MOTION

JEE MAIN 2026

SAMPLE PAPER - 3

WITH SOLUTIONS

मोशन है , तो भरोसा है

MOTION

Sample Paper 3

Duration: 3 Hours **Max Marks: 300**

INSTRUCTIONS

In each part of the paper contains **25** questions. Please ensure that the Question 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 **5 Numeric Answer type questions.** 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** & **1 mark** will be deducted for each wrong answer.

NOTE : GENERAL INSTRUCTIONS 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.

INSTRUCTIONS FOR NUMERIC ANSWER FILLING IN OMR SHEET

1. Each answer contains four columns in numerical questions. (⓪⓪⓪⓪)

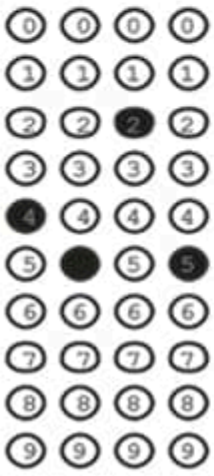
2. It is mandatory to fill all four columns while attending any of numerical questions, otherwise it will not be considered. (●●●●)

3. In numerical questions first two columns are reserved for 'Integers' and last two columns or 'Decimal' (⓪⓪ • ⓪⓪)

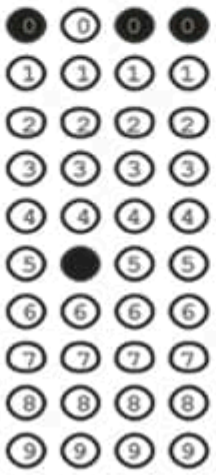
4. Don't use pen or pencil to mark decimal point. (⓪⓪•⓪⓪)

5. For your further guidance please go through the below mentioned examples:

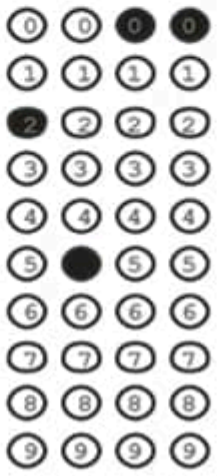
{a} Suppose your answer is - 45.25
Then mention it like



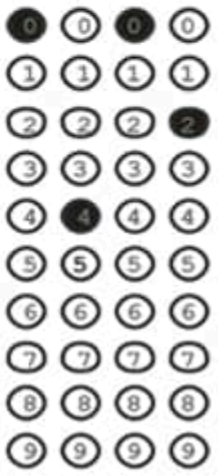
{b} Suppose your answer is - 5
Then mention it like



{c} Suppose your answer is – 25
Then mention it like



{d} Suppose your answer is – 4.02
Then mention it like



MATHS

SECTION - A

[SINGLE CORRECT TYPE]

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

1. If the set of values of p for which roots of the equation $2x^2 - (2p - 3)x + 2 = 0$ are $2^{\frac{-2}{\pi}\sin^{-1}\alpha}$ and $2^{\frac{2}{\pi}\sin^{-1}\alpha}$ for some value of α in [−1, 1] is [a, b], then 12(a + b) is

(A) 30

(B) 50

(C) 90

(D) 100

2. Let R = {(1, 2), (2,3), (3,3)} be a relation defined on the set {1, 2, 3, 4}. Then the minimum number of elements, needed to be added in R so that R becomes an equivalence relation, is:

(A) 10

(B) 9

(C) 8

(D) 7

3. The sum $\sum_{r=0}^{30} {}^{30}C_r \cdot \sin(rx) \cdot \cos(30 - r)x$ is equal to

(A) $2^{30} \cdot \cos 30x$

(B) $2^{29} \cdot \cos 30x$

(C) $2^{29} \cdot \sin 29x$

(D) $2^{29} \cdot \sin 30x$

4. The value of $\lim\limits_{n\to\infty} \left(\frac{n!}{(mn)^n}\right)^{\frac{1}{n}}$ is

(A) em

(B) $\frac{e}{m}$

(C) $\frac{1}{em}$

(D) $\frac{m}{e}$

5. Let $f(x) = |||x| - 1| - 1|$ and $g(x) = \{\text{Max}\, f(t) : x \le t \le x + 1, x \in R\}$. Then the number of points of nondifferentiability of g(x) is

(A) 6

(B) 7

(C) 8

(D) 10

1. यदि p जिसके लिए अन्तराल [−1, 1] में α के किसी मान के लिए समीकरण $2x^2 - (2p - 3)x + 2 = 0$ के मूल $2^{\frac{-2}{\pi}\sin^{-1}\alpha}$ तथा $2^{\frac{2}{\pi}\sin^{-1}\alpha}$ हैं, के मानों का समुच्चय [a, b] है, तब 12(a + b) है-

(A) 30

(B) 50

(C) 90

(D) 100

2. माना R = {(1, 2), (2,3), (3,3)}, समुच्चय {1, 2, 3, 4} पर परिभाषित एक सम्बन्ध है। तब R को तुल्यता सम्बन्ध बनाने के लिए R में जोड़े जाने वाले अवयवों की न्यूनतम संख्या है:

(A) 10

(B) 9

(C) 8

(D) 7

3. योगफल $\sum_{r=0}^{30} {}^{30}C_r \cdot \sin(rx) \cdot \cos(30 - r)x$ बराबर है

(A) $2^{30} \cdot \cos 30x$

(B) $2^{29} \cdot \cos 30x$

(C) $2^{29} \cdot \sin 29x$

(D) $2^{29} \cdot \sin 30x$

4. $\lim\limits_{n\to\infty} \left(\frac{n!}{(mn)^n}\right)^{\frac{1}{n}}$ का मान है

(A) em

(B) $\frac{e}{m}$

(C) $\frac{1}{em}$

(D) $\frac{m}{e}$

5. माना $f(x) = |||x| - 1| - 1|$ तथा $g(x) = \{\text{Max}\, f(t) : x \le t \le x + 1, x \in R\}$ हैं। तब g(x) के अन-अवकलनीयता के बिन्दुओं की संख्या है-

(A) 6

(B) 7

(C) 8

(D) 10

6. If the value of the integral $\int_0^5 \frac{x+[x]}{e^{x-[x]}}dx = \alpha e^{-1} + \beta$, where $\alpha, \beta \in R$, $5\alpha + 6\beta = 0$, and [x] denotes the greatest integer less than or equal to x, then the value of $(\alpha + \beta)^2$ is equal to :

(A) 36

(B) 100

(C) 16

(D) 25

6. यदि समाकलन $\int_0^5 \frac{x+[x]}{e^{x-[x]}}dx = \alpha e^{-1} + \beta$ है, जहाँ $\alpha, \beta \in R$, $5\alpha + 6\beta = 0$ तथा [x] महत्तम पूर्णांक < x है, तो $(\alpha + \beta)^2$ का मान बराबर है:

(A) 36

(B) 100

(C) 16

(D) 25

7. If a function $f : R \to R$ is defined as $f(x) = \int \frac{x^8+4}{x^4-2x^2+2}dx$ and f(0) = 1, then which of the following is correct?

(A) f(x) is an even function

(B) f(x) is an onto function

(C) f(x) is an odd function

(D) f(x) is many one function

7. यदि एक फलन $f : R \to R$ है जो $f(x) = \int \frac{x^8+4}{x^4-2x^2+2}dx$ द्वारा परिभाषित है तथा f(0) = 1 है, तब निम्नलिखित में से कौनसा परिभाषित है ?

(A) f(x) एक सम फलन है

(B) f(x) एक आच्छादक फलन है

(C) f(x) एक विषम फलन है

(D) f(x) बहुएकैकी है

8. The range of $f(x) = \cot^{-1}(-x) - \tan^{-1}x + \sec^{-1}x$ is

(A) $\left[-\frac{\pi}{2}, \frac{3\pi}{2}\right]$

(B) $\left[\frac{\pi}{2}, \pi\right) \cup \left(\pi, \frac{3\pi}{2}\right]$

(C) $\left(\frac{-\pi}{2}, \frac{3\pi}{2}\right)$

(D) $\left(\frac{\pi}{2}, \pi\right) \cup \left(\pi, \frac{3\pi}{2}\right)$

8. $f(x) = \cot^{-1}(-x) - \tan^{-1}x + \sec^{-1}x$ की परास है

(A) $\left[-\frac{\pi}{2}, \frac{3\pi}{2}\right]$

(B) $\left[\frac{\pi}{2}, \pi\right) \cup \left(\pi, \frac{3\pi}{2}\right]$

(C) $\left(\frac{-\pi}{2}, \frac{3\pi}{2}\right)$

(D) $\left(\frac{\pi}{2}, \pi\right) \cup \left(\pi, \frac{3\pi}{2}\right)$

9. Equation of the curve satisfying $xdy - ydx = \sqrt{x^2 - y^2}\,dx$; $y(1) = 0$ is : -

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

(B) $y^2 = x(x-1)^2$

(C) $y^2 = x^2(x-1)$

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

9. वक्र जो $xdy - ydx = \sqrt{x^2 - y^2}\,dx$; y(1) = 0 को संतुष्ट करता है, का समीकरण है:

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

(B) $y^2 = x(x-1)^2$

(C) $y^2 = x^2(x-1)$

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

10. The smaller area enclosed by y = f(x), when f(x) is a polynomial of least degree satisfying $\lim_{x\to 0}\left[1 + \frac{f(x)}{x^3}\right]^{1/x} = e$ and the circle $x^2 + y^2 = 2$ above the x - axis is :

(A) $\frac{\pi}{2}$

(B) $\frac{3}{2}$

(C) $\frac{\pi}{2} - \frac{3}{5}$

(D) $\frac{\pi}{2} + \frac{3}{5}$

10. यदि f(x) न्यूनतम घात का एक बहुपद है जो $\lim_{x\to 0}\left[1 + \frac{f(x)}{x^3}\right]^{1/x} = e$ को संतुष्ट करता है, तब y = f(x) तथा वृत्त $x^2 + y^2 = 2$ द्वारा x-अक्ष के ऊपर परिबद्ध क्षेत्र का क्षेत्रफल है :

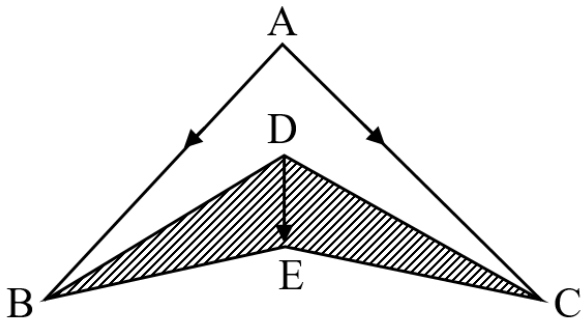
(A) $\frac{\pi}{2}$

(B) $\frac{3}{2}$

(C) $\frac{\pi}{2} - \frac{3}{5}$

(D) $\frac{\pi}{2} + \frac{3}{5}$

11. Let $\overrightarrow{AB} = 3\hat{i} - \hat{j}$, $\overrightarrow{AC} = 2\hat{i} + 3\hat{j}$ and $\overrightarrow{DE} = 4\hat{i} - 2\hat{j}$. The area of the shaded region in the adjacent figure, is



(A) 5

(B) 6

(C) 7

(D) 8

12. Let OABC is a tetrahedron with equal edges and $\overrightarrow{OA} = \vec{a}$, $\overrightarrow{OB} = \vec{b}$ & $\overrightarrow{OC} = \vec{c}$, where $|\vec{a}| = |\vec{b}| = |\vec{c}| = 2$. If $\hat{p}$, $\hat{q}$ and $\hat{r}$ are unit vectors along bisectors of angle between pair of edges represented by $\overrightarrow{OA}$,$\overrightarrow{OB}$; $\overrightarrow{OB}$, $\overrightarrow{OC}$ and $\overrightarrow{OC}$, $\overrightarrow{OA}$ respectively, then the value of $\frac{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{[\hat{p}+\hat{q}\ \ \hat{q}+\hat{r}\ \ \hat{r}+\hat{p}]}$ is equal to :

(A) $\frac{3\sqrt{3}}{32}$

(B) $\frac{3\sqrt{3}}{16}$

(C) $6\sqrt{3}$

(D) $\frac{3\sqrt{3}}{8}$

13. Let A be 2 × 2 matrix such that |A| = 2
and B be 3 × 3 matrix such that |B| = 3
and C be 4 × 4 matrix such that |C| = 4
Then value of

$$\frac{4}{|ABC|}\begin{vmatrix} |A| & |B| & |C| \\ |Adj\ A| & |AdjB| & |AdjC| \\ |A^{-1}| & |3B^{-1}| & |4C^{-1}| \end{vmatrix}$$

when |D| represents value of D.

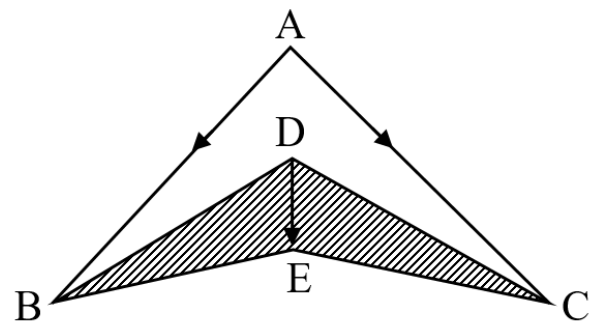
(A) –40

(B) –39

(C) –41

(D) –37

11. माना $\overrightarrow{AB} = 3\hat{i} - \hat{j}$, $\overrightarrow{AC} = 2\hat{i} + 3\hat{j}$ तथा $\overrightarrow{DE} = 4\hat{i} - 2\hat{j}$ हैं। संलग्न चित्र में छायांकित भाग का क्षेत्रफल है -



(A) 5

(B) 6

(C) 7

(D) 8

12. माना समान भुजाओं वाला एक चतुष्फलक OABC है तथा $\overrightarrow{OA} = \vec{a}$, $\overrightarrow{OB} = \vec{b}$ तथा $\overrightarrow{OC} = \vec{c}$ हैं, जहाँ $|\vec{a}| = |\vec{b}| = |\vec{c}| = 2$ है। यदि $\hat{p}$, $\hat{q}$ तथा $\hat{r}$ क्रमशः $\overrightarrow{OA}, \overrightarrow{OB}$; $\overrightarrow{OB}, \overrightarrow{OC}$ तथा $\overrightarrow{OC}, \overrightarrow{OA}$ के द्वारा प्रदर्शित भुजाओं के युग्मों के मध्य कोण के समद्विभाजक के अनुदिश इकाई सदिश हैं, तब $\frac{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{[\hat{p}+\hat{q}\ \ \hat{q}+\hat{r}\ \ \hat{r}+\hat{p}]}$ का मान बराबर है:

(A) $\frac{3\sqrt{3}}{32}$

(B) $\frac{3\sqrt{3}}{16}$

(C) $6\sqrt{3}$

(D) $\frac{3\sqrt{3}}{8}$

13. माना A, एक 2×2 का आव्यूह इस प्रकार है कि |A| = 2 तथा B एक 3 × 3 का आव्यूह इस प्रकार है कि |B| = 3 तथा C, एक 4 × 4 का आव्यूह इस प्रकार है कि |C| = 4 है। तब $\frac{4}{|ABC|}\begin{vmatrix} |A| & |B| & |C| \\ |Adj\ A| & |AdjB| & |AdjC| \\ |A^{-1}| & |3B^{-1}| & |4C^{-1}| \end{vmatrix}$ का मान है, जब |D|, D के मान को दर्शाता है-

(A) –40

(B) –39

(C) –41

(D) –37

14. The system equations $\alpha x + y + z = \alpha - 1$, $x + \alpha y + z = \alpha - 1$, $x + y + \alpha z = \alpha - 1$ has no solution, if α is

(A) -2

(B) either -2 or 1

(C) not -2

(D) 1

15. The number of the functions f : {1, 2, 3, 4} $\rightarrow$ $\{a \in Z : |a| \leq 8\}$ satisfying $f(n)+\frac{1}{n}$ $f(n+1)= 1, \forall n \in \{1, 2, 3\}$ is

(A) 1

(B) 4

(C) 2

(D) 3

16. The number of different words which can be formed using all the letters from the word 'NARAYAN' so that N does not lie between any two A's, is

(A) 126

(B) 105

(C) 63

(D) 42

17. A letter is chosen at random out of 'ASSININE' and one is chosen at random out of 'ASSASSIN'. Find the probability that the same letter is chosen on both occasions.

(A) $\frac{7}{16}$

(B) $\frac{7}{32}$

(C) $\frac{5}{16}$

(D) $\frac{9}{32}$

18. Let z_1, z_2 & z_3 are vertices of acute angled ΔABC in anticlockwise order and origin be the circumcenter of the triangle.If bisector of $\angle A$ meets the circumcircle at point $P(z)$, then $\arg\left(\frac{z}{z_3 - z_2}\right)$ is

(A) $\frac{\pi}{2}$

(B) $\frac{-\pi}{2}$

(C) $\frac{\pi}{6}$

(D) none of these

14. समीकरण निकाय $\alpha x + y + z = \alpha - 1$, $x + \alpha y + z = \alpha - 1$, $x + y + \alpha z = \alpha - 1$ का कोई हल नहीं है, यदि α का मान है -

(A) -2

(B) या तो -2 या फिर 1

(C) -2 नहीं

(D) 1

15. $f(n) + \frac{1}{n} f(n+1) = 1, \forall n \in \{1, 2, 3\}$ को संतुष्ट करने वाले फलनों $f : \{1, 2, 3, 4\} \rightarrow \{a \in Z : |a| \leq 8\}$ की संख्या है

(A) 1

(B) 4

(C) 2

(D) 3

16. शब्द 'NARAYAN' के सभी अक्षरों का उपयोग करके कितने भिन्न-भिन्न शब्द बनाए जा सकते हैं ताकि N किसी भी दो A के बीच में न हो।

(A) 126

(B) 105

(C) 63

(D) 42

17. 'ASSININE' में से एक अक्षर को यादृच्छिक रूप से चुना जाता है और 'ASSASSIN' में से एक अक्षर को यादृच्छिक रूप से चुना जाता है। यह प्रायिकता ज्ञात कीजिए कि दोनों अवसरों पर वही अक्षर चुना जाता है।

(A) $\frac{7}{16}$

(B) $\frac{7}{32}$

(C) $\frac{5}{16}$

(D) $\frac{9}{32}$

18. माना z_1, z_2 और z_3 वामावर्त दिशा में न्यूनकोण ΔABC के शीर्ष हैं और मूलबिंदु, त्रिभुज का परिकेंद्र है। यदि $\angle A$ का समद्विभाजक, परिवृत्त को बिंदु $P(z)$ पर मिलता है, तो $\arg\left(\frac{z}{z_3 - z_2}\right)$ है -

(A) $\frac{\pi}{2}$

(B) $\frac{-\pi}{2}$

(C) $\frac{\pi}{6}$

(D) इनमें से कोई नहीं

19. If $p = \cos 55^\circ$, $q = \cos 65^\circ$ and $r = \cos 175^\circ$, then the value of $\frac{1}{p} + \frac{1}{q} + \frac{r}{pq}$ is equal to:

(A) 0

(B) –1

(C) 1

(D) 2

20. Find the locus of the mid point of the chord of a circle $x^2 + y^2 = 4$ such that the segment intercepted by the chord on the curve $x^2 - 2x - 2y = 0$ subtends a right angle at the origin.

