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PAPER-1 (B.E./B. TECH.) OF JEE (MAIN)

JEE (MAIN) 2018

CBT TEST PAPER

DATE : 16-04-2018

SUBJECT : PHYSICS, CHEMISTRY, MATHEMATICS

Resonance Eduventures Ltd.
Registered & Corporate Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.)-324005
Tel.No.: 0744-6607777, 3012100, 3012222, 6635555 | **Fax:** +91-022-39167222 | 08003 444 888
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Classroom: 4095 | DLP + eLP: 2146
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Classroom: 1724 | DLP + eLP: 1251
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PHYSICS

Straight Objective Type

This section contains **30 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

1. The relative uncertainty in the period of a satellite orbiting around the earth is 10^{-2}. If the relative uncertainty in the radius of the orbit is negligible the relative uncertainty in the mass of the earth is :

(1) 2×10^{-2} (2) 6×10^{-2} (3) 3×10^{-2} (4) 10^{-2}

2. At some instant a radioactive sample S_1 having an activity 5 μCi has twice the number of nuclei as another sample S_2 which has an activity of 10 μCi. The half lives of S_1 and S_2 are :

(1) 5 years and 20 years, respectively (2) 20 years and 5 years, respectively
(3) 20 years and 10 years, respectively (4) 10 years and 20 years, respectively

3. Two moles of helium are mixed with an moles of hydrogen. If $\frac{C_P}{C_V} = \frac{3}{2}$ for the mixture then the value of n is

(1) 1 (2) 3 (3) 2 (4) 3/2

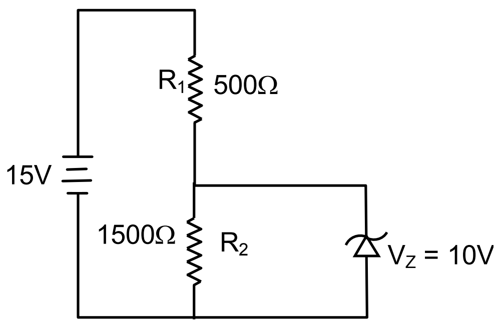
4. Unpolarized light of intensity I is incident on a system of two polarizers, A followed by B. The intensity of emergent light is $I/2$. If a third polarizer C is placed between A and B the intensity of emergent light is reduced to $I/3$. The angle between the polarizers A and C is θ, then

(1) $\cos\theta = \left(\frac{2}{3}\right)^{1/4}$ (2) $\cos\theta = \left(\frac{1}{3}\right)^{1/4}$ (3) $\cos\theta = \left(\frac{1}{3}\right)^{1/2}$ (4) $\cos\theta = \left(\frac{2}{3}\right)^{1/2}$

5. The de-Broglie wavelength (λ_B) associated with the electron orbiting in the second excited state of hydrogen atom is related to that in the ground state (λ_G) by :

(1) $\lambda_B = 3\lambda_G$ (2) $\lambda_B = 2\lambda_G$ (3) $\lambda_B = 3\lambda_{G/3}$ (4) $\lambda_B = 3\lambda_{G/2}$

6. In the given circuit the current through zener diode is :



(1) 3.3mA (2) 2.5mA (3) 5.5mA (4) 6.7mA

7. The end correction of a resonance column is 1cm. If the shortest length resonating with the tuning fork is 10cm, the next resonating length should be :

(1) 32cm (2) 40cm (3) 28cm (4) 36cm

8. Two sitar strings A and B playing the note 'Dha' are slightly out of tune and produce beats of frequency 5Hz. The tension of the string B is slightly increased and the beat frequency is found to decrease by 3Hz. If the frequency of A is 425 Hz. the original frequency of B is :

(1) 428 Hz (2) 430 Hz (3) 422 Hz (4) 420 Hz

9. A power transmission line feeds input power at 2300V to a step down transformer with its primary windings having 4000 turns giving the output power at 230V. If the current in the primary of the transformer is 5A and its efficiency is 90% the output current would be :

(1) 45A (2) 50A (3) 20A (4) 25A

10. A body of mass m starts moving from rest along x-axis so that its velocity varies as $\upsilon = a\sqrt{s}$ where a is a constant and s is the distance covered by the body. The total work done by all the forces acting on the body in the first t seconds after the start of the motion is :

(1) $8ma^4t^2$ (2) $\frac{1}{4}ma^4t^2$ (3) $4ma^4t^2$ (4) $\frac{1}{8}ma^4t^2$

11. Suppose that the angular velocity of rotation of earth is increased. Then as a consequence :

(1) Weight of the object every where on the earth will decrease

(2) Weight of the object every where on the earth will increase

(3) Except at poles weight of the object on the earth will decrease

(4) There will be no change in weight anywhere on the earth.

