MOTION

JEE MAIN 2026

SAMPLE PAPER - 2

WITH SOLUTIONS

मोशन है , तो भरोसा है

MOTION

Sample Paper 2

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)

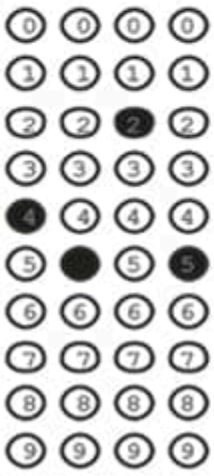
2. It is mandatory to fill all four columns while attending any of numerical questions, otherwise it will not be considered. (●●●●)

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

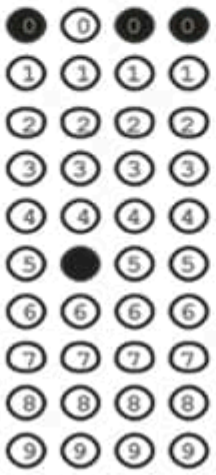
4. Don't use pen or pencil to mark decimal point. (⓪⓪•⓪⓪)

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

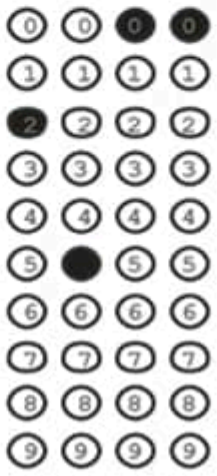
{a} Suppose your answer is - 45.25
Then mention it like



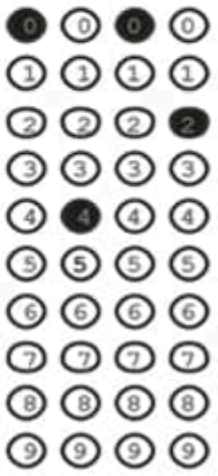
{b} Suppose your answer is - 5
Then mention it like



{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 a, b, c are in A.P. and p, p' are respectively AM and GM between a and b, while q, q' are respectively A.M. and G.M. between b and c, then-

(A) $p^2 + q^2 = p'^2 + q'^2$

(B) $pq = p'q'$

(C) $p^2 - q^2 = p'^2 - q'^2$

(D) $p^2 + p'^2 = q^2 + q'^2$

2. If the roots of the equation $4x^2 + 4kx + b = 0$ are real & differ by at most k (k > 0), then b lies in

(A) [0, k]

(B) $[-k^2, 0]$

(C) $(- k^2, k^2)$

(D) $[0, k^2]$

3. Let $R = \left(5 \cdot \sqrt{5} + 11\right)^{2n+1}$ and f = R–[R], where [.] denotes the greatest integer function. The value of R.f is

(A) 4^{2n+1}

(B) 4^{2n}

(C) 4^{2n-1}

(D) 4^{-2n}

4. Value of $\lim_{n\to\infty} \left[\left(1+\frac{n}{1}\right)^{1/n}\left(1+\frac{n}{2}\right)^{2/n}\left(1+\frac{n}{3}\right)^{3/n}\ldots 2\right]^{1/n}$ is equal to

(A) e

(B) $\sqrt{e}$

(C) $\sqrt[4]{e}$

(D) $\frac{1}{\sqrt{e}}$

5. The AM and variance of 10 observation are 10 and 4 resp. Later it is discovered that one observation was incorrectly read as 8 instead of 18. Then the correct value of mean & variance are -

(A) 20,9

(B) 20,14

(C) 11,9

(D) 11,5

1. यदि a, b, c समान्तर श्रेणी में हैं तथा a व b के मध्य AM और GM क्रमशः p, p' हैं, जबकि b व c के मध्य AM व GM क्रमशः q, q' है, तब-

(A) $p^2 + q^2 = p'^2 + q'^2$

(B) $pq = p'q'$

(C) $p^2 - q^2 = p'^2 - q'^2$

(D) $p^2 + p'^2 = q^2 + q'^2$

2. यदि समीकरण $4x^2 + 4kx + b = 0$ के मूल वास्तविक हैं और अधिकतम k(k > 0) से भिन्न हैं, तो b निम्न में स्थित है-

(A) [0, k]

(B) $[-k^2, 0]$

(C) $(- k^2, k^2)$

(D) $[0, k^2]$

3. माना $R = \left(5\sqrt{5} + 11\right)^{2n+1}$ तथा $f = R - [R]$, जहाँ $[.]$ महत्तम पूर्णांक फलन को दर्शाता है, तब R.f का मान है -

(A) 4^{2n+1}

(B) 4^{2n}

(C) 4^{2n-1}

(D) 4^{-2n}

4. $\lim_{n\to\infty} \left[\left(1+\frac{n}{1}\right)^{1/n}\left(1+\frac{n}{2}\right)^{2/n}\left(1+\frac{n}{3}\right)^{3/n}\ldots 2\right]^{1/n}$ का मान बराबर है

(A) e

(B) $\sqrt{e}$

(C) $\sqrt[4]{e}$

(D) $\frac{1}{\sqrt{e}}$

5. 10 प्रेक्षणों का स.मा तथा प्रसरण क्रमश:10 व 4 है| आगे जाकर यह पाया जाता है कि एक प्रेक्षण में 18 को गलती से 8 पढ लिया जाता है| तब माध्य तथा प्रसरण के सही मान होंगे

(A) 20,9

(B) 20,14

(C) 11,9

(D) 11,5

6. The direction cosines of two lines are related by $\ell + m + n = 0$ and $al^2 + bm^2 + cn^2 = 0$. The lines are parallel if -

(A) $a + b + c = 0$

(B) $a^{-1} + b^{-1} + c^{-1} = 0$

(C) $a = b = c$

(D) None of these

7. The ratio of the number of the roots of the equation $x + 2\tan x = \frac{\pi}{2}$, to the number of roots of the equation $2\tan x - x = \pi/2$ in the interval $[0, 2\pi]$ is

(A) 1/2

(B) 3/2

(C) 2/3

(D) None of these

8. Let x satisfies the equation $(4x)^{\log 2} = (9x)^{\log 3}$ and $y \in I$ is such that $(y + 1)^2$ is greater than $(5y - 1)$ and less than $(7y - 3)$. Find the value of $\frac{xy+1}{x}$

(A) 40

(B) 39

(C) 37

(D) 38

9. If $y = 2^{1/\log_x 4}$, then x is equal to

(A) $\sqrt{y}$

(B) y

(C) y^2

(D) y^4

10. In a network of railways, a small island has 15 stations. The number of different types of ticket to be printed for each class; if every station must have tickets for other station is

(A) 105

(B) 210

(C) 230

(D) 460

11. Range of f(x) = [sin x] is-

(A) $(-\infty, \infty)$

(B) $[-1, 1]$

(C) {-1, 0, 1}

(D) $\left[1 - \sqrt{2}, \sqrt{2}\right]$

6. दो रेखाओं की दिक्कोज्यायें $\ell + m + n = 0$ और $al^2 + bm^2 + cn^2 = 0$ द्वारा संबंधित हैं। रेखाएँ समान्तर हैं यदि -

(A) $a + b + c = 0$

(B) $a^{-1} + b^{-1} + c^{-1} = 0$

(C) $a = b = c$

(D) इनमें से कोई नहीं

7. अंतराल $[0, 2\pi]$ मे समीकरण $2\tan x - x = \pi/2$ के मूलो की संख्या से समीकरण $x + 2\tan x = \frac{\pi}{2}$ के मूलो की संख्या का अनुपात होगा -

(A) 1/2

(B) 3/2

(C) 2/3

(D) इनमे से कोई नही

8. माना x समीकरण $(4x)^{\log 2} = (9x)^{\log 3}$ को संतुष्ट करता है और $y \in I$ इस प्रकार है कि $(y + 1)^2$, $(5y - 1)$ से अधिक है और $(7y - 3)$ से कम है। $\frac{xy+1}{x}$ का मान ज्ञात कीजिए।

(A) 40

(B) 39

(C) 37

(D) 38

9. यदि $y = 2^{1/\log_x 4}$ है, तब x बराबर है

(A) $\sqrt{y}$

(B) y

(C) y^2

(D) y^4

10. रेलवे के एक नेटवर्क में, एक छोटे से द्वीप में 15 स्टेशन हैं। प्रत्येक श्रेणी के लिए मुद्रित किए जाने वाले विभिन्न प्रकार के टिकटों की संख्या; यदि प्रत्येक स्टेशन के पास अन्य स्टेशनों के लिए टिकट होने चाहिए, होगी -

(A) 105

(B) 210

(C) 230

(D) 460

11. फलन f(x) = [sin x] का परिसर है -

(A) $(-\infty, \infty)$

(B) $[-1, 1]$

(C) {-1, 0, 1}

(D) $\left[1 - \sqrt{2}, \sqrt{2}\right]$

12. If $A = \begin{bmatrix} 3 & 4 \\ 5 & 7 \end{bmatrix}$, then A (adj A) =

(A) I

(B) |A|

(C) 2|A|

(D) None of these

13. The length of a focal chord of the parabola $y^2 = 4ax$ at a distance b from the vertex is c, then

(A) $2a^2 = bc$

(B) $a^3 = b^2c$

(C) $ac = b^2$

(D) $b^2c = 4a^3$

14. If $f(x) = 2x^3 + 9x^2 + \lambda x + 20$ is a decreasing function of x in the largest possible interval $(-2, -1)$ then λ is equal to-

(A) $\lambda = 12$

(B) $\lambda = 10$

(C) $\lambda = 8$

(D) $\lambda = 4$

15. If (α, β) lies on $x^2 + y^2 = 25$, then minimum value of $\frac{225}{\alpha^2} + \frac{25}{\beta^2}$ is equal to

(A) 1

(B) 8

(C) $\frac{1}{4}$

(D) 16

16. Area enclosed by the figure described by the equation $x^4 + 1 = 2x^2 + y^2$, is

(A) 3

(B) $\frac{8}{3}$

(C) $\frac{7}{3}$

(D) $\frac{10}{3}$

17. If $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\vec{d}$ are unit vectors such that $(\vec{a} \times \vec{b}) . (\vec{c} \times \vec{d}) = 1$ and $\vec{a} . \vec{c}$ = $\frac{1}{2}$, then

(A) $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar

(B) $\vec{b}, \vec{c}\ \vec{d}$ are non-coplanar

(C) $\vec{b}, \vec{d}$ are non-parallel

(D) $\vec{a}, \vec{d}$ are parallel and $\vec{b}, \vec{c}$ are parallel

12. यदि $A = \begin{bmatrix} 3 & 4 \\ 5 & 7 \end{bmatrix}$ तब A (adj A) =

(A) I

(B) |A|

(C) 2|A|

(D) इनमें से कोई नहीं

13. परवलय $y^2 = 4ax$ की एक नाभिय जीवा जो शीर्ष से b दूरी पर है, की लम्बाई c है, तब -

(A) $2a^2 = bc$

(B) $a^3 = b^2c$

(C) $ac = b^2$

(D) $b^2c = 4a^3$

14. यदि अधिकतम संभव अन्तराल (–2, –1) में, x का एक हासमान फलन $f(x) = 2x^3 + 9x^2 + \lambda x + 20$ है, तब λ बराबर है -

(A) $\lambda = 12$

(B) $\lambda = 10$

(C) $\lambda = 8$

(D) $\lambda = 4$

15. यदि $x^2 + y^2 = 25$ पर एक बिन्दु (α, β) स्थित है, तब $\frac{225}{\alpha^2} + \frac{25}{\beta^2}$ का न्यूनतम मान निम्न के बराबर है -

(A) 1

(B) 8

(C) $\frac{1}{4}$

(D) 16

16. समीकरण $x^4 + 1 = 2x^2 + y^2$ द्वारा परिभाषित आकृति द्वारा परिबद्ध क्षेत्रफल है -

(A) 3

(B) $\frac{8}{3}$

(C) $\frac{7}{3}$

(D) $\frac{10}{3}$

17. यदि $\vec{a}, \vec{b}, \vec{c}$ तथा $\vec{d}$ इकाई सदिश इस प्रकार है कि $\left(\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{c} \times \vec{d}\right)\right) = 1$ तथा $\vec{a} \cdot \vec{c} = \frac{1}{2}$ हैं, तब

(A) $\vec{a}, \vec{b}, \vec{c}$ असमतलीय है

(B) $\vec{b}, \vec{c}, \vec{d}$ असमतलीय है

(C) $\vec{b}, \vec{d}$ समान्तर नहीं है

(D) $\vec{a}, \vec{d}$ समान्तर हैं तथा $\vec{b}, \vec{c}$ समान्तर हैं

18. Solution of the differential equation $\frac{dy}{dx} + y\ \sec^2 x = \tan x\ \sec^2 x$ is

(A) $y = \tan\ x - 1\ +\ ce^{-\tan x}$

(B) $y^2 = \tan\ x - 1\ +\ ce^{\tan x}$

(C) $ye^{\tan x} = \tan\ x - 1\ +\ c$

(D) $ye^{-\tan x} = \tan x - 1 + c$

19. If $f(x) = [2 + 7\sin x]$, $0 < x < \pi$,, then number of points at which ([.] represents greatest integer function) the function is discontinuous is

(A) 13

(B) 7

(C) 6

(D) 1

20. If $e^{\log_e 2\left[\sin^2\alpha + \sin^4\alpha + \sin^6\alpha + \ldots\infty\right]}$ is a root of equation $x^2 - 9x + 8 = 0$ where $0 < \alpha < \frac{\pi}{2}$ then principal value of $\sin^{-1}\sin\left(\frac{2\pi}{3}\right)$ is :-

(A) α

(B) 2 α

(C) − α

(D) −2 α

18. अवकल समीकरण $\frac{dy}{dx} + y\ \sec^2 x = \tan x\ \sec^2 x$ का हल है

(A) $y = \tan\ x - 1\ +\ ce^{-\tan x}$

(B) $y^2 = \tan\ x - 1\ +\ ce^{\tan x}$

(C) $ye^{\tan x} = \tan\ x - 1\ +\ c$

(D) $ye^{-\tan x} = \tan x - 1 + c$

19. यदि $f(x) = [2 + 7\sin x]$, $0 < x < \pi$ है, तब बिन्दुओं की संख्या जिनपर फलन असतत् है, है- (जहाँ [.] महत्तम पूर्णांक फलन को प्रदर्शित करता है)

(A) 13

(B) 7

(C) 6

(D) 1

20. यदि $e^{\log_e 2\left[\sin^2\alpha + \sin^4\alpha + \sin^6\alpha + \ldots\infty\right]}$ समीकरण $x^2 - 9x + 8 = 0$ का एक मूल है, जहाँ $0 < \alpha < \frac{\pi}{2}$ है, तब $\sin^{-1}\sin\left(\frac{2\pi}{3}\right)$ का मुख्य मान है :-

(A) α

(B) 2 α

(C) − α

(D) −2 α

MATHS

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. A bag contains 15 red and 20 black balls. Each ball is numbered $1, 2$ or 3 . 20% of red balls are numbered 1 and 40% are numbered 3. Similarly 45% of black balls are numbered 2 and 30% are numbered 3. One ball is drawn at random and found to be numbered 2. If probability that it was red ball is p, then $15\mathrm{p}$ is

21. एक थैले में 15 लाल तथा 20 काली गैंदें हैं। प्रत्येक गेंद पर 1, 2 या 3 अंकित है। 20% लाल गेंदों पर 1 अंकित है तथा 40% पर 3 अंकित है। इसी प्रकार 45% काली गेंदों पर 2 अंकित है तथा 30% पर 3 अंकित है। एक गेंद यादृच्छिक रुप से निकाली जाती है तथा उस पर 2 अंकित मिलता है। यदि प्रायिकता ताकि यह गेंद लाल थी, P है, तब 15 P है-

22. If $\frac{1}{a+\omega}+\frac{1}{b+\omega}+\frac{1}{c+\omega}+\frac{1}{d+\omega}=\frac{1}{\omega}$, where, a, b, c, $d \in R$ and ω is a complex cube root of unity then $\sum \frac{1}{a^2-a+1}$ is equal to

22. यदि $\frac{1}{a+\omega}+\frac{1}{b+\omega}+\frac{1}{c+\omega}+\frac{1}{d+\omega}=\frac{1}{\omega}$, जहाँ a, b, c, $d \in R$ तथा इकाई के सम्मिश्र घनमूल ω है तब $\sum \frac{1}{a^2-a+1}$ बराबर है

23. The value of $\int_{-1}^{1}\left[x\left[1+\sin\pi x\right]+1\right]dx$ _____, is ([.] denotes the greatest integer)

23. $\int_{-1}^{1}\left[x\left[1+\sin\pi x\right]+1\right]dx$ का मान है (जहां [.] महत्तम पूर्णांक फलन को दर्शाता है)

24. The radius of a circle with centre $(1, a)$, which bisects the circumference of the circle $(x-3)^2+(y-4)^2=4$ and touches the x-axis, is

24. केन्द्र (1, a) वाला एक वृत्त जो वृत्त $(x - 3)^2 + (y - 4)^2 = 4$ की परिधि को समद्विभाजित करता है तथा x-अक्ष को स्पर्श करता है, की त्रिज्या है -

25. If the lines $2x+3y=6$ and $x+ay=a$ cut the coordinate axes at four concyclic points, then the value of $\frac{2}{a}$ is equal to.....

