon            |

Choose the **correct** answer from the options given below:

- A - I    B - III    C - II    D - IV
- A - IV    B - II    C - I    D - III
- A - II    B - IV    C - I    D - III
- A - III    B - I    C - IV    D - II

**Ans key: 3**

**Sol:** Both List I and list II are correctly matched in the option (3).

102. In angiosperms, root hairs arise from which one of the following regions of the root?

- The root cap zone
- The region of meristematic activity
- The region of elongation
- The region of maturation

**Ans key: 4**

**Sol:** Root hairs arise from the region of maturation of root - tip.

103. Which one of the following is **not** a characteristic of plant cells in the phase of elongation?

- Increased vacuolation
- Large conspicuous nuclei
- Cell enlargement
- New cell wall deposition

**Ans key: 2**

**Sol:** Development of plant cell shows increased vacuolisation, cell enlargement and new cell wall formation.

104. Which of the following statements are correct with reference to a transcription unit?

- A transcription unit in DNA is defined primarily by three regions : promoter, structural gene and terminator.
- The promoter is said to be located towards the 5'-end of the structural gene.
- The promoter is a DNA sequence that provides binding site for RNA polymerase.
- The promoter defines the template and coding strands.
- The terminator is located towards the 3'-end of the coding strand and it defines the end of the process of transcription.

Choose the **correct** answer from the options given below:

- (1) A, B, C, D and E
- (2) B, C, D and E only
- (3) A, C, D and E only
- (4) A, B, C and D only

**Ans key: 1**

**Sol:** All the given statements are correct about transcription unit.

**105.** Alpha-helix is found in which level of protein structure?

- (1) Quaternary structure
- (2) Tertiary structure
- (3) Primary structure
- (4) Secondary structure

**Ans key: 4**

**Sol:** Alpha – helix is found in the secondary structure of protein.

**106.** Which of the following statements are correct regarding amino acids?

- A. They are substituted methanes.
- B. Serine is an aromatic amino acid.
- C. Valine is a neutral amino acid.
- D. Lysine is an acidic amino acid.

Choose the **correct** answer from the options given below:

- (1) C and D only
- (2) A and B only
- (3) A and C only
- (4) B and C only

**Ans key: 3**

**Sol:** Serine is neutral amino acid and lysine is basic amino acid.

**107.** The main function of bulliform cells in grasses is:

- (1) to make the leaf impermeable to fungal spores.
- (2) to perform photosynthesis
- (3) to minimize water loss during water stress.
- (4) to transport water.

**Ans key: 3**

**Sol:** Bulliform cells cause flaccidity in grass leaf and minimise water loss.

**108.** Find the **incorrect** statement(s) about photosynthesis from the following:

- A. The water plitting complex is associated with PS I.
- B. C<sub>4</sub> plants use the C<sub>3</sub> pathway of CO<sub>2</sub> fixation as the main biosynthetic pathway.
- C. In C<sub>4</sub> plants, photorespiration does not occur.
- D. C<sub>3</sub> plants exhibit 'Kranz' anatomy.
- E. ATP synthesis in chloroplast occurs through chemiosmosis.

Choose the answer from the options given below:

- (1) B only
- (2) A and D only
- (3) B and C only
- (4) B and E only

**Ans key: 2**

**Sol:** Water splitting complex is associated to PS II. "Kranz' anatomy is found in C<sub>4</sub> plants.

**109.** Match List I with List II:

| List I              | List II   |
|---------------------|---|
| A. Conjunctive      | I. Specialised cells in the vicinity of guard cells |
| B. Casparian strips | II. Endodermal cells rich in starch                 |
| C. Subsidiary cells | III. Tissue between xylem and phloem                |
| D. Starch sheath    | IV. Endodermal cells with suberin deposition        |

Choose the **correct** answer from the options given below:

- (1) A - IV B - III C - I D - II
- (2) A - III B - IV C - II D - I
- (3) A - III B - IV C - I D - II
- (4) A - IV B - III C - II D - I

**Ans key: 3**

**Sol:** Both List I and list II are correctly matched in the option (3).

**110.** Match List I with List II:

| List I                  | List II                             |
|-------------------------|-------------------------------------|
| A. Genetically modified | I. <i>Agrobacterium tumefaciens</i> |
| B. Thermostable DNA     | II. Bt cotton                       |
| C. Ti plasmid           | III. <i>Thermus aquaticus</i>       |
| D. pBE322               | IV. <i>Escherichia coli</i>         |

Choose the **correct** answer from the options given below:

- (1) A - II B - I C - IV D - III
- (2) A - I B - IV C - III D - II
- (3) A - II B - III C - I D - IV
- (4) A - I B - II C - IV D - III

**Ans key: 3**

**Sol:** Both List I and list II are correctly matched in the option (3).

111. Heterophyllous development in response to environment is an example of which of the following phenomena?
- (1) Dedifferentiation
  - (2) Elasticity
  - (3) Redifferentiation
  - (4) Plasticity

**Ans key: 4**

**Sol:** Heterophyllous feature is the plasticity.

112. In racemose inflorescence, \_\_\_\_\_
- (1) the main axis terminates in a flower
  - (2) the growth is limited
  - (3) flowers are borne in an acropetal succession
  - (4) flowers are solitary

**Ans key: 3**

**Sol:** Acropetal succession of flowers is the key feature of racemose inflorescence.

113. Which one of the following disorders is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule?
- (1) Haemophilia
  - (2) Thalassaemia
  - (3) Sickle-cell anaemia
  - (4) Phenylketonuria

