JEE MAIN – SAMPLE PAPER
FULL SYLLABUS TEST

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. Ratio in which area bounded by the curves $y^2=12x$ and $x^2=12y$ is divided by $x=3$ is

(A) 3 : 1 (B) 15: 49
(C) 7 : 4 (D) 1 : 3

2. Solution of $\frac{dy}{dx}+2xy^2=y^2$ is

(A) $\frac{1}{y}=x^2-x+C$ (B) $y = x^2 - x^3+C$
(C) $\frac{1}{y^2}=x^3-x+C$ (D) $y = x^2 -1 +C$

(Where C is constant of integration)

3. The tangent to $y = ax^2 +bx+\frac{7}{2}$ at M(1,2) is parallel to the tangent at N(-2,2)on the curve $y =x^2 + 6x + 10$ then $\left(\frac{a}{2}-b\right)$ is equal to

(A) 7 (B) 3 (C)4 (D) 5

4. For a given arithmetic series the sum of first 50 terms is 200 and the sum of the next 50 terms is 2700, the first term of the series is

(A)-12221 (B) -20.5
(C)-21.5 (D) 3

5. The simplified form of

$$\cos\left(\sin^{-1}\left(\tan\left(\cos^{-1}\left(\sin\left(\tan^{-1}\left(\frac{4}{3}\right)\right)\right)\right)\right)\right)$$

(A) $\frac{3}{5}$ (B) $\frac{4}{5}$ (C) $\frac{3}{5}$ (D) $\frac{\sqrt{7}}{4}$

6. The point on the line $x=4$ from which the tangents drawn to the circle $x^2+y^2=18$ are at right angle is

(A)(4,5) (B) (4,3)
(C)(4,7) (D) $(4,2\sqrt{5})$

7. Two vertices of a triangle are (1,5) and (2,4), if the orthocentre is at the origin then coordinates of the third vertex are

(A) (4,2) (B) (2,2)
(C) $\left(\frac{1}{7},\frac{1}{7}\right)$ (D) $\left(\frac{11}{3},\frac{11}{3}\right)$

(SPACE FOR ROUGH WORK)

8. If the tangent at the point P(2,4) to the parabola $y^2=8x$ meets the parabola $y^2=8x+5$ at Q and R, then mid point of chord QR is

(A) (4,2) (B) (5,7)
(C) (2,4) (D)(3,10)

9. $\lim_{x\to -1^+} \frac{\sqrt{\pi}-\sqrt{\cos^{-1}x}}{\sqrt{x+1}}$ is equal to:-

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{2\pi}}$
(C) $\frac{1}{\sqrt{\pi}}$ (D) None of these

10. Number of terms in the expansion of $(1 + x)^{101} (1 + x^2 - x)^{100}$ is

(A) 302 (B) 301
(C) 202 (D) 101

11. If $\sin^2 x + \sin x\cos x - 6\cos^2 x = 0$ and $\frac{-\pi}{2} < x < 0$, then value of sin 2x is

(A) $\frac{-3}{10}$ (B) $\frac{-3}{5}$ (C) $\frac{2}{5}$ (D) $\frac{4}{5}$

12. Let A = {1, 2, 3, 4} and $x,y \in A$, then the value of max $(\sin^{-1}(\sin x) + \cos^{-1}(\cos y))$ is

(A) $\pi-1$ (B) $\pi+1$
(C) π (D)None

13. If A & B are two independent events and if probability that exactly one of them occurs is $\frac{26}{49}$ and the probability that none of them occurs is $\frac{15}{49}$, then probability of more probable of two events is-

(A) $\frac{3}{7}$ (B) $\frac{4}{7}$ (C) $\frac{5}{7}$ (D) $\frac{6}{7}$

14. The value of definite integral $\int_{1/2}^{2} \left\{\left|x-\frac{1}{x}\right|\right\}dx$ is equal to - (where {.} denotes fractional part of function)

(A) $\frac{3}{4}$ (B) $\frac{5}{8}$
(C) $\frac{5}{4}$ (D) $\frac{7}{16}$

(SPACE FOR ROUGH WORK)

15. Let f(x) = $\begin{bmatrix} 1 & x & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then $(f(x))^n$ $(n \in N)$ is equal to

(A) f(x) (B) nf(x)

(C) f(nx) (D) $f(x^n)$

16. $\left(\vec{a}\times\vec{b}\right)\times\left[(\vec{b}\times\vec{c})\times(\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a})\right]$ is

(A) $[\vec{a}\ \vec{b}\ \vec{c}][(\vec{b}.\vec{a}+\vec{a}.\vec{c})\vec{b}-(|\vec{b}|^2+\vec{b}.\vec{c})\vec{a}]$

(B) $[\vec{a}\ \vec{b}\ \vec{c}][(\vec{b}.\vec{a}+\vec{a}.\vec{c})\vec{b}+(|\vec{b}|^2-\vec{b}.\vec{c})\vec{a}]$

(C) $[\vec{a}\ \vec{b}\ \vec{c}][(\vec{b}.\vec{a}-\vec{a}.\vec{c})\vec{b}+(|\vec{b}|^2+\vec{b}.\vec{c})\vec{a}]$

(D) $[\vec{a}\ \vec{b}\ \vec{c}][(\vec{a}.\vec{c}-\vec{b}.\vec{a})\vec{b}+(|\vec{b}|^2-\vec{b}.\vec{c})\vec{a}]$

17. If the range of $f(x)=\dfrac{2x^4-14x^2-8x+49}{x^4-7x^2-4x+23}$ is (a, b], then (a + b) is

(A) 3 (B) 4 (C) 5 (D) 6

18. The equation of the plane through the intersection of the planes x + 2y + z -1 = 0 and 2x + y + 3z - 2 = 0 and perpendicular to the plane x+y+z-1=0 and x+ky + 3z -1 = 0. Then the value of k is

(A) $-\frac{5}{2}$ (B) $-\frac{3}{2}$ (C) $+\frac{5}{2}$ (D) $+\frac{3}{2}$

19. The statement $[(p\wedge q)\rightarrow p]\rightarrow(q\wedge \square q)$ is

(A)tautology

(B)contradiction

(C)open statement

(D)neither tautology nor contradiction

20. The number of ways in which 3 children can distribute 10 tickets out of 15consecutively numbered tickets themselves such that they get consecutive blocks of 5, 3 and 2 tickets is

(A) ${}^8C_5$ (B) ${}^8C_3 3!$

(C) ${}^8C_5(3!)^2$ (D) None of these

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. If a,b and c are positive and 9a + 3b +c = 90, then the maximum value of loga + logb+logc (base of the logarithm is 10)

(SPACE FOR ROUGH WORK)

2. The parallelogram is bounded by the linesy =ax +c, y = ax +d,y = bx +c and y = bx +d and has the area equal to 18, the parallelogram bounded by the lines y = ax + c, y = ax-d, y = bx + c and y = bx - d has area 72, given that a,b,c and d are positive integers find smallest possible value of a + b + c + d

3. The projection of line joining (3,4,5) and (4,6,3) on the line joining(-1,2,4) and (1,0,5) is $\frac{k}{3}$ then'k' equals.

4. The distance of the point (1,-2,3) from the plane x-y+z=5 measured parallel to the line whose direction cosines are proportional to 2,3,-6 is :

5. If $\frac{3iz_2}{5z_1}$ is purely real, then find $5\left|\frac{3z_1+7z_2}{3z_1-7z_2}\right|$.

6. If a + 2b + 3c = 6, then the greatest value of abc^2 is (where a,b,c are positive real numbers) equal to p/q then value of p + q is ?

7. Given z is a complex number such that $|z| \leq 2$,then the maximum value of$|iz+6-8i|$ is equal to-

8. If $\sum_{i=1}^{5}(x_i-10)=5$ and $\sum_{i=1}^{5}(x_i-10)^2=25$,then standard deviation of observations $2x_1+7$, $2x_2+7$, $2x_3+7$, $2x_4+7$ and $2x_5+7$ is equal to

9. Given $a_1,a_2,a_3.....$ form an increasing geometric progression with common ratio r such that $\log_8 a_1 + \log_8 a_2 + ... + \log_8 a_{12} = 2014$,then the number of ordered pairs of integers (a_1, r) is equal to -

10. Given the system of equation a(x + y + z)=x, b(x + y + z) = y, c(x + y + z) = z where a,b,c are non-zero real numbers. If the real numbers x,y,z are such that $xyz \neq 0$, then (a + b + c) is equal to-

(SPACE FOR ROUGH WORK)

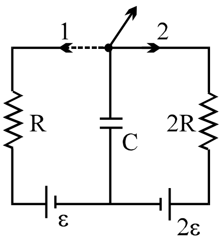
PART - II [PHYSICS]

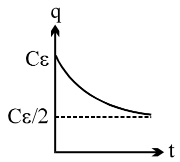
SECTION - A

[STRAIGHT OBJECTIVE TYPE]

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

1. In the circuit shown, the switch is shifted from position 1 $\rightarrow$ 2 at t = 0. The switch was initially in position 1 since a long time. The graph between charge on capacitor C and time 't' is



(A)


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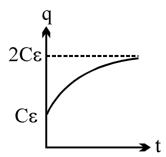
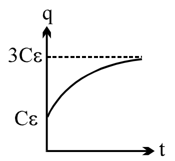
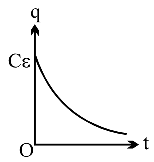
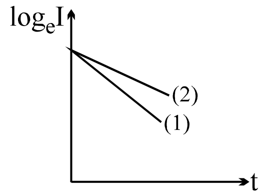


(C)


(D)


2. A graph between current & time during charging of a capacitor by a battery in series with a resistor is shown. The graphs are drawn for two circuits. R_1, C_1 and V_1 are the values of resistance, capacitance and EMF of the cell in one circuit and R_2, C_2 and V_2 for another circuit respectively. If only two parameters (out of resistance, capacitance, EMF) are different in the two circuits. What is the correct option?