12. Both the nucleus and the atom of some element are in their respective first excited states. They get de-excited by emitting photons of wavelengths λ_N, λ_A respectively. The ratio $\frac{\lambda_N}{\lambda_A}$ is closest to :

(1) 10^{-1} (2) 10^{-6} (3) 10 (4) 10^{-10}

13. A plane electromagnetic wave of wavelength λ has an intensity I. It is propagating along the positive Y-direction. The allowed expressions for the electric and magnetic fields are given by :

(1) $\vec{E} = \sqrt{\frac{2I}{\varepsilon_0 c}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}$; $\vec{B} = +\frac{1}{c}E\hat{i}$

(2) $\vec{E} = \sqrt{\frac{I}{\varepsilon_0 c}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}$; $\vec{B} = +\frac{1}{c}E\hat{i}$

(3) $\vec{E} = \sqrt{\frac{2I}{\varepsilon_0 c}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}$; $\vec{B} = \frac{1}{c}E\hat{i}$

(4) $\vec{E} = \sqrt{\frac{I}{\varepsilon_0 c}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{i}$; $\vec{B} = \frac{1}{c}E\hat{k}$

14. A charge q is spread uniformly over an insulated loop of radius r. If it is rotated with an angular velocity ω with respect to normal axis then magnetic moment of the loop is :

(1) $\frac{3}{2}q\omega r^2$ (2) $\frac{1}{2}q\omega r^2$ (3) $q\omega r^2$ (4) $\frac{4}{3}q\omega r^2$

15. A heating element has a resistance of 100Ω at room temperature. When it is connected to a supply of 220V a steady current of 2A passes in it and temperature is 500°C more than room temperature. What is the temperature coefficient of resistance of the heating element?

(1) 5×10^{-4} °C^{-1} (2) 2×10^{-4} °C^{-1} (3) 1×10^{-4} °C^{-1} (4) 0.5×10^{-4} °C^{-1}

16. A coil of cross-sectional area A having n turns is placed in a uniform magnetic field B. When it is rotated with an angular velocity ω the maximum e.m.f. induced in the coil will be :

(1) $\frac{3}{2}$ nBAω (2) 3nBAω (3) nBAω (4) $\frac{1}{2}$ nBAω

17. A ray of light is incident at an angle of 60° on one face of a prism of angle 30°. The emergent ray of light makes an angle of 30° with incident ray. The angle made by the emergent ray with second face of prism will be :

(1) 0° (2) 90° (3) 30° (4) 45°

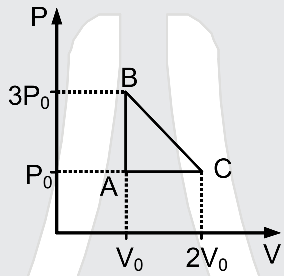
18. A galvanometer with its coil resistance 25Ω requires a current of 1mA for its full deflection. In order to construct an ammeter to read up to a current of 2A the approximate value of the shunt resistance should be :

(1) 1.25×10^{-2}Ω (2) 2.5×10^{-3}Ω (3) 2.5×10^{-2}Ω (4) 1.25×10^{-3}Ω

19. An oscillator of mass M is at rest in the equilibrium position in a potential $V = \frac{1}{2}k(x - X)^2$. A particle of mass m comes from right with speed u and collides completely inelastically with M and sticks to it. This process repeats every time the oscillator crosses its equilibrium position. The amplitude of oscillations after 13 collisions is : (M = 10, m = 5, u = 1, k = 1)

(1) $\frac{2}{3}$ (2) $\frac{1}{\sqrt{3}}$ (3) $\sqrt{\frac{3}{5}}$ (4) $\frac{1}{2}$

20. One mole of an ideal monatomic gas is taken along the path ABCA as shown in the PV diagram. The maximum temperature attained by the gas along the path BC is given by :

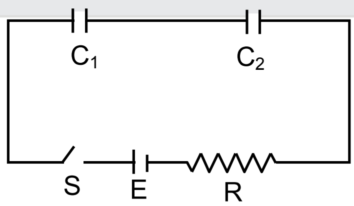


(1) $\frac{25}{4}\frac{P_0V_0}{R}$ (2) $\frac{5}{8}\frac{P_0V_0}{R}$ (3) $\frac{25}{8}\frac{P_0V_0}{R}$ (4) $\frac{25}{16}\frac{P_0V_0}{R}$

