JEE MAIN 2026

Sample Paper - 18

Time Allowed: 3 hours **Maximum Marks:** 300

General Instructions:

1. The test consists of total 75 questions.

2. Each subject (PCM) has 25 questions.

3. Each subject divided into two sections. Section A consists of 20 multiple-choice questions & Section B consists of 5 numerical value-type questions.

4. Marking Scheme:

- Section A (MCQs): +4 marks for each correct answer, -1 mark for each incorrect answer, 0 marks for unattempted.
- Section B (Numerical): +4 marks for each correct answer, 0 marks for incorrect or unattempted.

5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.

6. All calculations/written work should be done in the rough sheet is provided with the Question Paper.

MATHEMATICS **Max Marks: 100**

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. $\lim\limits_{x\to 0^+} \dfrac{\tan x\sqrt{\tan x}-\sin x\sqrt{\sin x}}{x^3.\sqrt{x}}$ Equals

1) 0.75 **2)** 0.85 **3)** 0.95 **4)** 1

2. The mean and standard deviation of 20 observations are found to be 10 and 2 respectively. On rechecking it was found that an observation by mistake was taken 8 instead of 12. The correct standard deviation is

1) $\sqrt{3.86}$ **2)** 1.8 **3)** $\sqrt{3.96}$ **4)** 1.94

3. Let the solution curve y = f(x) of the differential equation

$\dfrac{dy}{dx}+\dfrac{xy}{x^2-1}=\dfrac{15x^4+4x^3+4x+1}{\sqrt{1-x^2}}, x\in(-1,1)$ passes through the origin. Then $\int\limits_{-1/2}^{1/2}\dfrac{f(x)dx}{\left(x^2+2\right)}$ is equal to.

1) $\dfrac{\pi}{6}$ **2)** $\dfrac{\pi}{6}-\dfrac{\sqrt{3}}{4}$ **3)** $\dfrac{\pi}{3}-\dfrac{\sqrt{3}}{4}$ **4)** $\dfrac{\pi}{3}-\dfrac{1}{4}$

4. Let $S_k=\sum\limits_{r=1}^{k}\tan^{-1}\left(\dfrac{6^r}{2^{2r+1}+3^{2r+1}}\right)$. Then $\lim\limits_{k\to\infty}S_k$ is equal to

1) $\tan^{-1}\left(\dfrac{3}{2}\right)$ **2)** $\dfrac{\pi}{2}$ **3)** $\cot^{-1}\left(\dfrac{3}{2}\right)$ **4)** $\tan^{-1}(3)$

5. The value of the definite integral $\int\limits_{\pi/8}^{3\pi/8}\dfrac{11+4\cos 2x+\cos 4x}{1-\cos 4x}dx$ equals:

1) $-6-\dfrac{\pi}{4}$ **2)** $6\sqrt{2}-\dfrac{\pi}{4}$ **3)** $12-\dfrac{\pi}{2}$ **4)** $6-\dfrac{\pi}{4}$

6. If p, q, r are prime numbers and α,β,γ are positive integers such that L. C. M. of α,β,γ is p^3q^2r and greatest common divisor of α,β,γ is pqr, then the number of possible triplets (α,β,γ) will be:

1) 36 **2)** 72 **3)** 144 **4)** 60

7. Let f(x) = Max $\left\{x^2,(1-x)^2,2x(1-x)\right\}$ Where $0\le x\le 1$, if the Area of the region bounded by the curves y=f(x), x-axis, x=0 and x=1 is $\frac{p}{q}$; (where p, q are coprime numbers) then $p+q=$___.

1) 30 **2)** 40 **3)** 44 **4)** 72

8. Match the items of Column-I with Column-II

Column-I		**Column-II**	
I	If the coordinates of a point are $(4\tan\theta,3\sec\theta)$ where $\theta\ (\theta\neq(2n+1)\frac{\pi}{2},n\in Z)$ is parameter then the points lies on a conic whose eccentricity is	P	$\sqrt{3}$
II	If an ellipse has the length of major axis 10 units and semi minor axis length 4 units , then this ellipse has eccentricity	Q	$\frac{4}{5}$
III	If AB is double ordinate of a hyperbola $\frac{x^2}{a^2}-\frac{y^2}{9}=1$ such that triangle OAB is an equilateral triangle of side '2' then eccentricity of hyperbola is (where O is centre of Hyperbola)	R	$\frac{5}{3}$
IV	If the foci of ellipse $\frac{x^2}{K^2a^2}+\frac{y^2}{a^2}=1$ and hyperbola $\frac{x^2}{a^2}-\frac{y^2}{a}=1$ coincide then K can be	S	$\frac{3}{5}$
		T	$\sqrt{\frac{13}{3}}$

1) I-R; II-S; III-T; IV-P **2)** I-S; II-P; III-Q; IV-T

3) I-P; II-T; III-S; IV-Q **4)** I-Q; II-S; III-P; IV-T

9. An urn contains 7 white and 5 black balls. A ball is drawn at a random and is put back into the urn along with 3 additional balls of the same colour as that of the ball drawn. A ball is again drawn at a random. Then the probability that the ball drawn is white is

1) $\frac{7}{32}$ **2)** $\frac{5}{12}$ **3)** $\frac{7}{12}$ **4)** $\frac{10}{25}$

10. Let $a_1, a_2, a_3 \ldots\ldots\ldots$ be an arithmetic progression. If $\frac{a_1 + a_2 + \ldots\ldots\ldots + a_{10}}{a_1 + a_2 + \ldots\ldots\ldots + a_P} = \frac{100}{P^2} (where\ P \neq 0)$

then $\frac{a_{11}}{a_{10}} =$ _____

1) $\frac{19}{21}$ **2)** $\frac{100}{21}$ **3)** $\frac{21}{19}$ **4)** $\frac{121}{100}$

11. A straight line L intersects perpendicularly both the lines:

$\frac{x+2}{2} = \frac{y+6}{3} = \frac{z-34}{-10}$ and $\frac{x+6}{4} = \frac{y-7}{-3} = \frac{z-7}{-2}$

Then the square of perpendicular distance of origin from L is

1) 5 **2)** 6 **3)** 7 **4)** 8

12. Let origin lies inside the circle $x^2 + y^2 - \quad x - \sqrt{2}y - c = \quad c >$. A PQ chord through origin(where P,Q lies on circle) is such that OP = 2, OQ = 8 (where O is the origin), then the radius of the circle is

1) 5 **2)** 6 **3)** 7 **4)** 8

13. The length of focal chord AB of ellipse $\frac{x^2}{4} + \frac{y^2}{3} = 1$ is $\left(Given\ A = \left(\frac{8}{5}, \frac{3\sqrt{3}}{5} \right) \right)$

1) $\frac{4}{5}$ **2)** $\frac{16}{5}$ **3)** $\frac{32}{5}$ **4)** $\frac{64}{5}$

14. Let $f(x) = \int x^{\sin x} (1 + x.\cos x.ln\, x + \sin x)\, dx$ and $f\left(\frac{\pi}{2}\right) = \frac{\pi^2}{4}$. Find the value of $\cos\left(f(\pi)\right)$.

1) $\frac{\pi}{2}$ **2)** -1 **3)** π **4)** 1

15. The value of $\sum_{r=1}^{5}\left(x^r+\frac{1}{x^r}\right)^2$, where x satisfies the equation $x^2+x+1=0$, is

1) 5 **2)** 6 **3)** 7 **4)** 8

16. Let R be a relation on real numbers given by $R=\{(a,b):3a-3b+\sqrt{7}\ \textit{is an irrational number}\}$.

Then R is

1) Reflexive but neither symmetric nor transitive

2) Reflexive and transitive but not symmetric

3) Reflexive and symmetric but not transitive

4) An equivalence relation

17. A function f is defined on $[-3,3]$ as $f(x)=\begin{cases}\min\{|x|,2-x^2\}, & -2\le x\le 2\\ [|x|] & 2<|x|\le 3\end{cases}$ $[x]$ denote greatest integer $\le x$, number of points where f is not differentiable in $(-3,3)$ is

1) 3 **2)** 4 **3)** 5 **4)** 2

18. If m and n be the absolute maximum and minimum values of the function $f(x)=|x^2-7x+10|-5x+27; x\in[-2,14]$ then m+n is

1) 65 **2)** 66 **3)** 68 **4)** 70

19. If the parabola $y=ax^2+bx+c$ has vertex at $(4,2)$ and $a\in[1,3]$, then the absolute difference between the extreme values of abc is

1) 3600 **2)** 144 **3)** 3456 **4)** 169

20. Let set $A=\{x\in I^+: f(x)=x^3-8x^2+20x-13\ \textit{is a prime number}\}$ Consider the statements:

Statement – I: Number of elements in set A is 3

Statement – II: sum of all elements in set A is 9, then

1) Both Statement – I and Statement – II are true

2) Statement – I is true and Statement – II is false

3) Statement – I is false and Statement – II is true

4) Both Statement – I and Statement – II are false

SECTION-II (NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. Let $\vec{a},\vec{b},\vec{c}$ are three vectors of which every pair is non collinear, and the vectors $\vec{a}+3\vec{b}$ and $2\vec{b}+3\vec{c}$ are collinear with $\vec{c}$ and $\vec{a}$ respectively. If $\vec{b}.\vec{b}=1$, then find $\left|2\vec{a}+9\vec{c}\right|$.

22. The sum of the cubes of all the roots of the equation $x^4-3x^3-2x^2+3x+1=0$ is ____

23. Let $f(\theta)=\dfrac{1}{1+(\tan\theta)^x}$ and $s=\sum_{\theta=1^0}^{89^0} f(\theta)$ then the value of $\sqrt{2s-25}=$ _____

24. The remainder when the number $3^{2^{2^3}}-\left(3^{2^2}\right)^3$ is divide by 8, is.....

25. let $A=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$ *and* $B=\begin{bmatrix}a & b\\ c & d\end{bmatrix}$ are two matrices such that $AB=BA$ and $c\neq 0$. Then the value of $\dfrac{a-d}{3b-c}$ *is* $\dfrac{-14}{K}$ then $K=$

PHYSICS **Max Marks: 100**

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

26. Consider $S = x\cos\theta$ for $x = (2.0 \pm 0.2)\text{cm}$ and $\theta = (53+2)^\circ = (0.9250 \pm 0.0035)$ Radians. find absolute error in S. Given $\cos 53^\circ = \frac{3}{5}, \sin 53^\circ = \frac{4}{5}$.