(A) $V_1 = V_2$, $R_1 > R_2$, $C_1 > C_2$

(B) $V_1 > V_2$, $R_1 > R_2$, $C_1 = C_2$

(C) $V_1 < V_2$, $R_1 < R_2$, $C_1 = C_2$

(D) $V_1 < V_2$, $C_1 < C_2$, $R_1 = R_2$

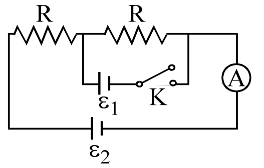
3. Two balls of same mass are dropped from the same height h , on to the floor. The first ball bounces to a height h/4 ,after the collision & the second ball to a height h/16. The impulse applied by the first & second ball on the floor are I_1 and I_2 respectively. Then

(A) $5I_1 = 6I_2$ (B) $6I_1 = 5I_2$

(C) $I_1 = 2I_2$ (D) $I_2 = 2I_1$

(SPACE FOR ROUGH WORK)

4. In the given circuit, when key K is open, reading of ammeter is I. Now key K is closed then the correct statement is:



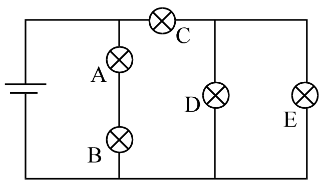
(A) If ε_1 > IR, reading of the ammeter is less than I

(B) If IR < ε_1, reading of the ammeter is greater than I

(C) If ε_1 < 2IR, reading of the ammeter will be zero

(D) Reading of ammeter will not change

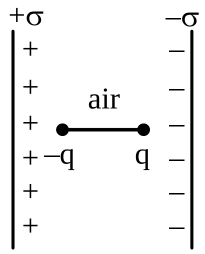
5. The circuit below is made up using identical light bulbs. The light bulbs of maximum brightness of the following will be



(A) A (B) C

(C) D (D) E

6. An electric dipole of dipole moment P is kept perpendicular to the plane of 2 large charged conducting plates as shown. The potential energy of the dipole is given as -



(A) zero (B) $\frac{-2\sigma P}{\epsilon_0}$

(C) $\frac{-\sigma P}{\epsilon_0}$ (D) $\frac{\sigma P}{\epsilon_0}$

7. An electric dipole is placed at the origin O such that its equator is y-axis. At a point P far away from dipole, the electric field direction is along y-direction. OP makes an angle α with the x-axis such that :

(A) $\tan\alpha = \sqrt{3}$ (B) $\tan\alpha = \sqrt{2}$

(C) $\tan\alpha = 1$ (D) $\tan\alpha = \frac{1}{\sqrt{2}}$

(SPACE FOR ROUGH WORK)

8. When a ray of light of frequency 6×10^{14} Hz travels from water of refractive index 4/3 to glass of refractive index 8/5, its

(A) frequency becomes $\frac{5}{6}$th of its initial value

(B) speed becomes $\frac{5}{6}$th of its initial value

(C) wavelength becomes $\frac{6}{5}$th of its initial value

(D) speed becomes $\frac{6}{5}$th of its initial value

9. A hair is placed at one edge between two flat glass plates. When this arrangement is illuminated with yellow light of wavelength λ = 600 nm, a total of 121 dark bands are counted starting at the contact point between the plates, and ending at the hair. How thick is the hair?

(A) 3.6×10^{-5} m (B) 1.8×10^{-5} m

(C) 3.6×10^{-4} m (D) 1.8×10^{-4} m

10. In YDSE setup, light of wavelength 640 nm is used with d = 0.8 mm and D = 1m. If intensity at central maxima is I_0 and it's position is y = 0

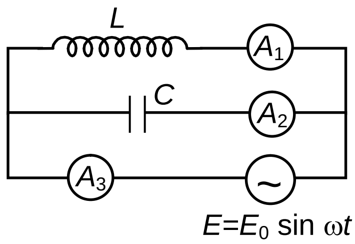
(A) Intensity at y = 0.4 mm is zero

(B) Intensity at y = 0.4 mm is $\frac{I_0}{2}$

(C) Intensity at y = 0.4 mm is $\frac{I_0}{\sqrt{2}}$

(D) Intensity at y = 0.4 mm is I_0

11. An inductor L and a capacitor C are connected in the circuit as shown in the figure. The frequency of the power supply is equal to the resonant frequency of the circuit. Which ammeter will read zero ampere ?



(A) A_1 (B) A_2

(C) A_3 (D) none of these

12. Calculate z for the following case.

z = (x − 2.5 y + w) for x = (4.72 ± 0.12) m, y = (4.4 ± 0.2) m, w = (15.63 ± 0.16) m.

(A) 9.35 ± 0.78 (B) 9.3 ± 0.8

(C)9.4 ± 0.8 (D) 9.30 ± 0.80

(SPACE FOR ROUGH WORK)

13. A block is given certain upward velocity along the incline of elevation α . The time of ascent to upper point was found to be half the time of descent to initial point. The co-efficient of friction between block and incline is :

(A) $0.5 \tan \alpha$ (B) $0.3 \tan \alpha$
(C) $0.6 \tan \alpha$ (D) $0.2 \tan \alpha$

14. A plank of mass 2kg and length 1 m is placed on a horizontal floor. A small block of mass 1 kg is placed on top of the plank, at its right extreme end. The coefficient of friction between plank and floor is 0.5 and that between plank and block is 0.2. If a horizontal force = 30 N starts acting on the plank to the right, the time after which the block will fall off the plank is ($g = 10\ m/s^2$)

(A) (2/3) s
(B) 1.5 s
(C) block will never fall off the plank.
(D) (4/3) s

15. A concave lens with unequal radii of curvature made of glass ($\mu_g = 1.5$) has a focal length of 40 cm. In air if it is immersed in a liquid of refracive index $\mu_l = 2$, then

(A) it behaves like convex lens of 80 cm focal length
(B) it behave like a convex lens of 20 cm focal length
(C) its focal length becomes 60 cm
(D) nothing can be said.

16. A glass prism is kept in air. The angle of deviation is plotted for the different angles of incidence of a monochromatic beam. First we experiment with red colour and then with violet colour.

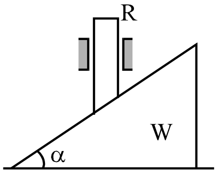
(A) the maximum deviation as well as minimum deviation is more for violet colour.
(B) the maximum deviation as well as minimum deviation is more for red colour.
(C) the maximum deviation is more for violet colour but minimum deviation is more for red colour.
(D) the maximum deviation is more for red colour but minimum deviation is more for violet colour.

17. A uniform circular ring of radius R is fixed in plane. A particle is placed on the axis of the ring at a distance much greater than R and allowed to fall towards the ring under the influence of the ring's gravity. The particle achieves a maximum speed v. The ring is replaced with one of the same (linear) mass density but radius 2R, and the experiment is repeated. What is the new maximum speed of the particle ?

