MOTION™

SAMPLE PAPER – JEE MAIN

Duration: 3 Hours	Max. Marks : 300

INSTRUCTIONS

In each part of the paper contains **30** questions. Please ensure that the Questions paper you have received contains ALL THE QUESTIONS in each Part.

In each Part of The paper **Section A** Contain **20 Questions**. Each Question has four choices (A), (B), (C), (D) out of which **only one is correct** & carry **4 marks** each. **1 mark** will be deducted for each wrong answer.

In each Part of The paper **Section B** Contains **10 Numeric Value type questions. Candidates have to attempt any 5 Ques. out of 10**. For each question, enter the correct numerical value ((If the numerical value has more than two decimal places, truncate/ round-off the value to TWO decimal places; e.g. 6.25, 7.00, 0.33, 30.27, 127.30.)

Each Question Carry **4 Marks** & **No** Negative marking in these Section.

NOTE : GENERAL INSTRUCTION FOR FILLING THE OMR ARE GIVEN BELOW.

1. Use only **blue/black pen (avoid gel pen)** for darkening the bubble.
2. Indicate the correct answer for each question by filling appropriate bubble in your OMR answer sheet.
3. The Answer sheet will be checked through computer hence, the answer of the question must be marked by shading the circles against the question by dark **blue/black pen**.
4. Blank papers, Clipboards, Log tables, Slide Rule, Calculators, Cellular Phones, Pagers and Electronic Gadgets in any form are **not** allowed to be carried inside the examination hall.

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PART - I [MATHEMATICS]

SECTION - A

[STRAIGHT OBJECTIVE TYPE]

Q.1 to ***Q.20*** has four choices (A), (B), (C), (D) out of which ***ONLY ONE*** is correct

1. Number of ways of selection of 4 letters of the word " PERFECT" is

(A) 15 (B) 21
(C) 25 (D) 31

2. A pole 50m high on a building 250m high. An observer at a height of 300m from ground the building and pole subtend equal angle θ. If horizontal distance of observer and pole is 'x'. Then

(A) $x = 25\sqrt{3}$m (B) $x = 25\sqrt{6}$m
(C) $x = 5\sqrt{3}$m (D) $x = 5\sqrt{6}$m

3. The negation of the compound proposition $p \vee (\sim p \vee q)$ is

(A) $(p \wedge \sim q) \wedge \sim p$ (B) $(p \wedge \sim q) \vee \sim p$
(C) $(p \vee \sim q) \vee \sim p$ (D) None of these

4. If $A^3 = 0$ then $I+A+A^2$ equals:-

(A) $I-A$ (B) $(I-A)^{-1}$
(C) $(I+A)^{-1}$ (D) I

5. If $x^2 + y^2 + z^2 = 1$, where $x, y, z \in R^+$ then greatest value of $x^2y^3z^4$ is

(A) $\frac{2^5}{3^{15/2}}$ (B) $\frac{2^{10}}{3^{15}}$ (C) $\frac{2^{10}}{3^{9/2}}$ (D) $\frac{2^{12}}{3^9}$

6. A coin is tossed 7 times, Then probability that at least 4 consecutive heads appear is :

(A) $\frac{3}{16}$ (B) $\frac{5}{32}$ (C) $\frac{1}{8}$ (D) $\frac{1}{4}$

7. If $p,q,r,s \in R$ then equation :
$(x^2 + px + 3q)(-x^2 + rx + q)$
$(-x^2 + sx - 2q) = 0$ has

(A) 6 real roots
(B) at least two real roots
(C) 2 real and 4 imaginary roots
(D) 4 real & 2 Imaginary roots

(SPACE FOR ROUGH WORK)

8. The solution set of inequality $(\tan^{-1}x)(\cot^{-1}x) - (\tan^{-1}x)\left(1+\frac{\pi}{2}\right) - 2\cot^{-1}x + 2\left(1+\frac{\pi}{2}\right) > \lim\limits_{x\to-\infty}\left[\sec^{-1}x - \frac{\pi}{2}\right]$ is (where [.] denotes the greatest integer function)

(A) (tan1, tan2) (B) (–cot1, cot2)
(C) (–tan1, tan2) (D) (–tan1, ∞)

9. If $w = \frac{z-(1/5)i}{z}$ and $|w| = 1$, then complex number z lies on

(A) a parabola (B) a circle
(C) a line (D) none of these

10. $(x+\sqrt{x^3-1})^5 + (x-\sqrt{x^3-1})^5$ is a polynomial of the order of -

(A) 5 (B) 6 (C) 7 (D) 8

11. Let $f(x) = \begin{cases} \frac{\sin ax^2}{x^2}; & x \neq 0 \\ \frac{3}{4}+\frac{1}{4a}; & x = 0 \end{cases}$

for what values of a, f(x) is continuous at x = 0:

(A) 1, –1/4 (B) 1, 0
(C) 1/4, 1 (D) None

12. If $f(x) = \frac{10^x - 10^{-x}}{10^x + 10^{-x}} + 2$; then $f^{-1}(y)$ = ?

(A) $\frac{1}{2}\log_{10}\left(\frac{y-1}{y-3}\right)$ (B) $\frac{1}{2}\log_{10}\left(\frac{y-3}{y-1}\right)$

(C) $\frac{1}{2}\log_{10}\left(\frac{y-1}{3-y}\right)$ (D) $\frac{1}{2}\log_{10}\left(\frac{y-1}{y}\right)$

13. If $f(x) = \begin{vmatrix} x^2+3x & x-1 & x-3 \\ x+1 & 2-x & x-3 \\ x-3 & x+4 & 3x \end{vmatrix}$,

then f '(0) is equal to

(A) – 39 (B) 64
(C) 24 (D) 52

14. $\lim\limits_{n\to\infty} n\left\{\frac{1}{(n+1)(n+2)} + \frac{1}{(n+2)(n+4)} + \ldots\ldots + \frac{1}{6n^2}\right\}$ =

(A) log (3/2) (B) log (2/3)

(C) $\frac{1}{3}\log 2$ (D) $\frac{1}{2}\log 3$

15. The area bounded by the loop of the curve $4y^2 = x^2(4 - x^2)$ is

(A) 7/3 sq. units (B) 8/3 sq. units
(C) 11/3 sq. units (D) 16/3 sq. units

(SPACE FOR ROUGH WORK)

16. Equation of the curve satisfying

$xdy - ydx = \sqrt{x^2 - y^2}\ dx$; $y(1) = 0$ is :-

(A) $y = x^2 \sin(\log x)$ (B) $y^2 = x(x-1)^2$

(C) $y^2 = x^2(x-1)$ (D) $y = x\sin(\log x)$

17. Let $\alpha_0, \alpha_1, \alpha_2, \ldots\ldots, \alpha_{n-1}$ be the n distinct n^{th} roots of the unity, then the value of $\sum_{r=0}^{n-1} \frac{\alpha_r}{3-\alpha_r}$ is equal to

(A) $\frac{n}{3^n - 1}$ (B) $\frac{n-1}{3^n - 1}$

(C) $\frac{n+1}{3^n - 1}$ (D) $\frac{n+2}{3^n - 1}$

18. A pole inclined from vertical at 15° towards the sun. Length of the shadow of the pole is $\sqrt{3} + 1$ meter at the time when angle of elevation of the sun is 30°, then length of pole is

(A) $\frac{\sqrt{3}-1}{\sqrt{2}}$ m (B) $\frac{\sqrt{2}}{\sqrt{3}-1}$ m

(C) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$ m (D) $\frac{1}{\sqrt{2}}$ m

19. Let $\alpha \in R$ and the three vectors ,
$\vec{a} = \alpha\hat{i} + \hat{j} + 3\hat{k}$ $\vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}$ and $\vec{c} = \alpha\hat{i} - 2\hat{j} + 3\hat{k}$. Then the set S = {α : $\vec{a}$, $\vec{b}$ and $\vec{c}$ are coplanar}

(A) is singleton

(B) Contains exactly two numbers only one of which of positive

(C) Contains exactly two positive numbers

(D) is empty

20. The length of the perpendicular drawn from the point (2, 1, 4) to the plane containing the lines

$\vec{r} = (\hat{i} + \hat{j}) + \lambda(\hat{i} + 2\hat{j} - \hat{k})$

and $\vec{r} = (\hat{i} + \hat{j}) + \mu(-\hat{i} + \hat{j} - 2\hat{k})$ is:

(A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$

(C) $\frac{1}{3}$ (D) 3

SECTION – B

[NUMERICAL VALUE TYPE]

Q.1 to ***Q.10*** are **NUMERIC VALUE TYPE** Questions. **Candidates have to attempt any 5 Ques. out of 10.**

(SPACE FOR ROUGH WORK)

1. How many ways 5 balls can be placed in 3 boxes such that no box remains empty if balls as well as boxes are identical ?

