27/03/2026

Code-B_Phase-1

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13, Sector-18, Udyog Vihar, Gurugram, Haryana - 122015, ***Ph.***+91-1244168300

MM : 720 Final Test Series(P1)_NEET2026_Test-04B **Time : 180 Min.**

PHYSICS

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CHEMISTRY

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ZOOLOGY

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180. (2)

Hints and Solutions

PHYSICS

(1) **Answer :** (2)
Solution:

A. Mean free path $\left(\lambda\right) = \frac{1}{\sqrt{2}\pi n d^2} \propto \frac{1}{d^2}$

B. At constant volume, *n* = constant

$\therefore$ λ does not depend on P

C. $\lambda = \frac{K_B T}{\sqrt{2}\pi d^2 P}$

$\therefore$ $\lambda \propto T$ when $P =$ constant

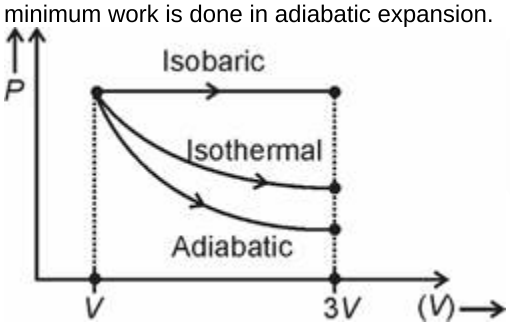
D. $PM_o = \rho RT \Rightarrow \frac{T}{P} \propto M_o$

$\therefore$ $\lambda \propto M_o$

(2) **Answer :** (1)
Solution:
As block moves rightwards, the net spring constant is 5 × 2 = 10 N/m (all springs are in parallel)
As block moves leftward, left four springs will slack and net spring constant is 2 N/m.

$T = \pi\sqrt{\frac{10}{10}} + \pi\sqrt{\frac{10}{2}} = \left(1+\sqrt{5}\right)\pi$ s

(3) **Answer :** (2)
Hint:
Work done is equal to area under *P-V* diagram.
Solution:
When *P-V* diagram is drawn, maximum area is under isobaric expansion and minimum under adiabatic expansion. Therefore minimum work is done in adiabatic expansion.



(4) **Answer :** (1)
Solution:
A real gas behaves like an ideal gas at high temperature and low pressure.

(5) **Answer :** (2)
Solution:

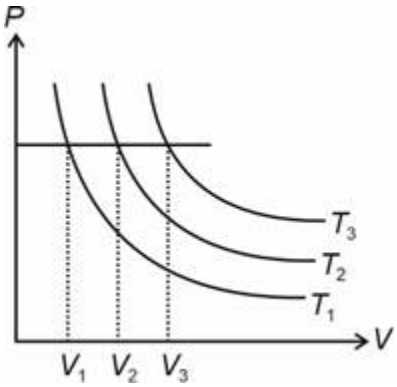
$C_p = \frac{5R}{2}$ and $C_v = C_p - R = \frac{3R}{2}$

Adiabatic constant, $\gamma = \frac{C_p}{C_v} = \frac{5}{3}$

Adiabatic process is $PV^{\gamma} = PV^{\frac{5}{3}} = \text{constant}$

$\Rightarrow$ $P \propto V^{-\frac{5}{3}}$

(6) **Answer :** (2)
Solution:



$V_3 > V_2 > V_1$

Using $T = \frac{PV}{nR}$, $T \propto V$

$T_3 > T_2 > T_1$

(7) **Answer :** (4)
Solution:

$v_p = \left(-\frac{dy}{dx}\right) v$

For particles *D, E, F* : $\frac{dy}{dx}$ = negative & *v* = positive

⇒ v_p = positive

⇒ These particles, *D*, *E*, *F* are all moving upwards.
On the other hand, particles *A* and *B* are both moving downward.

(8) **Answer :** (2)
Solution:
On a humid day, sound in air travels faster than that on a dry day. Sound waves, being mechanical waves, require medium to propagate and hence they do not propagate in vacuum.

(9) **Answer :** (3)
Solution:
Most probable speed is the speed possessed by maximum number of gas molecules, which is 0.3 km/s.

(10) **Answer :** (3)
Solution:

$P = P_0\left[1 - \left(\frac{V_0}{2V_0}\right)^2\right] = \frac{3P_0}{4}$

$\left(K.E.\right)_{\text{trans}} = \frac{3}{2}nRT = \frac{3}{2}PV = \frac{3}{2}\left(\frac{3P_0}{4}\right)2V_0 = \frac{9}{4}P_0V_0$

(11) **Answer :** (3)
Solution:
Beyond equilibrium position: let the spring elongate further by Δx_1, when the block comes down by Δx
Increase in tension on block = ΔT
(A-ii) $\Delta x_1 = 2\,\Delta\, x\ (\text{from constraint relation})$
Increase in spring force = $\frac{\Delta T}{2} = k\,\Delta\, x_1 \quad \Rightarrow \quad \Delta\, T = 4k\,\Delta\, x$

In vector form, $4m\,\vec{a} = -\Delta\vec{T} = -4k\Delta\vec{x}$

$\vec{a} = -\frac{k}{m}\Delta\vec{x} = -\omega^2\Delta\vec{\text{x}}$

$\therefore \quad \omega^2 = \frac{k}{m} \Rightarrow \omega = \sqrt{\frac{k}{m}}$

⇒ Time period $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$

(B-iii) $\Delta x_1 = \Delta x$ (from constraint relation)
Increase in spring force = $\Delta T = k\Delta x_1 \Rightarrow \Delta T = k\Delta x$

In vector form, $4\,m\,\vec{a} = -\Delta\vec{T} = -k\Delta\vec{x}$

$\vec{a} = -\frac{k}{4\,m}\Delta\vec{x} = -\omega^2\Delta\vec{x}$

$\therefore\ \omega^2 = \frac{k}{4m} \Rightarrow \omega = \sqrt{\frac{k}{4m}} = \frac{1}{2}\sqrt{\frac{k}{m}}$

⇒ Time period $T = \frac{2\pi}{\omega} = 4\pi\sqrt{\frac{m}{k}}$

(C-iv) $\Delta x_1 = \frac{\Delta x}{2}$ (from constraint relation)

