### ANSWEeR KEY FOR MAJOR TEST- 4 (FOR 2021 ASPIRANTS) 23rd June 2020

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1. Correct option is (2)

**Solution:**
For the equilibrium of charge Q,
\[
\frac{kQ^2}{r^2} + \frac{kqQ}{r^2} = 0
\]
\[
\frac{kQ^2}{r^2} + \frac{4kqQ}{r^2} = 0
\]
\[
Q + 4q = 0
\]
\[
q = -\frac{Q}{4}
\]

2. Correct option is (4)

**Solution:**
Total electrostatic interaction energy of system of charges is
\[
U = \frac{k(-Q)(q)}{\ell} + \frac{k(-3Q)(q)}{\ell} + \frac{k(-Q)(-3Q)}{2\ell}
\]
\[
= -\frac{4kqQ}{\ell} + \frac{3kQ^2}{2\ell}
\]
\[
= \frac{kQ}{\ell} \left( -4q + \frac{3Q}{2} \right)
\]
\[
U > 0, \text{ if } \frac{3Q}{2} > 4q \Rightarrow q < \frac{3Q}{8}
\]

3. Correct option is (4)

**Solution:**
Force between two charges does not depend upon the presence or absence of third charge

4. Correct option is (4)

**Solution:**
In the case of unlike charges, null point will be formed outside the charges.
Location of null point is
\[ x = \frac{r}{\sqrt{\frac{|q_2|}{|q_1|}} - 1} \text{ from the charge } |q_1| \]

\[ = \frac{20 \text{ cm}}{\sqrt{\frac{8 \times 10^{-6} \text{ C}}{2 \times 10^{-6} \text{ C}}} - 1} \]

\[ = \frac{20 \text{ cm}}{2 - 1} \]

\[ = 20 \text{ cm to the right of B} \]

5. Correct option is (4)
Solution:
\[ E_{\text{net}} = \frac{1}{4\pi\varepsilon_0} \frac{q}{L^2} \]

6. Correct option is (2)
Solution:
\[ \bar{r} = (9 - 3)i + (12 - 4)j = 6i + 8j \]
\[ |\bar{r}| = \sqrt{6^2 + 8^2} = 10 \text{ m} \]
\[ E = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} = \left(9 \times 10^9\right) \frac{100 \times 10^{-6}}{(10)^2} = \left(9 \times 10^9\right) \frac{(10^{-4})}{10^2} = 9000 \text{ V/m} \]

7. Correct option is (4)
Solution:
Radius of the given charged spherical shell is 5 m.
Distance (r) to the point P from the centre of the spherical shell is
\[ r = \sqrt{l^2 + l^2 + 2^2} = \sqrt{6} < R \]
So, the given point P is inside the charged spherical shell.
Electric field intensity at a point inside the charged spherical shell is zero.

8. Correct option is (3)
Solution:
Electric flux is \( \Phi = \frac{1}{\varepsilon_0} (q_{\text{enclosed}}) \)

9. Correct option is (2)
Solution:
Inward flux is negative and outward flux is positive. So \( \Phi_1 \) is negative and \( \Phi_2 \) is positive.
From Gauss’s law,
\[ \Phi_2 - \Phi_1 = \frac{1}{\varepsilon_0} q_{\text{enclosed}} \]
\[ q_{\text{enclosed}} = (\Phi_2 - \Phi_1) \varepsilon_0 \]

10. Correct option is (1)
Solution:
At any point on the curved surface, E vector and area vector are perpendicular to each other.
11. Correct option is (1)
Solution:
\[
\left( F_{\text{on dipole due to charge}} \right)_{\text{due to charge}} = \left( F_{\text{on charge due to dipole}} \right)_{\text{due to dipole}}
\]
\[
= QE_{\text{dipole}}
\]
\[
= Q \left( \frac{1}{4\pi \epsilon_0} \frac{2p}{r^3} \right)
\]
\[
= \frac{\vec{p}Q}{2\pi \epsilon_0 r^3}
\]

12. Correct option is (3)
Solution:
Dipole moment is along the direction of electric field \( (\theta = 0^\circ) \)
Torque acting on the dipole due to uniform electric field is
\[
\tau = pE \sin \theta = pE \sin 0^\circ = 0
\]
Potential energy of the dipole due to uniform electric field is
\[
U = -pE \cos \theta
\]
\[
= -pE \cos 0^\circ
\]
\[
= -pE
\]
\[
= \text{minimum}
\]

13. Solution:
\[
E_x = -\frac{\partial V}{\partial x} = -\frac{\partial}{\partial x} \left[ \frac{y^2}{2} - 2x \right] = -\left[ 0 - 2(1) \right] = 2
\]
\[
E_y = -\frac{\partial V}{\partial y} = -\frac{\partial}{\partial y} \left[ \frac{y^2}{2} - 2x \right] = -\left[ \frac{1}{2} (2y) - 0 \right] = -y = -1
\]
\[
\vec{E} = E_x \hat{i} + E_y \hat{j}
\]
\[
= 2\hat{i} - \hat{j}
\]