**Ans key: 3**

**Sol:** Sickle cell anaemia is point mutation disorder.

114. Match List I with List II:

| List I                   | List II  |
|--------------------------|--|
| A. Incomplete dominance  | I. Human skin colour                                       |
| B. Co-dominance          | II. Inheritance of flower colour in <i>Antirrhinum</i> sp. |
| C. Pleiotropy            | III. Phenylketonuria disease in humans                     |
| D. Polygenic inheritance | IV. ABO blood groups                                       |

Choose the **correct** answer from the options given below:

- (1) A - II B - IV C - III D - I
- (2) A - I B - III C - II D - IV
- (3) A - II B - I C - III D - IV
- (4) A - I B - IV C - III D - II

**Ans key: 1**

**Sol:** Both List I and list II are correctly matched in the option (1).

115. Arrange the following in the correct developmental sequence related to microsporogenesis:
- A. Microspore tetrads
  - B. Sporogenous tissue
  - C. Pollen grains
  - D. Pollen mother cells

Choose the **correct** answer from the options given below:

- (1) D, A, C, B
- (2) B, D, C, A
- (3) B, D, A, C
- (4) A, D, C, B

**Ans key: 3**

**Sol:** Option (3) is the correct sequence of microsporogenesis.

116. Arrange the following steps of DNA fingerprinting in a correct sequence.
- A. Isolation of DNA and its digestion by restriction endonucleases.
  - B. Hybridisation using a labelled VNTR probe.
  - C. Transferring of separated DNA fragments to synthetic membranes.
  - D. Detection of hybridised DNA fragments by autoradiography.
  - E. Separation of DNA fragments by electrophoresis.

Choose the **correct** answer from the options given below:

- (1) A, E, C, B, D
- (2) A, E, B, C, D
- (3) A, B, D, C, E
- (4) A, D, B, E, C

**Ans key: 1**

**Sol:** Option (1) is the correct sequence of DNA finger printing.

117. Exploring molecular, genetic and species-level diversity for products of economic importance is called:
- (1) Biomagnification
  - (2) Biofortification
  - (3) Bioremediation
  - (4) Bioprospecting

**Ans key: 4**

**Sol:** Option (4) is correct about exploring molecular, genetic and species – level diversity for products of economic importance.

118. Which of the following statements are true with reference to the sex-determination in honeybees?
- A. An offspring formed from the union of a sperm and an egg, develops as a female (queen or worker).
  - B. An unfertilized egg develops as a male by parthenogenesis.
  - C. A male has half the number of chromosomes than that of a female.
  - D. Males produce sperms by meiosis.
  - E. Honeybees have a haplodiploid sex-determination system.

Choose the **correct** answer from the options given below:

- (1) B, C, D and E only
- (2) A, B, C and D only
- (3) A, B, D and E only
- (4) A, B, C and E only

**Ans key: 4**

**Sol:** Option (4) is with correct statements about sex – determination in honeybees.

**119.** Identify the correct sequence of steps in each cycle of Polymerase Chain Reaction:

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

**Ans key: 1**

**Sol:** Option (1) is correct sequence of steps in PCR.

**120.** Which of the following statements are correct with respect to DNA separation, isolation and visualization?

- A.** The cutting of DNA is done by molecular scissors.
- B.** The DNA fragments separate according to their size in an agarose gel, upon electrophoresis.
- C.** The separated DNA fragments can be seen without staining when exposed to UV light.
- D.** The separated DNA fragments, when stained with ethidium bromide, can be seen in visible light.

Choose the **correct** answer from the options given below:

- (1) A and D only                      (2) B and D only
- (3) B and C only                      (4) A and B only

**Ans key: 4**

**Sol:** Option (4) is with correct statements about DNA isolation, separation and its visualisation.

**121.** The main criteria used for Five Kingdom Classification proposed by R.H Whittaker (1969) included:

- A. Cell structure
- B. Body organization
- C. Presence of flagellum
- D. Reproduction
- E. Phylogenetic relationships

Choose the **correct** answer from the options given below:

- (1) A, B, D and E only
- (2) A, B, C, D and E
- (3) A, B and E only
- (4) B, C and D only

**Ans key: 1**

**Sol:** Option (1) is with the criteria proposed by R.H. Whittaker for five kingdom classification.

**122.** Which one of the following is a triploid cell?

- (1) Central cell
- (2) Primary endosperm cell

- (3) Zygote
- (4) Synergid

**Ans key: 2**

**Sol:** Option (2) is correct about triploid cell.

**123.** Which of the following statements are correct with reference to packaging of DNA helix?

- A.** Histones are organized to form a unit of eight molecules called histone octamer.
- B.** Histones are negatively charged basic proteins.
- C.** Histones are rich in the basic amino acid residues – lysine and arginine.
- D.** The positively charged DNA is wrapped around the histone octamer to form nucleosome.
- E.** The packaging of chromatin at higher levels requires an additional set of proteins called non-histone chromosomal proteins.