25. यदि रेखाएं 2x + 3y = 6 तथा x + ay = a चार समचक्रीय बिन्दुओं पर निर्देशी अक्षों को काटती हैं, तब $\frac{2}{a}$ का मान बराबर है _____

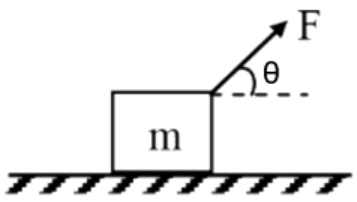
PHYSICS

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. At t = 0, a force F = kt is applied on a block of mass m making an angle θ with the horizontal. Suppose surfaces to be smooth. The velocity of the body at the moment of its breaking off the plane is -



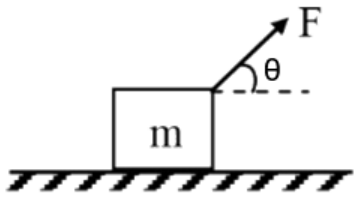
(A) $\frac{mg^2\cos\theta}{2k\sin^2\theta}$

(B) $\frac{mg\ \cos\theta}{2\,k\sin^2\theta}$

(C) $\frac{2mg^2\cos\theta}{k\sin^2\theta}$

(D) $\frac{2mg\ \cos\theta}{k\,\sin^2\theta}$

1. t = 0 पर, एक बल F = kt को क्षैतिज के साथ θ कोण बनाते हुए द्रव्यमान m के एक ब्लॉक पर लगाया जाता है। मान लीजिए कि सतह चिकनी है। समतल से अलग होने के क्षण पर पिंड का वेग है -



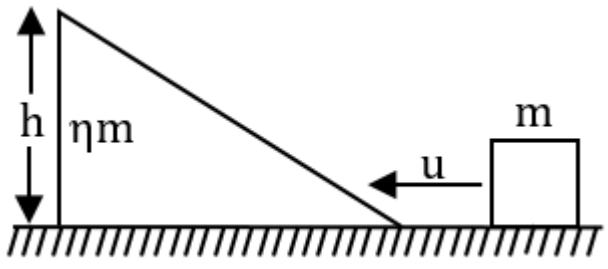
(A) $\frac{mg^2\cos\theta}{2k\sin^2\theta}$

(B) $\frac{mg\ \cos\theta}{2\,k\sin^2\theta}$

(C) $\frac{2mg^2\cos\theta}{k\sin^2\theta}$

(D) $\frac{2mg\ \cos\theta}{k\,\sin^2\theta}$

2.



A block of mass m is pushed towards a movable wedge of mass ηm and height h, with a velocity u. All surfaces are smooth. The minimum value of u for which the block will reach the top of the wedge is :-

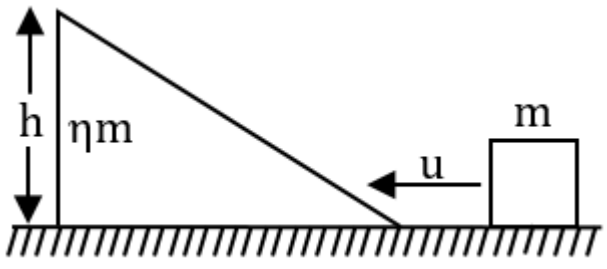
(A) $\sqrt{2\,gh}$

(B) $\eta\sqrt{2\,gh}$

(C) $\sqrt{2\,gh(1+1/\eta)}$

(D) $\sqrt{2\,gh(1-1/\eta)}$

2.



द्रव्यमान m के एक ब्लॉक को, वेग u , द्रव्यमान ηm और ऊंचाई h के एक गतिशील वेज की ओर धकेला जाता है। सभी सतहें चिकनी हैं। u का न्यूनतम मान जिसके लिए ब्लॉक वेज के शीर्ष तक पहुंचेगा, हैं -

(A) $\sqrt{2\,gh}$

(B) $\eta\sqrt{2\,gh}$

(C) $\sqrt{2\,gh(1+1/\eta)}$

(D) $\sqrt{2\,gh(1-1/\eta)}$

3. A huge circular arc of length 4.4 ly subtends an angle '4s' at the centre of the circle. How long it would take for a body to complete 4 revolution if its speed is 8AU per second ?

Given : 1 ly = 9.46×10^{15} m

1 AU = 1.5×10^{11} m

(A) 4.1×10^8 s

(B) 3.5×10^6 s

(C) 7.2×10^8 s

(D) 4.5×10^{10} s

3. 4.4 ly लम्बाई का एक विशाल वृत्ताकार चाप वृत्त के केन्द्र पर '4s' कोण अंतरित करता है। यदि किसी वस्तु की चाल 8AU प्रति सैकण्ड है, तो उसे 4 चक्कर (revolution) पूर्ण करनें में कितना समय लगेगा ?

दिया है : 1 ly = 9.46×10^{15} m

1 AU = 1.5×10^{11} m

(A) 4.1×10^8 s

(B) 3.5×10^6 s

(C) 7.2×10^8 s

(D) 4.5×10^{10} s

4. A body placed at a distance R_0 from the centre of earth, starts moving from rest. The velocity of the body on reaching at the earth's surface will be

(R_e = radius of earth and M_e = mass of earth)

(A) $GM_e\left(\frac{1}{R_e}-\frac{1}{R_0}\right)$

(B) $2GM_e\left(\frac{1}{R_e}-\frac{1}{R_e}\right)$

(C) $GM_e\sqrt{\frac{1}{R_e}-\frac{1}{R_0}}$

(D) $\sqrt{2GM_e\left(\frac{1}{R_e}-\frac{1}{R_0}\right)}$

5. A particle performing uniform circular motion has angular frequency is doubled & its kinetic energy halved, then the new angular momentum is –

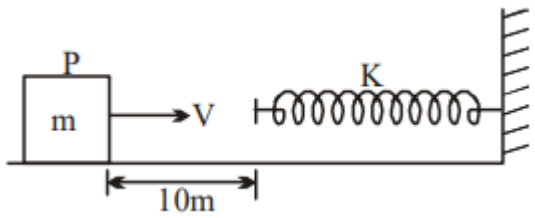
(A) $\frac{L}{4}$

(B) 2L

(C) 4L

(D) $\frac{L}{2}$

6. A block of mass 1 kg kept over a smooth surface is given velocity 2 m/s towards a spring of spring constant 1 N/m at a distance of 10 m. Find after what time block will be passing through P again



(A) $(-10-\pi)$ sec.

(B) 10 sec.

(C) $(5+\pi)$ sec.

(D) $(10+\pi)$ sec.

7. The velocity of sound in a gas at temperature $27^\circ C$ is V then in the same gas its velocity will be $3\,V$at temperature :

(A) $81^\circ C$

(B) $627^\circ C$

(C) $2427^\circ C$

(D) $82^\circ C$

4. पृथ्वी के केन्द्र से दूरी R_0 पर रखा एक पिंड विराम से चलना प्रारम्भ करता है। पृथ्वी सतह पर पहुँचने पर पिंड का वेग होगा

(R_e = पृथ्वी की त्रिज्या और M_e = पृथ्वी का द्रव्यमान)

(A) $GM_e\left(\frac{1}{R_e}-\frac{1}{R_0}\right)$

(B) $2GM_e\left(\frac{1}{R_e}-\frac{1}{R_e}\right)$

(C) $GM_e\sqrt{\frac{1}{R_e}-\frac{1}{R_0}}$

(D) $\sqrt{2GM_e\left(\frac{1}{R_e}-\frac{1}{R_0}\right)}$

5. एकसमान वृत्तीय गति करते हुए एक कण की कोणीय आवृत्ति दोगुनी कर दी जाती है और गतिज ऊर्जा आधी कर दी जाती है, तब नया कोणीय संवेग है -

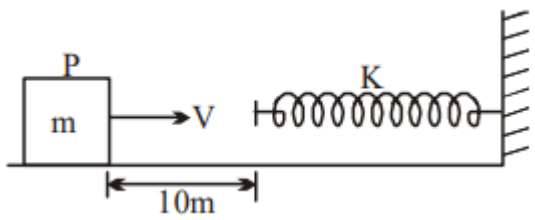
(A) $\frac{L}{4}$

(B) 2L

(C) 4L

(D) $\frac{L}{2}$

6. एक चिकनी सतह पर रखे 1 kg द्रव्यमान के एक ब्लॉक को 10 m की दूरी पर 1 N/m स्थिरांक के स्प्रिंग की ओर 2 m/s वेग दिया गया है। ज्ञात कीजिए कि कितने समय बाद ब्लॉक पुनः P से होकर गुजरेगा



(A) $(-10-\pi)$ sec.

(B) 10 sec.

(C) $(5+\pi)$ sec.

(D) $(10+\pi)$ sec.

7. $27^\circ C$ ताप पर एक गैस में ध्वनि का वेग V है तब समान गैस में इसका वेग किस ताप पर $3\,V$ होगा-

(A) $81^\circ C$

(B) $627^\circ C$

(C) $2427^\circ C$

(D) $82^\circ C$

8. A metallic sphere having a radius 0.08 m and mass m = 10 kg is heated to a temperature of 227ºC and suspended inside a body where walls are at a temperature of 27ºC. The maximum rate at which its temperature will fall is : (Take e = 1, Stefan's constant $\sigma=5.8 \times 10^{-8}$ Wm^{-2} K^{-4} and specific heat of the metals = 90 cal/kg/ºC, J = 4.2 Joules/calorie)

(A) 0.055ºC/sec

(B) 0.066ºC/sec

(C) 0.044ºC/sec

(D) 0.03ºC/sec

9. In a cyclic process, the amount of heat given to a system is equal to

(A) net increase in internal energy

(B) net work done by the system

(C) net decrease in internal energy

(D) net change in volume

10. Water flows through a horizontal pipe with cross-sectional areas A_1 = 0.04 m^2 and A_2 = 0.01 m^2. If the velocity at A_1 is 3 m/s, calculate the velocity at A_2.

(A) 9 m/s

(B) 12 m/s

(C) 3 m/s

(D) 15 m/s

11. A vessel, whose bottom has round holes with diameter of $1\ \mathrm{mm}$ is filled with water. Assuming that surface tension acts only at holes, then the maximum height to which the water can be filled in vessel without leakage is : (surface tension of water is $75 \times 10^{-3}\ \mathrm{N/m}$ and $\mathrm{g} = 10\ \mathrm{m/s^2}$)

(A) $3\ \mathrm{cm}$

(B) $0.3\ \mathrm{cm}$

(C) $3\ \mathrm{mm}$

(D) $3\ \mathrm{m}$

8. 0.08 m त्रिज्या तथा m = 10 kg द्रव्यमान के एक धात्विक गोले को 227ºC के ताप तक गर्म किया जाता है तथा इसे एक वस्तु के अन्दर लटकाया जाता है जहाँ दीवारो का ताप 27ºC है | इसका तापमान किस अधिकतम दर से गिरेगा : (e = 1, स्टीफन नियतांक $\sigma=5.8 \times 10^{-8}$ Wm^{-2} K^{-4} तथा धातु की विशिष्ट ऊष्मा = 90 cal/kg/ºC, J = 4.2 जूल/कैलोरी लीजिए)

(A) 0.055ºC/sec

(B) 0.066ºC/sec

(C) 0.044ºC/sec

(D) 0.03ºC/sec

9. एक चक्रीय प्रक्रम में, एक निकाय को दी गई ऊष्मा की मात्रा निम्न में से किसके बराबर है

(A) आंतरिक ऊर्जा में कुल वृद्धि

(B) निकाय द्वारा किया गया कुल कार्य

(C) आंतरिक ऊर्जा में कुल कमी

(D) आयतन में कुल परिवर्तन

10. पानी एक क्षैतिज पाइप से बहता है जिसका अनुप्रस्थ काट क्षेत्रफल A_1 = 0.04 m^2 और A_2 = 0.01 m^2 है। यदि A_1 पर वेग 3 m/s है, तो A_2 पर वेग की गणना करें।

(A) 9 m/s

(B) 12 m/s

(C) 3 m/s

(D) 15 m/s

11. एक बर्तन, जिसके तल में 1 मिमी व्यास वाले गोल छेद हैं, पानी से भरा हुआ है। यह मानते हुए कि पृष्ठ तनाव केवल छिद्रों पर कार्य करता है, तो अधिकतम ऊँचाई जिस तक पानी बिना रिसाव के बर्तन में भरा जा सकता है: (पानी का पृष्ठ तनाव $75 \times 10^{-3}\ \mathrm{N/m}$ और $\mathrm{g} = 10\ \mathrm{m/s^2}$ है)

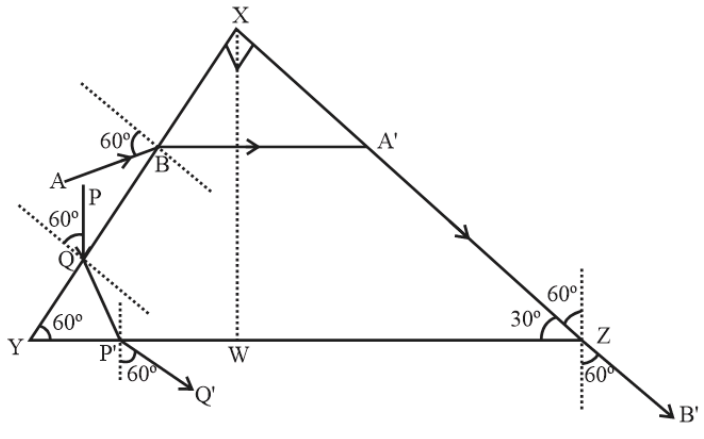
(A) $3\ \mathrm{cm}$

(B) $0.3\ \mathrm{cm}$

(C) $3\ \mathrm{mm}$

(D) $3\ \mathrm{m}$

12. The prism XYZ shown here is made up of two different materials. Section XYW is made up of material of refractive index $\sqrt{3}$, while the other section XWZ is made up of material of unknown refractive index μ Rays AB and PQ are incident on face XY of the prism as shown corresponding to AB and PQ, A′ B′ and P′ Q′ are the emergent rays. What is the value of μ for which A′ B′ is parallel to P′Q′ ?