2. Let f:(-3, 3) $\rightarrow$ R be a differentiable function with f(0) = -2, and f'(0) = -1 and g(x) = $(f(3f(x) + 6))^3$. then g'(0) is equal to .

3. At present a firm is manufacturing 2000 items. It is estimated that the rate of change of production P w.r.t. additional number of workers x is given by $\frac{dP}{dx} = 100 - 12\sqrt{x}$. If the firm employs 25 more workers, them the new level production of items is:

4. Given vectors

$\vec{p} = (a+1)\hat{i} + a\hat{j} + a\hat{k}$

$\vec{q} = a\hat{i} + (a+1)\hat{j} + a\hat{k}$

$\vec{r} = a\hat{i} + a\hat{j} + (a+1)\hat{k}$

are coplanar and $3(\vec{p}.\vec{q})^2 - \lambda\,|\vec{r}\times\vec{q}|^2 = 0$ then λ =

5. Numbers of complex numbers satisfying $|z| = 1$ and $\left|\frac{z}{\bar{z}} + \frac{\bar{z}}{z}\right| = 1$ is

.

6. The number of solutions of system of equations $2\sin^2 x + \sin^2 2x = 2\sin 2x + \cos 2x = \tan x$ in $[0, 4\pi]$ satisfying $2\cos^2 x + \sin x \le 2$ is

7. $\underset{x\to\frac{\pi}{2}}{Lim} \frac{\sin x - (\sin x)^{\sin x}}{1 - \sin x + \ln(\sin x)}$ is equal to

8. Let a = 8 and b = 3^9 and we define a sequence $\{u_n\}$ as follows u_1 = b,

$u_{n+1} = \begin{cases} \frac{1}{3}u_n; & \text{if } u_n \text{ is multiple of 3} \\ u_n + a; & \text{otherwise} \end{cases}$

then

$u_{500} - u_{300} - u_{400}$ is equal to

9. Let A = $[a_{ij}]_{3\times 3}$, B = $[b_{ij}]_{3\times 3}$ where $b_{ij} = 3^{i-j}a_{ij}$ and C = $[c_{ij}]_{3\times 3}$, where $c_{ij} = 4^{i-j}b_{ij}$ be any three matrices. If det. A = 2, then det. B + det. C is equal to

(SPACE FOR ROUGH WORK)

10. If $\sqrt{a}+\sqrt{d}=\sqrt{c}+\sqrt{b}$ and ad = bc, where a,b,c,d $\in R^+$ then the family of lines $(a^2x+b^2y+c^2)+d^2x=0$ passes through a fixed point $M(x_0,y_0)$. Find the value of $\left(x_0^{-1}+y_0^{-1}\right)+1$

(SPACE FOR ROUGH WORK)

PART - II [PHYSICS]

SECTION - A
[STRAIGHT OBJECTIVE TYPE]

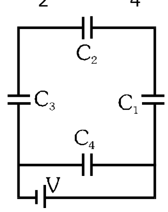
Q.1 to ***Q.20*** has four choices (A), (B), (C), (D) out of which ***ONLY ONE*** is correct

1. A particle of mass m_1 is moving with a velocity v_1 and another particle of mass m_2 is moving with a velocity v_2. Both of them have the same momentum but their different kinetic energies are E_1 and E_2 respectively. If $m_1 > m_2$ then :

(A) $E_1 < E_2$ (B) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$

(C) $E_1 > E_2$ (D) $E_1 = E_2$

2. A network of four capacitors of capacity equal to C_1=C, C_2=2C, C_3=3C and C_4=4C are connected to a battery as shown in the figure. The ratio of the charges on C_2 and C_4 is



(A) $\frac{7}{4}$ (B) $\frac{22}{3}$

(C) $\frac{3}{22}$ (D) $\frac{4}{7}$

3. The moment of inertia of a uniform circular disc of radius 'R' and mass 'M' about an axis passing from the edge of the disc and normal to the disc is-

(A) $\frac{1}{2}$ MR^2 (B) $\frac{7}{2}$ MR^2

(C) $\frac{3}{2}$ MR^2 (D) MR^2

4. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates :-

(A) Decreases

(B) Does not change

(C) Becomes zero

(D) Increases

5. Two bodies have their moments of inertia I and 2I resepctively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio-

(A) 1 : 2 (B) $\sqrt{2} : 1$

(C) $1 : \sqrt{2}$ (D) 2 : 1

(SPACE FOR ROUGH WORK)

6. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by μ_d, μ_p and μ_f respectively, then :-

(A) $\mu_p = 0$ and $\mu_f \neq 0$

(B) $\mu_d \neq 0$ and $\mu_p = 0$

(C) $\mu_d \neq 0$ and $\mu_f \neq 0$

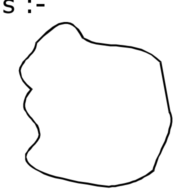
(D) $\mu_d = 0$ and $\mu_p \neq 0$

7. An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to

(A) $\sqrt{\frac{v}{B}}$ (B) $\frac{v}{B}$

(C) $\frac{B}{v}$ (D) $\sqrt{\frac{B}{v}}$

8. As a result of change in the magnetic flux linked to the closed loop shown in the figure, an e.m.f. V volt is induced in the loop. The work done (joules) in taking a charge Q coulomb once along the loop is :-



(A) QV (B) QV/2

(C) 2QV (D) शून्य

9. A particle executing simple harmonic motionof amplitude 5 cm has maximum speed of 31.4 cm/s. The frequency of oscillation is :

(A) 1 Hz (B) 3 Hz

(C) 2 Hz (D) 4 Hz

10. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45º. The value of C is-

(A) $\frac{1}{2\pi f(2\pi fL - R)}$ (B) $\frac{1}{2\pi f(2\pi fL + R)}$

(C) $\frac{1}{\pi f(2\pi fL - R)}$ (D) $\frac{1}{\pi f(2\pi fL + R)}$

11. A wave in a string has an amplitude of 2cm. The wave travels in the +ve direction of x-axis with a speed of 128 m/sec and it is noted that 5 complete waves fit in 4m length of the string. The equation describing the wave is-

(A) y = (0.02)m sin(7.85x – 1005t)

(B) y = (0.02)m sin(7.85x + 1005t)

(C) y = (0.02)m sin(15.7x – 2010t)

(D) y = (0.02)m sin(15.7x + 2010t)

12. The pressure exerted by an electromagnetic wave of intensity I (Wm^{-2}) on a non-reflecting surface is (c is the velocity of light)

(A) Ic (B) Ic^2

(C) I/c (D) I/c^2

(SPACE FOR ROUGH WORK)

13. Which one of the following statements is true-
(A) Both light and sound waves in air are transverse
(B) The sound waves in air are longitudinal while the light waves are transverse
(C) Both light and sound waves in air are longitudinal
(D) Both light and sound waves can travel in vacuum

14. The work functions for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5eV. According to Einstein's equation, the metals which will emit photo electrons for a radiation of wavelength 4100Å is/are :-
(A) None
(B) A only
(C) A and B only
(D) All the three metals

15. A quantity y is related to another quantity x by the equation $y = kx^a$ where k and a are constant. If percentage error in the measurement of x is p, then error in y depends upon
(A) k and a (B) x and a
(C) p and a (D) p, k and a all

16. An electron and proton are accelerated through same potential, then λ_e/λ_p will be
(A) 1 (B) m_e/m_p
(C) m_p/m_e (D) $\sqrt{m_P / m_e}$

17. An ideal gas heat engine operater in carnot cycle between 227°C and 127°C. It absorbs 6×10^4 cals of heat at higher temperature Amount of heat converted to work is.
(A) 2.4×10^4 cals (B) 6×10^4 cals
(C) 1.2×10^4 cals (D) 4.8×10^4 cals

18. The nuclei of which one of the following pairs of nuclei are isotones :-
(A) ${}_{34}Se^{74}$, ${}_{31}Ga^{71}$ (B) ${}_{38}Sr^{84}$, ${}_{38}Sr^{86}$
(C) ${}_{42}Mo^{92}$, ${}_{40}Zr^{92}$ (D) ${}_{20}Ca^{40}$, ${}_{16}S^{32}$

19. The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is-
(A) $\frac{7}{5}$ (B) $\frac{8}{7}$
(C) $\frac{5}{7}$ (D) $\frac{9}{7}$

(SPACE FOR ROUGH WORK)

20. Energy levels A, B and C of a certain atom correspond to increasing values of energy i.e. $E_A<E_B<E_C$. If λ_1, λ_2 are λ_3 wave lengths of radiations corresponding to transitions C to B, B to A and C to A respetively, which of the following relaitons is correct ?