Choose the **correct** answer from the options given below:

- (1) A, B and D only                      (2) A, C and E only
- (3) C, D and E only                      (4) B, D and E only

**Ans key: 2**

**Sol:** Option (2) is with correct statements about packaging of DNA helix.

**124.** Which of the following is an *in situ* conservation method?

- (1) Sacred Groves
- (2) Wildlife Safari Parks
- (3) Botanical Gardens
- (4) Seed Banks

**Ans key: 1**

**Sol:** Wildlife Safari Park, Botanical Gardens and Seed Banks are *ex situ* conservation methods.

**125.** In the *lac* operon, the *z* gene codes for:

- (1) transacetylase
- (2) the repressor of *lac* operon
- (3) permease
- (4) beta-galactosidase

**Ans key: (4)**

**Sol:** In *lac* operon *z* gene codes beta – galactosidase enzyme.

126. Match List I with List II:

| List I<br>(Growth Regulator) | List II<br>(Function/Effect)        |
|------------------------------|-------------------------------------|
| A. 2, 4-D                    | I. Brewing industry                 |
| B. GA <sub>3</sub>           | II. Stimulation of stomatal closure |
| C. Kinetin                   | III. Herbicide                      |
| D. ABA                       | IV. Nutrient mobilisation           |

Choose the **correct** answer from the options given below:

- (1) A - IV B - III C - II D - I  
(2) A - I B - II C - IV D - III  
(3) A - III B - I C - IV D - II  
(4) A - I B - IV C - III D - II

**Ans key: 3**

**Sol:** Both List I and list II are correctly matched in the option (3).

127. Arrange the following steps of somatic hybridisation in a correct sequence.

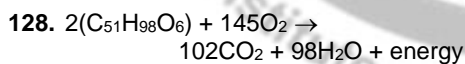
- A. Digestion of cell walls.  
B. Isolation of naked protoplasts.  
C. Fusion of protoplasts to get hybrid protoplast.  
D. Isolation of single cells from two different varieties of plants.  
E. Growing of hybrid protoplast to form a new plant.

Choose the **correct** answer from the options given below:

- (1) E, A, B, C, D (2) D, A, B, C, E  
(3) E, B, A, D, C (4) D, B, A, E, C

**Ans key: 2**

**Sol:** Option (2) is the correct sequence of somatic hybridisation.



The Respiratory Quotient (RQ) of a biomolecule used for respiration, as per the above equation, would be:

- (1) Less than 0.5  
(2) Between 0.5 and 0.95  
(3) Between 1.25 and 2  
(4) 1.0

**Ans key: 2**

**Sol:** RQ of tripalmitin is 0.7, hence option (2) is correct.

129. Since the origin and diversification of life on Earth, there have been five episodes of mass extinction of species. How is the sixth extinction, which is in progress, different from the previous episodes?

- (1) The current species extinction rates are far lower than those in previous episodes.  
(2) The present species extinction rates are 100 to 1000 times faster than in the pre-human times.  
(3) The present net species extinction rate is zero  
(4) The current species extinction rate is nearly 10 times faster than that in previous episodes.

**Ans key: 2**

**Sol:** Option (2) is correct about sixth extinction of biodiversity.

130. Match List I with List II:

| List I            | List II                           |
|-------------------|-----------------------------------|
| A. Trypsin        | I. Intercellular ground substance |
| B. Morphine       | II. Lectin                        |
| C. Concanavalin A | III. Enzyme                       |
| D. Collagen       | IV. Alkaloid                      |

Choose the **correct** answer from the options given below:

- (1) A - III B - IV C - II D - I  
(2) A - I B - II C - III D - IV  
(3) A - III B - II C - IV D - I  
(4) A - IV B - III C - II D - I

**Ans key: 1**

**Sol:** Both List I and list II are correctly matched in the option (1).

131. Which one of the following statements is **not** true about the universal rules of binomial nomenclature?

- (1) Both the words in a biological name, when handwritten, are separately underlined or printed in italics.  
(2) The specific epithet in the biological name starts with a small letter.  
(3) The first word in the biological name represents the specific epithet, while the second component denotes the genus.  
(4) Biological names are generally in Latin.

**Ans key: 3**

**Sol:** In binomial nomenclature, the first word is genus and the second component is specific epithet.

132. The enzyme required for carboxylation in the Calvin cycle is:

- (1) PEP carboxylase  
(2) RuBP carboxylase – oxygenase  
(3) Carboxypeptidase  
(4) Hexokinase

**Ans key: 2**

**Sol:** RuBisCO is the enzyme involved in Calvin cycle.

133. Which of the following floral formula is the correct floral formula of Solanaceae family?

- (1)  $\oplus \overline{\text{K}}_{(5)} \overline{\text{C}}_{(5)} \overline{\text{A}}_5 \underline{\text{G}}_{(2)}$   
(2)  $\oplus \overline{\text{K}}_5 \overline{\text{C}}_{(5)} \overline{\text{A}}_5 \underline{\text{G}}_{(2)}$   
(3)  $\oplus \overline{\text{K}}_{(5)} \overline{\text{C}}_{(5)} \overline{\text{A}}_5 \underline{\text{G}}_{(2)}$   
(4)  $\oplus \overline{\text{K}}_5 \overline{\text{C}}_5 \overline{\text{A}}_5 \underline{\text{G}}_{(2)}$

**Ans key: (1)**

**Sol:** Option (1) is the correct floral formula of Solanaceae family.

134. Which one of the following types of pollination brings genetically different types of pollen grains to the stigma?

- (1) Geitonogamy (2) Autogamy  
(3) Xenogamy (4) Cleistogamy

**Ans key: 3**

**Sol:** Option (3) is correct about bringing genetically different types of pollen grains to the stigma.

135. Match List I with List II:

| List I<br>(Process)        | List II<br>(Location)           |
|----------------------------|---------------------------------|
| A. Glycolysis              | I. Inner mitochondrial membrane |
| B. ETS                     | II. Mitochondrial matrix        |
| C. Accumulation of protons | III. Cytoplasm                  |
| D. Krebs' cycle            | IV. Intermembrane space         |