(A) $\frac{2}{\sqrt{3}}$

(B) $\sqrt{3}$

(C) $\frac{4}{\sqrt{3}}$

(D) none of these

13. In case of a dipole, field –

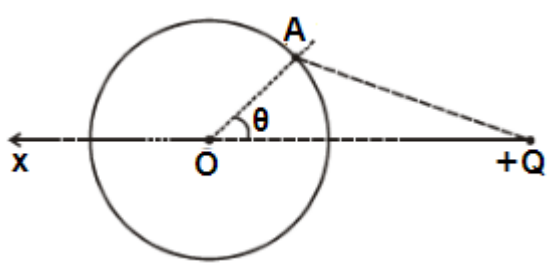
(A) Intensity can be zero

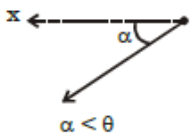
(B) Potential can be zero

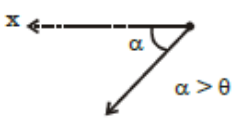
(C) Both can be zero

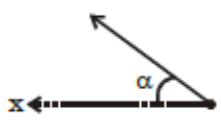
(D) None can be zero

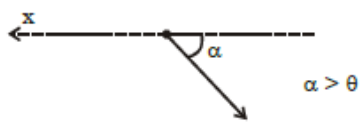
14. Consider a conducting sphere having net charge zero and a positive point charge Q is placed as shown in figure. Choose the option correctly representing the direction of electric field at point A (just outside the sphere) due to induced charges on sphere.



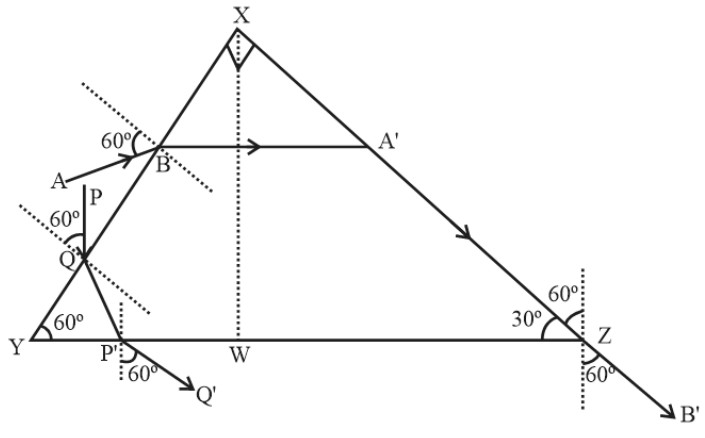
(A) 

(B) 

(C) 

(D) 

12. यहाँ दिखाया गया प्रिज्म XYZ दो अलग-अलग पदार्थों से बना है। भाग XYW अपवर्तनांक $\sqrt{3}$ के पदार्थ से बना है, जबकि दूसरा भाग XWZ अज्ञात अपवर्तनांक के पदार्थ μ से बना है। किरणें AB और PQ प्रिज्म के फलक XY पर आपतित होती हैं,जैसा कि दिखाया गया है, AB और PQ के संगत A′B′ और P′Q′ निर्गत किरणें हैं। μ का वह मान क्या है जिसके लिए A′B′, P′Q′ के समांतर है?



(A) $\frac{2}{\sqrt{3}}$

(B) $\sqrt{3}$

(C) $\frac{4}{\sqrt{3}}$

(D) इनमें से कोई नही

13. द्विध्रुव की स्थिति में, क्षेत्र -

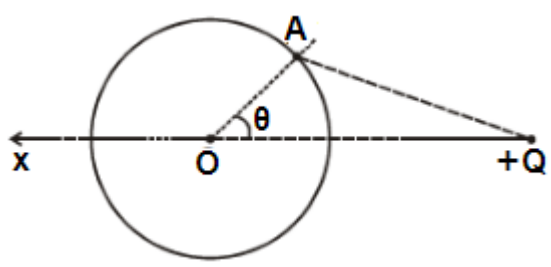
(A) तीव्रता शून्य हो सकती है

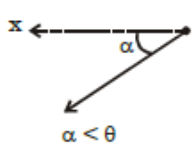
(B) विभव शून्य हो सकता है

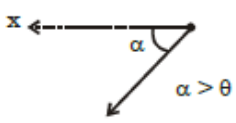
(C) दोनों शून्य हो सकते है

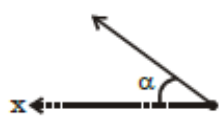
(D) कोई भी शून्य नहीं हो सकता है

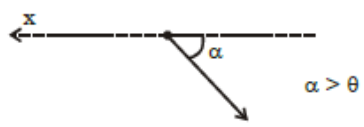
14. एक चालक गोले पर विचार करें जिसका कुल आवेश शून्य है तथा एक धनात्मक बिन्दु आवेश Q रखा गया है जैसा कि चित्र में दिखाया गया है। गोले पर प्रेरित आवेशों के कारण बिंदु A (गोले के ठीक बाहर) पर विद्युत क्षेत्र की दिशा को सही ढंग से दर्शाने वाले विकल्प का चयन करें।



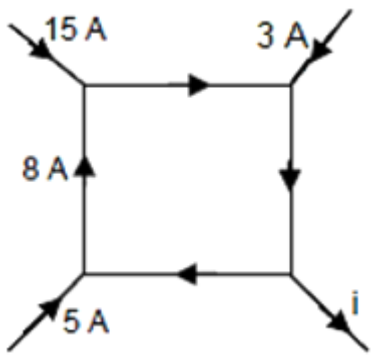
(A) 

(B) 

(C) 

(D) 

15. The figure shows a network of currents. The current i will be



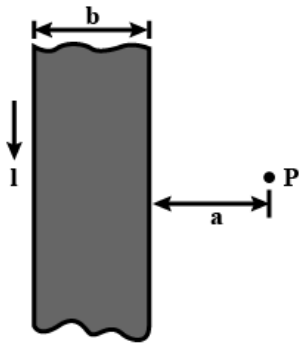
(A) 3 A

(B) 13 A

(C) 23 A

(D) –3 A

16. A very long thin strip of metal of width 'b' carries a current I along its length as shown in figure. Find the magnitude of magnetic field in the plane of the strip at a distance 'a' from the edge nearest to the point. Assume uniform distribution of current.



(A) $\frac{\mu_0}{4\pi}\frac{2I}{b}\log_e\left[1+\frac{a}{b}\right]$

(B) $\frac{\mu_0}{4\pi}\frac{2I}{a}\log_e\left[1+\frac{b}{a}\right]$

(C) $\frac{\mu_0}{4\pi}\frac{2I}{b}\log_e\left[1+\frac{b}{a}\right]$

(D) $\frac{\mu_0}{4\pi}\frac{I}{b}\log_e\left[1+\frac{a}{b}\right]$

17. An RLC series circuit is driven by a sinusoidal emf with angular frequency ω_d. If ω_d is increased without changing the amplitude of the emf, the current amplitude increases. If L is the inductance, C is the capacitance, and R is the resistance, this means that

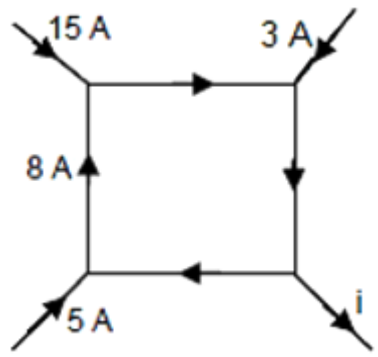
(A) $\omega_d L > \frac{1}{\omega_d C}$

(B) $\omega_d L < \frac{1}{\omega_d C}$

(C) $\omega_d L = \frac{1}{\omega_d C}$

(D) $\omega_0 L > R$

15. चित्र धाराओ के एक नेटवर्क को दर्शाता है। तब धारा i होगी



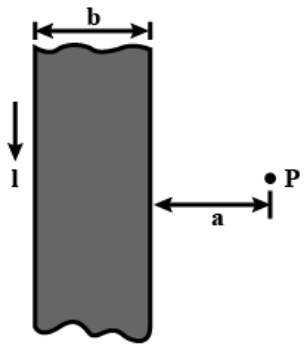
(A) 3 A

(B) 13 A

(C) 23 A

(D) –3 A

16. 'b' चौड़ाई की धातु की एक पतली लम्बी पट्टीका, जो इसकी लम्बाई के अनुदिश धारा I वहन करती है जेसा चित्र में दर्शाया गया है | पट्टीका के तल में बिन्दु के समीपतम किनारे (edge) से 'a' दूरी पर चुम्बकीय क्षेत्र का परिमाण ज्ञात करो ? माना की धारा का वितरण एकसमान है |



(A) $\frac{\mu_0}{4\pi}\frac{2I}{b}\log_e\left[1+\frac{a}{b}\right]$

(B) $\frac{\mu_0}{4\pi}\frac{2I}{a}\log_e\left[1+\frac{b}{a}\right]$

(C) $\frac{\mu_0}{4\pi}\frac{2I}{b}\log_e\left[1+\frac{b}{a}\right]$

(D) $\frac{\mu_0}{4\pi}\frac{I}{b}\log_e\left[1+\frac{a}{b}\right]$

17. एक RLC श्रेणी परिपथ, कोणीय आवृत्ति ω_d के साथ एक ज्या वक्रीय विद्युत वाहक बल द्वारा संचालित होता है। यदि विद्युत वाहक बल के परिमाण को बिना परिवर्तित किये ω_d को बढ़ाया जाता है, तो धारा का परिमाण बढ़ जाता है। यदि L प्रेरकत्व है, C धारिता है, और R प्रतिरोध है, तो इसका अर्थ है कि -

(A) $\omega_d L > \frac{1}{\omega_d C}$

(B) $\omega_d L < \frac{1}{\omega_d C}$

(C) $\omega_d L = \frac{1}{\omega_d C}$

(D) $\omega_0 L > R$

18. Determine the wavelength of the radiation required to excite the electron in L i^{++} from the first to the third Bohr orbit.

(A) 12. 4 nm

(B) 11. 4 nm

(C) 10. 4 nm

(D) 13. 4 nm

19. Activity of a radioactive substance is $\mathrm{R_1}$ at time $\mathrm{t_1}$ and $\mathrm{R_2}$ at time $\mathrm{t_2}(\mathrm{t_2} > \mathrm{t_1})$. Then the ratio $\frac{\mathrm{R_2}}{\mathrm{R_1}}$ is :

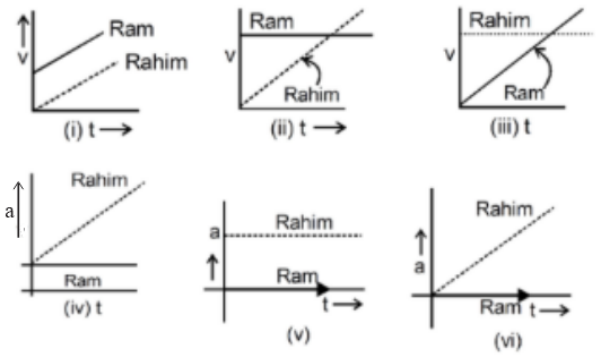
(A) $\frac{\mathrm{t_2}}{\mathrm{t_1}}$

(B) $\mathrm{e}^{-\lambda(\mathrm{t_1}+\mathrm{t_2})}$

(C) $\mathrm{e}\left(\frac{\mathrm{t_1}-\mathrm{t_2}}{\lambda}\right)$

(D) $\mathrm{e}^{\lambda(\mathrm{t_1}-\mathrm{t_2})}$

20. The velocity-time graph as well as the acceleration-time graph of Ram and Rahim are respectively.



(A) (i) and (iv)

(B) (ii) and (iv)

(C) (ii) and (v)

(D) (i) and (vi)

18. प्रथम से तृतीय बोहर कक्षा तक Li^{++} में इलेक्ट्रॉन को उत्तेजित करने के लिए आवश्यक विकिरण की तरंगदैर्ध्य ज्ञात करें।

(A) 12. 4 nm

(B) 11. 4 nm

(C) 10. 4 nm

(D) 13. 4 nm

19. समय t_1 पर एक रेडिओएक्टिव पदार्थ की सक्रियता R_1 है तथा समय $t_2\,(t_2 > t_1)$ पर R_2 है, तब अनुपात $\frac{R_2}{R_1}$ का क्या मान होगा |

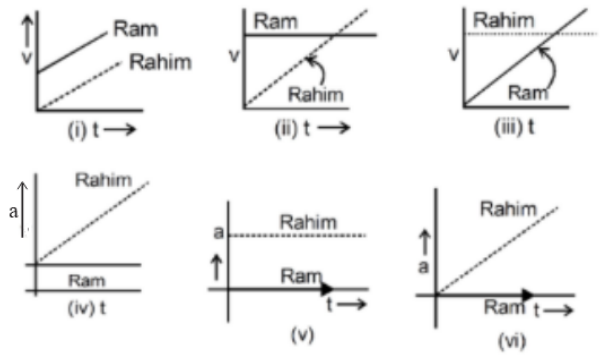
(A) $\frac{t_2}{t_1}$

(B) $e^{-\lambda(t_1+t_2)}$

(C) $e\left(\frac{t_1-t_2}{\lambda}\right)$

(D) $e^{\lambda(t_1-t_2)}$

20. राम और रहीम के लिए वेग - समय ग्राफ और त्वरण - समय ग्राफ क्रमशः होंगे -



(A) (i) और (iv)

(B) (ii) और (iv)

(C) (ii) और (v)

(D) (i) और (vi)

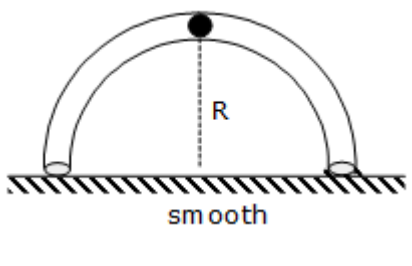
PHYSICS

SECTION - B

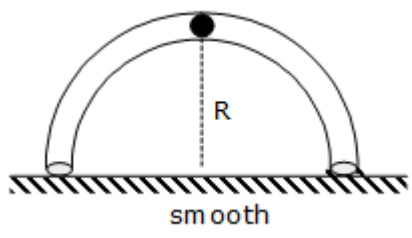
[NUMERIC VALUE TYPE]

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

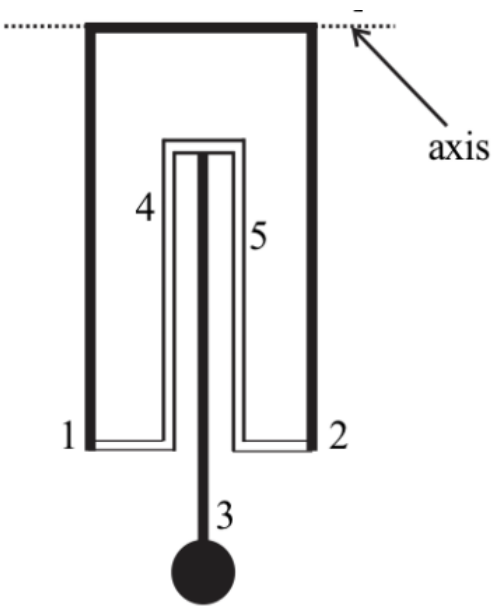
21. A smooth narrow semicircular tube (in vertical plane) contains a small ball of mass m at its top as shown. System is initially at rest and now ball is slightly pushed to its right such that system starts moving. If the acceleration of the tube just before the ball hits the floor is $\left[\frac{4g}{\eta}\right]$, find η. (Take mass of tube = 2 m and neglect the break-off of the tube from floor)



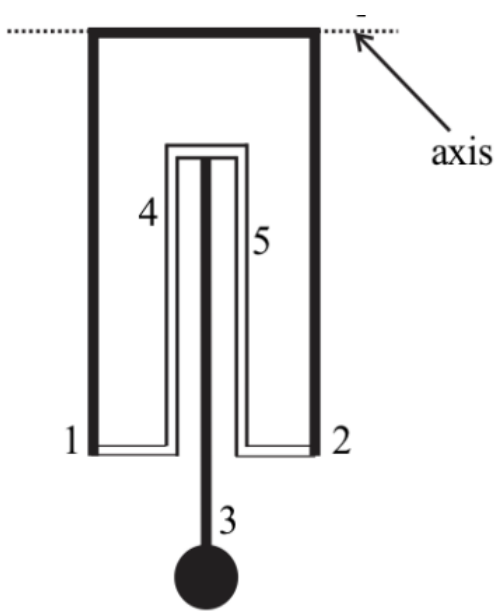
21. एक चिकनी संकीर्ण अर्धवृत्ताकार नली (ऊर्ध्वाधर तल में) के शीर्ष पर द्रव्यमान m की एक छोटी गेंद है जैसा कि दिखाया गया है। निकाय प्रारंभ में विराम पर है और अब गेंद को थोडा सा इसके दाईं ओर इस प्रकार धकेला जाता है की निकाय चलना प्रारंभ कर देती है। यदि गेंद के फर्श से टकराने से ठीक पहले नली का त्वरण $\left[\frac{4g}{\eta}\right]$ है, तो η ज्ञात करो । (नली का द्रव्यमान = 2 m लें और नली के फर्श से टूटने की उपेक्षा करें)