(A) $x^2 + y^2 - 2x - 2y = 0$

(B) $x^2 + y^2 + 2x - 2y = 0$

(C) $x^2 + y^2 + 2x + 2y = 0$

(D) $x^2 + y^2 - 2x + 2y = 0$

19. यदि $p = \cos 55^\circ$, $q = \cos 65^\circ$ तथा $r = \cos 175^\circ$ हैं, तब $\frac{1}{p} + \frac{1}{q} + \frac{r}{pq}$ का मान बराबर है:

(A) 0

(B) –1

(C) 1

(D) 2

20. एक वृत्त $x^2 + y^2 = 4$ की जीवा के मध्य बिन्दु का बिन्दुपथ ज्ञात कीजिए, ताकि वक्र $x^2 - 2x - 2y = 0$ पर उस जीवा द्वारा प्रतिच्छेदित रेखाखण्ड, मूलबिन्दु पर समकोण अन्तरित करता है।

(A) $x^2 + y^2 - 2x - 2y = 0$

(B) $x^2 + y^2 + 2x - 2y = 0$

(C) $x^2 + y^2 + 2x + 2y = 0$

(D) $x^2 + y^2 - 2x + 2y = 0$

SECTION - B

[NUMERIC VALUE TYPE]

Q.21 to ***Q.25*** are ***NUMERIC VALUE TYPE*** Questions. The answer to each question is a **NUMERICAL VALUE.**

21. Suppose a parabola $y = x^2 - ax - 1$ intersects the coordinate axes at three points A, B and C respectively, The circumcircle of ΔABC intersects the y-axis again at the point D(0, t). Find the value of t.

22. If eccentricity of hyperbola $x^2 - y^2 \operatorname{cosec}^2 \alpha = 5$ is $\sqrt{3}$ times eccentricity of the ellipse $x^2 \operatorname{cosec}^2 \alpha + y^2 = 25$. Then $\tan^2 \alpha =$

23. Let $\sum_{r=1}^{n} \frac{r^4}{(2r-1)(2r+1)} = \frac{n^3}{A} + \frac{n^2}{B} + \frac{5n}{C} + \frac{f(n)}{D}$ (A,B,C,D,$\in$ N) where f(n) is the ratio of two linear polynomials such that $\lim_{n\to\infty} f(n) = \frac{1}{2}$ find the value of |A+2B–C+D|

24. Let $X_1, X_2, \ldots\ldots X_{18}$ be eighteen observation such that $\sum_{i=1}^{18} (X_i - \alpha) = 36$ and $\sum_{i=1}^{18} (X_i - \beta)^2 = 90$, where α and β are distinct real numbers. If the standard deviation of these observations is 1, then the value of $|\alpha - \beta|$ is _____.

25. If the straight line y = mx – m + 2 passes through a fixed point P and intersects the curve $y = \frac{x^2-2x+5}{4}$ in A and B, then $\frac{1}{PA} + \frac{1}{PB}$ is equal to

21. माना एक परवलय $y = x^2 - ax - 1$ निर्देशांक अक्षों को तीन बिंदुओं क्रमशः A, B और C पर प्रतिच्छेद करता है। Δ ABC का परिवृत्त, y-अक्ष को पुनः बिंदु D(0, t) पर प्रतिच्छेद करता है। t का मान ज्ञात कीजिए।

22. यदि अतिपरवलय $x^2 - y^2 \operatorname{cosec}^2 \alpha = 5$ की उत्केन्द्रता, दीर्घवत्त $x^2 \operatorname{cosec}^2 \alpha + y^2 = 25$ की उत्केन्द्रता का $\sqrt{3}$ गुना है, तब $\tan^2 \alpha =$

23. माना $\sum_{r=1}^{n} \frac{r^4}{(2r-1)(2r+1)} = \frac{n^3}{A} + \frac{n^2}{B} + \frac{5n}{C} + \frac{f(n)}{D}$ (A, B, C, D$\in$ N) जहाँ f(n) दो रेखीय बहुपदों का अनुपात इस प्रकार है कि $\lim_{n\to\infty} f(n) = \frac{1}{2}$ है, तब |A + 2B – C + D| का मान ज्ञात कीजिए।

24. माना $X_1, X_2, \ldots\ldots X_{18}$ अठारह प्रेक्षण इस प्रकार हैं, कि $\sum_{i=1}^{18} (X_i - \alpha) = 36$ तथा $\sum_{i=1}^{18} (X_i - \beta)^2 = 90$ हैं, जहाँ α तथा β भिन्न वास्तविक संख्याऐं है। यदि इन प्रेक्षणों का मानक विचलन 1 है, तो $|\alpha - \beta|$ का मान बराबर है_____।

25. यदि एक सरल रेखा y = mx – m + 2 एक स्थिर बिन्दु P से गुजरती है, तथा वक्र $y = \frac{x^2-2x+5}{4}$ को क्रमशः A व B पर प्रतिच्छेद करती हैं, तब $\frac{1}{PA} + \frac{1}{PB}$ बराबर है-

PHYSICS

SECTION - A

[SINGLE CORRECT TYPE]

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

1. Two identical balls are projected, one vertically up and the other at an angle of 30° with the horizontal, with same initial speed. The potential energy at the highest point is in the ratio

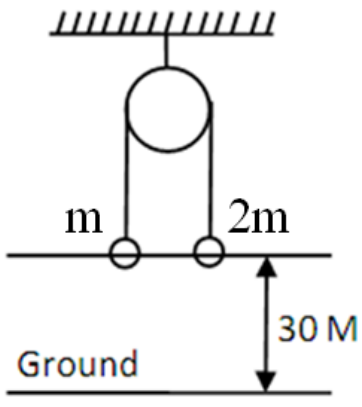
(A) $4 : 3$

(B) $3 : 4$

(C) $4 : 1$

(D) $1 : 4$

2. Two masses m and 2m are connected by a massless string, which passes over a pulley as shown in figure. The masses are held initially with equal lengths of the strings on either side of the pulley. Find the velocity of masses at the instant the lighter mass moves up a distance of 15m. ($g = 10\ m/s^2$)



(A) 8

(B) 10

(C) 12

(D) 15

1. दो समान गेंदों को समान प्रारंभिक चाल से एक ऊर्ध्वाधर ऊपर की ओर तथा दूसरी क्षैतिज से 30° के कोण पर प्रक्षेपित किया जाता है,। उच्चतम बिंदु पर स्थितिज ऊर्जा निम्न में से किस अनुपात में है -

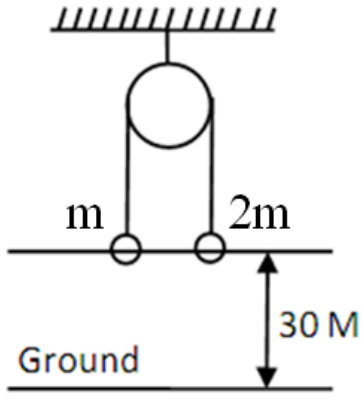
(A) $4 : 3$

(B) $3 : 4$

(C) $4 : 1$

(D) $1 : 4$

2. दो द्रव्यमान m और 2m एक द्रव्यमान रहित डोरी से जुड़े हुए हैं, जो चित्र में दिखाए अनुसार एक घिरनी के ऊपर से गुजरती है। प्रारम्भ में द्रव्यमानों को घिरनी के दोनों ओर समान लंबाई की डोरियों के साथ रखा जाता है। उस क्षण पर द्रव्यमानों का वेग ज्ञात कीजिए जब हल्का द्रव्यमान 15 मीटर की दूरी तक ऊपर गति करता है। ($g = 10\ m/s^2$)



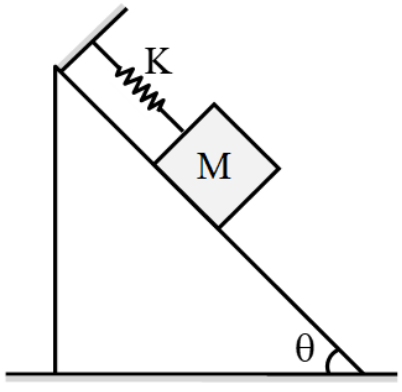
(A) 8

(B) 10

(C) 12

(D) 15

3. A system of wedge and block as shown in figure is released with the spring in its natural length. All surfaces are frictionless. Maximum elongation in the spring will be :



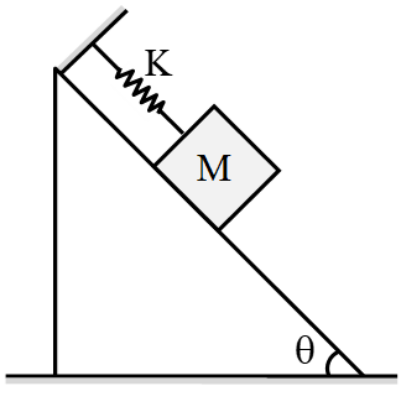
(A) $\frac{2mg\sin\theta}{K}$

(B) $\frac{mg\sin\theta}{K}$

(C) $\frac{4mg\sin\theta}{K}$

(D) $\frac{mg\sin\theta}{2K}$

3. जैसा कि चित्र में दिखाया गया है, वेज और ब्लॉक की एक निकाय को स्प्रिंग की प्राकृतिक लंबाई के साथ छोड़ा जाता है। सभी सतहें घर्षण रहित हैं। स्प्रिंग में अधिकतम प्रसार होगा:



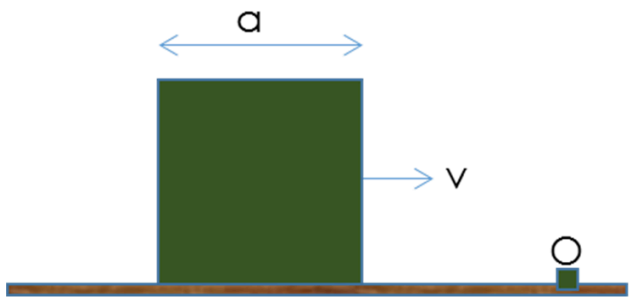
(A) $\frac{2mg\sin\theta}{K}$

(B) $\frac{mg\sin\theta}{K}$

(C) $\frac{4mg\sin\theta}{K}$

(D) $\frac{mg\sin\theta}{2K}$

4. A cubical block of side a is moving with a velocity v on a smooth horizontal plane as shown. It hits a ridge at point O. The angular speed of the block when it hits O is –



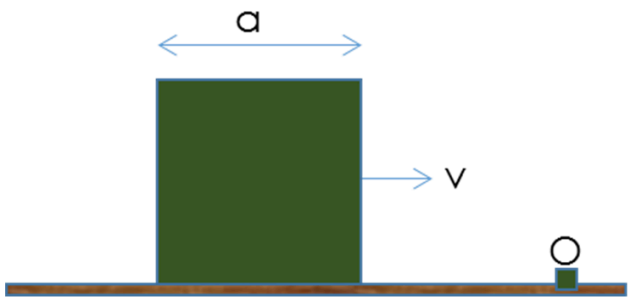
(A) $\frac{3v}{4a}$

(B) $\frac{3v}{2a}$

(C) $\frac{\sqrt{3}v}{\sqrt{2}a}$

(D) zero

4. भुजा a वाला एक घनाकार ब्लॉक, चित्र में दिखाए अनुसार, एक चिकने क्षैतिज तल पर v वेग से घूम रहा है। यह बिंदु O पर एक रिज (ridge) से टकराता है। जब यह O से टकराता है तो ब्लॉक की कोणीय गति है –



(A) $\frac{3v}{4a}$

(B) $\frac{3v}{2a}$

(C) $\frac{\sqrt{3}v}{\sqrt{2}a}$

(D) शून्य

5. If on ascending upwards, the value of g is reduced by 5% in order to obtain correct time the length of the pendulum has to undergo.

(A) no change

(B) an increment by the same percentage

(C) an decrement by the same percentage

(D) none of these

5. यदि ऊपर की ओर जाने पर, g का मान 5% घट जाता है तो सही समय ज्ञात करने के लिये लोलक की लम्बाई में

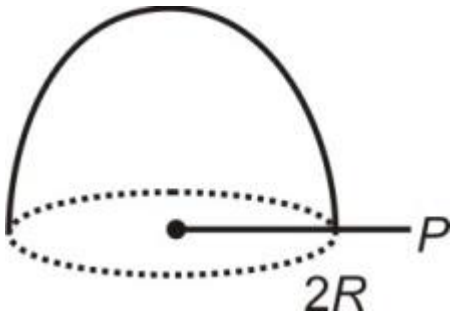
(A) कोई परिवर्तन नहीं होता है

(B) समान प्रतिशत की वृद्धि होती है

(C) समान प्रतिशत की कमी होती है

(D) इनमें से कोई नहीं

6. A non-conducting uniformly charged thin spherical shell having potential of 10 volts at its surface is cut into two equal parts then the electric potential at the point P at distance $2\,R$ (R is radius of hemisphere) from its centre in the absence of the other part is (as shown in figure):



(A) 2.5 volt

(B) 5 volt

(C) Zero volt

(D) Between $2.5\ \mathrm{V}$ and $5\ \mathrm{V}$

7. What is the flux through a cube of side 'a' if a point charge of q is at one of its corner :

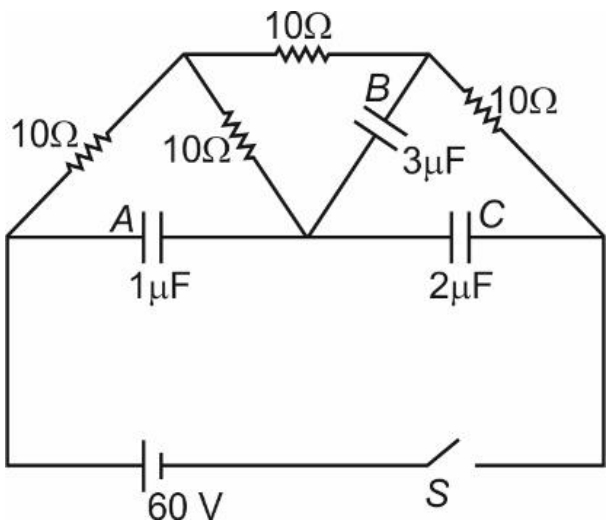
(A) $\frac{2q}{\varepsilon_0}$

(B) $\frac{q}{8\varepsilon_0}$

(C) $\frac{q}{\varepsilon_0}$

(D) $\frac{q}{2\varepsilon_0}$

8. In the adjacent figure the switch S is closed at $t = 0$. Q_A, Q_B and Q_C are charge on the capacitor A, Capacitor B and capacitor C in the steady state respectively. Choose the correct statement.



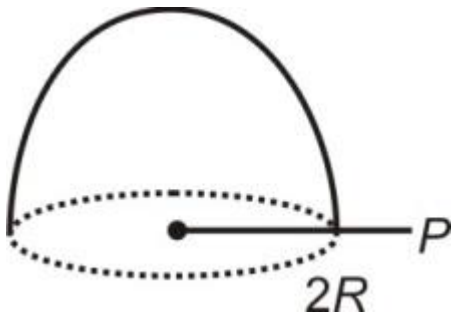
(A) $Q_A < Q_B < Q_C$

(B) $Q_A < Q_C < Q_B$

(C) $Q_C < Q_A < Q_B$

(D) $Q_C < Q_B < Q_A$

6. एक अचालक समान रूप से आवेशित पतला गोलीय कोश , जिसकी सतह पर 10 वोल्ट का विभव है, को दो बराबर भागों में काटा जाता है, तो दूसरे भाग की अनुपस्थिति में इसके केंद्र से 2R दूरी (R अर्धगोले की त्रिज्या है) पर स्थित बिंदु P पर विद्युत विभव होगा (जैसा कि चित्र में दिखाया गया है) -



(A) 2.5 volt

(B) 5 volt

(C) शून्य volt

(D) $2.5\ \mathrm{V}$ और $5\ \mathrm{V}$ के मध्य

7. यदि q बिन्दु आवेश, भुजा 'a' वाले घन के किसी एक कोने पर रखा है, तो घन से निर्गत फ्लक्स क्या होगा ?

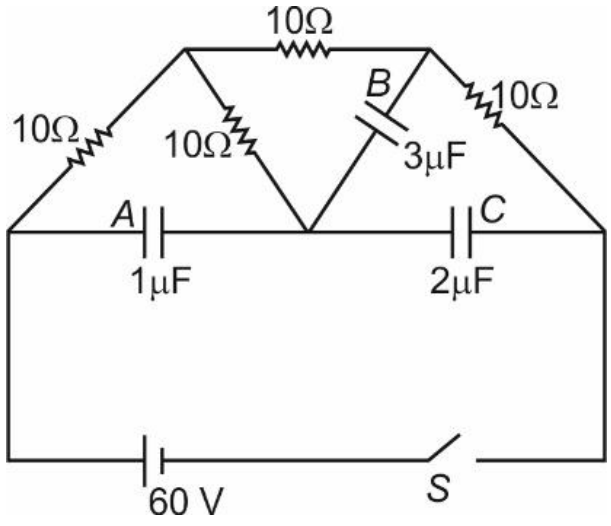
(A) $\frac{2q}{\varepsilon_0}$

(B) $\frac{q}{8\varepsilon_0}$

(C) $\frac{q}{\varepsilon_0}$

(D) $\frac{q}{2\varepsilon_0}$

8. संलग्न चित्र में स्विच S, $t = 0$ पर बंद है। Q_A, Q_B और Q_C स्थिर अवस्था में क्रमशः संधारित्र A, संधारित्र B और संधारित्र C पर आवेश हैं। सही कथन चुनें।



(A) $Q_A < Q_B < Q_C$

(B) $Q_A < Q_C < Q_B$

(C) $Q_C < Q_A < Q_B$

(D) $Q_C < Q_B < Q_A$

9. A balloon of volume 20 m^3 is filled with helium. It rises to a height of 180 m in 30sec starting from rest. The mass of balloon and equipment (excluding payload and helium) is 12 kg. If density of air is 1.29 kg/m^3 and density of helium is 0.18 kg/m^3 and are constant, find the mass of payload lifted by the balloon :-

(A) 7.5 kg

(B) 8 kg

(C) 8.8 kg

(D) 9.2 kg

9. 20 m^3 आयतन का एक गुब्बारा हीलियम से भरा हुआ है। यह विराम अवस्था से 30 सेकंड में 180 मीटर की ऊंचाई तक ऊपर उठता है। गुब्बारे और उपकरण (लाद भार (payload) और हीलियम को छोड़कर) का द्रव्यमान 12 किलोग्राम है। यदि हवा का घनत्व 1.29 kg/m^3 और हीलियम का घनत्व 0.18 kg/m^3 है और नियत है, तो गुब्बारे द्वारा उठाए गए लाद भार (payload) का द्रव्यमान ज्ञात करें:-

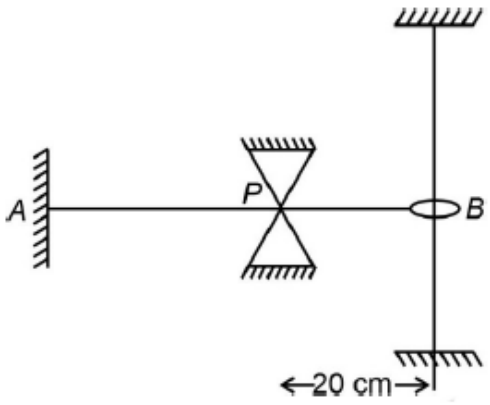
(A) 7.5 kg

(B) 8 kg

(C) 8.8 kg

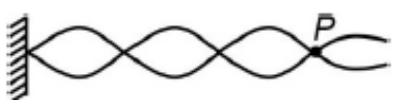
(D) 9.2 kg

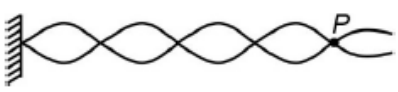
10. A 1 meter long wire having tension T is fixed at A and free at B, as shown in figure. Point P is constrained to be stationary. What is the shape of the string for the fundamental mode of vibration?