(A) $\frac{1}{2}v$ (B) $\frac{1}{\sqrt{2}}v$
(C) v (D) $\sqrt{2}\,v$

(SPACE FOR ROUGH WORK)

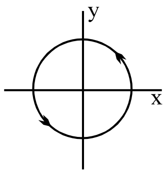
18. In the arrangement shown, all surfaces are frictionless. The rod R is constrained to move vertically. The vertical acceleration of R is a_1 and the horizontal acceleration of the wedge W is a_2. The ratio a_1/a_2 is equal to



(A) $\sin\alpha$ (B) $\cos\alpha$

(C) $\tan\alpha$ (D) $\cot\alpha$

19. Current i = 2.5 A flows along the circle $x^2 + y^2 = 9\ cm^2$ (here x & y are in cm) as shown. Magnetic field **(in Tesla)** at point (0, 0, 4 cm) is



(A) $(36\pi \times 10^{-7})\hat{k}$

(B) $(36\pi \times 10^{-7})(-\hat{k})$

(C) $\left(\frac{9\pi}{5}\times 10^{-7}\right)\hat{k}$

(D) $\left(\frac{9\pi}{5}\times 10^{-7}\right)(-\hat{k})$

20. A closed organ pipe is vibrating in its second overtone. The length of the pipe is 10cm and maximum amplitude of vibration of particles of the air in the pipe is 2mm. Then the amplitude of S.H.M. of the particles at 9cm from the open end is:

(A) $\sqrt{3}$ mm

(B) $\sqrt{2}$ mm

(C) $\frac{\sqrt{3}}{2}$ mm

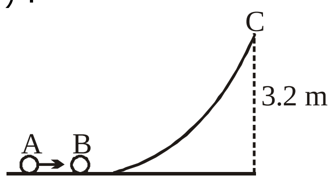
(D) none of these

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. Two identical balls A and B lie on a smooth horizontal surface, which gradually merges into a curve to a height 3.2 m. Ball A is given a velocity of 10 m/s, it collides head on with ball B, which then takes up the curved path. What is the minimum coefficient of restitution e for the collision between A and B, in order that ball B reaches the highest point C of the curve ? (g = 10 m/s^2) :



(SPACE FOR ROUGH WORK)

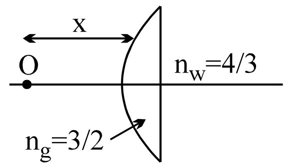
2. When a charge Q was distributed uniformly on the surface of a sphere, the potential at the centre was 100 V. What will be the potential (in volt) at the centre if this charge would be uniformly distributed within the volume of the sphere.

3. The diffraction pattern from a single slit is viewed on a screen. Using blue light of wavelength 0.42 μm, the width of the central maximum is 2.0 cm. What is the width (in μm) of the central maximum when red light of wavelength 0.70 μm is used ?

4. A capacitor and a coil in series are connected to a 6 volt ac source. By varying the frequency of the source, maximum current of 600 mA is observed. If the same coil is now connected to a cell of emf 6 volt and internal resistance of 2 Ω, What is the current (in A) flow through it ?

5. Vernier callipers has 20 divisions on its vernier scale which coincide with 19 divisions on the main scale. Least count of the instrument is 0.1 mm. What is the main scale division (in mm) ?

6. An object 'O' is kept in air in front of a thin plano convex lens of radius of curvature 10 cm. It's refractive index is 3/2 and the medium towards right of plane surface is water of refractive index 4/3. What should be the distance 'x' (in cm) of the object so that the rays become parallel finally.



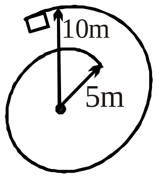
7. A satellite revolving in a circular equatorial orbit from west to east appears over a certain point on the equator every 8 hours. Find out time period of satellite (in hr) -

8. The equation of the path of the projectile is $y = 0.5x - 0.04x^2$. What is the initial speed of the projectile (in m/s) ?

9. A plane is travellling at a constant air speed of 400 km/hr. A wind is blowing southward with a speed of 240 kmph. For an observer on the ground, the plane seems to be moving due east with the speed of about P km/hr. Then find the value of P -

(SPACE FOR ROUGH WORK)

10. A block enters a horizontal smooth spiral track in which the radius of the track decreases from 10 m to 5m. If the block enters the spiral at a speed of 10 m/s, what is it's speed (in m/s) at the end of the spiral?



(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. Standard reduction potential of silver and nickel are :

$E^0_{Ag^+/Ag}$ = 0.8 V and $E^0_{Ni^{2+}/Ni}$ = – 0.23 V

Which of the following statement is **true** ?

(A) Ag^+ is oxidising agent but Ni^{2+} is a reducing agent.

(B) Ag^+ is better oxidising agent than Ni^{2+} and Ag is better reducing agent than Ni.

(C) Ni^{2+} can be reduced by silver metal.

(D) Ag^+ is a better oxidizing agent than Ni^{2+} and Ni is better reducing agent than Ag.

2. Identify the **incorrect** statement :

(A) Amorphous solids on heating can become crystalline at some temperature.

(B) Crystalline solids are anisotropic.

(C) Dislocation defect is found in ZnS crystal.

(D) F-centre is formed due to metal deficiency defect.

3. Identify the **incorrect** statement :

(A) Rate of corrosion will be more in presence of water containing HCl as compared to pure water.

(B) The overall reaction during charging of nickel cadmium cell is Cd(s) + $2Ni(OH)_3(s) \rightarrow 2Ni(OH)_2(s) + H_2O(l)$

(C) During electrolysis of $AgNO_3$(aq) in presence of silver electrodes concentration of Ag^+ will remain unchanged.

(D) On increasing concentration of weak electrolyte molar conductivity of solution will decrease.

4. Which of the following occur if a 0.1 M solution of weak acid is diluted to 0.01 M at constant temperature?

(A) Hydrogen ion concentration decreases to 0.01 M.

(B) pH decreases.

(C) Ionization constant K_a decreases.

(D) Percentage of ionization increases.

5. Elements X and Y can combine to form two different compounds. If 1.6 g of X reacts with exactly 1.6 g of Y, the compound produced has formula XY_2. However under different condition, 2.4 g of X will react with 1.6 g of Y to form a second compound, whose empirical formula is -

(A) X_3Y_4 (B) XY

(C) XY_3 (D) X_2Y

(SPACE FOR ROUGH WORK)

6. For 1 mol of a Vander waal gas at high pressure, identify the **incorrect** expression.
(where Z = compressibility factor).

(A) $P = \frac{RT + Pb}{V}$ (B) $P = \frac{RT}{V} - \frac{a}{V^2}$

(C) $Z = 1 + \frac{Pb}{RT}$ (D) $Z > 1$

7. Identify the **correct** statement :

(A) Aquatic species are more comfortable in hot water than cold water due to higher solubility of $O_2(g)$ in hot water.

(B) A minimum boiling azeotrope will have higher vapor pressure than both of its components.

(C) If 0.1 M NaCl(aq) solution is diluted then its boiling point will remain same because number of particles of NaCl are constant.

(D) Osmotic pressure get changed if solvent is changed keeping same concentration.

8. Which of the following set of transition metal of 3d-series have maximum and minimum melting point respectively?

(A) Cr and Mn (B) Fe and Zn

(C) Cr and Zn (D) Fe and Hg

9. In which of the following complex, ligands are considered as strong field ligands (SFL) ?

(A) $[NiCl_4]^{2-}$ (B) $[PtCl_4]^{2-}$

(C) $[Fe(NH_3)_6]^{2+}$ (D) $[FeF_6]^{3-}$

10. Which of the following would not result in the formation of paramagnetic substance ?

(A) $K_2O_{2(s)} + H_2O_{(l)} \xrightarrow{\text{R.T.}}$

(B) $K_{(s)} + NH_{3(l)} \xrightarrow{0°C}$

(C) $K_{(s)} + H_2O_{(l)} \xrightarrow{\text{R.T.}}$

(D) $K_{(s)} + \text{air} \xrightarrow{\text{R.T.}}$

11. Select the species having highest dipole moment.

(A) I_3^- (B) CCl_3^-

(C) XeF_4 (D) SF_4

12. Select the correct match regarding one of the product of hydrolysis at room temperature.

(A) Al_4C_3 : Propyne (B) BN : NH_3

(C) B_4C : CH_4 (D) NCl_3 : NH_3

13. Select the correct order of stability of oxidation state .

(A) $Ge^{2+} > Sn^{2+} > Pb^{2+}$

(B) $Cr^{6+} > Mo^{6+} > W^{6+}$

(C) $Cr^{2+} < Cr^{3+}$

(D) $Co^{2+} < Co^{3+}$

(SPACE FOR ROUGH WORK)

14. Which of the following can act as oxidising as well as reducing agent depending on acidic and basic medium.

(A) $KMnO_4$ (B) $K_2Cr_2O_7$

(C) H_2O_2 (D) conc. HNO_3

15. The decreasing order of the rate of nitration of the following compounds is :

I. Benzene II. C_6D_6

III. Nitrobenzene IV. Chlorobenzene

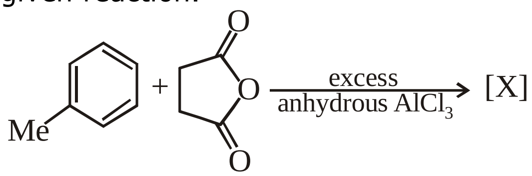
(A) (I) > (II) > (III) > (IV)

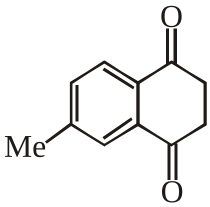
(B) (I) > (II) > (IV) > (III)

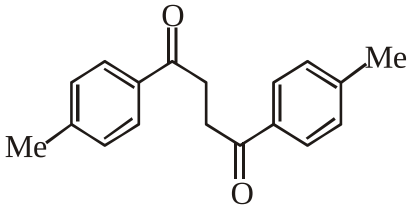
(C) (I) = (II) > (IV) > (III)

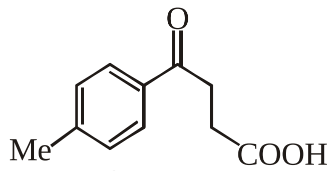
(D) (I) = (II) > (III) > (IV)

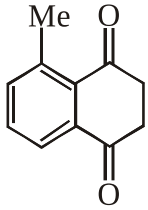
16. Find the major product X formed in the given reaction.



