

MHT CET 2020 Mathematics Memory Based Question Paper PDF

Part I: Physics

1. The potential differences that must be applied across the parallel and series combination of 3 identical capacitors is such that the energy stored in them becomes the same. The ratio of potential difference in parallel to series combination is:
(a) $1/4$
(b) $1/6$
(c) $1/3$
(d) $1/8$
2. The unit vector $(a\hat{i} + b\hat{j})$ is perpendicular to $(\hat{i} + \hat{j})$. The value of 'b' is:
(a) $+1/\sqrt{3}$
(b) $-1/\sqrt{3}$
(c) $+1/2$
(d) $-1/\sqrt{2}$
3. Figure shows three forces $\vec{F}_1$, $\vec{F}_2$ and $\vec{F}_3$ acting along the sides of an equilateral triangle. If the total torque acting at point 'O' (centre of the triangle) is zero then the magnitude of $\vec{F}_3$ is:
(a) $(F_1 - F_2)/2$
(b) $F_1 - F_2$
(c) $F_1 + F_2$
(d) F_1/F_2
4. A pipe open at one end has length 0.8 m. At the open end of the tube a string 0.5 m long is vibrating in its 1st overtone and resonates with fundamental frequency of pipe. If tension in the string is 50 N, the mass of string is (speed of sound = 320 m/s):
(a) 25 gram
(b) 15 gram
(c) 20 gram
(d) 10 gram
5. If the dimensions of a physical quantity are given by $[L^a M^b T^c]$ then the physical quantity is:

- (a) velocity if $a = -1, b = 0, c = +1$
(b) force if $a = -1, b = 1, c = -2$
(c) pressure if $a = -1, b = 1, c = -2$
(d) acceleration if $a = 1, b = 1, c = -2$
6. Two wires 'A' and 'B' of equal lengths are connected in left and right gaps, of meter bridge, respectively. The null point is obtained at 40 cm from left end. Diameters of the wires 'A' and 'B' are in the ratio 3 : 1, the ratio of specific resistance of 'A' to that of 'B' is:
- (a) 3 : 1
(b) 1 : 1
(c) 6 : 1
(d) 9 : 1
7. A parallel combination of pure inductor and capacitor is connected across a source of alternating e.m.f. 'e'. The currents flowing through an inductor and capacitor are i_L and i_C respectively. In this parallel resonant circuit, the condition for currents i, i_L and i_C is (i = net r.m.s. current in the circuit):
- (a) $i \approx 0, i_L = i_C \neq 0$
(b) $i \neq 0, i_L = i_C = 0$
(c) $i \approx i_L = i_C$
(d) $i \approx 0, i_L \neq i_C$
8. The frequency of two tuning forks A and B are 1.5% more and 2.5% less than that of the tuning fork C. When A and B are sounded together, 12 beats are produced in 1 second. The frequency of tuning fork C is:
- (a) 200 Hz
(b) 300 Hz
(c) 240 Hz
(d) 360 Hz
9. A ball of mass 'm' is attached to the free end of an inextensible string of length 'l'. Let 'T' be the tension in the string. The ball is moving in horizontal circular path about the vertical axis. The angular velocity of the ball at any particular instant will be:
- (a) $\sqrt{\frac{T}{ml}}$
(b) $\sqrt{\frac{Tl}{m}}$
(c) $\sqrt{\frac{ml}{T}}$
(d) $\sqrt{\frac{Tm}{l}}$
10. The maximum velocity of the photoelectron emitted by the metal surface is 'v'. Charge and mass of the photoelectron is denoted by 'e' and 'm' respectively. The stopping potential in volt is:
- (a) $\frac{v^2 m}{e}$