Increase in spring force = $2\Delta T = k\Delta x_1$

$\Rightarrow \Delta T = \frac{k\Delta x}{4}$

In vector form, $4m\vec{a} = -\Delta\vec{T} = -\frac{k}{4}\Delta\vec{x}$

$\vec{a} = -\frac{k}{16m}\Delta\vec{x} = -\omega^2\Delta\vec{x}$

$\therefore\ \omega^2 = \frac{k}{16m} \Rightarrow \omega = \sqrt{\frac{k}{16m}}$

⇒ Time period $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{16m}{k}} = 8\pi\sqrt{\frac{m}{k}}$

(12) **Answer :** (3)
Hint:
Use conservation of momentum and energy.
Solution:
Initial extension in spring is $x_0 = \frac{mg}{k}$
After collision, speed of combined system is $\frac{v}{2}$
Applying conservation of energy.
$\frac{1}{2}\left(2\mathrm{m}\right)\left(\frac{\mathrm{v}}{2}\right)^2 + \frac{1}{2}\mathrm{k}\left(\frac{\mathrm{mg}}{\mathrm{k}}\right)^2 = 2\,\mathrm{mg}\left(\frac{\mathrm{mg}}{\mathrm{k}}\right)$
On solving, $v = \sqrt{\frac{6mg^2}{k}}$

(13) **Answer :** (4)
Solution:
$y = \cos\omega t + \sin\omega t = \sqrt{2}\ \sin\left(\omega t + \phi\right)$
Time period of SHM, $T = \frac{2\pi}{\omega}$

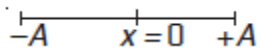
(14) **Answer :** (3)
Solution:
On comparing with standard differential equation of SHM. $\frac{d^2y}{dt^2} + \omega^2 y = 0$
$\omega^2 = 4$
$\omega = 2$ rad/s

(15) **Answer :** (1)
Solution:
In case of damped oscillation, both amplitude and energy of the oscillating body decrease exponentially with time.

(16) **Answer :** (1)
Solution:
Work done by gas = Area under P-V curve $= \pi\, r_1 r_2 = \pi\left(5\ \mathrm{m}^3\right)\left(4\,\mathrm{Nm}^{-2}\right) = 20\pi\ \mathrm{J}$

(17) **Answer :** (1)
Solution:
$\eta = 1 - \frac{T_2}{T_1}$
$\Rightarrow\ 0.4 = 1 - \frac{300}{T_1}$
⇒ T_1 = 500 K

(18) **Answer :** (1)
Solution:



$x_1 = \frac{A}{2} = A\ \sin\ \omega t_1$
$t_1 = \frac{\pi}{6\omega}$
$x_2 = \frac{A}{\sqrt{2}} = A\sin\omega t_2$

$t_2 = \frac{\pi}{4\omega}$

$\therefore \quad \Delta t = t_2 - t_1 = \frac{\pi}{12\omega}$

(19) **Answer :** (4)
Hint:
$v_{rms} \propto \sqrt{T}$
Solution:
As temperature increases, speed also increases. Hence number of collision per second will increase as well as momentum change per collision will also increase. Hence force exerted on the container wall will increase, so pressure will increase.

(20) **Answer :** (4)
Solution:
At constant phase, $\phi = 3x + 4t = \text{constant}$
As time increases, x decreases.
Therefore the wave travels along negative x-axis.

(21) **Answer :** (3)
Solution:
As per zeroth law of thermodynamics, if two systems are in thermal equilibrium with a third system separately, then all 3 systems are in thermal equilibrium with each other. $\therefore \quad \mathrm{T_A} = \mathrm{T_B} = \mathrm{T_C}$

(22) **Answer :** (3)
Solution:
Consider an atom of a solid, vibrating about its mean position in three dimensions, thus acting as a 3*D* harmonic oscillator. An oscillator in one dimension has average energy $= 2 \times \frac{1}{2} k_B T = k_B T$
In three dimensions, the average energy $= 3 \times k_B T = 3k_B T$

(23) **Answer :** (4)
Solution:
Let $y = a_0 \sin(Kx) \sin(\omega t + \varphi)$
$AB = \frac{L}{2} - \frac{L}{3} = \frac{L}{6} = \frac{\lambda}{4} \Rightarrow \lambda = \frac{4L}{6} = \frac{2L}{3}$
$k = \frac{2\pi}{\lambda} = \frac{2\pi}{2L} \times 3 = 3\pi$ and $\Phi = 0$
$\therefore$ Equation will be $y = a_0 \sin(3\pi x) \sin(\omega t)$
$a' = \left| a_0 \sin\left(\frac{3\pi}{L} \times \frac{5L}{6}\right) \right| = a_0$

(24) **Answer :** (1)
Solution:
Temperature is fundamentally defined by the zeroth law of thermodynamics.

(25) **Answer :** (4)
Solution:
For polytropic process
$C = C_v + \frac{R}{1-x}$
If x is greater than 1, then $C < C_V$

(26) **Answer :** (3)
Solution:
At constant pressure, work done $dW = PdV = nRdT$
The ratio $dQ : dU : dW = nC_p dT : nC_v dT : nRdT$
$= \frac{5R}{2} : \frac{3R}{2} : R = 5 : 3 : 2$

(27) **Answer :** (4)
Solution:
The required graph in option (4) first shows a decrease in specific heat capacity of water and then an increase as the temperature rises from 0°C to 100°C.

(28) **Answer :** (4)
Solution:
Internal energy $U = n_1(C_V)_1 T + n_2(C_V)_2 T = 4 \times \frac{5R}{2} \times T + 4 \times \frac{3R}{2} \times T$
$= 10RT + 6RT = 16RT$

(29) **Answer :** (3)
Solution:

Wave goes up with acceleration g/2
Particle goes down with acceleration g
$a_{rel} = 3g/2$
$\Rightarrow S_{rel} = \frac{1}{2} a_{rel}\, t^2$
$\Rightarrow L = \frac{1}{2}\frac{3g}{2} t^2$
$\Rightarrow t = 2\sqrt{\frac{L}{3g}}$
$\therefore$ Distance travelled by particle $= \frac{1}{2} g\, t^2$
$= \frac{1}{2} g \times \frac{4L}{3g}$
$= \frac{2L}{3}$

(30) **Answer :** (3)
Solution:
$PV = nRT \Rightarrow PM = \rho RT$
From *A* to *B* and *C* to *D* : $\rho \propto P$ as *T* = constant
From *B* to *C* and *D* to *A*: $\rho \propto \frac{1}{T}$ as *P* = constant

(31) **Answer :** (2)
Solution:
On filing, f_A increases.
On loading with wax, f_B decreases.
Beat frequency = $|f_A - f_B|$ also decreases.
$\therefore$ Initially, $f_A < f_B$
$\Rightarrow f_B - f_A = 6$
$\Rightarrow f_B = 250 + 6 = 256$ Hz