14. Correct option is (2)

15. Correct option is (3)
Solution:
\[
W = q \Delta V
\]
\[
2 \ J = (20 \ C)(\Delta V)
\]
\[
\Delta V = 0.1 \text{ volt}
\]

16. Correct option is (3)
Solution:
Charge appears on the outermost surfaces of outermost plates is
\[
q_{\text{outermost}} = \frac{\sum Q}{2} = \frac{Q + (-2Q)}{2} = -\frac{Q}{2}
\]

17. Correct option is (4)
Solution:
18. Correct option is (3)

Solution:

\[ E_{\text{loss}} = \frac{1}{2} \left( \frac{C_1 C_2}{C_1 + C_2} \right) (V_1 - V_2)^2 \]

\[ = \frac{1}{2} \left( \frac{C}{2C} \right) [V - (-V)]^2 \]

\[ = \frac{1}{2} \frac{C}{2} (2V)^2 \]

\[ = CV^2 \]

19. Correct option is (1)

Solution:
Charge remains constant on the plates of the capacitor when battery is connected.

\[ \frac{A e_0}{d} = \frac{A e_0}{(d + x) - t + \frac{t}{k}} \]

\[ d = (d + x) - t + \frac{t}{k} \]

\[ x = t \left( 1 - \frac{1}{k} \right) \]

1.6mm = 2mm \( 1 - \frac{1}{k} \)

0.8 = 1 - \frac{1}{k}

\[ \frac{1}{k} = 0.2 \]

\[ k = 5 \]

20. Correct option is (1)

Solution:
(a): The equivalent circuit is shown in figure.

\[ C_{AB} = 3 \ \mu F \]

21. Correct option is (2)

**Solution:**

\[
V_{\text{net}} = (V_A)_{\text{out}} + (V_B)_{\text{out}} + (V_C)_{\text{in}}
\]

\[
= \frac{1}{4\pi\varepsilon_0} \frac{Q_1}{r} + \frac{1}{4\pi\varepsilon_0} \frac{Q_2}{r} + \frac{1}{4\pi\varepsilon_0} \frac{Q_3}{c}
\]

\[
= \frac{1}{4\pi\varepsilon_0} \left[ \frac{Q_1}{r} + \frac{Q_2}{r} + \frac{Q_3}{c} \right]
\]

\[
= \frac{1}{4\pi\varepsilon_0} \left[ \frac{Q_1 + Q_2 + Q_3}{r} \right]
\]

22. Correct option is (1)

**Solution:**

According to KVL,
\[0 + 10 - \frac{q}{C} - \frac{q}{C} - \frac{q}{2C} = 0\]
\[10 = \frac{2q}{C} + \frac{q}{2C}\]
\[10 = \frac{5q}{2C}\]
\[\frac{q}{C} = 4 \quad \text{(1)}\]
\[0 + 10 - \frac{q}{C} - \frac{q}{C} = V_A\]
\[V_A = 10 - 4 - 4 = 2 \text{ volt}\]

23. Correct option is (1)
   **Solution:**
   It is in the form of balanced Wheatstone’s bridge. So equivalent capacitance between the points a and b is C

24. Correct option is (3)
   **Solution:**
25. Correct option is (3)
   **Solution:**
   \[ v_d = \frac{I}{A e} \Rightarrow v_d \propto \frac{1}{A} \]
   As \( A \) increases, drift velocity \( v_d \) decreases, so \( v_p > v_Q \)

26. Correct option is (4)
   **Solution:**
   In the case of metals (conductors), as temperature increases, resistance increases, and as temperature decreases, resistance decreases.
   In the case of semiconductors, as temperature increases, resistance decreases, and as temperature decreases, resistance increases.

27. Correct option is (2)
   **Solution:**
   \[ \Delta q = \int_{2}^{3} I \, dt \]
   \[ = \int_{2}^{3} (2t + 3t^3) \, dt \]
   \[ = \left[ t^2 + t^4 \right]_{2}^{3} \]
   \[ = \left[ (3^2 + 3^4) - (2^2 + 2^4) \right] \]
   \[ = \left[ (9 + 81) - (4 + 16) \right] \]
   \[ = 36 - 12 \]
   \[ = 24 \, \text{C} \]

28. Correct option is (3)
   **Solution:**
\[ R = R_0 \left[ 1 + \int_0^T \alpha dT \right] \]
\[ = R_0 \left[ 1 + \int_0^T (3T^2 + 2T) dT \right] \]
\[ = R_0 \left[ 1 + \int_0^T 3T^2 dT + \int_0^T 2T dT \right] \]
\[ = R_0 \left[ 1 + T^3 + T^2 \right] \]
\[ = R_0 \left[ 1 + T^2 + T^3 \right] \]

29. Correct option is (3)

Solution:
\[ R = R_1 + R_2 + R_3 \]
\[ \frac{3\ell}{\sigma_{eq} A} = \frac{\ell}{\sigma_1 A} + \frac{\ell}{\sigma_2 A} + \frac{\ell}{\sigma_3 A} \]
\[ \frac{3}{\sigma_{eq}} = \frac{1}{\sigma_1} + \frac{1}{\sigma_2} + \frac{1}{\sigma_3} \]
\[ \sigma_{eq} = \frac{3\sigma_1 \sigma_2 \sigma_3}{\sigma_1 \sigma_2 + \sigma_2 \sigma_3 + \sigma_1 \sigma_3} \]