22. Pendulum of a clock consists of very thin sticks of iron and an alloy. At room temperature the iron sticks 1 and 2 have length L_0 each. Length of each of the two alloy sticks 4 and 5 is ℓ_0 and the length of iron stick 3 (measured up to the centre of the iron bob) is λ_0. Thickness of connecting strips are negligible and mass of everything except the bob is negligible. The pendulum oscillates about the horizontal axis shown in the figure. It is desired that the time period of the pendulum should not change even if temperature of the room change. The coefficient of linear expansion (α) of the alloy if the coefficient of linear expansion for iron is α_0, is $x\alpha_0$. Find x. [GivenL $L_0 = 3\ell_0$, $\lambda_0=2\ell_0$]



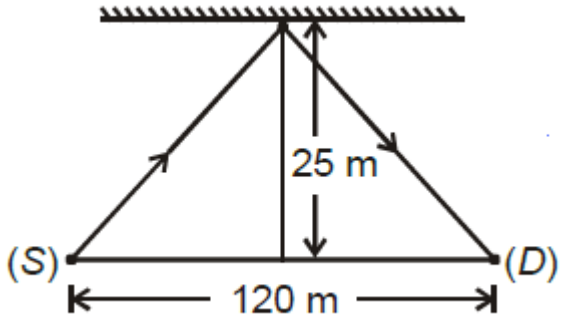
22. एक घड़ी के लोलक में लोहे और एक मिश्र धातु की बहुत पतली छड़ें हैं। कमरे के तापमान पर लोहे की छड़ें 1 और 2, प्रत्येक की लंबाई L_0 है। मिश्र धातु की दो छड़ें 4 और 5 में से प्रत्येक की लंबाई ℓ_0है और लोहे की छड़ 3 की लंबाई (लोहे के गोलक के केंद्र तक मापी गई) λ_0 है। जोड़ने वाली पट्टियों की मोटाई नगण्य है और गोलक को छोड़कर प्रत्येक का द्रव्यमान नगण्य है। लोलक चित्र में दिखाए अनुसार क्षैतिज अक्ष के परितः दोलन करता है। यह अपेक्षित है कि कमरे का तापमान बदलने पर भी लोलक का आवर्तकाल नहीं बदलना चाहिए। यदि लोहे के लिए रैखिक प्रसार गुणांक α_0 है, तो मिश्रधातु का रैखिक प्रसार गुणांक (α) का मान $x\alpha_0$ है। x ज्ञात करें। [दिया गया है $L_0 = 3\ell_0$, $\lambda_0=2\ell_0$]



23. A parallelepiped has length 'a', breadth '2a' and height '3a'. Length a is measured and measured value is (2 ± 0.02) cm. The maximum percentage error in the measurement of its value is -

23. एक समानांतर षट्फलक की लंबाई 'a', चौड़ाई '2a' और ऊँचाई '3a' है। लंबाई a को मापा गया है और मापित मान (2 ± 0.02) सेमी है। इसके मान के मापन में अधिकतम प्रतिशत त्रुटि है -

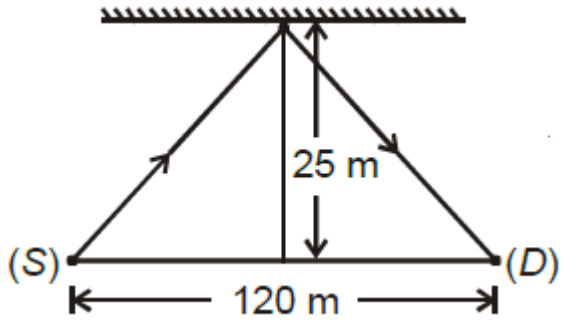
24. In a hall a detector (D) receives sound waves one directly from the source (S) and the other from the reflection from the $25\ \mathrm{m}$ high ceiling. The maximum wavelength for which there is minima at position of detector, is _____ m



25. Dimensional formula of inductance (L) is given by $[ML^2T^{-x}A^{-2}]$. Find x.

Given : Inductance (L) = $\frac{2\times\text{energy}}{(\text{current})^2}$

24. एक हॉल में एक संसूचक (D) ध्वनि तरंगों को सीधे स्रोत (S) से और दूसरी $25\ \mathrm{m}$ ऊंची छत से परावर्तन से प्राप्त करता है। अधिकतम तरंगदैर्घ्य जिसके लिए संसूचक की स्थिति पर निम्निष्ठ है , _____ m है -



25. प्रेरकत्व (L) का विमीय सूत्र $[ML^2T^{-x}A^{-2}]$ द्वारा दिया गया है। x ज्ञात करें।

दिया गया है: प्रेरकत्व (L) = $\frac{2\times\text{ऊर्जा}}{(\text{धारा})^2}$

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. Identify the compound that will react with Hinsberg's reagent to give a solid which dissolves in alkali.

(A) $CH_3–CH_2–NO_2$

(B) $CH_3–CH_2–NH–CH_3$

(C) $CH_3–CH_2–NH_2$

(D) $CH_3–CH_2–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{N}}–CH_2–CH_3$

2. Which of the following statements is correct ?

(A) Ionisation energy of A^- is greater than A when A is a halogen atom.

(B) Ionisation energy of A^+ is greater than that of A^{2+} when A is the member of alkali metals.

(C) Successive ionisation energy is always increasing for 1^{st} and 2^{nd} period element.

(D) Electron affinity value of 'A^+' is numerically identical with the ionisation potential of A^- [for any atom].

3. The minimum mass of mixture of A_2 and B_4 required to produce at least 1 kg of each product is :

(Given At. mass of `A\' = 10;

At mass of `B\' = 120)

$5A_2 + 2B_4 \rightarrow 2AB_2 + 4A_2B$

(A) 2120 gm

(B) 1060 gm

(C) 560 gm

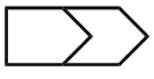
(D) 1660 gm

4. A compound with molecular formula C_8H_{14}, contains 12 secondary and two tertiary H atoms. The compound is not:

(A)

(B)

(C)

(D) 

1. उस यौगिक को पहचानिये जो हिन्सबर्ग अभिकर्मक के साथ क्रिया करके एक ठोस देता है जो क्षार मे घुल जाता है

(A) $CH_3–CH_2–NO_2$

(B) $CH_3–CH_2–NH–CH_3$

(C) $CH_3–CH_2–NH_2$

(D) $CH_3–CH_2–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{N}}–CH_2–CH_3$

2. निम्न में से कौनसा कथन सही है

(A) A^- की आयनन ऊर्जा A से अधिक है जब A एक हेलोजन परमाणु है

(B) A^+ की आयनन ऊर्जा A^{2+} से अधिक है जब A क्षार धातुओ का सदस्य है

(C) क्रमागत आयनन ऊर्जा 1^{st} तथा 2^{nd} आवर्त तत्व के लिये हमेशा बढ़ती है

(D) 'A^+' की इलेक्ट्रॉन बंधुता मान संख्यात्मक रूप से [किसी भी परमाणु के लिये] A^- के आयनन विभव के समान होता है

3. प्रत्येक उत्पाद के लगभग 1 kg को उत्पन्न करने के लिए A_2 औऱ B_2 के कितने न्युनतम मिश्रण की आवश्यकता होंगी | (दिया है परमाणु भार 'A' का = 10; परमाणु भार 'B' का = 120)

$5A_2 + 2B_4 \rightarrow 2AB_2 + 4A_2B$

(A) 2120 gm

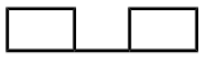
(B) 1060 gm

(C) 560 gm

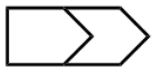
(D) 1660 gm

4. एक यौगिक जिसका अणुसूत्र C_8H_{14} है , 12 द्वितीयक तथा 2 तृतीयक H परमाणु रखता है | यौगिक नही है :

(A)

(B) 

(C)

(D) 

5. **Assertion :** Anhydrous $AlCl_3$ is more soluble in diethyl ether than hydrous $AlCl_3$.
Reason : Anhydrous $AlCl_3$ is electron deficient and acts as Lewis acid.

(A) Both Assertion and Reason are correct and Reason is correct for the Assertion.

(B) Both Assertion and Reason are correct but Reason is not correct for Assertion

(C) Assertion is correct but Reason is incorrect.

(D) Assertion is incorrect but Reason is correct.

6. The correct order of increasing energy of atomic orbitals is :

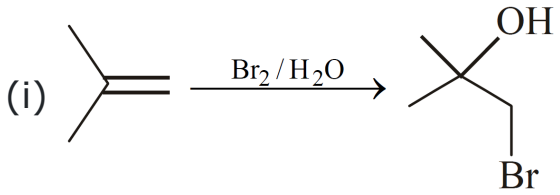
(A) $5p < 4f < 6s < 5d$

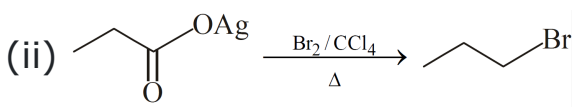
(B) $5p < 6s < 4f < 5d$

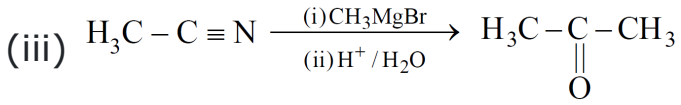
(C) $5p < 5d < 4f < 6s$

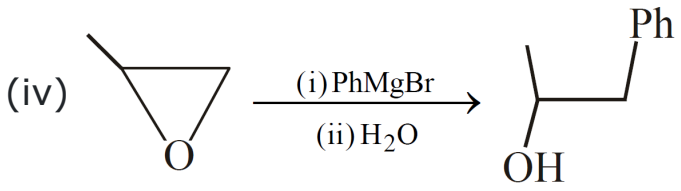
(D) none of these

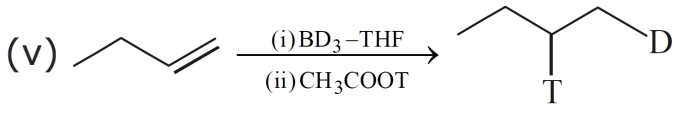
7. Write number of reactions which produce correct mentioned product as major product.

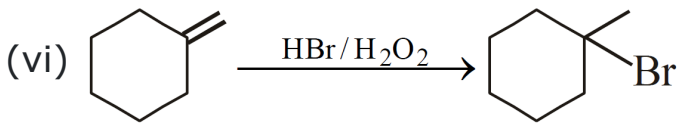
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(A) 3

(B) 4

(C) 5

(D) 6

8. Which of the following species have maximum number of unpaired electrons

(A) O_2

(B) O_2^+

(C) O_2^-

(D) O_2^{2-}

5. **कथन :** निर्जलीय $AlCl_3$, जलीय $AlCl_3$ की तुलना में डाईऐथिल ईथर में अधिक विलेय है
कारण : निर्जलीय $AlCl_3$ इलेक्ट्रॉन न्यून है तथा लुईस अम्ल के रूप में कार्य करता है

(A) दोनो कथन तथा कारण सही है तथा कारण, कथन की सही व्याख्या है

(B) दोनो कथन तथा कारण सही है तथा कारण, कथन की सही व्याख्या नही है

(C) कथन सही है परन्तू कारण गलत है

(D) कथन गलत है परन्तू कारण सही है

6. परमाणु कक्षको की बढ़ती ऊर्जा का सही क्रम है:

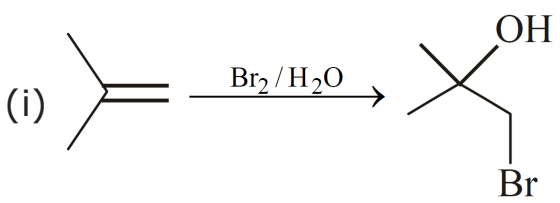
(A) $5p < 4f < 6s < 5d$

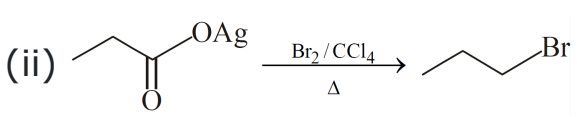
(B) $5p < 6s < 4f < 5d$

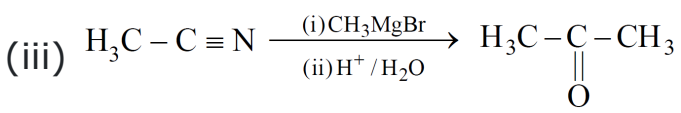
(C) $5p < 5d < 4f < 6s$

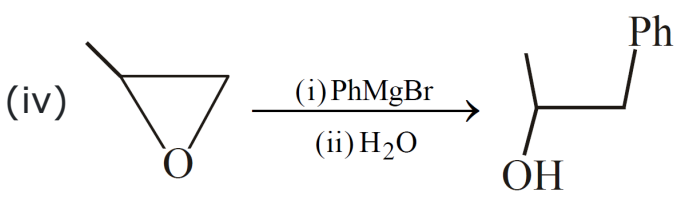
(D) इनमें से कोई नहीं

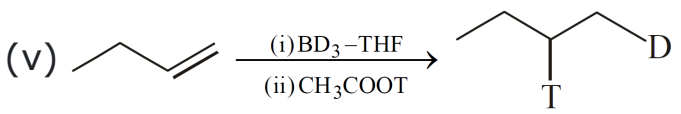
7. उन अभिक्रियाओं की संख्या लिखिये जो मुख्य उत्पाद के रूप में सही उत्पाद को दर्शाता है।

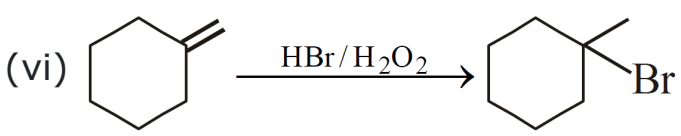
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(A) 3

(B) 4

(C) 5

(D) 6

8. निम्नलिखित में से कौन अयुग्मित इलेक्ट्रॉनों की अधिकतम संख्या रखता है

(A) O_2

(B) O_2^+

(C) O_2^-

(D) O_2^{2-}

9. The mole fraction of $CCl_4(g)$ In the vapour in equilibrium with liquid mixture of CCl_4 and $SiCl_4$ is 0.3474. The vapour pressure of $SiCl_4$, and CCl_4 is 238.3 and 114.9 mm. respectively, at the same temperature. Calculate % by weight of CCl_4 in liquid mixture.

(A) 50 %

(B) 40 %

(C) 30 %

(D) 60 %

10. Which of the following compound is not formed in haloform reaction?

(A) CHF_3

(B) $CHCl_3$

(C) CHI_3

(D) $CHBr_3$

11. The correct name of $[Pt(NH_3)_4Cl_2]$ $[PtCl_4]$ is –

(A) Tetraammine dichloro platinum (IV) tetrachloroplatinate (II)

(B) Dichloro tetra ammine platinium (IV) tetrachloro platinate (II)

(C) Tetrachloro platinum (II) tetraammine platinate (IV)

(D) Tetrachloro platinum (II) dichloro tetraamine platinate (IV)

12. For the reaction $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, K_p = 1.642 atm at 727ºC. If 4 moles of $CaCO_3(s)$ was put into a 50 litre container and heated to 727ºC. What mole percent of the $CaCO_3$ remains unreacted at equilibrium?

