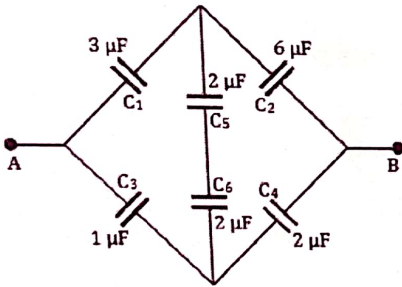


APPENDIX - VI - SAMPLE QUESTIONS

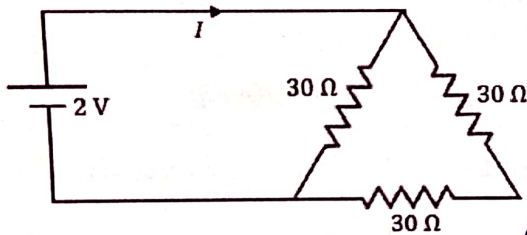
PHYSICS

1. A mass m rotates in a vertical circle of radius R and has a circular speed v_c at the top. If the radius of the circle is increased by a factor of 4, circular speed at the top will be
 A) decreased by a factor of 2 B) decreased by a factor of 4 C) increased by a factor of 2 D) increased by a factor of 4
2. A vessel contains 1 mol of O_2 and 2 mol of He. What is the value of ' C_p/C_v ' of the mixture?
 A) 17/11 B) 71/65 C) 38/15 D) 46/15
3. The effective capacitance between terminals A and B (as shown in the figure) is



- A) $16 \mu F$ B) $8 \mu F$ C) $6 \mu F$ D) $8/3 \mu F$

4. The current I in the circuit shown below is



- A) $\frac{1}{45} A$ B) $\frac{1}{15} A$ C) $\frac{1}{10} A$ D) $\frac{1}{5} A$
5. An electric wire in the wall of a building carries a DC current of 25 A vertically upward. What is the magnetic field due to this current at a point which is 10 cm to the right of the wire?
 A) $3.1 \times 10^{-4} T$ B) $5.0 \times 10^{-5} T$ C) $4.23 \times 10^{-4} T$ D) $5.11 \times 10^{-3} T$
6. In an electric circuit, R , C , L and AC voltage are all connected in series. When L is removed from the LCR circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, C is removed from the LCR circuit, the phase difference is again $\pi/3$. Determine the power factor of the circuit.
 A) $\frac{1}{2}$ B) $\frac{1}{\sqrt{2}}$ C) 1 D) $\frac{\sqrt{3}}{2}$
7. A short object of length l is placed along the principal axis of a concave mirror away from focus. The object distance is x . If the mirror has a focal length f what will be the length of the image? ($l \ll |v - f|$, where v is the image distance)
 A) $\frac{(x-f)^2}{f^2 l}$ B) $\frac{f^2 l}{(x-f)^2}$ C) $\frac{fl}{(x-f)}$ D) $\frac{(x-f)}{fl}$

8. The wavelength of the characteristic X-ray K_α line emitted by a hydrogen like element is 0.32 \AA . The wavelength of K_β line emitted by the same element will be
 A) 0.21 \AA B) 0.27 \AA C) 0.34 \AA D) 0.40 \AA
9. The number of alpha-particles scattered at 60° is 100 per minute in an alpha-scattering experiment on gold foil. The number of alpha-particles scattered per minute at 90° will be
 A) 25 B) 50 C) 16 D) 32
10. A $p-n$ junction diode connected in series with a resistor of 200Ω is forward biased so that a current of 200 mA flows. If the voltage across this combination is instantaneously reversed at $t = 0$, the current through diode is approximately,
 A) 400 mA B) 200 mA C) 100 mA D) 0 mA

CHEMISTRY

1. The set of quantum numbers not allowed in the hydrogen atom is

- A) $n = 2, l = 1, m_l = -1$ B) $n = 3, l = 2, m_l = 2$ C) $n = 4, l = 3, m_l = 4$ D) $n = 8, l = 7, m_l = -6$

2. Gibbs energy of formation of two oxides (CO and Al_2O_3) are given below as a function of temperature $\Delta G_{\text{CO}} = -0.2T - 195.4$ and $\Delta G_{\text{Al}_2\text{O}_3} = 0.2T - 1104$. Which one of the scenarios is possible based on Ellingham diagram at $T = 2000 \text{ K}$?