(32) **Answer :** (2)
Solution:
On comparing, ($\omega t - kx$) = $2\pi\left(20t - \frac{x}{2}\right)$
we get angular wave number $k = \frac{2\pi}{2} = \pi\ \mathrm{m}^{-1}$
Phase difference $\Delta\phi = k\Delta x = \pi\frac{50}{100} = \frac{\pi}{2}\mathrm{rad}$

(33) **Answer :** (3)
Hint:
Use molar specific heat for polytropic process
$C = C_V + \frac{R}{1-x}$
Solution:
$P \propto V^3 \Rightarrow PV^{-3}$ = constant
$C = C_V + \frac{R}{1+3} = C_V + \frac{R}{4}$
$C = \frac{5R}{2} + \frac{R}{4} = \frac{11R}{4}\left[\because\ C_V = \frac{5R}{2}\right]$
Heat = $Q = nC\Delta T = 2 \times \frac{11}{4} R \times 100 = 550R$
$W = \frac{nR\Delta T}{1-x} = \frac{2\times R\times 100}{1+3} = 50R$
$\frac{W}{Q} = \frac{50R}{550R} = \frac{1}{11}$

(34) **Answer :** (4)
Solution:
As per the law of equipartition of energy, each translational and rotational degree of freedom contributes $\frac{1}{2} k_B T$ to the energy while a vibrational mode contributes $k_B T$.
C_v(not rigid diatomic) = $\frac{7}{2} R$

(35) **Answer :** (1)
Solution:
According to Boyle's law, the volume of a gas is inversely proportional to its pressure (at constant temperature).

(36) **Answer :** (1)
Hint:

$\ell_1 + e = \frac{\lambda}{4}$, $\ell_3 + e = \frac{5\lambda}{4}$

Solution:

ℓ_1 = 22.5

ℓ_3 = 116.5

$\Rightarrow \frac{\ell_1+e}{\ell_3+e} = \frac{1}{5}$

$\Rightarrow$ 5 ℓ_1 + 5e = ℓ_3 + e

$\Rightarrow \frac{\ell_3-5\ell_1}{4} = e$

$\Rightarrow e = \frac{116.5-112.5}{4}$

= 1 cm

(37) **Answer :** (1)

Solution:

In an SHM, velocity and acceleration can both be simultaneously positive or negative. So, both can be in the same direction.

For a simple pendulum, time period $T = 2\pi\sqrt{\frac{l}{g}}$ is independent of the mass of the bob.

(38) **Answer :** (3)

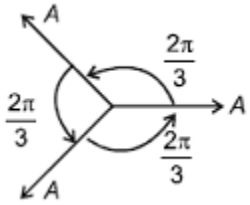
Solution:

Speed of transverse wave, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{Tl}{m}}$

$\Rightarrow v = \sqrt{\frac{4050 \times 10}{45}} = \sqrt{900} = 30$ m/s

(39) **Answer :** (3)

Solution:



∴ Resultant amplitude = zero

(40) **Answer :** (4)

Solution:

Process on the **left part** is adiabatic : $PV^\gamma = \text{constant}$ where $\gamma = \frac{7}{5}$

$P_0V_0^\gamma = P_f\left(\frac{V_0}{32}\right)^{\frac{7}{5}} \Rightarrow P_f = 2^7P_0$

$T_0V_0^{\gamma-1} = T_f\left(\frac{V_0}{32}\right)^{\frac{7}{5}-1} \Rightarrow T_f = 2^2T_0$

Work done $W_1 = -\Delta U = -nC_V\Delta T$

$\Rightarrow W_1 = -4 \times \frac{5R}{2}\left(T_f - T_0\right) = -10R\left(3T_0\right) = -30RT_0$

Final volume of **right part** is V_1

$2V_0 = V_1 + \frac{V_0}{32} \Rightarrow V_1 = \frac{64V_0-V_0}{32} = \frac{63}{32}V_0$

Final pressure of right part is also P_f as pressure on both sides is same at equilibrium.

Number of moles on right part = constant

$\frac{P_0V_0}{T_0} = \frac{P_fV_1}{T'} \Rightarrow T' = 2^7\frac{63}{32}T_0 = 4 \times 63T_0 = 252T_0$

Using $Q = \Delta U + W$

$Q = n \times \frac{3R}{2}\left(252T_0 - T_0\right) + \left(-W_1\right)$

$= 6R(251T_0) + 30RT_0 = 1536RT_0$

(41) **Answer :** (1)

Solution:

If $\omega = 1$ rad/s, then $v^2 = \omega^2\left(A^2 - x^2\right)$ becomes $v^2 = A^2 - x^2$

$\Rightarrow v^2 + x^2 = A^2$

∴ Curve between v and x would be circular

(42) **Answer :** (1)
Solution:
Time period of $\mathrm{SHM},\ T = 2\ \mathrm{seconds}$
Time period of oscillation of $\mathrm{P.E.} = \frac{T}{2} = \frac{2}{2} = 1\ \mathrm{second}$

(43) **Answer :** (2)
Hint:
For adiabatic process PV^{γ}
= constant
Solution:
Since mass of gas remains constant and $\left(\frac{m}{V}\right) = d$
$\Rightarrow \quad d \propto \frac{1}{V}$
$\therefore$ for adiabatic process
$P\left(\frac{1}{d}\right)^{\gamma} =$ constant
$Pd^{-\gamma}$ = constant
$Pd^{-\gamma} = P'\ d'^{-\gamma}$
$\frac{P'}{P} = \left(\frac{d'}{d}\right)^{\gamma} = 32^{\gamma}$
for diatomic gas : $\gamma = \frac{7}{5}$
$\frac{P'}{P} = (32)^{7/5} = 2^7 = 128$

(44) **Answer :** (3)
Hint:
$V_{\text{RMS}} = \sqrt{\frac{3RT}{M}}$
Solution:
$V_{\text{RMS}} = \sqrt{\frac{3PV}{\text{Mass of gas}}}$
At constant volume,
$V_{\text{RMS}} \propto \sqrt{P}$

(45) **Answer :** (4)
Solution:
Equilibrium at mean position is stable equilibrium as particle returns to mean position. The simple harmonic motion is periodic and potential energy of particle is variable