21. In a circuit for finding the resistance of a galvanometer by half deflection method a 6V battery and a high resistance of 11kΩ are used. The figure of merit of the galvanometer produces a deflection of θ = 9 divisions when current flows in the circuit. The value of the shunt resistance that can cause the deflection of $\theta/2$ is

(1) 550Ω (2) 220Ω (3) 55Ω (4) 110Ω

22. In the following circuit the switch S is closed at t = 0. The charge on the capacitor C_1 as a function of time will be given by $\left(C_{eq} = \frac{C_1C_2}{C_1 + C_2}\right)$



(1) $C_1E[1 - \exp(-tR/C_1)]$ (2) $C_{eq}E \exp(-t/RC_{eq})$

(3) $C_{eq}E [1 - \exp(-t/RC_{eq})]$ (4) $C_2E[1 - \exp(-t/RC_2)]$

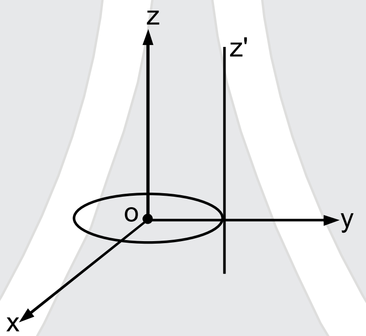
23. Let $\vec{A}=\left(\hat{i}+\hat{j}\right)$ and $\vec{B}=\left(2\hat{i}-\hat{j}\right)$. The magnitude of a coplanar vector $\vec{C}$ such that $\vec{A}.\vec{C}=\vec{B}.\vec{C}=\vec{A}.\vec{B}$ is given by :

(1) $\sqrt{\frac{9}{12}}$ (2) $\sqrt{\frac{20}{9}}$ (3) $\sqrt{\frac{5}{9}}$ (4) $\sqrt{\frac{10}{9}}$

24. A particle executes simple harmonic motion and is located at x = a, b and c at times t_0, $2t_0$ and $3t_0$ respectively. The frequency of the oscillation is :

(1) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+c}{2b}\right)$ (2) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+2b}{3c}\right)$ (3) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+b}{2c}\right)$ (4) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{2a+3c}{b}\right)$

25. A thin circular disk is in the xy plane as shown in the figure. The ratio of its moment of inertia about z and z' axes will be :



(1) 1 : 4 (2) 1 : 5 (3) 1 : 3 (4) 1 : 2

26. Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters and the force between them is F. A third identical conducting sphere C is uncharged. Sphere C is first touched to A then to B and then removed. As a result the force between A and B would be equal to :

(1) $\frac{3F}{4}$ (2) $\frac{F}{2}$ (3) $\frac{3F}{8}$ (4) F

27. Two particles of the same mass m are moving in circular orbits because of force given by $F(r) = \frac{-16}{r}-r^3$. The first particle is at distance r = 1 and the second at r = 4. The best estimate for the ratio of kinetic energies of the first and the second particle is closest to :

(1) 3×10^{-3} (2) 6×10^{2} (3) 6×10^{-2} (4) 10^{-1}

28. The percentage errors in quantities P, Q, R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3Q^2}{\sqrt{RS}}$. The maximum percentage error in the value of A will be :

(1) 6.5% (2) 7.5% (3) 6.0% (4) 8.5%

29. A carrier wave of peak voltage 14V is used for transmitting a message signal given to achieve a modulation index of 80% will be :

(1) 22.4V (2) 7V (3) 11.2V (4) 28V

30. A small soap bubble of radius 4cm is trapped inside another bubble of radius 6cm without any contact. Let P_2 be the pressure inside the inner bubble and P_0 the pressure outside the outer bubble. Radius of another bubble with pressure difference $P_2 - P_0$ between its inside and outside would be :

(1) 2.4cm (2) 12cm (3) 4.8cm (4) 6cm

CHEMISTRY

Straight Objective Type

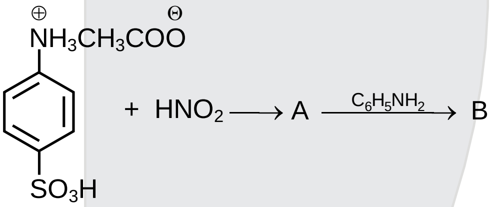
This section contains **30 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

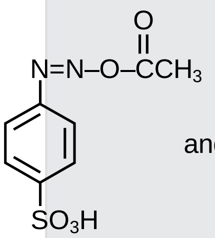
1. For standardizing NaOH solution, which of the following is used as a primary standard ?