1) 0.216 cm **2)** 0.126 cm **3)** 0.136 cm **4)** 0.116 cm

27. Statement – I : If the distance between plates of a charged isolated capacitor increases , then the potential energy in the electric field of capacitor increases.

Statement- II: The energy stored in a capacitor is always directly proportional to separation between the plates

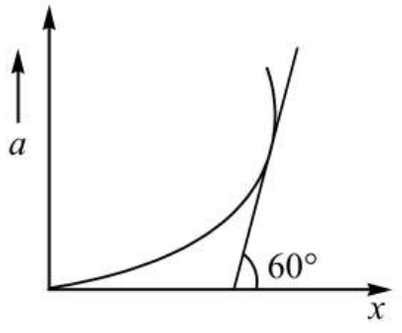
1) Both Statement – I and Statement – II are true

2) Statement – I is true and Statement – II is false

3) Statement – I is false and Statement – II is true

4) Both Statement – I and Statement – II are false

28. A particle starts moving with initial velocity $4\ \text{ms}^{-1}$ along the x-axis from origin. Its acceleration is varying with its position x in parabolic nature as shown in figure. At $x = \sqrt{3}$ m , a tangent to the curve makes an angle 60° with positive x-axis as shown. Then at $x = \sqrt{3}$ m



Statement-I : Velocity $(v)=\sqrt{\sqrt{3}+16}\ \text{ms}^{-1}$

Statement -II : Acceleration (a) $=3\ \text{ms}^{-2}$

1) Both Statement – I and Statement – II are true

2) Statement – I is true and Statement – II is false

3) Statement – I is false and Statement – II is true

4) Both Statement – I and Statement – II are false

29. A bird is flying at the height of 12 cm from the surface of a lake and a fish is swimming at a depth of 24 cm from the surface.

(Take is $\mu=4/3$)

Column-A		**Column-B**	
(A)	Distance of fish from the surface as seen by bird	(P)	16 cm
(B)	Distance of bird from the surface as seen by fish	(Q)	40 cm
(C)	Distance between fish and bird as seen by bird	(R)	18 cm
(D)	Distance between fish and bird as seen by fish	(S)	30 cm

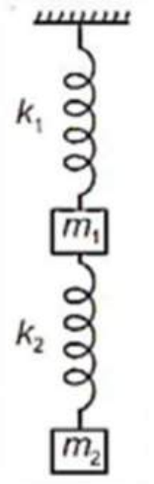
1) $A\to P,B\to R,C\to S,D\to Q$ **2)** $A\to R,B\to P,C\to Q,D\to S$

3) $A\to R,B\to P,C\to S,D\to Q$ **4)** $A\to P,B\to R,C\to Q,D\to S$

30. A particle undergoes from position $O(0,0,0)$ to $A(a,2a,0)$ via path $y=\dfrac{2x^2}{a}$ in $x-y$ plane under the action of a force which varies with particle's (x,y,z) coordinate as $\vec{F}=x^2y\hat{i}+yz^2e^{2z}\hat{j}-\left(\dfrac{z}{x+2y}\right)\hat{k}$. Work done by the force $\vec{F}$ is: (all symbols have their usual meaning and they are in SI unit.)

1) $\dfrac{4a^4}{5}$ **2)** $\dfrac{a^4}{5}$ **3)** $\dfrac{a^3}{4}$ **4)** $\dfrac{2a^4}{5}$

31. Find the ratio of the extension in upper spring to lower spring.



1) $\frac{m_1k_1}{m_2k_2}$ **2)** $\frac{m_2k_1}{m_1k_2}$ **3)** $\frac{(m_1+m_2)k_2}{m_1k_1}$ **4)** $\frac{(m_1+m_2)k_2}{m_2k_1}$

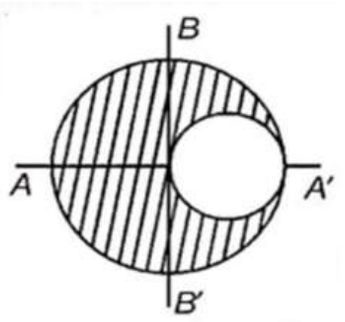
32. A source of alternating emf $E = E_0 \sin\omega t$ is connected in series with a capacitor and inductor in a circuit with negligible resistance. Natural frequency of LC oscillation is $\omega_0 = \frac{1}{\sqrt{LC}}$. If charge on capacitor at any moment is given by $Q = Q_0 \sin\omega t$ then magnitude of Q_0 is :

1) $\frac{E_0}{\left|\omega^2 - \omega_0^2\right|}$ **2)** $\frac{E_0}{L\omega^2}$ **3)** $\frac{E_0}{L\left|\omega^2 - \omega_0^{\ 2}\right|}$ **4)** $\frac{E_0}{L\omega_0^{\ 2}}$

33. Two spherical bodies of masses m and 5 m and radii R and $2R$ respectively, are released in free space with initial separation between their centres equal to $12R$. If they attract each other due to gravitational force only, the distance covered by smaller sphere just before collision is

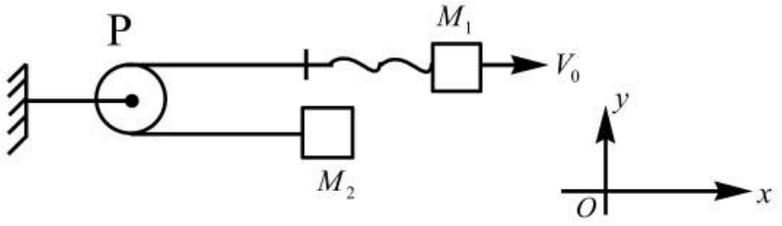
1) $\frac{15R}{2}$ **2)** $\frac{13R}{2}$ **3)** 10 R **4)** $\frac{17R}{2}$

34. From a uniform sphere of mass M and radius R a cavity of diameter R is created as shown, Find the ratio of moment of inertia of the sphere left about AA' and BB'



1) $\frac{15}{28}$ **2)** $\frac{28}{15}$ **3)** $\frac{31}{30}$ **4)** $\frac{62}{57}$

35. The particles M_1 & M_2, and the pulley P are lying on smooth horizontal surface. Initially the string is loose.



Assertion: The particle M_1 is projected with a speed V_0. Then the particle M_2 moves with a velocity $\left(\frac{M_1V_0}{M_1+M_2}\right)$ just after the collision.

Reason: The momentum of system (M_1+M_2) is conserved along x – direction.

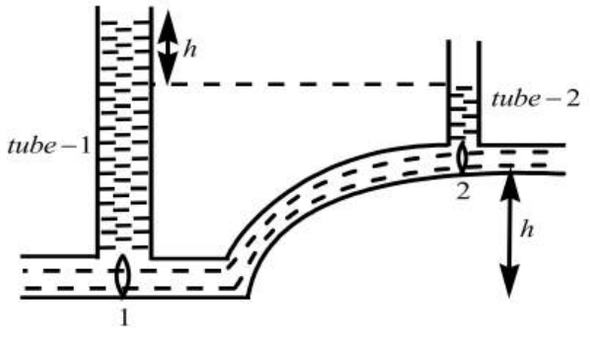
1) Assertion is True, **Reason** is True; **Reason** is a Correct explanation for **Assertion**

2) Assertion is True, **Reason** is True; **Reason** is NOT a Correct explanation for **Assertion**

3) Assertion is True, **Reason** is False

4) Assertion is False, **Reason** is True

36. A non-viscous fluid of density ρ is flowing in a tube as shown in figure. Area of section-(**1**) is double that of section-(**2**). Centre of mass of section-(**2**) is h height above the Centre of mass of section-(**1**) and level of water in tube-1 is 'h' height above that in tube-2. Then:



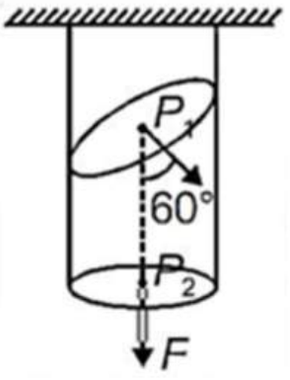
1) Velocity of fluid of section-(**1**) is $\sqrt{\frac{gh}{3}}$

2) Velocity of fluid at section-(**1**) is $\sqrt{\frac{2gh}{3}}$

3) Work done by gravitational force per unit volume from section-(**1**) to section-(**2**) is ρgh

4) Work done by elastic forces (pressure) per unit volume from section-(**1**) to section-(**2**) is $3\rho gh$

37. A massless uniform rod is subjected to force F at its free end as shown in figure. The ratio of tensile stress at plane P_1 to stress at P_2 is



1) 1:2 **2)** $\sqrt{2}:1$ **3)** 1:4 **4)** 3:2

38. Binding Energy per nucleon of a fixed nucleus X^A is 6 MeV. It absorbs a neutron moving with $KE = 2MeV$, and converts into Y, emitting a photon of energy 1 MeV. The Binding Energy per nucleon of Y (in MeV) is

1) $\frac{(6A+1)}{(A+1)}$ **2)** $\frac{(6A-1)}{(A+1)}$ **3)** 7 **4)** $\frac{6A+1}{A-1}$

39. Electrons with de-Broglie wavelength λ fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-rays is

1) $\lambda_0 = \frac{2mc\lambda^2}{h}$ **2)** $\lambda_0 = \frac{2h}{mc}$ **3)** $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$ **4)** $\lambda_0 = \lambda$

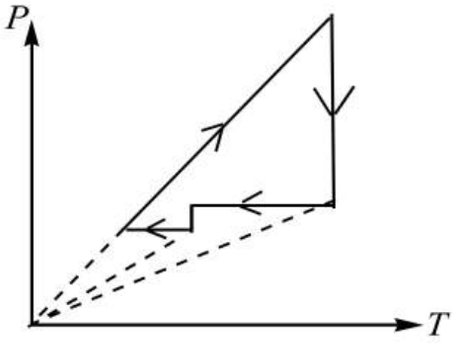
40. Time period of a particle executing SHM is 16 s. At time $t = 2s$, it crosses the mean position its amplitude of motion is $\frac{32\sqrt{2}}{\pi}m$. Its velocity at t=4s is

1) 1 ms^{-1} **2)** 2 ms^{-1} **3)** 4 ms^{-1} **4)** 8 ms^{-1}

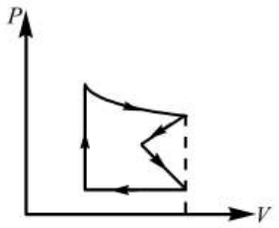
41. A thick uniform rope of Length L is hanging from a rigid support. A transverse wave of wavelength λ_0 is set up in the middle of the rope. The wavelength of the wave as it reaches the top most point is