CHEMISTRY

(46) **Answer :** (3)
Hint:
$\mathrm{k} = \frac{1}{\mathrm{t}} \mathrm{In}\ \frac{[\mathrm{A}]_0}{[\mathrm{A}]_{\mathrm{t}}}$
Solution:
$\mathrm{k} = \frac{1}{30} \mathrm{In}\left(\frac{100}{25}\right)$
$\mathrm{k} = \frac{1}{30} \mathrm{In}\,(4)$
For 93.75%
$\mathrm{t} = \frac{1}{\mathrm{k}} \mathrm{In}\left(\frac{100}{6.25}\right)$
$\mathrm{t} = \frac{30}{\mathrm{In}(4)} \mathrm{In}\,(16)$
$\mathrm{t} = \frac{30 \times 2\ \ \mathrm{In}\left(4\right)}{\mathrm{In}(4)}$
t = 60 minutes

(47) **Answer :** (2)
Hint:

$-\frac{1}{2}\frac{\Delta[A]}{\Delta t}=-\frac{1}{3}\frac{\Delta[B]}{\Delta t}=\frac{1}{6}\frac{\Delta[C]}{\Delta t}=\frac{1}{9}\frac{\Delta[D]}{\Delta t}$

Solution:

2A + 3B → 6C + 9D

Given: $\frac{\Delta[C]}{\Delta t}$ = 6 × 10^{-2} mol L^{-1} s^{-1}

Rate of reaction = $\frac{1}{6}\frac{\Delta[C]}{\Delta t}$ = 10^{-2} mol L^{-1} s^{-1}

(48) **Answer :** (4)

Hint:

For a zero order reaction, $k=\frac{[R]_0-[R]_t}{t}$

Solution:

$[R]_t = 0.9[R]_0$

So, $k=\frac{0.1[R]_0}{20}$

Now, $t_{1/2}=\frac{[R]_0}{2k}=\frac{[R]_0\times 20}{2\times 0.1\times[R]_0}=100\ s$

(49) **Answer :** (4)

Hint:

For first order reaction

$t=\frac{2.303}{k}\log\frac{[R]_0}{[R]}$

Solution:

$t=\frac{2.303}{k}\log\left(\frac{a}{a-\frac{a\times 20}{100}}\right)=\frac{2.303}{k}\log\left(\frac{100}{80}\right)$

$t=\frac{2.303}{1.8424\times 10^{-3}}\log\frac{100}{80}$

= 1.25 × 10^3 [log10 – log8]

= 1.25 ×10^3 [1 – log$(2)^3$]

= 1.25 × 10^3 × 0.1

= 125 s

(50) **Answer :** (4)

Hint:

Arrhenius equation $k=Ae^{-E_a/RT}$

Solution:

ln k = ln $A-\frac{E_a}{RT}$

log k = $\log A-\frac{E_a}{2.303\,RT}$

Slope for log k *vs* $\frac{1}{T}$ is $\frac{-E_a}{2.303\,R}$ (if we compare with straight line equation, y = mx + c)

$\frac{-E_a}{2.303\,R}=-11$

E_a = 2.303 R×11

(51) **Answer :** (1)

Hint:

$\log\frac{k_2}{k_1}=\frac{E_a}{2.303\,K}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$

Solution:

$\log\frac{4}{1}=\frac{E_a}{2.303\times 8.314}\left[\frac{1}{303}-\frac{1}{323}\right]$

E_a = 56.4 kJ/mol

(52) **Answer :** (1)

Hint:

Radioactive decay is a first order reaction.

Solution:

Half life of first order reaction do not depend on the initial concentration.

$1\to\frac{1}{2}\to\frac{1}{4}\to\frac{1}{8}\to\frac{1}{16}\to\frac{1}{32}$

Time taken = $5 \times t_{1/2} = 5 \times 4 = 20$ s

(53) Answer : (2)
Solution:
Arrhenius equation is $k = Ae^{-E_a/RT}$
Given, $k = Ae^{-1000}$
Comparing the two :
$\frac{E_a}{RT} = 1000$
$E_a = \frac{1000 \times 2 \times 500}{1000}$ $\left(R = \frac{2}{1000} kcal K^{-1} mol^{-1}\right)$
$E_a = 1000$ kCal mol^{-1}

(54) Answer : (3)
Solution:
Depression in freezing point is a colligative property.

(55) Answer : (2)
Hint:
Molarity of solution = $\frac{\text{No. of moles of solute}}{\text{Volume of solution (l)}}$
Solution:
Molecular mass of NaOH
= 23 + 16 + 1 = 40 g mol^{-1}
Molarity of solution = $\frac{4 \times 1000}{40 \times 500} = 0.2$ M
Molarity of NaOH solution is 0.2 M.

(56) Answer : (4)
Solution:
π = iCRT
= 0.1 × 0.082 × 300 (i = 1 for glucose)
= 2.46 atm

(57) Answer : (4)
Solution:
Moles of ethyl alcohol = $\frac{92}{46} = 2$
Moles of water = $\frac{144}{18} = 8$
Mole fraction of water = $\frac{8}{8+2} = 0.8$

(58) Answer : (2)
Hint:
Moles of HNO_3 = 800 × 3 × 10^{-3} = 2.4
Solution:
Mass of HNO_3 in the given solution
= 2.4 × 63
= 151.2 g
Mass of concentrated HNO_3 required
= $\frac{100 \times 151.2}{70}$
= 216 g

(59) Answer : (1)
Hint:
$2H^+(aq) + 2e^- \rightarrow H_2(g)$
$E_{H^+/H_2} = E^\circ_{H^+/H_2} - \frac{0.0591}{2} \log \frac{pH_2}{[H^+]^2}$
Solution:
$E_{H^+/H_2} = 0 - \frac{0.0591}{2} \log \frac{1}{(10^{-5})^2}$
$= -\frac{0.0591}{2} \log 10^{10}$
$= -\frac{0.0591}{2} \times 10 = -0.296$

(60) **Answer :** (3)
Solution:
During discharging of lead storage battery, Pb and PbO_2 both converted into $PbSO_4$.