(A) $\lambda_1, \lambda_2+\lambda_3$ (B) $\lambda_1+\lambda_2+\lambda_3 = 0$

(C) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$ (D) $\lambda_3 = \dfrac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$

SECTION – B

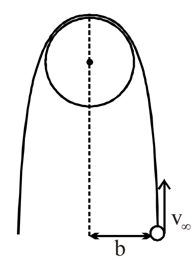
[NUMERICAL VALUE TYPE]

Q.1 to ***Q.10*** are **NUMERIC VALUE TYPE** Questions. **Candidates have to attempt any 5 Ques. out of 10.**

1. A body is projected horizontally near the surface of the earth with $\sqrt{1.5}$ times the orbital velocity. The maximum height up to which it will rise above the surface of the earth is 'n' times the radius of earth. Fill 'n' is OMR Sheet.

2. The magnetic field of a beam emerging from a filter facing a floodlight is given by $B_0 = 12 \times 10^{-8} \sin (1.20 \times 10^7 z - 3.60 \times 10^{15} t)$ T. What is the average intensity of the beam ?

3. A small meteor approaches a planet on a hyperbolic path as shown. When it is at a large distance, it has a velocity v_∞ and impact parameter b = 8000 km. The escape speed from the planet is 6 km/s. What should be v_∞ (in km/s) so that the meteor just grazes the planet. The radius of planet is 6400 km.

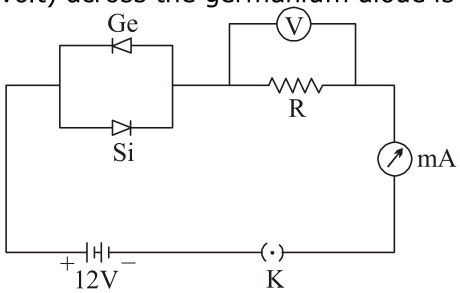


4. A 1 KW signal is transmitted using a communication channel which provides attenuation at the rate of –2dB per km. If the communication channel has a total length of 5 km, the power (in W) of the signal received is

[gain in dB = $10 \log\left(\dfrac{P_0}{P_t}\right)$]

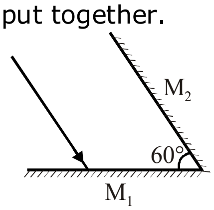
(SPACE FOR ROUGH WORK)

5. Germanium and silicon junction diodes are connected in parallel. These are connected in series with a resistance R, a milliammeter (mA) and a key (K) as shown in fig. When key (K) is closed a current begins to flow in the milliammeter. The potential drop (in volt) across the germanium diode is



6. What is the maximum height (in m) of a brick column of uniform cross section for which column deformation due to its own weight is within the elastic limit? [$P_{atmospheric}$ = 100 kPa, $\rho = 1.8 \times 10^3$ kg/m^3. Elastic limit, σ = 3.7 M Pa.]

7. Two identical plane mirrors are separated by 60°, as the drawing illustrates. If a ray strikes mirror M_1 at its midpoint parallel to M_2, how many total reflections will occur from both mirrors put together.



8. N^{th} level of Li^{2+} has the same energy as the ground state energy of the hydrogen atom. If r_N and r_1 is the radii of the N^{th} Bohr orbit of Li^{2+} and H atom respectively, then the ratio r_N/r_1 is

9. Deuterium ions (deuterons) are accelerated to an energy of 2.0 MeV, and they strike a tritium target. As a result of the collision, fusion reaction occurs. Determine the kinetic energy (in MeV) of neutrons emitted perpendicular to the beam of incident deuterons. The fusion reaction is accompanied by the emission of one neutron. Approximate your answer to the nearest integer. For Q value, Take : m_D = 2.014 amu, m_T = 3.016 amu, m_{He} = 4.002 amu, m_n = 1.008 amu. Take 1 amu = 900 MeV.

10. A motorboat covers a given distance in 6 hr moving downstream on a river. It covers the same distance in 10 hr moving upstream. If the time it takes to cover the same distance in still water is t, then write $\frac{t}{2.5}$ in hrs.

(SPACE FOR ROUGH WORK)

PART - III [CHEMISTRY]

SECTION - A

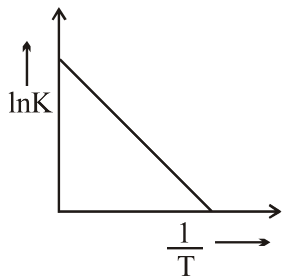
[STRAIGHT OBJECTIVE TYPE]

Q.1 to ***Q.20*** has four choices (A), (B), (C), (D) out of which ***ONLY ONE*** is correct

1. For the reaction,

$AB_2(g) + A(s) \rightleftharpoons B_2(g) + A_2(g)$,

following graph is obtained



where $K \rightarrow$ Equilibrium Constant

$T \rightarrow$ Temperature in Kelvin

Which of the following will increase the concentration of AB_2 at equilibrium.

(A) Adding more of A (s)

(B) Decreasing temperature

(C) Adding inert gas at constant volume

(D) Increasing the volume of container

2. The degree of hydrolysis of 0.1 M NaCN solution is 4%. What will be the solubility of $Al(OH)_3$ in this solution.

$[K_{sp\ Al(OH)_3} = 6.4 \times 10^{-20}]$

(A) 0.04 mol L^{-1}

(B) 10^{-15} mol L^{-1}

(C) 10^{-12} mol L^{-1}

(D) 1.6×10^{-7} mol L^{-1}

3. Surfactant molecules can cluster together as micelles, which are colloid sized cluster of molecules. Micelles form only above critical micelle concentration (CMC) and above certain temperature called Kraft temperature. ΔH of micelle formation can be positive or negative. Which of the following is **NOT TRUE** about micelle formation?

(A) ΔS of micelle formation is positive

(B) the hydrophobic part lie towards interior of micelle

(C) the hydrophilic part lie towards surface of micelle

(D) ΔS of micelle formation is negative

(SPACE FOR ROUGH WORK)

4. Identify the **correct** statement.
(A) Half life of first order reaction is independent of temperature
(B) For zero order reaction half life depends on initial concentration of reactant.
(C) A reactant molecule having sufficient energy must get converted into product.
(D) First order reaction must be complex

5. If ε_0 be the permittivity of vacuum and r be the radius of orbit of H-atom in which electron is revolving then velocity of electron is given by :
(A) $v = \frac{e}{\sqrt{4\pi\varepsilon_0 rm}}$ (B) $v = e \times \sqrt{4\pi\varepsilon_0 rm}$
(C) $v = \frac{4\pi\varepsilon_0 rm}{e}$ (D) $v = \frac{4\pi\varepsilon_0 rm}{e^2}$

6. $Na_2CrO_4 + H_2SO_4 \rightarrow$
For the above said reaction select correct statement -
(A) It is a redox reaction in which green solution of $[Cr(H_2O)_6]^{3+}$ is produced.
(B) One of the product in reaction has trigonal planer structure.
(C) Dimeric bridged tetrahedral complex is produced.
(D) Dark blue colour is obtained in reaction.