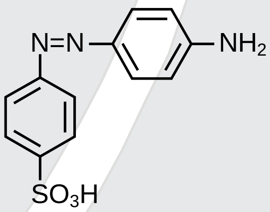
(1) Sodium tetraborate (2) Ferrous Ammonium Sulfate

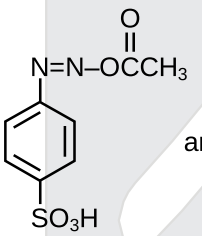
(3) Oxalic acid (4) dil. HCl

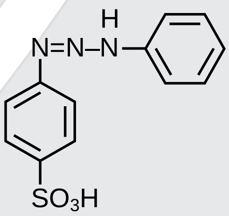
2. Products A and B formed in the following reactions are respectively :

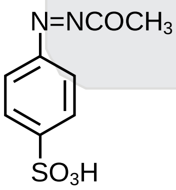


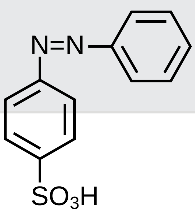
(1) 

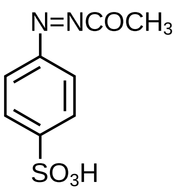
and 

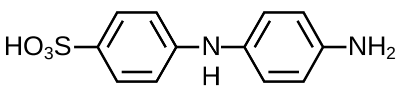
(2) 

and 

(3) 

and 

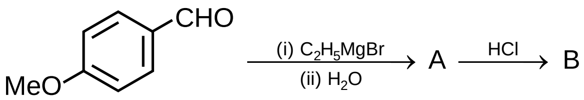
(4) 

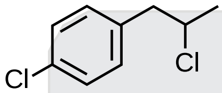
and 

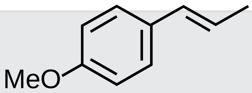
3. When XO_2 is fused with an alkali metal hydroxide in presence of an oxidizing agent such as KNO_3 ; a dark green product is formed which disproportioates in acidic solution to afford a dark purple solution. X is :

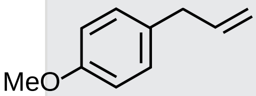
(1) Mn (2) Cr (3) V (4) Ti

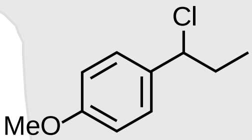
4. The major product B formed in the following reaction sequence is :



(1) 

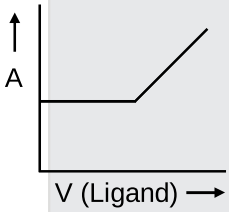
(2) 

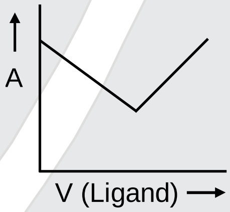
(3) 

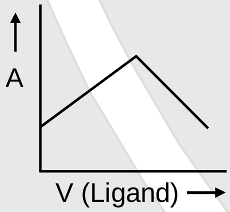
(4) 

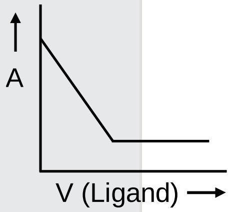
5. In a complexometric titration of metal ion with ligand

M (Metal ion) + L (Ligand) $\rightarrow$ C (Complex) end point is estimated spectrophotometrically (through light absorption). If 'M' and 'C' do not absorb light and only 'L' absorbs, then the titration plot between absorbed light (A) versus volume of ligand 'L' (V) would look like :

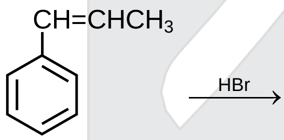
(1) 

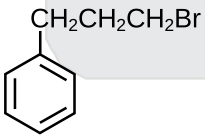
(2) 

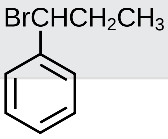
(3) 

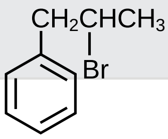
(4) 

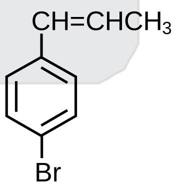
6. The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

7. Among the following, the **incorrect** statement is :

(1) Cellulose and amylase has 1,4-glycosidic linkage.

(2) Lactose contains β-D-galactose and β-D-glucose.

(3) Maltose and lactose has 1,4-glycosidic linkage.

(4) Sucrose and amylose has 1,2-glycosidic linkage.