Choose the **correct** answer from the options given below:

- (1) A - I B - IV C - III D - II  
(2) A - III B - I C - IV D - II  
(3) A - IV B - II C - I D - III  
(4) A - II B - III C - IV D - I

**Ans key: 2**

**Sol:** Both List I and list II are correctly matched in the option (2).

136. Insertion of a foreign DNA at BamHI site in an E.coli cloning vector pBR322 results in the loss of antibiotic resistance towards:

- (1) Gentamycin  
(2) Ampicillin and tetracycline  
(3) Tetracycline  
(4) Ampicillin

**Ans key: 3**

**Sol:** BamHI site of tetracycline resistance gene is in the vector pBR322

137. The sixth mutant codon of beta globin gene causing polymerization of Haemoglobin and change in RBC shape is \_\_\_\_\_.

- (1) CAG (2) GUG  
(3) AUG (3) GAG

**Ans key: 2**

**Sol:** 'GUG' is the mutant codon of beta globin gene in sickle - cell anaemia.

138. Choose the correct statement regarding GIFT to overcome infertility.

- (1) Ova collected from a female donor are transferred to the uterus of an infertile female.  
(2) It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ovum but can provide suitable environment for fertilization and development.  
(3) Early embryos with up to 8 blastomeres are transferred to the uterus of an infertile female.  
(4) Early embryos with up to 8 blastomeres are transferred into the fallopian tube of an infertile female.

**Ans key: 2**

**Sol:** GIFT (Gamete intra fallopian transfer) is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ovum but can provide suitable environment for fertilization and development.

139. Which one of the following is an appropriate example of 'sexual deceit'?

- (1) Female wasp and fig  
(2) Cuckoo and crow  
(3) *Ophrys* and bumblebee  
(4) Sea anemone and clown fish

**Ans key: 3**

**Sol:** The appropriate example of 'sexual deceit' is of Mediterranean Orchid *Ophrys* and bumblebees.

140. Evolution of human appears parallel to the progressive development of brain and language skills. As such, the evolution of individual species in the sequence of their appearance is:

- (1) *Homo habilis* → *Homo erectus* → *Ramapithecus* → *Neanderthal* → *Homo sapiens*  
(2) *Ramapithecus* → *Homo habilis* → *Homo erectus* → *Neanderthal* → *Homo sapiens*

- (3) *Homo sapiens* → *Ramapithecus* → *Homo habilis* → *Neanderthal* → *Homo erectus*  
 (4) *Neanderthal* → *Ramapithecus* → *Homo habilis* → *Homo erectus* → *Homo sapiens*

**Ans key: 2**

**Sol:** The correct sequence of evolution of human is given in option (2).

141. Match List I with List II:

| List I  | List II                   |
|---|---------------------------|
| A. The foetus movement starts and hair appears on the head                              | I. 24 weeks of pregnancy  |
| B. The foetus develops limbs and digits   | II. 20 weeks of pregnancy |
| C. The foetus develops external genital organs  | III. 8 weeks of pregnancy |
| D. The foetus body is covered with fine hair; eyelids separate and eyelashes are formed | IV. 12 weeks of pregnancy |

Choose the **correct** answer from the options given below:

- (1) A - III B - II C - IV D - I  
 (2) A - II B - IV C - III D - I  
 (3) A - IV B - II C - III D - I  
 (4) A - II B - III C - IV D - I

**Ans key: 4**

**Sol:** Both List I and list II are correctly matched in the option (4).

142. A group of researchers procured some fish-like animals and upon investigation the following characters were observed:

- A. Endoskeleton was made of cartilage.  
 B. Ectoparasitic; as they were found attached on fish skin with their circular sucking mouth.  
 C. Paired fins and scales were absent, but 7 pairs of gill slits were present.

Which of the following species of animals did they consider to fit best with these characters?

- (1) *Exocoetus* sp. (2) *Brachiostoma* sp.  
 (3) *Petromyzon* sp. (4) *Scoliodon* sp.

**Ans key: 3**

**Sol:** All the observed characters are of *Petromyzon* sps. belongs to class: Cyclostomata.

143. Spermatogonia undergo a series of cell divisions to produce sperms. Select the correct statements from the following:

- A. Spermatogonia always undergo meiotic cell division.  
 B. Primary spermatocytes divide mitotically to produce secondary spermatocytes.  
 C. Secondary spermatocytes, through their second meiotic division, produce haploid spermatids.  
 D. Spermatids produce spermatozoa through mitosis.  
 E. Spermatids transform into spermatozoa by spermiogenesis.

Choose the **correct** answer from the options given below:

- (1) C and E only  
 (2) A, C and E only  
 (3) B, C and D only  
 (4) A and E only

**Ans key: 1**

**Sol:** Spermatogonia undergo mitotic divisions to produce primary spermatocytes; where as secondary spermatocytes are formed by the meiotic divisions of primary spermatocytes.

144. What is the probability of having children with 'O' blood group, where both mother and father are heterozygous for 'A' and 'B' blood group, respectively?