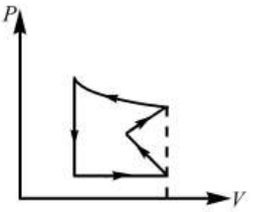
1) $2\lambda_0$ **2)** $\sqrt{2}\lambda_0$ **3)** $\frac{\lambda_0}{\sqrt{2}}$ **4)** λ_0

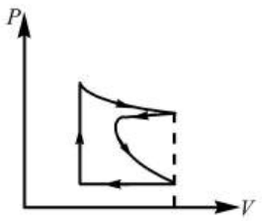
42. P -T curve for a cyclic process is as shown

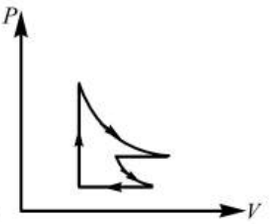


P – V graph for this process will be:

1) 

2) 

3) 

4) 

43. **Assertion:** The photodiode is used to detect the optical signals. These diodes are preferably operated in reverse biased mode

Reason: fractional change in majority carriers produce higher reverse bias current

1) Assertion is True, **Reason** is True; **Reason** is a Correct explanation for **Assertion**

2) Assertion is True, **Reason** is True; **Reason** is NOT a Correct explanation for **Assertion**

3) Assertion is True, **Reason** is False

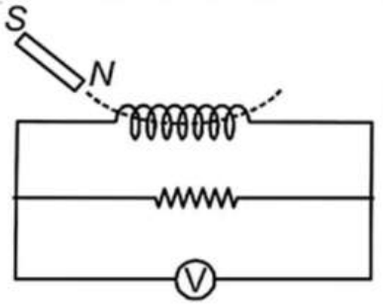
4) Assertion is False, **Reason** is True

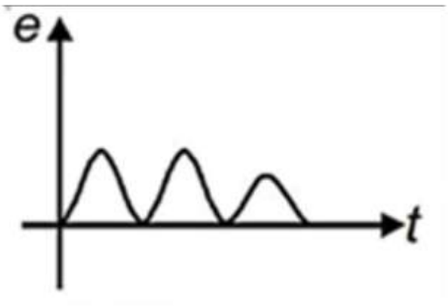
44. Energy required to place a body of mass m from an orbit of radius 2R to 3R is (Given that M=mass of earth, R=Radius of Earth)

1) $\frac{GMm}{3R}$ **2)** $\frac{GMm}{12R}$ **3)** $\frac{GMm}{18R}$ **4)** $\frac{GMm}{6R}$

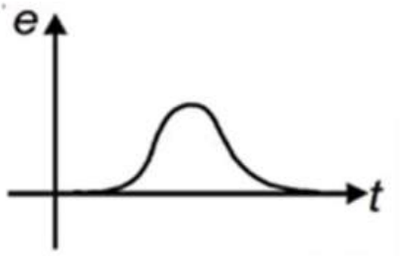
45. A small magnet is made to oscillate with a particular frequency through a coil as shown in figure.

The time variation of magnitude of emf generated across the coil during one cycle is





1)



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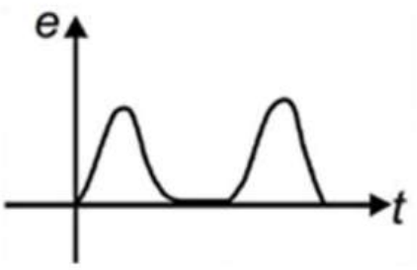

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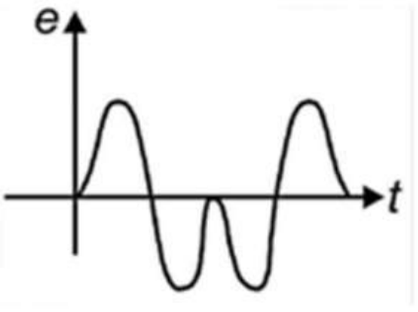


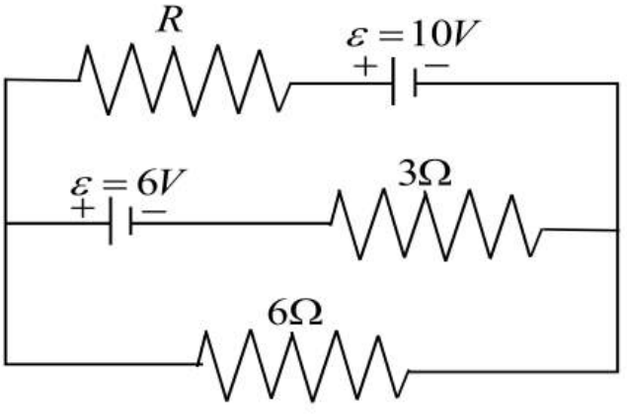
4)

SECTION-II (NUMERICAL VALUE TYPE)

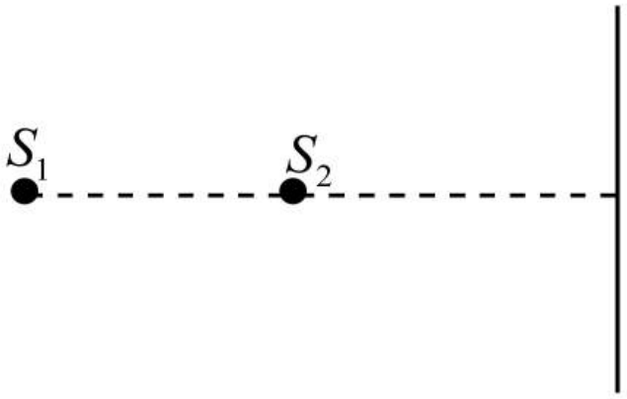
This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

46. In the given circuit if the internal resistance of the batteries are negligible, then for what value of resistance R (in Ω) will the thermal power generated in it be maximum.

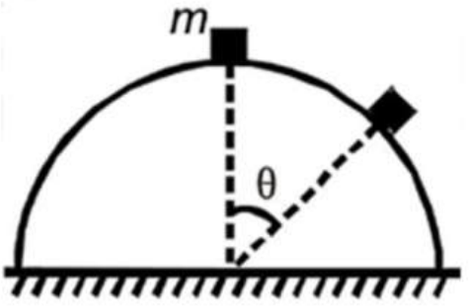


47. Two coherent monochromatic point sources S_1 and S_2 are placed in front of an infinite screen as shown in figure. Wavelength of the light emitted by both the sources is λ. Initial phase difference between the sources is zero.

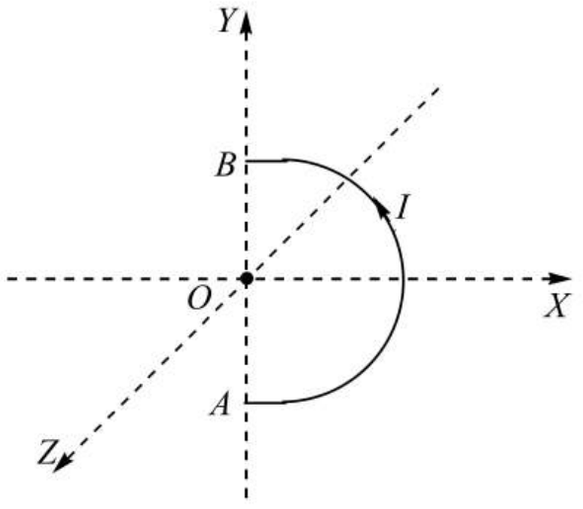


Initially $S_1S_2 = 2.5\lambda$ and the number of bright circular rings on the screen in n_1. If the distance S_1S_2 is increased and made 5.7λ, the number of bright circular rings becomes n_2. The difference $n_2 - n_1$ is:

48. A particle mass of m is placed in equilibrium at the top of a fixed rough hemisphere of radius R. Now the particle is given a gentle push so that it starts sliding on the surface of the hemisphere. It is found that the particle leaves the contact with the surface of the hemisphere at angular position θ with the vertical where $\cos\theta = \frac{3}{5}$. If the work done against friction is $\frac{2mgR}{10x}$, find x.



49. A conductor carrying current 60A is in the form of a semicircle AB of radius R and lying in xy-plane with its centre ' O ' at origin as shown in the figure. The magnitude of $\oint \vec{B} \cdot \vec{d\ell}$ for the circle $x^2 + z^2 = 3R^2$ in xz-plane due to current in curve AB is $10n\mu_0$. Find the value of n (n is an integer)



50. The electric resistance of medium depends upon permeability (μ) and permittivity (ε) as given below $R \propto (\mu)^a (\varepsilon)^b$ .If $a - b = N$. The value of N is .....

CHEMISTRY

Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

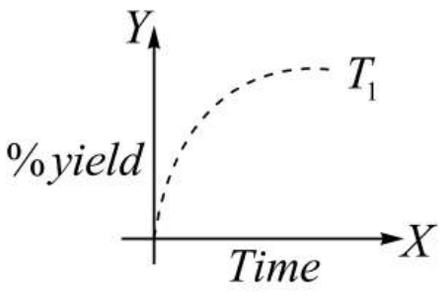
Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

51. Percentage composition of Carbon by mole in isopentane

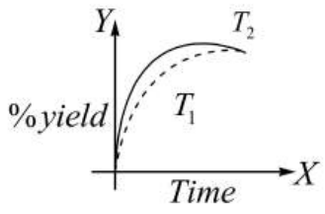
1) 29.41% **2)** 28.41% **3)** 50% **4)** 60%

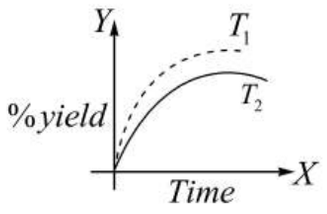
52. The percentage yield of $SO_3(g)$ as a function of time in the reaction

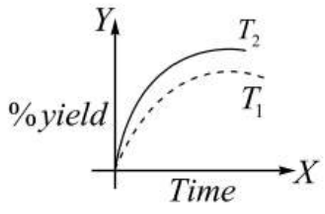
$SO_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$, $\Delta H_r < 0$ at (P, T_1) is given below



If this reaction is conducted at (P, T_2) with $T_2 > T_1$. The percentage yield of SO_3 as a function of time is represented by

1)


2)


3)