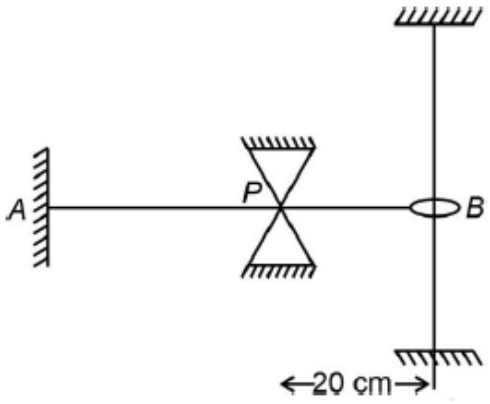
(A)

(B)

(C) 

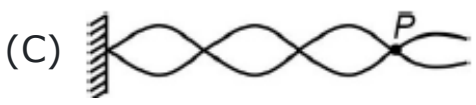
(D) 

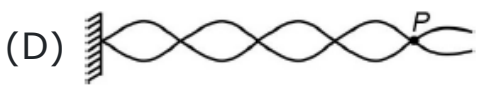
10. तनाव T वाला 1 मीटर लंबा तार A पर स्थिर है और B पर स्वतंत्र है, जैसा कि चित्र में दिखाया गया है। बिन्दु P स्थिर रहने के लिए बाध्य है। कंपन की मूल विधा के लिए डोरी का आकार क्या है?



(A)

(B)

(C) 

(D) 

11. A $50V$ battery is connected across a 10 ohm resistor. The current is 4.5 amperes. The internal resistance of the battery is

(A) Zero

(B) 0.5 ohm

(C) 1.1 ohm

(D) 5.0 ohm

11. एक $50V$ बैटरी को 10 ohm प्रतिरोधक से जोड़ा गया है। धारा 4.5 एम्पियर है। बैटरी का आंतरिक प्रतिरोध है -

(A) शून्य

(B) 0.5 ohm

(C) 1.1 ohm

(D) 5.0 ohm

12. If a long hollow copper pipe carries a current, then magnetic field is produced:

(A) inside the pipe only

(B) outside the pipe only

(C) both inside and outside the pipe

(D) no where

12. यदि एक लंबा खोखला तांबे का पाइप धारा का वहन करता है,तो चुंबकीय क्षेत्र उत्पन्न होता है:

(A) केवल पाइप के अंदर

(B) केवल पाइप के बाहर

(C) पाइप के अंदर और बाहर दोनों जगह

(D) कहीं नहीं

13. When a coil of area 2 cm^2 and having 30 turns, whose plane is normal to the magnetic field, is drawn out of the magnetic field, a charge of 1.5×10^{-4} coulomb flows in the circuit. If its resistance is 40 ohm, then the magentic flux density in Telsa will be -

(A) 10

(B) 0.1

(C) 1

(D) 0.01

14. **Statement I :** Thermodynamic processes in nature are irreversible.
Statement II : Dissipative effects cannot be eliminated.

(A) Both statement I and statement II are true.

(B) Both statement I and statement II are false.

(C) Statement I is true but statement II is false.

(D) Statement I is false but statement II is true.

15. The period of oscillation of a magnet in a vibration magnetometer is 2 sec. The period of oscillation of a magnet whose magnetic moment is four times that of the first magnet is :

(A) 1 sec

(B) 4 sec

(C) 8 sec

(D) 0.5 sec

16. In a Searle's experiment for determination of Young's Modulus, when a load of 50 kg is added to a 3 meter long wire micrometer screw having pitch 1 mm needs to be given a quarter turn in order to restore the horizontal position of spirit level. Young's modulus of the wire if its cross sectional area is 10^{-5} m^2 is

(A) 6×10^{11} N/m^2

(B) 1.5×10^{11} N/m^2

(C) 3×10^{11} N/m^2

(D) None

13. जब 2 cm^2 क्षेत्रफल वाली तथा 30 फेरों वाली एक कुण्डली, जिसका तल चुम्बकीय क्षेत्र के अभिलम्बवत है, चुम्बकीय क्षेत्र से बाहर खींची जाती है, तो परिपथ में 1.5×10^{-4} कूलॉम आवेश प्रवाहित होता है। यदि इसका प्रतिरोध 40 ओम है, तो टेस्ला में चुम्बकीय फ्लक्स घनत्व होगा-

(A) 10

(B) 0.1

(C) 1

(D) 0.01

14. **कथन I:** प्रकृति में ऊष्मागतिकी प्रक्रम अनुत्क्रमणीय है।
कथन II: क्षयकारी प्रभाव विलुप्त नहीं हो सकते है।

(A) कथन I तथा कथन II दोनों सत्य है।

(B) कथन I तथा कथन II दोनों असत्य है।

(C) कथन I सत्य है परन्तु कथन II असत्य है।

(D) कथन I असत्य है परन्तु कथन II सत्य है।

15. दोलन चुम्बकत्वमापी में एक चुंबक के दोलन का आवर्तकाल 2 सेकंड है। एक चुंबक का दोलन काल, जिसका चुंबकीय आघूर्ण पहले चुंबक के चुंबकीय आघूर्ण का चार गुना है, है:

(A) 1 sec

(B) 4 sec

(C) 8 sec

(D) 0.5 sec

16. यंग मापांक के मापन के लिए एक सर्ल के प्रयोग में, जब 3 मीटर लंबे तार पर 50 किग्रा का भार जोड़ा जाता है, तो स्पिरिट सतह (level) की क्षैतिज स्थिति को पुनः स्थापित करने के लिए 1 मिमी पिच वाले माइक्रोमीटर स्क्रू को एक चौथाई घुमाव देने की आवश्यकता होती है। यदि तार का अनुप्रस्थ काट क्षेत्रफल 10^{-5} m^2 है, तो तार का यंग मापांक -

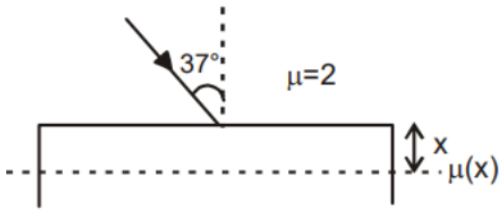
(A) 6×10^{11} N/m^2

(B) 1.5×10^{11} N/m^2

(C) 3×10^{11} N/m^2

(D) कोई नहीं

17. A ray of light travelling in a medium of refractive index 2, is incident onto the flat surface of a slab, the angle of incidence is 37°. The refractive index of the material of the slab varies with depth (x) from the top surface, $\mu(x) = a - bx$, where $a = 2$, $b = 1m^{-1}$ and x is in 'm'. The maximum depth reached by the ray is



(A) 8/5 m

(B) 6/5 m

(C) 3/5 m

(D) 4/5 m

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

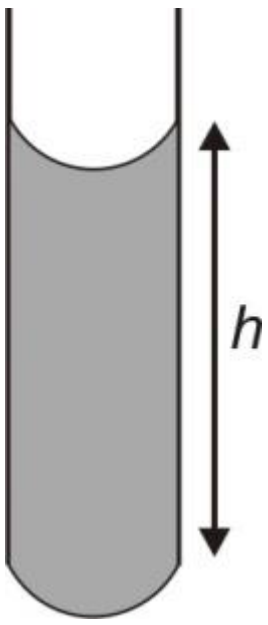
(A) Ic

(B) Ic^2

(C) I/c

(D) I/c^2

19. Surface tension of a liquid is $\mathrm{S} = 0.01\ \mathrm{N/m}$. Density of the liquid is $1\ \mathrm{g}/\mathrm{cm}^3$. A capillary tube contain $12\ \mathrm{cm}$ the liquid column. If R_1 and R_2 are radii of curvature of two surfaces then $\frac{\mathrm{R}_1+\mathrm{R}_2}{\mathrm{R}_1\mathrm{R}_2}$ is



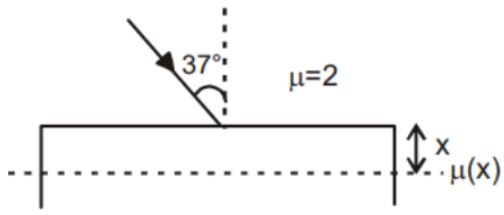
(A) $3 \times 10^4\ \mathrm{m}^{-1}$

(B) $4 \times 10^4\ \mathrm{m}^{-1}$

(C) $12 \times 10^3\ \mathrm{m}^{-1}$

(D) $6 \times 10^4\ \mathrm{m}^{-1}$

17. अपवर्तनांक 2 के माध्यम में गमन कर रही प्रकाश की किरण, पट्टिका (slab) की समतल सतह पर आपतित होती है, आपतन कोण 37° है। पट्टिका (slab) के पदार्थ का अपवर्तनांक ऊपरी सतह से गहराई (x) के साथ परिवर्तित होता है, $\mu(x) = a - bx$, जहाँ $a = 2$, $b = 1m^{-1}$ और x 'm' में है। किरण द्वारा तय की गई अधिकतम गहराई है



(A) 8/5 m

(B) 6/5 m

(C) 3/5 m

(D) 4/5 m

18. I $\left(\mathrm{Wm}^{-2}\right)$ तीव्रता की विद्युत चुम्बकीय तरंग द्वारा एक अपरावर्ती सतह पर लगाया गया दाब है - (c प्रकाश का वेग है)

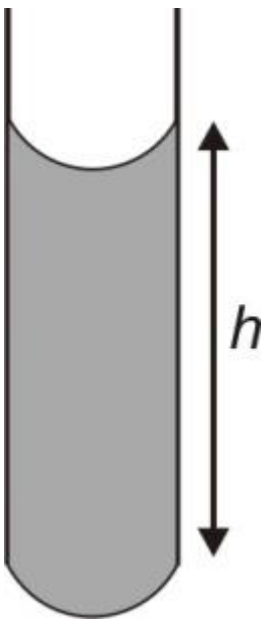
(A) Ic

(B) Ic^2

(C) I/c

(D) I/c^2

19. किसी द्रव का पृष्ठ तनाव $\mathrm{S} = 0.01\ \mathrm{N/m}$ है। द्रव का घनत्व $1\ \mathrm{g}/\mathrm{cm}^3$ है। एक केशिका नली में $12\ \mathrm{cm}$ द्रव स्तंभ है। यदि R_1 और R_2 दो सतहों की वक्रता त्रिज्याएँ हैं तो $\frac{\mathrm{R}_1+\mathrm{R}_2}{\mathrm{R}_1\mathrm{R}_2}$ है -



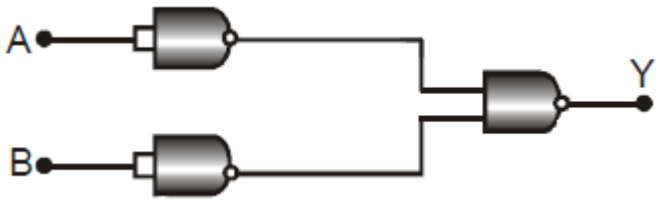
(A) $3 \times 10^4\ \mathrm{m}^{-1}$

(B) $4 \times 10^4\ \mathrm{m}^{-1}$

(C) $12 \times 10^3\ \mathrm{m}^{-1}$

(D) $6 \times 10^4\ \mathrm{m}^{-1}$

20. The combination of the gates shown in the figure below produces



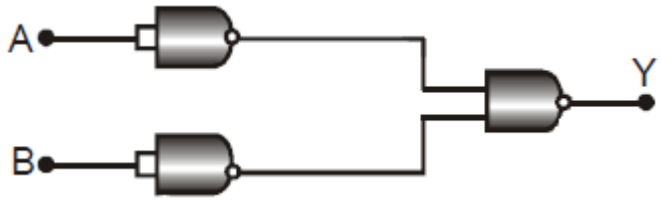
(A) OR gate

(B) NOR gate

(C) AND gate

(D) XOR gate

20. नीचे चित्र में दर्शाए गए गेट का संयोजन किस गेट का निर्माण करता है-



(A) OR गेट

(B) NOR गेट

(C) AND गेट

(D) XOR गेट

PHYSICS

SECTION - B

[NUMERIC VALUE TYPE]

Q.21 to ***Q.25*** are ***NUMERIC VALUE TYPE*** Questions. The answer to each question is a **NUMERICAL VALUE.**

21. Hydrogen atoms in ground states are excited by monochromatic radiation of wavelength 975 Å. The number of spectral lines in the resulting spectrum emitted will be :

21. मूल स्तरों में हाइड्रोजन परमाणुओं को 975 Å. तरंग दैर्ध्य की एकवर्णीय विकिरण के द्वारा उत्तेजित किये जाते है। उत्सर्जित परिणामी स्पैक्ट्रम में स्पैक्ट्रम रेखाओ की संख्या होगी -

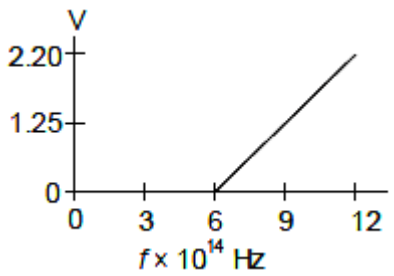
22. The Ra^{226} nucleus undergoes α-decay according to equation $\mathrm{Ra}_{88}^{226} \rightarrow \mathrm{Rn}_{86}^{222} + \mathrm{He}_{2}^{4}$. If the Q value of reaction is Q = X MeV then find [X]. Where [X] represents the greatest integer of X.

(Given : $\mathrm{m}\left(\mathrm{Ra}_{88}^{226}\right)$ = 226.025406u, $\mathrm{m}\left(\mathrm{Rn}_{86}^{222}\right)$ = 222.017574u, $\mathrm{m}\left(\mathrm{He}_{2}^{4}\right)$ = 4.002603u)

22. Ra^{226} नाभिक समीकरण $\mathrm{Ra}_{88}^{226} \rightarrow \mathrm{Rn}_{86}^{222} + \mathrm{He}_{2}^{4}$ के अनुसार α-क्षय से गुजरता है। यदि अभिक्रिया का Q मान Q = X MeV है तो [X] ज्ञात करें। जहाँ [X] X का महत्तम पूर्णांक को दर्शाता है।

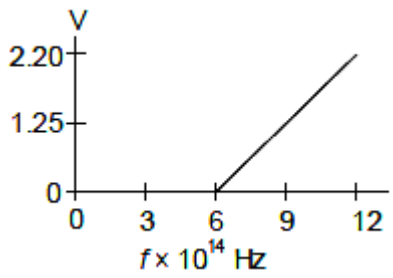
($\mathrm{m}\left(\mathrm{Ra}_{88}^{226}\right)$ = 226.025406u, $\mathrm{m}\left(\mathrm{Rn}_{86}^{222}\right)$ = 222.017574u, $\mathrm{m}\left(\mathrm{He}_{2}^{4}\right)$ = 4.002603u दिया गया है)

23. Figure shows the stopping potential versus the light frequency for a metal cathode used in a photoelectriceffect experiment. Suppose this cathode is now illuminated with $6.63\ \mu\mathrm{W}$ of $300\ \mathrm{nm}$ light and that the efficiency of converting photons to photoelectrons is 10%. Take $\mathrm{h} = 6.63 \times 10^{-34}\ \mathrm{Js}, \mathrm{c} = 3 \times 10^{8}\ \mathrm{ms}^{-1}$.



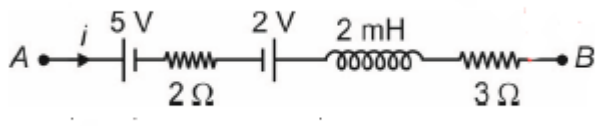
What is the power (in watt) of emitted photoelectron beam assuming that on an average, each photoelectron emitted has energy $\frac{5\mathrm{K}_{\max}}{6}$? Assume that anode potential is sufficiently positive. Express your answer in form of $'\mathrm{X}' \times 10^{-5}\mathrm{W}$. Find the value of $\frac{\mathrm{X}}{11}$ in OMR sheet after rounding off to nearest integer.