7. When heated above 916ºC, iron changes its bcc crystalline form to fcc without the change in the radius of atom. The ratio of density of the crystal before heating and after heating is :
(A) 1.069 (B) 0.918
(C) 0.725 (D) 1.231

8. Which of the following metal nitrate can show given change.
Aqueous solution of metal nitrate $\xrightarrow[NH_4OH]{Excess}$ (No change in colour and no precipitate in test tube)
(A) $Pb(NO_3)_2$ (B) $Fe(NO_3)_2$
(C) $AgNO_3$ (D) $Hg(NO_3)_2$

9. When sodium is gradually added to liquid NH_3 then which of the following property do not change ?
(A) Magnetic moment
(B) Electrical Conductivity
(C) Colour
(D) Oxidation state of Nitrogen

10. Which of the following would not give disproportionation reaction on hydrolysis?
(A) KO_2 (B) N_2O_5
(C) XeF_4 (D) K_2O_2

(SPACE FOR ROUGH WORK)

11. If number of monovalent oxygen and number of divalent oxygen per tetrahedral unit of silicate are equal then the silicate can be :

(A) Soro silicate (B) Neso silicate

(C) Pyroxene (D) Sheet silicate

12. For carbonates of alkali metals as we move down the group what will be the correct order of covalent characters, solubility and thermal stability -

(A) Increase, Decrease, Increase

(B) Decrease, Increase, Increase

(C) Increase, Increase, Decrease

(D) Decrease, Decrease, Increase

13. Select correct order of stability of following oxides.

(A) $Cl_2O > Br_2O > I_2O$

(B) $Cl_2O > I_2O > Br_2O$

(C) $I_2O > Cl_2O > Br_2O$

(D) $I_2O > Br_2O > Cl_2O$

14. Which of the following properties does not belong to the complex formed in Mond's process.

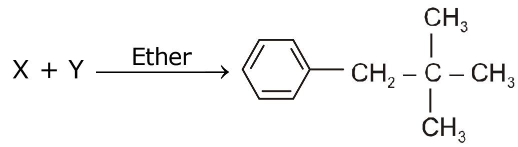
(A) It is diamagnetic

(B) It follows 18 electron rule

(C) It is square planar

(D) Volatile at 100°C

15. The best yield of given product can be obtained by using which set of reactants X and Y respectively



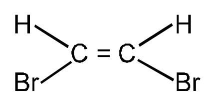
(A) PhLi + Neopentyl chloride

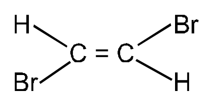
(B) PhMgBr + Neopentyl bromide

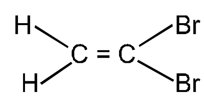
(C) t-Bu–MgBr + Benzyl bromide

(D) Benzylchloride + t-Butyl chloride $\xrightarrow{Na}$

16. Which of the following isomers having molecular formula $C_2H_2Br_2$ has highest dipole moment and boiling point but lowest melting point ?

(A) 

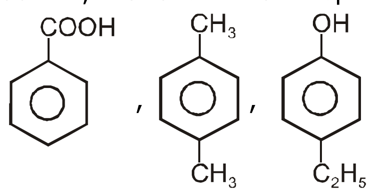
(B) 

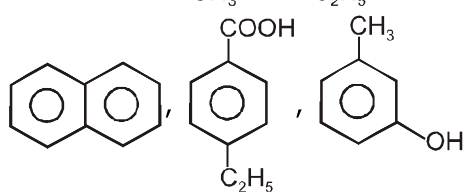
(C) 

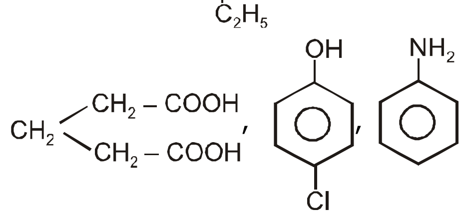
(D) Not applicable to any single isomer

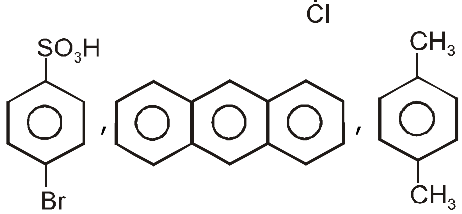
(SPACE FOR ROUGH WORK)

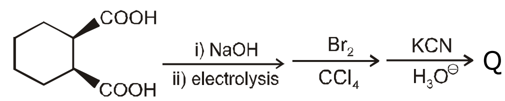
17. When the mixture of [A + B + C] is dissolved in $NaHCO_3$, A dissolves in $NaHCO_3$, B & C remain as a residue after that residue dissolves in aq. NaOH, C dissolves in it and B remains as residue. A, B and C will be respectively.

(A) 

(B) 

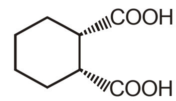
(C) 

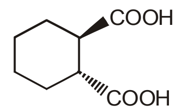
(D) 

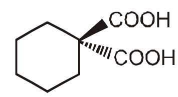
18. 

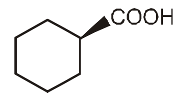
(P)

In the above reaction Q may be :

(A) 

(B) 

(C) 

(D) 

19. Which of the following is fully fluorinated polymer-

(A) Teflon
(B) Neoprene
(C) PVC
(D) Thiokol

20. Which is incorrect in following –

(A) polysaccharides are amorphous, insoluble in water and tasteless

(B) raffinose on hydrolysis gives glucose, fructose and galactose

(C) Monosaccharides cannot be hydrolysed to simpler compounds

(D) None of these

(SPACE FOR ROUGH WORK)

SECTION – B

[NUMERICAL VALUE TYPE]

Q.21 *to* ***Q.25*** *are* ***NUMERIC VALUE TYPE*** *Questions.*

1. Consider the following cell

Pt | $H_2(P_1 atm)$ | H^+ (M_1) | | H^+ (M_2) | H_2 $(P_2$ atm) | Pt

Where P_1 and P_2 are pressures. M_1 and M_2 are molarities.

What will be the emf of cell at 25°C if $P_1 = P_2$ and M_1 is 50% higher than M_2? Repeat the magnitude of emf by multiplying with 10000.

[Take : $\frac{2.303RT}{F} = 0.06$ **and log 3 = 0.48 , log 2 = 0.3]**

2. An unknown compound A dissociates at 500ºC to give products as follows -

$$A(g) \rightleftharpoons B(g) + C(g) + D(g)$$

Vapour density of the equilibrium mixture is 60 when it dissociates to the extent to 20%. What will be the molecular weight of Compound A –

3. At 500 kilobar pressure density of diamond and graphite are 3 g/cc and 2 g/cc respectively, at certain temperature 'T'. Find the value of $|\Delta H - \Delta U|$ (kJ /mole) for the conversion of 1 mole of graphite to 1 mole of diamond at temperature 'T' .

4. The following sequence of reaction occurs in commercial production of aqueous nitric acid.

$$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l) \quad \Delta H = -904kJ \quad ...(1)$$
$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g) \quad \Delta H = -112kJ \quad ...(2)$$
$$3NO_2(g) + H_2O(l) \longrightarrow 2HNO_3(aq) + NO(g) \quad \Delta H = -140kJ \quad ...(3)$$

Determine the total heat (in kJ/mole) liberated at constant pressure for the production of exactly 1 mole of aqueous nitric acid by this process.

5. How many P–O–P bonds are present in P_4O_{10}?

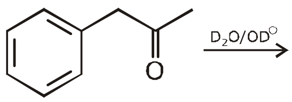
6. Give the total number of possible structural isomers of the compound $[\overset{II}{Cu}(NH_3)_4][\overset{II}{Pt}I_4]$.

7. Find the number of native ores out of given ores.

Pyrolusite, Chromite, Siderite, Cassiterite, Calamine, Argentite, Lime stone, Chalcopyrite.

(SPACE FOR ROUGH WORK)

8. Consider the following reaction



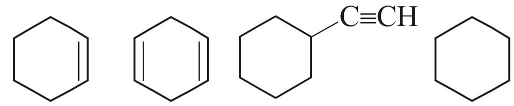
How many maximum H-atom can be exchanged by deutrium ?

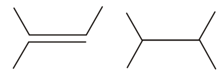
9. $HC \equiv CH \xrightarrow{2CH_3MgBr}$

$(A) \xrightarrow[\text{(ii) } HOH/H^{\oplus}]{\text{(i) } 2CO_2} (B) \xrightarrow[HgSO_4]{H_2SO_4} (C) \xrightarrow{\Delta} (D)$

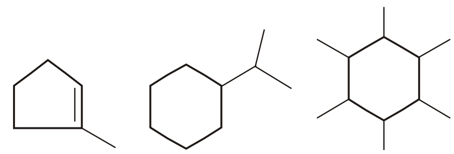
If the MW of D is x gm, then write your answer as $\frac{x}{2}$.