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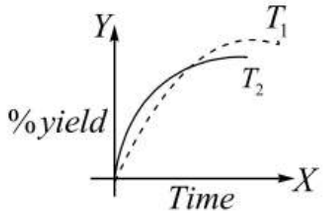
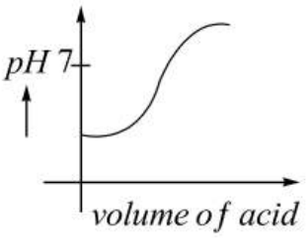
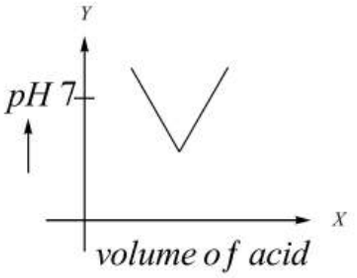


53. The plot of pH-metric titration of weak base like methyl amine vs strong acid hydrobromic acid looks like

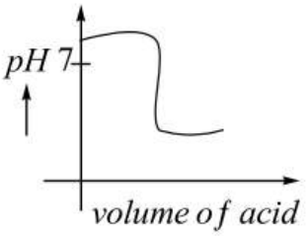
1)



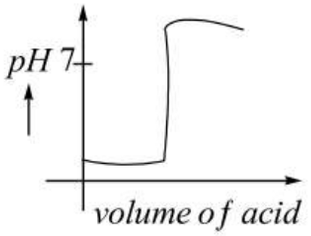
2)



3)



4)



54. Given below are two statements: one labelled as Assertion A and other is labelled as Reason R

Assertion A: $1.24g$ of hydrated hypo dissolved in water to make $250.0ml$ solution result in 0.2M hypo solution

Reason R: Molar mass of hydrated hypo is $248gmol^{-1}$

In the light of the above statements. Choose the correct answer from the options given below

1) A is true but R is false

2) A is false but R is true

3) Both A and R are true but R is not the correct explanation of A

4) Both A and R are true and R is the correct explanation of A

55. Given below are two statements

Statement-1: The limiting molar conductivities of potassium sulphate is higher compared to that of propionic acid

Statement-2: Molar conductivity decreases with decrease in concentration of electrolyte

In the light of the above statements, choose the most appropriate answer from the options

1) Both statement-1 and Statement-2 are false

2) Statement-1 is true and Statement-2 is false

3) Statement-1 is false but Statement-2 is true

4) Both Statement-1 and Statement-2 are true

56. Iron is extracted from its ore via the reaction

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

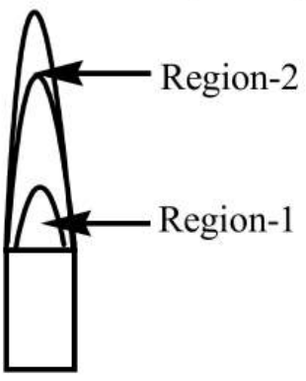
(Fe = 56amu)

The volume of CO (at STP) required to produce 2kg of Iron is _____ Liters

1) 1200 **2)** 1300 **3)** 1400 **4)** 1000

57. In borax bead test of Cobalt metal B_2O_3 or borax $Na_2\left[B_4O_5(OH)_4\right].8H_2O$ is heated in a Bunsen burner flame with Cobalt(II) oxide on loop of platinum wire the mixture fuses to give a glass like metaborate bead.

The colour of bead in flame region 1 and 2 respectively are



1) Blue and Green only **2)** Green and Blue only

3) Blue and Blue only **4)** Yellow and Blue only

58. $\underset{(yellow\,colour)}{PbCrO_4(s)} + (excess)\,NaOH(aq) \rightarrow A(Soluble\,complex) + \underset{[yellow\,colour]}{Na_2CrO_4(aq)}$

Correct formula of complex 'A' is

1) $Pb(OH)_2$ **2)** $Na_2\left[Pb(OH)_4\right]$ **3)** $Na_3\left[Pb(OH)_6\right]$ **4)** $Na_4\left[Pb(OH)_5\right]$

59. Match List-I with List-II

	List-I Molecular Ions		**List-II Number of lone pair of electrons on central atom**
A	IF_7	I	Three
B	ICl_4^-	II	One
C	SO_2	III	Two
D	I_3^-	IV	Zero

Choose the correct answer from the options given below

1) $A-IV; B-I; C-II, D-III$ **2)** $A-II; B-I; C-IV, D-III$

3) $A-II; B-III; C-IV, D-I$ **4)** $A-IV; B-III; C-II, D-I$

60. Given below are two statements one is labelled as Assertion A and other is labelled as Reason R

Assertion A: Fluorine forms only one oxoacid HOF. Where as other halogens forms more

Reason R: Fluorine has smallest size among all halogen and is highly electronegative

In the light of above statements choose, The most appropriate answer from the options given below

1) A is correct but R is not correct

2) A is not correct but R is correct

3) Both A and R are correct and R is the correct explanation of A

4) Both A and R are correct and R is not the correct explanation of A

61. Outer most electronic configuration of Th^{+3} ion is

1) $5f^1$ **2)** $5f^0$ **3)** $6d^1$ **4)** $6d^2 7s^2$

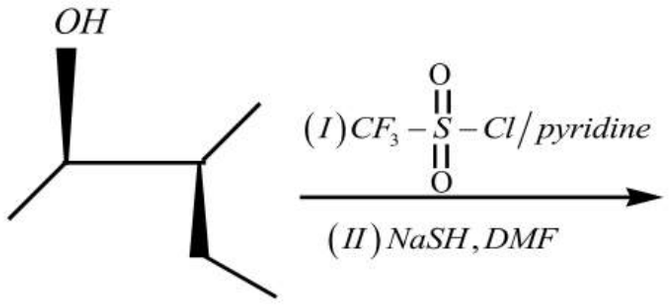
62. The crystal field stabilization energy $(CFSE)$ and magnetic moment (spin-only) of an octahedral aqua complex of metal ion (M^{Z+}) are $-0.8\Delta_0$ and $3.87BM$ respectively identify (M^{Z+})

1) Ti^{+2} **2)** Co^{2+} **3)** Cr^{+3} **4)** Mn^{+2}

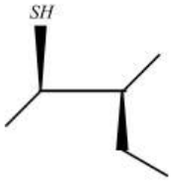
63. An organic compound "A" with molecular formula C_8H_8O forms an orange red precipitate with 2,4-DNP reagent and gives yellow precipitate on heating with iodine in the presence of sodium hydroxide. It neither reduces Tollens or Fehlings reagent, nor does it decolourises bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, It gives a carboxylic acid (B) having molecular formula $C_7H_6O_2$. Degree of unsaturation of compound (A) and (B) respectively are

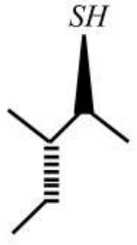
1) 5, 5 **2)** 4, 4 **3)** 3, 5 **4)** 3, 3

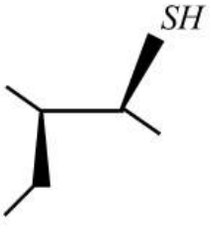
64.

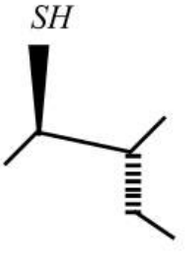


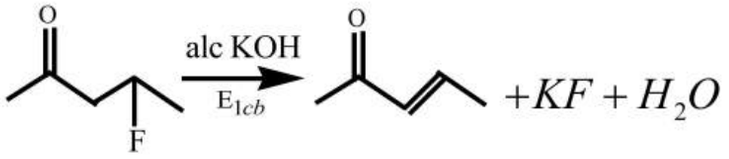
Most stable product of the above following reaction is

1) 

2) 

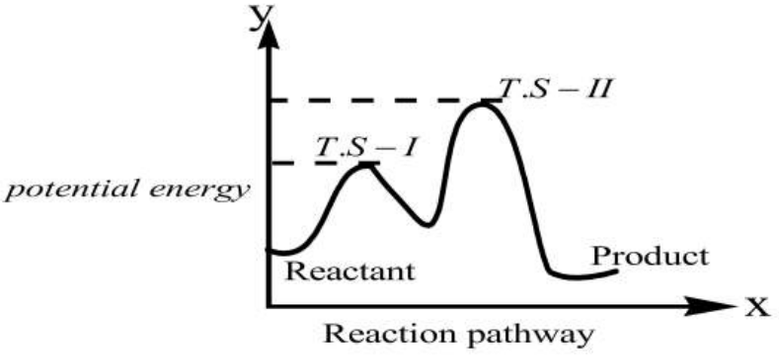
3) 

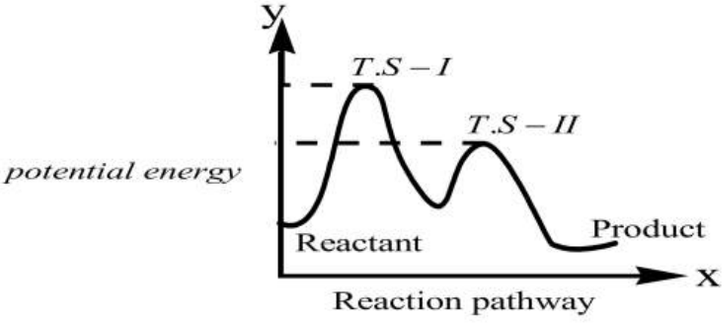
4) 

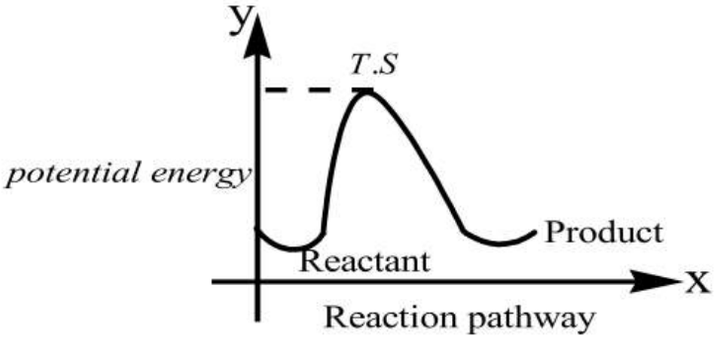
65. 