(A) 20

(B) 25

(C) 50

(D) 75

9. CCl_4 और $SiCl_4$ के द्रव मिश्रण के साथ साम्य में वाष्प में $CCl_4(g)$ का मोल प्रभाव 0.3474 है। उसी ताप पर $SiCl_4$ और CCl_4 का वाष्प दाब क्रमशः 238.3 और 114.9 mm है। द्रव मिश्रण में CCl_4 की % भार द्वारा गणना करें।

(A) 50 %

(B) 40 %

(C) 30 %

(D) 60 %

10. निम्न मे से कौनसा यौगिक हैलोफॉर्म अभिक्रिया में निर्मित नही होता है

(A) CHF_3

(B) $CHCl_3$

(C) CHI_3

(D) $CHBr_3$

11. $[Pt(NH_3)_4Cl_2]$ $[PtCl_4]$ का सही नाम होगा -

(A) टेट्राएम्मीन डाईक्लोरो प्लेटिनम (IV) टेट्राक्लोरो प्लेटिनेट (II)

(B) डाईक्लोरो टेट्राएम्मीन प्लेटिनम (IV) टेट्राक्लोरो प्लेटिनेट (II)

(C) टेट्राक्लोरो प्लेटिनम (II) टेट्राएम्मीन प्लेटिनेट (IV)

(D) टेट्राक्लोरो प्लेटिनम (II) डाईक्लोरो टेट्राएम्मीन प्लेटिनेट (IV)

12. अभिक्रिया $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, के लिए, 727ºC पर K_p = 1.642 atm है। यदि 4 मोल $CaCO_3(s)$ को 50 लीटर पात्र में लिया जाता है तथा 727ºC तक गर्म किया जाता है। साम्य पर शेष अनअभिकृत $CaCO_3$ का मोल प्रतिशत क्या है?

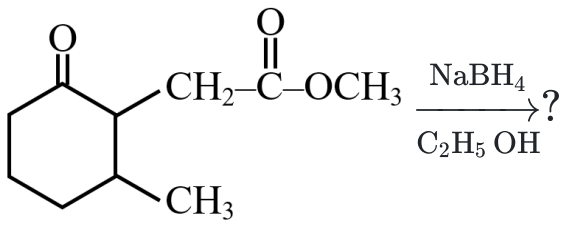
(A) 20

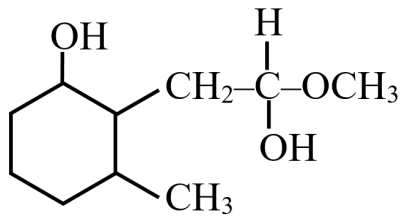
(B) 25

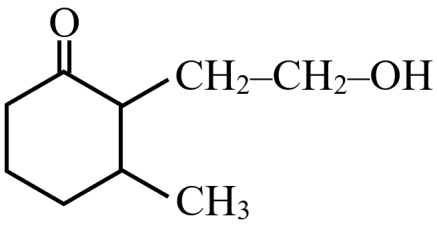
(C) 50

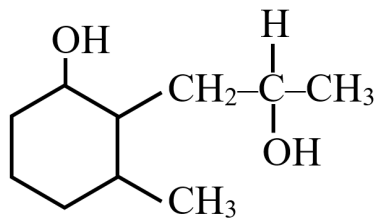
(D) 75

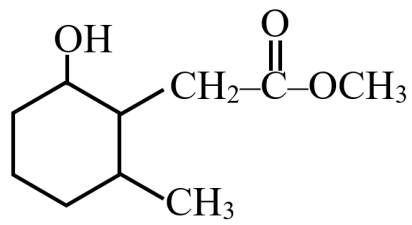
13. The product formed in the following chemical reaction is :



(A) 

(B) 

(C) 

(D) 

14. Which of the following metal do not forms interstitial hydride :-

(A) Ti

(B) Fe

(C) Cr

(D) Zn

15. The heats of neutralization four acids A, B, C and D when neutralised against a common base are 13.7, 9.4, 11.2 and 12.4 kcal, respectively. The weakest among these acids is

(A) A

(B) B

(C) C

(D) D

16. $RCH_2OH \xrightarrow{KMnO_4 / OH^-} P$. What is the compound P?

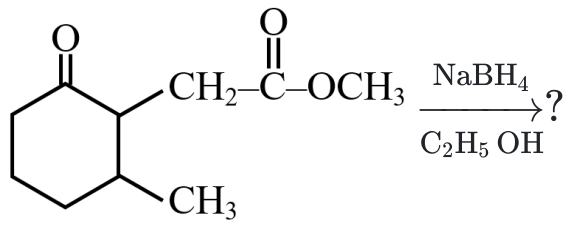
(A) RCOOH

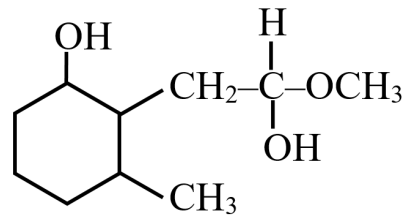
(B) RCHO

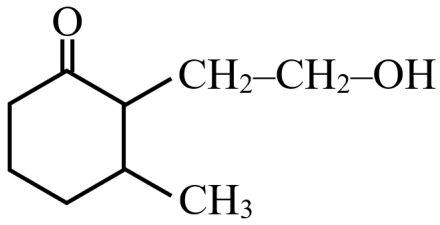
(C) RCH_2OH

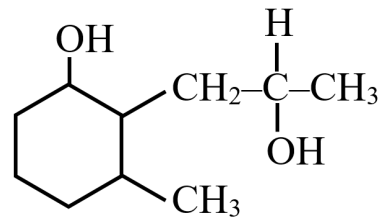
(D) None of these

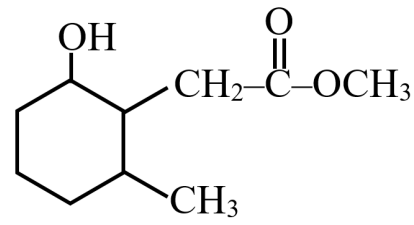
13. निम्न रसायनिक अभिक्रिया मे निर्मित उत्पाद है



(A) 

(B) 

(C) 

(D) 

14. निम्न में से कौनसी धातु अन्तराकाशी हाइड्राइड नहीं बनाती :-

(A) Ti

(B) Fe

(C) Cr

(D) Zn

15. चार अम्ल A, B, C तथा D की किसी क्षार के साथ उदासीनीकरण ऊष्मा का मान क्रमशः 13.7, 9.4, 11.2 तथा 12.4 kcal है इन अम्लो में दुर्बलतम अम्ल है

(A) A

(B) B

(C) C

(D) D

16. $RCH_2OH \xrightarrow{KMnO_4 / OH^-} P$.

यौगिक P क्या है ?

(A) RCOOH

(B) RCHO

(C) RCH_2OH

(D) इनमे से कोई नहीं

17. The outer electron configuration of Gd(atomic No. 64) is $[Xe]4f^x5d^y6s^z$. The value of x + y + z is:

(A) 7

(B) 8

(C) 9

(D) 10

18. If equal volume of reactants are used, then no. moles of $KMnO_4$ used in acidic medium required to completely oxidises the 0.5 mole $FeSO_3$?

(A) 0.3

(B) 0.1

(C) 0.2

(D) 0.4

19. A compound 'A' transform by two parallel first order paths

$$A\left(g\right) \xrightarrow{k_1\left(\text{min}^{-1}\right)} 2\,B\left(g\right)$$

$$k_1 = 6.93 \times 10^{-3}\ \text{min}^{-1}$$

$$A\left(g\right) \xrightarrow{k_2\left(\text{min}^{-1}\right)} C\left(g\right)$$

$$k_2 = 6.93 \times 10^{-3}\ \text{min}^{-1}$$

If reaction started with pure 'A' with conc. 0.1 mol/L in a closed container with initial pressure 2 atm. What is the pressure (in atm) developed in container after 50 minutes from start of experiment.

(A) 1.25

(B) 0.75

(C) 1.50

(D) 2.50

17. Gd(परमाणु संख्या 64) का बाह्यतम इलेक्ट्रॉनिक विन्यास $[Xe]4f^x5d^y6s^z$ है | x + y + z का मान है:

(A) 7

(B) 8

(C) 9

(D) 10

18. यदि क्रियाकारको का समान आयतन प्रयुक्त किया जाता है तो 0.5 मोल $FeSO_3$ को पूर्ण रूप से ऑक्सीकृत करने के लिये अम्लीय माध्यम मे प्रयुक्त आवश्यक $KMnO_4$ के मोलो की संख्या होगी

(A) 0.3

(B) 0.1

(C) 0.2

(D) 0.4

19. एक यौगिक दो समान्तर प्रथम कोटि पथों के द्वारा रूपान्तरित होता है

$$A\left(g\right) \xrightarrow{k_1\left(\text{min}^{-1}\right)} 2\,B\left(g\right)$$

$$k_1 = 6.93 \times 10^{-3}\ \text{min}^{-1}$$

$$A\left(g\right) \xrightarrow{k_2\left(\text{min}^{-1}\right)} C\left(g\right)$$

$$k_2 = 6.93 \times 10^{-3}\ \text{min}^{-1}$$

यदि अभिक्रिया प्रारम्भिक दाब 2 atm के साथ एक बंद पात्र में 0.1 mol/L सान्द्रता वाले शुद्ध 'A' से प्रारम्भ होती है। प्रयोग के प्रारम्भ में 50 मिनट बाद पात्र में उत्पन्न दाब (atm में) क्या होगा

(A) 1.25

(B) 0.75

(C) 1.50

(D) 2.50

20. Match the order of reaction (in List I) with its property (in List II) :

	List I (order of reaction)		**List II (Property)**
(A)	Zeroth	(p)	Half life $\propto \frac{1}{a^2}$
(B)	First	(q)	Half life $\propto \frac{1}{a}$
(C)	Second	(r)	Half life is doubled on doubling the initial concentration.
(D)	Third	(s)	50% reaction takes same time even if con - centration is halved or doubled.

(A) (A)$\rightarrow$(r); (B)$\rightarrow$(s); (C)$\rightarrow$(q); (D)$\rightarrow$(p)

(B) (A)$\rightarrow$(s); (B)$\rightarrow$(q); (C)$\rightarrow$(p); (D)$\rightarrow$(r)

(C) (A)$\rightarrow$(q); (B)$\rightarrow$(p); (C)$\rightarrow$(r); (D)$\rightarrow$(s)

(D) (A)$\rightarrow$(p); (B)$\rightarrow$(q); (C)$\rightarrow$(r); (D)$\rightarrow$(s)

20. अभिक्रिया की कोटि (सूची I में) को उनके गुणों (सूची II में) के साथ सुमेलित कीजिये :

	सूची I (कोटि)		**सूची II (गुण)**
(A)	शून्य	(p)	अर्द्ध आयु $\propto \frac{1}{a^2}$
(B)	प्रथम	(q)	अर्द्ध आयु $\propto \frac{1}{a}$
(C)	द्वितीय	(r)	प्रारम्भिक सांद्रता दुगनी करने पर अर्द्ध आयु दुगनी हो जाती है ।
(D)	तृतीय	(s)	सांद्रता को दुगना अथवा आधा कर देने पर भी अभिक्रिया की 50% पूर्णता के लिए समान समय लगता है ।

(A) (A)$\rightarrow$(r); (B)$\rightarrow$(s); (C)$\rightarrow$(q); (D)$\rightarrow$(p)

(B) (A)$\rightarrow$(s); (B)$\rightarrow$(q); (C)$\rightarrow$(p); (D)$\rightarrow$(r)

(C) (A)$\rightarrow$(q); (B)$\rightarrow$(p); (C)$\rightarrow$(r); (D)$\rightarrow$(s)

(D) (A)$\rightarrow$(p); (B)$\rightarrow$(q); (C)$\rightarrow$(r); (D)$\rightarrow$(s)

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. Sucralose is chloro-derivative of sucrose. How many chlorine-atom is/are present in a molecule of sucralose ?

22. How many elements are possible for the I^{st} period of periodic table if azimuthal quantum number can have integral values from 0 to (n + 1). [n = shell number & other rules are remaning same to form periodic table.

23. Find the total No. of linkage isomers of $K_3[Fe(CN)_3(NO_2)_3]$

24. 10 ml of $\frac{M}{200}H_2SO_4$ is mixed with 40 ml of $\frac{M}{200}H_2SO_4$. The pH of the resulting solution is

25. At $407\ K$ the rate constant of a chemical reaction is $9.5 \times 10^{-5}\ s^{-1}$ and at $420\ K$, the rate constant is $1.9 \times 10^{-4}\ s^{-1}$. The frequency factor of the reaction is $x \times 10^5\ s^{-1}$.The value of $'x'$ is. Report your answer by rounding it up to nearest whole number.

21. सुक्रालोस, सुक्रोस का क्लोरो व्युत्पन्न है | सुक्रालोस के एक अणु में कितने क्लोरीन परमाणु उपस्थित होते है ?

22. आवर्त सारणी के प्रथम आवर्त के लिए कितने तत्व संभव हैं यदि द्विगंशी क्वाण्टम संख्या में 0 से (n + 1) तक अभिन्न मान हो सकते हैं। [n = कोश संख्या और अन्य नियम आवर्त सारणी बनाने के लिए समान हैं]

23. $K_3[Fe(CN)_3(NO_2)_3]$ के बंधनी समावयवी की कुल संख्या ज्ञात कीजिए |

24. 10 ml, $\frac{M}{200}H_2SO_4$ को 40 ml, $\frac{M}{200}H_2SO_4$ के साथ मिलाया जाता है, बनने वाले विलयन की pH क्या होगी ?

25. $407\ K$ पर एक रासायनिक अभिक्रिया का वेग स्थिरांक $9.5 \times 10^{-5}\ s^{-1}$ है और $420\ K$ पर वेग स्थिरांक $1.9 \times 10^{-4}\ s^{-1}$ है। अभिक्रिया का आवृत्ति गुणांक $x \times 10^5\ s^{-1}$ है। 'x' का मान निकटतम पूर्णांक संख्या तक लिखें।

Maths - Section A

1. Answer: C

Sol:

$p = \frac{a+b}{2}$ $q = \frac{b+c}{2}$ $2b = a + c$

$p' = \sqrt{ab}$ $q' = \sqrt{bc}$ $p^2 = \left(\frac{a+b}{2}\right)^2$

$(p')^2 = ab$ $(q')^2 = bc$ $q^2 = \left(\frac{b+c}{2}\right)^2$

$\Rightarrow p^2 - q^2 = \frac{\left(a^2-c^2\right)+2b\left(a-c\right)}{4}$

$p^2 - q^2 = \frac{\left(a^2-c^2\right)+\left(a^2-c^2\right)}{4} = \frac{a^2-c^2}{2}$

$p'^2 - q'^2 = ab - bc = b(a - c)$

$= \frac{a+c}{2}(a - c) = \frac{a^2-c^2}{2}$

$\Rightarrow p^2 - q^2 = p'^2 - q'^2$

2. Answer: D

Sol:

$\because 0 \le | \alpha - \beta | \le k$

$\Rightarrow 0 \le (\alpha - \beta)^2 \le k^2$

$\Rightarrow 0 \le (\alpha + \beta)^2 - 4 \alpha \beta \le k^2$

$\Rightarrow 0 \le k^2 - 4 \quad \le k^2$

$\Rightarrow - k^2 \le - b \le 0$

$\Rightarrow 0 \le b \le k^2$]

Therefore, the correct answer is (D)

3. Answer: A

Sol:

R= $\left(5\sqrt{5}+11\right)^{2n+1}$, f = R - [R]

f_1= $\left(5\sqrt{5}-11\right)^{2n+1}$

$0<5\sqrt{5}-11<1$

$0\left(5\sqrt{5}+11\right)^{2n+1}-\left(5\sqrt{5}-11\right)^{2n+1}$

$= 2[{}^{2n+1}C_1\left(5\sqrt{5}\right)^{2n}-(11)+{}^{2n+1}C_3\left(5\sqrt{5}\right)^{2n-2}(11)^3+.....+{}^{2n+1}C_{2n+1}(11)^{2n+1}]$

[R]+f-f_1 = even= f-f_1 = integer

0 f-f_1= 0

$Rf = Rf_1 = \left[5\sqrt{5}+11\right]^{2n+1}\left[5\sqrt{5}-11\right]^{2n+1}$

$= [125\text{-}121]^{2n+1}$

$= 4^{2n+1}$

Therefore, the correct answer is (A)

4. Answer: B

Sol:

$\log y=\lim_{n\to\infty}\frac{1}{n}\sum_{r=1}^{n}\left(\frac{r}{n}\log\left(1+\frac{n}{r}\right)\right)$

$\log y=\int_0^1 x\ \ln\left(1+\frac{1}{x}\right)dx$

$\log y=\frac{1}{2}$

$y=\sqrt{e}$

5. Answer: C

Sol:

$\because \bar{x}=\frac{\sum x}{n}\Rightarrow \sum x=n\bar{x}=10.10=100$

Actual $\bar{x}=\frac{100-8+18}{10}=11$

$\therefore\ \sigma^2=\frac{\sum x_i^2}{n}-\left(\frac{\sum x_i}{n}\right)^2=4\Rightarrow\ \frac{\sum x^2}{10}-(10)^2=4$

$\Rightarrow \sum x^2=1040$

Actual $\sigma^2=\frac{1040-64+324}{10}-11^2=130-121=9$

Therefore the correct answer is (C).