30. Correct option is (2)

Solution:
\[ V_{net} = V_{point\ mass} + V_{spherical\ shell} \]
\[ = -\frac{GM}{(\frac{a}{2})} + \left[-\frac{GM}{\frac{a}{2}}\right] \]
\[ = -\frac{3GM}{a} \]

31. Correct option is (2)

Solution:
If projected velocity is less than escape velocity \( v_{projected} = \frac{v_{esc}}{n} \) (\( n > 1 \)) then the maximum height attained by the body above the surface of the earth is \( h = \frac{R}{n^2 - 1} \)

In the given question, projected velocity is
\[ v = \sqrt{gR} = \frac{\sqrt{2gR}}{\sqrt{2}} = \frac{v_{esc}}{n}, \ n = \sqrt{2} \]

Therefore, maximum height attained by the body is
\[ h = \frac{R}{n^2 - 1} = \frac{R}{(\sqrt{2})-1} = R \]

32. Correct option is (3)

Solution:
If a body is lifted from the surface of the earth to a height \( h = nR \) then increase in its PE is
\[
\Delta U = \left( \frac{n}{n+1} \right) mgR
\]

In the question, it is given that \( h = \frac{1}{4}R \), so \( n = \frac{1}{4} \).
Therefore, increase in its PE is
\[
\Delta U = \left( \frac{n}{n+1} \right) mgR
= \left( \frac{\frac{1}{4}}{\frac{1}{4}+1} \right) mgR
= mgR \left( \frac{1}{5} \right)
\]

33. Correct option is (1)
Solution:
\[
F_\parallel \propto \frac{1}{R^n}
F_\parallel = \frac{k}{R^n}
F_\parallel = F_{\parallel p}
\]
\[
k \left( \frac{4\pi^2}{T^2} \right) = \frac{mR}{R^n}
T^2 \propto R^{n+1}
T \propto R^{\left( \frac{n+1}{2} \right)}
\]

34. Correct option is (3)
Solution:
If a body is projected with a velocity greater than escape velocity \( v_{\text{projected}} = n v_{\text{esc}} \ (n > 1) \) then speed of the body in the interplanetary space is
\[
v = v_{\text{esc}} \sqrt{n^2 - 1}
\]
In the question, it is given that the projected velocity is \( v_{\text{projected}} = 2 v_{\text{esc}} \), so \( n = 2 \), then
\[
v = v_{\text{esc}} \sqrt{2^2 - 1} = \sqrt{3} v_{\text{esc}}.
\]

35. Correct option is (2)
Solution:
From Kepler’s third law,
\[ T^2 \propto r^3 \]
\[ T \propto r^{3/2} \]
\[ \frac{T_1}{T_2} = \left( \frac{r_1}{r_2} \right)^{3/2} \]
\[ \frac{R + h_1}{R + h_2} \]
\[ \frac{2R}{8R} \]
\[ \frac{T_1}{T_2} = \frac{1}{8} \]

36. Correct option is (2)
Solution:
Maximum height attained by the body is \( H = \frac{u^2}{2g} \) \( \Rightarrow H \propto u^2 \)
Time of flight is \( T = \frac{2u}{g} \) \( \Rightarrow T \propto u \)

37. Correct option is (3)
Solution:
Let \( v \) is the speed of the projected body when it is making an angle \( \frac{\theta}{2} \) with the horizontal.
In projectile motion, horizontal component of velocity is constant at all points.
\[ u \cos \theta = v \cos \left( \frac{\theta}{2} \right) \]
\[ v = \frac{u \cos \theta}{\cos \left( \frac{\theta}{2} \right)} \]
\[ u \left[ 2 \cos^2 \left( \frac{\theta}{2} \right) - 1 \right] \]
\[ = \frac{u}{\cos \left( \frac{\theta}{2} \right)} \]
\[ = u \left[ 2 \cos \left( \frac{\theta}{2} \right) - \frac{1}{\cos \left( \frac{\theta}{2} \right)} \right] \]
\[ v = u \left[ 2 \cos \left( \frac{\theta}{2} \right) - \sec \left( \frac{\theta}{2} \right) \right] \]

38. Correct option is (2)
Solution:

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On 10 kg mass, the only driving force is spring force.
10 kg mass:
\[ F_{\text{net}} = F_{sp} \]
\[ ma = F_{sp} \]
\[ F_{sp} = (10 \text{ kg})(12 \text{ m/s}^2) = 120 \text{ N} \]
20 kg mass:
\[ F_{\text{net}} = F_{\text{app}} - F_{sp} \]
20 \( a \) = 200 N − 120 N
20\( a \) = 80
\( a \) = 4 m/s\(^2\)

39. Correct option is (4)
Solution:
\[ W = \int_{0}^{5} F \, dx \]
\[ = \int_{0}^{5} (7 - 2x + 3x^2) \, dx \]
\[ = 7[x^5]_{0}^{5} - [x^3]_{0}^{5} + [x^3]_{0}^{5} \]
\[ = 35 - 25 + 125 \]
\[ = 135 \text{ J} \]