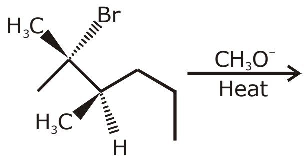
(A) 

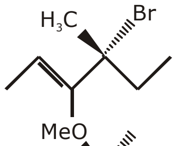
(B) 

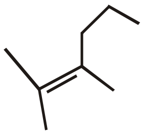
(C) 

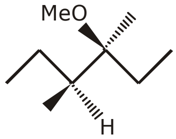
(D) 

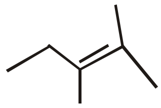
17. What is the major product of the reaction ?



(A) 

(B) 

(C) 

(D) 

18. Which of the following conversion can be carried out by hydrazine in alkaline medium with ethylene glycol?

(A) Cyclohexanone to cyclohexanol

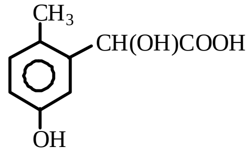
(B) 2-Butanol to butane

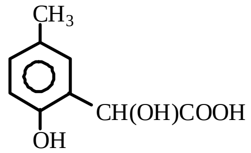
(C) Ethanal to Ethyl alcohol

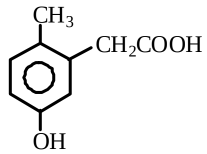
(D) Acetophenone to ethyl benzene

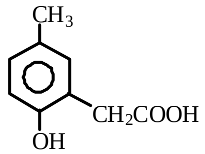
(SPACE FOR ROUGH WORK)

19. p-Cresol reacts with chloroform in alkaline medium to give the compound (A) which adds hydrogen cyanide to form, the compound (B). The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of carboxylic acid is -

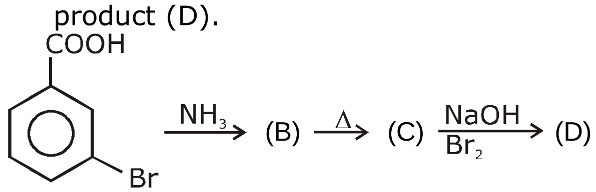
(A) 

(B) 

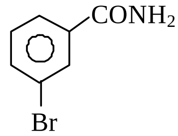
(C) 

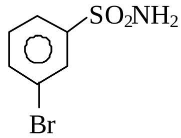
(D) 

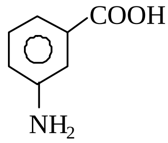
20. In a set of reactions m-bromobenzoic acid gave a product (D). Identify the product (D).

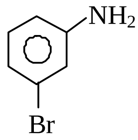


(A)

(A) 

(B) 

(C) 

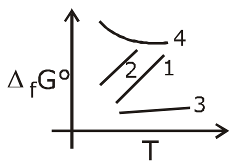
(D) 

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. The Gibbs free energy of formation ($\Delta_f G°$) for the reaction : $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$ is measured and plotted as function of temperature (T). Of the 4 possible graph below, which one would most likely represent the observed trend?



2. 50.0 mL of a gaseous mixture of H_2 and HCl is exposed to a sodium amalgam. The volume decreases to 42.5 mL. If 100.0 mL of the same mixture is added to 50.0 mL of gaseous ammonia and then exposed to water, what will be the volume of the final mixture ?

(SPACE FOR ROUGH WORK)

3. A 1 litre sample of a 0.1 M Cr^{3+} is electrolyzed with a current of 96.5 A. If the remaining Cr^{3+} concentration is 0.08 M then the duration of the process in second is

4. 2 moles of a mixture of CH_4 and He is present in 8.21 L vessel at 400 K. If the gas is allowed to effuse through an orifice, it effused with an initial molar composition CH_4 : He = 3 : 2. The partialpressure **(in atm)** of CH_4 in the original mixture is :

5. Find the number of reactions in which hybridisation of underlined atom would not change after the given reaction.

(1) $\underline{P}Cl_3 + Cl_2 \longrightarrow$ (2) $H_2\underline{S}O_4 \xrightarrow{\Delta}$

(3) $\underline{N}Cl_3 + H_2O$ (4) $\underline{Xe}F_4 + F^- \longrightarrow$

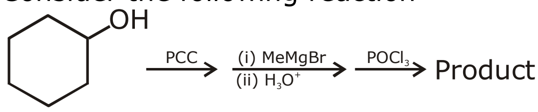
(5) $\underline{S}O_2Cl_2 \xrightarrow{\Delta}$ (6) $\underline{P}Cl_5 + H_2O \rightarrow$

(7) $Na\underline{N}O_3 \xrightarrow{\Delta}$ (8) $XeF_4 + \underline{Sb}F_5 \rightarrow$

6. When Cl_2 reacts with Hot and Conc. NaOH what is the sum of the oxidation number of Cl in product.

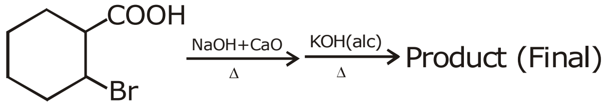
7. Sum of the oxidation state of chlorine in product, when it reacts with hot and conc. Alkali.

8. Consider the following reaction



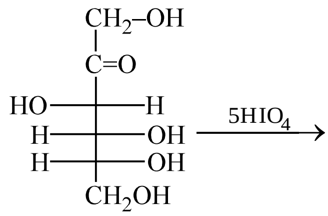
mass % of carbon in the final product is :

9.

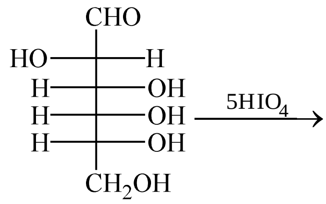


DOU of final product is :

10. Reaction 1—



Reaction 2—



Ratio of moles of formaldehyde obtained in the reaction (1) and reaction (2)

(SPACE FOR ROUGH WORK)

MOTION™

JEE MAIN SAMPLE PAPER

FULL SYLLABUS TEST

PART - I [MATHEMATICS]

SECTION : A

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

SECTION : B

1	2	3	4	5	6	7	8	9	10
3	16	4	1	5	17	12	4	46	1

PART - II [PHYSICS]

SECTION : A

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

SECTION : B

1	2	3	4	5	6	7	8	9	10
0.6	150	3.3	0.5	2	20	6	12.5	320	10

PART - III [CHEMISTRY]

SECTION : A

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

SECTION : B

1	2	3	4	5	6	7	8	9	10
1	70	60	6	2	4	4	80	2	2

SECTION – A

1. **B**

A = total area = $\frac{16\times3\times3}{3}=48$

$A_1=\int_0^3\left(2\sqrt{3}x^{1/2}-\frac{x^2}{12}\right)dx=\frac{45}{4}$

$\text{Ratio}=\frac{45/4}{48-\frac{45}{4}}=\frac{15}{49}$

2. **A**

$\frac{dy}{y^2}=(1-2x)dx$

integrate both side

3. **B**

$2=a+b+\frac{7}{2}$ ....(A)

$2a+b=-\frac{1}{2}$ ......(B)

Solve (A) & (B)

4. **B**

$200=\frac{50}{2}(2a+49d)$ ....(A)

$2900=\frac{100}{2}(2a+99d)$ .....(B)

Solve (A)& (B)

5. **D**

$\cos\left(\sin^{-1}\left(\tan\left(\cos^{-1}\left(\sin\left(\tan^{-1}\left(\frac{4}{3}\right)\right)\right)\right)\right)\right)$

$\cos\left(\sin^{-1}\left(\tan\left(\cos^{-1}\left(\frac{4}{5}\right)\right)\right)\right)$

$\cos\left(\sin^{-1}\left(\frac{3}{4}\right)\right)=\frac{\sqrt{7}}{4}$

6. **D**

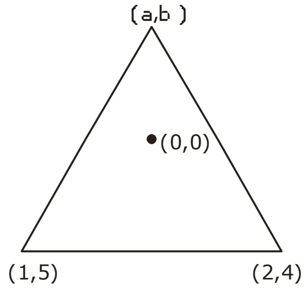
Director circle of given

circle $x^2+y^2= 36$ ...... (A)

$x=4$ ...... (B)

Solve (A) & (B)

7. **D**



$\left(\frac{b-0}{a-0}\right)\times\frac{5-4}{1-2}=-1$ ......(A)

$\left(\frac{b-4}{a-2}\right)\times\frac{5-0}{1-0}=-1$ ....(B)

Solve (A) & (B)

8. **C**

Tangent at point p(2,4) to be parabola $y^2=8x$

$y.4 = 4 (x+2)$

$y = x+2$

Solve $y = x + 2$ & $y^2=8x + 5$ and find mid point

9. **B**

$$\lim_{x\to-1^+}\frac{+\frac{1}{2\sqrt{\cos^{-1}x}\sqrt{1-x^2}}}{\frac{1}{2\sqrt{x+1}}}$$

$$=\lim_{x\to-1^+}+\frac{1}{\sqrt{\cos^{-1}x}\sqrt{1-x}}=\frac{1}{\sqrt{2\pi}}$$

10. **C**

$(1 + x) \{(1 + x) (1 + x^2 - x)\}^{100}$

$= (1 + x) \quad (1 + x^3)^{100}$

....

