MENIIT

NEET | IIT-JEE | FOUNDATION

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BITSAT 2012

Previous Year Questions

English

Single correct answer type

1. Out of the four alternatives, choose the one which expresses the right meaning of the given word.

Dubious

(A) Doubtful (B) Disputable (C) Duplicate (D) Dangerous

Ans. (A)

2. Out of the four alternatives, choose the one which expresses the right meaning of the given word.

Flabbergasted

(A) Scared (B)Embarrassed (C) Dumbfounded (D) Humiliated

Ans. (C)

3. Out of the four alternatives, choose the one which expresses the right meaning of the given word.

Eternal

(A) Innumerable (B) Unmeasurable (C) Prolonged (D) Perpetual

Ans. (D)

4. Choose the word opposite in meaning to the given word. Despair

(A) Belief (B) Trust (C) Hope (D) Faith

Ans. (C)

5. Choose the word opposite in meaning to the given word. In toto

(A) Bluntly (B) Partially (C) Entirely (D) Strongly

Ans. (B)

6. Choose the word opposite in meaning to the given word. Protean

(A) Amateur (B) Catholic (C) Unchanging (D) Rapid

Ans. (C)

7. A part of the sentence is underlined. Below are given alternatives to the improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is 'd'

He declined all the allegations against him.

(A) spurned (B) refused (C) refuted (D) no improvement

Ans. (D)

8. A part of the sentence is underlined. Below are given alternatives to the improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is 'd'.

It is time we <u> leave. </u>

(A) left (B) have to leave (C) would leave (D) no improvement

Ans. (A)

9. A part of the sentence is underlined. Below are given alternatives to the improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is 'd'.

We spent an hour discussing about his character.

(A) on his character (B) of his character (C) his character (D) no improvement

Ans. (C)

10. Sentences are given with blanks to be filled in with an appropriate and suitable word. Four alternatives are suggested for each question. Choose the correct alternative out of the four. Are your really desirous …….. visiting Japan?

(A) of (B) in (C) to (D) about

Ans. (A)

11. Sentences are given with blanks to be filled in with an appropriate and suitable word. Four alternatives are suggested for each question. Choose the correct alternative out of the four. When Indians from the South move North, they find certain aspects of life quite …… from their own.

(A) strange (B) separate (C) different (D) divergent

Ans. (A)

12. Sentences are given with blanks to be filled in with an appropriate and suitable word. Four alternatives are suggested for each question. Choose the correct alternative out of the four. The sky is overcast, we …….. The storm will soon burst.

(A) expect (B) hope (C) trust (D) suspect

Ans. (D)

13. The first and the last parts of the sentence are numbered 1 to 6. The rest of the sentence is spelt into four parts and named P, Q, R and S. These four parts are not given in their proper order. Read the parts and find out which of the four combinations is correct. Then find the correct answer.

1. Early to bed, early to rise, makes a man healthy, wealthy and wise.

P. But for the morning tea, I had to wait for someone to get up before me.

Q. This saying inspired me to rise early.

R. That day I was the first to get up.

S. One day I got up early in the morning.

6. Then I realized that it was a waste of time to get up early and wait for the morning tea.

(A) QSRP (B) QPRS (C) PQRS (D) SPQR

Ans. (A)

14. 1. A wood-cutter was cutting a tree on a river bank.

P. He knelt down and prayed.

Q. His axe slipped and fell into the water.

R. God Mercury appeared before him and asked about the matter.

S. He could not get it back as the river was very deep.

6. He dived into the water and came up with an axe of good.

(A) RPQS (B) RPSQ (C) QSRP (D) QSPR

Ans. (D)

15. 1. A dog stole a piece of meat from a butcher's shop.

P. He barked in anger.

Q. He ran to the jungle with the piece of meat.

R. He saw his reflection.

S. He crossed a river on the way.

6. He lost his piece of meat.

(A) QPSR (B) QSRP (C) QPRS (D) SRPQ

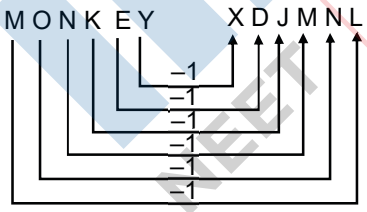
Ans. (B)

16. In a certain code MONKEY is XDJMNL. How is 'TIGER' written as?

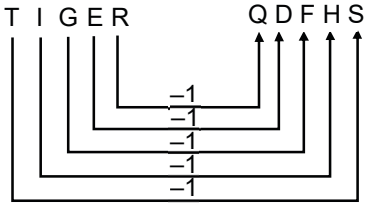
(A) QDFHS (B) SDFHS (C) SHFDQ (D) UJHFS

Ans. (A)

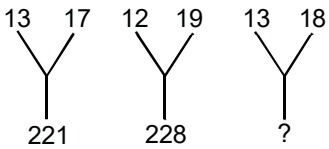
Sol.



Similarly,



17. Find the missing number from the given responses.



(A) 31 (B) 229 (C) 234 (D) 312

Ans. (C)

Sol. Similarly,

$13 \times 17 = 221$

$12 \times 19 = 228$

Similarly, $13 \times 18 = 234$

18. If the day before yesterday was Thursday, when will Sunday be?

(A) tomorrow (B) day after tomorrow

(C) today (D) two days after today

Ans. (A)

Sol. If the day before yesterday was Thursday. Then, today will be Saturday and the Sunday will be tomorrow.

19. In a row of children Ravi is fourth from right and Shyam is second from left. When they interchange positions Ravi is ninth from right. What will be Shyam position from left?

(A) Fifth (B) Sixth (C) Seventh (D) Eighth

Ans. (C)

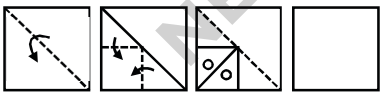
Sol. When Ravi and Shyam interchange their position than Ravi's new position (ninth from right) is the same as Shyam's initial position (second from left)

$\therefore$ Total number of students in the row

$= 8 + 1 + 1$

$= 10$

So, Shyam's new position is same as Ravi's initial position (fourth from right) third from left. So, Shyam's new position from left

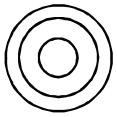
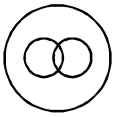
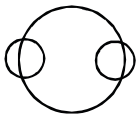
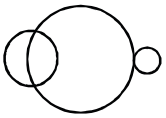
20. 

(A)  (B)  (C)  (D) 

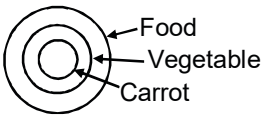
Ans. (D)

Sol. Answer figure (d) will appear when a piece of paper folded and cut as shown in the question figure.

21. Which represents carrot, food, vegetable?

(A)  (B)  (C)  (D) 

Ans. (A)

Sol. 

22. "All the members of the Tennis club are members of the badminton club too". No woman plays badminton"?