- (1) 50% (2) 0%  
 (3) 75% (4) 25%

**Ans key: 4**

**Sol:** There will be 25% probability of 'O' blood group children, when both the parents are heterozygous for 'A' and 'B' blood group respectively.

145. Arrange the following events occurring in Renin-Angiotensin mechanism in the correct order:

- A. Increase in blood pressure and Glomerular filtration rate.  
 B. Reabsorption of Na<sup>+</sup> and water from distal parts of tubule due to Aldosterone.  
 C. Fall in Glomerular filtration rate.  
 D. Vasoconstriction by Angiotensin II and release of Aldosterone.  
 E. Renin converts Angiotensinogen into Angiotensin I, followed by Angiotensin II.

Choose the **correct** answer from the options given below:

- (1) C, A, B, D, E  
 (2) A, D, B, E, C  
 (3) A, C, E, B, D  
 (4) C, E, D, B, A

**Ans key: 4**

**Sol:** The correct sequence of events occurring in Renin – Angiotensin mechanism is given in option (4).

**Sol:** Ribosomes are non-membraned cell organelles found in both prokaryotic and eukaryotic cells.

146. Match List I with List II:

| List I<br>(Respiratory Volume)      |      | List II<br>(Capacity in mL) |  |
|-------------------------------------|------|-----------------------------|--|
| A. ERV (Expiratory Reserve Volume)  | I.   | 2500-3000 mL                |  |
| B. RV (Residual Volume)             | II.  | 500 mL                      |  |
| C. IRV (Inspiratory Reserve Volume) | III. | 1000-1100 mL                |  |
| D. TV (Tidal Volume)                | IV.  | 1100-1200 mL                |  |

Choose the **correct** answer from the options given below:

- (1) A - III B - I C - IV D - II  
 (2) A - I B - III C - II D - IV  
 (3) A - III B - IV C - I D - II  
 (4) A - I B - II C - III D - IV

**Ans key: 3**

**Sol:** Both List I and list II are correctly matched in the option (3).

147. Match List I with List II:

| List I           |      | List II                                |  |
|------------------|------|--|--|
| A. Progestasert  | I.   | Barrier made of rubber used by females |  |
| B. Multiload 375 | II.  | Oral contraceptive                     |  |
| C. Diaphragm     | III. | Hormone releasing IUD                  |  |
| D. Saheli        | IV.  | Copper releasing IUD                   |  |

Choose the **correct** answer from the options given below:

- (1) A - III B - IV C - I D - II  
 (2) A - III B - IV C - II D - I  
 (3) A - IV B - II C - I D - III  
 (4) A - IV B - III C - I D - II

**Ans key: 1**

**Sol:** Both List I and list II are correctly matched in the option (1).

148. Non-membrane bound cell organelles found in both prokaryotic and eukaryotic cells are

- (1) Centrosomes  
 (2) Ribosomes  
 (3) Lysosomes  
 (4) Mitochondria

**Ans key: 2**

149. Ecological pyramids represent the relationship between the organisms at different trophic levels and they are generally inverted for:

- (1) Pyramid of energy in pond ecosystem  
 (2) Pyramid of biomass in sea  
 (3) Pyramid of number in grassland  
 (4) Pyramid of biomass in grassland

**Ans key: 2**

**Sol:** The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds than that of phytoplanktons.

150. The flightless bird with forelimbs modified as paddle-like structures suited for swimming is known as:

- (1) *Struthio*  
 (2) *Psittacula*  
 (3) *Neophron*  
 (4) *Aptenodytes*

**Ans key: 4**

**Sol:** *Aptenodytes* (penguin) is a flightless bird whose forelimbs are highly modified into rigid, paddle – like flippers used for underwater 'flight' rather than air flight.

151. Match List I with List II:

| List I<br>(Bioactive molecules) |      | List II<br>(Importance)                 |  |
|---------------------------------|------|---|--|
| A. Streptokinase                | I.   | Immunosuppressive agent                 |  |
| B. Statins                      | II.  | Removal of clots from the blood vessels |  |
| C. Lipases                      | III. | Blood cholesterol-lowering agent        |  |
| D. Cyclosporin A                | IV.  | Detergent formulations                  |  |

Choose the **correct** answer from the options given below:

- (1) A - II B - III C - IV D - I  
 (2) A - IV B - III C - II D - I  
 (3) A - II B - III C - I D - IV  
 (4) A - III B - II C - IV D - I

**Ans key: 1**

**Sol:** Both List I and list II are correctly matched in the option (1).

152. Choose the correct statements regarding cell organelles and their inclusions.

- The endomembrane system includes Golgi complex, endoplasmic reticulum and mitochondria.
- Rough endoplasmic reticulum bears ribosomes on its surface.
- Both mitochondria and plastids have circular DNA.
- A network of microtubules, microfilaments and intermediate filaments presents in the cytoplasm is called cytoskeleton.
- Mitochondrion is a single membrane-bound structure.