40. Correct option is (4)
Solution:
According to law of conservation of momentum in between just before collision, and just after collision,
\[ m \, v_0 = (m + 3m) \, v \]
\[ v = \frac{v_0}{4} \]

According to conservation of energy,
\[ \frac{1}{2}(4 \, m) \left( \frac{v_0}{4} \right)^2 = \frac{1}{2} kx^2 \]
\[ \frac{m \, v_0^2}{4} = kx^2 \]
\[ x = \sqrt{\frac{m \, v_0^2}{4k}} \]

41. Correct option is (1)
Solution:

\[ m_{\text{cone}} \propto \frac{1}{3} \pi R^2 h \quad \Rightarrow \quad m_{\text{cone}} = k\left(\frac{1}{3} \pi R^2 h\right) \]

\[ m_{\text{hemisphere}} \propto \frac{2}{3} \pi R^3 \quad \Rightarrow \quad m_{\text{hemisphere}} = k\left(\frac{2}{3} \pi R^3\right) \]

Take point O as the reference, then \((x_{\text{cm}}, y_{\text{cm}}) = (0, 0)\)

\[ y_{\text{cm}} = 0 \]

\[ \frac{m_{\text{cone}}y_{\text{cone}} + m_{\text{hemisphere}}y_{\text{hemisphere}}}{m_{\text{cone}} + m_{\text{hemisphere}}} = 0 \]

\[ k\left(\frac{1}{3} \pi R^2 h\right)\left(\frac{h}{4}\right) + k\left(\frac{2}{3} \pi R^3\right)\left(-\frac{3R}{8}\right) = 0 \]

\[ \left(\frac{1}{3} \pi R^2 h\right)\left(\frac{h}{4}\right) = \left(\frac{2}{3} \pi R^3\right)\left(\frac{3R}{8}\right) \]

\[ \frac{h^2}{4} = \frac{6}{8} R^2 \]

\[ \frac{h}{R} = \sqrt{\frac{3}{8}} \]

42. Correct option is (3)

Solution:

\[ \omega_0 = \frac{2\pi \times 60}{60} = \omega, \quad t = 60 \text{ s} \]

\[ 0 = 2\pi - \alpha \times 60 \Rightarrow \alpha = \frac{\pi}{30} \text{ rad/s}^2 \]

\[ \tau = I\alpha = 2 \times \frac{\pi}{30} = \frac{\pi}{15} \text{ N-m} \]

43. Correct option is (2)

44. Correct option is (2)

Solution:
\[ T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1} \]
\[ T_2 = T_1 \left( \frac{V_1}{V_2} \right)^{\gamma-1} \]
\[ = (300 \text{ K}) \left( \frac{27}{8} \right)^{2/3} \]
\[ = (300 \text{ K}) \left( \frac{9}{4} \right) \]
\[ = 675 \text{ K} \]
\[ \Delta T = T_2 - T_1 \]
\[ = 675 \text{ K} - 300 \text{ K} \]
\[ = 375 \text{ K} \]

45. Correct option is (2)

Solution:

Consider \( \theta \) is the temperature of the junction.

\[
\frac{(3k)(A)(100 - \theta)}{ℓ} + \frac{(2k)(A)(50 - \theta)}{ℓ} + \frac{(k)(A)(0 - \theta)}{ℓ} = 0
\]

\[
300 - 30 + 100 - 20 - \theta = 0
\]

\[
400 = 60
\]

\[
\theta = \frac{200}{3} \degree C
\]
66. (A)

\[ A(g) \rightarrow 2B(g) + 3C(s) \]

\[ t = 0: \quad a \]

\[ t = t: \quad a - x \quad 2x \quad - \]

\[ \text{At } t = 0 \quad P_0 = a \quad \text{At } t = t \quad P_T = P_t \]

\[ P_0 = a \quad a - x + 2x = P_t \quad a + x = P_t \]

\[ k = \frac{1}{t} \ln \left( \frac{a}{a - x} \right) \]

\[ x = P_t - P_0 \]

\[ k = \frac{1}{t} \ln \left( \frac{aP_0}{P_0 - (P_t - P_0)} \right) = \frac{1}{t} \ln \left( \frac{P_0}{2P_0 - P_t} \right) \]

67. (C)

\[ \text{rate} = k[A]^2[B][C] \]

The reaction is first order with respect to C.