8. In the extraction of copper from its sulphide ore, metal is finally obtained by the oxidation of cuprous sulphide with :

(1) SO_2 (2) Fe_2O_3 (3) Cu_2O (4) CO

9. Among the oxides of nitrogen :

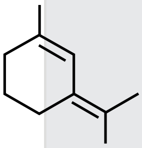
N_2O_3, N_2O_4 and N_2O_5 ; the molecule(s) having nitrogen-nitrogen bond is/are :

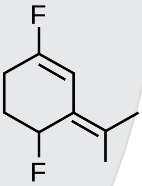
(1) N_2O_3 and N_2O_4 (2) N_2O_4 and N_2O_5 (3) N_2O_3 and N_2O_5 (4) Only N_2O_5

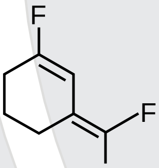
10. Which of the following conversions involves change in both shape and hybridisation ?

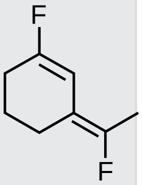
(1) $H_2O \rightarrow H_3O^+$ (2) $BF_3 \rightarrow BF_4^-$ (3) $CH_4 \rightarrow C_2H_6$ (4) $NH_3 \rightarrow NH_4^+$

11. The most polar compound among the following is :

(1) 

(2) 

(3) 

(4) 

12. In Wilkinson's catalyst, the hybridization of central metal ion and its shape are respectively :

(1) sp^3d, trigonal bipyramidal (2) d^2sp^3, octahedral

(3) dsp^2, square planar (4) sp^3, tetrahedral

13. At 320 K, a gas A_2 is 20 % dissociated to A(g). The standard free energy change at 320 K and 1 atm in J mol^{-1} is approximately : (R = 8.314 JK^{-1} mol^{-1} ; ln 2 = 0.693 ; ln 3 = 1.098)

(1) 1844 (2) 2068 (3) 4281 (4) 4763

14. Which of the following complexes will show geometrical isomerism ?

(1) Potassium tris(oxalato)chromate(III)

(2) Pentaaquachlorochromium(III)chloride

(3) Aquachlorobis(ethylenediamine)cobalt(II) chloride

(4) Potassium amminetrichloroplatinate(II)

15. Which of the following statements is **false** ?

(1) Splitting of spectral lines in electrical field is called Stark effect.

(2) Frequency of emitted radiation from a black body goes from a lower wavelength of higher wavelength as the temperature increases.

(3) Photon has momentum as well as wavelength.

(4) Rydberg constant has unit of energy.

16. When 9.65 ampere current was passed for 1.0 hour into nitrobenzene in acidic medium, the amount of p-aminophenol produced is :

(1) 109.0 g (2) 98.1 g (3) 9.81 g (4) 10.9 g

17. For which of the following processes, ΔS is negative ?

(1) C(diamond) $\rightarrow$ C(graphite) (2) N_2(g, 1 atm) $\rightarrow$ N_2(g, 5 atm)

(3) N_2(g, 273 K) $\rightarrow$ N_2(g, 300 K) (4) H_2(g) $\rightarrow$ 2H(g)

18. An unknown chlorohydrocarbon has 3.55 % of chlorine. If each molecule of the hydrocarbon has one chlorine atom only ; chlorine atoms present in 1 g of chlorohydrocarbon are :

(Atomic wt. of Cl = 35.5 u ; Avogadro constant = 6.023×10^{23} mol^{-1})

(1) 6.023×10^{9} (2) 6.023×10^{23} (3) 6.023×10^{21} (4) 6.023×10^{20}

19. The **incorrect** statement is :

(1) Cu^{2+} ion gives chocolate coloured precipitate with potassium ferrocyanide solution.

(2) Cu^{2+} and Ni^{2+} ions give black precipitate with H_2S in presence of HCl solution.

(3) Ferric ion gives blood red colour with potassium thiocyanate.

(4) Cu^{2+} salts give red coloured borax bead test in reducing flame.

20. The mass of a non-volatile, non-electrolyte solute (molar mass = 50 g mol^{-1}) needed to be dissolved in 114 g octane to reduce its vapour pressure to 75 %, is :

(1) 37.5 g (2) 75 g (3) 150 g (4) 50 g

21. The **incorrect** geometry is represented by :

(1) NF_3 – trigonal planar (2) BF_3 – trigonal planar

(3) AsF_5 – trigonal bipyramidal (4) H_2O – bent

22. Assuming ideal gas behaviour, the ratio of density of ammonia to that of hydrogen chlroide at same temperature and pressure is : (Atomic wt. of Cl 35.5 u)