Choose the **correct** answer from the options given below:

- C, D and E only
- A and B only
- A, B and C only
- B, C and D only

**Ans key: 4**

**Sol:** The endomembrane system includes Endoplasmic reticulum (ER), Golgi complex, lysosomes and vacuoles.

153. Select the set of fishes which belong to the class Osteichthyes :

- Devil fish, Cuttlefish and Hagfish
- Starfish, Hagfish and Cuttlefish
- Flying fish, Angel fish and Fighting fish
- Saw fish, Fighting fish and Dog fish

**Ans key: 3**

**Sol:** Flying fish (*Exocoetus*) fighting fish (*Bella*) and Angel fish (*pterophyllum*) are set of Bony fishes.

154. In a population of a grasshopper species, the chromosome number of some members is 23 and some other members possess 24 chromosomes. The 23 and 24 chromosome-bearing members in this species are \_\_\_\_\_

- all males
- all females
- females and males, respectively
- males and females, respectively

**Ans key: 4**

**Sol:** Grass hoppers exhibit XO type of sex determination, in which male grass hoppers have one chromosome less than females (XX) grass hoppers.

155. The WBC count of a person's blood sample is 8000/ cu.mm. how many eosinophils and lymphocytes would be in the same blood sample approximately?

- 160-240/ cu.mm and 1600-2000/cu.mm, respectively
- 100-120/ cu.mm and 160-200/cu.mm, respectively

- 300-500/ cu.mm and 500-700/cu.mm, respectively
- 300-500/ cu.mm and 1200-1500/cu.mm, respectively

**Ans key: 1**

**Sol:** In a person the Eosinophils ranges from (2 – 3%) and that of lymphocytes are (20 – 25%)

156. The toxin proteins isolated from *Bacillus thuringiensis*, coded by which of the following genes would control cotton bollworms and corn borer, respectively?

- cryIAc* and *cryIIAb*
- cryIAc* and *cryIAb*
- cryIAc* and *cryIAb*
- cryIIAc* and *cryIAb*

**Ans key: 3**

**Sol:** Proteins encoded by the genes *cryIAc* and *cryII Ab* control the cotton bollworms, that of *cryIAb* controls corn borer.

157. Match List I with List II:

| List I<br>(Drug) | List II<br>(Effect)   |
|------------------|---|
| A. Nicotine      | I. Causes sense of euphoria and increased energy                              |
| B. Morphine      | II. Stimulates adrenal gland to release catecholamines into blood circulation |
| C. Heroin        | III Effective sedative and painkiller   |
| D. Cocaine A     | IV A depressant; slows down body function                                     |

Choose the **correct** answer from the options given below:

- A - III B - II C - IV D - I
- A - II B - III C - IV D - I
- A - II B - III C - I D - IV
- A - III B - II C - I D - IV

**Ans key: 2**

**Sol:** Both List I and list II are correctly matched in the option (2).

158. Match List I with List II:

| List I                  | List II  |
|-------------------------|--|
| A. Tetany               | I. Inflammation of joints  |
| B. Arthritis            | II. Autoimmune disorder affecting neuromuscular junction                 |
| C. Myasthenia gravis    | III Wild contraction in muscle due to low Ca <sup>++</sup> in body fluid |
| D. Muscular dystrophy A | IV Progressive degeneration of skeletal muscle                           |

Choose the **correct** answer from the options given below:

- (1) A - III B - I C - II D - IV
- (2) A - IV B - III C - II D - I
- (3) A - I B - II C - III D - IV
- (4) A - III B - II C - I D - IV

**Ans key: 1**

**Sol:** Both List I and list II are correctly matched in the option (1).

**159.** In which animal do haploid cells divide mitotically to produce gametes?

- (1) Male honeybees
- (2) Male grasshoppers
- (3) Male earthworms
- (4) Male frogs

**Ans key: 1**

**Sol:** In male honeybees haploid cells divide mitotically to produce sperms .

**160** In humans, respiration occurs in the following steps. Arrange these steps in the correct order.

- A. Diffusion of O<sub>2</sub> and CO<sub>2</sub> between blood and tissues
- B. Diffusion of O<sub>2</sub> and CO<sub>2</sub> across alveolar membrane
- C. Pulmonary ventilation by which atmospheric air is drawn in and CO<sub>2</sub> rich alveolar air is released out
- D. Cellular respiration
- E. Transport of gases by the blood

Choose the **correct** answer from the options given below:

- (1) A, B, C, D, E
- (2) E, A, C, D, B
- (3) C, A, B, E, D
- (4) C, B, E, A, D

**Ans key: 4**

**Sol:** The correct order of steps involved in human respiration is given in option (4).

**161.** Arrange the following cell layers/ structures around the female gamete, from outer to inner side:

- A. Zona pellucida
- B. Perivitelline space
- C. Corona radiata
- D. Plasma membrane of ovum

Choose the **correct** answer from the options given below:

- (1) C, A, D, B
- (2) C, A, B, D
- (3) D, B, A, C
- (4) A, C, B, D

**Ans key: 2**

**Sol:** Corona radiata is the outermost layer and plasma membrane is the innermost layer of ovum.

**162.** The human protein named  $\alpha$ -1-antitrypsin, obtained from transgenic animals, is used for the treatment of \_\_\_\_\_

- (1) Alzheimer's disease
- (2) Emphysema
- (3) Rheumatoid arthritis
- (4) Cystic fibrosis

**Ans key: 2**

**Sol:** The human protein named  $\alpha$  - 1 antitrypsin obtained from transgenic animals, is used for the treatment of Emphysema

**163.** Select the correct statements regarding cell membrane in eukaryotic cell.

- A. Membrane of human RBCs has approximately 52% protein.
- B. Major phospholipids are arranged in a bilayer.
- C. Extensions of the plasma membrane into the cell form mesosomes.
- D. Tails towards the inner part of lipids are hydrophobic and thus protected from aqueous medium.
- E. Glycocalyx is present on the outer surface of the plasma membrane.