6. **Answer:** B

Sol:

For n = − (ℓ + m), the second relation gives

$al^2 + bm^2 + c(\ell + m)^2 = 0$

or $(a + c)\, l^2 + 2clm + (b + c)\, m^2 = 0$. {Quad. in *l*)

For parallel lines, the two roots must be equal

$\Rightarrow D = 0$

$\Rightarrow 4c^2 - 4(b + c)(a + c) = 0$

$\Rightarrow ab + bc + ca = 0$

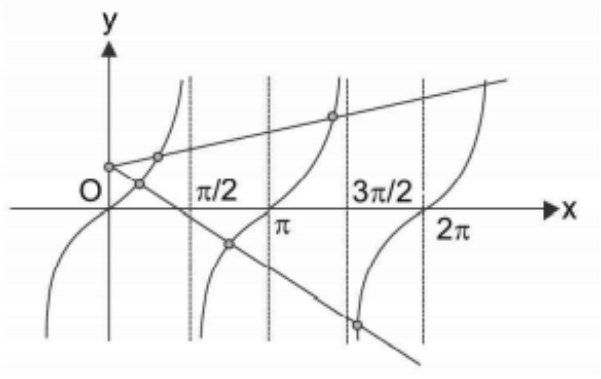
Therefore, the correct answer is (B)

7. **Answer:** B

Sol:

We have $x+2\tan x = \pi/2$ and $2\tan x - x = \pi/2$

$\Rightarrow \tan x = \pi/4 - x/2$ and $\tan x = \pi/4 + x/2$



Now the graphs of the curve $y = \tan x$ and $y = \pi/4 - x/2$ in the interval $[0, 2\pi]$ intersect at three points while $y = \tan x$ and $y = \pi/4 + x/2$ intersect at two points. The abscissa of these points are the roots of the corresponding equation. So the required ratio is 3/2.

Therefore the correct answer is (B).

8. **Answer:** B

Sol:

Let (log2)(2 log 2 + log x) = (log 3)(2 log3 + log x)

$(\log 2 - \log 3)\log x = 2(\log^2 3 - \log^2 2)$

$\log x = -2(\log 3 + \log 2) = \log 6^{-2}$

$\therefore x = \frac{1}{36}$

Also y = 3.

Hence, $y + \frac{1}{x} = 3 + 36 = 39$

9. Answer: C

Sol:

Given $y = 2^{1/\log_x 4} \Rightarrow \log y = \frac{1}{\log_x 4}(\log 2)$

$\Rightarrow \log_x 4 = \frac{\log 2}{\log\ y} \Rightarrow \frac{2\log 2}{\log\ x} = \frac{\log\ 2}{\log\ y}$

$\Rightarrow$ 2 log y = logx $\Rightarrow$ x = y^2

Therefore, the correct answer is (C)

10. Answer: B

Sol:

For each pair of station two different types of ticket are required. Now the number of selection of 2 station from 15 station $= {}^{15}C_2$

Required number of types of tickets

$= 2 \cdot {}^{15}C_2 = 2 \cdot \frac{15\times14}{2} = 210$

11. Answer: C

Sol:

f(x) = [sin x]
$-1 \leq \sin x \leq 1$
[sin x] = – 1, 0, 1
Range of f(x) = {–1, 0, 1}

12. Answer: A

Sol:

Given $A = \begin{bmatrix} 3 & 4 \\ 5 & 7 \end{bmatrix}$

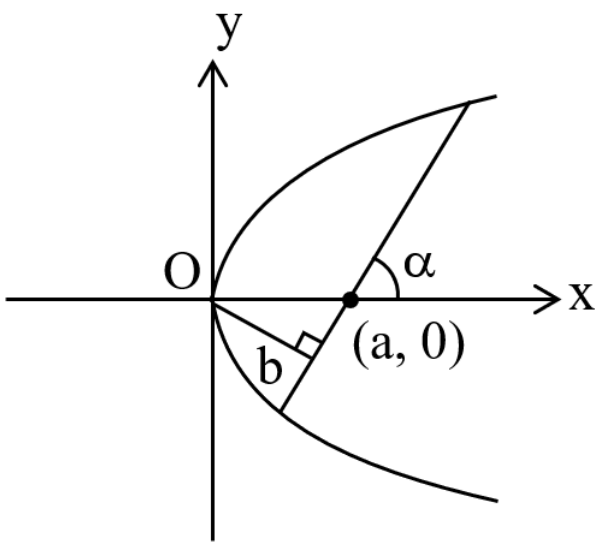
$|A| = 21 - 20 = 1$

$\therefore \quad A\left(\text{adj}A\right) = \begin{bmatrix} 3 & 4 \\ 5 & 7 \end{bmatrix}\begin{bmatrix} 7 & -4 \\ -5 & 3 \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = 1 \cdot \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \left|A\right| \cdot I$

13. Answer: D

Sol:



Let the focal chord be AB

AB: y – 0 = m(x – a)

Distance of AB from vertex is b

$\left|\frac{m(0-a)-0}{\sqrt{m+1}}\right| = b$

$\Rightarrow a^2m^2 = b^2m^2 + b^2$

$\Rightarrow m^2(a^2 - b^2) = b^2$

$\Rightarrow m^2 = \frac{b^2}{a^2-b^2} \Rightarrow m = \frac{\pm b}{\sqrt{a^2-b^2}}$ $\tan\alpha = m$

Length of focal chord = $4a\text{cosec}^2\alpha$

$= 4a\left(1 + \frac{1}{m^2}\right)$

$= 4a\left(1 + \frac{a^2-b^2}{b^2}\right)$

$c = \frac{4a^3}{b^2}$

$\Rightarrow b^2c = 4a^3$

14. Answer: A

Sol:

Since f(x) is decreasing in the interval $(-2, -1)$, therefore,

$f'(x) < 0 \Rightarrow 6x^2 + 18x + \lambda \leq 0.$

The value of λ should be such that the equation

$6x^2 + 18x + \lambda = 0$ has roots -2 and -1.

Therefore, $(-2)(-1) = \frac{\lambda}{6} \Rightarrow \lambda = 12.$

Final Answer: Option (A)

15. Answer: D

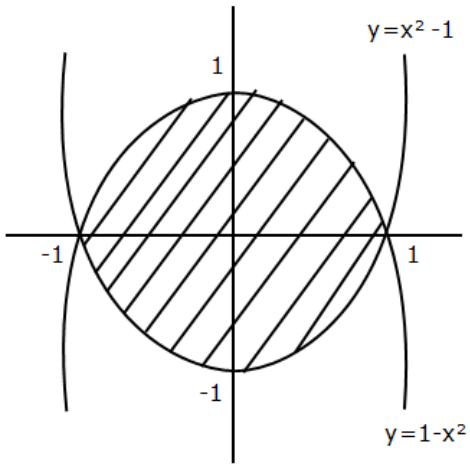
Sol:

x= 5 cos θ & y = 5 sin θ
min(9sec2 θ + cosec2 θ) = $(3+1)^2$ = 16
min = 16

16. Answer: B

Sol:

We have $y^2 = (x^2 - 1)^2 \Rightarrow y = x^2 - 1$ or $y = 1 - x^2$



Area $= 4\left\{\int_0^1 \sqrt{1-y}\,dy\right\}$

$= 4\left[\frac{2}{3}(1-y)^{3/2}\right]_0^1$

$= \frac{8}{3}$

17. Answer: C

Sol:

$[(\vec{a}.\vec{c})\vec{b} - (\vec{b}.\vec{c})\vec{a}].\vec{d} = 1$

$\left(\frac{\vec{b}.\vec{d}}{2}\right) - (\vec{b}.\vec{c})(\vec{a}.\vec{d}) = 1$

$\left(\frac{\vec{b}.\vec{d}}{2}\right) - 1 = 1 \Rightarrow \vec{b}.\vec{d} = 4$

$\vec{b}$ & $\vec{d}$ are non-parallel

18. Answer: A

Sol:

I.F. $= e^{\int \sec^2 x dx} = e^{\tan x}$

$\therefore$ Solution is $ye^{\tan x} = c + \int \tan\ xe^{\tan x}\sec^2 x dx$

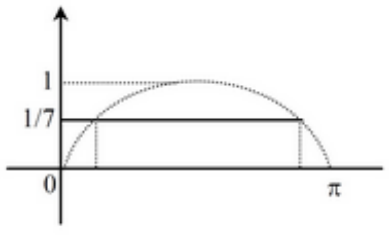
$\Rightarrow y = ce^{-\tan x} + \tan x - 1.$

Therefore, the correct answer is (A)

19. Answer: A

Sol:

f(x) will be discontinuous at the points where$\sin x = \frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}, \frac{6}{7}, \frac{7}{7}$ and sin*x* will be 1/7 for two values of *x* in the intervals.



20. Answer: A

Sol:

x^2-9x+8= 0

x^2-8x-x+8= 0

(x-8) (x-1)= 0

$\Rightarrow e^{\left[\sin^2\alpha+\sin^4\alpha+.....\infty\right]\log e^2}$

$\Rightarrow e^{\frac{\sin^2 x}{1-\sin^2 x}\ln^2} = 2^{\log^2 x}$

question not complete.

Maths - Section B

21. Answer: 6

Sol:

	(1)	(2)	(3)
Red balls	20%	40%	40%
Black balls	25%	45%	30%

$$p = \frac{\frac{15}{35} \times \frac{40}{100}}{\frac{15}{35} \times \frac{40}{100} + \frac{20}{35} \times \frac{45}{100}}$$

$$p = \frac{40}{40+60} = \frac{2}{5}$$

$$15p = 6$$

22. Answer: 1

Sol:

$$\frac{1}{a+\omega} + \frac{1}{b+\omega} + \frac{1}{c+\omega} + \frac{1}{d+\omega} = \frac{1}{\omega} \text{ ..... (i)}$$

Taking conjugate we get,

$$\frac{1}{a+\omega^2} + \frac{1}{b+\omega^2} + \frac{1}{c+\omega^2} + \frac{1}{d+\omega^2} = \frac{1}{\omega^2} \text{ .....(ii)}$$

Taking difference, $\sum\left(\frac{1}{a+\omega} - \frac{1}{a+\omega^2}\right) = \frac{1}{\omega} - \frac{1}{\omega^2}$

$$\Rightarrow \left(\omega^2 - \omega\right)\sum \frac{1}{(a+\omega)(a+\omega^2)} = \omega^2 - \omega$$

$$\Rightarrow \sum \frac{1}{a^2-a+1} = 1$$

Therefore, the correct answer is 1.

23. Answer: 2

Sol:

$$\int_{-1}^{1}\left[x\left[1+\sin\pi x\right]+1\right]dx = \int_{-1}^{0}\left[x\left[1+\sin\pi x\right]+1\right]$$

$$dx + \int_{0}^{1}\left[x\left[1+\sin\pi x\right]+1\right]dx$$

Now $-1 < x < 0 \Rightarrow [1+\sin\pi x] = 0$

$0 < x < 1 \Rightarrow [1+\sin\pi x] = 1 \Rightarrow [x[1+\sin\pi x]+1] = 1$

so $\int_{-1}^{1}\left[x\left[1+\sin\pi x\right]+1\right]dx = 2$

24. Answer: 3

Sol:

Required circle is

$(x-1)^2 + (y-a)^2 = a^2$

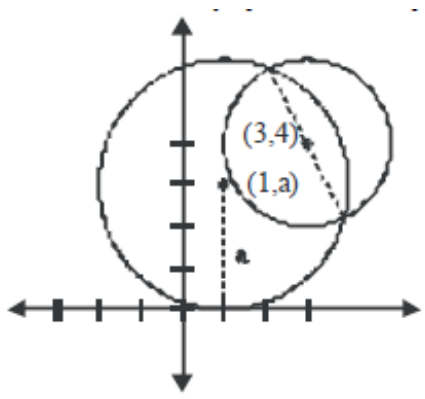
$x^2 + y^2 - 2x - 2ay + 1 = 0 \quad ....(A)$

$(x-3)^2(y-4)^4 = 4$

$x^2 + y^2 - 6x - 8y + 21 = 0 \qquad .....(B)$

$S_1 - S_2 = 0$

$\Rightarrow 4x + y(8-2a) - 20 = 0$

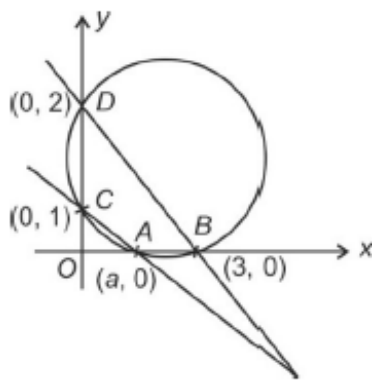


$(3,\ 4) \Rightarrow 12 + 4(8-2a) - 20 = 0$

$3 + 8 - 2a - 5 = 0 \Rightarrow a = 3]$

25. Answer: 3

Sol:



$OA \times OB = OC \times OD$

$a \times 3 = 1 \times 2$

$3a = 2$

Physics - Section A

1. Answer: A

Sol:

F cos θ = m $\frac{dv}{dt}$

kt cos θ = m $\frac{dv}{dt}$

k cos θ $\int t.dt = \int m.dv$

mv = k cos θ × $\frac{t^2}{2}$

$v = \frac{k\cos\theta}{2m} \times \frac{m^2g^2}{k^2\sin^2\theta}$

Therefore, the correct answer is (A)

2. Answer: C

Sol:

When block just reaches the top, it is at rest wrt wedge, so that u is minimum.

The centre of mass of 'block plus wedge' must move with speed v_{CM}.

From conservation of linear momentum,

$\frac{mu}{m+\eta\, m} = \frac{u}{1+\eta} = v_{CM}$

From energy conservation

$\frac{1}{2}mu^2 - mgh = \frac{1}{2}\left(m + \eta\, m\right) v_{CM}^2$

So, $u = \sqrt{2\, gh(1 + 1/\eta)}$

Therefore, the correct answer is (C).