(61) **Answer :** (3)
Hint:
Λ_m° (NH_4OH) = Λ_m° (NH_4NO_3) + Λ_m° (KOH) – Λ°_m (KNO_3)
$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$
Solution:
Λ°_m (NH_4OH) = 128 + 239 – 125 = 242 S cm^2 mol^{-1}
$\alpha = \frac{14}{242} = 0.0578 \simeq 0.06$

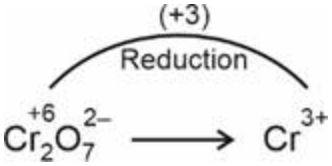
(62) **Answer :** (1)
Solution:
For an electrochemical cell
$\Delta G = -nFE_{cell}$
if $E_{cell} > 0$
$\Delta G < 0$
Hence reaction will be spontaneous

(63) **Answer :** (1)
Hint:
E°_{Cell} is intensive property while ΔG° is extensive property.
Solution:

	E°_{cell}	ΔG°	
$Cu^{2+} + 2e^- \rightarrow Cu$	x V	–2Fx	...(i)
$Cu^{2+} + e^- \rightarrow Cu^+$	y V	–Fy	...(ii)

(i) – (ii) will give
$Cu^+ + e^- \rightarrow Cu$; z V or (Fy – 2Fx) V
–zF = Fy – 2Fx
z = 2x – y

(64) **Answer :** (2)
Hint:
$n \times n_F = \frac{q}{F}$
Solution:



n_F = 6 (for 1 mole of $Cr_2O_7^{2-}$)
$0.5 \times 6 = \frac{q}{F}$
3F = q

(65) **Answer :** (4)
Hint:
$\Delta_r G^\circ = -nFE^\circ_{cell}$
Solution:
$\Delta_r G^\circ = -2F(1.05)$
= – 2.1 F

(66) **Answer :** (1)
Hint:
$\Lambda_m = \frac{\kappa \times 1000}{M}$
Solution:
For 0.1 M solution, $\kappa = c \times \frac{\ell}{a}$
$0.014 = \frac{1}{40} \times \frac{\ell}{a}$

$\therefore \ \frac{\ell}{a} = 0.014 \times 40 \ cm^{-1}$

For 0.2 M solution,

$\wedge_m = \frac{\kappa \times 1000}{M} = \frac{\left(\frac{1}{210} \times 0.014 \times 40\right) \times 1000}{0.2}$

=13.33 S cm² mol^{-1}

(67) **Answer :** (2)
Solution:
Lower is the $E^{o}_{reduction}$ value, higher will be the reducing power of the metal.

(68) **Answer :** (3)
Solution:
Mass of copper deposited = $\frac{9.65 \times 10 \times 60}{96500} \times \frac{63.5}{2}$
= 0.03 × 63.5 g

(69) **Answer :** (4)
Hint:
More the number of ions in aqueous solution, more will be conductivity.
Solution:
NaCl is a strong electrolyte($\alpha \simeq 1$) so it will produce maximum number of ions in aq. solution hence maximum conductivity.

(70) **Answer :** (1)
Solution:
Gases with more solubility has less value of K_H
$He \rightarrow 144.97 \ bar^{-1}$
$N_2 \rightarrow 76.28 \ bar^{-1}$
$H_2 \rightarrow 69.16 \ bar^{-1}$
$O_2 \rightarrow 34.86 \ bar^{-1}$

(71) **Answer :** (4)
Solution:
$P_s = P^o_A X_A + P^o_B X_B$

$= \frac{200 \times 0.426}{0.42+0.94} + 415 \times \frac{0.54}{0.42+0.94}$
$= 200 \times 0.31 + 415 \times 0.69$
$= 348.35$
$X_{CHCl_3} = \frac{62}{348.35}$
$= 0.18$

(72) **Answer :** (1)
Solution:
Scuba divers must cope with high concentrations of dissolved gases while breathing air at high pressure underwater. Increased pressure increases the solubility of atmospheric gases in blood. When the divers come towards surface, the pressure gradually decreases. This releases the dissolved gases and leads to the formation of bubbles of nitrogen in the blood. This blocks capillaries and creates a medical condition known as *bends*, which are painful and dangerous to life. To avoid bends, as well as, the toxic effects of high concentrations of nitrogen in the blood, the tanks used by scuba divers are filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen).

(73) **Answer :** (1)
Solution:
• Osmotic pressure is most effective Colligative property to calculate MW.
• If colligative property increases molar mass decreases hence MW of $C_6H_{12}O_6$ that is 180

(74) **Answer :** (4)
Solution:
Negative Deviation: Phenol and aniline. Chloroform and acetone
Positive Deviation: Carbondisulphide and acetone. Ethanol and water.

(75) **Answer :** (4)
Solution:
Since dissolution of gas in liquid is an exothermic process solubility of gases in liquid decreases with increase in temperature.

(76) **Answer :** (4)

Solution:

Solute	Solvent	Common Examples
Gas	Gas	Mixture of oxygen and nitrogen gases
Liquid	Gas	Chloroform mixed with nitrogen gas
Solid	Gas	Camphor in nitrogen gas
Gas	Liquid	Oxygen dissolved in water
Liquid	Liquid	Ethanol dissolved in water
Solid	Liquid	Glucose dissolved in water
Gas	Solid	Solution of hydrogen in palladium
Liquid	Solid	Amalgam of mercury with sodium

(77) **Answer :** (2)
Solution:
Cryoscopic constant depends on nature of solvent.

(78) **Answer :** (1)
Solution:

More reactive element can displace less reactive element from its aqueous solution hence Fe can replace Cu^{2+}.

- SRP of Br is higher than O_2 hence Br_2 is more reactive.

(79) **Answer :** (1)
Solution:
If $\mathrm{DC}$is used during measurement of conductance using Wheatstone bridge it will cause decomposition of electrolyte resulting change in concentration hence ACpower source is used.

(80) **Answer :** (1)
Solution:

(a) $\mathrm{E_{cell}} - \mathrm{E^{o}_{cell}} = \frac{-0.0591}{2}\log\frac{(0.01)}{(0.1)^2} = 0.0295$

(b) $\mathrm{E_{cell}} - \mathrm{E^{o}_{cell}} = \frac{-0.0591}{3}\log\frac{(0.1)}{(0.1)^3} = -0.0394$

(c) $\mathrm{E_{cell}} - \mathrm{E^{o}_{cell}} = \frac{-0.0591}{2}\log\frac{0.01}{(0.1)^2} = 0$

(d) $\mathrm{E_{cell}} - \mathrm{E^{o}_{cell}} = \frac{-0.0591}{3}\log\frac{(0.1)^3}{0.01} = 0.0197$

(81) **Answer :** (3)
Solution:

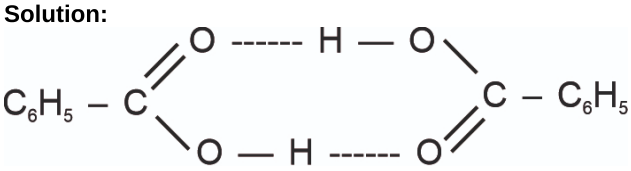
$\mathrm{E^{o}_{cell}} = \left(\mathrm{E^{o}_{RP}}\right)_{\mathrm{cathode}} - \left(\mathrm{E^{o}_{RP}}\right)_{\mathrm{anode}}$
$= 0.8 - 0.34$
$= 0.46\ \mathrm{V}$
ΔG^{o} = n – F E^{o}_{Cell}
= – 2 × 96500 × 0.46
= – 88.78 kJ mol^{-1}
= – 2 × 96500 × 0.46
ΔG^{o} = – RT ln k_{eq}
$k_{eq} = 3.62 \times 10^{15}$

(82) **Answer :** (1)
Solution:
Since electrode potential does not depend on quantity or size of electrode hence it is an intensive property.