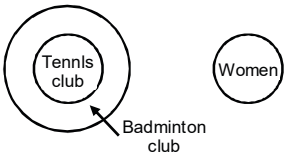
(A) Some women play Tennis

(B) No member of the Tennis club plays badminton

(C) Some women are members of the Tennis club

(D) No woman is a member of Tennis club

Ans. (D)

Sol. 

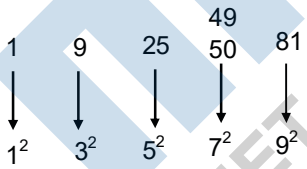
23. Which number is wrong in the given series?

1, 9, 25, 50, 81

(A) 1 (B) 25 (C) 0 (D) 81

Ans. (C)

Sol. The pattern of series is



Hence, 50 is the wrong number.

24. In the following question and stands for any of the Mathematical signs at different places, which are given as choices under each question. Select the choice with the correct sequence of signs which when substituted makes the question as correct equation?

24 Δ 4 Δ 5 Δ 4

(A) X += (B) = X + (C) +X = (D) = +X

Ans. (B)

Sol. Given equation, 24 Δ 4 Δ 5 Δ 4

From option (= +X),

24 = 4 + 5 × 4

24 = 4 + 20

24 = 24

24. Which answer figure is the exact mirror image of the given figure when the mirror is held from the right at PQ?

(A) 

(B) 

(C) 

(D) 

Ans. (C)

Sol. Answer figure (C) is correct mirror image of question figure.

MATHEMATICS

Single correct answer type

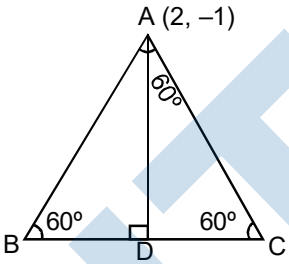
1. The equation of the base BC of an equilateral ΔABC is $x + y = 2$ and A is $(2, -1)$. The length of the side of the triangle is

(A) $\sqrt{2}$ (B) $\left(\frac{3}{2}\right)^{\frac{1}{2}}$ (C) $\left(\frac{1}{2}\right)^{\frac{1}{2}}$ (D) $\left(\frac{2}{3}\right)^{\frac{1}{2}}$

Ans. **(D)**

Sol. Length of perpendicular from A(2, –1) to the line $x + y - 2 = 0$ is

$$AD = \left|\frac{2-1-2}{\sqrt{1+1}}\right| = \frac{1}{\sqrt{2}}$$



In Δ ABD, $\frac{AD}{AB} = \sin 60^\circ$

$$\Rightarrow \frac{1}{\sqrt{2}AB} = \sqrt{\frac{3}{2}}$$

$$\therefore AB = \sqrt{\frac{2}{3}}$$

2. The equation of the circle circumscribing the triangle formed by the lines $x + y = 6$, $2x + y = 4$ and $x + 2y = 5$ is

(A) $x^2 + y^2 + 17x + 19y - 50 = 0$ (B) $x^2 + y^2 - 17x - 19y - 50 = 0$

(C) $x^2 + y^2 + 17x - 19y - 50 = 0$ (D) $x^2 + y^2 - 17x - 19y + 50 = 0$

Ans. (D)

Sol. Lines, $x + y = 6$, $2x + y = 4$ and $x + 2y = 5$

Intersect at points (–2, 8), (7, –1) and (1, 2).

Now, all these points lie on

$x^2 + y^2 - 17x - 19y + 50 = 0$

3. The length of the tangent from (5, 1) to the circle is $x^2 + y^2 + 6x - 4y - 3 = 0$ is

(A) 7 (B) 49 (C) 63 (D) 21

Ans. (A)

Sol. Required length of tangent is $\sqrt{S_1}$, where

$S_1 = 25 + 1 + 30 - 4 - 3 = 49$

$\therefore \sqrt{S_1} = 7$

4. If the length of the major axis of the ellipse $\left(\frac{x^2}{a^2}\right)+\left(\frac{y^2}{b^2}\right)$ = 1 is three times the length of minor axis, its eccentricity is

(A) $\frac{1}{3}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\sqrt{\frac{2}{3}}$ (D) $\frac{2\sqrt{2}}{3}$

Ans. (D)

Sol. Length of minor axis = 2b and according to the given condition length of major axis = 3(2b) = 6b

$$\therefore e = \sqrt{1-\frac{b^2}{(3b)^2}} = \sqrt{\frac{8}{9}} = \frac{2\sqrt{2}}{3}$$

5. S and T are the foci of the ellipse $\left(\frac{x^2}{a^2}\right)+\left(\frac{y^2}{b^2}\right)$ = 1 and B is an end of the minor axis. If STB is equilateral triangle, then eccentricity of the ellipse is

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) $\sqrt{\frac{3}{2}}$

Ans. (C)

Sol. In Δ BOT,

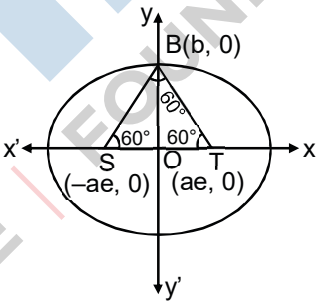
$$\frac{b}{ae} = \tan 60^\circ \Rightarrow b = ae\sqrt{3}$$

$$\therefore e = \sqrt{1-\frac{b^2}{a^2}} = \sqrt{1-\frac{a^2e^2 3}{a^2}}$$

$$\Rightarrow e^2 = 1 - 3e^2 \Rightarrow 4e^2 = 1 \Rightarrow e = \pm\frac{1}{2}$$

$$\Rightarrow e = \frac{1}{2}$$

($\therefore$ e cannot be negative)



6. The difference of the focal distance of any point on the hyperbola is equal to its

(A) latusrectum

(B) eccentricity

(C) length of the transverse axis

(D) half the length of the transverse axis

Ans. (C)

Sol. The difference of the focal distance at any point on the hyperbola is same as length of the transverse axis. i.e., 2a

7. If A + B + C = 180°, then $\frac{\cot A+\cot B+\cot c}{\cot A\cot B\cot C}$ is equal to

(A) 1 (B) cot A cot B cot C (C) –1 (D) 0

Ans. (A)

Sol. Since, A + B + C = 180°

$\Rightarrow$ cot (A + B + C)

$= \frac{\sum \cot A\cot B-1}{\cot A\cot B\cot C-\sum \cot A} = \frac{1}{0}$

$\Rightarrow$ cot A cot B cot C – $\sum$ cot A = 0

$\Rightarrow \frac{\cot A\cot B+\cot C}{\cot A\cot B\cot C} = 1$

8. The angles of a triangle are in AP and the least angle is 30°. The greatest angle in radians is

(A) $\frac{7\pi}{12}$ (B) $\frac{2\pi}{3}$ (C) $\frac{5\pi}{6}$ (D) $\frac{\pi}{2}$

Ans. (D)

Sol. Now, $30^\circ = 30^\circ \times \frac{\pi}{180}\text{ rad} = \frac{\pi}{6}$