68. (A)

\[ W_{CE} = E_{CE} \]

\[ W_{A1} = E_{A1} \]
\[ W_{cr} = \frac{52.3}{0.54} 10^3 \]

\[ W_{cr} = 0.0866 \text{ g m} \]

69. (d)

70. (a)

\[ E_{cell} = 0.06 \log \frac{[H^+]^2_c}{2 [H^+]^2_a} \]

\[ [H^+] = \sqrt{c_1 k_{a1}} \Rightarrow [H^+]^2 = c_1 k_{a1} \]

\[ E_{cell} = 0.03 \log \frac{c_1 k_{a1}}{c_1 k_{a2}} \]

\[ E_{cell} = 0.03 \log \frac{10^{-5}}{10^{-6}} = 0.03 \]

71. (c)

\[ 0_2 : \gamma \]

\[ a : b \]

\[ 40 = 82a + 80b \Rightarrow a = 5b \]

\[ a + b \]
\[
0_{2+Y}
\]

\[
b: a
\]

Mean molecular mass = \[
\frac{32b + 80a}{a + b}
\]

= \[
\frac{32b + 80 \times 5b}{5b + b} = \frac{432}{6} = 72
\]

72. (D)

\[
k = \frac{l}{p \cdot R(A)}
\]

Cell constant = \[
\lambda = k \times R = 0.013 \times 300
\]

\[
A = 3.9 \text{ cm}^{-1}
\]

73. (B)

\[
E_{\text{photon}} = \phi + (k.E)
\]

\[
12400 = 2.5 + (k.E)
\]

\[
3100
\]

\[
k.E = 4 - 2.5 = 1.5 eV
\]

\[
\left(1_{\text{de Broglie}}\right)_{e^-} = \sqrt{\frac{150}{(k.E)}} = \sqrt{150} = 10\text{Å}
\]
74. \( \Delta G^o \) = \( \Delta G^o_1 + \Delta G^o_2 \)
\[ = -5F \times 1.5 + (-2F \times (-1.25)) \]
\[ = -7.5F + 2.5F \]
\[ = -5F = -5 \times 96,500 = -482.5 \text{ kJ} \]

75. \( \therefore \)
\[ Z_1 = \frac{p_1V_1}{RT_1} \Rightarrow 1.9 = \frac{800 \times 1 \times 570}{330 \times 200 \times V_2} \]
\[ Z_2 = \frac{p_2V_2}{RT_2} \]
\[ V_2 = 4L \]

76. (d)
Buffer capacity = \( \frac{\text{No. of moles of SB added per litre}}{\text{change in pH}} \)
\[ = \frac{20 \times 0.1 \times 1000}{1000 \times 250} \]
\[ = 6.54 - 6.52 \]
\[ = 0.4 \]
77. (c) \[ Ag_2(CrO_4) \rightarrow 2Ag^+ + CrO_4^{2-} \]

\[ K_{sp} = (2S)^2(S) \]

\[ 32 \times 10^{-12} = 4S^3 \]

\[ S = 2 \times 10^{-4} \]

\[ [Ag^+] = 2S = 2 \times [2 \times 10^{-4}] = 4 \times 10^{-4} \]

78. (a)

79. (d) \[ 6HCHO \rightarrow C_6H_{12}O_6 \]

\[ 1 - \alpha \]

\[ \alpha^6 \]

\[ 150 = 30(1 - \alpha^6) + 150 \times \alpha^6 \]

\[ 1 - \alpha + \frac{\alpha^6}{6} \]

\[ 150 = 30 \]

\[ 1 - \frac{5 \alpha^6}{6} \]

\[ \alpha^6 = 0.96 \]
80. (B)
\[ \text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O} \]
\[ 0.4 \ 0.2 \ 0.2 \ 0.2 \ 0.2 \]
\[ (\eta_{\text{H}_2\text{O}}) \text{ produced } = 0.2. \]
\[ \text{Energy released } = 0.2 \times 57 = 11.4 \text{ KJ} \]

81. (A)
\[ E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \]
\[ E^0_{\text{Cu}^{2+}/\text{Cu}} > E^0_{\text{H}^+/\text{H}_2} > E^0_{\text{Sn}^{2+}/\text{Sn}} \]

82. (B)
\[ \Delta E = W \]
\[ \eta_{\text{H}_2 \Delta T} = -3000 \quad (W = -ve; \text{because of} \]
\[ 1 \times 20 (T_2 - 300) = -3000 \quad \text{(Expansion)} \]
\[ T_2 - 300 = -150 \]
\[ T_2 = 150 \text{K} \]
83. (c)

\[ \text{Bond order} \quad 1.5 \quad 2 \quad 2.5 \quad 1 \]

84. (A)

85. (c)

\[ \Delta_0 < \Delta \quad \Delta_0 > \Delta \]

Pairing will not occur.

Pairing will occur.

Weak field

Strong field

Ligand

Ligand
Mn$^{3+}$: $[\text{Ar}] 3d^4$  $[\text{Ar}] 3d^6$

$1L11 \uparrow \downarrow$  $1L11 \downarrow \uparrow$

High spin  Low spin

$\Delta_0 \uparrow \lambda$ absorbed $\downarrow \lambda$ reflected $\uparrow$

$(\Delta_0)_y > (\Delta_0)_x$

86 (3)

$[\text{Fe(NH}_3)_6]^{2+}$

Fe$^{2+}$: $[\text{Ar}] 3d^6$.

Here NH$_3$ act as W.F.L. and No. pairing.