(1) 1.46 (2) 1.64 (3) 0.46 (4) 0.64

23. The correct match between items of List-I and List-II is :

	List-I		List-II
(A)	Phenelzine	(P)	Pyrimidine
(B)	Chloroxylenol	(Q)	Furan
(C)	Uracil	(R)	Hydrazine
(D)	Ranitidine	(S)	Phenol

(1) (A)-(S), (B)-(R), (C)-(Q), (D)-(P) (2) (A)-(R), (B)-(S), (C)-(P), (D)-(Q)

(3) (A)-(R), (B)-(S), (C)-(Q), (D)-(P) (4) (A)-(S), (B)-(R), (C)-(P), (D)-(Q)

24. The gas phase reaction $2NO_2(g) \rightarrow N_2O_4(g)$ is an exothermic reaction. The decomposition of N_2O_4, in equilibrium mixture of $NO_2(g)$ and $N_2O_4(g)$, can be increased by :

(1) addition of an inert gas at constant pressure.

(2) lowering the temperature

(3) increasing the pressure

(4) addition of an inert gas at constant volume.

25. Which one of the following is not a property of physical adsorption ?

(1) Higher the pressure, more the adsorption

(2) Greater the surface area, more the adsorption

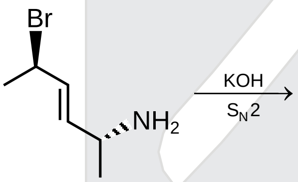
(3) Lower the temperature, more the adsorption

(4) Unilayer adsorption occurs

26. A group 13 element 'X' reacts with chlorine gas to produce a compound XCl_3. XCl_3 is electron deficient and easily reacts with NH_3 to form $Cl_3X \leftarrow NH_3$ adduct; however, XCl_3 does not dimerize. X is :

(1) B (2) Al (3) In (4) Ga

27. The major product of the following reaction is :



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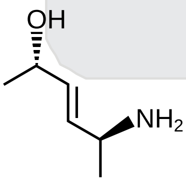

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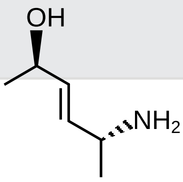

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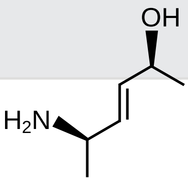

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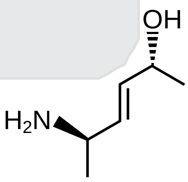
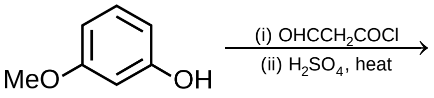
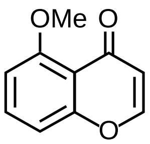


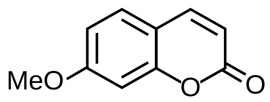
28. If 50 % of a reaction occurs in 100 second and 75 % of the reaction occurs in 200 second, the order of this reaction is :

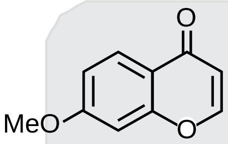
(1) 2 (2) 3 (3) Zero (4) 1

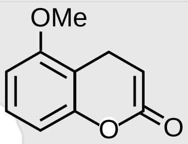
29. The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

30. Which of the following compounds will most readily be dehydrated to give alkene under acidic condition?

(1) 4-Hydroxypentan-2-one

(2) 3-Hydroxypentan-2-one

(3) 1-Pentanol

(4) 2-Hydroxycyclopentanone

MATHEMATICS

Straight Objective Type

This section contains **30 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

1. If $x = \sqrt{2^{\text{cosec}^{-1}t}}$ and $y = \sqrt{2^{\sec^{-1}t}}$ $(|t| \geq 1)$, then $\frac{dy}{dx}$ is equal to :

(1) $\frac{y}{x}$ (2) $-\frac{y}{x}$ (3) $-\frac{x}{y}$ (4) $\frac{x}{y}$

2. Let N denote the set of all natural numbers. Define two binary relations on N as $R_1 = \{(x, y) \in N \times N : 2x + y = 10\}$ and $R_2 = \{(x, y) \in N \times N : x + 2y = 10\}$. Then

(1) Both R_1 and R_2 are transitive relations (2) Range of R_2 is {1, 2, 3, 4}.

(3) Range of R_1 is {2, 4, 8} (4) Both R_1 and R_2 are symmetric relations.