(83) **Answer :** (3)
Solution:
On electrolysis of $\mathrm{aq\ NaCl}$ using Hg cathode, $\mathrm{Na^{+}_{(aq)}}$ gets reduced at cathode as it forms $\mathrm{Na-Hg}$ Amalgam. SRP of $\mathrm{Na^{+}_{(aq)}}$ is less than $\mathrm{H_2O}$.

(84) **Answer :** (1)

Solution:



Benzoic acid undergoes association resulting lesser elevation in boiling point.

(85) **Answer :** (1)
Solution:
Since Aqueous solution of HNO_3shows negative deviation from ideal behaviour, it can form maximum boiling azeotrope.

(86) **Answer :** (2)
Solution:

$K_b = \frac{R \times M_1 \times T_b^2}{100\, \Delta_{vap}\, H}$

M_1 = Molar mass of solvent
T_b= Boiling point of solvent
$\Delta_{vap} H$ = Heat of vapourisation of solvent

(87) **Answer :** (2)
Solution:
Inversion of cane sugar is psuedo first order reaction.

(88) **Answer :** (1)
Solution:

$t = \frac{2.303}{K} \log\left(\frac{a_0}{a_0 - x}\right)$

$= \frac{2.303}{0.02} \log\left(\frac{6}{0.3}\right)$ = 149.7 s

(89) **Answer :** (1)
Solution:

$\triangle_r H = (E_a)_f - (E_a)_b$

$= 40 - 60$

$= -20 \text{ kJ mol}^{-1}$

(90) **Answer :** (1)
Solution:
It rate constant at T_1 and T_2 temperature is K_1 and K_2 respectively then

$\log\left(\frac{K_2}{K_1}\right) = \frac{E_a}{2.303\, R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

BOTANY

(91) **Answer :** (1)
Hint:
Heterophylly is an example of plasticity.
Solution:
Transpiration does not occur from the submerged part of the plant.

(92) **Answer :** (1)
Solution:
Absolute growth rate is the measurement and the comparison of total growth per unit time. Absolute growth rate of both the leaves is same.

$\text{Relative growth rate} = \frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$

Relative growth rate of leaf A is more than that of leaf B.

(93) **Answer :** (2)
Solution:
Cytokinin promotes the lateral shoot growth in plants.

(94) **Answer :** (3)
Solution:

The phytohormone that plays an important role in seed development, maturation, and dormancy is abscisic acid (ABA).

(95) **Answer :** (3)
Solution:
Auxin promotes apical dominance. Removal of shoot tip removes the effect of apical dominance and hence, boosts the lateral leaf growth.

(96) **Answer :** (3)
Solution:
Both intrinsic and extrinsic factors are involved in the development of plants.

(97) **Answer :** (3)
Solution:
• A root elongating at a constant rate exemplifies an arithmetic growth pattern.
• On plotting the length of the organ against time, a linear curve is obtained.
• It can be mathematically be expressed as $L_t = L_0 + rt$.

(98) **Answer :** (3)
Solution:
Abscisic acid is a general growth inhibitor at any concentration.

(99) **Answer :** (4)
Solution:
Floral rewards and attractants are required for pollination by insects.

(100) **Answer :** (3)
Hint:
This hormone is a gaseous PGR.
Solution:
Thinning of fruits in cotton, cherry and walnut is done by the use of ethylene.

(101) **Answer :** (4)
Hint:
Monoecious plants have both sexes.
Solution:
Xenogamy is the transfer of pollens from anther to stigma of another plant of the same species. It is not possible in case of cleistogamous flowers.

(102) **Answer :** (3)
Hint:
Transfer of pollen grain can occur from one plant to the other in the population of monoecious plant species.
Solution:
Xenogamy is the transfer of pollen grains from anther to the stigma of another flower of different plant of the same species. The plant species may be monoecious or dioecious.

(103) **Answer :** (3)
Solution:
Apomixis is a form of asexual reproduction that mimics sexual reproduction. This process can be seen in some species of Asteraceae and grasses.

(104) **Answer :** (3)
Hint:
Transfer of pollen grains to the stigma of a pistil is termed as pollination.
Solution:
All these events, from pollen deposition on the stigma, until pollen tubes enter the ovule, are together referred to as pollen-pistil interaction.

(105) **Answer :** (4)
Solution:
Formation of PEC takes place during fertilization. After fertilization, PEC develops into endosperm.

(106) **Answer :** (4)
Solution:
Megaspore is a haploid cell.

(107) **Answer :** (2)
Solution:
Proximal end of the filament of stamen is attached to the thalamus or the petal, whereas the distal end attaches to the anther.

(108) **Answer :** (2)

Hint:
Maize produces unisexual flowers.
Solution:
Emasculation is required when the parent flower is bisexual.

(109) Answer : (2)
Hint:
Epiblast is found in some monocots.
Solution:
Remains of second cotyledon that occur in some grasses are called epiblast.

(110) Answer : (1)
Hint:
Sexual reproduction produces more genetic variations.
Solution:
Zygotes are the results of sexual reproduction, which are formed by the union of gametes. Gamete formation and their fusion, both the processes bring genetic variability.

(111) Answer : (2)
Solution:
Plants that adopt abiotic pollination have:
- Well exposed stamens
- Presence of a mucilaginous covering
- Large, often-feathery stigma
- Presence of single ovule in each ovary

(112) Answer : (4)
Solution:
Antipodals are haploid. Asymmetric mitotic division occurs during pollen development.

(113) Answer : (1)
Solution:
Seeds have better adaptive strategies for dispersal to new habitats. They generate new genetic combinations leading to variations.
Seeds help species to colonise in other areas.
They have sufficient food reserves to nourish young seedlings until they are capable of photosynthesising on their own.

(114) Answer : (3)
Solution:
Anther is the part of stamen that produces and contains pollens. Only sporogenous tissues participate in microspore formation, not all tissues participate in microspore formation.