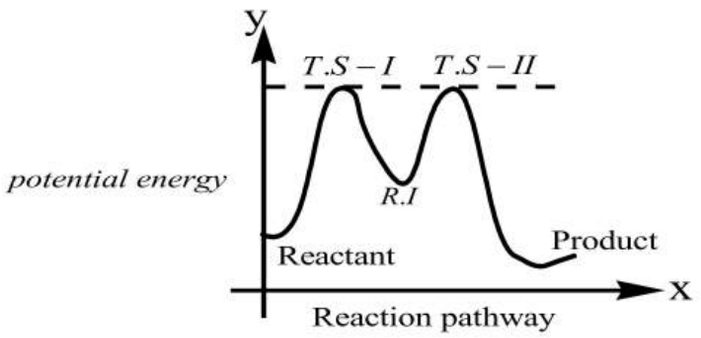
Correct energy profile diagram of the above reaction is

(T.S = Transition state; R.I = Reaction intermediate)

1) 

2) 

3) 

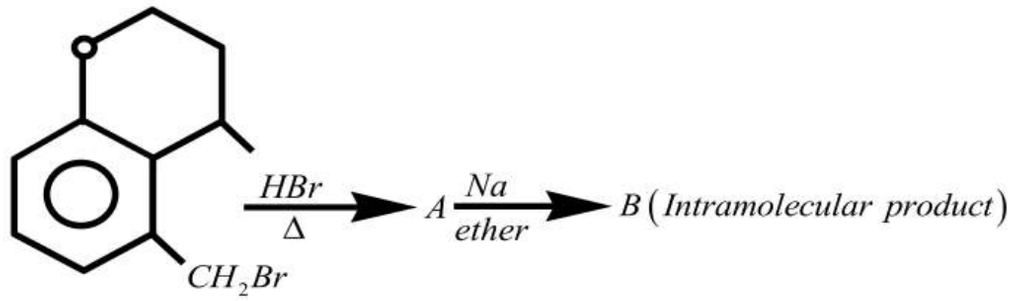


4)

66. Vitamin-C $\xrightarrow[10\%\ aqueous\ NaH\,{}^{14}CO_3]{}$ $gas\uparrow$. Evolved gas in the product is

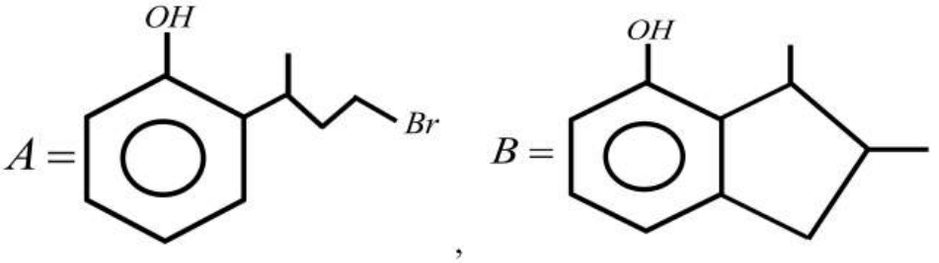
1) ${}^{14}CO_2$ **2)** ${}^{12}CO_2$ **3)** SO_2 **4)** can not liberate any gas

67.

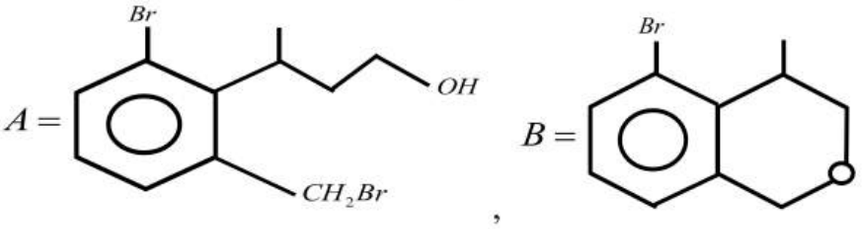


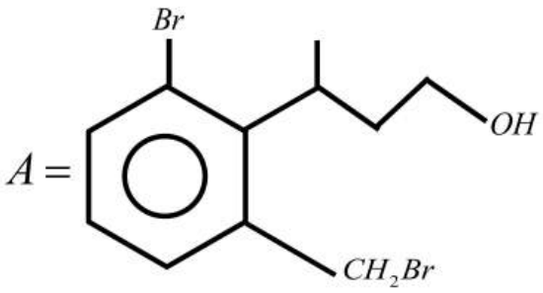
Structure of A and B will be

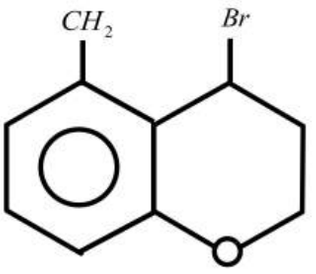
1)

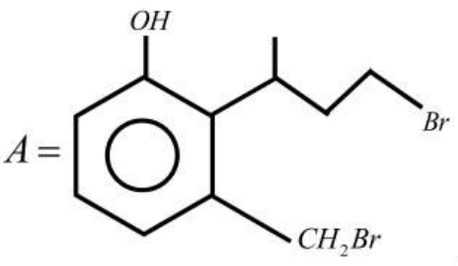


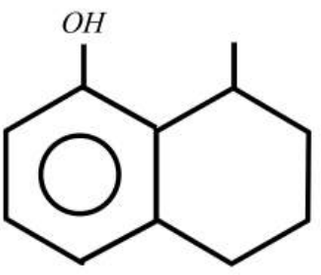
2)



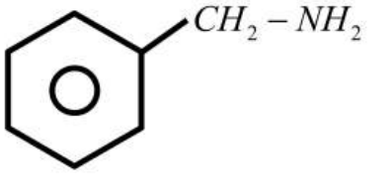
3) $A =$ 

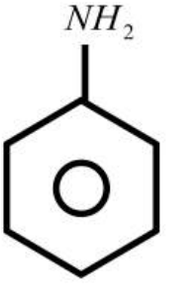
, $B =$ 

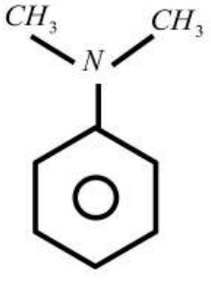
4) $A =$ 

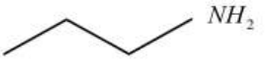
, $B =$ 

68. Which of the following compound in $HCl + NaNO_2 / 0 - 5^0C$ will form a coloured dye on reaction with $\beta - Naphthol$ in aq $NaOH$

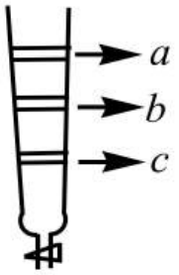
1) 

2) 

3) 

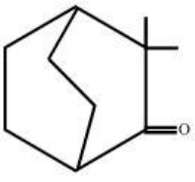
4) 

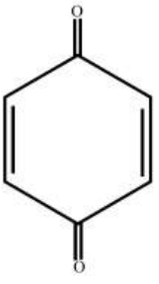
69. From the figure of column chromatography given below identify the correct statement

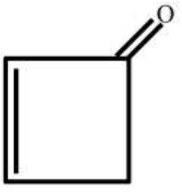


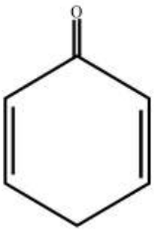
A) compound "c" is more polar than "a" and "b"
B) compound "a" is least polar
C) compound "b" comes out of the column before "c" and after "a"
D) compound "a" spend more time in the column
Choose the correct answer from the options given below
1) A, B, D only **2)** B and D only **3)** only D **4)** A, B, C only

70. Compound which can exhibit stable keto enol tautomerism

1) 

2) 

3) 

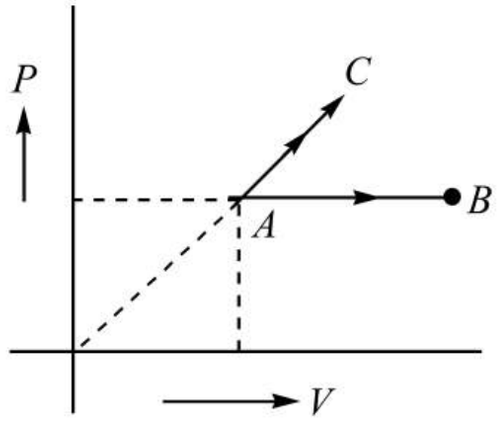
4) 

SECTION-II (NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

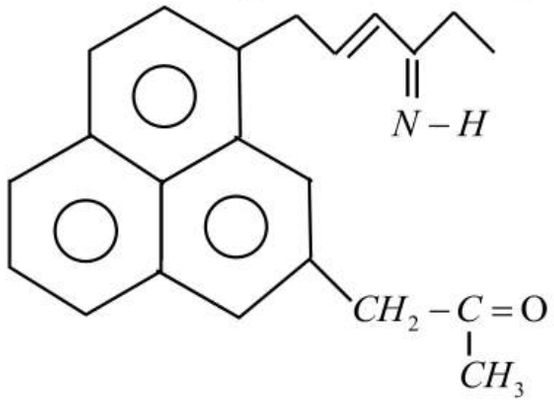
71. A soft drink was bottled with partial pressure of CO_2 of $6\,bar$ over the liquid at room temperature. The partial pressure of CO_2 over the solution approaches a value of 60 bar when 88g of CO_2 is dissolved in 1kg of water at room temperature. The approximate pH of the soft drink is _____ $\times 10^{-1}$.
(first dissociation constant of $H_2CO_3 = 4.0 \times 10^{-7}$, $\log 2 = 0.3$
density of the soft drink $= 1 gml^{-1}$)

72. Two mole ideal diatomic gas is heated according to path AB and AC. If the temperature of state B and state C are equal. Calculate $\frac{q_{AC}}{q_{AB}} \times \frac{7}{6}$ (Assume ideal diatomic gas at low temperature)



73. Radius ratio of second orbit of He^{+} and fourth orbit of Be^{+3} is $x \times 10^{-1}$. Value of 'x' is

74. Number of electrophilic centre in the given compound is _____



75. oxidation number of Mn in potassium manganate is _____

ANSWER KEY

MATHEMATICS

1	**1**	2	**3**	3	**2**	4	**3**	5	**4**
6	**2**	7	**3**	8	**1**	9	**3**	10	**3**
11	**1**	12	**3**	13	**2**	14	**2**	15	**4**
16	**1**	17	**3**	18	**2**	19	**3**	20	**1**
21	**6**	22	**36**	23	**8**	24	**0**	25	**14**

PHYSICS

26	**2**	27	**2**	28	**2**	29	**3**	30	**4**
31	**4**	32	**3**	33	**1**	34	**4**	35	**3**
36	**2**	37	**3**	38	**2**	39	**1**	40	**3**
41	**2**	42	**4**	43	**3**	44	**2**	45	**3**
46	**2**	47	**3**	48	**2**	49	**3**	50	**1**

CHEMISTRY

1	**1**	52	**4**	53	**3**	54	**2**	55	**1**
56	**1**	57	**3**	58	**2**	59	**4**	60	**3**
61	**1**	62	**2**	63	**1**	64	**2**	65	**1**
66	**1**	67	**4**	68	**2**	69	**3**	70	**4**
71	**36**	72	**1**	73	**5**	74	**3**	75	**6**