3. The coefficient of x^2 in the expansion of the product $(2-x^2)\cdot((1 + 2x + 3x^2)^6 + (1 - 4x^2)^6)$ is :

(1) 107 (2) 108 (3) 155 (4) 106

4. If the area of the region bounded by the curves, $y = x^2$, $y = \frac{1}{x}$ and the lines y = 0 and x = t (t > 1) is 1 sq. unit, then t is equal to :

(1) $e^{\frac{2}{3}}$ (2) $e^{\frac{3}{2}}$ (3) $\frac{3}{2}$ (4) $\frac{4}{3}$

5. If the length of the latus rectum of an ellipse is 4 units and the distance between a focus and its nearest vertex on the major axis is $\frac{3}{2}$ units, then its eccentricity is :

(1) $\frac{2}{3}$ (2) $\frac{1}{2}$ (3) $\frac{1}{9}$ (4) $\frac{1}{3}$

6. The number of numbers between 2,000 and 5,000 that can be formed with the digits 0, 1, 2, 3, 4 (repetition of digits is not allowed) and are multiple of 3 is :

(1) 36 (2) 30 (3) 24 (4) 48

7. Two different families A and B are blessed with equal number of children. There are 3 tickests to be distributed amongst the children of these families so that no child gets more than one ticket. If the probability that all the tickets go to the children of the family B is $\frac{1}{12}$, then the number of children in each family is :

(1) 6 (2) 5 (3) 3 (4) 4

8. $\lim_{x\to 0} \frac{(27+x)^{\frac{1}{3}}-3}{9-(27+x)^{\frac{2}{3}}}$ equals :

(1) $-\frac{1}{6}$ (2) $\frac{1}{6}$ (3) $\frac{1}{3}$ (4) $-\frac{1}{3}$

9. Let p, q and r be real numbers ($p \neq q$, $r \neq 0$), such that the roots of the equation $\frac{1}{x+p}+\frac{1}{x+q}=\frac{1}{r}$ are equal in magnitude but opposite in sign, then the sum of squares of these roots is equal to :

(1) $p^2 + q^2$ (2) $\frac{p^2+q^2}{2}$ (3) $2(p^2 + q^2)$ (4) $p^2 + q^2 + r^2$

10. Let $\frac{1}{x_1}, \frac{1}{x_2}, \ldots, \frac{1}{x_n}$ ($x_i \neq 0$ for i = 1, 2, …., n) be in A.P. such that $x_1 = 4$ and $x_{21} = 20$. If n is the least positive integer for which $x_n > 50$, then $\sum_{i=1}^{n}\left(\frac{1}{x_i}\right)$ is equal to :

(1) 3 (2) $\frac{1}{8}$ (3) $\frac{13}{4}$ (4) $\frac{13}{8}$

11. The differential equation representing the family of ellipses having foci either on the x-axis or on the y-axis, centre at the origin and passing through the point (0, 3) is :

(1) $xy\,y' - y^2 + 9 = 0$ (2) $xy\,y'' + x(y')^2 - y\,y' = 0$
(3) $xy\,y' + y^2 - 9 = 0$ (4) $x + y\,y'' = 0$

12. The sum of the intercepts on the coordinate axes of the plane passing trhough the point (–2, –2, 2) and containing the line joining the points (1, –1, 2) and (1, 1, 1), is :

(1) 4 (2) 12 (3) –8 (4) –4

13. Let A = $\begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ and B = A^{20}. Then the sum of the elements of the first column of B is :

(1) 210 (2) 211 (3) 251 (4) 231

14. Let A, B and C be three events, which are pair-wise independent and $\bar{E}$ denotes the complement of an event E. If $P(A \cap B \cap C) = 0$ and $P(C) > 0$, then $P[(\bar{A} \cap \bar{B}) | C]$ is equal to :

(1) $P(\bar{A}) - P(B)$ (2) $P(\bar{A}) - P(\bar{B})$ (3) $P(\bar{A}) + P(\bar{B})$ (4) $P(A) + P(\bar{B})$

15. If $p \rightarrow (\sim p \vee \sim q)$ is false, then the truth values of p and q are respectively :

(1) F, F (2) T, T (3) F, T (4) T, F

16. If the function f defined as $f(x) = \frac{1}{x} - \frac{k-1}{e^{2x}-1}$, $x \neq 0$, is continuous at x = 0, then the ordered pair (k, f(0)) is equal to :

(1) (2, 1) (2) (3, 1) (3) (3, 2) (4) $\left(\frac{1}{3}, 2\right)$

17. If the angle between the lines, $\frac{x}{2}=\frac{y}{2}=\frac{z}{1}$ and $\frac{5-x}{-2}=\frac{7y-14}{p}=\frac{z-3}{4}$ is $\cos^{-1}\left(\frac{2}{3}\right)$, then p is equal to :

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

18. The locus of the point of intersection of the lines, $\sqrt{2}\,x - y + 4\sqrt{2}\,k = 0$ and $\sqrt{2}\,kx + ky - 4\sqrt{2} = 0$ (k is any non-zero real parameter), is :

(1) an ellipse whose eccentricity is $\frac{1}{\sqrt{3}}$.