Let angle be a, a + d, a + 2d area in AP

Now, 3a + 3d = π ($\therefore$ A + B + C = π)

$\Rightarrow 3 \times \frac{1}{3}\left(\pi-\frac{\pi}{2}\right)=\frac{\pi}{6}$

$\therefore$ Greatest angle = a + zd

$= \frac{\pi}{2} + 2.\ \frac{\pi}{6}=\frac{\pi}{2}$

9. If tan 20° = p, then $\frac{\tan 160^\circ-\tan 110^\circ}{1+\tan 160^\circ\tan 110^\circ}$ is equal to

(A) $\left(\frac{1-p^2}{2p}\right)$ (B) $\left(\frac{2p}{1+p^2}\right)$ (C) $\left(\frac{1+p}{2p}\right)$ (D) $\left(\frac{1-p}{2p}\right)$

Ans. (A)

Sol. Given that, tan20° = p

$\therefore \frac{\tan 160^\circ-\tan 110^\circ}{1+\tan 160^\circ\tan 110^\circ}$

$= \frac{\tan(180^\circ-20^\circ)-\tan(90^\circ+20^\circ)}{1+\tan(180^\circ-20^\circ)\tan(90^\circ+20^\circ)}$

$$= \frac{-\tan 20^\circ + \cot 20^\circ}{1 + \tan 20^\circ \cot 20^\circ}$$

$$= \frac{-p + \frac{1}{p}}{1+1} = \frac{1-p^2}{2p}$$

10. If $4\sin^{-1}x + \cos^{-1}x = \pi$, then x is equal to

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

Ans. (A)

Sol. Given, $4\sin^{-1}x + \cos^{-1}x = \pi$

$$\Rightarrow \frac{4\sin^{-1}x + \pi}{2} - \sin^{-1}x = \pi$$

$$\Rightarrow 3\sin^{-1}x = \frac{\pi}{2}$$

$$\Rightarrow x = \sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$$

11. In a ΔABC, a = 2, b = 3 and $\sin A = \frac{2}{3}$. Then, cos C is equal to

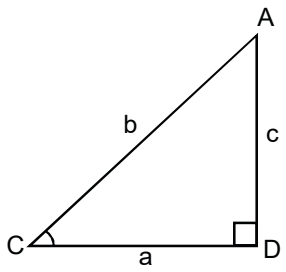
(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{2}{\sqrt{13}}$ (D) $\frac{1}{\sqrt{13}}$

Ans. (B)

Sol. $a = 2, b = 3, \sin A = \frac{2}{3} \Rightarrow \sin^2 A = \frac{4}{9}$

$$\therefore \cos^2 A = 1 - \sin^2 A = \frac{5}{9}$$

$$\Rightarrow \cos A = \frac{\sqrt{5}}{3}$$



By sine rule, $\frac{\sin A}{a} = \frac{\sin B}{b}$

$$\Rightarrow \frac{2}{a} \times \frac{1}{2} = \frac{\sin B}{a}$$

In ΔABC, $\cos C = \frac{a}{b} = \frac{2}{a}$

12. The vector equation $\vec{r} = \hat{i} - 2\hat{j} - \hat{k} + t(6\hat{i} - \hat{k})$ represents a straight line passing through the points

(A) (0, 6, –1) and (1, –2, –1) (B) (0, 6, –1) and (–1, –4, –2)

(C) (1, –2, –1) and (1, 4, –2) (D) (1, –2, –1) and (0, –6, 1)

Ans. (C)

Sol. Equation of the line passing through a and b is a + t(b – a)

Here, $b - a = 6\hat{j} - k$

$\Rightarrow b = 6\hat{j} - k + I - 2j - k$

$= I + 1j - 2k$

$\therefore$ Given line passes through (1, –2, –1) and (1, 4, –2)

13. The work done by the force 4i – 3j + 2k in moving a particle along a straight line from the point (3, 2, –1) to (2, –1, 4) is

(A) 0 units (B) 4 units (C) 15 units (C) 19 units

Ans. (C)

Sol. Work done = (Force displacement)

= (4i – 34j + 2k) – {(2i – j + 4k) – (3i + 2j – k)}

= (4i – 3j + 2k) – (–i – 3j + 5k)

= (–4 + 9 + 10) = 15 units

14. $\lim_{x\to 0}\left(\frac{(2+x)\sin(2+x)-2\sin 2}{x}\right)$ is equal to

(A) sin 2 (B) cos 2 (C) 1 (D) 2 cos 2 + sin 2

Ans. (D)

Sol. $\lim_{x\to 0}\frac{(2+x)\sin(2+x)-2\sin 2}{x}\quad\left(\frac{0}{0}\text{form}\right)$

$=\lim_{x\to 0}\frac{\sin(2+x)+(2+x)\cos(2+x)}{1}$

= sin 2 + 2 cos 2

15. If $f(x) = \frac{3x+\tan^2 x}{x}$ is continuous at x = 0, then f(0) is equal to

(A) 3 (B) 2 (C) 4 (D) 0

Ans. (A)

Sol. Now, $\lim_{x\to 0} f(x) = \lim_{x\to 0}\frac{3x+\tan^2 x}{x}\quad\left(\frac{0}{0}\text{form}\right)$

$=\lim_{x\to 0}\frac{3+2\tan x\sec^2 x}{1}=3$

Since, f(x) is continuous at x = 0

$\therefore$ f(0) = 3

16. If x is measured in degree, then $\frac{d}{dx}$ (cos x) is equal to

(A) – sin x (B) $-\frac{180}{\pi}\sin x$ (C) $-\frac{\pi}{180}\sin x$ (D) sin x

Ans. (C)

Sol. $\frac{d}{dx}(\cos x) = -\frac{\pi}{180}\sin\pi$

17. $\left(\frac{d}{dx}\right)$ [log(sec x – tan x)] is equal to

(A) – sec x (B) sec x + tan x (C) sec x (D) sec x – tan x

Ans. (A)

Sol. $\frac{d}{dx}[\log(\sec x - \tan x)]$

$= \frac{1}{\sec x - \tan x}[\sec x \tan x - \sec^2 x]$

$= \frac{\sec x[\tan x - \sec x]}{\sec x - \tan x} = -\sec x$

18. If $x = \cos^2\theta$ and $y = \sin^3\theta$, then $1 + \left(\frac{dy}{dx}\right)^2$ is equal to

(A) $\tan^2\theta$ (B) $\cot^2\theta$ (C) $\sec^2\theta$ (D) $\text{cosec}^2\theta$

Ans. (C)

Sol. Given, $x = \cos^3\theta$, $y = \sin^3\theta$

On differentiating w. r. t.θ respectively, we get

$\frac{dx}{d\theta} = -3\cos^2\theta\sin\theta$

Ans $\frac{dy}{d\theta} = 3\sin2\theta\cos\theta$

Now, $\frac{dy}{dx} = -\frac{3\sin^2\theta\cos\theta}{3\cos^2\theta\sin\theta} = -\tan\theta$