(115) Answer : (4)
Solution:
In *Michelia*, gynoecium has more than one pistil, which are free from each other.

(116) Answer : (2)
Solution:
In angiosperms, the process of formation of microspores from a pollen mother cell (PMC) through meiosis is called microsporogenesis. It involves, nuclear division which reduces the chromosome number by half.

(117) Answer : (3)
Solution:
The embryo sac in the angiosperms is also called as female gametophyte.

(118) Answer : (4)
Solution:
Polar nuclei in the embryo sac are present in the large central cell.

(119) Answer : (1)
Solution:
Inner wall of the pollen grain is called intine and it is made up of cellulose and pectin.

(120) Answer : (4)
Solution:
Endosperm development precedes embryo development. The primary endosperm cell divides repeatedly and forms a triploid endosperm tissue. The cells of this tissue are filled with reserve food materials and are used for the nutrition of the developing embryo.

(121) Answer : (3)

Solution:
Gibberellins increase stem length and thereby, increase sugar content, which finally increase the sugarcane yield by as much as twenty tonnes per acre.

(122) Answer : (4)
Solution:
Cytokinins do not promote root hair formation. Horizontal or lateral growth is also influenced by the auxins and ethylene. Gymnosperms do not produce fruits.

(123) Answer : (4)
Solution:
ABA acts as an antagonist to GA and it stimulates the closure of the stomata and increases the tolerance of plants to various kinds of stresses.

(124) Answer : (4)
Solution:
Cork cambium is the dedifferentiated tissue.

(125) Answer : (2)
Solution:
Micro-essential elements are required by the plants for synthesis of protoplasm. During germination and seedling development of bean, epicotyl comes out of the soil and hypocotyl remains underground.

(126) Answer : (3)
Solution:
The intrinsic factors which affect the development of plants are chemicals, such as plant growth regulators and extrinsic factors include light, temperature, water and oxygen etc.

(127) Answer : (1)
Solution:
Carotenoids are the accessory pigments that act as a precursor for the synthesis of ABA.

(128) Answer : (2)
Solution:
The natural auxins are IAA and IBA and synthetic auxins are 2,4-D and NAA.

(129) Answer : (2)
Solution:
Microorganisms, growing in a culture dish, show geometric growth.

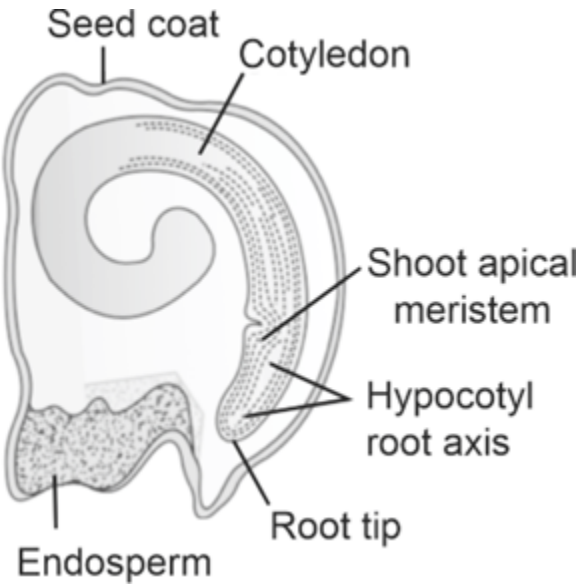
(130) Answer : (4)
Solution:
Cytokinins counteract apical dominance.

(131) Answer : (3)
Solution:
Maize does not show heterophylly.

(132) Answer : (1)
Solution:
It is because tracheids have made themselves strong, elastic, etc. by process of differentiation, *i.e.*, specialised for particular function.

(133) Answer : (3)
Solution:
One spore mother cell undergoes meiosis and forms four microspores.
Each microspore forms a pollen grain.
Each pollen grain produces two male gametes. Male gamete from one pollen sac = 8x
Number of pollen sac in an anther = 4x
Total male gametes = 4 * 8x = 32 x
$32x = 800$
x = 25

(134) Answer : (4)
Solution:



(135) Answer : (3)

Solution:

In pea, seeds are non-endospermic.

Perisperm is not a nutritive tissue.

ZOOLOGY

(136) Answer : (3)

Solution:

a.	CNS	Site of information processing and control
b.	PNS	Divided into somatic and autonomic neural system
c.	ANS	Divided into sympathetic and parasympathetic neural system.
d.	Visceral neural system	Comprises whole complex of nerve fibres, plexuses and ganglia.

(137) Answer : (4)

Solution:

Resting membrane potential is maintained by the sodium-potassium pump.

Neurons are excitable cells because their membranes are in a polarised state. The electrical potential difference across resting plasma membrane is called the resting potential. The potential difference across the plasma membrane in depolarised state is called action potential, which is in fact termed as nerve impulse.

(138) Answer : (2)

Hint:

An animal cell

Solution:

Animal cells are devoid of cell wall and a muscle cell is an animal cell.

In a muscle fibre, Ca^{2+} is stored in sarcoplasmic reticulum.

(139) Answer : (2)

Hint:

Each myofibril contains many serially arranged units called sarcomere.

Solution:

Muscle fibre is the anatomical unit of muscles. Each muscle fibre has many parallelly arranged filaments in the sarcoplasm called myofilaments or myofibrils. Each myofibril contains many serially arranged units called sarcomere which are the functional units of muscles.

(140) Answer : (3)

Solution:

Pia mater is the inner most cranial meninx.

(141) Answer : (4)

Solution:
Human kidneys are situated between the levels of T_{12} and L_3 vertebra close to the dorsal inner wall of the abdominal cavity.

(142) Answer : (2)
Solution:
Vasa recta are highly developed in juxta medullary nephrons.

(143) Answer : (3)
Solution:
The descending limb of loop of Henle is almost impermeable to electrolytes.

(144) Answer : (3)
Solution:
Dialysing fluid does not contain nitrogenous waste products such as urea, uric acid and creatinine.

(145) Answer : (4)
Solution:
All statements are correct. Loop of Henle helps to conserve water by creating a high concentration osmotic gradient in the kidney's medulla, allowing for maximum water reabsorption and the production of concentrated urine.

(146) Answer : (1)
Solution:
Glucose and amino acids are actively reabsorbed along with Na^+. Most of the substances are reabsorbed by simple diffusion and water is reabsorbed passively by osmosis.

(147) Answer : (2)
Solution:
CNS sends motor messages to initiate contraction of detrusor muscle of urinary bladder and cause simultaneous relaxation of urethral sphincter.
JGA is formed by cellular modifications in the DCT and afferent arteriole at the location of their contact.