101 terms

↓

two type terms = Power of x 3k type

& power of x (3k + 1) type

= 101 + 101 = 202 terms

11. **B**

$\sin^2x+\sin x.\cos x-6\cos^2x=0$

$\Rightarrow \tan^2x + \tan x-6 = 0$

i.e. $\tan x = -3$

$\sin2x=\frac{-3}{5}$

12. **B**

	$\sin^{-1}(\sin x)$	$\cos^{-1}(\cos x)$
x = 1	1	1
x = 2	$\pi - 2$	2
x = 3	$\pi - 3$	3
x = 4	$\pi - 4$	$2\pi - 4$

max = $\pi -2 + 3 = \pi+1$

13. B

$P(A) + P(B) - 2P(A)P(B) = \frac{26}{49}$ and

$P(A) + P(B) - P(A)\,P(B) = \frac{34}{49}$

$\therefore\ P(A) = \frac{4}{7}\ \ P(B) = \frac{2}{7}$

or $P(A) = \frac{2}{7}\ \ P(B) = \frac{4}{7}$

14. B

Let $I = \int_{1/2}^{2} \left\{\left|x - \frac{1}{x}\right|\right\} dx$ ......(1)

Put $x = \frac{1}{t}$

$\Rightarrow I = \int_{1/2}^{2} \left\{t - \frac{1}{t}\right\} \frac{dt}{t^2}$ ......(2)

$\therefore$ (1) + (2) gives

$= I = \int_{1/2}^{2} \left\{t - \frac{1}{t}\right\} \left(1 + \frac{1}{t^2}\right) dt$ .....(3)

Put $\left(t - \frac{1}{t}\right) = y$

$\Rightarrow 2I = \int_{-3/2}^{3/2} \{|y|\}\, dy$

$\Rightarrow I = \int_{0}^{3/2} \{y\}\, dy$

$\Rightarrow I = \int_0^1 y\,dy + \int_1^{3/2} (y-1)\,dy = \frac{1}{2} + \frac{1}{8}$

$\Rightarrow I = \frac{5}{8}$

15. C

$f(x) = I + B,\ B = \begin{bmatrix} 1 & x & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$(f(x))^n = (I + B)^n$

$= I^n + {}^nC_1 I^{n-1} B + {}^nC_2 B^2 I^{n-2}........ + B^n$

$= I + {}^nC_1 B$ as $B^2 + 0$

$\begin{bmatrix} 1 & nx & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

16. D

$(\vec{a} \times \vec{b}) \times \left(-[\vec{b}\,\vec{c}\,\vec{a}]\vec{b} + [\vec{b}\,\vec{c}\,\vec{a}]\vec{c}\right)$

$= [\vec{b}\,\vec{c}\,\vec{a}]\left(-(\vec{a}.\vec{b})\vec{b} + |\vec{b}|^2 \vec{a} + (\vec{a}.\vec{c})\vec{b} - (\vec{b}.\vec{c})\vec{a}\right)$

$= [\vec{a}\,\vec{b}\,\vec{c}][\left(\vec{a}.\vec{c} - \vec{b}.\vec{a}\right)\vec{b} + (|\vec{b}|^2 - \vec{b}.\vec{c})\vec{a}]$

17. C

$f(x) = 2 + \frac{3}{x^4 - 7x^2 - 4x + 23}$

Let $h(x) = x^4 - 7x^2 - 4x + 23$
$= (x^2-4)^2 + (x-2)^2 + 3$
$h(x) \geq 3$
Range of $h(x)$ is $[3, \infty)$
$\Rightarrow$Range of $f(x)$ is $(2, 3]$

18. C

D.R's of normal to plane $x + y + z - 1 = 0$ and
$x + ky + 3z - 1 = 0$ is $(1, 1, 1)$ and $(1, k, 3)$ respectively
$\Rightarrow$ D.R. of normal to a plane perpendicular to given planes

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

$\Rightarrow \frac{1+2\lambda}{3-k} = \frac{2+\lambda}{-2} = \frac{1+3\lambda}{k-1}$

$\Rightarrow -2-4\lambda = 6+3\lambda-2k-\lambda k$

$-4-10\lambda = 4+2\lambda \Rightarrow 12\lambda = -8 \Rightarrow \lambda = -\frac{2}{3}$

$\Rightarrow -2 + \frac{8}{3} = 6 - 2 - 2k + 2 - k = 3$

$\Rightarrow \frac{2}{3} - 4 = -\frac{4}{3}k \Rightarrow -\frac{10}{3} = -\frac{4}{3}k \Rightarrow k = \frac{5}{2}$

19. B

p	q	$p\wedge q$	$(p\wedge q)\to p$	$\sim q$	$q\wedge\sim q$	$[(p\wedge q)\to p] \to (q\wedge\sim q)$
T	T	T	T	F	F	F
T	F	F	T	T	F	F
F	T	F	T	F	F	F
F	F	F	T	T	F	F

Given compound statement is always false. So it is a contradiction

20. C

Problem is same as arranging 8 things out of which 5 identical i.e $\frac{8i}{5i}$ which gives total number of ways of selecting block and distributing them away 3 children i.e. $\frac{8i}{5i}3!$

Section - B

1. **3**

$$\frac{3a+b+\frac{c}{3}}{3} \geq (abc)^{1/3}$$

abc $\leq$ 1000

$\log_{10}abc \leq 3$

2. **16**

Area of parallelogram

$$= \frac{|c_1 - c_2||d_1 - d_2|}{|m_1 - m_2|}$$

$$\frac{|c-d|^2}{|a-b|} = 18 \qquad ..... (1)$$

$$\frac{|c+d|^2}{|a-b|} = 72 \qquad .....(2)$$

$|c - d|^2 = |a - b| . 18$

$\Rightarrow |c + d|^2 = |a-b|.72$

$\Rightarrow$ a = 1 & b=3

hence c-d = 6

c+d = 12

c = 9 and d = 3

a + b +c + d = 16

3. **4**

dr's of line joining (-1,2,4) and (1,0,5) are

$<1+1, 0-2, 5-4>$

i.e.$<2,-2,1>$

dc's of this line are

$$< \frac{2}{\sqrt{4+4+1}}, \frac{-2}{\sqrt{4+4+1}}, \frac{1}{\sqrt{4+4+1}} >$$

i.e. $< \frac{2}{3}, -\frac{2}{3}, \frac{1}{3} >$

$\because$ Reqd. projection

$$= |\ell(x_2 - x_1) + m(y_2 - y_1) + n(z_2 - z_1)|$$

$$= \left|\frac{2}{3}(4-3) - \frac{2}{3}(6-4) + \frac{1}{3}(3-5)\right|$$

$$= \left|\frac{2}{3} - \frac{4}{3} - \frac{2}{3}\right| = \frac{4}{3}$$

$$\therefore \frac{k}{3} = \frac{4}{3}$$

then k = 4.