SOLUTION
MATHEMATICS

1. $\lim_{x\to 0}\dfrac{(\tan x)^{3/2}\left[1-(\cos x)^{3/2}\right]}{x^{3/2}.x^2}$

$= 1\times\lim_{x\to 0}\dfrac{1-\cos^3 x}{x^2}.\dfrac{1}{1+(\cos x)^{3/2}} \qquad = \dfrac{1}{2}.\dfrac{1}{2}\left(1+\cos x+\cos^2 x\right)=\dfrac{3}{4}$

2. $\dfrac{\sum x_i}{20}=10, \sum x_i = 10\times 20 = 200$

If 8 replaced by 12 then $\sum x_i = 200-8+12=204$

Now, correct mean $(\bar{x})=\dfrac{\sum x_i}{20}=\dfrac{204}{20}=10.2$

Standard deviation $=2$

So, variance $=(S.D)^2=2^2=4$

By definition, $\Rightarrow \dfrac{\sum x_i^2}{20}-\left(\dfrac{\sum x_i}{20}\right)=4 \Rightarrow \dfrac{\sum x_i^2}{20}-(10)^2=4$

$\Rightarrow \sum x_i^2 = 2080$

$\Rightarrow V_{ar}=\dfrac{\sum x_i^2}{20}-\left(\dfrac{\sum x_i}{20}\right)^2=\dfrac{2160}{20}-(10.2)^2$

3. $I.F.=e^{\int\frac{xdx}{x^2-1}}=\sqrt{1-x^2}$

$y=f(x)=\dfrac{3x^5+x^4+2x^2+x}{\sqrt{1-x^2}}=\int_{-1/2}^{1/2}\dfrac{f(x)}{\left(x^2+2\right)}dx=\dfrac{\pi}{6}-\dfrac{1}{4}$

4. $S_k=\sum_{r=1}^{k}\tan^{-1}\left(\dfrac{\frac{1}{3}\left(\frac{2}{3}\right)^r}{\left(\frac{2}{3}\right)^{2r+1}+1}\right)=\sum_{r=1}^{k}\left[\tan^{-1}\left(\dfrac{2}{3}\right)^r-\tan^{-1}\left(\dfrac{2}{3}\right)^{r+1}\right]=\tan^{-1}\left(\dfrac{2}{3}\right)^r-\tan^{-1}(0)=\cot^{-1}\left(\dfrac{3}{2}\right)$

5. $2|=2\int_{\pi/8}^{3\pi/8}\dfrac{11+\cos 4x}{1-\cos 4x}dx$

$\Rightarrow|=|=\int_{\pi/8}^{3\pi/8}\dfrac{12-(1-\cos 4x)}{1-\cos 4x}=12\int_{\pi/8}^{3\pi/8}\dfrac{1}{2\sin^2 2x}dx-\int_{\pi/8}^{3\pi/8}dx=6\int_{\pi/8}^{3\pi/8}\cos ec^2 2x\,dx-\dfrac{\pi}{4}$

$=\left[-\dfrac{6}{2}\cot 2x\right]_{\frac{3\pi}{8}}^{\frac{\pi}{8}}-\dfrac{\pi}{4}=-3\left[(1)+(1)\right]-\dfrac{\pi}{4}=-6-\dfrac{\pi}{4}$

6. LCM of $\alpha,\beta,\gamma = p^3q^2r$ & $HCF = pqr \qquad \therefore a=p^{m_1}q^{n_1}r$

$\beta=p^{m_2}q^{n_2}r \quad \gamma=p^{m_3}q^{n_3}r$

Minimum of $(m_1,m_2,m_3)=1$ & maximum of $(m_1,m_2,m_3)=3$

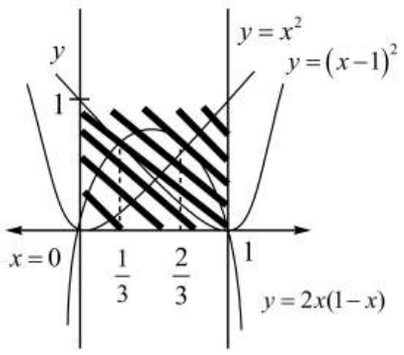
$\therefore$ Number of possibilities for $m_1,m_2,m_3=12$

And minimum of $n_1, n_2, n_3 = 1$ and maximum $(n_1, n_2, n_3) = 2$

$\therefore$ Number of possibilities = 6

$\therefore$ Total Number of ordered triplets = 12 x 6 = 72

7. The required Area $A = \int_0^1 f(x)$



$$= \int_0^{\frac{1}{3}} (1-x)^2\,dx + \int_{\frac{1}{3}}^{\frac{2}{3}} 2x(1-x)\,dx + \int_{\frac{2}{3}}^{1} x^2\,dx = \left[-\frac{1}{3}(1-x)^3\right]_0^{\frac{1}{3}} + \left[\left(x^2 - \frac{2x^3}{3}\right)\right]_{\frac{1}{3}}^{\frac{2}{3}} + \left[\frac{x^3}{3}\right]_{\frac{2}{3}}^{1} = \frac{17}{27}$$

8. I) $\frac{y^2}{9} - \frac{x^2}{16} = 1 \quad \frac{x^2}{16} - \frac{y^2}{9} = 1 \quad e = \sqrt{\frac{16+9}{16}} = \frac{5}{4} \quad \frac{1}{e^2} + \frac{1}{e'^2} = 1$

$\frac{1}{e'^2} = 1 - \frac{16}{25} = \frac{9}{25} \quad e' = \frac{5}{3}$

II) $2a = 10 \Rightarrow a = 5 \quad b^2 = 16 \quad b = 4 \quad e = \sqrt{\frac{25-16}{25}}$

III) $(a\sec\theta, 3\tan\theta)$

$6\tan\theta = 2 \qquad \tan\theta = \frac{1}{3} \qquad \frac{1}{\sqrt{3}} = \frac{3\tan\theta}{a\sec\theta}$

$a^2\sec^2\theta = 27.\frac{1}{9}$

$a^2\left(1 + \frac{1}{9}\right) = 27.\frac{1}{9} \qquad a^2(10) = 27$

IV) $k^2a^2 - a^2 = a^2 + a^2 \qquad k^2 - 1 = 2 \Rightarrow k^2 = 3 \Rightarrow \sqrt{3}$

9. W_1 = ball drawn in the first drawn is white

W_2 = ball drawn in the second drawn is white $P(W_1) = \frac{7}{12}$

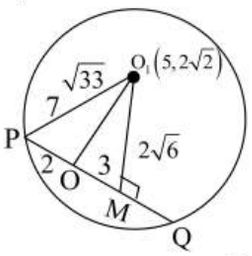
$P(B_1) = \frac{5}{12}, P(W_2/W_1) = \frac{10}{15}, P(W_2/B_1) = \frac{7}{15}$

$P(W_2) = P(W_1) \times P(W_2/W_1) + P(B_1) \times P(W_2/B_1)$

10. $\frac{S_{10}}{S_P} = \frac{100}{P^2} \Rightarrow S_P = \frac{S_{10}P^2}{100}, \frac{a_{11}}{a_{10}} = \frac{S_{11} - S_{10}}{S_{10} - S_9} = \frac{21}{19}$

11. Line L is the shortest distance line of given lines.

12. $O_1O=\sqrt{33}$ *and* $OM=3$



$\Rightarrow O_1M=2\sqrt{6}$ And PM = 5 $\Rightarrow O_1P=7$.

13. $\because \quad 2\cos\theta_1=\frac{8}{5}\Rightarrow\cos\theta_1=\frac{4}{5}\Rightarrow\tan\frac{\theta_1}{2}=\sqrt{\frac{1-\frac{4}{5}}{1+\frac{4}{5}}}=\frac{1}{3}$ and e $=\frac{1}{2}$

$\because \quad \tan\frac{\theta_2}{2}\times\frac{1}{3}=\frac{-\frac{1}{2}}{\frac{3}{2}} \quad \frac{\theta_2}{2}=\frac{3\pi}{4}\Rightarrow\theta_2=\frac{3\pi}{2}$

$B=\left(0,-\sqrt{3}\right)\Rightarrow AB=2+2-\frac{1}{2}\times\frac{8}{5}=4-\frac{4}{5}=\frac{16}{5}$

14. $f(x)=\int x^{\sin x}\left(1+x.\cos x.inx+\sin x\right)dx$

$f(x)=x^{\sin x}=e^{\sin x.inx}$, then

$f(x)=\int\left(f(x)+xf'(x)\right)dx=x.x^{\sin x}+c$

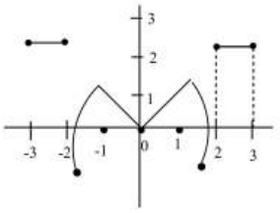
$f\left(\frac{\pi}{2}\right)=\frac{\pi}{2}.\left(\frac{\pi}{2}\right)+cc \qquad \Rightarrow c=0$

$f(x)=(x)(x)^{\sin x}, f(\pi)=\pi$.

15. $x^2+x+1=0 \quad \Rightarrow \quad x+\frac{1}{x}=-1 \quad \therefore \quad \sum_{r=1}^{5}\left(x^r+\frac{1}{x^r}\right)^2=8$.

16. Check for reflexivity . As $3(a-a)+\sqrt{7}=\sqrt{7}$ which belongs to relation
So relation is reflexive, Check for symmetric
Take $a=\frac{\sqrt{7}}{3},b=0$ LNow $(a,b)\in R$ but $(b,a)\notin R$
As $3(b-a)+\sqrt{7}=0$ which is rational so relation is not symmetric
Check for Transitivity, Take (a,b) as $\left(\frac{\sqrt{7}}{3},1\right)$ & (b,c) as $\left(1,\frac{2\sqrt{7}}{3}\right)$
So now $(a,b)\in R\,\&\,(b,c)\in R$ *but* $(a,c)\notin R$, Which means relation is not transitive

17.