(148) Answer : (1)
Solution:
Prawn - Green glands
Earthworm - Nephridia
Hydra - Body surface (through diffusion)

(149) Answer : (3)
Solution:
Each muscle bundle contains a number of muscle fibres held together by a common collagenous connective tissue layer called fascia.
In the center of each 'I' band, an elastic fibre *i.e.*, 'Z' line is present.

(150) Answer : (4)
Solution:
A fall in GFR and glomerular blood pressure stimulates secretion of renin.

(151) Answer : (2)
Solution:
Release of neurotransmitters at neuromuscular junction generates an action potential in sarcolemma which spreads from sarcolemma to the T-tubules, ultimately causing the release of Ca^{2+} in the sarcoplasm.

(152) Answer : (2)
Solution:
The tail is called light meromyosin (LMM).
Heavy meromyosin = Globular head + short arm

(153) Answer : (3)
Solution:
First 7 pairs of ribs directly articulate with strenum. 8^{th}, 9^{th} and 10^{th} pairs of ribs are vertebro-chondral ribs.
Ribs articulate with sternum anteriorly and are connected posteriorly to the thoracic vertebrae.

(154) Answer : (2)
Solution:


An actin (thin) filament.

(155) Answer : (1)
Solution:
Fibres of the tracts are covered with the myelin sheath, which constitute the inner part of the cerebral hemispheres. They give an opaque white appearance to the layer and hence, is called the white matter.

(156) Answer : (1)
Solution:
Na^+/K^+ pumps help to restore the resting membrane potential (Polarised state), after depolarisation (impulse). In case if Na^+/K^+ pumps is not working, Na^+ will build up inside the neuron and K^+ concentration will rise outside, disrupting the normal resting state.

(157) Answer : (4)
Solution:
The gap junctions function as the direct channels between adjacent cells, allowing rapid passage of ions and helping in the fast conduction of nerve impulses.

(158) Answer : (2)
Solution:
The motor cortex area of cerebrum is crucial for controlling voluntary movements but coordination of muscle contraction is a function of cerebellum. Cerebellum is a part of the hind brain. It has convoluted surface.

(159) Answer : (2)
Solution:
Depolarisation occurs at the point 'C' when stimulus arrives and membrane permeability for Na^+ increases, causing influx of Na^+.

(160) Answer : (1)
Solution:
Schwann cells are absent in CNS.
Ganglia and nerve plexuses are the parts of visceral nervous system (PNS).

(161) Answer : (4)
Solution:
Ammonia (as it is readily soluble) is generally excreted by diffusion across body surface or through gill surfaces in fishes. Ammonia is the highly toxic nitrogenous waste and the process of excreting ammonia is called ammonotelism. Ammonia is continuously produced by human cells as a natural byproduct of amino acid metabolism.

(162) Answer : (2)
Solution:
Ultrafiltration process depends mainly upon blood pressure gradient in the glomerular capillaries.

(163) Answer : (3)
Solution:
The counter-current mechanism occurs between Henle's loop and vasa recta. This mechanism helps to maintain a concentration gradient in the medullary interstitium.

(164) Answer : (2)
Solution:
A person suffering from diabetes mellitus shows symptoms like increased thirst, frequent urination, fatigue, *etc*.

(165) Answer : (4)
Solution:
Tubular secretion maintains blood pH by actively releasing excess of H^+ and NH_4^+ from the blood into the filtrate.

(166) Answer : (4)
Solution:
ADH or vasopressin causes increase in water reabsorption.

(167) Answer : (3)
Solution:
Drugs that block the production of angiotensin-II are widely used in the treatment of hypertension.
Blocking of angiotensin-II from narrowing blood vessels, leads to decrease in salt/water retention and lowering of blood pressure.

(168) Answer : (2)
Solution:

Myasthenia gravis is an auto-immune disorder affecting neuro-muscular junction leading to fatigue, weakening and paralysis of skeletal muscles.
Accumulation of uric acid crystals leads to gout. Low levels of estrogens causes weakening of bones.

(169) Answer : (2)
Solution:
Muscle and nerve cells are excitable cells that conduct impulses. Both the cells contain nucleus. Nerve cells do not contract.

(170) Answer : (4)
Solution:
Red muscle fibres are smaller in diameter and are least powerful type of muscle fibres. They contain large amount of myoglobin and less number of Ca^{++} containing sarcoplasmic reticulum, in comparison to white muscle fibres.
Red muscle fibres are characterized by a slow rate of contraction but can maintain the activity for long duration without undergoing fatigue.

(171) Answer : (2)
Solution:
The wall of aorta and atria contain smooth muscle and cardiac muscle fibres, respectively.
Cardiac muscle fibres are branched, cylindrical in shape, striated, possess intercalated discs and gap junctions.
while smooth muscle fibres are fusiform (spindle) shaped.

(172) Answer : (2)
Solution:
One pelvic girdle consists of two coxal bones. Each coxal bone contains a cavity called acetabulum at the point of fusion of three bones - ilium, ischium and pubis.

(173) Answer : (3)
Solution:
Total number of lumbar vertebrae = 5
Total number of cervical vertebrae = 7
Total number of thoracic vertebrae = 12
Total number of facial bones = 14
Total number of ear ossicles = 6
Total number of carpals in one limb = 8
Total number of tarsals in one limb = 7

(174) Answer : (2)
Solution:
Ear ossicle - Stapes
Coxal bone - Pubis
Cranial bone - Ethmoid
Facial bone - Maxilla
Vertebra - Axis

(175) Answer : (4)
Solution:
Fibrous joint is present between temporal and parietal bones

(176) Answer : (3)
Hint:
Medial surface is closer to central axis of the body.
Solution:
• Glenoid cavity is present below acromion process.
• Patella covers the knee ventrally.
• Fibula is present on the lateral aspect of hind limb.
• One end of clavicle articulates with acromion process of scapula and another end articulates with sternum.

(177) Answer : (1)
Hint:
Plasma membrane of muscle fibre is called sarcolemma.
Solution:
A characteristic feature of the muscle fibre is the presence of a large number of parallely arranged filaments in the sarcoplasm called myofilaments or myofibrils.

(178) Answer : (1)
Solution:
Scapula and patella are a part of the appendicular skeleton system.

(179) Answer : (3)

Solution:
The type of nerve fibres that supply muscles used in walking are a part of somatic nervous system.

(180) Answer : (2)
Solution:
Macrophages and leucocytes exhibit amoeboid movement.