$\therefore 1 + \left(\frac{dy}{dx}\right)^2 = 1 + \tan^2\theta = \sec^2\theta$

19. If $x = at^2$, $y = 2at$, then $\frac{d^2y}{dx^2}$ is equal to

(A) $-\frac{1}{t^2}$ (B) $-\frac{1}{2at^3}$ (C) $\frac{1}{t^2}$ (D) $-\frac{a}{2t^3}$

Ans. (B)

Sol. $x = at^2$, $y = 2at$

On differentiating w. r. t. t, respectively

$\Rightarrow \frac{dx}{dt} = 2at, \frac{dy}{dt} = 2a$

$\therefore \frac{dy}{dx} = \frac{2a}{2at} = \frac{1}{t}$

$= -\frac{1}{t^2}.\frac{1}{2at}$

$= -\frac{1}{2at^3}$

20. If the rate of change in the circumference of a circle of 0.3 cm/s, then the rate of change in the area of the circle when the radius is 5 cm, is

(A) 1.5 sq cm/s (B) 0.5 sq cm/s (C) 5 sq cm/s (D) 3 sq cm/s

Ans. (A)

Sol. Circumference of circle, $C = 2\pi r$

$\Rightarrow \frac{dC}{dt} = 2\pi\frac{dr}{dt}$

$\Rightarrow \frac{0.3}{2\pi} = \frac{dr}{dt}$ $\left(\because \frac{dc}{dt} = 0.3\,cm/s\,given\right)$

Now $A = \pi r^2$

$\Rightarrow \frac{dA}{dt} = r \times 0.3$

$\Rightarrow \left[\frac{dA}{dt}\right]_{r=5} = 5 \times 0.3 = 1.5$ sq cm/s

21. If $y = x^3 - ax^2 + 48x + 7$ is an increasing function for all real values of x, then a lies in

(A) (–14, 14) (B) (–12, 12) (C) (–16, 16) (D) (–21, 21)

Ans. (B)

Sol. $\frac{dy}{dx} = 3x^2 - 2ax + 48 > 0$

($\because$ y is an increasing function)

$\therefore$ Discriminant, $D < 0$

$\Rightarrow 4a^2 - 4 \times 3 \times 48 < 0$

$\Rightarrow a^2 - 144 < 0$

$\Rightarrow a \varepsilon (-12, 12)$

22. Rolle's theorem is not applicable for the function f(x) = $|x|$ in the interval, [–1, 1] because

(A) f' (1) does not exist (B) f'(–1) does not exist

(C) f(x) is discontinuous at = 0 (D) f'(0) does not exist

Ans. (D)

Sol. Rolle's theorem is not applicable for the function f(x) = $|x|$ inn [–1, 1]

$\because$ f(0) does not exit.

23. $\int \frac{2dx}{(e^x + e^{-x})^2}$ is equal to

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

Ans. (A)

Sol. Let = $\int \frac{2dx}{(e^x + e^{-x})^2}$

$= \int \frac{2dx}{e^{2x} + e^{-2x} + 2}$

$= \int \frac{2e^{2x}dx}{e^{4x} + 2e^{2x} + 1}$

= Put $e^{2x} = t \Rightarrow 2e^{2x}\,dx = dt$

$\therefore I = \int \frac{dt}{t^2 + 2t + 1} = \int \frac{dt}{(t-1)^2} = -\frac{1}{t+1} + C$

$= -\frac{1}{e^{2x} + 1} = \frac{e^{-x}}{e^x + e^{-x}} + C$

24. $\int_0^{\frac{\pi}{2}} \frac{\sin^n \theta}{\sin^n \theta + \cos^n \theta} d\theta$ is equal to

(A) 1 (B) 0 (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$

Ans. (D)

Sol. Let = $\int_0^{\frac{\pi}{2}} \frac{\sin^n \theta}{\sin^n \theta + \cos^n \theta} d\theta$ ... (i)

$= \int_0^{\frac{\pi}{2}} \frac{\sin^n(\pi/2 - \theta)}{\sin^n(\pi/2 - \theta) + \cos^n(\pi/2 - \theta)} d\theta$

$= \int_0^{\frac{\pi}{2}} \frac{\cos^n \theta}{\cos^n \theta + \sin^n \theta}\, d\theta$ ... (ii)

On adding eqs. (i) and (ii) we get]

$2I = \int_0^{\frac{\pi}{2}} \frac{\sin^n \theta + \cos^n \theta}{\cos^n \theta + \sin^n \theta}\, d\theta$

$= \int_0^{\frac{\pi}{2}} d\theta = \frac{\pi}{2} \Rightarrow I = \frac{\pi}{4}$

25. $\int_0^{\pi} \cos^{101} x\, dx$ is equal to

(A) $\frac{\pi}{4}$ (B) $\frac{1}{102}$ (C) $\left(\frac{\pi}{3}\right)^{101}$ (D) 0

Ans. (D)

Sol. Let $I = \int_0^{\pi} \cos^{101} x\, dx$

$\Rightarrow I = \int_0^{\pi} [\cos(\pi - x)]^{101}\, dx$

$\Rightarrow I = \int_0^{\pi} -\cos^{101} x\, dx$

$\therefore 2I = \int_0^{\pi} (\cos^{101} x - \cos^{101} x)\, dx$

$\Rightarrow I = 0$

26. $\lim_{n\to\infty} \left[\frac{1}{n+1} + \frac{1}{n+2} + ... + \frac{1}{6n}\right]$

(A) log 2 (B) log $(1+\sqrt{5})$ (C) log 6 (D) 0

Ans. (C)

Sol. $\lim_{n\times\infty} \left[\frac{1}{n+1} + \frac{1}{n+2} + ... + \frac{1}{6n}\right]$

$\lim_{n\times\infty} \sum_{r=0}^{5n} \frac{1}{n+r} = \lim_{n\times\infty} \left[\frac{1}{n} \sum_{r=0}^{5n} \frac{n}{n+r}\right]$

$\lim_{n\times\infty} \left[\frac{1}{n} \sum_{r=0}^{5n} \frac{1}{1+(r/n)}\right]$

$= \int_0^5 \frac{1}{1+x}\, dx = [\log(1+x)]_0^5$

$= \log 6 - \log 1 = \log 6$

27. By eliminating the arbitrary constant A and B from $y = Ax^2 + Bx$, we get the differential equation

(A) $\frac{d^3y}{dx^3} = 0$ (B) $x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + 2y = 0$

(C) $\frac{d^2y}{dx^2} = 0$ (D) $x^2 \frac{d^2y}{dx^2} + y = 0$

Ans. (B)

Sol. Given, $y = Ax^2 + Bx$ .....(i)