It is non diff at 5 point $-2,-1,0,12$

18. $\begin{Bmatrix} x^2-12x+37 & ; & x\le 2 \\ 2x-x^2+17 & ; & 2<x<5 \\ x^2-12x+37 & ; & x\ge 5 \end{Bmatrix}$

19. $y=ax^2+bx+c$

$\frac{-b}{2a}=4 \quad \Rightarrow b=-8a$

$16a+4b+c=2 \quad c=16a+2$

$As \ \ a\in[1,3]\Rightarrow c\in[18,50]$

20. A= {2, 3, 4}

21. Given

$\vec{a}+3\vec{b}=\lambda\vec{c}$

$2\vec{b}+3\vec{c}=\mu\vec{a}$

$\Rightarrow 2\vec{b}+3\vec{c}=\mu\left(\lambda\vec{c}-3\vec{b}\right)$

$\Rightarrow(2+3\mu)\vec{b}+(3-\mu\lambda)\vec{c}$

$\Rightarrow \mu=-\frac{2}{3}$

$Thus, 2\vec{a}+6\vec{b}+9\vec{c}=\vec{0}$

$\Rightarrow\left|2\vec{a}-9\vec{c}\right|=6\left|\vec{b}\right|=6$

22. $x^4-3x^3-x^2-x^2+3x+1=0$

$\left(x^2-1\right)\left(x^2-3x-1\right)=0$

Let the root of $x^2-3x-1=0$ be α and β other two roots of given of given equation are 1 and -1

So, sum of cubes of roots $=1^3+(-1)^3+\alpha^3+\beta^3$

$=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)=(3)^3-3(-1)(3)=36$

23. $f(\theta)=\frac{(\cos\theta)^x}{(\cos\theta)^x+(\sin\theta)^x}, f(\theta)+f\left(\frac{\pi}{2}-\theta\right)=1$

24. $3^{256}-3^{12}=3^{12}\times\left(3^{256}-1\right) \ =(1+8)^6\left((1+8)^{112}-1\right) \quad =(1+8\lambda)(1+8\mu-1)$

$=8\mu(1+8\lambda)$, Which is divisible by 8. Hence, remainder is zero

25. $AB=\begin{bmatrix} a+2c & b+2d \\ 3a+4c & 3b+4d \end{bmatrix}$

$BA=\begin{bmatrix} a+3b & 2a+4b \\ c+3d & 2c+4d \end{bmatrix}, AB=BA\Rightarrow 2a-2d=-3b, \frac{a-d}{3b-c}=-1$

PHYSICS

26. $\Delta S = \Delta x \cos\theta + x \sin\theta . \Delta\theta$

27. For a given charge $U = a^2 / 2C = \frac{Q^2 d}{2 \epsilon_0 A} i.e., U \propto d.$

28. Assume $a = c_1 x^2 \Rightarrow \frac{da}{ax} = c_1 x \Rightarrow c_1\sqrt{3} =$ 0

$$\Rightarrow c_1 = \frac{1}{2} \Rightarrow v^2 - 4^2 = \frac{1}{2}\left[\frac{\left(\sqrt{3}\right)^3}{3} - 0^2\right]$$

29. Range will be maximum at only one value of θ that is possible if

$$R_{max}^2 - 4\left(\frac{gR_{max}^2}{2v^2}\right)\left(H - \frac{gR_{max}^2}{2v^2}\right) = 0, 0 = \frac{v^2}{2g} + H - \frac{gR_{max}^2}{2v^2}, R_{max} = \frac{v}{g}\sqrt{^2 + 2gH}$$

30. $\vec{F} = x^2 y\hat{i} + yz^2 e^{2z}\hat{j} - \left(\frac{z}{x+2y}\right)\hat{k}$

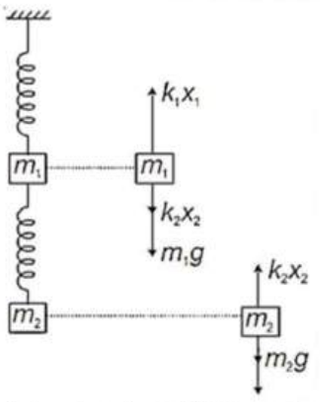
$$d\vec{r} = dx\hat{i} + dy\hat{j} + dz\hat{k}$$

$$dw = \vec{F} \cdot d\vec{r} = x^2 y dx + yz^2 e^{2z} dy - \left(\frac{z}{x+2y}\right)dz$$

for the given path $z = 0, y = \frac{2x^2}{a}$

$$dw = x^2 y dx = \frac{2x^4}{a} dx \, , w = \int dw = \frac{2}{a}\int_0^a x^4 dx = \frac{2a^4}{5}$$

31.



$$k_1 x_1 = k_2 x_2 + m_1 g; k_2 x_2 = m_2 g$$

$$x_1 = \frac{k_2}{k}\left[\frac{m_2 g}{k_2}\right] + \frac{m_1 g}{k_1};$$

$$x_2 = \frac{m_2 g}{k_2}$$

$$x_1 = \frac{(m_1 + m_2) g}{k_1}$$

$$\frac{x_1}{x_2} = \frac{(m_1 + m_2) k_2}{k_1 m_2}$$

32. Ans: 3

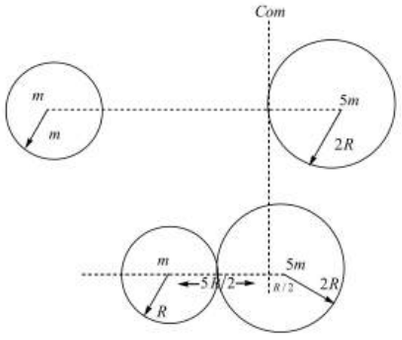
$$E_0 \sin\omega t = \frac{Q}{C} + L\frac{d^2Q}{dt^2}$$

Putting $Q = Q_0 \sin\omega t$

$$Q_0 = \frac{E_0}{L\left(\omega^2 - \omega_n^2\right)}$$

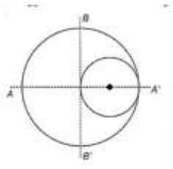
33. KEY: 1

Sol.



Distance covered by the smaller sphere $= 10R - \frac{5R}{2} = \frac{15R}{2}$

34.



$$I_{A'} = \frac{2}{5}MR^2 - \frac{2}{5}\frac{M}{8}\times\frac{R^2}{4}$$

$$I_{A'} = \frac{2}{5}MR^2 \times \frac{31}{32}$$

$$I_{B'} = \frac{2}{5}MR^2 - \frac{7}{5}\frac{M}{8}\frac{R^2}{4}$$

$$I_{B'} = \frac{2}{5}MR^2\left[1 - \frac{7}{64}\right]$$

$$I_{B'} = \frac{2}{5}MR^2 \times \frac{57}{64}$$

$$\frac{I_{A'}}{I_{B'}} = \frac{31}{32}\times\frac{64}{57} = \frac{62}{57}$$

35. **Assertion** is True, **Reason** is False as impulse will be imparted by string

36. Applying Bernoulli is equation from section-(1) and (2)

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$$

$$P_1 + \frac{1}{2}\rho V^2 + 0 = P_2 + \frac{1}{2}\rho (2V)^2 + \rho g h$$

and $P_1 - P_2 = \rho g(2h)$

Solving we get, $V = \sqrt{\frac{2gh}{3}}$

(C) Work done by gravitation force per unit value W_g = decrease in gravitational

$PT_{value} = \rho g h_1 - \rho g_2$ $PT_{value} = \rho g h_1 - \rho g h_2$

$W_{gr} = 0 - \rho g h$

(D) Work done by elastic force volume, W_e = decrease in elastic P.E vol = decrease in pressure $E_{vol} = P_1 - P_2 = \rho G(2h)$.

37.

$At\ P_2, Stress = S_2 = \frac{F}{A}$

$At\ P_1, stress = S_1 \times \frac{F\cos 60^0}{\frac{A}{\cos 60^0}} = \frac{F}{4A}$

$\Rightarrow \frac{S_1}{S_2} = \frac{1}{4}$

38. [Because absorption of energy decreases BE and release of energy increases BE] In Y nucleus there are $A+1$ nucleus.$\therefore$ $\frac{BE}{\text{nucleon}} = \frac{6A-1}{A+1}$

39. $p = \frac{h}{\lambda}$

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

$\frac{h^2}{2m\lambda^2} = \frac{hc}{\lambda_0}$

$\lambda_0 = \frac{2mc\lambda^2}{h}$

40. $For\ SHM, x = A\sin\omega t = A\sin\frac{2\pi t}{T}, v = \omega\sqrt{A - x^2}$, When t=4s. time taken by particle to travel from the mean position to given position=4-2=2s

$x = A\sin\frac{2\pi t}{T} = A\sin\frac{2\pi\times 2}{16} = \frac{A}{\sqrt{2}}$

, $\omega\sqrt{-x^2}$ $\omega\sqrt{^2\ \frac{A^2}{2}}$ $\frac{\omega A}{\sqrt{2}}$ $\frac{\pi}{16}$ $\frac{\sqrt{2}}{\pi}$ $\sqrt{2}$

41. Here frequency f is constant. Speed of wave

$v = \sqrt{\frac{T}{\mu}} \Rightarrow \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{Mg/2}{Mg}} \Rightarrow \lambda_2 = \sqrt{2}\lambda_1 = \sqrt{2}\lambda_0$

42. $\Rightarrow$ Slope of line joining origin to that point $\propto \frac{1}{V}$

as the slope of line OE is greater than the slope of line OC, SO, volume at ' E ' is less than that at ' C '. So, ans.is (D).

43. A photodiode is reverse biased. When light falling on it produces charge carriers, the fractional change, in minority carriers is high since the original current is very small.