- (b) $\frac{v^2 e}{m}$
(c) $\frac{v^2 m}{2e}$
(d) $\frac{v^2 e}{2m}$
11. A stationary body explodes into two parts of masses M_1 and M_2 . They move in opposite directions with velocities v_1 and v_2 . The ratio of their kinetic energies is:
(a) M_2/M_1
(b) $(M_2/M_1)^{1/2}$
(c) $(M_1/M_2)^2$
(d) $(M_2/M_1)^2$
12. In meter bridge experiment, to minimize an error due to contact resistance:
(a) use non-uniform meter bridge wire.
(b) repeat the experiment by interchanging the resistance in gaps.
(c) increase the current flowing through meter bridge wire.
(d) changing the value of known resistance in the gap.
13. Magnetic field at the centre of a circular loop of area 'A' is 'B'. The magnetic moment of the loop will be (μ_0 = permeability of free space):
(a) $\frac{BA^{3/2}}{\mu_0 \pi}$
(b) $\frac{2BA^{3/2}}{\mu_0 \pi^{1/2}}$
(c) $\frac{2BA^2}{\mu_0 \pi}$
(d) $\frac{BA^{3/2}}{\mu_0 \pi^{1/2}}$
14. Above the curie temperature the susceptibility of a ferromagnetic substance varies:
(a) directly as the absolute temperature.
(b) inversely as the absolute temperature.
(c) inversely as the square root of absolute temperature.
(d) directly as the square root of absolute temperature.
15. A solid cylinder of mass 'M' and radius 'R' rolls down a smooth inclined plane about its own axis and reaches the bottom with velocity 'v'. The height of the inclined plane is (g = acceleration due to gravity):
(a) $\frac{3v^2}{4g}$
(b) $\frac{4v^2}{5g}$
(c) $\frac{7v^2}{9g}$
(d) $\frac{2v^2}{3g}$
16. A body is projected vertically upwards from earth's surface with velocity $2v_e$, where v_e is escape velocity from earth's surface. The velocity when body escapes the gravitational pull is:
(a) $\sqrt{7}v_e$

- (b) $\sqrt{3}v_e$
(c) $\sqrt{5}v_e$
(d) $2v_e$
17. Two cars of masses m_1 and m_2 are moving in the circles of radii r_1 and r_2 respectively. Their angular speeds ω_1 and ω_2 are such that they both complete one revolution in the same time 't'. The ratio of linear speed of m_1 to the linear speed of m_2 is:
- (a) $r_1 : r_2$
(b) $T_1^2 : T_2^2$
(c) $\omega_1^2 : \omega_2^2$
(d) $m_1 : m_2$
18. Resultant of two vectors $\vec{P}$ and $\vec{Q}$ is of magnitude R_1 . If direction of $\vec{Q}$ is reversed, the resultant is of magnitude R_2 . The value of $(R_1^2 + R_2^2)$ is $[\cos(\pi - \theta) = -\cos \theta]$:
- (a) $(P^2 + Q^2)$
(b) $2(P^2 + Q^2)$
(c) $2(P^2 - Q^2)$
(d) $(P^2 - Q^2)$
19. Choose the correct statement. In conductors:
- (a) valence band and conduction band overlap each other.
(b) valence band and conduction band are separated by a large energy gap.
(c) very small number of electrons are available for electrical conduction.
(d) valence band and conduction band are separated by a small energy gap.
20. Two identical wires are vibrating in unison. If the tension in one of the wires is increased by 2%, five beats are produced per second by the two vibrating wires. The initial frequency of each wire is ($\sqrt{1.02} \approx 1.01$):
- (a) 1000 Hz
(b) 500 Hz
(c) 400 Hz
(d) 200 Hz