10. How many of the following ten compounds will decolourize Bayer's reagent as well as Br_2 water.





$Me - C \equiv C - Me$



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MOTION™

HINT & SOLUTION

SAMPLE PAPER – JEE MAIN

Duration: 3 Hours | Max. Marks : 300

PART - I [MATHEMATICS]

SECTION : A									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	B	A	B	A	B	B	C	C	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	B	A	D	D	A	B	D	A
SECTION : B									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2	36	3500	1	8	8	2	5	4	1

PART - II [PHYSICS]

SECTION : A									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A	C	C	D	B	D	A	A	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	B	C	D	D	C	A	A	D
SECTION : B									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2	1.71	8	100	0.7	200	2	3	15	3

PART - III [CHEMISTRY]

SECTION : A									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
B	**C**	**D**	**B**	**A**	**C**	**B**	**C**	**D**	**B**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	**B**	**C**	**C**	**C**	**C**	**A**	**B**	**A**	**D**
SECTION : B									
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
108	**168**	**100**	**493**	**6**	**4**	**0**	**5**	**44**	**6**

SECTION - A

1. **C**

7 letters

$P \to 1$

$E \to 2$

$R \to 1$

$F \to 1$

$C \to 1$

$T \to 1$

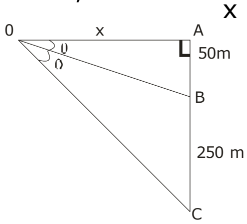
2 alike + 2 diff. $1 \times {}^5C_2 = 10$

All 4 different = ${}^6C_4 = 15 \Rightarrow 25$

2. **B**

$\Delta AOB,\ \tan\theta = \dfrac{50}{x}$ ....(1)

$\Delta AOC,\ \tan 2\theta = \dfrac{300}{x}$



$$\frac{2\tan\theta}{1-\tan^2\theta} = \frac{300}{x}$$

Put value of $\tan\theta$

3. **A**

$\sim[p \vee (\sim p \vee q)$

Demorgen's

$\sim p \wedge \sim (p \vee q)$

$\sim p \wedge (p \wedge \sim q)$

4. **B**

$(I-A)^{-1} = I + A + A^2 + A^3 + \ldots\ \propto = I + A + A^2$

5. **A**

6. **B**

$* \to$ Any Head or tail ; $P(H) = P(T) = \dfrac{1}{2}$,

$P(*) = 1$

for at least four consecutive heads, we havefollowingpatterns

$$\left.\begin{matrix} \text{(i)} & HHHH*** \\ \text{(ii)} & THHHH** \\ \text{(iii)} & *THHHH* \\ \text{(iV)} & **THHHH \end{matrix}\right] \Rightarrow \left(\frac{1}{2}\right)^4 1 + 3\left(\frac{1}{2}\right)^5 \Rightarrow \frac{5}{32}$$

7. **B**

$D_1 = p^2 - 12q.\ D_2 = r^2 + 4q;\ D_3 = s^2 - 8q$

Case I - If $q < 0$ then $D_1 > 0$, $D_3 > 0$ and D_2 may or may not be + ve

Case II - If $q > 0$ then $D_2 > 0$ and D_1, D_3 may or may not be + ve

Case III - If $q = 0$ then $D_1, D_2, D_3 \geq 0$

so, given equation has at least two real roots

8. **C**

$$(\tan^{-1}x - 2)\left(\cot^{-1}x - 1 - \frac{\pi}{2}\right) > 0$$

$\Rightarrow (\tan^{-1}x + 1)(\tan^{-1}x - 2) < 0$

$\Rightarrow -1 < \tan^{-1}x < 2$

$\Rightarrow -\tan 1 < x < \tan 2$

9. **C**

$|w| = 1 \Rightarrow |z - (1/5)i| = |z|$

$\Rightarrow |z - (1/5)i|^2 = |z|^2$

$\Rightarrow |x + iy - 1/5i]^2 = |x + iy|^2$

$\Rightarrow x^2 + (y - 1/5)^2 = x^2 + y^2$

$\Rightarrow -2/5y + 1/25 = 0$

$\Rightarrow 10y = 1$, which is a line .

10. **C**

$$(x + \sqrt{x^3 - 1})^5 + (x - \sqrt{x^3 - 1})^5$$

$= 2[x^5 + 5C_2.x^3(x^3 - 1) + 5C_4\, x(x^3 - 1)^2]$

$= 2[x^5 + 10x^3(x^3 - 1) + 5x(x^6 - 2x^3 + 1)]$

$= 10x^7 + 20x^6 + 2x^5 - 20x^4 - 20x^3 + 10x$

$\therefore$ polynomial has order of 7.

11. **A**

12. **C**

13. **B**

$$f(x) = \begin{vmatrix} x^2+3x & x-1 & x-3 \\ x+1 & 2-x & x-3 \\ x-3 & x+4 & 3x \end{vmatrix}$$

$f'(0) =$

$$\begin{vmatrix} 3 & -1 & -3 \\ 1 & 2 & -3 \\ 1 & 4 & 0 \end{vmatrix} + \begin{vmatrix} 0 & 1 & -3 \\ 1 & -1 & -3 \\ -3 & 1 & 0 \end{vmatrix} + \begin{vmatrix} 0 & -1 & 1 \\ 1 & 2 & 1 \\ -3 & 4 & 3 \end{vmatrix}$$

$= 36 + 3 - 6 + 9 + 6 + 6 + 10 = 64.$

14. **A**

$$S = \lim_{n\to\infty}\left\{\frac{1}{(n+1)(n+2)} + \frac{1}{(n+2)(n+4)} + \ldots\ldots + \frac{1}{(n+n)(n+2n)}\right\}$$

$$= \lim_{n\to\infty}\sum_{r=1}^{n}\frac{n^2}{(n+r)(n+2r)}.\frac{1}{n}$$

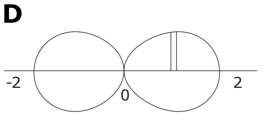
$$= \lim_{n\to\infty}\sum_{r=1}^{n}\frac{1}{\left(1+\frac{r}{n}\right)\left(1+\frac{2r}{n}\right)}.\frac{1}{n}\quad \frac{r}{n}\to x, \frac{1}{n}\to dx$$

$$a = \lim_{n\to\infty}(r/n)_{r=1} = 0, b = \lim\left(\frac{r}{n}\right)_{r=n} = 1$$

$$\Rightarrow S = \int_0^1\frac{dx}{(1+x)(1+2x)} = \int_0^1\left(\frac{2}{1+2x} - \frac{1}{1+x}\right)dx$$

$$= \left[\log(1+2x) - \log(1+x)\right]_0^1 = \log(3/2)$$

15. **D**



Given loop is

$4y^2 = x^2\,(4 - x^2)$

$$\text{Required area} = \frac{4}{2}\int_0^2 x\sqrt{4-x^2}.dx$$

$$= \left[\begin{array}{l}4 - x^2 = t^2\\ xdx = -tdt\end{array}\right.$$

$$= -2\int_2^0 t\quad tdt = -2\left(\frac{t^3}{3}\right)_2^0$$

$$= -\frac{2}{3}\left(0-8) = \frac{16}{3}\right)\text{sq. unit}$$

16. **D**

$$\frac{xdy - ydx}{x^2} = \sqrt{1-\left(\frac{y}{x}\right)^2}.\frac{dx}{x}$$

$$\frac{d\left(\frac{1}{x}\right)}{\sqrt{1-\left(\frac{y}{x}\right)^2}} = \left(\frac{dx}{x}\right) \Rightarrow \sin^{-1}\left(\frac{y}{x}\right) = \log x + C$$

$x = 1,\ y = 0$

$\Rightarrow C = 0$

$y = x\sin(\log x)$

17. **A**

$(z^n - 1) = (z - \alpha_0)\,(z - \alpha_1)\ \ldots\ldots\ (z - \alpha_{n-1})$

$\ln\,(z^n - 1) = \ln\,(z - \alpha_0) + \ln\,(z - \alpha_1)\ \ldots\ldots + \ln\,(z - \alpha_{n-1})$

$$\frac{n\cdot z^{n-1}}{z^n - 1} = \sum_{r=0}^{n-1}\frac{1}{z-\alpha_r} \Rightarrow \frac{n\cdot 3^{n-1}}{3^n - 1}$$

$$= \sum_{r=0}^{n-1}\frac{1}{3^n - \alpha_r}$$

$$\text{Now, } \sum_{r=0}^{n-1}\frac{\alpha_r}{3-\alpha_r} = \sum_{r=0}^{n-1}\left(\frac{3}{3-\alpha_r} - 1\right) = \frac{n\cdot 3^n}{3^n - 1} - n = \frac{n}{3^n - 1}$$

18. **B**

By sine rule

$$\frac{\sin 30^\circ}{\ell} = \frac{\sin 45^\circ}{\left(\sqrt{3}+1\right)}$$

$$\Rightarrow \ell = \frac{\sqrt{3}+1}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{3}-1}$$

19. **D**

$$\begin{vmatrix}\alpha & 1 & 3\\ 2 & 1 & -4\\ \alpha & -2 & 3\end{vmatrix} = 0$$