23. चित्र में प्रकाश वैद्युत प्रभाव प्रयोग में प्रयुक्त धातु कैथोड के लिए निरोधी विभव बनाम प्रकाश आवृत्ति को दर्शाया गया है। मान लीजिए कि यह कैथोड अब $300\ \mathrm{nm}$ प्रकाश के $6.63\ \mu\mathrm{W}$ से प्रकाशित है और फोटॉन को प्रकाश इलेक्ट्रोनों में परिवर्तित करने की दक्षता 10% है। $\mathrm{h} = 6.63 \times 10^{-34}\ \mathrm{Js}, \mathrm{c} = 3 \times 10^{8}\ \mathrm{ms}^{-1}$.ले

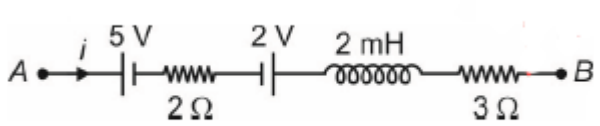


उत्सर्जित प्रकाश इलेक्ट्रोन पुंज की शक्ति (वाट में) क्या है, यह मानते हुए कि औसतन, उत्सर्जित प्रत्येक प्रकाश इलेक्ट्रोन की ऊर्जा $\frac{5\mathrm{K}_{\max}}{6}$ है ? मान लें कि एनोड विभव पर्याप्त रूप से धनात्मक है । अपने उत्तर को $'\mathrm{X}' \times 10^{-5}\mathrm{W}$ के रूप में व्यक्त करें। निकटतम पूर्णांक तक पूर्णांकित करने के बाद OMR शीट में $\frac{\mathrm{X}}{11}$ का मान ज्ञात करें।

24. The figure shows a network which is part of a circuit. At the instant shown current $\mathrm{i} = 3\ \mathrm{A}$ and it is decreasing at a rate $3 \times 10^{3}\ \mathrm{A/s}$. The potential difference $\mathrm{V_A} - \mathrm{V_B}$ at this instant is .....Volt



24. चित्र में एक नेटवर्क दिखाया गया है जो एक परिपथ का भाग है। दर्शाये गए क्षण पर धारा $\mathrm{i} = 3\ \mathrm{A}$ है और यह $3 \times 10^{3}\ \mathrm{A/s}$ की दर से घट रही है। इस क्षण पर विभवांतर $\mathrm{V_A} - \mathrm{V_B}$ ..... वोल्ट है



25. A stone hanging from a massless string of length $15\,\mathrm{m}$ is projected horizontally with speed $\sqrt{147}\,\mathrm{m/s}$. Then the speed of the particle at the point where tension in string equals the weight of particle is -

25. $15\,\mathrm{m}$ लम्बी द्रव्यमान रहित डोरी से लटके हुए पत्थर को $\sqrt{147}\,\mathrm{m/s}$ की चाल से क्षैतिज दिशा में फेंका जाता है। तो उस बिंदु पर कण की चाल, जहाँ डोरी में तनाव कण के भार के बराबर है, होगी -

CHEMISTRY

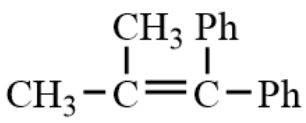
SECTION - A

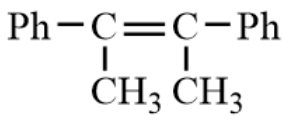
[SINGLE CORRECT TYPE]

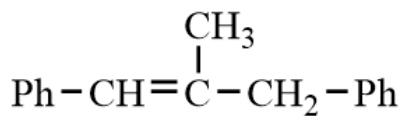
Q.1 to ***Q.20*** has four choices (A), (B), (C), (D) out of which ***ONLY ONE*** is correct.

1. Compound 'A' ($C_{16}H_{16}$) on ozonolysis gives only one product 'B', (C_8H_8O). 'B' gives positive Iodoform test and forms sodium benzoate as one of the product. Identify the structure of 'A.

(A) Ph – CH_2 – CH = CH – CH_2 – Ph

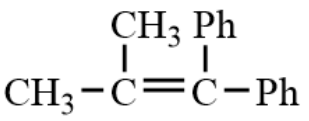
(B) 

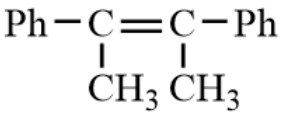
(C) 

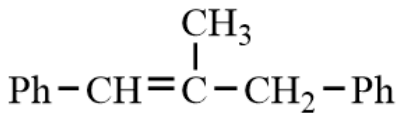
(D) 

1. यौगिक 'A' ($C_{16}H_{16}$) के ओजोनीअपघटन पर केवल एक उत्पाद 'B' (C_8H_8O) प्राप्त होता है। 'B' धनात्मक आयोडोफॉर्म परिक्षण देता है और सोडियम बेंजोएट बनाता है। 'A' की संरचना की पहचान करें।

(A) Ph – CH_2 – CH = CH – CH_2 – Ph

(B) 

(C) 

(D) 

2. The presence of Zirconium and Hafnium atoms and ions are almost the same because both -

(A) Both are metals and belong to the same period

(B) Have high melting point and belong to the d-block element

(C) Have almost identical ionic radius and covalent radius

(D) Are electro positive in nature

2. जिरकोनियम तथा हॉफनियम परमाणुओं तथा आयनों की उपस्थिति लगभग समान होती है क्योंकि -

(A) दोनों धातु होते है तथा समान आवर्त से संबंधित होते है

(B) दोनों के गलनांक उच्च होते है तथा d - ब्लॉक तत्व से संबंधित होते है

(C) दोनों की आयनिक त्रिज्या तथा सहसंयोजी त्रिज्या लगभग समान होती है

(D) दोनों विद्युतधनी प्रकृति के होते है

3. Consider an elementary reaction A$\rightarrow$B. Calculate ratio of remaining concentration of reactant and initial concentration after 40 days. [Given : $t_{1/2}$=8 days]

(A) $\frac{1}{16}$

(B) $\frac{1}{8}$

(C) $\frac{1}{32}$

(D) $\frac{1}{24}$

3. एक प्राथमिक अभिक्रिया A$\rightarrow$B पर विचार कीजिये 40 दिनों के बाद क्रियाकारक की शेष सान्द्रता तथा प्रारम्भिक सान्द्रता के अनुपात की गणना कीजिये।
[दिया गया है $t_{1/2}$=8 दिन]

(A) $\frac{1}{16}$

(B) $\frac{1}{8}$

(C) $\frac{1}{32}$

(D) $\frac{1}{24}$

4. Iron(II) sulphate in acidic medium reduces permanganate to Mn^{+x}. The solution becomes yellow because of the formation of A. The yellow colour disappears if potassium fluoride is added because they form colourless complex with A.

The correct statement about the above reaction is

(A) In this reaction, Mn^{+7} is converted to Mn^{+4}

(B) A is Fe^{3+}

(C) A is Mn^{2+}

(D) In this reaction Mn^{+7} convert to Mn^{+6}

4. आयरन (II) सल्फेट अम्लीय माध्यम में परमैंगनेट को Mn^{+x} में अपचयित करता है। A के निर्माण के कारण विलयन पीला हो जाता है। यदि पोटैशियम फ्लोराइड मिलाया जाए तो पीला रंग गायब हो जाता है क्योंकि वे A के साथ रंगहीन संकुल बनाते हैं।

उपरोक्त अभिक्रिया के बारे में सही कथन है

(A) इस अभिक्रिया में, Mn^{+7} Mn^{+4} में परिवर्तित हो जाता है

(B) A, Fe^{3+} है

(C) A, Mn^{2+} है

(D) इस अभिक्रिया में Mn^{+7}, Mn^{+6} में परिवर्तित हो जाता है

5. When a concentrated solution of an electrolyte is diluted ?

(A) Its specific conductance increases

(B) Its equivalent conductance decreases

(C) Its specific conductance decreases and equivalent conductance increases

(D) Both specific and equivalent conductance increase

6. Consider following reagent :

I. Br_2 water

II. Tollen's reagent

III. Fehling's solution

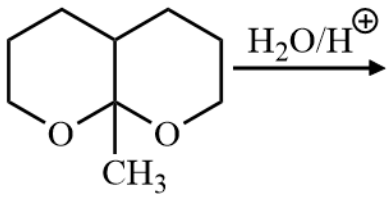
Which can not be used to make distinction between glucose and a fructose ?

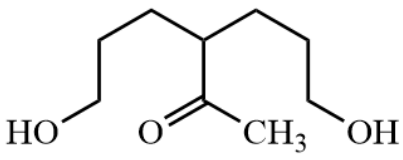
(A) I, II and III

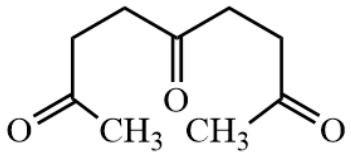
(B) II and III

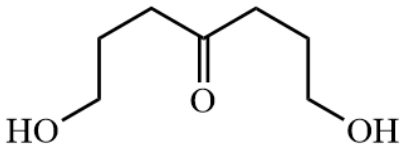
(C) I only

(D) II only

7.  'X'. 'X' will be:

(A) 

(B) 

(C) 

(D) All of these

8. The most non-metallic element among the following is -

(A) $1s^2, 2s^2, 2p^4$

(B) $1s^2, 2s^2, 2p^2$

(C) $1s^2, 2s^2, 2p^3$

(D) $1s^2, 2s^2, 2p^5$

5. जब एक वैद्युत-अपघट्य के सान्द्र विलयन को तनु किया जाता है तो ?

(A) इसका विशिष्ट चालकत्व बढ़ता है।

(B) इसकी तुल्याँकी चालकता घटती है।

(C) इसका विशिष्ट चालकत्व घटता है तथा तुल्याँकी चालकता बढ़ती है।

(D) विशिष्ट चालकता तथा तुल्यांकी की चालकता दोनों के मान में वृद्धि होती है।

6. निम्न अभिकर्मक पर विचार कीजिए :

I. Br_2 जल

II. टॉलेन अभिकर्मक

III. फेहलिंग का विलयन

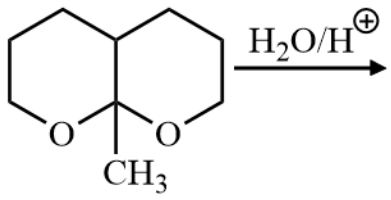
ग्लूकोज और फ्रुक्टोज के बीच अंतर करने के लिए किसका उपयोग नहीं किया जा सकता है?

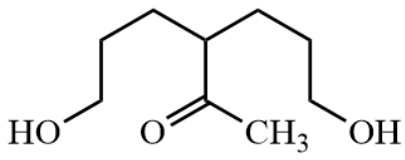
(A) I, II और III

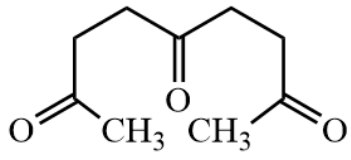
(B) II और III

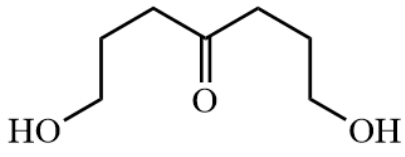
(C) केवल I

(D) केवल II

7.  'X'. 'X' होगा :

(A) 

(B) 

(C) 

(D) ये सभी

8. निम्नलिखित में से सबसे अधिक अधात्विक तत्व है -

(A) $1s^2, 2s^2, 2p^4$

(B) $1s^2, 2s^2, 2p^2$

(C) $1s^2, 2s^2, 2p^3$

(D) $1s^2, 2s^2, 2p^5$

9. The electron of the hydrogen atom is shifted from the first Bohr orbit to the fifth Bohr orbit. what is the wavelength of the light emitted when the electron returns to the ground state?

$\left(\frac{1}{R} = 912Å\right)$

(A) 900 Å

(B) 950 Å

(C) 800 Å

(D) 850 Å

9. हाइड्रोजन परमाणु के इलेक्ट्रॉन को प्रथम बोहर कक्षा से पाँचवी बोहर कक्षा में स्थानान्तरित किया जाता है। जब इलेक्ट्रॉन आद्य अवस्था में वापस आता है तब उत्सर्जित प्रकाश की तरंगदैर्ध्य क्या होगी।

$\left(\frac{1}{R} = 912Å\right)$

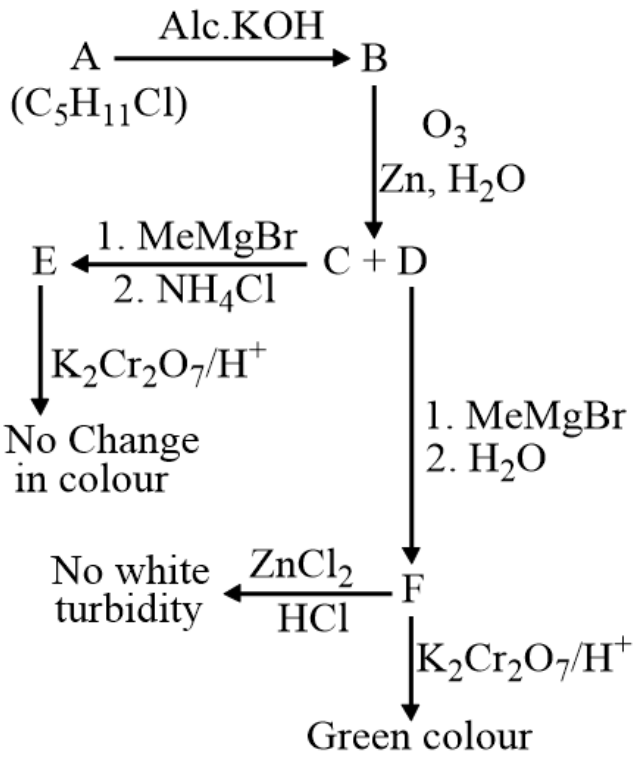
(A) 900 Å

(B) 950 Å

(C) 800 Å

(D) 850 Å

10.



Which of the following option is incorrect?

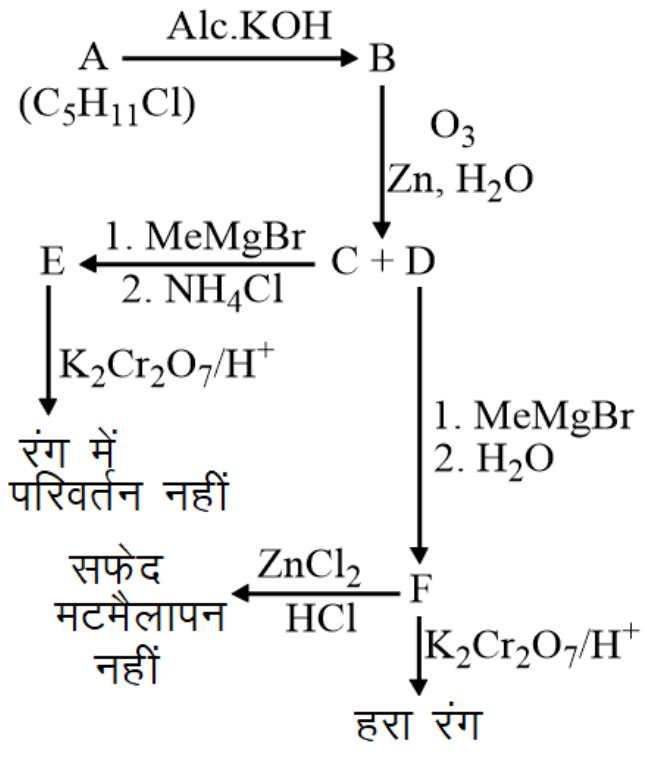
(A) Compound B is 2-methyl but-1-ene

(B) Compound D is formaldehyde

(C) Compound E give blood red colour in victor meyer test

(D) Compound F give haloform test

10.



निम्नलिखित में से कौन सा विकल्प गलत है?

(A) यौगिक B , 2-मेथिल ब्यूट-1-इन है

(B) यौगिक D फॉर्मेल्डीहाइड है

(C) यौगिक E विक्टर मेयर परिक्षण में लाल रंग देता है

(D) यौगिक F हेलोफॉर्म परिक्षण देता है

11. Fe^{2+} does not give Prussian blue color with $K_4[Fe(CN)_6]$ but on its reaction with (X), Prussian blue color appears. (X) can be :

(A) MnO_4^-/ H^+

(B) H_2SO_4

(C) NH_3

(D) All true

11. Fe^{2+}, $K_4[Fe(CN)_6]$के साथ प्रशियन ब्लू रंग नहीं देता है, लेकिन इसकी (X) के साथ क्रिया करने पर प्रशियन ब्लू रंग आता है तो (X) होगा।

(A) MnO_4^-/ H^+

(B) H_2SO_4

(C) NH_3

(D) सभी सही है।

12. $n_1A + n_2B \rightarrow m_1C + m_2D$,

which is correct for given reaction?

(A) n_1 mole of A react with n_2 mole of B

(B) n_1 gm equivalent of A react with n_2 gm equivalent of B

(C) n_1 gm of A react with n_2 gm of B

(D) None

12. $n_1A + n_2B \rightarrow m_1C + m_2D$,

कौनसा दी गई अभिक्रिया के लिये सही है

(A) n_1 मोल A, n_2 मोल B के साथ क्रिया करते है।

(B) A के n_1 gm तुल्यांक B के n_2 gm तुल्याँक के साथ क्रिया करते है।

(C) n_1 gm A, n_2 gm B के साथ क्रिया करते है।

(D) इनमे से कोई नहीं

13. Which of the following is correct IUPAC name of any complex compound.

(A) Tris (acetyl acetonato) iron (III) chloride

(B) Hexachloroplatinum (IV) tetraammine dicyano platinate (IV)

(C) Ammine bromochloro methylamine platinum (II)

(D) Cis dichloro (ethylenediamine) platinum (II)

14. The pressure of mixture of equal weights of two gases of molecular weight 4 and 40 is 1.1 atm. The partial pressure of the lighter gas in the gas mixture is:

(A) 0.55 atm

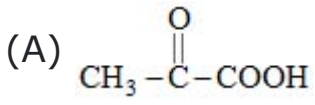
(B) 0.11 atm

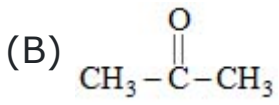
(C) 1 atm

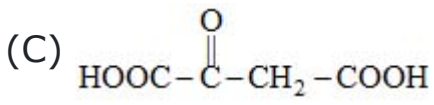
(D) 0.1 atm

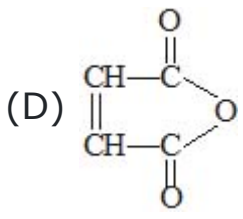
15. $HC \equiv CH \xrightarrow{2\,CH_3MgBr}$

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

(A) 

(B) 

(C) 

(D) 

13. निम्न मे से कौनसा किसी संकुल यौगिक का सही IUPAC नाम है

(A) ट्रिस (ऐसिटिल ऐसिटोनेटो) आयरन (III) क्लोराइड

(B) हेक्साक्लोरोप्लेटिनम (IV) टेट्राएम्मीन डाईसायनो प्लेटिनेट (IV)

(C) एम्मीन ब्रोमोक्लोरो मेथिल ऐमीन प्लेटिनम (II)

(D) सिस डाईक्लोरो (ऐथिलीन डाई ऐमीन) प्लेटिनम (II)

14. अणुभार 4 तथा 40 की दो गैसों के समान भारो के मिश्रण का दाब 1.1atm है। गैस मिश्रण में हल्की गैस का आंशिक दाब होगा

(A) 0.55 atm

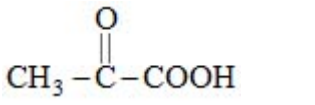
(B) 0.11 atm

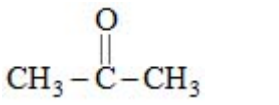
(C) 1 atm

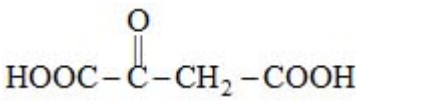
(D) 0.1 atm

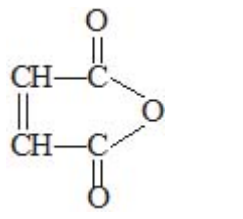
15. $HC \equiv CH \xrightarrow{2\,CH_3MgBr}$

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

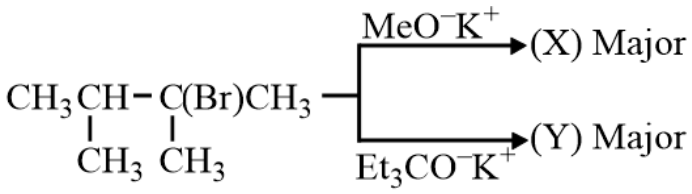
(A) 

(B) 

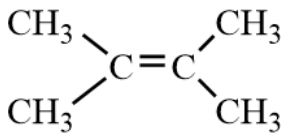
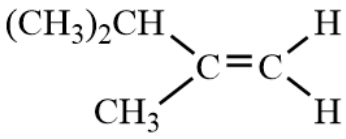
(C) 

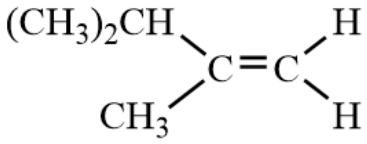
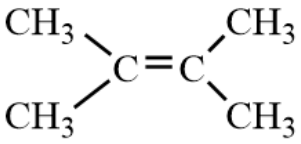
(D) 

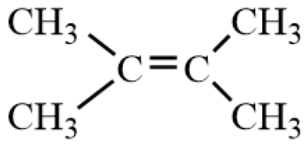
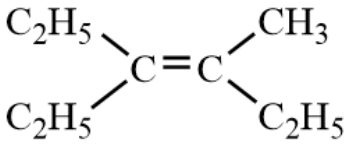
16.