On differentiating, we get

$$\frac{dy}{dx} = 2Ax + B$$

$$\Rightarrow \frac{d^2y}{dx^2} = 2A$$

$$\therefore \frac{dy}{dx} - \frac{d^2y}{dx^2} x = B$$

From eq. (i), we get

$$y = \frac{1}{2} \frac{d^2y}{dx^2} x^2 + x \left[\frac{dy}{dx} - \frac{d^2y}{dx} - \frac{d^2y}{dx^2} x\right]$$

$$\Rightarrow y = -\frac{1}{2} x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx}$$

$$\therefore x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + 2y = 0$$

28. If $f(x) = \frac{\log(1+ax) - \log(1-bx)}{x}$ for $x \neq 0$ and $f(0) = k$ and $f(x)$ is continuous at $x = 0$, then k is equal to

(A) a + b (B) a – b (C) a (D) b

Ans. (A)

Sol. Given, $f(x) = \frac{\log(1+ax) - \log(1-bx)}{x}$

f(x) is continuous at x = k and f(0) = k

$$\therefore \lim_{x\to 0} f(x) = \lim_{x\to 0} \frac{\log(1+ax) - \log(1-bx)}{x} \left(\frac{0}{0} \text{form}\right)$$

$$= \lim_{x\to 0} \left(\frac{1}{1+ax} a + \frac{b}{1-bx}\right)$$

$$= a + b$$

$$\therefore a + b = f(0) = k$$

29. If 4 – 5i is a root of the quadratic equation, $x^2 + ax + b = 0$, then (a, b) is equal to

(A) (8, 41) (B) (–8, 41) (C) (41, 8) (D) (–41, 8)

Ans. (B)

Sol. If $4 - 5i$ is root of $x^2 + ax + b = 0$, then $4 + 5i$ is also the root.

$\therefore$ Sum of roots $= -a - 8$

$\Rightarrow a = -8$

And product of roots $= 16 + 25$

$= b = 41$

$\therefore (a, b) = (-8, 41)$

30. If α and β are the roots of the quadratic equation $4x^2 + 3x + 7 = 7$, then the value of $\frac{1}{\alpha}+\frac{1}{\beta}$ is

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

Ans. (B)

Sol. Given equation can be rewritten as

$x^2 + \frac{3}{4}x + \frac{7}{4} = 0$

$\Rightarrow \alpha + \beta = -\frac{3}{4}$, $ab = \frac{7}{4}$

Now, $\frac{1}{\alpha}+\frac{1}{\beta}=\frac{\alpha+\beta}{\alpha\beta} = -\frac{3}{7}$

31. If α, β are the roots of $ax^2 + bx + c = 0$ and $\alpha + k, \beta + k$ are the roots of $px^2 + qx + r = 0$, then $\frac{b^2 - 4ac}{q^2 - 4pr}$ is equal to

(A) $\frac{a}{p}$ (B) 1 (C) $\left(\frac{a}{p}\right)^2$ (D) 0

Ans. (C)

Sol. Since, α, β are the roots of the equation

$ax^2 + bx + c = 0$

$$\left.\begin{aligned}\text{Then, } \alpha &= -\frac{b}{2a}+\frac{\sqrt{b^2-4ac}}{2a}\\ \text{and } \beta &= -\frac{b}{2a}-\frac{\sqrt{b^2-4ac}}{2a}\end{aligned}\right\} \quad \ldots\ldots. \text{(i)}$$

And $\alpha + k, \beta + k$ are the roots of the equation $px^2 + qx + r = 0$

Then, $\alpha + k - \frac{q}{2p}+\frac{\sqrt{q^2-4r}}{2p}$

$\Rightarrow k = -\frac{q}{2p}+\frac{\sqrt{q^2-4r}}{2p}+\frac{b}{2a}-\frac{\sqrt{b^2-4ac}}{2a}$

$$\Rightarrow \frac{\sqrt{q^2-4pr}}{2p} - \frac{\sqrt{b^2-4ac}}{2a}$$

$$= \frac{-\sqrt{q^2-4pr}}{2p} + \frac{\sqrt{b^2-4ac}}{2a}$$

$$\Rightarrow \frac{\sqrt{q^2-4pr}}{p} = \frac{\sqrt{b^2-4ac}}{a}$$

$$\Rightarrow \frac{q^2-4pr}{p^2} = \frac{b^2-4ac}{a^2}$$

$$\therefore \frac{b^2-4ac}{q^2-4qr} = \left(\frac{a}{p}\right)^2$$

32. Area of the triangle in the argand diagram formed by the complex number z, is z + iz, where z = x + iy is

(A) $|z|$ (B) $|z|^2$ (C) $2|z|^2$ (D) $\frac{1}{2}|z|^2$

Ans. (D)

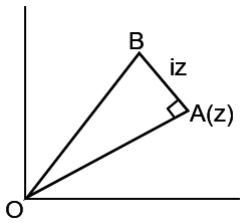
Sol. Since, $iz = ze^{i\pi/2}$

This implies that iz is the vector obtained by rotating vector z in anti-clockwise direction through 90°.

$\therefore$ OA $\perp$ AB

So, area of $\Delta OAB = \frac{1}{2}$ OA × OB

$$= \frac{1}{2}|z|\,|iz| = \frac{1}{2}|z|^2$$



33. The sum of n terms of the series $\frac{1}{2}+\frac{3}{4}+\frac{7}{8}+\frac{15}{16}+\ldots$.is

(A) $n - 1 + 2^{-n}$ (B) 1 (C) n – 1 (D) $1 + 2^{-n}$

Ans. (A)

Sol. Let S_n be the sum of first n terms of the series.

$$\therefore S_n = \frac{1}{2}+\frac{3}{4}+\frac{7}{8}+\frac{15}{16}+\ldots$$

$$\Rightarrow S_n = \left(1-\frac{1}{2}\right)+\left(1-\frac{1}{4}\right)+\left(1-\frac{1}{8}\right)+\ldots$$

$$S_n = n - \frac{1}{2}\frac{(1-1/2)}{2(1-1/2)} = n - 1 + \frac{1}{2^n}$$

$$\Rightarrow = n - 1 + 2^{-n}$$

34. 0.2 + 0.22 + 0.222 + … to n terms is equal to

(A) $\left(\frac{2}{9}\right) - \left(\frac{2}{81}\right)(1 - 10^{-n})$ (B) $n - \left(\frac{1}{9}\right)(1 - 10^{-n})$

(C) $\left(\frac{2}{9}\right)\left[n - \left(\frac{1}{9}\right)(1 - 10^{-n})\right]$ (D) $\left(\frac{2}{9}\right)$

Ans. (C)

Sol. 0.2 + 0.22 + 0.222 + …. n terms

= 2(0.1 + 0.11 + 0.111 + … n terms)

$= 2\left(\frac{1}{10} + \frac{1}{100} + \frac{111}{100} + ...n\text{terms}\right)$

$= \frac{2}{9}\left(\frac{9}{10} + \frac{99}{100} + \frac{999}{1000} + ...n\text{terms}\right)$

$= \frac{2}{9}\left(1 - \frac{1}{10} + 1 - \frac{1}{100} + 1 - \frac{1}{1000} + ...n\text{terms}\right)$

$= \frac{2}{9}\left[n - \left(\frac{1}{10} + \frac{1}{100} + \frac{1}{1000} + ...n\right)\right]$