$\Rightarrow 3\alpha^2 + 18 = 0$

$\Rightarrow a \in \phi$

20. **A**

Perpendicular vector to the plane

$$\vec{n} = \begin{vmatrix} i & j & k\\ 1 & 2 & -1\\ -1 & 1 & -2\end{vmatrix} = -3\hat{i} + 3\hat{j} + 3\hat{k}$$

Eq. of plane

$-3(x-1)+3(y-1)+3z = 0$

$\Rightarrow x - y - z = 0$

$$d_{(2,1,4)} = \frac{|2-1-4|}{\sqrt{1^2+1^2+1^2}} = \sqrt{3}$$

SECTION - B

1. **2**

3,1,1, & 2,2,1 $\rightarrow$ two methods only

2. **36**

3. **3500**

4. **1**

$\vec{p}, \vec{q}, \vec{r}$ being coplanar

$[\vec{p}\ \vec{q}\ \ \vec{r}\ ] = 0$

$$\begin{vmatrix} a+1 & a & a \\ a & a+1 & a \\ a & a & a+1 \end{vmatrix} = 0$$

$\Rightarrow a = -\dfrac{1}{3}$

$3(\vec{p}\,.\,\vec{q}\,)^2 = \lambda\,|\vec{r}\ \times \vec{q}\ |^2$

$3\left(\dfrac{1}{9}\right) = \lambda\left(\dfrac{1}{3}\right)$

$\lambda = 1$

5. **8**

Let z = $\cos\theta + i\sin\theta$, $\theta \in [0,2p)$ then

$\left|\dfrac{z}{\bar{z}} + \dfrac{\bar{z}}{z}\right| = 1 \Rightarrow \left|\dfrac{z^2 - \bar{z}^2}{|z|^2}\right| = 1$

$\Rightarrow 2|\cos2\theta| = 1 \Rightarrow \cos2\theta = \dfrac{1}{2}$ or $\dfrac{1}{2}$

$\therefore$ Number of values of θ = 8

$\therefore$ Number of values of z = 8

6. **8**

$2\sin^2 x + \sin^2 2x = 2$

$\Rightarrow 2\sin^4 x - 3\sin^2 x + 1 = 0$

$\Rightarrow (2\sin^2 x - 1)(\sin^2 x - 1) = 0$ ....(A)

Also $\sin 2x + \cos 2x = \tan x$

$\Rightarrow (1 + \tan x)(\tan^2 x - 1) = 0$ ....(B)

$2\cos^2 x + \sin x \le 2$

$\Rightarrow \sin x\,(2\sin x - 1) \ge 0$

$\Rightarrow \sin x \le 0$ or $\sin x \ge \dfrac{1}{2}$ ....(C)

From (A), (B) & (C) get results

7. **2**

Put $\sin x = 1 + t \Rightarrow$ if $x \to \dfrac{\pi}{2}$

$\Rightarrow t \to 0^-\ \lim\limits_{t\to0^-} \dfrac{(1+t)-(1+t)^{(1+t)}}{-t+\ln(1+t)}$

$= \lim\limits_{t\to0^-} \dfrac{(1+t)^t - 1}{t - \ln(1+t)}$

$= \lim\limits_{t\to0^-} \dfrac{1+t^2+\dfrac{t\,(t+1)\,t^2}{2!}+.......-1}{t-\left(t-\dfrac{t^2}{2}+\dfrac{t^3}{3}+.......\right)}$ = 2.]

8. **5**

$u_{10} = 1 = u_{13} = u_{16}$ ..... $= u_{3k+1}$ for $k \ge 3$

$u_{11} = 9 = u_{14} = u_{17}$...... $= u_{3k+2}$

$u_{12} = 3 = u_{15} = u_{18}$ .... $= u_{3k}$

$u_{500} = 9$

$u_{400} = 1$

$u_{300} = 3$

9. **4**

We have det. B = det. C = det.A = 2, because

$$\text{det. B} = \begin{vmatrix} a_{11} & \dfrac{a_{12}}{3} & \dfrac{a_{13}}{3^2} \\ 3a_{21} & a_{22} & \dfrac{1}{3}a_{23} \\ 9a_{31} & 3a_{32} & a_{33} \end{vmatrix} = |A| = 2$$

Similarly det. C = det. B = |A| = 2

Hence det. B + det. C = 2 + 2 = 4

10. **1**

We have $a + d + 2\sqrt{ad} = c + b + 2\sqrt{bc}$

$\Rightarrow a + d = c + b$ (As ad = bc)

$\because a^2+d^2+2ad = c^2+b^2+2bc$

$\Rightarrow a^2+d^2=c^2+b^2$

$(a^2+d^2)x+b^2y+c^2=0$

$\Rightarrow (b^2+c^2)x+b^2y+c^2=0$

$\Rightarrow b^2(y+x)+c^2(x+1)=0$

$(y+x) + \dfrac{c^2}{b^2}(x+1) = 0$

Which is of the form $L_1+\lambda L_2=0$.

So, fixed point is $(-1,1) = (x_0,y_0)$ (Given).

Hence . $\left(x_0^{-1} + y_0^{-1}\right) = -1 + 1 = 0$

SECTION – A

1. **A**

$\therefore$ K.E $= \frac{p^2}{2m}$

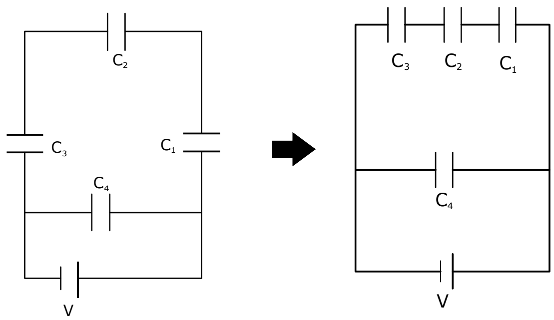
Given momentum is same

and $m_1 > m_2$

$$\frac{E_1}{E_2} = \frac{\frac{p^2}{2m_1}}{\frac{p^2}{2m_2}} = \frac{m_2}{m_1}$$

So, $E_1 < E_2$

2. **C**



Equivalent capacitance for three capacitors (C_1, C_2 & C_3) in series is given by

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{C_2C_3 + C_3C_1 + C_1C_2}{C_1C_2C_3}$$

$$\Rightarrow C_{eq.} = \frac{C_1C_2C_3}{C_1C_2 + C_2C_3 + C_3C_1}$$

$$\Rightarrow C_{eq.} = \frac{C(2C)(3C)}{C(2C) + (2C)(3C) + (3C)C} = \frac{6}{11}C$$

$\Rightarrow$ Charge on capacitors (C_1,C_2 & C_3) in series

$$= C_{eq.}V = \frac{6C}{11}V$$

Charge on capacitor $C_4 = C_4V = 4CV$

$$\frac{\text{Charge on } C_2}{\text{Charge on } C_4} = \frac{\frac{6C}{11}V}{4CV} = \frac{6}{11} \times \frac{1}{4} = \frac{3}{22}$$

3. **C**

By Parallel axis theorem

$I = I_{cm} + MR^2$

$I = \frac{MR^2}{2} + MR^2$

$I = \frac{3MR^2}{2}$

4. **D**

If we increase the distance between the plates its capacity decreases resulting in higher potential as we know Q = CV. Since Q is constant (bettery has been disconnected), on decreasing C, V will increase

5. **B**

Given rotational KE are same

K.E. $= \frac{1}{2} I\omega^2$

$I_1\omega_1^2 = I_2\omega_2^2$

$I\ \omega_1^2 = 2I\ \omega_2^2$

$\frac{\omega_1}{\omega_2} = \sqrt{2}$

$\frac{L_1}{L_2} = \frac{I_1\omega_1}{I_2\omega_2}$

$= \frac{I}{2I} \times \sqrt{2}$

$\frac{L_1}{L_2} = \frac{1}{\sqrt{2}}$

6. **D**

$\mu_d = 0$ & $\mu_p \neq 0$

7. **A**

Centripetal force is provided by magnetic

$F_{centripetal} = F_{magnetic}$

$\therefore \frac{mv^2}{r} = 2vB$

$r = \frac{mv}{2B}$

$r \propto \frac{v}{B}$

8. **A**

Work done due to a charge W = QV.