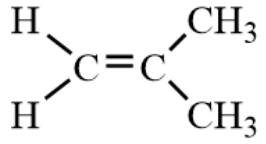
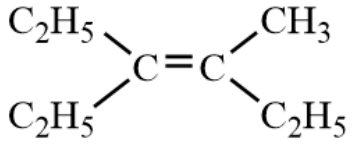


X and Y are respectively :

(A)  and 

(B)  and 

(C)  and 

(D)  and 

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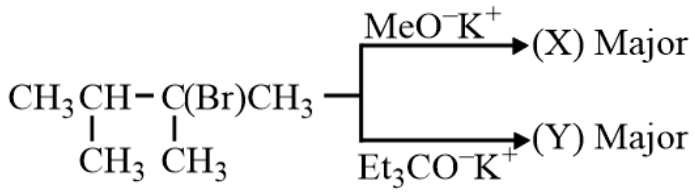
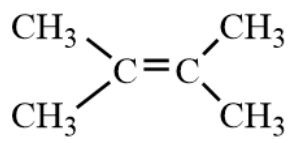
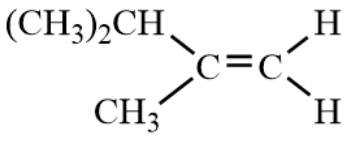
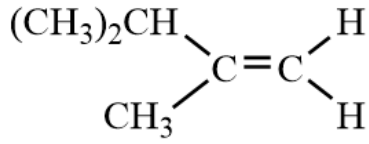
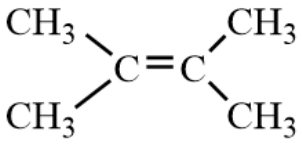
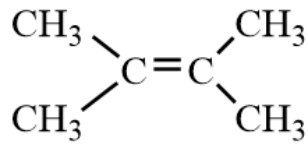
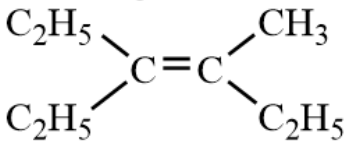
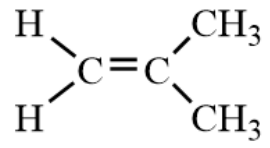
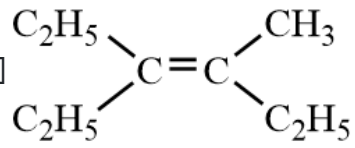


X और Y क्रमशः हैं :

(A)  □ और □ 

(B)  □ और □ 

(C)  □ और □ 

(D)  □ और □ 

17. Choose the paramagnetic oxide in the following

(A) Na_2O

(B) MgO

(C) BeO

(D) KO_2

18. A(g)+B(g)⇌AB(g) is a reversible reaction. At equilibrium 0.4 mole of AB is formed when each A and B are taken one mole. How much of A changes into AB?

(A) 20%

(B) 40%

(C) 60%

(D) 4%

17. निम्न में से अनुचुम्बकीय ऑक्साइड चुनिये :

(A) Na_2O

(B) MgO

(C) BeO

(D) KO_2

18. A(g)+B(g)⇌AB(g) एक उत्क्रमणीय अभिक्रिया है साम्य पर 0.4 मोल AB निर्मित होता है जब प्रत्येक A तथा B का एक मोल लिया जाता है कितना A, AB मे परिवर्तित होता है

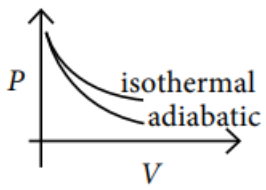
(A) 20%

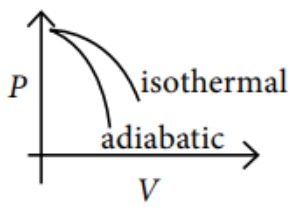
(B) 40%

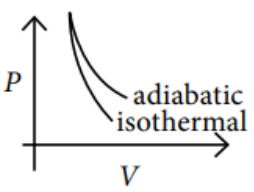
(C) 60%

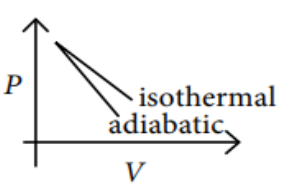
(D) 4%

19. The correct figure representing isothermal and adiabatic expansions of an ideal gas from a particular initial state is :

(A) 

(B) 

(C) 

(D) 

20. In following redox reaction

$xFe^{2+}+yCr_2O_7^{-2}+14H^+ \rightarrow 6Fe^{3+}+2Cr^{3+}+zH_2O$

The value of x, y, z are

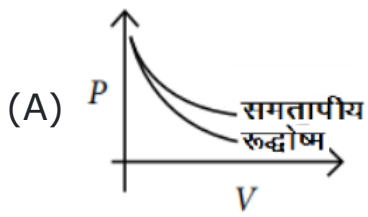
(A) x=6, y=1, z=7

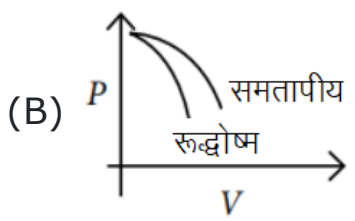
(B) x=3, y=6, z=8

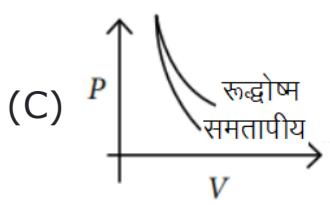
(C) x=6, y=2, z=7

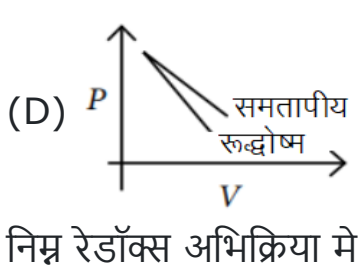
(D) x=4, y=6, z=7

19. एक विशेष प्रारम्भिक अवस्था से एक आदर्श गैस के समतापीय (isothermal) तथा रूद्धोष्म (adiabatic) प्रसार को प्रदर्शित करने वाला सही चित्र हैः –

(A) 

(B) 

(C) 

(D) 

20. निम्न रेडॉक्स अभिक्रिया मे

$xFe^{2+}+yCr_2O_7^{-2}+14H^+ \rightarrow 6Fe^{3+}+2Cr^{3+}+zH_2O$

x, y, z के मान है

(A) x=6, y=1, z=7

(B) x=3, y=6, z=8

(C) x=6, y=2, z=7

(D) x=4, y=6, z=7

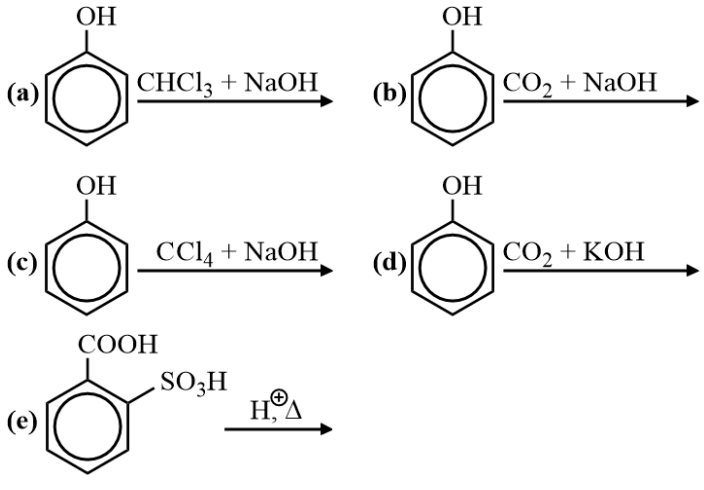
CHEMISTRY

SECTION - B

[NUMERIC VALUE TYPE]

Q.21 to ***Q.25*** are ***NUMERIC VALUE TYPE*** Questions. The answer to each question is a **NUMERICAL VALUE.**

21. Identify number of reaction that would give salicylic acid as major product.



22. Consider following complex formation reaction.

(i) $Co^{3+}_{(aq.)} + KCN_{(excess)} \rightleftharpoons$ complex ion 'P'

(ii)

$Ni^{2+}_{(aq.)} + KCN_{(excess)} \rightleftharpoons$ complex ion 'Q'

and find the value of $\frac{(x+y)}{3}$ for complex ion P and Q.

where

x = Total number of electron(s) present in t_{2g} orbitals of central metal cation of complex ion 'P'.

y = Total number of electron(s) present in d_{z^2} orbital of central metal cation of complex ion 'Q'.

23. How many of the following chemical compound (s) / ion (s) has lone pair(s) at equatorial position of central atom?

$ClF_3,\ XeF_2,\ SF_4,\ IF_5,\ [SbF_4]^-,$

$[SF_5]^-,\ IO_4^-,\ SOF_4,\ XeOF_2$

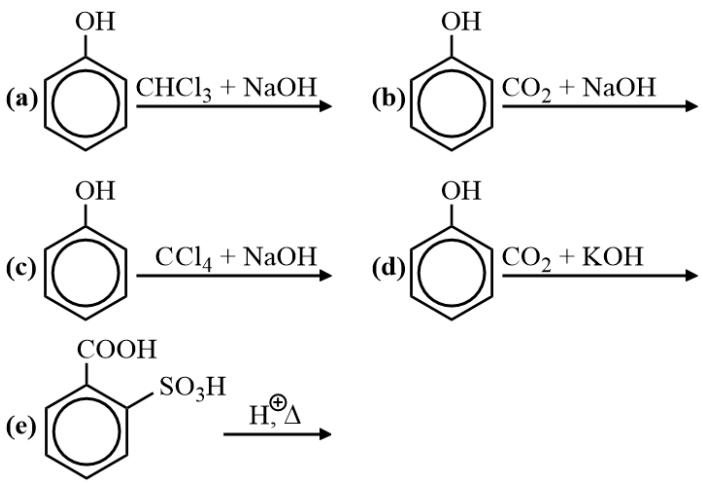
24. What will be the pH of 0.1 M CH_3COONH_4

[Ka = 1.8×10^{-5} ; Kb = 1.8×10^{-5}]

25. Molar conductivity of $0.0625\ M\ KCl$ is $120\ S\ cm^2\ mol^{-1}$. The molar conductivity of $\left(\frac{x}{100}\right)$ molar $NaCl$ is $90\ S\ cm^2\ mol^{-1}$. the vale of 'x' will be :

$\left[\wedge^0_{Na^+} = 50 Scm^2\ mol^{-1},\right.$
$\wedge^0_{Cl^-} = 76 Scm^2\ mol^{-1},$
$\left.\wedge^0_{K^+} = 74 Scm^2\ mol^{-1}\right]$

21. अभिक्रियाओं की संख्या बताइये जो मुख्य उत्पाद के रूप में सेलिसिलीक अम्ल देगी



22. निम्न संकुल निर्माण अभिक्रिया पर विचार कीजिए -

(i) $Co^{3+}_{(aq.)}$ + KCN(आधिक्य) $\rightleftharpoons$ संकुल आयन P'

(ii) $Ni^{2+}_{(aq.)}$ + KCN(आधिक्य) $\rightleftharpoons$ संकुल आयन Q'

और संकुल आयन P और Q के लिए $\frac{(x+y)}{3}$ का मान ज्ञात कीजिए -

जहाँ

x = संकुल आयन 'P' के केन्द्रीय धातु धनायन के t_{2g} कक्षक में उपस्थित इलेक्ट्रानों की कुल संख्या

y = संकुल आयन 'Q' के केन्द्रीय धातु धनायन के d_{z^2} कक्षक में उपस्थित इलेक्ट्रानों की कुल संख्या

23. निम्न रासायनिक यौगिको/आयनों में से कितने केन्द्रीय परमाणु की निरक्षीय स्थिति पर एकल युग्म रखते है

$ClF_3,\ XeF_2,\ SF_4,\ IF_5,\ [SbF_4]^-,$

$[SF_5]^-,\ IO_4^-,\ SOF_4,\ XeOF_2$

24. 0.1 M CH_3COONH_4 की pH क्या होगी?

[$K_a = 1.8 \times 10^{-5}$; $K_b = 1.8 \times 10^{-5}$]

25. $0.0625\ M\ KCl$ की मोलर चालकता $120\ S\ cm^2\ mol^{-1}$ है। $\left(\frac{x}{100}\right)$ मोलर $NaCl$ की मोलर चालकता $90\ S\ cm^2\ mol^{-1}$ है। 'x' का मान होगाः

$\left[\wedge^0_{Na^+} = 50 Scm^2\ mol^{-1},\right.$
$\wedge^0_{Cl^-} = 76 Scm^2\ mol^{-1},$
$\left.\wedge^0_{K^+} = 74 Scm^2\ mol^{-1}\right]$

ROUGH-WORK

ROUGH-WORK

ROUGH-WORK

ROUGH-WORK

ROUGH-WORK

ROUGH-WORK

Maths - Section A

1. Answer: C

Sol:

For any value of α, product of the roots is 1 and sum of the roots lying in $[2, \frac{5}{2}]$

$\therefore 2 \leq \frac{2p-3}{2} \leq \frac{5}{2}$

$\Rightarrow 4 \leq 2p - 3 \leq 5$

$\Rightarrow p \in \left[\frac{7}{2}, 4\right]$

2. Answer: D

Sol:

A = {1, 2, 3, 4}

R = {(1, 2)(2, 3)(3, 3)}

Reflexive: (1, 1), (2, 2), (4, 4)

Symmetric: (2, 1), (3, 2), (3, 1)

transitive: (1, 3)

Minimum elements to be added {(1, 1), (2, 2), (4, 4), (2, 1), (3, 2), (3, 1), (1, 3) }

$\therefore$7 element

3. Answer: D

Sol:

$S = {}^{30}C_0 \cdot \text{tasin}(0x) \cdot \cos 30x + {}^{30}C_1 \cdot \sin 1x$

$\cdot \cos 29x + \ldots\ldots + {}^{30}C_{30} \cdot \sin 30x \cdot \cos 0x$

$S = {}^{30}C_{30} \cdot \sin(30x) \cdot \cos(0x) + {}^{30}C_{29}$

$\sin 29x \cdot \cos 1x + \ldots\ldots\ldots +$

$2S = \sum_{r=0}^{30} {}^{30}C_r \left(\sin\left(rx\right) \cdot \cos(30 - r)x + \cos(rx) \cdot \sin(30 - r)x\right)$

$2S = \sum_{r=0}^{30} {}^{30}C_r \cdot \sin(30x)$

$S = 2^{29} \cdot \sin(30x)$

4. Answer: C

Sol:

$$L = \lim_{n\to\infty} \frac{1}{m}\left(\frac{1}{n} \times \frac{2}{n} \times \frac{3}{n} \times \ldots\ldots\ldots \frac{n}{n}\right)^{1/n}$$

taking log both side

$$\ln L = \lim_{n\to\infty} \left[\ln\left(\frac{1}{m}\right) + \frac{1}{n}\left(\ln\frac{1}{n} + \ln\frac{2}{n} + \ldots.. \ln\frac{n}{n}\right)\right]$$

$$= -\ln m + \lim_{n\to\infty} \frac{1}{n}\sum_{r-1}^{n} \ln\left(\frac{r}{n}\right)$$

$$-\ln m + \int_0^1 \ln x dx = -\ln m - 1 = \ln\left(\frac{1}{em}\right)$$

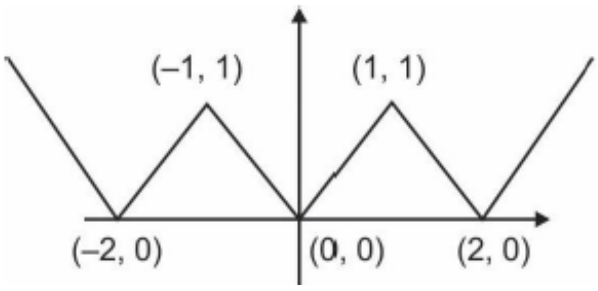
$$L = \frac{1}{em}$$

Therefore, the correct answer is (C)

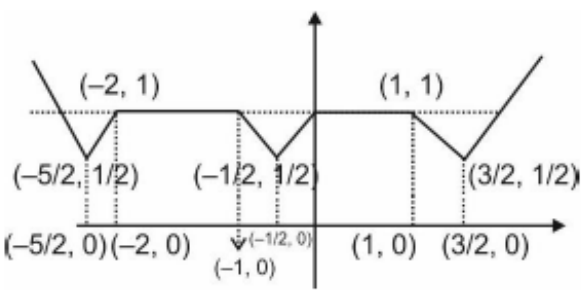
5. Answer: B

Sol:

Graph of $y = |||x| - 1| - 1|$ is as follows



And the graph of g(x) is as follow :



$\Rightarrow$ so there are seven points of nondifferentiability of the function $y = g(x)$