$1L11 \uparrow \downarrow \downarrow$

High Spin & Sp$^3d^2$
[Cu(NH₃)₄][PtCl₆]

[Cu(NH₃)₄]²⁺ [PtCl₆]²⁻

Tetraammine copper(II) tetrachloroplatinate

Pt²⁺ : - 5d⁸ (pairing, dsp², p(4), N=0)

γ : [PtCl₆]²⁻

Cu²⁺ : - 3d⁹ (no pairing, sp³, p(8), n=5/2)

2 : MnO₄²⁻

Mn⁶⁺ : - [Ar] 3d¹ (d³S, p(11), n=5/2)

= 1.73

88. (A)

89. (A)

90. (A)
91. (1) Living world - Taxonomic studies of all known organisms have led to the development of common categories like kingdom, phylum or division, class, order, family, genus and species. Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

92. (1) Biological Classification - A *Gonyaulax* reproduces in such a great numbers that the water may appear red, producing a red tides and kills large marine animals like fishes. *Gonyaulax* belongs to dinoflagellates.

93. (3) Plant kingdom - The leaves are small (microphyll) as in *Selaginella* or large (macrophyll) as in ferns. *Funaria, Polytrichum* and *Sphagnum* are common examples of mosses.

94. (1) Plant kingdom

95. (4) Morphology - Tomato and tobacco both belong to the family Solanaceae. Solanaceae has some identifying characteristics-bicarpellary, syncarpous superior ovary, axile placentation, fruit is berry or capsule.

96. (3) Morphology - Liliaceae is the characteristics of monocotyledonous plants. Floral characters of this family are: tricarpellary, actinomorphic, polyandrous, superior ovary, axile placentation.

97. (3) Anatomy - Teak, mango and palm belong to angiosperms in which presence of vessels is a characteristic feature. Pine is a gymnosperm which lack vessels in their xylem.

98. (4) Anatomy - Soft wood is non-porous, homoxyalous gymnospermic wood rich in tracheids and xylem parenchyma, vessels and fibres are absent and resin canals are present, e.g., Deodar (*Cedrus*), Pine (*Pinus*).

99. (1) Cell - In the given figure of cilia/flagella, the marked part as A, B, C and D are respectively plasma membrane, interdoublet bridge, central microtubule, and radial spoke.

100. (3) Cell division - The given figure shows (I - phase) Interphase (called resting phase) is the time during which cell is preparing for division by undergoing both cell growth and DNA replication in a systemic manner. According to the given figure, the phases marked as A, B, C and D are respectively G1, S, G2 and M phase. G1 phase: It is also called antephase as during the phase the cell stores ATP for cell division. In this phase, synthesis of protein, RNA, amino acids, ATP and nucleotides occur. S phase: It is also called invisible stage of M phase. In this stage, synthesis of DNA and histone proteins occurs. G2 Phase: In this phase, synthesis of RNA and proteins continues and formation of macromolecules for spindle and organelle formation occurs. In this the quantity of DNA within the cells has increased to 4C but the cell is still considered diploid. M phase: In M phase, mitosis occurs when the nucleus of the cell divides into two identical nuclei with the same number and type of chromosomes, followed by cytokinesis when the cytoplasm, for both plant and animal cells, divides, thus creating two daughter cells that are genetically equal and approximately identical in size.

101. (1) Photosynthesis - Jan Ingenhousz showed that sunlight is essential to the plant process that somehow purifies the air fouled by burning candles or breathing animals. In genhousz in an experiment with an aquatic plant showed that in bright sunlight, small bubbles were formed around the green parts while in the dark they did not form any bubbles. Later he identified the bubbles as oxygen. Hence, he showed that it is only the green parts of the plants that could release oxygen.

102. (1) Respiration in plants -

103. (2) Photosynthesis - Half leaf experiment proves that CO2 is essential for photosynthesis.

104. (4) Respiration in plants - In the presence of an enzyme complex, pyruvate dehydrogenase complex, sulphur containing CoA and NAD+, pyruvate undergoes oxidative decarboxylation or both oxidation
(removal of hydrogen) and decarboxylation (removal of CO₂). It produces a 2-carbon active acetate group or acetyl CoA, NADH + H⁺ and CO₂.

105. (2) Photosynthesis - Paper chromatography is an analytical method that is used to separate coloured chemicals or substances, especially pigments. This can also be used in secondary or primary colours in ink experiments. Leaf pigments of any green plants can be separated by using paper chromatography. A chromatographic separation of the leaf pigments shows that the colour we see in leaves is due to a single pigment but due to four pigments: chlorophyll a (bright or blue green in the chromatogram), chlorophyll b (yellow green), xanthophylls (yellow) and carotenoids (yellow to yellow orange).

106. (2) Respiration in plants - In the fermentation of one glucose molecule, there is net gain of two molecules of ATP.

107. (1) Photosynthesis - In Calvin cycle, carboxylation is the most crucial step where CO₂ is utilised for the carboxylation of RuBP. In this CO₂ reacts with ribulose 1,5 biphosphate to yield two molecules of 3-phosphoglycerate, a reaction catalyzed by the chloroplast enzyme ribulose biphosphate carboxylase-oxygenase, referred to as RuBisCO.

108. (2) Respiration in plants - Yeast cell perform alcoholic fermentation under anaerobic conditions where incomplete oxidation of glucose is achieved by sets of reaction in which pyruvic acid is converted to CO₂ and ethanol (C₂H₅OH). The enzymes, pyruvic acid decarboxylase and alcohol dehydrogenase catalyse these reactions.