9. **A**

$v_{max} = A\omega$

$\frac{31.4}{100} = 2\pi f \times \frac{5}{100}$

$f = \frac{10}{10}$, f = 1 Hz

10. **B**

$\tan\phi = \frac{x_c - x_L}{R}$

$\tan 45^0 = \frac{\frac{1}{2\pi fc} - 2\pi fL}{R}$

$C = \frac{1}{2\pi f(2\pi fL + R)}$

11. **A**

A = 2 cm, $\frac{\omega}{k} = 128ms^{-1}, 5\lambda = 4,\ \lambda = \frac{4}{5}m$

Y = A sin ($kx - \omega t$)

$K = \frac{2\pi}{\lambda} = \frac{2\pi \times 5}{4} = \frac{31.4}{4} = 7.85$

$\therefore \omega = 128 \times 7.85 = 1005$

So, Y = 0.02m sin ($7.85x - 1005t$)

12. **C**

We know = $F = \frac{IA}{C}$

$P = \frac{F}{A} = \frac{I_{A/C}}{A} = \frac{I}{C}$

13. **B**

14. **C**

Energy of electron with an associated wavelength of 4100 A° is

$\Rightarrow \frac{hc}{\lambda} = 4.85 \times 10^{-19} J$ = 3.024 ev

This incident electron would emit photon from metals whose work potential is less than its energy.

Thus, it would emit photons from metal A and B

15. **D**

$y = kx^a$

$\frac{\Delta y}{y} = q \times \frac{\Delta x}{x} = a \times p$

16. **D**

$\lambda \propto \frac{1}{\sqrt{2mE}}$

$\lambda \propto \frac{1}{\sqrt{m}}$

$\frac{\lambda_e}{\lambda_P} = \sqrt{\frac{m_P}{m_e}}$

17. **C**

$\eta = \frac{W}{Q} = 1 - \frac{T_2}{T_1} \Rightarrow W = Q\left(1 - \frac{T_2}{T_1}\right)$

$= 1.2 \times 10^4$ cals

18. **A**

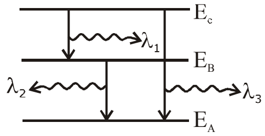
By Theory

19. **A**

$C_P = \frac{7}{2}R$, $C_V = C_P - R = \frac{7}{2}R - R = \frac{5}{2}R$

$\frac{C_P}{C_V} = \frac{(7/2)R}{(5/2)R} = \frac{7}{5}$

20. **D**



$E_c - E_B = hc/\lambda_1$ —(1)

$E_B - E_A = hc/\lambda_2$ —(2)

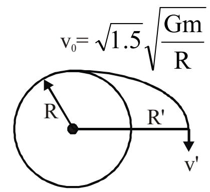
$E_c - E_A = hc/\lambda_3$ —(3)

(1) + (2) – (3) = 0

$\Rightarrow \frac{1}{\lambda_1} + \frac{1}{\lambda_2} = \frac{1}{\lambda_3} = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2} = \lambda_3$

SECTION - B

1. **2**



R' → Maximum height

Apply momentum & energy conservation

momentum conservation

$mv_0 R = mv'R'$ ...(i)

Energy conservation

$-\frac{GMm}{R} + \frac{1}{2}mV_0^2$

$= -\frac{GMm}{R'} + \frac{1}{2}mv'^2$ ...(ii)

From eq^n (i) & (ii)

R' = 3R

$\Rightarrow$ R = h = 3R

[$\therefore$ h $\rightarrow$ heigh from earth surface]

h = 2R

2. **1.71**

$I_{av} = \frac{1}{2}c\frac{B_0^2}{\mu_0} = \frac{1}{2} \times \frac{3 \times 10^8 \times (12 \times 10^{-8})^2}{1.26 \times 10^{-6}}$

$= 1.71$ w/m^2

3. **8**

L = const.

$mbV_\infty = mV_1 \times R$

$-\frac{GMm}{\infty} + \frac{1}{2}mV_\infty^2 \left(\frac{b^2}{R^2} - 1\right)$

$V_\infty = \sqrt{\frac{2GM}{R}} \times \frac{R}{\sqrt{b^2 - R^2}}$

$= 6 \times \frac{6400}{\sqrt{800^2 - 6400^2}}$

$= 6 \times \frac{6400}{800\sqrt{100 - 64}}$

= 8 km/s

4. **100**

5. **0.7**

In fig. germanium diode is reverse biased and silicon diode is forward biased. Therefore, there will be no current in the branch of germanium diode. The potential barrier of silicon diode is 0.7V. Therefore, for conduction minimum potential difference across silicon is 0.7 V.

Maximum potential difference across resistance, R = 12 – 0.7 = 11.3 V.

6. **200**

$P_0 + H\rho g = 3.7 \times 10^6$

$H \times 1.8 \times 10^3 \times 10 = 3.6 \times 10^6$

$H = \frac{36}{18} \times 10^2 = 200$

7. **2**

After two reflection, ray will become parallel to first mirror.

8. **3**

9. **15**

${}_1H^2 + {}_1H^3 \rightarrow {}_2He^4 + {}_0n^1$

$Q = [(M_D + M_T) - (M_\alpha + M_n)]\ 900$

$= 18$ MeV

$KE_n + KE_\alpha = 18 + 2 = 20$ MeV .....(i)

Also if outgoing newton is scattered at 90° then

$Q = KE_\alpha \left(1 + \frac{M_\alpha}{M_n}\right) - KE_D \left(1 + \frac{M_D}{M_N}\right)$ .....(ii)

From (i) and (ii)

Put $M_\alpha = 4$ m, $M_D = 2$m

$M_n = m$, $M_n = m$

$KE_n = 15.172$ MeV

10. **3**

$d = (v + u)\ 6$ ...(1)

$d = (v - u)\ 10$ ...(2)

$\left(\frac{v + u}{v - u}\right) \frac{6}{10} = 1$

$v = 4u$

$d = (5u)\ 6 \quad \Rightarrow d = 30\ u$

$d = vt$

$t = \frac{d}{v} = \frac{30u}{4u} = 7.5$ hr

SECTION - A

1. **B**

Reaction is endothermic $\Rightarrow \Delta H$ = positive
So on increasing temperature reaction will shift forward. On decreasing volume concentration of every species will increases.

2. **C**

$CN^- + H_2O \rightleftharpoons HCN + OH^-$

$0.1 - 0.1\,h \qquad 0.1\,h$

$[OH^-] = 0.1 \times 0.04 = 4 \times 10^{-3}$ M

$K_{sp} = [Al^{3+}]\,[OH^-]^3$

$6.4 \times 10^{-20} = S \times [4 \times 10^{-3}]^3$

$S = 10^{-12}$ mol L^{-1}

3. **D**

The formation of micelle only above certain temperature called Kraft temperature suggests positive ΔS of micelle formation which even overcome effect of positive ΔH of micelle formation. Besides kinetic effect also become important at high temperature.

4. **B**

5. **A**

$$\frac{mv^2}{r} = \frac{KZe^2}{r^2}$$

For H : Z = 1

$$\frac{mv^2}{r} = \frac{Ke^2}{r^2}\left(K = \frac{1}{4\pi\varepsilon_0}\right)$$

$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$$

$$v^2 = \frac{e^2}{4\pi\varepsilon_0 rm}$$

$$v = \frac{e}{\sqrt{4\pi\varepsilon_0 rm}}$$

6. **C**

$$\underset{\text{(Yellow)}}{2CrO_4^{2-}} \underset{OH^-}{\overset{H^+}{\rightleftharpoons}} \underset{\text{(d}^3\text{s, tetrahedral)}}{Cr_2O_7^{2-}} + H_2O$$

7. **B**

$$\frac{d_{bcc}}{d_{fcc}} = \frac{\left(2M \times 3\sqrt{3}/(N_A \times 64r^3)\right)}{\left(4M \times 2\sqrt{2}/(N_A \times 64r^3)\right)} = 0.918$$

8. **C**

(A) $Pb(NO_3)_2$ (White) $\xrightarrow[NH_4OH]{\text{Excess}}$ $Pb(OH)_2 \downarrow$ (White)

(B) $Fe(NO_3)_2$ (White) $\xrightarrow[NH_4OH]{\text{Excess}}$ $Fe(OH)_2 \downarrow$ (Green)

(C) $AgNO_3$ (White) $\xrightarrow[NH_4OH]{\text{Excess}}$ $[Ag(NH_3)_2]^+$
(soluble complex)

(D) $Hg(NO_3)_2$ (White) $\xrightarrow[NH_4OH]{\text{Excess}}$ $HgO.HgNH_2NO_3 \downarrow$

9. **D**

$Na + (x+y)\,NH_3(l) \rightarrow [Na^+(NH_3)_x] + [e^-\,(NH_3)_y]$

10. **B**

(A) $K\overset{-1}{O_2} + H_2O \longrightarrow \overset{(+5)}{KOH} + H_2\overset{(-2)}{O_2} + \overset{(0)}{O_2}$