3. Answer: D

Sol:

Given,

Length of arc, L = 4.4 light years = .4 × 9.46 × 10^{15}m = 4.15 × 10^{16} m

Angle suspended at the centre, $\theta = 4\,\mathrm{s}$

Velocity, $\mathrm{v} = 8\ \mathrm{AU/s} = 8 \times 1.5 \times 10^{11} = 1.2 \times 10^{12}\,\mathrm{m/s}$

The angle subtended at the center of the circle is given as 4seconds. To convert seconds into radians, we use the conversion factor:

$1\,\mathrm{s} = \frac{1}{3600}\mathrm{degree} = \frac{1}{3600} \times \frac{\pi}{180}\ \mathrm{rad}$

Now, $4\,\mathrm{s} = 4 \times \frac{1}{3600} \times \frac{\pi}{180}\ \mathrm{rad} = \frac{\pi}{162000}\ \mathrm{rad}$

The length of the arc can be given by, $\mathrm{R} = \frac{\mathrm{L}}{\theta}$

Now the time taken to complete 4 revolution ,

$$\mathrm{T} = \frac{\mathrm{Total\ \ distance}}{\mathrm{Speed}}$$

$$\mathrm{T} = \frac{4 \times \mathrm{circumference\ \ of\ \ circle}}{\mathrm{v}}$$

$$\Rightarrow \mathrm{T} = \frac{4 \times 2\pi\mathrm{R}}{\mathrm{v}}$$

$$\Rightarrow \mathrm{T} = \frac{4 \times 2\pi}{\mathrm{v}} \times \frac{\mathrm{L}}{\theta}$$

$$\Rightarrow \mathrm{T} = \frac{4 \times 2\pi}{1.2 \times 10^{12}} \times \frac{4.15 \times 10^{16}}{\frac{\pi}{162000}}$$

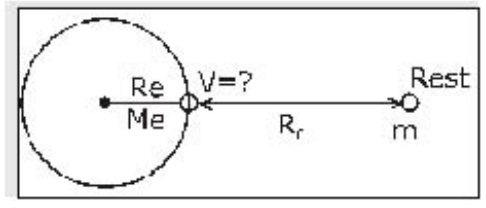
$$\Rightarrow \mathrm{T} = \frac{4 \times 2\pi}{1.2 \times 10^{12}} \times \frac{6.723 \times 10^{21}}{\pi}$$

$$\Rightarrow \mathrm{T} = \frac{5.3784 \times 10^{22}}{1.2 \times 10^{12}}$$

$$\Rightarrow \mathrm{T} = 4.5 \times 10^{10}\ \mathrm{s}$$

4. Answer: D

Sol:



apply energy conservation

$E_i = E_f$

$K_i + U_i = K_f + U_f$

$$0 - \frac{\mathrm{GMem}}{\mathrm{R_0}} = 1/2\,\mathrm{MV}^2 - \frac{\mathrm{GMeM}}{\mathrm{Re}}$$

$$\mathrm{V} = \sqrt{2\,\mathrm{GMe}\left(\frac{1}{\mathrm{R_e}} - \frac{1}{\mathrm{R_0}}\right)}$$

Therefore, correct answer is (D)

5. **Answer:** A

Sol:

Angular momentum of a particle performing uniform circular motion,

$L = I\omega$ .....(1)

Kinetic energy of a particle performing uniform circular motion,

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

From Eq. (1) & (2)

$\Rightarrow K = \frac{1}{2}L\omega$

$\Rightarrow L = \frac{2k}{\omega}$

Now new angular momentum will be,

$\Rightarrow L' = \frac{2k'}{\omega'}$

$\Rightarrow \frac{L'}{L} = \frac{2k'}{\omega'} \times \frac{\omega}{2K}$

$\Rightarrow \frac{L'}{L} = \frac{2\left(\frac{K}{2}\right)}{2\omega} \times \frac{\omega}{2K}$

$\Rightarrow \frac{L'}{L} = \frac{1}{4}$

$\Rightarrow L' = \frac{L}{4}$

Therefore, the correct option is (A)

6. **Answer:** D

Sol:

For 1-D motion

$t = \frac{20}{2} = 10\,sec$

For the part of SHM

$\frac{T}{2} = \frac{2\pi}{2}\sqrt{\frac{M}{k}} = \pi\sqrt{\frac{1}{1}} = \pi$

$(10 + \pi)$ sec Ans.

7. **Answer:** C

Sol:

$V = \sqrt{\frac{\gamma RT}{M_w}}$

8. **Answer:** B

Sol:

$\frac{dT}{dt} = \frac{\sigma A}{ms}\left(T^4 - T_0^4\right)$

$= \frac{\sigma 4\pi r^2}{ms}\left(T^4 - T_0^4\right)$

Now, solve using data given in the question

9. **Answer:** B

Sol:

net work done by the system

We have heat equation

$\Delta Q = W + \Delta U$

For cyclic process, $\Delta U = 0$

So, $\Delta Q = \Delta W$

So in a cyclic process, the amount of heat given to a system is equal to net work done by the system.

10. **Answer:** B

Sol:

Using the continuity equation:

$A_1 v_1 = A_2 v_2$

$\Rightarrow v_2 = \frac{A_1 v_1}{A_2} = \frac{0.04 \times 3}{0.01} = 12 \text{ m/s}.$

11. **Answer:** A

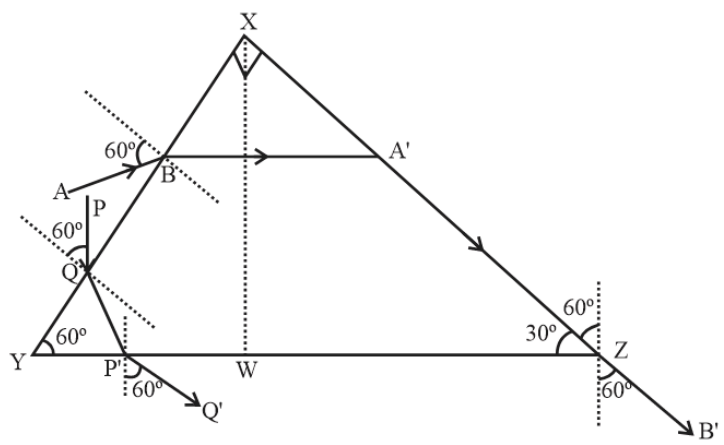
Sol:

$P_1 = P_2$

$\rho g h = T(2\pi R)\frac{\left(\pi D^2\right)}{4}$

12. **Answer:** A

Sol:



$\mu \sin 60° = \sin 90° \Rightarrow \mu = \frac{2}{\sqrt{3}}$

13. Answer: B

Sol:

In case of dipole

Electric field intensity at any point

$$\mathrm{E} = \frac{1}{4\pi\varepsilon_{\mathrm{o}}}\frac{\mathrm{P}}{\pi^3}\sqrt{3\cos^2\theta + 1}$$

where P = dipole moment

it never can be zero.

Electric potential at any point

$$\mathrm{V} = \frac{1}{4\pi\varepsilon_{\mathrm{o}}}\frac{\mathrm{P}\cos\theta}{\mathrm{r}^2}$$

potential will be zero, when $\cos\theta = 0$

$\Rightarrow \theta = \frac{\pi}{2}$

Therefore, correct option is (B).

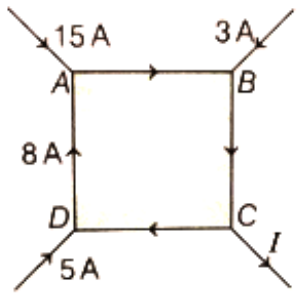
14. Answer: B

Sol:

Conceptional

15. Answer: C

Sol:



Applyin Kirchhoff's first law at juntion A,B, C, D

At A, $\mathrm{I_{AB}} = 15 + 8 \ = \ 23\ \mathrm{A}$

At B, $\mathrm{I}_{BC} = 23 + 3 \ = 26\ \mathrm{A}$

At D, $\mathrm{I}_{CD} = 8 - 5 \ = 3\ \mathrm{A}$

At D, $\mathrm{I_{CD}} + \mathrm{I} = \mathrm{I_{BC}}$

or 3 + I = 26

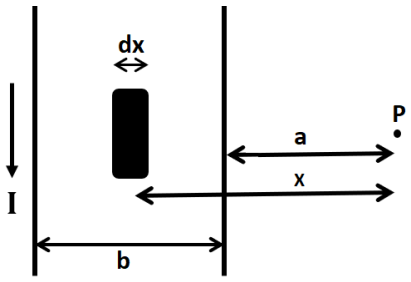
I = 23 A

16. Answer: C

Sol:

Assuming the strip to be made up of a large number of elements parallel to its length, consider an element of length dx at a distance x from the point P. Treating the element as a long current–carrying wire, Let I' be the current in strip 'dx'

$$dB = \frac{\mu_0 2I'}{4\pi x}$$



$$I' = \frac{I}{b}dx$$

and hence, $dB = \frac{\mu_0}{4\pi}\frac{2I}{b}\frac{dx}{x}$

So, $B = \frac{\mu_0}{4\pi}\frac{2I}{b}\int_a^{(a+b)}\frac{dx}{x}$

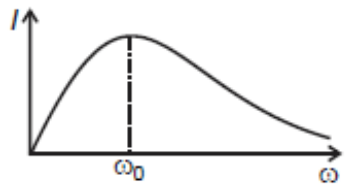
$$\Rightarrow B = \frac{\mu_0}{4\pi}\frac{2I}{b}\log_e\left[1+\frac{b}{a}\right]$$

Therefore, the correct answer is (C).

17. Answer: B

Sol:

Current varies with angular frequency as shown in graph



18. Answer: B

Sol:

Given, for, Li ++, Z = 3 and as the excitation is from first to third Bohr orbit, so n_1 = 1, n_2 = 3

Using the relation,

$$\frac{1}{\lambda} = Z^2R\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$= (3)^2R\left(\frac{1}{1^2}-\frac{1}{3^2}\right) = 8R$$

$\Rightarrow$Wavelength, $\lambda = \frac{1}{8R} = \frac{1}{8\times1.097\times10^7} = 0.11\times10^{-7}$

= 11.4 nm

19. Answer: D

Sol:

we know that,

Activity, $\mathrm{R} = \mathrm{R}_0\mathrm{e}^{-\lambda \mathrm{t}}$

So, from given conditions,

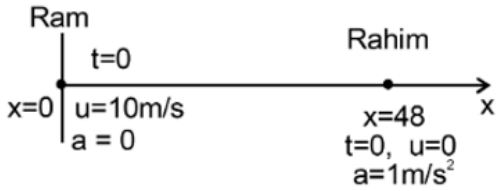
$\mathrm{R}_1 = \mathrm{R}_0\mathrm{e}^{-\lambda \mathrm{t}_1}$

and, $\mathrm{R}_2 = \mathrm{R}_0\mathrm{e}^{-\lambda \mathrm{t}_2}$

hence, $\frac{\mathrm{R}_2}{\mathrm{R}_1} = \mathrm{e}^{-\lambda\left(\mathrm{t}_2 - \mathrm{t}_1\right)}$

20. Answer: C

Sol:



For Ram $\mathrm{v} = 10\mathrm{m/s}(\mathrm{const.})$

For Rahim $\mathrm{v} = \mathrm{at} \quad = \mathrm{t}$

Acceleration for Ram a = 0

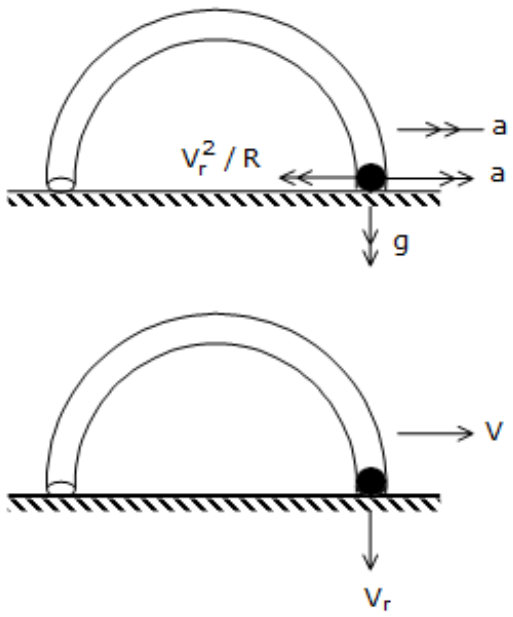
(const. veclotcity)

Rahim $\mathrm{a} = 1\mathrm{m/s}^2$ (const.)

Physics - Section B

21. Answer: 6

Sol:



a = acceleration of tubejust before the ball hits the floor

y_r =velocity of ball w.r.t. tube

y = velocity of tube w.r.t. ground

as floor is smooth, acceleration of CM of the system in horizontal direction is zero

$\Rightarrow m\left(a-\left(-\frac{{v_r}^2}{R}\right)\right)+2ma=0$

using ME conservation for the system in ground frame,

$mgR=\frac{1}{2}m\left({v_r}^2+v^2\right)+\frac{1}{2}\left(2m\right)v^2$

on solving, we will get:

$a=\frac{4g}{6}$.

So, the value of n here is 6.

22. Answer: 5

Sol:

Length of the pendulum is $\mathrm{L}=\mathrm{L}_0+\lambda_0-\ell_0$

$\Delta\mathrm{L}=\Delta\mathrm{L}_0+\Delta\lambda_0-\Delta\ell_0$

$\therefore 0=\mathrm{L}_0\alpha_0\Delta\theta+\lambda_0\alpha_0\Delta\theta-\ell_0\alpha\Delta\theta$ [$\Delta\theta$ = change in temperature]

$\Rightarrow\alpha=\frac{\left(\mathrm{L}_0+\lambda_0\right)\alpha_0}{\ell_0}=5\alpha_0\Rightarrow\mathrm{x}=5$

23. Answer: 3

Sol:

In the measurement of length the relative error = $\frac{\text{error in length}}{\text{total length}}$

$= \pm\frac{0.02}{2}$

$= \pm 0.01$

The percentage error in the measurement of length = $\pm 0.01 \times 100 = \pm 1\%$

Therefore,

Volume = length $\times$breadth$\times$height

$= a \times 2a \times 3a$

$= 6a^2$

The relative error in volume = $\frac{\text{change in volume}}{\text{total volume}}$

$= \frac{\Delta V}{V}$

$= \pm 3\left(\frac{\Delta a}{a}\right)$

$= \pm 3 \times 0.01$

The percentage error in volume = relative error in volume $\times$100%

$= 3 \times 0.01 \times 100\%$

$= \pm 3\%$

The maximum percentage error in the volume is $\pm 3\%$

24. Answer: 20.00

Sol:

Path difference $\Delta X = 2\sqrt{60^2 + 25^2} - 120$

$$\Delta X = 130 - 120 = 10\ m$$

For silence zone,

$\Delta x = \left(n + \frac{1}{2}\right)\lambda$

$\lambda = \frac{\Delta x}{n+\frac{1}{2}}$

25. **Answer:** 2

Sol:

Given,

$$\text{Inductance} = \frac{2\times\text{energy}}{\text{current}^2}$$

$$\text{inductance [L]} = \frac{\left[\mathrm{ML^2T^{-2}}\right]}{\left[\mathrm{A}\right]^2}$$

$$= [ML^2T^{-2}A^{-2}]$$

$\therefore$ on compairing with the dimension of time

$[ML^2T^{-x}A^{-2}] = [ML^2T^{-2}A^{-2}]$

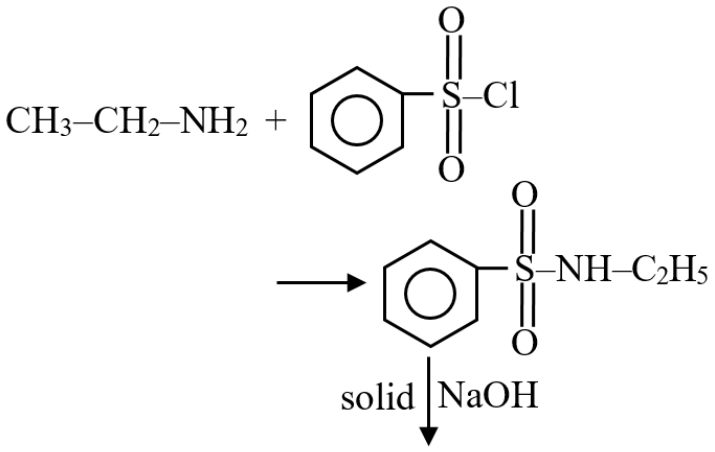
$\therefore x = 2$

Chemistry - Section A

1. Answer: C

Sol:

1º amine reaction with Hinsberg's reagent to give a solid which dissolves in alkali.