109. (3) Photosynthesis - Number of carbons in the primary CO₂ fixation product of C₄ plant is 4. The C₄ acid, oxaloacetic acid (OAA) is formed in the mesophyic cells.

110. (1) Respiration in plants -

111. (3) Photosynthesis - In C₃ plants the primary CO₂ acceptor is RuBP and the initial stable product is PGA. While in C₄ plants, the primary CO₂ acceptor is PEP and the first stable product is OAA.

112. (4) Respiration in plants - Terminal cytochrome of respiratory chain is cyt a₃. cyt a₃ possesses two copper centres. It helps in transfer of electrons to oxygen.

113. (1) Photosynthesis - A : Photolysis of water - oxygen evolving complex ferric oxalate
   B : ATP synthesis - Proton gradient concentration
   C : Pigments - Absorbs light at specific wavelengths
   D : High oxygen - Photorespiration

114. (2) Respiration in plants - The ratio of the volume of CO₂ liberated to the volume of oxygen absorbed per molecule during respiration is called Respiratory Quotient (RQ). The value of RQ indicates the types of respiratory substrate.

115. (1) Photosynthesis - In the given diagram of Calvin cycle, CO₂ is incorporated at stage P.

116. (2) Respiration in plants - The correct sequence of electron acceptor in ATP synthesis is cyt b c a a₃. These are arranged in order of their increasing redox potential and electron flow through the chain in step wise manner from the more electronegative compound to the more electropositive O₂. On the basis of redox potential cytochrome acceptor order is cyt b c a a₃.

117. (2) Photosynthesis - 6CO₂, 18ATP and 12NADPH₂ are required for the production of one molecule of glucose, 18 ADP and 12 NADP through 6 rounds of Calvin cycle.

118. (4) Respiration in plants - Oxaloacetic acid is the acceptor of acetyl coA in Krebs’ cycle.

119. (1) Photosynthesis - PEPcase; C₄ cycle in mesophyll and RuBisco, C₃ cycle in bundle sheath is correct for C₄ plants.

120. (3) Respiration in plants - During the conversion of succinyl CoA to succinic acid a molecule of GTP is synthesized. This is a substrate level phosphorylation. In the presence of enzyme succinyl CoA synthase, succinyl CoA is hydrolysed to CoA and succinate are formed. The energy liberated during the process is used in synthesis of ATP in plants, and GTP in animals.
121. (4) Photosynthesis - Photosynthesis occurs particularly in specialized cell called mesophyll cells. These cells contain chloroplast, which is the actual sites for photosynthesis. The cactus stem and guard cell of stomata contain chloroplasts, so they can manufacture food by photosynthesis. The epidermal cells do not contain chloroplasts, so they do not perform photosynthesis.

122. (4) Respiration in plants - Oxidation of molecule of NADH gives rise to 3 molecules of ATP, while that of one molecule of FADH2 produces 2 molecules of ATP. Therefore 2 NADH2 = 6 ATP molecules
3 FADH2 = 6 ATP molecules
Total = 12 ATP molecules

123. (4) Photosynthesis - During light phase, ATP & NADPH are produced whereas oxygen is byproduct during light phase.

124. (3) Respiration in plants - ETS (Electron transport system or chain) is a series of coenzymes and coenzymes that takes part in the passage of electrons from a chemical to its ultimate acceptor. ETS is present in the inner mitochondrial membrane, oxidation of one molecule of NADH gives rise to 3 molecules of ATP, while that of one molecule of FADH2 produces 2 molecules of ATP. In respiration, energy of oxidation - reduction is utilized for the production of proton gradient.

125. (3) Photosynthesis - One molecule of RuBP and one molecule of CO2 are required to produce two molecules of 3-PGA. Therefore, for the production of 6 molecules of 3-PGA, 3 molecules of RuBP and 3 molecules of CO2 are required.

126. (4) Respiration in plants - Cellular respiration is the mechanism of breakdown of food materials within the cell to release energy and the trapping of this energy for synthesis of ATP. In cellular respiration, NADH is oxidised to NAD+.

127. (4) Photosynthesis - Chloroplast is disrupted and the stroma separated from the lamella, the isolated stroma will fix CO2 if it is supplied with ATP+NADPH.

128. (1) Respiration in plants - P, Q, R and S in the given major pathway of anaerobic respiration are respectively NAD+, ethanol, lactic acid and PEP respectively.

129. (3) Photosynthesis - In C4 plants, photosynthesis occurs in chloroplast of mesophyll and bundle sheath cells. While in C3 plants photosynthesis occurs only in mesophyll cells.

130. (3) Respiration in plants -

131. (1) Photosynthesis - In C4 plants, a 4 - C compound oxaloacetic acid (OAA) is the first stable product, and phosphoenol pyruvate (PEP) is the CO2 acceptor. This reaction is catalyzed by the enzyme PEP carboxylase or PEPcase in mesophyll cells of the leaf.

132. (3) Respiration in plants - ATP is the major source of energy for cellular reactions and is commonly known as the energy currency of the cell. This energy is released during its conversion to ADP. Energy accumulates in ATP in high energy phosphate bonds.