$TE(2R) = -\dfrac{GMm}{4R}$

$TE(3R) = -\dfrac{GMm}{6R}$

44. $\Delta E = TE(3R) - TE(2R)$

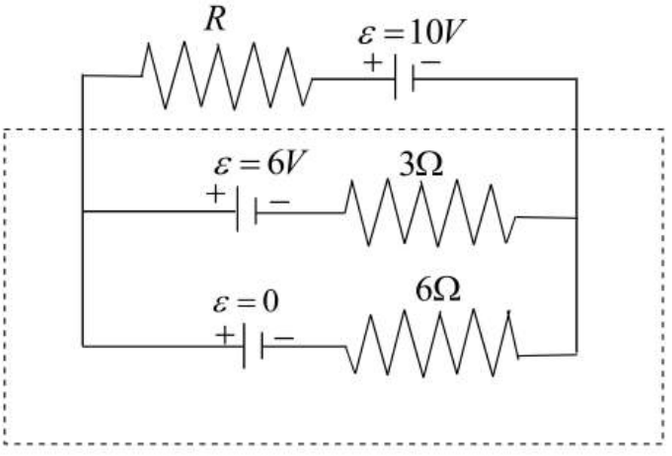
$\Delta E = -\dfrac{GMm}{6R} + \dfrac{GMm}{4R} = \dfrac{GMm}{R}\left[\dfrac{1}{4} - \dfrac{1}{6}\right]$

$\Delta E = \dfrac{GMm}{R}\left[\dfrac{6-4}{24}\right] = \dfrac{GMm}{12R}$

45. The polarity of induced voltage changes periodically

46. KEY: 2

Sol. Given circuit can be simplified as dotted part can be replaced as



$P = \left(\dfrac{6}{2+R}\right)^2 R = \dfrac{36R}{(2+R)^2}$,

for P to be maximum $\dfrac{dP}{dR} = 0$

47. For $S_1S_2 = 2.5\lambda$, max path different $= 2.5\lambda$

min path different $= 0$

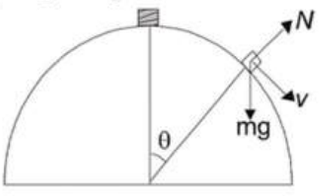
Between 2.5λ and 0 lie 2λ and $\lambda \Rightarrow$ two circular bright fringes

$n_1 = 2$ For $S_1S_2 = 5.7\lambda$, max. path different $= 5.7\lambda$ min path different $= 0$

Between 5.7λ and 0 lie $5\lambda, 4\lambda, 3\lambda, 2\lambda, \lambda \Rightarrow$ Five circular bright fringes. $\Rightarrow n_2 = 5$

$\therefore n_2 - n_1 = 5 - 2 = 3$

48. Angular position θ



$$mg\cos\theta - N = \frac{mv^2}{R}$$

$If\ it\ loosen\ contct, N = 0$

$$\Rightarrow v = \sqrt{gR\cos\theta}$$

$$Now, \cos\theta = \frac{3}{5} \Rightarrow v = \sqrt{\frac{3}{5}gR}$$

$By\ work\ energy\ theorem, w_{mg} + w_f = \frac{1}{2}mv^2$

$$mgR(1-\cos\theta) + w_f = \frac{1}{2}m \times \frac{3}{5}gR$$

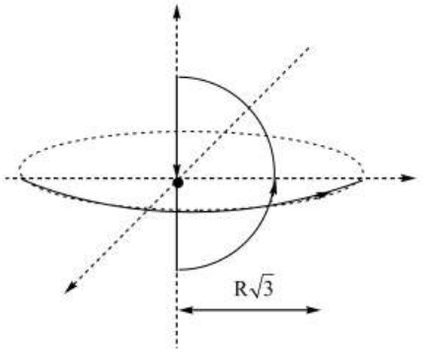
$$w_f = -\frac{1}{10}mgR$$

$$\Rightarrow x = 2$$

49. $\oint \vec{B}_{net} \cdot d\vec{\ell} = \oint \vec{B}_1 \cdot d\vec{\ell} + \oint \vec{B}_2 \cdot d\vec{\ell}$

$\vec{B}_1$ is magnetic field due to straight part,

$\vec{B}_2$ is magnetic field due to curved part



$$= {}_1\ \pi\ \sqrt{3} + \int {}_2 \cdot\ \vec{\ell}$$

$$= -\frac{\mu_0 I}{4\pi R\sqrt{3}}\ \pi\ \sqrt{3} + \int {}_2 \cdot\ \vec{\ell}$$

$$0 = -\frac{\mu_0 I}{2} + \int \vec{B}_2 \cdot d\vec{\ell}$$

50.

$$ML^2\ T^{-3}\ A^{-2} = \left[MLT^{-2}\ A^{-2}\right]^a \left[M^{-1}\ L^{-3}\ T^4\ A^2\right]^b$$

$$a - b = 1$$

$$a - 3b = 2$$

$$a = \frac{1}{2},\ b = -\frac{1}{2}$$

CHEMISTRY

51. $C_5H_{12} = \dfrac{5 \text{ mole Carbon atom}}{17 \text{ mole atom}} \times 100\% = 29.41\%$

52. As the $T \uparrow$ rate of reaction increases in the beginning after same time
Being exothermic reaction equilibrium shift backward and yield decreases

53. Weak base strong acid titration curve

54. $Na_2S_2O_3.5H_2O$ called hypo
Mol.wt = 248
$M = \dfrac{1.24}{248} \times \dfrac{1000}{250} = 0.02$

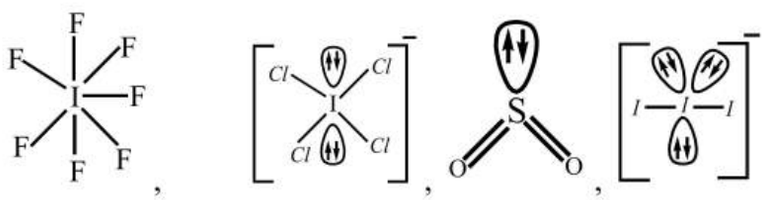
55. Limiting Λm of weak electrolyte > strong electrolyte
$\Lambda m \propto$ volume of solution

56. 3 mole CO occupies $= 3 \times 22.4$
$= 67.22$
112g Fe production required $= 67.2$ *Liter CO*
$2000g\ Fe - - - - - = \dfrac{67.2}{112} \times 2000 \qquad = 1200$ *Liters*

57. Cobalt gives blue colour both in oxidizing flame or in reducing flame

58. $PbCrO_4 + 4NaOH \rightarrow Na_2\left[Pb(OH)_4\right] + Na_2CrO_4$

59.

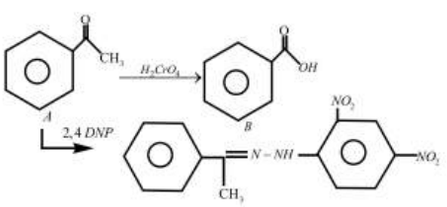


60. Fluorine forms only oxy acid HOF due to smaller size and highest electronegativity

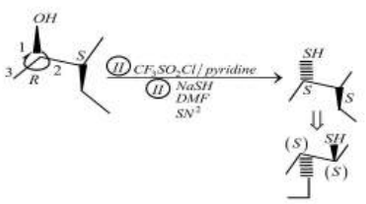
61. $Th^{+3} = 5f^1$

62. H_2O (W.F.L) no force pairing hence C.F splitting E = C.F stabilisation energy
$CO^{+2} = 3d^7 \quad t_{2g}^5\ e_g^2 \quad C.F.S.E = (-0.4 \times 5 + 2 \times 0.6)\Delta_0 = -0.8\Delta_0 \quad \mu = \sqrt{3(3+2)} = 3.87Bm$

63.

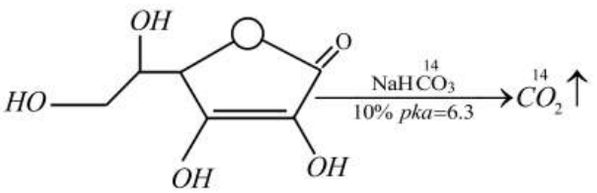


64.



65. E_{1cb} 1st step is fast and 2nd step is slow

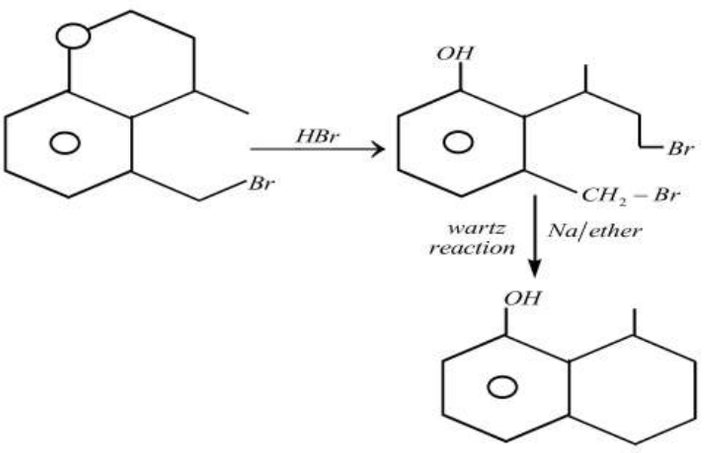
66.



Vita min – *C*

$pka = 4.1$

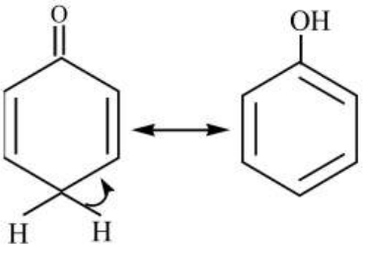
67.



68. β – naphthol does not give coupling reaction in strong acidic medium

69. Most polar compound retains at the top of column and eluted last

70.



71. $\frac{P_1}{P_2} = \frac{m_1}{m_2} \quad = \frac{6}{60} = \frac{m_1}{88}$

$m_1 = 8.8g \quad \text{Mole} = \frac{8.8}{44} = 0.2$

$pH = \frac{1}{2} pka - \log c \quad = \frac{1}{2} \times 6.4 - \log\left(2 \times 10^{-1}\right)$

$ka = 4 \times 10^{-7} \quad pka = 7 - 0.6 = 6.4 \quad \Rightarrow 3.2 + 0.35 = 3.55 \; = 35.5 \times 10^{-1} = 36 \times 10^{-1}$

72. AB Isobaric $C_{p,m} = \frac{7R}{2}$

AC polytropic process $P = KV$

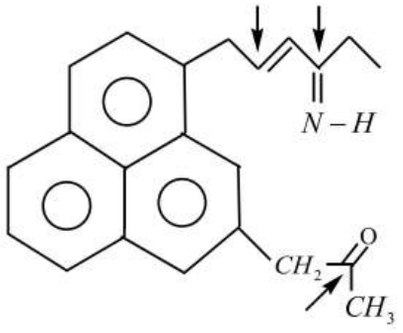
$PV^{-1} = K$

$$C_{p,m} = C_{v,m} + \frac{R}{(1-x)} \quad [x=-1] = \frac{5R}{2} + \frac{R}{2} \quad = 3R$$

$$\frac{q_{AC}}{q_{AB}} = \frac{\int_{T_A}^{T_C} nC_m.dT}{\int_{T_A}^{T_B} nC_m.dT} = \frac{2\times 3R\times 2}{2\times 7R}\frac{(T_C - T_A)}{(T_B - T_A)} = \frac{6}{7} \qquad \Rightarrow \frac{6}{7}\times\frac{7}{6} = 1$$

73. $\frac{rHe^{+}}{rBe^{+3}} = \frac{n_1^2}{z_1}\times\frac{z_2}{n_2^2} = \frac{2^2}{2}\times\frac{4}{16} = \frac{1}{2} = 0.5 = 5\times10^{-1}$

74.



75. K_2MnO_4 +6