$x \in \left\{\frac{-5}{2}, -2, -1, \frac{-1}{2}, 0, 1, \frac{3}{2}\right\}$

6. Answer: D

Sol:

$$I=\int_0^5 \frac{x+[x]}{e^{x-[x]}}\,dx$$

$$\int_0^1 \frac{x}{e^x}dx+\int_1^2 \frac{x+1}{e^{x-1}}dx \quad \downarrow \quad x=t+1$$
$$+\int_2^3 \frac{x+2}{e^{x-2}}dx+\ldots\ldots\int_4^5 \frac{x+4}{e^{x-4}}dx \quad \downarrow \quad \downarrow \quad x=z+2 \quad x=y+4$$

$$\int_0^1 \frac{t+2}{e^t}\,dt+\int_0^1 \frac{z+4}{e^z}\,dz+\ldots+\int_0^1 \frac{y+8}{e^y}\,dy$$

$$\Rightarrow \int_0^5 \frac{5x+20}{e^x}\,dt=5\int_0^1 \frac{x+4}{e^x}\,dx$$

$$\Rightarrow 5\int_0^1 (x+4)e^{-x}\,dx$$

$$\Rightarrow 5e^{-x}(-x-5)]_0^1 \Rightarrow -\frac{30}{e}+25$$

$\alpha=-30$

$\beta=25 \Rightarrow 5\alpha+6\beta=0$

$(\alpha+\beta)^2=5^2=25$

7. Answer: B

Sol:

$$f(x)=\int \frac{(x^8+4+4x^4)-(4x^4)}{x^4-2x^2+2}dx$$

$$=\int\left(\frac{(x^4+2)^2-(2x^2)^2}{x^4-2x^2+2}\right)dx$$

$$=\int \frac{(x^4+2x^2+2)(x^4-2x^2+2)}{(x^4-2x^2+2)}dx$$

$$f(x)=\frac{x^5}{5}+\frac{2x^3}{3}+2x+C$$

$$f(0)=0+0+0+C=1 \Rightarrow C=1$$

$$f(x)=\frac{x^5}{5}+\frac{2x^3}{3}+2x+1$$

Range of f(x) is R, so f(x) is an onto function

$f(-x)\neq f(x)$, so not even

$f(-x)\neq -f(x)$, so not odd

$f'(x)>0 \forall x\in R$, so $f(x)$ is one-one

8. Answer: B

Sol:

We have $f(x)=\pi-\cot^{-1}x-\tan^{-1}x+\sec^{-1}x$

$=\pi-\frac{\pi}{2}+\sec^{-1}x=\frac{\pi}{2}+\sec^{-1}x$

As domain of $f(x)$ is $(-\infty,-1]\cup[1,\infty)$

$\left(\text{As } \cot^{-1}(-x)=\pi-\cot^{-1}x\right)$

$\therefore$ Range of f(x) is $\left[\frac{\pi}{2},\pi\right)\cup\left(\pi,\frac{3\pi}{2}\right]$.

9. Answer: D

Sol:

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

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

$x=1,\ y=0$

$\Rightarrow C=0$

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

10. Answer: C

Sol:

Since , $\lim\limits_{x\to 0}\left[1+\frac{f(x)}{x^3}\right]^{1/x}$

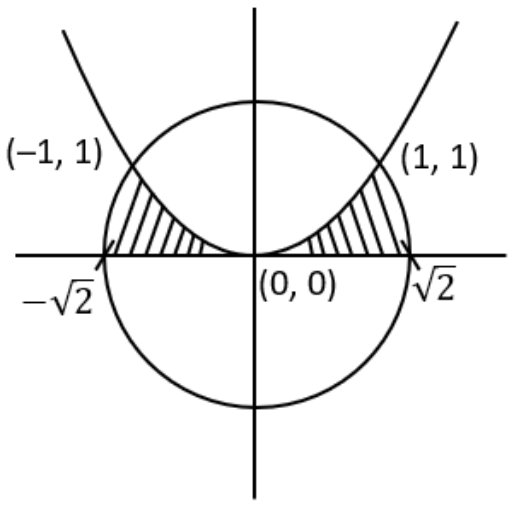
exists, so, $\lim\limits_{x\to 0}\frac{f(x)}{x^3}=0$

$\therefore$ $f(x) = a_4x^4 + a_5x^5 + ...+a_nx^n$, $a_n \neq 0$. $n \geq 4$

Since, f(x) is of least degree

$\Rightarrow$ $f(x) = a_4x^4$

Again $\lim\limits_{x\to 0}\left[1+\frac{f(x)}{x^3}\right]^{1/x}=e$



$\Rightarrow$ $a_4 = 1$

$\Rightarrow f(x) = x^4$

The graph of $y = x^4$ and $x^2 + y^2 = 2$ are shown in figure

$x^2+x^8\ =2put\ x^2\ =t\ in\ above\ eqnt^3\ +t-2\ =0\left(t-1\right)\left(t^2+t+2\right)\ =0here\ t=1\ \Rightarrow\ x^2=1x\ =1,\ -1$

The required area = $2\int_0^1\left|\sqrt{2-x^2}-x^4\right|dx$

$A=2\left[\int_0^1 x^4dx+\int_1^{\sqrt{2}}\sqrt{2-x^2}\,dx\right]$

$=2\left[\left(\frac{x^5}{5}\right)_0^1+\left[\frac{x}{2}\sqrt{2-x^2}+\frac{2}{2}\sin^{-1}\frac{x}{\sqrt{2}}\right]_1^{\sqrt{2}}\right]$

$=2\left(\frac{1}{5}+\left[\frac{\pi}{2}-\frac{1}{2}-\frac{\pi}{4}\right]\right)$

$=2\left(\frac{-3}{10}+\frac{\pi}{4}\right)$

$A=\frac{\pi}{2}-\frac{3}{5}$

$=\frac{\pi}{2}-\frac{3}{5}$

Therefore, the correct answer is (C)

11. Answer: C

Sol:

Given $\left.\begin{matrix}\vec{b}-\vec{a}=3\hat{i}-\hat{j}\\ \vec{c}-\vec{a}=2\hat{i}+3\hat{j}\end{matrix}\right]$ and $\vec{e}-\vec{d}=4\hat{i}-2\hat{j}$

Area $=\frac{1}{2}\left(\left|\overrightarrow{BE}\times\overrightarrow{BD}\right|+\left|\overrightarrow{EC}\times\overrightarrow{ED}\right|\right)$

$$=\frac{1}{2}\begin{bmatrix}\left(\vec{e}-\vec{b}\right)\times\left(\vec{d}-\vec{b}\right)\\ +\left(\vec{c}-\vec{e}\right)\times\left(\vec{d}-\vec{e}\right)\end{bmatrix}$$

$$=\frac{1}{2}\begin{bmatrix}\vec{e}\times\vec{d}-\vec{e}\times\vec{b}-\vec{b}\times\vec{d}\\ +\vec{c}\times\vec{d}-\vec{c}\times\vec{e}-\vec{e}\times\vec{d}\end{bmatrix}$$

$$=\frac{1}{2}\left[\left(\vec{e}\times\vec{c}-\vec{e}\times\vec{b}\right)-\vec{b}\times\vec{d}+\vec{c}\times\vec{d}\right]$$

$$=\frac{1}{2}\left[\vec{e}\times\left(\vec{c}-\vec{b}\right)-\left(\vec{b}-\vec{c}\right)\times\vec{d}\right]$$

$$=\frac{1}{2}\left[\left(\vec{b}-\vec{c}\right)\times\vec{e}-\left(\vec{b}-\vec{c}\right)\times\vec{d}\right]$$

$$=\frac{1}{2}\left[\left(\vec{b}-\vec{c}\right)\times\left(\vec{e}-\vec{d}\right)\right]$$

$$=\frac{1}{2}\left[\left\{\left(3\hat{i}-\hat{j}\right)-\left(2\hat{i}+3\hat{j}\right)\right\}\times\left(4\hat{i}-2\hat{j}\right)\right]$$

$=\frac{1}{2}\left[\left(\hat{i}-4\hat{j}\right)\times\left(4\hat{i}-2\hat{j}\right)\right]=7$ sq. units

12. Answer: C

Sol:

$p=\frac{\hat{a}+\hat{b}}{\left|\hat{a}+\hat{b}\right|},q=\frac{\hat{b}+\hat{c}}{\left|\hat{b}+\hat{c}\right|},$

$r=\frac{\hat{c}+\hat{a}}{\left|\hat{c}+\hat{a}\right|}$

$\left|\hat{a}+\hat{b}\right|=\sqrt{1+1+2.\frac{1}{2}}=\sqrt{3}$

Similarly, $\left|\hat{b}+\hat{c}\right|=\left|\hat{c}+\hat{a}\right|=\sqrt{3}$

Now, $\frac{\left[\hat{a}\ \hat{b}\ \hat{c}\right]}{\left[\hat{p}+\hat{q}\ \hat{q}+\hat{r}\ \hat{r}+\hat{p}\right]}=\frac{\left[\hat{a}\ \hat{b}\ \hat{c}\right]}{2\left[\hat{p}\ \hat{q}\ \hat{r}\right]}$

$$=\frac{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{2\left[\frac{\vec{a}+\vec{b}}{\sqrt{3}}\ \ \frac{\vec{b}+\vec{c}}{\sqrt{3}}\ \ \frac{\vec{c}+\vec{a}}{\sqrt{3}}\right]}$$

$$=\frac{\left[2\vec{a}\ \ 2\vec{b}\ \ 2\vec{c}\right]}{\frac{2}{2\sqrt{3}}.2\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$$

$$=\frac{8\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{\frac{4}{3\sqrt{3}}\left[\vec{a}\ \vec{b}\ \vec{c}\right]}=6\sqrt{3}$$

13. Answer: B

Sol:

Given that |A| = 2, |B| = 3 and |C| = 4

We know that,

|adj A| = |A| = 2

$|\text{adj B}| = |\text{B}|^2 = 9$

$|\text{adj C}| = |\text{C}|^3 = 64$

Now, $\frac{4}{|\text{ABC}|}\begin{vmatrix} |\text{A}| & |\text{B}| & |\text{C}| \\ |\text{adjA}| & |\text{adjB}| & |\text{adjC}| \\ \frac{1}{|\text{A}|} & \frac{3^3}{|\text{B}|} & \frac{4^4}{|\text{C}|} \end{vmatrix}$

$= \frac{4}{24}\begin{vmatrix} 2 & 3 & 4 \\ 2 & 9 & 64 \\ \frac{1}{2} & \frac{3^3}{3} & \frac{4^4}{4} \end{vmatrix}$

$= \frac{1}{6}\begin{vmatrix} 2 & 3 & 4 \\ 2 & 9 & 64 \\ \frac{1}{2} & 9 & 64 \end{vmatrix}$

$= \frac{1}{6}\left[2(0) - 3(128 - 32) + 4\left(18 - \frac{9}{2}\right)\right]$

$= \frac{1}{6} \times (-234)$

= –39

14. Answer: A

Sol:

The system of given equations has no solution, if

$\begin{vmatrix} \alpha & 1 & 1 \\ 1 & \alpha & 1 \\ 1 & 1 & \alpha \end{vmatrix} = 0$

Applying $C_1 \rightarrow C_1 + C_2 + C_3$

$\Rightarrow \begin{vmatrix} \alpha+2 & 1 & 1 \\ \alpha+2 & \alpha & 1 \\ \alpha+2 & 1 & \alpha \end{vmatrix} = 0$

Applying $R_2 \rightarrow R_2 - R_1$, $R_3 - R_1$

$\Rightarrow (\alpha + 2)\begin{vmatrix} 1 & 1 & 1 \\ 0 & \alpha-1 & 0 \\ 0 & 0 & \alpha-1 \end{vmatrix} = 0$

$\Rightarrow \alpha = 1, -2$

But $\alpha = 1$ makes given three equations same. So, the system of equation have infinite solution. So, answer is $\alpha = -2$ for which the system of equations has no solution.

Therefore, the correct answer is (A)

15. Answer: C

Sol:

$\because \quad f : \{1,2,3,4\} \to \{a \in \mathbb{Z} : |9| \leq 8\}$ and $\mathrm{f(n)} + \frac{1}{\mathrm{n}}\mathrm{f(n+1)} = 1$

$\Rightarrow \mathrm{nf(n)} + \mathrm{f(n+1)} = \mathrm{n}$ ... (1)

n = 1

$\therefore \quad \mathrm{f(1)} + \mathrm{f(2)} = 1$

$\Rightarrow \mathrm{f(2)} = 1 - \mathrm{f(1)}$

$\text{But } \mathrm{f(1)} \in [-8, 8]$

Hence, $\mathrm{f(2)} \in [-8,8] \Rightarrow \mathrm{f(1)} \in [-7,8]$ ... (A)

n = 2

2f(2) + f(3) = 2 $\Rightarrow$f(3) = 2f(1)

$\therefore \; 2\mathrm{f(1)} \in [-8,8] \Rightarrow \mathrm{f(1)} \in [-4,4]$ ...(B)

n = 3

3f(3) + f(4) = 3$\Rightarrow$f(4)$\Rightarrow$3 – 6f(1)

$\therefore \; \mathrm{f(1)} \in \left[-\frac{5}{6}, \frac{11}{6}\right]$ ...(C)

From (A), (B) and (C): f(1) = 0 or 1

$\therefore$ Only two functions are possible.

16. Answer: A

Sol:

N does not lie between any two A's

$\therefore$ These 5 letters can be arranged by 3 ways only

N N A A A
N A A A N
A A A N N

Required number of ways

$= {}^{7}\mathrm{C}_{2} \times 2! \times 3$

$= 126$ Ans.]

17. Answer: B

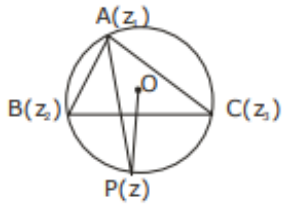
Sol:

$$\mathrm{P} = \underset{\frac{1\times2 \;+\; 2\times4 +\; 2\times1+2\times1}{8\times8}}{\overset{both\ 'a'}{\downarrow} \quad \overset{both\ 's'}{\downarrow} \quad \overset{both\ 'i'}{\downarrow} \quad \overset{both\ 'm'}{\downarrow}} = \frac{14}{64} = \frac{7}{32}$$

18. Answer: B

Sol:

since $\mathrm{OP} \perp \mathrm{BC}$



$\Rightarrow \arg\left(\frac{z}{z_3-z_2}\right) = -\frac{\pi}{2}$

19. Answer: A

Sol:

$\because \frac{1}{p} + \frac{1}{q} + \frac{r}{pq} = \frac{p+q+r}{pq}$

$= \frac{\cos 55^\circ + 2\cos 120^\circ \cos 55^\circ}{pq} = 0$

20. Answer: A

Sol:

Let the midpoint be (h,k)

Equation of chord T = S

$\Rightarrow hx + ky = h^2 + k^2$

Let the above line intersects curve $x^2 - 2x - 2y = 0$ at A and B.

Let O be the origin .

For finding OA × OB, we will use homogenization.

$x^2 - 2x\left(\frac{(hx+ky)}{h^2+k^2}\right) - 2y\left(\frac{hx+ky}{h^2+k^2}\right) = 0$

$x^2\left(h^2+k^2\right) - 2x(hx+ky) - 2y(hx+ky) = 0$

$\Rightarrow x^2\left(h^2+k^2\right) + x^2(-2h) - 2kxy - 2hxy - 2\,ky^2 = 0$

$\Rightarrow x^2\left(h^2+k^2-2h\right) + y^2(-2k) + y(-2hx - 2\,kx) = 0$

$\because$ OA and OB are perpendicular.

$\Rightarrow h^2 + k^2 - 2h - 2k = 0$

$\Rightarrow h^2 + k^2 = 2(h+k)$

$\therefore$ Locus is

$x^2 + y^2 = 2(x+y)$

$\Rightarrow x^2 + y^2 - 2x - 2y = 0$

Maths - Section B

21. Answer: 1

Sol:

We have $x = \frac{a \pm \sqrt{a^2+4}}{2}$

$\alpha = \frac{a+\sqrt{a^2+4}}{2}$; $\beta = \frac{a-\sqrt{a^2+4}}{2}$

Equation of family of circles through A and B is

$(x-\alpha)(x-\beta) + y^2 + \lambda y = 0$

As it passes through C(0, –1),

$\alpha\beta + 1 - \lambda = 0$ (But $\alpha\beta = -1$)

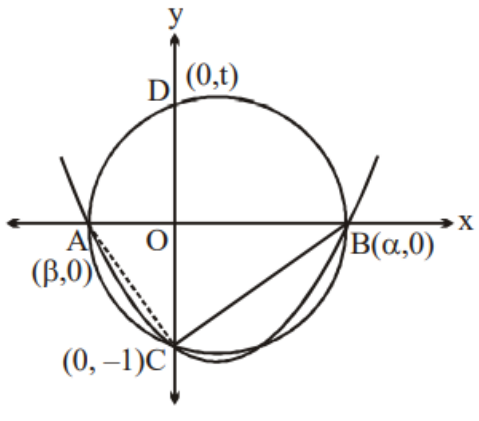
$-1 + 1 - \lambda = 0 \Rightarrow \lambda = 0$

$\therefore$ Equation of circle through A, B and C is $(x-\alpha)(x-\beta) + y^2 = 0$

It cuts the y-axis when x = 0, so $\alpha\beta + y^2 = 0$ (Put $\alpha\beta = -1$)

$y^2 = 1 \Rightarrow y = 1$ or -1

Hence t = 1



22. Answer: 1

Sol:

Given equations are:

Hyperbola: $x^2 - y^2\,\text{cosec}^2\,\alpha = 5$ and

Ellipse: $x^2\,\text{cosec}^2\,\alpha + y^2 = 25$

We can rewrite the equations as :

Hyperbola: $\frac{x^2}{5} - \frac{y^2}{5\sin^2\alpha} = 1$ and

Ellipse $\frac{x^2}{25\sin^2\alpha} + \frac{y^2}{25} = 1$

Now,

Essentricity of Hyperbola : $e_1 = \sqrt{1 + \frac{5\sin^2\alpha}{5}} = \sqrt{1 + \sin^2\alpha}$

Essentricity of Ellipse : $e_2 = \sqrt{1 - \frac{25\sin^2\alpha}{25}} = \sqrt{1 - \sin^2\alpha} = \cos\alpha$

It is given that,

$e_1 = \sqrt{3}e_2$

$\sqrt{1 + \sin^2\alpha} = \sqrt{3}\cos\alpha$

Squaring both sides, we get

$1 + \sin^2\alpha = 3\cos^2\alpha$

$\sin^2\alpha + \cos^2\alpha + \sin^2\alpha = 3\cos^2\alpha$ $\quad\ldots\ldots\{ \because \cos^2\alpha + \sin^2\alpha = 1$