Part II: Chemistry

- Which of the following is a character of catalyst?
 - It changes the position of equilibrium.
 - It increases the rates of both forward and backward reactions equally in reversible reaction.
 - It affects the energies of reactants and products of the reaction.
 - It increases the activation energy of reactants.
- Identify the decreasing order of boiling point of alkanes (i) n-pentane (ii) Isopentane (iii) Neopentane:
 - Isopentane > n-pentane > Neopentane
 - Neopentane > Isopentane > n-pentane
 - n-pentane > Isopentane > Neopentane
 - Isopentane > Neopentane > n-pentane
- Which of the following oxyacid of sulphur contains S=S linkage?
 - $H_2S_2O_4$
 - H_2SO_3
 - $H_2S_2O_5$
 - $H_2S_2O_2$
- Methoxy ethane on reaction with hot concentrated HI gives:
 - iodomethane and ethanol
 - iodomethane and iodoethane
 - methanol and ethanol
 - methanol and iodoethane
- When alkyl halide is boiled with large excess of alcoholic ammonia it forms:
 - primary amine
 - tertiary amine
 - secondary amine
 - quaternary ammonium salt
- Which of the following pairs of solution is isotonic? (molar mass: urea = 60, sucrose = 342 g/mol⁻¹):
 - 3.0 gL⁻¹ urea and 17.19 gL⁻¹ sucrose
 - 0.3 gL⁻¹ urea and 1.719 gL⁻¹ sucrose
 - 3.0 gL⁻¹ urea and 1.719 gL⁻¹ sucrose
 - 0.3 gL⁻¹ urea and 17.19 gL⁻¹ sucrose
- The P-P-P bond angle in white phosphorus is:
 - 90°

- (b) $109^{\circ}28'$
(c) 120°
(d) 60°
8. Which of the following statement is NOT correct about solution?
- (a) The three states of matter solid, liquid and gas may play the role of either solute or solvent.
(b) The component of solution which constitute smaller part is called solute.
(c) When water is solvent, the process of solvation is known as hydration.
(d) True solution is a heterogenous mixture of two or more substances with fixed composition.
9. Enthalpy of fusion and enthalpy of vaporization for water respectively are 6.01 kJ mol^{-1} and $45.07 \text{ kJ mol}^{-1}$ at 0°C what is enthalpy of sublimation at 0°C ?
- (a) $27.50 \text{ kJ mol}^{-1}$
(b) $48.07 \text{ kJ mol}^{-1}$
(c) $51.08 \text{ kJ mol}^{-1}$
(d) $39.06 \text{ kJ mol}^{-1}$
10. In the reaction $2\text{KClO}_{3(s)} \rightarrow 2\text{KCl}_{(s)} + 3\text{O}_{2(g)}$ $\Delta H^{\circ} = -78 \text{ kJ}$. If 33.6 L of oxygen gas is liberated at S.T.P. What is the mass of KCl produced? (at. mass K = 39, Cl = 35.5 g mol^{-1}):
- (a) 48.0 g
(b) 7.45 g
(c) 24.0 g
(d) 74.5 g
11. In resonance hybrid of ozone molecule, O-O bond length is:
- (a) 128 pm
(b) 134.5 pm
(c) 121 pm
(d) 148 pm
12. Which among the following elements is a soft element as compared to others?
- (a) Co
(b) Zn
(c) W
(d) Mo
13. Identify the polymer obtained by heating n moles of isobutylene with n moles of isoprene at 100°C in presence of anhydrous AlCl_3 :
- (a) Butyl rubber
(b) Buna-N

- (c) Buna-S
 - (d) Neoprene rubber
14. Sodium crystallizes in bcc structure with radius 1.86×10^{-8} cm. What is the edge length of unit cell of sodium?
- (a) 4.3×10^{-8} cm
 - (b) 3.72×10^{-8} cm
 - (c) 7.44×10^{-8} cm
 - (d) 5.26×10^{-8} cm
15. What is the oxidation number of carbon in glucose?
- (a) -6
 - (b) $+6$
 - (c) $+3$
 - (d) Zero