$= \frac{2}{9}\left[n - \frac{1}{10}\frac{\left\{1 - \left(\frac{1}{10}\right)^{n}\right\}}{\left(1 - \frac{1}{10}\right)}\right]$

$= \frac{2}{9}\left[n - \frac{1}{10} \times \frac{10}{9} \cdot \left(\frac{10^{n} - 1}{10^{n}}\right)\right]$

$= \frac{2}{9}\left[n - \frac{1}{9}(1 - 10^{-n})\right]$

35. The number of ways in which a term of 11 players can be selected from 22 players including 2 of them and excluding 4 of them is

(A) ${}^{16}C_{11}$ (B) ${}^{16}C_{5}$ (C) ${}^{16}C_{9}$ (D) ${}^{20}C_{8}$

Ans. (C)

Sol. Number of required ways

$= {}^{24-4-2}C_{11-2} = {}^{16}C_{9}$

36. The number of ways four boys can be seated around a round table in four chairs of different colours is

(A) 24 (B) 12 (C) 23 (D) 64

Ans. (A)

Sol. ∴ Required number of ways

= 4! = 24

37. If the coefficient of second, third and fourth terms in the expansion of $(1 + x)^n$ are in AP, then n is equal to

(A) 7 (B) 4 (C) 5 (D) 6

Ans. (A)

Sol. Since, $T_2 = {}^nC_1$

And $T_3 = {}^nC_2x$, $T_4 = {}^nC_3x$

Also, T_2, T_3, T_4 are in AP.

$$\Rightarrow \frac{{}^nC_1 + {}^nC_3}{2} = {}^nC_2$$

$${}^nC_1 + {}^nC_3 = 2.\ {}^nC_2$$

$$\Rightarrow \frac{n!}{(n-1)!(1)!} + \frac{n!}{(n-3)!3!} = \frac{2n!}{2!(n-2)!}$$

$$\Rightarrow \frac{1}{(n-1)(n-2)} + \frac{1}{31} = \frac{1}{(n-2)}$$

$$\Rightarrow 1 + \frac{(n-1)(n-2)}{6} = (n-1)$$

$$\Rightarrow 6 + n^2 - 3n + 2 = 6n - 6$$

$$\Rightarrow n^2 - 3n - 6n + 8 + 6 = 0$$

$$\Rightarrow n^2 - 9n + 14 = 0$$

$$\Rightarrow (n-7)(n-2) = 0$$

$$\Rightarrow n = 7 \text{ or } 2$$

$$\therefore n = 7 \qquad (\because n \neq 2)$$

38. If $\Delta = \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = k\,(a-b)\,(b-c)\,(c-a)$, then k is equal to

(A) –1 (B) 1 (C) 2 (D) abc

Ans. (B)

Sol. $\Delta = \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = \begin{vmatrix} 1 & a & a^2 \\ 0 & b-a & b^2-a^2 \\ 0 & c-a & c^2-a^2 \end{vmatrix}$ (using $R_2 \to R_2 - R_1$ and $R_3 \to R_3 - R_1$)

$$= (b-a)\,(c-a) \begin{vmatrix} 1 & a & a^2 \\ 0 & 1 & b+a \\ 0 & 1 & c+a \end{vmatrix}$$

= (b – a) (c – a) (c + a – b – a)

$\Rightarrow$ (b – a) (c – a) (c – b)

= k (a – b) (b – c) (c – a) (given)

39. $\begin{vmatrix} a+b & a & b \\ a & a+c & c \\ b & c & b+c \end{vmatrix}$ is equal to

(A) 4abc (B) abc (C) $a^2b^2c^2$ (D) $4a^2bc$

Ans. (A)

Sol. $\begin{vmatrix} a+b & a & b \\ a & a+c & c \\ b & c & b+c \end{vmatrix} = \begin{vmatrix} b & -a & b-c \\ a & a+c & c \\ b & c & b+c \end{vmatrix}$ (by $R_1 \to R_1 - R_2$)

$= \begin{vmatrix} 2b & a & 2b \\ a & a+c & c \\ 2b & 0 & 0 \end{vmatrix}$ (by $R_1 \to R_1 + R_2$)

$= \begin{vmatrix} 2b & 0 & 2b \\ a & a+c & c-a \\ b & c & c \end{vmatrix}$ (by $C_3 \to C_3 - C_1$)

= 2b(ac + c^2 – c^2 + ac)=4abc

40. If $= \begin{vmatrix} x & a & b \\ b & x & a \\ a & b & x \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$ are the given determinants, then

(A) $\Delta_1 = 3(\Delta_2)^2$ (B) $\left(\frac{d}{dx}\right)(\Delta_1) = 3\Delta_2$

(C) $\left(\frac{d}{dx}\right)(\Delta_1) = 3(\Delta_2)^2$ (D) $\Delta_1 = 3(\Delta_2)^{\frac{3}{2}}$

Ans. (B)

Sol. Given, $\Delta = \begin{vmatrix} x & a & b \\ b & x & a \\ a & b & x \end{vmatrix}, \Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$

$\therefore \frac{d}{dx}(\Delta_1)$

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

$$= \begin{vmatrix} x & a \\ b & x \end{vmatrix} + \begin{vmatrix} x & b \\ a & x \end{vmatrix} + \begin{vmatrix} x & a \\ b & x \end{vmatrix} = 3\Delta_2$$

$$\therefore \frac{d}{dx}(\Delta_1) = 3\Delta_2$$

41. The system x + 4y–2z = 3, 3x +y +5z = 7 and 2x + 3y + = 5 has

(A)infinite number of solutions (B)unique solution

(C)trivial solution (D)no solution

Ans. (D)

Sol. Given system equations are

x + 4y – 2z = 3

3x + y + 5a = 7

And 2x + 3y + z = 5

$$\therefore \Delta = \begin{vmatrix} 1 & 4 & -2 \\ 3 & 1 & 5 \\ 2 & 3 & 1 \end{vmatrix}$$

=1(1 – 15) – 4(3 – 10) – 2(9 – 2)

= –14 + 28 – 14 =0

And $\therefore \Delta_2 = \begin{vmatrix} 1 & 3 & -2 \\ 3 & 7 & 5 \\ 2 & 5 & 1 \end{vmatrix} = 1 \neq 0$

No solution will exist.