Choose the **correct** answer from the options given below:

- (1) A, C and E only
- (2) B, C and E only
- (3) C, D and E only
- (4) A, B and D only

**Ans key: (4)**

**Sol:** Mesosomes are plasma membrane extensions found in prokaryotic cell only.

**164.** Male frogs can be distinguished from female frogs due to the presence of :

- A. Bulging eyes
- B. Vocal sacs
- C. Webbed digits in feet
- D. Copulatory pad on first digit of fore limbs
- E. Olive green-coloured skin with dark irregular spots

Choose the **correct** answer from the options given below:

- (1) B and D only
- (2) B and C only
- (3) A and B only
- (4) C and E only

**Ans key: (1)**

**Sol:** Vocal sacs and copulatory pads are the features absent in female frogs.

165. Which of the following equations depicts Verhulst-Pearl logistic population growth?

- (1)  $\frac{dN}{dt} = rN \left( \frac{K-N}{K} \right)$   
 (2)  $\frac{dN}{dt} = rN \left( \frac{K+N}{K} \right)$   
 (3)  $\frac{dN}{dt} = rN \left( \frac{K}{K-N} \right)$   
 (4)  $\frac{dN}{dt} = rN \left( \frac{K-N}{N} \right)$

**Ans key: (1)**

**Sol:**  $\frac{dN}{dt} = rN \left( \frac{K-N}{K} \right)$  is the Verhulst-Pearl logistic population growth equation

166. Choose the correct statements regarding frog's anatomy :

- A. Hepatic portal system is the special venous connection between liver and intestine.  
 B. There are twelve pairs of cranial nerves arising from the brain.  
 C. The ureters and oviducts open separately into the cloaca in female frogs.  
 D. Hind-brain consists of cerebellum, medulla oblongata and optic lobes.  
 E. Sinus venosus joins the right atrium of heart.

Choose the **correct** answer from the options given below:

- (1) B and D only  
 (2) A, C and E only  
 (3) A, B and C only  
 (4) B and C only

**Ans key: (2)**

**Sol:** There are only 10 pairs of cranial nerves and optic lobe is the part of mid brain in frogs.

167. Select the **incorrect** statements with reference to Rh grouping.

- A. Erythroblastosis foetalis is a condition observed having foetus with Rh<sup>-ve</sup> blood and mother with Rh<sup>+ve</sup> blood.  
 B. Rh antigen is observed on RBCs in the majority of human beings.  
 C. Before blood transfusion, Rh group should also be matched.  
 D. Rh incompatibility is observed when a pregnant mother is Rh<sup>-ve</sup> and the foetus is Rh<sup>+ve</sup>.  
 E. Erythroblastosis foetalis can be avoided by administering anti-Rh antibodies to the mother immediately after the delivery of the second child.

Choose the answer from the options given below:

- (1) A and E only (2) A and B only  
 (3) B and C only (4) C and D only

**Ans key: (1)**

**Sol:** Rh incompatibility is observed when a pregnant mother is Rh<sup>-ve</sup> and the foetus is Rh<sup>+ve</sup>.

168. Which of the following statements are correct with reference to human endoskeleton?

- A. Human skull is monocondylic.  
 B. The joint between any two adjoining vertebrate is a cartilaginous joint.  
 C. In human beings, the number of cervical vertebrae is seven.  
 D. All ribs except the last 2 pairs are bicephalic.  
 E. The occipital bone of skull is articulated with atlas vertebra.

Choose the **correct** answer from the options given below:

- (1) A, B and D only  
 (2) B and E only  
 (3) B, C and E only  
 (4) C, D and E only

**Ans key: (3)**

**Sol:** Human skull is dicondylie: all 12 pairs of ribs are bicephalic.

169. Match List I with List II:

| List I             | List II   |
|--------------------|---|
| A. Cortisol        | I. Stimulates the formation of alveoli in mammary glands                    |
| B. Aldosterone     | II. Produces anti-inflammatory reactions                                    |
| C. Cholecystokinin | III. Stimulates reabsorption of Na <sup>+</sup> and water from renal tubule |
| D. Progesterone    | IV. Stimulates secretion of pancreatic enzymes and bile juice               |

Choose the **correct** answer from the options given below:

- (1) A - III B - II C - IV D - I  
 (2) A - II B - III C - IV D - I  
 (3) A - IV B - II C - I D - III  
 (4) A - II B - III C - I D - IV

**Ans key: (2)**

**Sol:** Both list I and list II are correctly matched in the option (1)

170. The following are the stages of life cycle of *Plasmodium*. Arrange the stages in the proper order.

- The parasites reproduce asexually in RBCs, bursting the cells.
- The parasites reproduce asexually in liver cells, bursting the cells and releasing into blood.
- Gametocytes develop in RBCs.
- Sporozolites reach the liver through the blood.
- Female mosquito injects sporozoites into humans during bite.

Choose the **correct** answer from the options given below:

- A, B, C, D, E
- E, D, B, A, C
- C, A, B, D, E
- E, C, D, B, A

**Ans key: (2)**

**Sol:** The stages of life cycle of *Plasmodium* in the proper order are given in option (2).

171. Select the **incorrect** statements from the following:

- Digestive system in Platyhelminthes is incomplete.
- Bilateral symmetry is a characteristic feature of adult Echinoderms.
- Pseudocoelom is possessed by Aschelminthes.
- Notochord is persistent throughout life in the class Chondrichthyes.
- Members of class Reptilia maintain a constant body temperature.