(B) $\overset{+5}{N_2}O_5 + H_2O \longrightarrow H\overset{(+5)}{N}O_3$

(C) $\overset{+4}{Xe}F_4 + H_2O \rightarrow \overset{0}{Xe} + \overset{+6}{Xe}O_3 + HF + O_2$

(D) $K_2O_2 + H_2O \xrightarrow{RT} KOH + H_2O + O_2$

11. **B**

No. of monovalent oxygen = no.of divalent oxygen = (2)
Name : Pyroxene (single chain)

12. **B**

Carbonates of alkali metals

(a) Covalent character $\rightarrow$ $Li_2CO_3 > Na_2CO_3 > K_2CO_3 > Rb_2CO_3 > Cs_2CO_3$

(b) Solubility $\rightarrow$ $Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$

(c) Thermal stability $\rightarrow$ $Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$

13. **C**

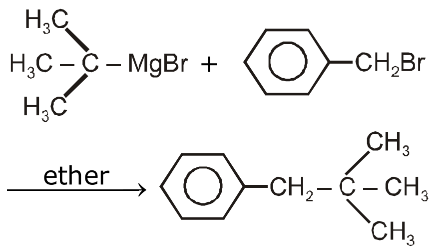
Stability of halogen oxide :
$I_2O > Cl_2O > Br_2O$

14. **C**

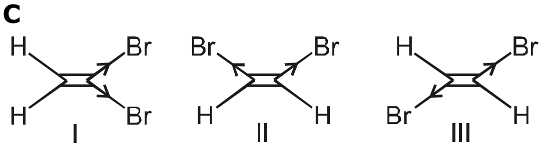
$Ni\ (s) + 4CO\ (g) \longrightarrow Ni(CO)_4(g)$

d^{10}, sp^3, tetrahedral complex

15. **C**



16. **C**

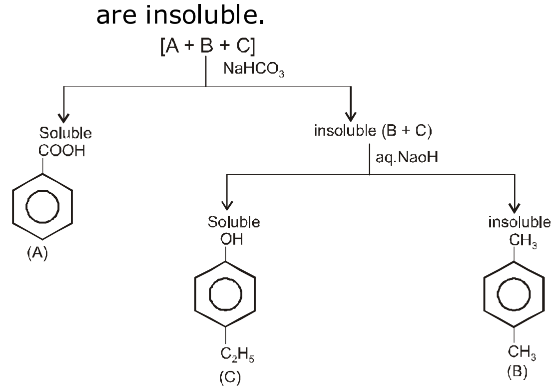


Order of dipole moment = I > II > III.

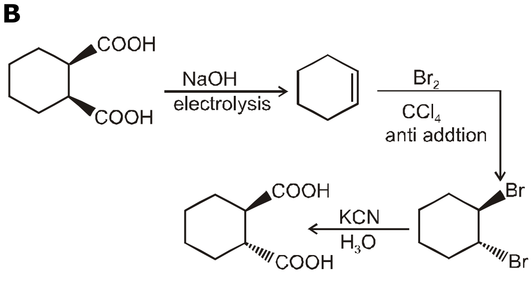
Boiling point depends on dipole moment while melting point depends on symmetry.

17. **A**

Acids dissolves in $NaHCO_3$ but phenols are insoluble.



18. **B**



19. **A**

20. **D**

SECTION – B

1. **108**

$Pt \mid H_2(P_1 atm) \mid H^+ (M_1) \mid \mid H^+ (M_2) \mid H_2 (P_2\ atm) \mid Pt$

at anode $\quad H_2 \longrightarrow 2H^+ + 2e^-$
$\quad P_1 \qquad (M_1)$

at cathode $\quad 2H^+ \longrightarrow H_2$
$\quad (M_2) \qquad P_2$

net cell reaction $\quad 2H^+ + H_2(P_1) \longrightarrow 2H^+ + H_2(P_2)$
$\quad (M_2) \qquad (M_1)$

$$E_{Cell} = E^{o}_{Cell} - \frac{0.06}{2}\log\frac{[H^+]^2(P_2)}{(H^+)^2(P_1)} \quad \because P_1 = P_2$$

$$E^{o}_{Cell} = 0$$

$$E_{Cell} = -\frac{0.06}{2}\log\frac{[H^+]^2_{M_1}}{[H^+]^2_{M_2}}$$

$$= -\frac{0.06}{2}\log(1.5)^2 = -0.0108V$$

2. **168**

$A(g) \rightleftharpoons B(g) + C(g) + D(g)$

$\alpha = 0.2 \qquad VD = 60$

$\Rightarrow M_{obs} = 120 \qquad n = 3 - 1 = 2$

$$\alpha = \frac{M_{Th} - M_{Obs}}{M_{Obs}(n-1)}$$

$$0.2 = \frac{M_{Th} - 120}{120(3-1)}$$

$M_{Th} = (0.2 \times 240) + 120$
$= 48 + 120$
$= 168$ Ans.

3. **100**

$C\ (graphite) \longrightarrow C\ (diamond)$

$\Delta H = \Delta U + P_2V_2 - P_1V_1$

$\Delta H - \Delta U = (500 \times 10^3 \times 10^5\ N/m^2)$

$\left(\frac{12}{3} - \frac{12}{2}\right) \times 10^{-6}$

$= \frac{48}{35} \times 500 \times 10^2\ J = \frac{48}{7} \times 10^4\ J$

$= 500 \times 2\times10^3 \times10^5 \times 10^{-6}$

$= 100$ kJ /mole

or $\quad 1000$ bar · litre $mole^{-1}$]

4. **493**

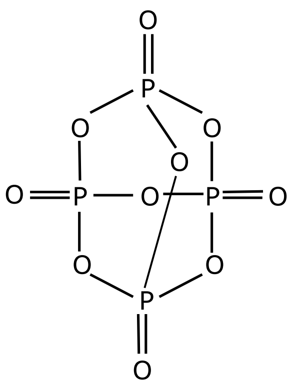
1 mole of HNO_3 = $\frac{3}{2}$ moles of $NO_2 \longrightarrow$

$\frac{3}{2}$ mole of NO $\longrightarrow \frac{3}{2}$ mole of NH_3

$$-\left(\frac{3}{2}\times\frac{1}{4}\right)(904)\ -\left(\frac{3}{2}\times\frac{1}{2}\right)(112)\ \ -\left(\frac{3}{2}\times\frac{1}{3}\right)(140)$$

= 493

5. **6**



P—O—P bond = 6

6. **4**

(1) $[Cu(NH_3)_4]\ [PtCl_4]$

(2) $[Cu(NH_3)_3Cl]\ [PtCl_3(NH_3)]$

(3) $[Pt(NH_3)_3Cl]\ [CuCl_3(NH_3)]$

(4) $[Pt(NH_3)_4]\ [CuCl_4]$

7. **0**

Native ore $\Rightarrow$ An sedimentary rock that contains a metal element in it pure state.

Pyrolusite $\rightarrow MnO_2$

Chromite $\rightarrow FeCr_2O_4$

Siderite $\rightarrow FeCO_3$

Cassiterite $\rightarrow SnO_2$

Calamine $\rightarrow ZnCO_3$

Argentite $\rightarrow Ag_2S$

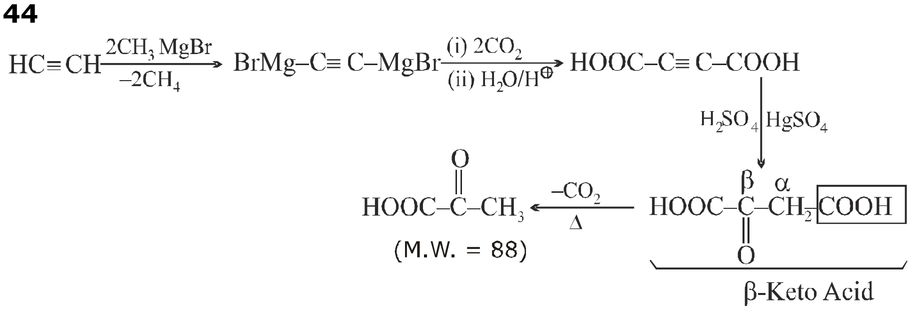
Lime stone $\rightarrow CaCO_3$

Chalcopyrite $\rightarrow CuFeS_2$

8. **5**

Because compound have 5 α-H-atom

9. **44**



10. **6**