Part III: Mathematics

1. $\int \frac{dx}{\sqrt{5+4x-x^2}} =$
 - (a) $\sin^{-1}\left(\frac{x-2}{3}\right) + c$
 - (b) $\log |(x-2) + \sqrt{5+4x-x^2}| + c$
 - (c) $\log |(x+2) + \sqrt{5+4x-x^2}| + c$
 - (d) $\sin^{-1}\left(\frac{x+2}{3}\right) + c$
2. Degree of the differential equation $e^{\frac{dy}{dx}} + \left(\frac{dy}{dx}\right)^3 = x$ is:
 - (a) 2
 - (b) 1
 - (c) not defined
 - (d) 3
3. If $\cos 2\theta = \sin \alpha$, then $\theta =$
 - (a) $2n\pi \pm \left(\frac{\pi}{2} - \alpha\right), n \in Z$
 - (b) $n\pi \pm \left(\frac{\pi}{4} + \frac{\alpha}{2}\right), n \in Z$
 - (c) $\frac{1}{2}[n\pi + (-1)^n\alpha], n \in Z$
 - (d) $n\pi \pm \left(\frac{\pi}{4} - \frac{\alpha}{2}\right), n \in Z$
4. The solution of differential equation $x^2 \frac{dy}{dx} = y^2 + xy$ is:
 - (a) $\frac{x}{y} + \log |x| = c$
 - (b) $\frac{y}{x} + \log |x| = c$
 - (c) $\frac{x}{y} - \log |x| = c$
 - (d) $\frac{y}{x} - \log |x| = c$
5. The maximum value of the function $y = e^{5+\sqrt{3}\sin x+\cos x}$ is:
 - (a) e^7
 - (b) e^2
 - (c) e^5
 - (d) e^8
6. If $y = \tan^{-1}(\sec x + \tan x)$, then $\frac{dy}{dx} =$
 - (a) $1/2$
 - (b) 1
 - (c) $-1/2$
 - (d) -1
7. The displacement of a particle at the time t is given by $s = \sqrt{1+t}$, then its acceleration 'a' is proportional to:
 - (a) square of the velocity

- (b) $\sqrt[3]{s}$
(c) $\sqrt{s}$
(d) cube of the velocity
8. If $\vec{a} = \frac{1}{\sqrt{10}}(3\hat{i} + \hat{k})$, $\vec{b} = \frac{1}{7}(2\hat{i} + 3\hat{j} - 6\hat{k})$, then the value of $(2\vec{a} - \vec{b}) \cdot [(\vec{a} \times \vec{b}) \times (\vec{a} + 2\vec{b})]$ is:
(a) 7
(b) -5
(c) 5
(d) -7
9. The statement pattern $[(p \vee q) \wedge \sim p] \wedge (\sim q)$ is:
(a) a contradiction
(b) equivalent to $p \wedge q$
(c) a contingency
(d) a tautology
10. Two cards are drawn from a pack of well shuffled 52 playing cards one by one without replacement. Then the probability that both cards are queens is:
(a) $1/221$
(b) $1/220$
(c) $3/220$
(d) $2/221$
11. $\int_0^{\pi/2} \frac{\sin x \cos x}{1 + \sin^4 x} dx =$
(a) $\pi/6$
(b) $\pi/8$
(c) $\pi/2$
(d) $\pi/4$
12. $\tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \cdots \times \tan 89^\circ =$
(a) $\sqrt{3}$
(b) 1
(c) $\sqrt{2}$
(d) 2
13. If $|\vec{a} \cdot \vec{b} \cdot \vec{c}| = 4$, then volume of parallelepiped with coterminus edges $\vec{a} + 2\vec{b}$, $\vec{b} + 2\vec{c}$, $\vec{c} + 2\vec{a}$ is:
(a) 36 units³
(b) 32 units³
(c) 20 units³
(d) 40 units³
14. $\int_{-5}^5 \left[\frac{e^x + e^{-x}}{e^x - e^{-x}} \right] dx =$

- (a) 0
- (b) 1
- (c) $3e^5$
- (d) $2e^5$

15. The area of the region bounded by the parabola $y^2 = 8x$ and its latus rectum is:

- (a) $16/3$ sq. units
- (b) $8/3$ sq. units
- (c) $32/3$ sq. units
- (d) $4/3$ sq. units