$2\sin^2\alpha = 2\cos^2\alpha$

$\Rightarrow \frac{\sin^2\alpha}{\cos^2\alpha} = \frac{2}{2}$

$\Rightarrow \tan^2\alpha = 1$

23. Answer: 4

Sol:

$T_r = \frac{r^4}{(2r-1)(2r+1)} = \frac{1}{16}\left[\frac{16r^4-1+1}{(2r-1)(2r+1)}\right]$

$T_r = \frac{1}{16}\left[\frac{(4r^2-1)(4r^2-1)+1}{4r^2-1}\right]$

$= \frac{1}{16}\left[(4r^2+1)+\frac{1}{(2r-1)(2r+1)}\right]$

$= \frac{1}{16}\left[(4r^2+1)+\frac{1}{2}\frac{(2r+1)-(2r-1)}{(2r-1)(2r+1)}\right]$

$T_n = \frac{1}{16}\left[4r^2+1+\frac{1}{2}\left(\frac{1}{(2r-1)}-\frac{1}{(2r+1)}\right)\right]$

$S_n = \frac{1}{4}\sum r^2 + \frac{1}{16}\sum 1 + \frac{1}{32}\sum\left(\frac{1}{2r-1}-\frac{1}{2r+1}\right)$

$= \frac{n(n+1)(2n+1)}{4.6} + \frac{n}{16} + \frac{1}{32}$

$\left[\left(1-\frac{1}{3}\right)+\left(\frac{1}{3}-\frac{1}{5}\right)+\ldots+\left(\frac{1}{2n-1}-\frac{1}{2n+1}\right)\right]$

$= \frac{2n^2+3n^2+n}{24} + \frac{n}{16} + \frac{1}{32}\left(1-\frac{1}{2n+1}\right)$

$S_n = \frac{n^3}{12} + \frac{n^2}{8} + \frac{5n}{48} + \frac{1}{16}\left(\frac{n}{2n+1}\right)$

$S_n = \frac{n^3}{A} + \frac{n^2}{B} + \frac{5n}{C} + \frac{f(n)}{D}$ (Given)

So $A = 12,\ B = 8,\ C = 48,\ D = 16$

Hence $|A + 2B - C + D| = |-4|$

= 4

24. Answer: 4

Sol:

Given, $\sum_{i=1}^{18}(X_i-\alpha)=36$

$\Rightarrow \sum x_i-18\alpha=36$

$\Rightarrow \sum x_i-18(\alpha+2)$ ...(1)

Also, $\sum_{i=1}^{18}(X_i-\beta)^2=90$

$\Rightarrow \sum x_i^2+18\beta^2-2\beta\sum x_i=90$

$\Rightarrow \sum x_i^2+18\beta^2$

$+2\beta\times 18(\alpha+2)=90$ (using equation (1))

$\Rightarrow \sum x_i^2=90-18\beta^2+36\beta(\alpha+2)$

$\sigma^2=1\Rightarrow \frac{1}{18}\sum x_i^2-\left(\frac{\sum x_i}{18}\right)^2=1$

(∵s = 1, given)

$\Rightarrow \frac{1}{18}(90-18\beta^2+36\alpha\beta+72\beta)$

$-\left(\frac{18(\alpha+2)}{18}\right)^2=1$

$\Rightarrow 90-18\beta^2+36\alpha\beta$

$+72\beta-18(\alpha+2)^2=18$

$\Rightarrow 5-\beta^2+2\alpha\beta+4\beta-(\alpha+2)^2=1$

$\Rightarrow 5-\beta^2+2\alpha\beta$

$+4\beta-\alpha^2-4-4\alpha=1$

$\Rightarrow \alpha^2-\beta^2+2\alpha\beta+4\beta-4\alpha=0$

$\Rightarrow (\alpha-\beta)(\alpha-\beta+4)=0$

$\Rightarrow \alpha-\beta=-4$

$\therefore |\alpha-\beta|=4$ $(\alpha\neq\beta)$

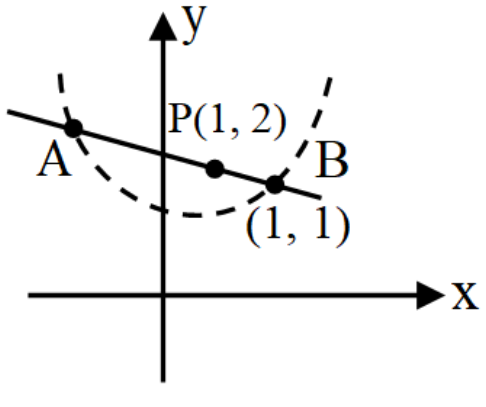
25. Answer: 1

Sol:

$y = \frac{1}{4}[(x-1)^2 + 4]$ $y = mx - m + 2$

$y = \frac{1}{4}(x-1)^2 + 1$ $y - 2 = m(x-1)$

$4(y-1) = (x-1)^2$



Let equation of PAB

$\frac{x-1}{\cos\theta} = \frac{y-2}{\sin\theta} = r$ (for point A)

$\Rightarrow$(1 + r $\cos\theta$, 2 + r$\sin\theta$)

as it satisfies the given curve we get a quadratic in r, whose roots are r_1 and r_2 (say PA and – PB)

$4(r\sin\theta + 1) = r^2\cos^2\theta$

$r^2\cos^2\theta - 4r\sin\theta - 4 = 0$

$r_1 + r_2 = \frac{4\sin\theta}{\cos^2\theta}$

$r_1 r_2 = \frac{-4}{\cos\theta}$

$\Rightarrow \frac{1}{PA} + \frac{1}{PB} = \left|\frac{1}{r_1} - \frac{1}{r_2}\right|$

$\left|\frac{1}{r_1} - \frac{1}{r_2}\right| = \frac{\sqrt{(r_1+r_2)^2 - 4r_1r_2}}{|r_1r_2|}$

on solving we get $\frac{1}{PA} + \frac{1}{PB} = 1$

Physics - Section A

1. Answer: C

Sol:

$h_1 = \frac{u^2}{2g}$, $h_2 = \frac{(u\sin 30^\circ)^2}{2g} = \frac{u^2}{8g}$

$h_1 : h_2 = 4 : 1$

2. Answer: B

Sol:

The masses *A* and *B* of *m* and 2*m* respectively are initially along the horizontal position through the line *AB.*

When the masses are left free, *B* comes down, *A* moves up with acceleration *a*.

Now, $a = \frac{(2m-m)}{2m+m} = \frac{g}{3}$

The initial velocities of both of them is zero. When the lighter mass *A* moves up through a height 15 m, its

velocity v is given by

$v = \sqrt{2 \times a \times S} = \sqrt{2 \times \frac{10}{3} \times 15} = 10\ m/s$

3. Answer: A

Sol:

$\frac{1}{2} \times kx^2 = (mg\sin\theta)x\frac{kx}{2} = mg\ \sin\theta$

$x = \frac{2mg\sin\theta}{K}$

4. Answer: A

Sol:

when block hits ridge at O, it will start rotating about an axis passing through O and perpendicular to the plane of paper. No external torque acts on block hence angular momentum is conserved Angular momentum before hitting, Li = M·V × AC

= MV · (a/2) = [(mva)/2]

after hitting, $L_f = I_0\omega$

I_0 is MI of block about axis through O and perpendicular to plane of block.
if I_C is MI about C then I_C = [(Ma^2)/6]
From parallel axes theorem,

$I_0 = I_C + Mr^2$
and $r^2 = (a/2)^2 + (a/2)^2 = (a^2/2)$

$I_0 = (1/6)Ma^2 + (1/2)Ma^2 = (2/3)Ma^2$

$\therefore L_f = (2/3)Ma^2 \cdot \omega$

also $L_i = L_f$ hence
[(mva)/2] = $(2/3)Ma^2\ \omega$ hence ω = (3V/4a)

5. **Answer:** C

Sol:

$\mathrm{T} \propto \frac{\sqrt{\ell}}{\sqrt{\mathrm{g}}}$

$\mathrm{g} \downarrow 5\%$

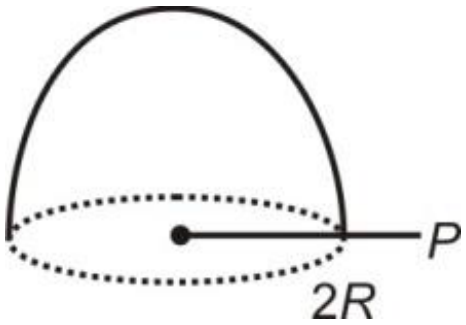
$\ell \uparrow 5\%$

For correct time

6. **Answer:** A

Sol:

$\frac{\mathrm{kq}}{\mathrm{R}} = 10$



So, for symmetrical point P,

$\mathrm{V_P} = \frac{\mathrm{kq}}{2 \times 2\mathrm{R}}$

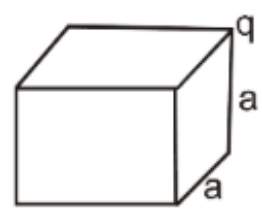
$\mathrm{V_P} = 2.5$ volt

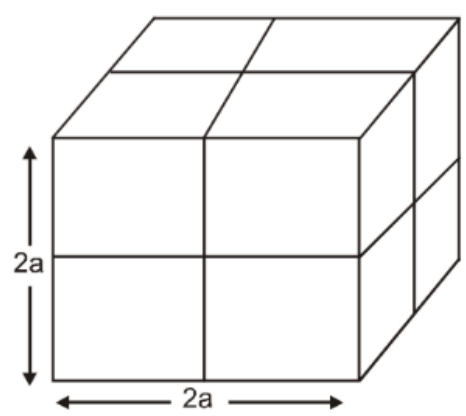
7. **Answer:** B

Sol:

Eight identical cubes are required to arranged so that this charge is at centre of the cube formed so flux.

$\phi = \frac{\mathrm{q}}{8\varepsilon_0}$





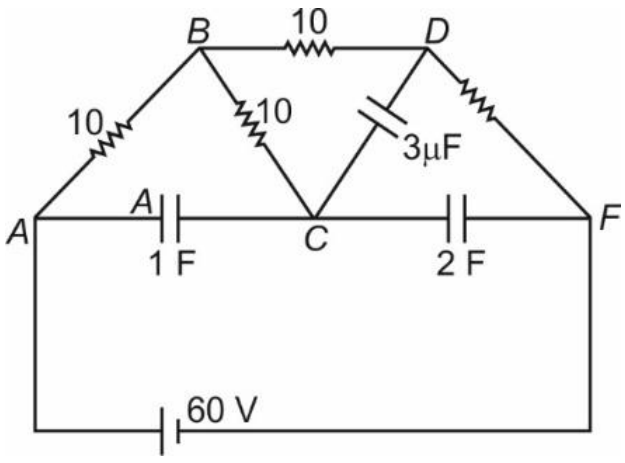
8. Answer: A

Sol:

$V_{AC} = V_{AB} = 10 \times 2 = 20\ V$

$V_{CD} = V_{BD} = 20\ V$

$V_{CF} = V_{BF} = V_{BD} + V_{DF} = 40\ V$



$Q_A = 20\mu C$

$Q_B = 60\mu C$

$Q_C = 80\mu C$

$Q_A < Q_B < Q_C$

9. Answer: D

Sol:

$v = 20\ m^3$

$s = \frac{1}{2}at^2$

$180 = \frac{1}{2}a \times 900$

$a = \frac{360}{900} = 0.4\ m/s^2$

$M_{HC} = 0.18 \times 20 = 3.6\ kg$

$B = e_{adv}vg = 1.29 \times 20 \times 10 = 258\ N$

Let mass of payload M.

$B = M(a + g)$

$258 = (3.6 + 12 + m) \times 10.4.2023$

$M = 24.8 – 15.6 = 9.2\ kg.$

10. Answer: B

Sol:

$\frac{\lambda}{4} = 20\ cm$

$\therefore\ \lambda = 80\ cm$

11. Answer: C

Sol:

$i = \frac{50}{R+r} \Rightarrow r = \frac{50}{4.5} - 10 = \frac{5}{4.5} = 1.1\Omega$

12. Answer: B

Sol:

According to Ampere's circuital law $B(2\pi r) = \mu_0 \times 0$

or $B = 0$ So, inside a hollow metallic (copper) pipe carrying current, the magnetic field is zero. But for external points, the whole current behaves as if it were concentrated at the axis only, so outside $B_0 = \frac{\mu_0 i}{2\pi r}$ Thus, the magnetic field is produced outside the pipe only.

13. Answer: C

Sol:

$q = \frac{\Delta\phi}{R}$

$q = \frac{NBA-0}{R}$

$B = 1(T)$

14. Answer: A

Sol:

Both statement I and statement II are true.

15. Answer: A

Sol:

$T \propto \frac{1}{\sqrt{M}}$

$\frac{T_1}{T_2} = \sqrt{\frac{M_1}{M_2}} = \sqrt{\frac{M}{4M}} = \frac{1}{2}$

$\frac{T_2}{2} = \frac{1}{2} \Rightarrow T_2 = 1\,s$

16. Answer: A

Sol:

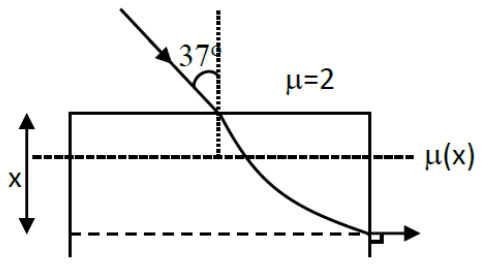
$\Delta L = \frac{Pitch}{4} = \frac{1}{4} \times 10^{-3}$

$y = \frac{F}{A} \cdot \frac{L}{\Delta L} = \frac{500}{10^{-5}} \times \frac{3\times4}{10^{-3}}$

$Y = 5 \times 12 \times 10^{10} \Rightarrow 6 \times 10^{11}\ N/m^2$

17. Answer: D

Sol:



$\mu = 2 - x$

$2\sin(37°) = \sin(90°)(2 - x)$

$2 \cdot \frac{3}{5} = 2 - x$

$\frac{6}{5} = 2 - x$

$x = 2 - \frac{6}{5} = \frac{10-6}{5} = \frac{4}{5}$

$x = 0.8m$

18. Answer: C

Sol:

We know that $\mathrm{F} = \frac{\mathrm{IA}}{\mathrm{c}}$

Pressure = Force/ Area

$\mathrm{P} = \frac{\mathrm{F}}{\mathrm{A}} = \frac{\mathrm{IA}/\mathrm{c}}{\mathrm{A}} = \frac{\mathrm{I}}{\mathrm{c}}$

Hence, the correct answer is option (C)

19. Answer: D

Sol:

Pressure difference due to capillary rise is balanced by surface tension:

$$\Delta \mathrm{P} = \rho g h$$

Laplace's law for a liquid meniscus with principal radii R1 and R2:

$$\Delta \mathrm{P} = S\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

Equating the two expressions for ΔP:

$$S\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \rho g h$$

Therefore,

$$\frac{R_1 + R_2}{R_1 R_2} = \frac{\rho g h}{S}$$

Substituting $\rho = 1000\mathrm{kg} \cdot m^{-3}, g = 9.8m \cdot s^{-2}, h = 0.12m, S = 0.01N \cdot m^{-1}$:

$\frac{1000 \times 9.8 \times 0.12}{0.01} = 117600m^{-1}$

20. Answer: A

Sol:

OR gate

Physics - Section B

21. Answer: 6

Sol:

$\mathrm{E}=\frac{\mathrm{hc}}{\lambda}=\frac{6.6\times10^{-34}\times3\times10^{8}}{375\times10^{-10}}=\frac{0.020\times10^{-16}}{1.6\times10^{-19}}\mathrm{eV}$

$=\frac{0.020}{1.6}\times10^{3}\mathrm{eV}=0.0125\times10^{3}\,\mathrm{eV}$

$=12.75\,\mathrm{eV}$

So electron will be excited to fourth energy state.

When the e^- will fall back, numbers of spectral lines emitted = $\frac{\mathrm{n}(\mathrm{n}-1)}{2}=\frac{4(4-1)}{2}=6$

Therefore, the correct answer is (6)

22. Answer: 4

Sol:

$Q = [M(Ra^{226}) - M(Rn^{222}) - M(He^{4})] \times 931$

$= (226.025406 - 222.017574 - 4.002603)\ u \times 931$

$= 0.005229\ u \times 931\ \frac{MeV}{u}$

$Q = 4.87\ MeV$

23. Answer: 2

Sol:

$\frac{\mathrm{dN}}{\mathrm{dt}}=\frac{\mathrm{P_0}\times\lambda}{\mathrm{hc}}\times\eta$

$=0.1\times\frac{6.63\times10^{-6}\times300\times10^{-9}}{6.63\times10^{-34}\times3\times10^{8}}=10^{12}\,\mathrm{sec}^{-1}$

$\mathrm{E}=\mathrm{h}(\mathrm{f}-\mathrm{f_T})$

$\mathrm{P}=2.2\times10^{-4}\ \mathrm{W}$

24. Answer: 12

Sol:

Applying Kirchhoff's voltage law from A to B gives the sum of voltage drops:

$V_A - V_B = V_{5V} + V_{2\Omega} - V_{2V} + V_L + V_{3\Omega}$

$v_L = L \times \frac{di}{dt} = 2 \times 10^{-3} \times \left(-3 \times 10^{3}\right) = -6V$

Summing all contributions:

$5 + 6 - 2 - 6 + 9 = 12\ V$

Final Answer: $12\ V$

25. Answer: 7

Sol:

$\mathrm{T}-\mathrm{mgcos}\theta=\frac{\mathrm{mv}^2}{\ell}$ and

$\mathrm{v}^2-\mathrm{u}^2=-2\,\mathrm{g}\ell$
$(\mathrm{I}-\mathrm{cos}\theta)$

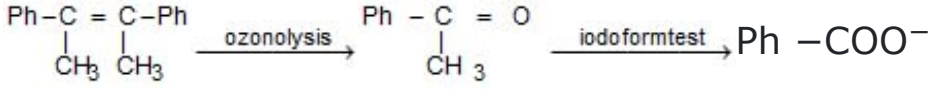
also $\mathrm{T}=\mathrm{mg}$

$=7\,\mathrm{m/s}$

Chemistry - Section A

1. Answer: C

Sol:



2. Answer: C

Sol:

The presence of Zirconium and Hafnium atom and ions are almost the same because of poor sheiding effect by 4f electrons, which lead to the lanthanoid contraction.

As result both have indentical ionic radius and covalent radius.