Choose the answer from the options given below:

- B and E only
- C and D only
- A and C only
- B and D only

**Ans key: (1)**

**Sol:** Radial symmetry is the characteristic feature of adult of Echinoderms.

172. The specific receptors for neurotransmitters in a synapse are present on \_\_\_\_\_

- Post-synaptic membrane
- Pre-synaptic membrane
- Myelin sheath
- Schwann cell

**Ans key: (1)**

**Sol:** The specific receptors for neurotransmitters in a synapse are present in post synaptic membrane.

173. Choose the correct statements regarding muscle contraction.

- A motor neuron carries a signal sent by the Central Nervous System (CNS) to the sarcolemma of the muscle fibre.

- The neural signal generates an action potential which causes the release of  $Ca^{++}$  into sarcoplasm.
- Increase in  $Ca^{++}$  inactivates the actin for breaking cross bridges.
- Actin binds to the myosin head to form a cross bridge.
- Shortening of sarcomere takes place, by pulling actin filaments towards the centre of 'A' band.

Choose the **correct** answer from the options given below:

- A, B, D and E only
- C and D only
- C and E only
- A and B only

**Ans key: (1)**

**Sol:** During muscular contractions, increase in  $Ca^{++}$  levels leads to the unmarking of active sites for myosin.

174. Which of the following is **not** an example of convergent evolution?

- Eyes of octopuses and mammals
- Fore limbs of whales and bats
- Wings of butterflies and birds
- Flippers of penguins and dolphins

**Ans key: (2)**

**Sol:** Forelimbs of whales and bats are homologous organs which results in divergent evolution.

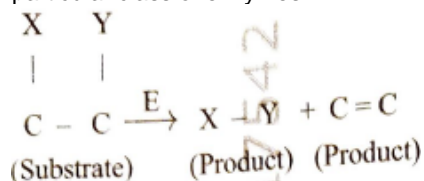
175. The JGA (Juxta Glomerular Apparatus) is a special sensitive region formed by cellular modifications in \_\_\_\_\_ related to the same nephron.

- Distal convoluted tubule and efferent renal arteriole.
- Proximal convoluted tubule and afferent renal arteriole.
- Distal convoluted tubule and afferent renal arteriole.
- Proximal convoluted tubule and efferent renal arteriole.

**Ans key: (3)**

**Sol:** JGA is a special sensitive region formed by the cellular modifications in distal convoluted tubule and afferent renal arteriole.

176. The following reaction depicts the activity of a particular class of enzymes :



Identify the enzyme class 'E' from the following options:

- (1) Ligases (2) Lyases  
(3) Isomerases (4) Transferases

**Ans key: (2)**

**Sol:** Lyases are a group of enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

177. Match List I with List II:

| List I              | List II                                 |
|---------------------|---|
| A. Molluscs         | I. Pulmonary respiration only           |
| B. Reptiles         | II. Branchial respiration               |
| C. Adult amphibians | III. Cellular respiration               |
| D. <i>Amoeba</i>    | IV. Pulmonary and Cutaneous respiration |

Choose the **correct** answer from the options given below:

- (1) A - III B - II C - I D - IV  
(2) A - II B - I C - IV D - III  
(3) A - II B - I C - III D - IV  
(4) A - I B - II C - IV D - III

**Ans key: (2)**

**Sol:** Both list I and list II are correctly matched in the option (2)

178. What is the reason behind production of large holes in 'Swiss Cheese'?

- (1) The production of large amount of CO<sub>2</sub> by *Clostridium butylicum*  
(2) The production of large amount CO<sub>2</sub> and H<sub>2</sub> by *Trichoderma polysporum*  
(3) The production of large amount CO<sub>2</sub> and H<sub>2</sub> by lactic acid bacteria called *Lactobacillus*  
(4) The production of large amount of CO<sub>2</sub> by *Propionibacterium sharmanii*

**Ans key: (4)**

**Sol:** The large holes in Swiss cheese is due to the production of large amount of CO<sub>2</sub> by *Propionibacterium sharmanii*

179. Match List I with List II:

| List I           | List II   |
|------------------|---|
| A. About 65 mya  | I. Jawless fish probably evolved                |
| B. About 500 mya | II. The dinosaurs suddenly                      |
| C. About 350 mya | III. Seaweeds and few plants probably existed   |
| D. About 320 mya | IV. Invertebrates were formed and became active |

Choose the **correct** answer from the options given below:

- (1) A - II B - IV C - I D - III  
(2) A - II B - IV C - III D - I  
(3) A - I B - II C - III D - IV  
(4) A - III B - IV C - I D - II

**Ans key: (1)**

**Sol:** Both list I and list II are correctly matched in the option (1)

180. Choose the correct statements regarding population interactions between two species.

- A. In both parasitism and commensalism, only one species benefits and the other species is harmed.  
B. Both species benefit in mutualism.  
C. Both species benefit in commensalism.  
D. In parasitism, only one species benefits and the other species is harmed.  
E. In amensalism, one species is harmed and the other is unaffected.

Choose the **correct** answer from the options given below:

- (1) A and D only  
(2) A and B only  
(3) B and E only  
(4) B, D and E only

**Ans key: (4)**

**Sol:** In commensalism one species is benefitted while the other is neither harmed or benefitted.