2. Answer: C

Sol:

(A) Ionisation energy of negative charge species ($A^{\ominus}$) is less compare to neutral species (A)

(2) If alkali metal then electronic configuration

$A \rightarrow$ [inert gas] ns^1

$(A^+) \rightarrow$ inert gas configuration

Hence $(I.P)_{II} > (I.P.)_I$

(3) successive ionization energy is always (↑) for 1^{st} and 2^{nd} period element because after first "IP" neutral element get positive charge.

Due to this size of ion (↓) & zeff (↑), now we want to remove II^{nd} $e^{\ominus}$ we need high amount of energy compared to first "IP".

(4) EA value of A^+ is numerically net identically with the ionization potential of $^{\ominus}$(for any atom)

Because different atom have different "IP"

3. Answer: A

Sol:

Molar Masses of AB_2 and A_2B are 250 g/mol and 140 g/mol respectively.

$5A_2+2B_4 \longrightarrow 2AB_2 + 4A_2B$

moles of $AB_2 = \frac{1000}{250} = 4$

It requires 10 moles A_2 and 4 moles B_4 respectively

1 kg of A_2B corresponds to 7.14 moles $\left(\frac{1000}{140}\right)$ it rerquires 8.9 moles A_2 and 3.57 moles By respectively.

Thus,

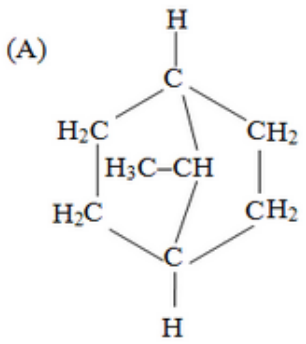
10 moles A_2 (200g) and 4 moles B_4 (1920'g) will produce atleast 1kg of each product minimum mass of mixture requvied is 200g + 1920g = 2120g.

Therefore, the correct answer is (A)

4. Answer: A

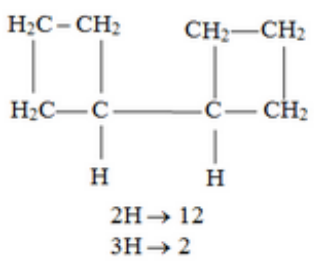
Sol:

(A)



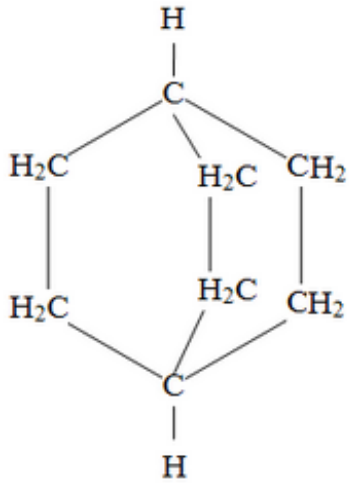
2H → 8
3H → 3

(B)



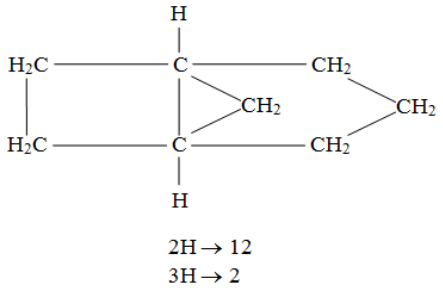
2H → 12
3H → 2

(C)



2H → 12
3H → 2

(D)



2H → 12
3H → 2

5. Answer: A

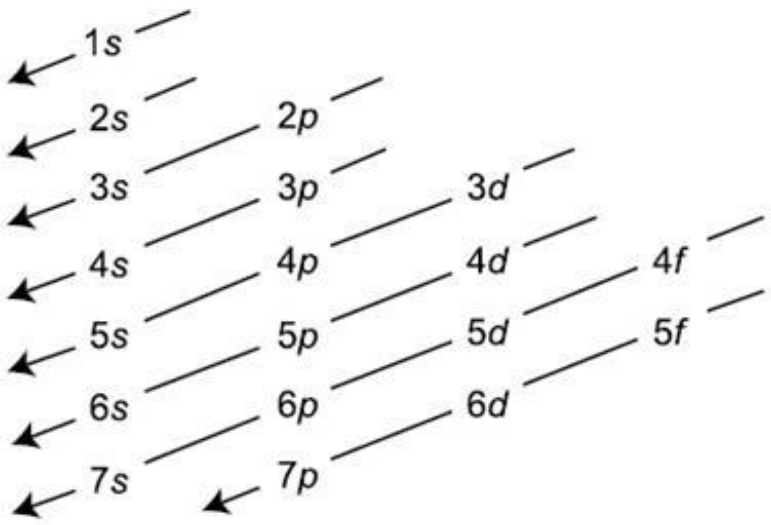
Sol:

Theory based

6. Answer: B

Sol:

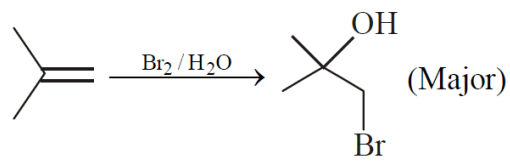
According to Aufbau principle, the available atomic orbitals with the lowest energy levels are occupied before those with higher energy levels.



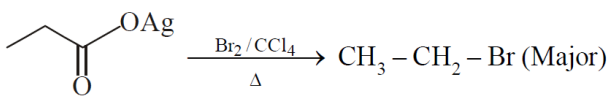
So, The correct order of increasing energy of atomic orbitals is :5p < 6s < 4f < 5d

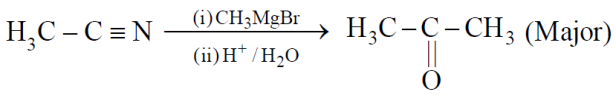
7. Answer: A

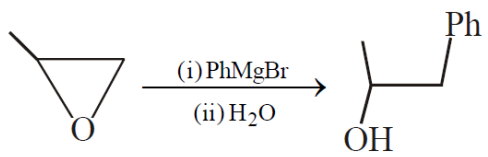
Sol:

(i) 

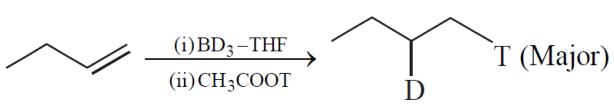
(Major)

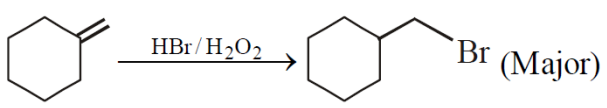
(ii) 

(iii) 

(iv) 

(Major)

(v) 

(vi) 

(Major)

8. Answer: A

Sol:

O_2 has 2 unpaired electron while O_2^+ and O_2^- has one each unpaired electrons while O_2^{2+} does not have any unpaired electron.

9. Answer: A

Sol:

$X_{CCl_4}(g) = 0.3474$

$X_{SiCl_4}(g) = 0.6526$

$P^{\circ}_{SiCl_4(g)} = 238.3\ mm$

$P^{\circ}_{CCl_4} = 114.9\ mm$

$P'_{CCl_4} = P^{\circ}_{CCl_4} \cdot X_{CCl_4(f)} = P_M \times X_{CCl_4(g)}$

$\therefore \quad 144.9 \times X_{CCl_4(\ell)} = P_M \times 0.3474$ .....(i)

Also, $238.3 \times X_{SiCl_4(\ell)} = P_M \times 0.6526$ ....(ii)

By equations (i) and (ii), we get

$\frac{X_{CCl_4(\ell)}}{X_{SiCl_4(\ell)}} = \frac{0.3474}{0.6526} \times \frac{238.3}{114.9} = 1.104$

Let a g CCl_4 and b g $SiCl_4$ be present in the liquid and the ratio of mole fraction is the ratio of their miles.

Then $\frac{a/154}{b/170} = 1.104 \Rightarrow \frac{a}{b} = 1$

Thus 50% by weight CCl_4 liquid is present in mixture.

10. Answer: A

Sol:

CHF_3 is not formed because the formation of CHF_3 is a highly exothermic reaction.

11. Answer: A

Sol:

Tetraammine dichloro platinum IVtetrachloroplatinate II

12. Answer: D

Sol:

For the reaction

	$CaCO_{3(s)} \rightarrow$	$CaO_{(s)} +$	$CO_{2(g)}$
initially	4	0	0
at equi.	4−x	x	x

K_p = $[CO_2]$ only

Then $K_p = P_{CO_2}$

From ideal gas equation:

PV = nRT

$P = \frac{nRT}{V}$

So, $K_p = \frac{nRT}{V}$

K_p = 1.642 atm ; T = 727ºC or 1000 K ; V = 50 litre

R = 0.0821 $LatmK^{-1}mol^{-1}$

$n = \frac{1.647 \times 50}{0.0821 \times 1000}$

n = 1 = x

Mole of $CaCO_3$ remaining = 4 − x ⇒ 4 − 1 = 3

Mole % of $CaCO_3$ unreacted = $\frac{3}{4} \times 100 = 75\%$

13. Answer: D

Sol:

$NaBH_4$ reduces ketone into 2º Alcohol but not ester

14. Answer: B

Sol:

Interstitial or Metallic Hydrides: Metallic hydrides are formed by the elements of groups 3, 4, 5, 10, 11, 12, (d-block), and f block elements. From group 6, only Cr forms the hydride, and metals of groups 7, 8, and 9 do not form hydrides.

Examples of such elements are Mn, Fe, Co, Ru, etc. These elements do not form hydrides on account of low affinity for hydrogen in their normal oxidation states.

So, (B) Fe is the correct answer.

15. Answer: B

Sol:

ΔH neutralisation will be lowest for weakest acid

16. Answer: A

Sol:

$$RCH_2OH \xrightarrow{KMnO_4 / OH^-} R-CH=O \xrightarrow{KMnO_4} R-COOH$$

Primary alcohols are oxidized to carboxylic acids with $KMnO_4$ in neutral, acidic or basic medium.

17. Answer: D

Sol:

Half-filled stabled configuration will be more favoured to Gd. Arrange the orbitals according to the increasing energy.

The configuration of Gd is

$[Xe]4f^7 5d^1 6s^2$

Hence value of x + y + z = 10

18. Answer: A

Sol:

Both Fe(II) and S(IV) in SO_3^{2-} can be oxidised to Fe(III) and S(VI) $(SO_4)^{2-}$ respectively hence, (3/5) × 0.5 = 0.3 mole/litre.

$$\left[MnO_4^- + 5e^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O\right] \times \frac{3}{5}$$

$$Fe^{2+} \rightarrow Fe^{3+} + 1e^-$$
$$SO_3^{2-} \rightarrow SO_4^{2-} + 2e^-$$

$$\frac{8}{5}MnO_4^- + \frac{24}{5}H^+ + Fe^{2+} + SO_3^{2-} \rightarrow 3\,Mn^{2+} + 4H_2O + Fe^{3+} + SO_4^{2-}$$

19. Answer: D

Sol:

$$A \xrightarrow{k_1} 2B$$

$a_0 - x - y \quad 2x$

$$A \xrightarrow{k2} C$$

$a_0 - x - y \quad y$

$$-\frac{d[A]}{dt} = (k_1 + k_2)\left[A\right]$$

$$\frac{[B]}{[C]} = \frac{2k_1}{k_2} = \frac{2x}{y} \Rightarrow \frac{k_1}{k_2} = \frac{x}{y}$$

$$\because k_1 = k_2 \quad \Rightarrow \quad x = y$$

$$(k_1 + k_2)t = \ln \frac{A_0}{A_t}$$

$$6.93 \times 2 \times 10^{-3} \times 50 = 0.693 = \ln \frac{A_0}{A_t}$$

$$\Rightarrow \quad \left[A\right]_t = \frac{[A_0]}{2}$$

$$\Rightarrow \quad a_0 - x - y = a_0/2 \quad (\because x = y)$$

$$\Rightarrow \quad a_0 - (a_0/2) = 2x$$

$$\Rightarrow \quad x = a_0/4$$

Total moles in container = $a_0 - x - y + 2x + y = a_0 + x$

$$\Rightarrow \quad a_0 + (a_0/4) = (5a_0)/4 = 1.25a_0$$ = 0.125 moles

Final pressure = 2.50

20. Answer: A

Sol:

$$(A) \rightarrow (r)\,;\ (B) \rightarrow (s)\,;\ (C) \rightarrow (q)\,;\ (D) \rightarrow (p)$$

$$t_{1/2} \propto \frac{1}{(\text{initial conc.})^{\text{order}-1}}$$

Chemistry - Section B

21. Answer: 3

Sol:

Sucrose : $C_{12}H_{22}O_{11}$
Sucralose : $C_{12}H_{19}Cl_3O_8$

22. Answer: 8

Sol:

n = 1 to ∞, ℓ = 0 to (n + 1)

n = 0, ℓ = 0, 1

n = 1, ℓ = 0, 1, 2 A/c of aufbau's diagram
ℓ = 0 (s) 1s 1p 1d
= 1 (p) 2s 2p 2d 2f
= 2 (d)
n = 2, ℓ = 0, 1, 2, 3

After 1p, the second shell starts filling only the elements having electrons present in 1s and 1p will belong to 1st period.8 e^- can fill before 2^{nd} Shell start filling electron ($1s^2$ $1p^6$).

($1s^1$ $1p^0$), ($1s^2$ $1p^0$), ($1s^2$ $1p^1$), ($1s^2$ $1p^2$), ($1s^2$ $1p^3$), ($1s^2$ $1p^4$)
($1s^2$ $1p^5$) ($1s^2$ $1p^6$) = Represents total 8 different elements

$$\boxed{\text{Answer} = 8}$$

23. Answer: 16

Sol:

CN^-	NC^-	NO_2^-	ONO^-
3	0	3	0
2	1	2	1
1	2	1	2
0	3	0	3

Total linkage isomers = 4 × 4 = 16

24. Answer: 2

Sol:

Number of moles of H_2SO_4 is
$= 10 \times 10^{-3} \times \frac{1}{200} + 40 \times 10^{-3} \times \frac{1}{200} = 50 \times 10^{-3} \times \frac{1}{200}$
Concentration after mixing
$= \frac{50 \times 10^{-3} \times \frac{1}{200}}{50 \times 10^{-3}}$
$= \frac{1}{200} M$
For strong electrolyte
$[H^+] \approx 2[H_2SO_4]$
$[H^+] = \frac{1}{100}$
So,
$pH = 2$
Answer: 2

25. Answer: 5

Sol:

The Arrhenius equation is,

$\log_{10} \frac{k_2}{k_1} = \frac{E_a}{2.303 \times R}\left[\frac{T_2 - T_1}{T_1\, T_2}\right]$

$\text{Given } k_1 = 9.5 \times 10^{-5}\ s^{-1}; k_2 = 1.9 \times 10^{-3}\ s^{-1}$

$R = 8.314\, \text{Jmol}^{-1}\ K^{-1}\ ;$

$T_1 = 407\ K \text{ and } T_2 = 420\ K$

Substituting the values in Arrhenius equation.

$\log_{10} \frac{1.9 \times 10^{-4}}{9.5 \times 10^{-5}} = \frac{E_a}{2.303 \times 8.314}\left[\frac{420 - 407}{420 \times 407}\right]$

$E_a = 75782.3\ \text{Jmol}^{-1}$

$\text{Applying now } \log k_1 = \log\ A - \frac{E_o}{2.303\, RT_1}$

$\log 9.5 \times 10^{-5} = \log A - \frac{75782.3}{2.303 \times 8.314 \times 407}$

$\log \frac{A}{9.5 \times 10^{-5}} = \frac{75782.3}{2.303 \times 8.314 \times 407} = 9.7246$

$\text{So, } A = 5.0 \times 10^{5}\ s^{-1}$

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