133. (3) Photosynthesis - Light induced CO2 liberation from a C2 compound (glycolic acid) of dark phase is called photorespiration. It occurs in green cells only. Photorespiration is absent in C4 plants and is present in C3 plants. Photorespiration involves three cell organelles— Peroxisomes, chloroplasts and mitochondria.

134. (4) Respiration in plants - Cytochrome c oxidase contain copper.

135. (1) Photosynthesis - The principle of limiting factors was formulated by Blackman (1905). It states that when a process is conditioned as to its rapidity by a number of separate factors, the rate of process is limited by the pace of slowest factor.

136. Chemical control and coordination , NCERT pg -338 (easy)

137. Breathing and exchange of gases , NCERT pg 271 , figures (easy)
138. Neural control and coordination, NCERT, Medulla is part of hindbrain and not midbrain (mesencephalon) (medium)

139. Neural control and coordination, NCERT pg 322, figure showing T.S of spinal cord, Cells bodies of neurons are located in grey matter (medium).

140. Chemical control and coordination, NCERT pg 336, last para (easy)

141. Neural control and coordination, NCERT Cerebellum – Muscle coordination (Difficult)

142. Chemical control and coordination, NCERT pg 333, Simmond’s disease – Adults, Acromegaly-hypersecretion of GH, Diabetes insipidus is due to ADH deficiency which is hormone of posterior lobe of pituitary (medium)

143. Neural control and coordination, NCERT pg 317, 1st para, 11th line (easy)

144. Neural control and coordination, Ophthalmic branch of Trigeminal nerve innervates Lacrimal glands. Trochlear and oculomotor- Extrinsic muscles of eyes, Optic nerve- Retina of eyes (difficult)

145. Neural control and coordination, NCERT Conscious body movements- Cerebrum of CNS (difficult)

146. Chemical control and coordination, NCERT, Vasopressin- inhibits diuresis, Glucagon- alpha cells of islets of Langerhans, Prolactin- Anterior lobe of pituitary (medium)

147. Neural control and coordination, NCERT pg 322 (figure), (medium)

148. Neural control and coordination, NCERT pg 322 (figure), (medium)

149. Chemical control and coordination, NCERT, Follicular cells of Thyroid- T3, T4. (medium)

150. Animal kingdom, Spongilla is fresh water sponge (medium)

151. Chemical control and coordination, NCERT, pg 337, 3rd para, Glucagon- Hyperglycemic hormone (easy)

152. Chemical control and coordination, NCERT, pg 337, 2nd para, Cortisol is a glucocorticoid and not a mineralocorticoid. (medium)

153. Neural control and coordination, NCERT, Cornea- Avascular. (medium)

154. Chemical control and coordination, NCERT, pg 332 2nd para, Delta cells of islets of Langerhans too secrete Somatostatin (difficult)

155. Chemical control and coordination, NCERT, pg 335. Osteoblast are dividing cells of bones to produce osteocytes and not secrete matrix (difficult)

156. Chemical control and coordination, NCERT, Parathyroid- PTH (medium)

157. Biomolecules, NCERT pg 144 (easy)

158. Chemical control and coordination, NCERT, Adrenaline-Adrenal medulla (easy)

159. Digestion and absorption, NCERT, pg 257, (easy)
160. Neural control and coordination, NCERT, pg 325 (easy)

161. Neural control and coordination, NCERT Cornea- Curved transparent membrane for refraction of light (difficult)

162. Body fluids and circulation, NCERT, pg 284, 285 (medium)

163. Chemical control and coordination, NCERT. Zona reticularis of adrenal cortex secretes sex corticoids (difficult)

164. Neural control and coordination, NCERT pg 319 last line, pg 317 1st para second last statement (medium)

165. Neural control and coordination, NCERT, pg 323 last line (easy)

166. Neural control and coordination, NCERT pg 326 figure (easy)

167. Chemical control and coordination, NCERT pg 340 (easy)

168. Locomotion and movement, NCERT, pg 326 1st para (easy)

169. Neural control and coordination, NCERT, pg 326, 1st para (easy)

170. Neural control and coordination, NCERT pg 317, 318 (medium)

171. Excretory products and their elimination, NCERT pg 295, 296 (medium)

172. Chemical control and coordination, NCERT pg 340, figure, (easy)

173. Chemical control and coordination, NCERT, pg 334 1st para last line (easy)

174. Chemical control and coordination, NCERT, pg 335, 3rd para, first line (easy)

175. Neural control and coordination, NCERT pg 317, figure (medium)

176. Neural control and coordination, NCERT, Occipital lobe- Vision, Foramen magnum- Ethmoid bone, Pneumotaxic centre- Pons. (difficult)

177. Chemical control and coordination, NCERT, (Medium)

178. Breathing and exchange of gases, NCERT pg 272, table (easy)

179. Animal kingdom, NCERT pg 54, Ophiura- Brittle star (medium)

180. Chemical control and coordination, NCERT, Progesterone- supports pregnancy, Thyroid - TCT regulates blood Ca level, Posterior lobe of pituitary- Oxytocin (medium)