42. If the three points (k,2k), (2k,3k) ,(3,1) are collinear, then k is equal to

(A) –2 (B) 1 (C) $\frac{1}{2}$ (D) $-\frac{1}{2}$

Ans. (A)

Sol. Area of triangle $= \frac{1}{2}\begin{vmatrix} k & 2k & 1 \\ 2k & 3k & 1 \\ 3 & 1 & 1 \end{vmatrix} = 0$

(using $R_2 \to R_2 - R_1$ and $R_3 \to R_3 - R_1$)

$$\Rightarrow \begin{vmatrix} k & 2k & 1 \\ k & k & 0 \\ 3-k & 1-2k & 0 \end{vmatrix} = 0$$

$\Rightarrow$ 1[k(1 – 2k) – k(3 – k)] = 0

$\Rightarrow$ k –2k^2 – 3k + k^2 = 0

$\Rightarrow$ –k^2 – 2k = 0

$\Rightarrow$ $-k(k+2)=0 \Rightarrow k=0,-2$

43. The foot of the perpendicular from the point (3,4) on the line $3x-4y+5=0$ is

(A) $\left(\frac{81}{25},\frac{92}{25}\right)$ (B) $\left(\frac{92}{25},\frac{81}{25}\right)$ (C) $\left(\frac{46}{26},\frac{54}{24}\right)$ (D) $\left(-\frac{81}{25},-\frac{92}{25}\right)$

Ans. (A)

Sol. Let M be the foot of perpendicular from (3,4) on the line $3x-4y+5=0$. Then, M is the point of intersection $3x-4y+5=0$ and line passing through P(3,4) and perpendicular to

$3x-4y+5=0$ .....(i)

Equation of the line perpendicular to

$3x-4y+5=0$ is $4x+3y+\lambda=0$

This passes through (3,4)

$\Rightarrow$ $12+12+\lambda$

$\Rightarrow$ $\lambda=-24$

Equation is $4x+3y-24=0$ .....(ii)

On solving equations (i) and (ii), we get

$y=92/25$

$x=81/25$

$\therefore$ Required point is $\left(-\frac{81}{25},-\frac{92}{25}\right)$.

44. A kite is flying at an inclination of 60° with the horizontal. If the length of the thread is 120 m, then the height of the kite is

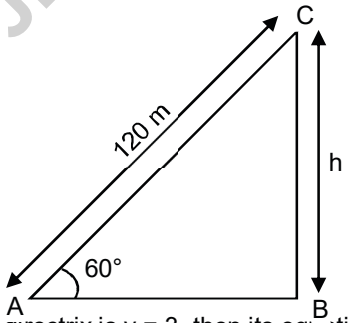
(A) $60\sqrt{3}$ m (B) 60 m (C) $\frac{60}{\sqrt{3}}$ m (D) 120 m

Ans. **(A)**

Sol. In D ABC, $\sin 60^\circ = \frac{h}{120}$

$\Rightarrow h=120\times\frac{\sqrt{3}}{2}$

$\therefore h=60\sqrt{3}$ m



45. If the focus of parabola is at (0 – 3) and its directrix is y = 3, then its equation is

(A) $x^2=-12y$ (B) $x^2=12y$ (C) $y^2=-12y$ (D) $y^2=12x$

Ans. (A)

Sol. Let (x.y) be any point on the parabola. Then, by definition

$\sqrt{(x-0)^2+(y+3)^2}=(y-3)$

$\Rightarrow x^2+(y+3)^2=(y-3)^2$

$\Rightarrow x^2+y^2+6y+9=y^2-6y+9$

$\Rightarrow x^2=-12y$

CHEMISTRY

Single correct answer type

1. The ionic conductance of Ba^{2+} and Cl^- are respectively 127 and 76 Ω^{-1} cm^2 at infinite dilution. The equivalent conductance (in Ω^{-1} cm^2) of $BaCl_2$ at infinite dilution will be

(A) 330 (B) 203 (C) 139.5 (D) 51

Ans. (C)

Sol. Λ_m^∞ for $BaCl_2 = \Lambda_m^\infty Ba^{2+} + 2\Lambda_m^\infty Cl^-$

$\therefore \Lambda_m^\infty$ for $BaCl_2 = \frac{1}{2}\Lambda_m^\infty Ba^{2+} + 2\Lambda_m^\infty Cl^-$

$= \frac{1}{2} \times 127 + 76$

$= 139.5\Omega^{-1}$ cm^2

2. If the elevation in boiling point of a solution of 10 g of solute (mol. wt. = 100) in 100 g of water is ΔT_b, the ebullioscopic constant of water is

(A) $\frac{\Delta T_b}{10}$ (B) ΔT_b (C) 10 ΔT_b (D) 100 ΔT_b

Ans. (B)

Sol. $m = \frac{1000 \times K_b \times w}{w \times \Delta T_b}$

Or $K_b = \frac{m \times W \times \Delta T_b}{1000 \times 10}$

$= \Delta T_b$

3. Given that;

$H_2O(l) \rightarrow H^+(aq) + OH^-(aq)$; $\Delta H = 57.32kJ$

$H2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l); \Delta H = -286.02kJ$

Then calculate the enthalpy of formation of OH^- at 25° C.

(A) –22.8kJ (B) –343.52kJ (C) +228.8 kJ (D) +343.52 kJ

Ans. (A)

Sol. Consider the formation of

$H2(g) + \frac{1}{2}O_2(g) \rightarrow H_2I(l); \Delta H = -286.20$ kJ

$$\Delta Hr = \Delta H_f(H_2O(l)) - \Delta H_f(H_2(g)) - \frac{1}{2}\Delta H_f(O_2(g))$$

$-286.20 = \Delta H_f(H_2O(l)) - 0 - 0$

$\therefore DH_f(H_2O(l) = -286.20$

Now consider the ionization of H_2O

$H_2O(l) \rightarrow H^+(aq) + OH^-(aq); \Delta H = 57.32$ kJ

4. Calculate the amount of heat evolved when 500 cm^3 of 0.1 M HCl is mixed with 200 cm^2 of 0.2 M NaOH.

(A) 57.3 kJ (B) 2.865 kJ (C) 2.292 kJ (D) 0.573 kJ

Ans. (C)

Sol. $HCl + NaOH \rightarrow NaCl + H_2O$

At t = 0,

Number of moles

$$= \frac{500 \times 0.1}{1000} \quad \frac{200 \times 0.2}{1000}$$

0.05 0.04

$\therefore$ During neutralisation of 1 mole of NaOH by 1 mole of HCl, heat evolved

$\therefore$ To neutralized 0.04, moles of NaOH by 0.04 mole of NaOH, heat evolved

= 57.3 ×0.4

= 2.292 kJ

5. Which of the following will be the most effective in the coagulation of $Fe(OH)_3$ sol?

(A) $Mg_3(PO_4)_2$ (B) $BaCl_2$ (C) NaCl (D) KCN

Ans. (A)

Sol. According to Hardy-Schulze rule, coagulation power of ions is directly proportional to charge onion.

$\therefore Fe(OH)_3$ is positively charged colloid.

$\therefore$ It will be coagulated by anion.

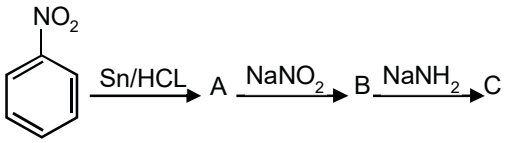
(a) $Mg_3(PO_4)_2 \rightarrow 3Mg^{2+} + 2PO_4^{3-}$ (B) $BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$

(C) $NaCl \rightarrow Na^+ + Cl^-$ (D) $KCN \rightarrow K^+ + CN^-$

$\because PO_4^{3-}$ has highest charge among the given anions.