3. Answer: C

Sol:

Number of half life $(\pi) = \frac{\text{Total time}}{\text{Half life}} = \frac{40}{8} = 5$

$\underset{A_0}{100} \rightarrow 50 \rightarrow 25 \rightarrow 12.5 \rightarrow 6.25 \rightarrow \underset{A_t}{3.125}$

$\frac{A_t}{A_0} \Rightarrow \frac{3.125}{100}$

$\frac{A_t}{A_0} \Rightarrow \left(\frac{1}{32}\right)$

4. Answer: B

Sol:

$KMnO_4 + FeSO_4 + H^+ \rightarrow Fe^{3+} + Mn^{2+}$

Yellow colour due to Fe^{3+}.

5. Answer: C

Sol:

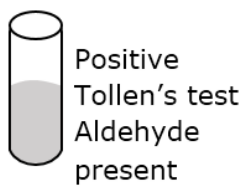
$\lambda = K\frac{1000}{N}$

6. Answer: B

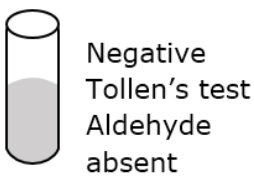
Sol:

Tollen's reagent and fehling's solution can be used to distinguish between aldose (contain aldehyde group) and ketose (contain ketone group).

Tollen's solution:-



(Dark grey precipitate of silver mirror)



Fehling's solution : -

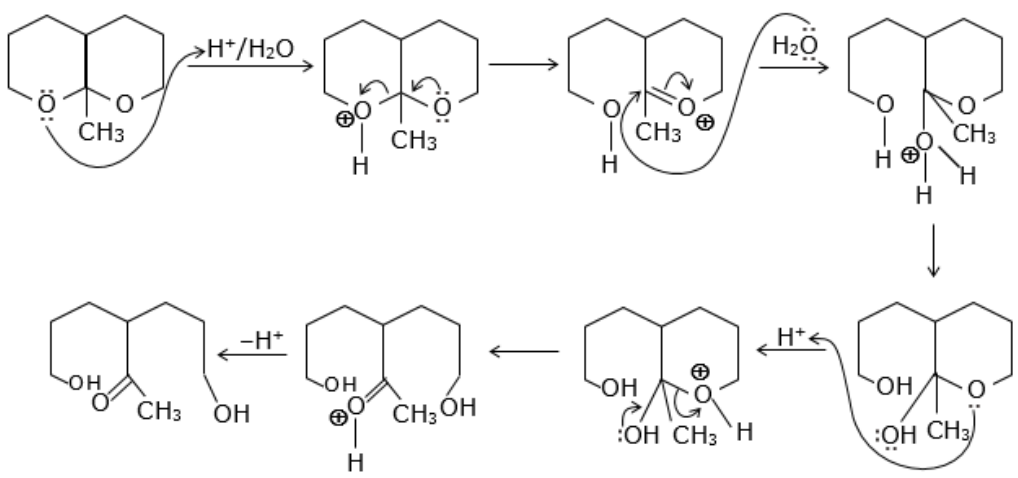
Negative test result (Ketone) (Deep blue colour)

Positive test result (Aldehydes) (Reddish brown colour)

Br_2 water test, used to identify the alkene or alkane functional groups present in the compound.

7. Answer: A

Sol:



Therefore, the correct answer is (A).

8. Answer: D

Sol:

Along the period EN increases so, non metallic character increases.

9. Answer: B

Sol:

$\frac{1}{\lambda} = R \times (1)^2 \left[\frac{1}{1^2} - \frac{1}{5^2}\right]$

$\frac{1}{\lambda} = R \times \left[1 - \frac{1}{5^2}\right]$

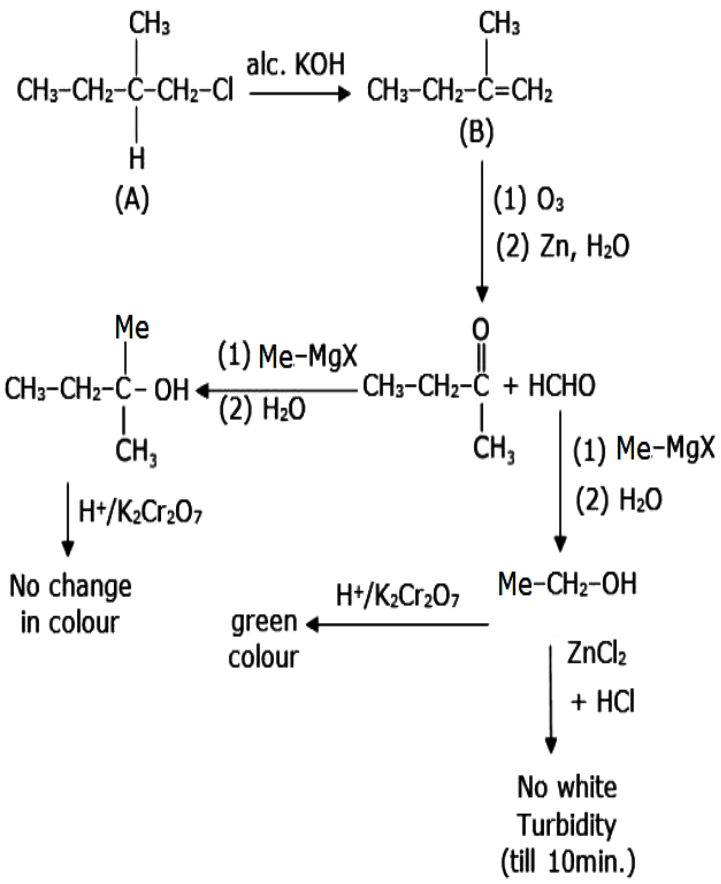
$\frac{1}{\lambda} = R \times \frac{24}{25}$

$\lambda = \frac{25}{24} \times \frac{1}{R}$

$= \frac{25}{24} \times 912 = 950\text{Å}$

10. Answer: C

Sol:



11. Answer: A

Sol:

Fe^{2+} gives prussian blue colour with MnO_4^- /H $^+$.
They acts as an oxidising agent, converts ferrous to ferric ion. This ferric ion reacts with $K_4[Fe(CN)_6]$ to form prussian blue colour of ferric ferro cyanide.
MnO_4^-/ $H^+ \rightarrow [O]$: $Fe^{2+} \overset{[O]}{\rightarrow} Fe^{3+} + [Fe(CN)_6]^{4-} \rightarrow Fe_4[Fe(CN)_6]_3$

Therefore, the correct answer is (A).

12. Answer: A

Sol:

$n_1A + n_2B \rightarrow m_1C + m_2D$

n_1 mole of A reacts with n_2 moles of B

13. Answer: C

Sol:

Correct name of (A) : Tris (acetylacetonato) iron (III)]

Correct name of (B) : Tetraammine dicyanoplatinum (IV) hexachloroplatinate (IV)

Correct name of (D) : Dichloro (ethylenediamine) platinum (II)

14. Answer: C

Sol:

Given : Let a gas (A) and another gas (B)

So, molecular weight of A = 4 and molecular weight of B = 40

P_{Total} = 1.1 atm and Let $(mass)_A = (mass)_B$ = x g

According to dalton law of partial pressure

$$P_{gas} = P_{Total} X_{gas}$$

$$n_A = \frac{x}{4} \quad , \qquad n_B = \frac{x}{40}$$

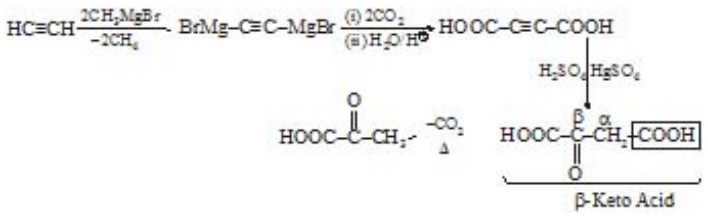
$$X_A = \frac{\frac{x}{4}}{\frac{x}{4}+\frac{x}{40}} = \frac{\frac{x}{4}}{\frac{11x}{40}} = \frac{10}{11}$$

$$\left(P_A\right) = \left(1.1\right) \times \frac{10}{11} = 1\,atm$$

Therefore the correct answer is (C).

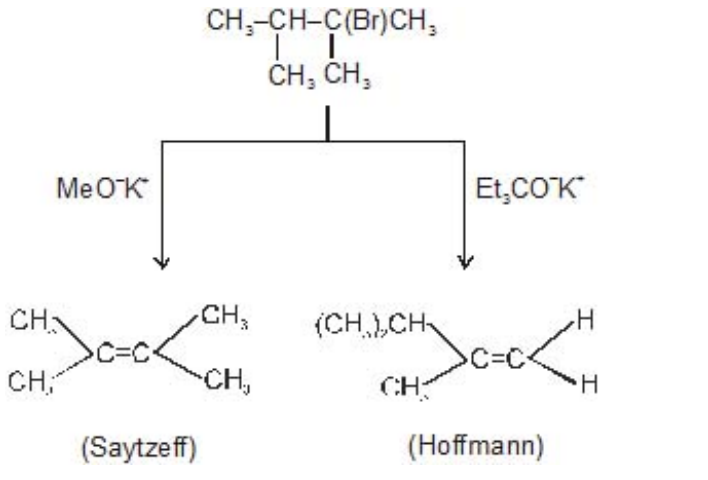
15. Answer: A

Sol:



16. Answer: A

Sol:



17. Answer: D

Sol:

It is said to be **diamagnetic** if a molecule has an even number of electrons (or) no unpaired electrons .

1) Na_2O–Number of electrons =2×11+8=30 (even number)–Diamagnetic in nature–Incorrect

2) MgO–Number of electrons = 12+8=20 (even number)- Diamgneticin nature-Incorrect

3) BeO–Number of electrons = 4+8=12 (even number)-Diamagnetic in nature-Incorrect

4) KO_2–Number of electrons = 192×8=35 (odd number)- Paramagnetic in nature-Correct

18. Answer: B

Sol:

$$\begin{matrix} \mathrm{A}+ & \mathrm{B} \rightleftharpoons & \mathrm{AB}; \\ 1 & 1 & 0 \\ (1-\mathrm{x}) & (1-\mathrm{x}) & \mathrm{x} \end{matrix}$$

Given x=0.4

\ Percentage of A changing to $\mathrm{AB} = \frac{0.4 \times 100}{1} = 40\%$

19. Answer: A

Sol:

For isothermal process ;

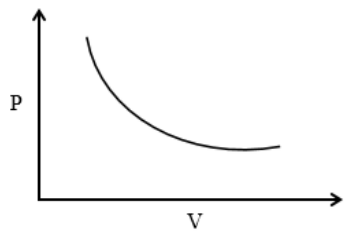
T $\rightarrow$ constant

ΔT = 0

PV = nRT = constant (K)

PV = K

$\downarrow \mathrm{P} = \frac{\mathrm{K}}{\mathrm{V}\uparrow}$



For adiabatic process ;

PV^{γ} = constant

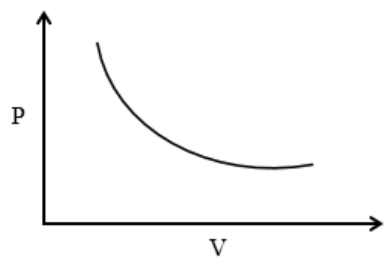
PV^{γ} = K^{1}

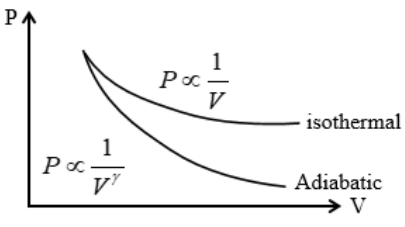
$\downarrow \mathrm{P} = \frac{\mathrm{K}^{1}}{\mathrm{V}} \gamma \uparrow$

$\gamma = \frac{\mathrm{C_p}}{\mathrm{C_v}}$

γ = $\frac{\mathrm{C_p}}{\mathrm{C_v}}$

γ > 1





Here adiabatic curve has higher slope.

20. Answer: A

Sol:

$$(Fe^{2+} \rightarrow Fe^{3+} + 1e^-) \times 6$$

$$6e^- + 14H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O$$

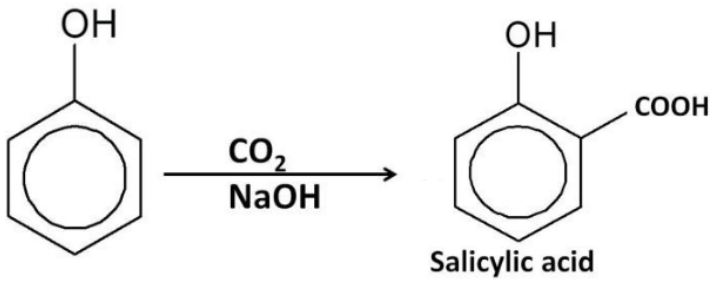
$$6Fe^{2+} + 14H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

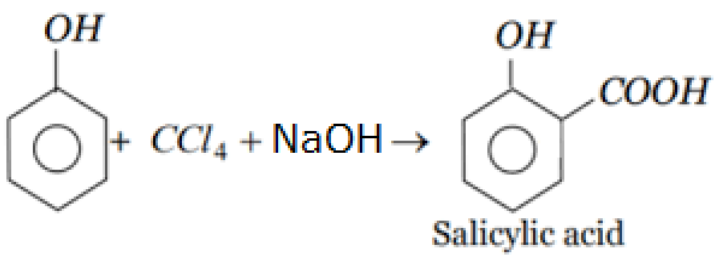
x=6, y=1, z=7

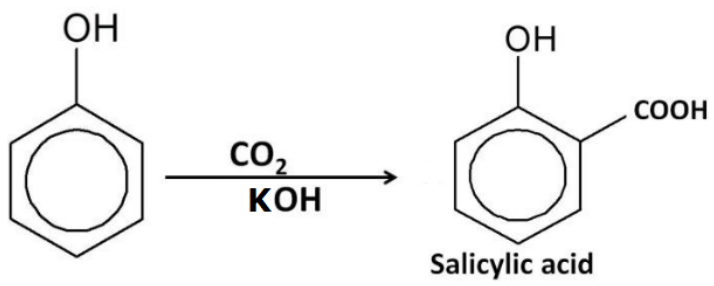
Chemistry - Section B

21. Answer: 3

Sol:







22. Answer: 2.66

Sol:

In complex ion P, Math input error 2g orbitals. Hence, $x = 6$.

In complex ion Q, Math input error ^{2} hybridisation. The square-planar splitting order (low to high) is dxz/dyz, dxy, dz_2, dx^2-y^2. Filling eight electrons gives two in dz_2, so $y = 2$.

Therefore, $\frac{x+y}{3} = \frac{6+2}{3} = \frac{8}{3}$.

Final Answer: $\frac{8}{3}$

23. Answer: 5

Sol:

ClF_3, XeF_2, SF_4, $[SbF_4]^-$, $XeOF_2$ are having lone pairs at equatorial position.

24. Answer: 7

Sol:

CH_3COONH_4 is salt formed from weak acid CH_3COOH and weak base NH_4OH.

CH_3COOH disociation constant $K_a = 1.8 \times 10^{-5}$

NH_4OH disociation constant $K_b = 1.8 \times 10^{-5}$

pH of CH_3COONH_4 solution = $7+\frac{1}{2}pKa-\frac{1}{2}pKb$

pH = $7+\frac{1}{2}pKa-\frac{1}{2}pKb$

pH = $7+\frac{1}{2}\left[-\log\left(1.8\times10^{-5}\right)\right]-\frac{1}{2}\left[-\log\left(1.8\times10^{-5}\right)\right]$

The pH of 0.1 M CH_3COONH_4 solution is 7.

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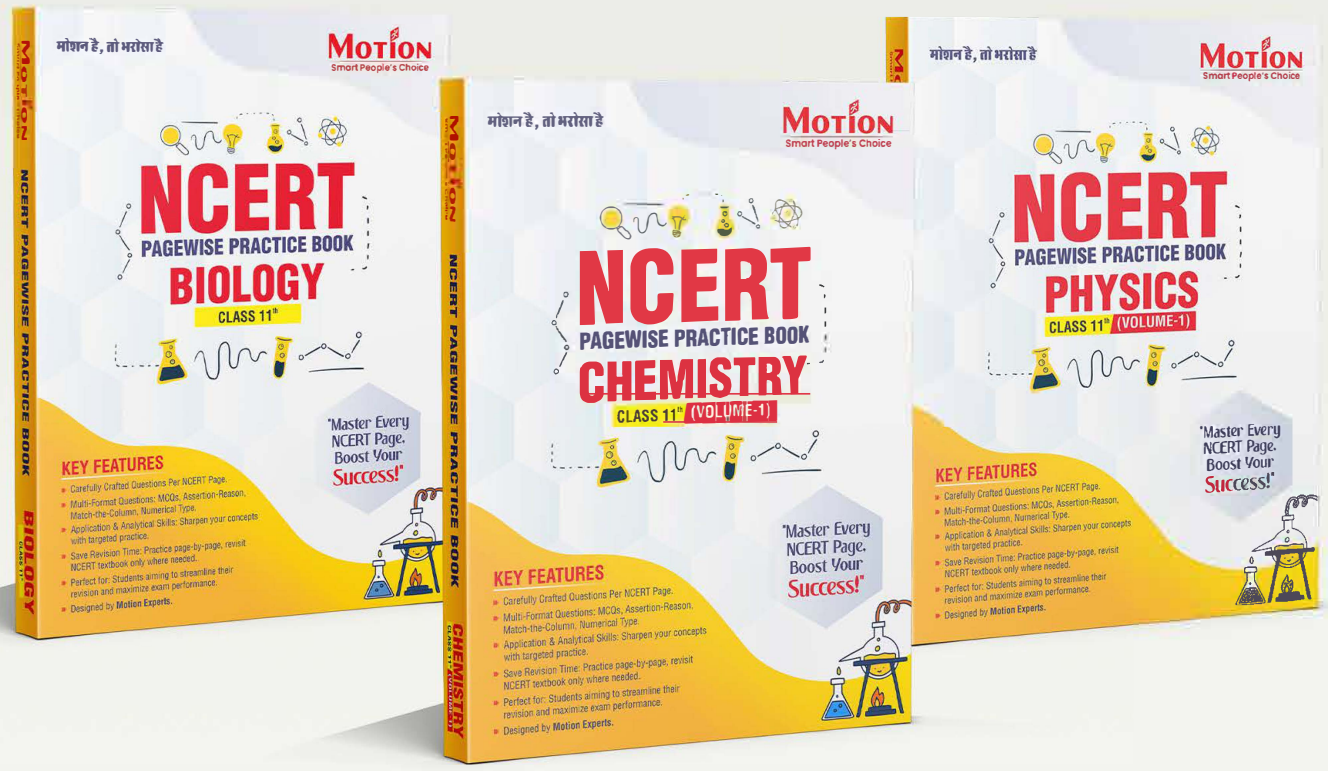

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