4. **1**

Equation of line through (1,-2,3) parallel to the direction with dr's 2,3,-6 is

$$\frac{x-1}{2} = \frac{y+2}{3} = \frac{z-3}{6} = r \text{ (Let)}$$

Any point of it is (2r + 1, 3r-2,3-6r)

This point lie on the plane x-y+z = 5

if 2r+1 -3r +2+3 -6r =5

i.e. if r = 1/7

$\therefore$ Point is $\left(\frac{9}{7}, \frac{-11}{7}, \frac{15}{7}\right)$

distance between $\left(\frac{9}{7}, \frac{-11}{7}, \frac{15}{7}\right)$ and (1,-2,3) is $= \frac{\sqrt{49}}{7} = 1.$

5. **5**

$$\frac{3iz_2}{5z_1} = ik \Rightarrow \frac{z_2}{z_1} = \frac{5k}{3}$$

6. **17**

Using A.M. $\geq$ G.M.

$$\frac{a+2b+\frac{3c}{2}+\frac{3c}{2}}{4} \geq \left(a.2b.\frac{3c}{2}.\frac{3c}{2}\right)^{\frac{1}{4}}$$

$$\Rightarrow \left(\frac{3}{2}\right)^4 \geq \frac{9}{2}abc^2 \Rightarrow abc^2 \leq \frac{9}{8}$$

7. **12**

$|iz + 6 - 8i| \leq |iz| + |6 - 8i| = 2 + 10$

= 12.

8. **4**

$\because$ var. $(2x_i + 7) = 4\text{var}(x_i)$

$$= 4\left(\frac{\Sigma x_i^2}{5} - \left(\frac{\Sigma x_i}{5}\right)^2\right)$$

$$= 4\left(\frac{25}{5} - \left(\frac{5}{5}\right)^2\right) = 4(5-1) = 16$$

$\therefore$ S.D= $\sqrt{16} = 4$

9. **46**

$\log_8(a_1a_2....a_{12}) = 2014$

$\Rightarrow a_1^{12}.r^{66} = 2^{6042}$ ...(i)

Let $a_1 = 2^m$ and $r = 2^n$

$\therefore (1) \Rightarrow 2^{12m + 66n} = 2^{6042}$

$\Rightarrow$ 2m +11n = 1007

$$\Rightarrow m = \frac{1007 - 11n}{2} \in N$$

$\therefore$ allowed values of n are

n = 1,3,5,7,...91

$\therefore$ total ordered pairs = 46.

10. **1**

Condition for non-trivial solution is

$$\begin{vmatrix} a-1 & a & a \\ b & b-1 & b \\ c & c & c-1 \end{vmatrix} = 0$$

$$\Rightarrow (a+b+c-1)\begin{vmatrix} 1 & 1 & 1 \\ b & b-1 & b \\ c & c & c-1 \end{vmatrix} = 0$$

$C_2 \to C_2 - C_1$

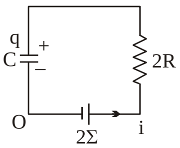
$C_3 \to C_3 - C_1$

$\Rightarrow a + b + c = 1$

PART - II [PHYSICS]

SECTION – A

1. **B**



$V_0 + 2\Sigma - 2iR - \frac{q}{C} = V_0$

$i = \frac{\Sigma}{R} - \frac{q}{2RC}$

also $\quad i = \frac{dq}{dt}$

$\therefore \int_{C\Sigma}^{q} \frac{dq}{\left(\frac{\Sigma}{R} - \frac{q}{2RC}\right)} = \int_0^t dt$

$\frac{\ln\left(\frac{\Sigma}{R} - \frac{q}{2RC}\right)\Big|_{C\Sigma}^{q}}{\left(-\frac{1}{2RC}\right)} = t$

$\ln\left(\frac{2\Sigma C - q}{\Sigma C}\right) = -\frac{t}{2RC}$

$q = 2\Sigma C - \Sigma C e^{-t/2RC}$

$q = \Sigma C\,(2 - e^{-t/2RC})$

2. **C**

$I = \frac{V}{R} e^{-t/(RC)}$

$\therefore \log_e I = \log_e\left(\frac{V}{R}\right) - \frac{t}{RC}$

when $t = 0$, $\log_e I = \log_e\left(\frac{V}{R}\right)$, which is same for both circuits. Hence, if one out of V and R is different, then another also has to be different.

$\therefore C_1 = C_2$

Now, $|\text{Slope}| = \frac{1}{RC}$ is greater for (1)

$\therefore R_1 < R_2$

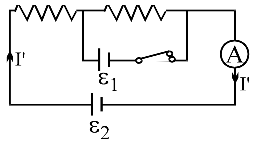
and hence $V_1 < V_2$

3. **A**

$\frac{I_1}{I_2} = \frac{m\sqrt{2gh} + m\sqrt{2gh/4}}{m\sqrt{2gh} + m\sqrt{2gh/16}}$

$= \frac{1+\frac{1}{2}}{1+\frac{1}{4}} = \frac{\frac{3}{2}}{\frac{3}{4}} = \frac{6}{5}$

4. **A**



$I = \frac{\varepsilon_2}{2R} \qquad \Rightarrow IR = \frac{\varepsilon_2}{2}$

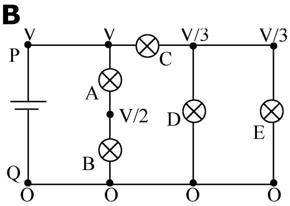
After closing $\qquad \varepsilon_2 - I'R - \varepsilon_1 = 0$

$\Rightarrow I' = \frac{\varepsilon_2 - \varepsilon_1}{R}$

$\varepsilon_1 < IR \Rightarrow \varepsilon_1 < \varepsilon_2/2 \Rightarrow I' > I$

$A \rightarrow \varepsilon_1 < \varepsilon_2/2$

5. **B**

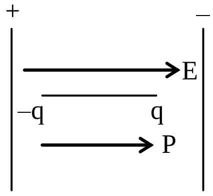


Let potential at P is O & that at Q is V

Potential difference across bulb C is maximum

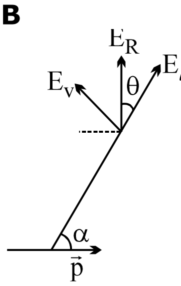
6. **C**

Here angle θ between $\vec{P}$ and $\vec{E}$ is 0°



$\therefore U = -PE\cos\theta = -\left(\frac{\sigma}{\epsilon_0}\right) = -\frac{\sigma P}{\epsilon_0}$

7. **B**



Given E_R along y-axis

thus $\theta = 90° - \alpha$

also

$\tan\theta = \frac{1}{2}\tan\alpha \qquad$ or $\tan\alpha = \sqrt{2}$

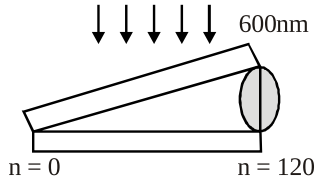
8. **B**

Frequency of the wave doesn't change but speed α wavelength do

$v_{water} = \frac{v_{air}}{(4/3)} \;\alpha\; v_{glass} = \frac{v_{air}}{(8/5)}$

Dividing $\qquad v_g = \frac{5}{6} v_{water}$

9. **A**



$\Delta x = 2t = n\lambda$ feel Dark fringe

$2d = 120 \times 600 \times 10^{-9}$

$d = \dfrac{120 \times 600 \times 10^{-9}}{2} = 3.6 \times 10^{-5}$ m

10. **A**

$I = I_0 \cos^2 \dfrac{\mu y d}{\lambda D}$

$= I_0 \cos^2 \dfrac{\pi \times 0.4 \times 0.8 \times 10^{-8}}{640 \times 10^{-9} \times 1}$

$= I_0 \cos^2 \dfrac{\pi}{2} = 0$

11. **C**

$I_3 = I_1 - I_2$

In resonance $X_L = X_C$

Hence $I_1 = I_2$ and $I_3 = 0$

12. **C**

$z = (x - 2.5y + w)$

$\Delta z = (\Delta x + 2.5\ \Delta y + \Delta w)$

$= (0.12 + 2.5 \times (0.2) + 0.16)$

$= 0.78 \approx 0.8$

$z = (4.75 - 2.5\ (4.4) + 15.63)$

$= 9.35 \approx 9.4$

$z = 9.4 \pm 0.8$

13. **C**

for upward motion

$t_a = \dfrac{u}{g\sin\alpha + \mu g\cos\alpha}$ ...(1)

$u^2 = 2(g\sin\alpha + \mu g\cos\alpha)s$ ...(2)

for downward motion

$t_d = \dfrac{v}{g\sin\alpha - \mu g\cos\alpha}$ ...(3)

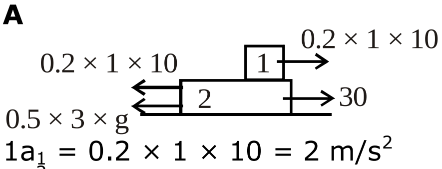
$v^2 = 2(g\sin\alpha - \mu g\cos\alpha)s$ ...(4)

Solving equation (1), (2), (3) & (4)

$\dfrac{t_a}{t_d} = \sqrt{\dfrac{\sin\alpha - \mu\cos\alpha}{\sin\alpha + \mu\cos\alpha}} = \dfrac{1}{2}$

$\Rightarrow u = 0.6 \tan\alpha$

14. **A**



$1a_1 = 0.2 \times 1 \times 10 = 2$ m/s^2

$2a^2 = 30 - 2 - 15 = 13$

$a_2 = 6.5$ m/s^2

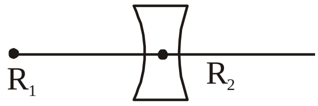
$a_{12} = -4.5$ m/s^2

$s_{12} = \dfrac{1}{2}\ a_{12}t^2$

$-1 = \dfrac{-9}{4}t^2$

$t = \dfrac{2}{3}$ sec.