(2) a hyperbola whose eccentricity is $\sqrt{3}$

(3) a hyperbola with length of its transverse axis $8\sqrt{2}$.

(4) an ellipse with length of its major axis $8\sqrt{2}$.

19. A man on the top of a vertical tower observes a car moving at a uniform speed towards the tower on a horizonatal road. If it takes 18 min. for the angle of depression of the car to change from 30° to 45° ; then after this, the time taken (in min.) by the car to reach the foot of the tower, is :

(1) $\frac{9}{2}(\sqrt{3} - 1)$ (2) $18(1 + \sqrt{3})$ (3) $18(\sqrt{3} - 1)$ (4) $9(1 + \sqrt{3})$

20. If an angle A of a ΔABC satisfies 5 cosA + 3 = 0, then the roots of the quadratic equaiton, $9x^2 + 27x + 20 = 0$ are :

(1) sec A, cotA (2) secA, tanA (3) tanA, cosA (4) sinA, secA

21. If a circle C, whose radius is 3, touches externally the circle, $x^2 + y^2 + 2x - 4y - 4 = 0$ at the point (2, 2), then the length of the intercept cut by this circle C, on the x-axis is equal to :

(1) $2\sqrt{3}$ (2) $\sqrt{5}$ (3) $3\sqrt{2}$ (4) $2\sqrt{5}$

22. Let P be a point on the parabola, $x^2 = 4y$. If the distance of P from the centre of the circle, $x^2 + y^2 + 6x + 8 = 0$ is minimum, then the equation of the tangent to the parabola at P, is :

(1) $x + y + 1 = 0$ (2) $x + 4y - 2 = 0$ (3) $x + 2y = 0$ (4) $x - y + 3 = 0$

23. If $f(x) = \int_0^x t(\sin x - \sin t)\,dt$ then :

(1) $f'''(x) - f''(x) = \cos x - 2x \sin x$ (2) $f'''(x) + f''(x) - f'(x) = \cos x$

(3) $f'''(x) + f''(x) = \sin x$ (4) $f'''(x) + f'(x) = \cos x - 2x \sin x$

24. The number of values of k for which the system of linear equations,

$(k + 2)x + 10y = k$

$kx + (k + 3)y = k - 1$ has no soution, is :

(1) 1 (2) 2 (3) 3 (4) 4

25. If $\int \frac{\tan x}{1 + \tan x + \tan^2 x}\,dx = x - \frac{K}{\sqrt{A}} \tan^{-1}\left(\frac{K \tan x + 1}{\sqrt{A}}\right) + C$, (C is a constant of integration), then the ordered pair (K, A) is equal to

(1) (2, 1) (2) (2, 3) (3) (–2, 1) (4) (–2, 3)

26. The least positive integer n for which $\left(\frac{1+i\sqrt{3}}{1-i\sqrt{3}}\right)^n = 1$, is

(1) 2 (2) 5 (3) 6 (4) 3

27. The sum of the first 20 terms of the series $1 + \frac{3}{2} + \frac{7}{4} + \frac{15}{8} + \frac{31}{16} + \ldots$, is :

(1) $39 + \frac{1}{2^{19}}$ (2) $38 + \frac{1}{2^{20}}$ (3) $38 + \frac{1}{2^{19}}$ (4) $39 + \frac{1}{2^{20}}$

28. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{c} = \hat{j} - \hat{k}$ and a vector $\vec{b}$ be such that $\vec{a} \times \vec{b} = \vec{c}$ and $\vec{a} \cdot \vec{b} = 3$. Then $|\vec{b}|$ equals :

(1) $\frac{11}{3}$ (2) $\frac{11}{\sqrt{3}}$ (3) $\sqrt{\frac{11}{3}}$ (4) $\frac{\sqrt{11}}{3}$

29. The mean and the standard deviation (s.d.) of five observations are 9 and 0, respectively. If one of the observations is changed such that the mean of the new set of five observations becomes 10, then their s.d. is :

(1) 0 (2) 2 (3) 4 (4) 1

30. Let M and m be respectively the absolute maximum and the absolute minimum values of the function, $f(x) = 2x^3 - 9x^2 + 12x + 5$ in the interval [0, 3]. Then M – m is equal to :

(1) 9 (2) 4 (3) 1 (4) 5

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