- A) C reducing Al_2O_3 B) Al reducing CO C) No reaction between Al and CO
D) C reducing Al_2O_3 and Al reducing CO

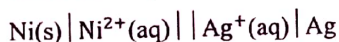
3. In a face centered cubic unit cell, the relation between ionic radii (r^+ and r^-) and edge length 'a' is

- A) $r^+ + r^- = \sqrt{2}a$ B) $r^+ + r^- = \sqrt{3}a$ C) $r^+ + r^- = a/2$ D) $r^+ + r^- = 2a$

4. When a catalyst is added to a system at equilibrium, a decrease occurs in the

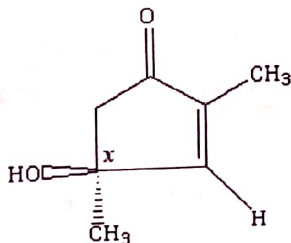
- A) potential energy of the reactants B) potential energy of the products C) heat of reaction D) activation energy

5. The Nernst equation for the following electrochemical cell will be:



- A) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - RT/2F \ln[\text{Ni}^{2+}]/[\text{Ag}^+]^2$ B) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - RT/2F \ln[\text{Ni}^{2+}]/[\text{Ag}^+]^2$
C) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - RT/2F \ln[\text{Ag}^+]^2/[\text{Ni}^{2+}]$ D) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - RT/2F \ln[\text{Ni}^{2+}]/[\text{Ag}^+]^2$

6. The stereochemical description of the chiral centre (marked as 'x') and the olefin in the following compound is



- A) 4R, 2Z B) 4S, 2Z C) 4R, 2E D) 4S, 2E

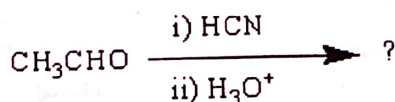
7. The reaction of but-1-ene with B_2H_6 followed by oxidation using $\text{H}_2\text{O}_2/\text{NaOH}$ gives

- A) Butan-2-ol B) Butan-2-one C) Butyraldehyde D) Butan-1-ol

8. In which one of the following reactions, a new carbon-carbon bond is not formed?

- A) Cannizzaro reactions B) Wurtz reaction C) Aldol reaction D) Friedel-Crafts reaction

9. The product formed in the following reaction is



- A) $\text{CH}_3\text{CH}_2\text{CN}$ B) $\text{CH}_3\text{CH}(\text{CN})\text{CHO}$ C) $\text{CH}_3\text{CH}(\text{OH})\text{CN}$ D) $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$

10. Nitrobenzene on reaction with Sn/HCl will produce

- A) 2-nitroaniline B) 4-nitroaniline C) aniline D) 4-chloroaniline

MATHEMATICS

1. If $G(x) = \begin{vmatrix} f(x)f(-x) & 0 & x^4 \\ 3 & f(x) - f(-x) & \cos x \\ x^4 & 2x & f(x)f(-x) \end{vmatrix}$, then $\int_{-2}^2 x^4 G(x) dx$ is equal to
 A) -1 B) 0 C) 2 D) 1
2. If $1, \alpha_1, \alpha_2, \alpha_3$ are the fourth roots of unity, then the value of $(1 + \alpha_1)(1 + \alpha_2)(1 + \alpha_3)$ is equal to
 A) -3 B) -1 C) 0 D) 2
3. A conic has focus $(1, 0)$ and corresponding directrix $x + y = 5$. If the eccentricity of the conic is 2, then its equation is
 A) $x^2 + 4xy + y^2 + 18x - 20y + 49 = 0$ B) $x^2 - 4xy + y^2 - 18x - 20y + 49 = 0$
 C) $x^2 + 4xy + y^2 - 18x + 20y + 49 = 0$ D) $x^2 + 4xy + y^2 - 18x - 20y + 49 = 0$
4. Let $\vec{u}, \vec{v}, \vec{w}$ to be three vectors such that $|\vec{u}| = 1, |\vec{v}| = 2, |\vec{w}| = 3$ and \vec{v} and \vec{w} are mutually perpendicular. If projection of \vec{v} along \vec{u} is equal to that of \vec{w} along \vec{u} then $|\vec{u} - \vec{v} + \vec{w}|$ equals to
 A) $\sqrt{7}$ B) 14 C) 2 D) $\sqrt{14}$
5. A plane at a unit distance from the origin intersects the coordinate axes at P, Q and R. If the locus of the centroid of ΔPQR satisfies the equation $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = k$, then the value of k is
 A) 3 B) 4 C) 9 D) 16
6. If g be an inverse function of f and $f'(x) = \frac{1}{1+x^5}$, then $g'(x)$ will be :
 A) $1 + x^5$ B) $1 + (g(x))^5$ C) $\left(\frac{1}{1+g(x)}\right)^5$ D) $(g(x))^5$
7. The area enclosed between the curves $y = |x^3|$ and $x = y^3$ is
 A) $\frac{1}{2}$ B) $\frac{1}{4}$ C) $\frac{1}{8}$ D) $\frac{1}{16}$
8. Let $f(x)$ be a differential function such that $f'(x) = f(x) + \int_0^2 f(x) dx$ and $f(0) = \frac{(4-e^2)}{3}$. Then $f(x)$ is:
 A) $e^x - \frac{(e^2-1)}{3}$ B) $e^x - \frac{(e^2-1)}{4}$ C) $e^x - \frac{(e^2+1)}{3}$ D) $e^x - \frac{(4-e^2)}{3}$
9. A coin is tossed n times. The maximum value of n such that the probability of getting no head is greater than $1/16$ is
 A) 4 B) 3 C) 5 D) 2
10. Suppose 5- digit numbers are formed by the digits 1,2,3,4 and 5 without repetition. If they are arranged in an ascending order, then 100th number is
 A) 51243 B) 51423 C) 51234 D) 51342