15. **A**



$\dfrac{1}{f_a} = ({}_a\mu_g - 1)\left[\dfrac{1}{(-R_1)} - \dfrac{1}{R_2}\right]$

$\dfrac{1}{f_i} = ({}_i\mu_g - 1)\left[\dfrac{1}{(-R_1)} - \dfrac{1}{R_2}\right]$

$\dfrac{f_i}{f_a} = \dfrac{{}_a\mu_g - 1}{{}_i\mu_g - 1}$

$\dfrac{f_i}{-40} = \dfrac{1.5 - 1}{\dfrac{1.5}{2} - 1}$

$f_i - 40 \times \dfrac{(0.5)}{-0.25} = 80$ cm

$f_i = +\ 80$ cm (convex nature)

16. **A**

$\mu = \dfrac{\sin\left(\dfrac{A + \delta_{min}}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

$\mu_V > \mu_R$

$(\delta_m)_V > (\delta_m)_R$

for maximum deviation

$1 \times \sin i = \mu \sin\,[90° - C)$

$\mu_V > \mu_R$

$i_V > i_R$

$\delta_{max} = i + 90 - A$

$(\delta_{max})_V > (\delta_{max})_R$

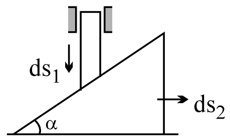
17. **C**

$PE = \dfrac{-G(\lambda 2\pi R)m}{R} = G\lambda 2\pi m$

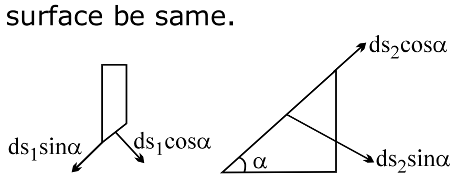
i.e. independent of R

18. **C**

After taking component parallel & perpendicular to common surface.



As, Distance perpendicular to common surface be same.



$ds_1 \cos\alpha = ds_2 \sin\alpha$

After differentiating two times.

$\boxed{a_1 \cos\alpha = a_2 \sin\alpha}$

19. **A**

Magnetic field on the axis of a circular loop

$B = \left(\frac{\mu_0}{4\pi}\right) \times \frac{2\pi I R^2}{(R^2 + z^2)^{3/2}}$

where R = radius of loop = 3×10^{-2} m

$= 10^{-7} \times \frac{2\pi \times 2.5 \times 3^2 \times 10^{-4}}{125 \times 10^{-6}} \hat{k}$

$= \left(\frac{9\pi}{25} \times 10^{-5}\ T\right)\hat{k} = (36\pi \times 10^{-7}\ T)\ \hat{k}$

20. **B**

$\frac{4L}{5} = \lambda \Rightarrow \lambda = 8cm$

thus 2 cm corresponds to $\Delta\phi = z/2$

1 cm corresponds to $\Delta\phi = z/4$

So y = Asm $\pi/4 = 2 \times \frac{1}{\sqrt{2}} = \sqrt{2}$

SECTION - B

1. **0.6**

$\frac{1}{2} m V_2^2 = mgh$

$\Rightarrow V_2 = \sqrt{2gh} = \sqrt{2 \times 10 \times 3.2} = 8$ m/s

$m \times 10 + m \times 0 = m \times V_1 + mV_2$

$V_1 = 2$ m/s

$e = \frac{V_2 - V_1}{10 - 0} = 0.6$

2. **150**

$\frac{kQ}{R} = 100$ V

$\frac{3kQ}{2R} = 150$ V

3. **3.3**

$y = \frac{f\lambda_2}{b}$

$\frac{y_1}{\lambda_1} = \frac{y_2}{\lambda_2}$

$\frac{2}{0.42} = \frac{y_2}{0.7}$

4. **0.5**

The maximum current is obtained at resonance where the net impedance is only resistive which is the resistance of the coil only. This gives the resistance of the coil as 10 ohm. Now, this coil along with the internal resistance of the cell gives a current of 0.5 A.

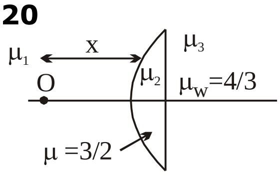
5. **2**

Least count = $\frac{1(\text{main scale})}{N}$

0.1 mn = $\frac{1(\text{main scale})}{20}$

1 Main scale division = 2mm

6. **20**



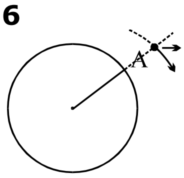
$\frac{\mu_3}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R_1} + \frac{\mu_3 - \mu_2}{R_2}$

$\frac{\mu_3}{\infty} - \frac{1}{x} = \frac{1.5 - 1}{10} + \frac{4/3 - 3/2}{\infty}$

$\frac{-1}{x} = \frac{0.5}{10}$

x = – 20 cm

7. **6**



$w_E - w_S = \frac{2\pi}{T}$

$\frac{2\pi}{8} - \frac{2\pi}{24} = \frac{2\pi}{T}$

$\frac{2\pi(3-1)}{24} = \frac{2\pi}{T}$

$w_S - w_E = \frac{2\pi}{T}$

$\frac{2\pi}{6} - \frac{2\pi}{24} = \frac{2\pi(4-1)}{24} = \frac{2\pi}{8}$

$w_S - w_E = \frac{2\pi}{T}$

$w_S - \frac{2\pi}{24} = \frac{2\pi}{8}$

$w_S = 2\pi\left[\frac{1}{24} + \frac{1}{8}\right]$

$w_S = 2\pi\left[\frac{1+3}{24}\right]$

$w_S = \frac{2\pi}{6}$

$T_{satellite} = 6$ hr

8. **12.5**

$y = 0.5 - 0.04\ x^2$

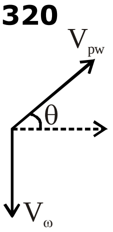
comparing with

$y = x\tan\theta - \frac{g}{2u^2\cos^2\theta} x^2$

we get $\tan\theta = ½ \Rightarrow \cos\theta = 2/\sqrt{5}$

$\frac{g}{2u^2\cos^2\theta} = 0.04 \Rightarrow u = 12.5$ m/s

9. **320**



$V_p = V_{pw} \cos\theta$

$V_w = V_{pw} \sin\theta$

$V_p = 400 \times 4/5 = 320$

10. **10**

Energy is conserved $\Rightarrow v_i = v_f$

PART - III [CHEMISTRY]

SECTION - A

1. **D**

Cell reaction involving both

$$\underset{RA}{Ni(s)} + \underset{OA}{2Ag^+(aq.)} \xrightleftharpoons{n=2} \underset{OA}{Ni^{2+}(aq.)} + \underset{RA}{2Ag(s)}$$

(A) Ag^+ and Ni^{2+} both are oxidising agent
(B) Ag^+ is better oxidising agent than Ni^{2+}
(C) Ni^{2+} can not be reduced by Ag metal
(D) Ag^+ is better oxidising agent than Ni^{2+} and Ni is better reducing agent than Ag.

2. **D**

Theory based

3. **B**

(A) Reaction of $O_2(g)$ take place in presence of H^+ ion.
(B) $Cd(s) + 2Ni(OH)_3(s) \rightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$
(C) Concentration of Ag^+ will remain same due to oxidation and reduction of Ag electrode.
(D) As concentration of electrolyte increases, $\wedge_m \downarrow$

4. **D**

Upon dilution of weak acid % ionisation increases.

5. **A**

For XY_2

X	Y
1.6g	1.6g

$$\frac{\left(\frac{1.6}{M_X}\right)}{\left(\frac{1.6}{M_Y}\right)} = \frac{1}{2}$$

For second compound

X	Y
2.4g	1.6g

$$\Rightarrow \frac{\left(\frac{2.4}{M_X}\right)}{\left(\frac{1.6}{M_Y}\right)} = \frac{3}{2}\cdot\frac{M_Y}{M_X}$$

$$= \frac{3}{2}\cdot\frac{1}{2} = \frac{3}{4} = \frac{n_X}{n_Y}$$

$\Rightarrow$ E.F. = X_3Y_4

6. **B**

For 1 mol Vander waal gas at high pressure.
(P) (V – b) = RT
PV – Pb = RT

$$P = \frac{RT + Pb}{V}$$

PV = RT + Pb

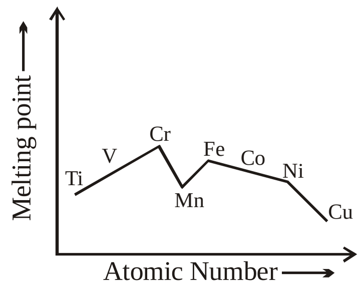
$$Z = 1 + \frac{Pb}{RT}$$

Z > 1

7. **B**

(A) Solubility of gas in liquid water increases with decrease in temperature.
(B) At minimum boiling point-vapour pressure of solution will be highest.
(C) $\Delta T_b = K_b.m$
as m changes, boiling pont of solution changes
(D) $\pi = CRT$

8. **C**



9. **B**

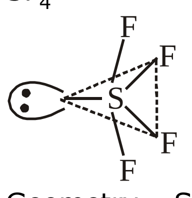
All ligands act as SFL for 4d & 5d series elements, so in $[PtCl_4]^{2-}$, ligand are considered as SFL.

10. **C**

(A) $K_2O_{2(s)} + H_2O_{(l)} \xrightarrow{R.T.} KOH + O_2$
(Paramagnetic)
(B) $K_{(s)} + NH_{3(l)} \xrightarrow{0°C} K^+$ (ammoniated) + e^- (ammoniated)
Paramagnetic (due to ammoniated e^-)
(C) $K_{(s)} + H_2O_{(l)} \xrightarrow{R.T.} 2KOH(aq.) + H_2(g)$
(D) $K_{(s)}$ + air $\xrightarrow{R.T.}$ KO_2 (super oxides) Paramagnetic

11. **D**

SF_4



Geometry – See Saw
Hybridisation – sp^3d
$\mu \neq 0$

12. **D**

$NCl_3 + H_2O \longrightarrow HOCl + NH_3$

13. **C**

Stability of oxidation state of $Cr^{2+} < Cr^{3+}$

t_{2g}^3 Half filled

14. **C**

H_2O_2 can act as oxidising as well as reducing agent.

15. **C**

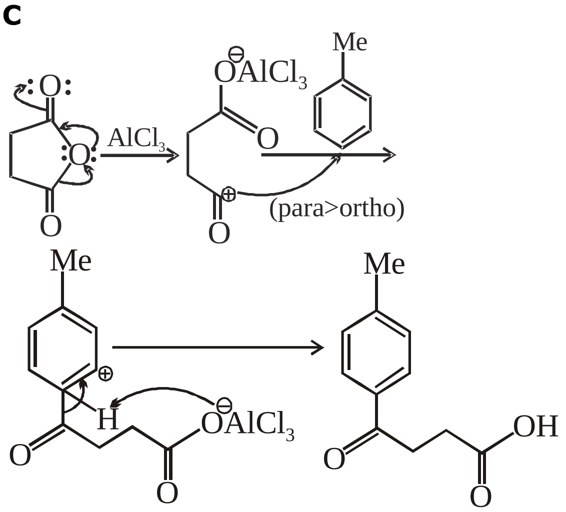
Rate is faster when the substituent activates the ring (+ I or/and + R, o/p) and the rate is slower when the substituent deactivates the ring (–I, R; m). Halogen deactivates the ring (–I, +R, –I > +R) but the orientation is o/p.

Rate of $C_6H_6 = C_6D_6$, since no kinetic isotope effect is observed when H is replaced by D.

Hence the order is as given in (c).

(I) = (II) > (IV) > (III).

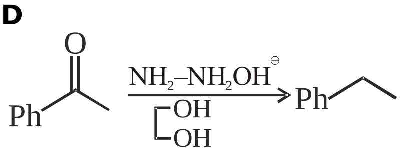
16. **C**



17. **B**

Saytzeff's (E2) elimination will give the desired product.

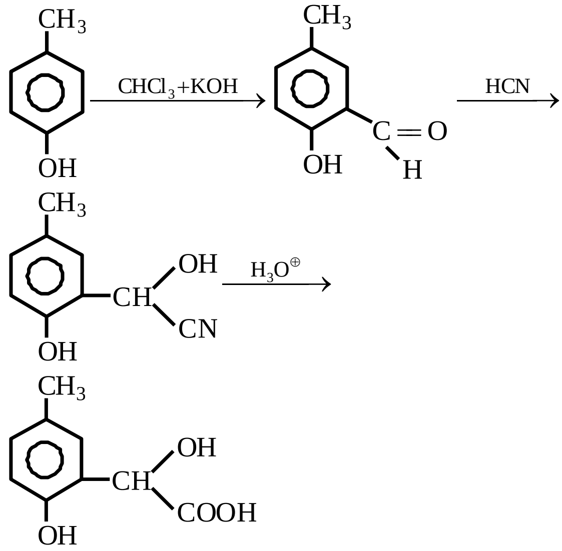
18. **D**



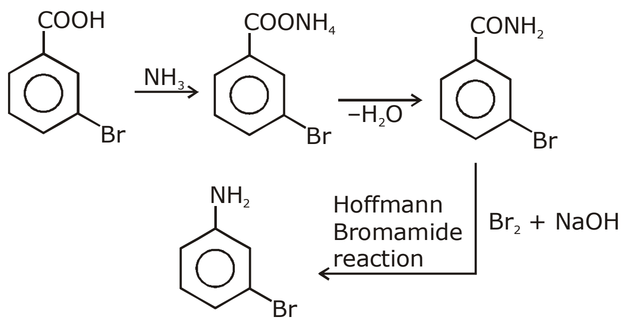
(Wolff kishner reduction)

Wolff kishner reduction is used to carbonyl compounds to alkanes.

19. **B**



20. **D**



SECTION – B

1. **1**

For reation : $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

$\Delta_f H = -ve$

$\Delta_f S = -ve$

$\Delta_f G° = \Delta_f H° - T\Delta_f S°$

As T increase, $\Delta_f G°$ increase

2. **70**

Na/Hg + 2HCl (g) → 2NaCl + H_2 + 2Hg

2 mol   1 mol

Contraction in volumne = 50.0 – 42.5

= 7.5 mL of $H_2(g)$

1 mol of $H_2(g) \equiv$ 2 mol of HCl(g)

7.5 mol of $H_2(g) \equiv$ 15 mol of HCl(g)

volume of H_2 = 50.0 – 15.0 = 35.0 mL

volumne of H_2 in 100.0 mixture

$= \frac{100 \times 35}{50}$ =70.0 mL

3. 60

Initially $\quad 0.1\ M$

$$Cr^{3+} \xrightarrow{\text{electrolysis}} Cr$$

Finally $\quad 0.08\ M$

Number of moles of Cr^{3+} reduced

$= M_1V_1 - M_2V_1$

$= 0.1 \times 1 - 0.08 \times 1$

$= 0.02$ mole

Number of equivalent of Cr^{3+} reduced

$= 0.02 \times 3$ equ.

$$\therefore\ 0.02 \times 3 = \frac{i.t}{96500}$$

$$i.t = 0.02 \times 3 \times 96500$$

$$t = \frac{0.02 \times 3 \times 96500}{96.5} = 60 \text{ sec.}$$

4. 6

$$P = \frac{nRT}{V} = 8 \text{ atm}$$

$$\frac{n_{CH_4}}{n_{He}} = \frac{P_{CH_4}}{P_{He}}\sqrt{\frac{M_{He}}{M_{CH_4}}}$$

$$\frac{3}{2} = \frac{x}{(8-x)}\sqrt{\frac{4}{16}}$$

X = 6 atm

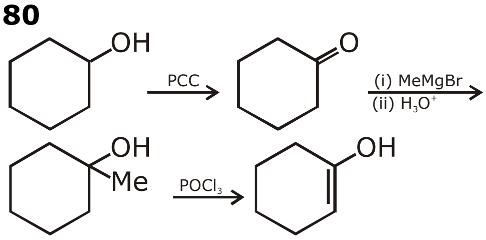
5. 2

6. 4

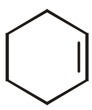
7. 4

$$Cl_2 + \underset{\text{(hot and conc.)}}{6NaOH} \rightarrow \underset{(X)}{5NaCl^{-1}} + \underset{(Y)}{Na\overset{+5}{Cl}O_3^{+3}}$$

8. 80

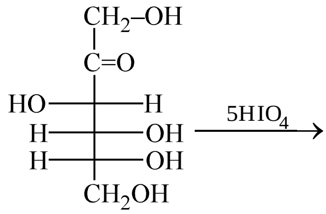


9. 2



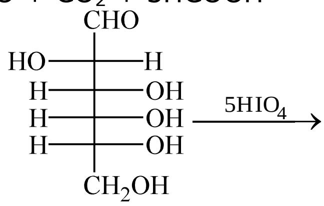
10. 2

Reaction I



2HCHO + CO_2 + 3HCOOH

Reaction II



HCHO + 5HCOOH

Ratio of reaction I and II = 2 : 1

$\Rightarrow$ 2 Ans.