$\therefore M\gamma(PO_4)_2$ is the most effective in coagulation of $Fe(OH)_3$ sol.

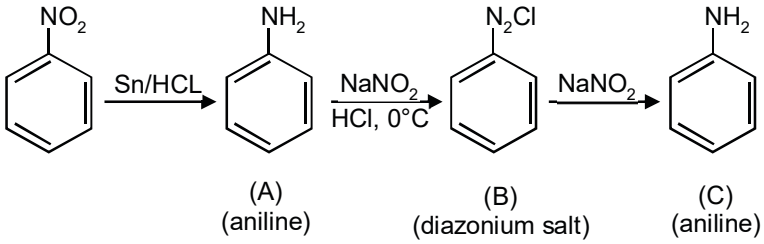
6. Identify 'C' in the following reaction;



(A) benzamide (B) benzoic acid (C) chlorobenzene (D) aniline

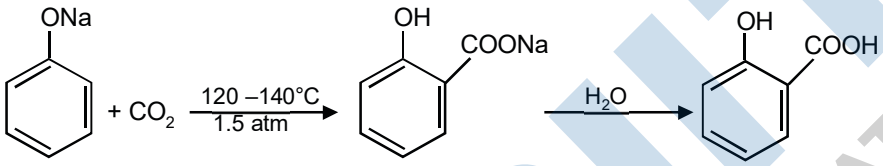
Ans. **(D)**

Sol.



(A) (aniline) (B) (diazonium salt) (C) (aniline)

7. The following reaction is known as



(A) Friedel-Craft reaction (B) Kolbe reaction

(C) Reamer-Tiemann reaction (D) Wittig reaction

Ans. (B)

Sol. At 120-140°C temperature and 1.5 atm pressure, sodium phenoxide reacts with CO_2 to yield sodium salicylate which on further hydrolysis gives salicylic acid.

8. Which of the following is isoelectronic of carbon?

(A) Na^+ (B) Al^{3+} (C) O^{2-} (D) N^+

Ans. (D)

Sol. Number of electrons in C = 6

Number of electrons in Al^{3+} = 13 – 3 = 10

Number of electrons in O^{2-} = 8 +2 =10

Number of electrons in N^+ = 7 – 1 = 6

$\therefore$ N^+ iso-electronic with C.

9. In which of the following species only one type of hybridization is present?

(A) $CH_3 - CH_2 - CH = CH_2$ (B) $CH3 - CH = CH - CH_2$

(C) $CH_2 = CH - CH = \overset{+}{C}H_2$ (D) $CH_3 - CH = CH - \overset{-}{C}H_2$

Ans. (C)

Sol. (a) $\underset{SP^3}{CH_3} - \underset{SP^3}{CH_2} - \underset{SP^2}{CH_2} = \underset{SP^2}{CH_2}$ (b) $\underset{SP^3}{CH_3} - \underset{SP^2}{CH} = \underset{SP^2}{CH} - \underset{SP^2}{\overset{+}{C}H_2}$

(c) $\underset{SP^2}{CH_2} = \underset{SP^2}{CH} - \underset{SP^2}{CH} = \underset{SP^2}{CH_2}$ (d) $\underset{SP^3}{CH_3} - \underset{SP^2}{CH} = \underset{SP^2}{CH} = \underset{SP^2}{\overset{-}{C}H_2}$

10. $2MnO_4^- + 5H_2 + 6H^6 \rightarrow 2Z + 50_2 + 8H_2O$, identify Z in the above reaction

(A) Mn^{2+} (B) Mn^{4+} (C) Mn (D) MnO_2

Ans. (A)

Sol. $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 50_2 + 8H_2O$

11. In the titration of NaOH and HCl, which of the following indicator will be used?

(A) Methyl orange (B) Methyl red

(C) Both (methyl orange) and (methyl red) (D) None of (methyl orange) and (methyl red)

Ans. (C)

Sol. In the titration of strong base with strong acid, we can use methyl orange, methyl red, phenolphthalein as indicator.

12. Which of the following is correct IUPAC name for $K_2[Cr(CN)_2O_2(O)_2NH_3]$?

(A) Potassium amminecyanoperoxodioxochromatic (IV)

(B) Potassium amminecyanoperoxodioxochromium (V)

(C) Potassium amminecyanoperoxodioxochromium (VI)

(D) Potassium amminedicyanodioxoper oxochromate (VI)

Ans. (D)

Sol. The IUPAC name of $K_2[Cr(CN)_2O_2(O)_2NH_3]$is potassium amminedicyanodioxoperoxochromate (VI).

13. Which of the following is process used for the preparation of acetone?

(A) Waber process (B) Wacker process

(C) Wolf-Kishner reduction (D) Gattermann-Koch synthesis

Ans. (B)

Sol. In Wacker process, when mixture of propane and air is passed through mixture of Pd and $CuCl_2$ at high pressure, acetone is formed.

$Pd + CuCL_2 \rightarrow PdCl_2 + 2CuCl$

$4CuCl + HCl + O_2 \rightarrow 4CuCl_2 + 2H_2O$

$CH_3CH = CH_2 + PdCl_2 + H_2O + \rightarrow C \rightarrow H_3COCH_3 + Pd + 2HCl$

propene

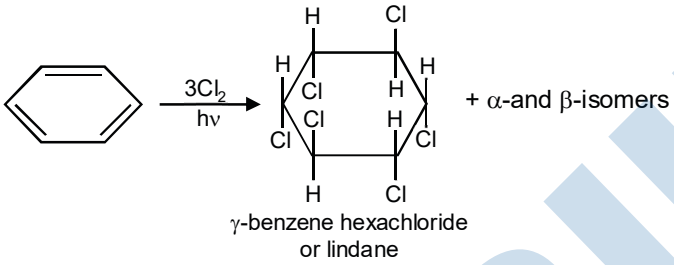
14. Lindane can be obtained by the reaction of benzene with

(A) CH_2Cl / anhydrous $AlCl_3$ (B) C_2H_4I / anhydrous $AlCl_3$

(C) CH_3COCl / anhydrous $AlCl_3$ (D) Cl_2 in sunlight

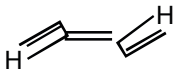
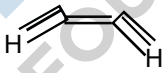
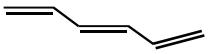
Ans. (D)

Sol. Lindane is γ -benzene hexachloride. It can be prepared by benzene with Cl_2 in sunlight.



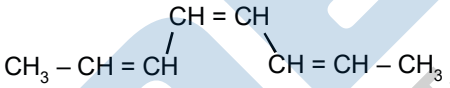
γ-benzene hexachloride
or lindane

15. The structure of cis-bis (propenyl) ethane is

(A)  (B)  (C)  (D) 

Ans. (B)

Sol. The two propenyl groups attached to 1,2 position of carbon in cis-form.



16. 5 moles of $Ba(OH)_2$ are treated with excess of CO_2. How much $BaCO_3$ will be formed?

(A) 39.4 g (B) 197 g (C) 591 g (D) 985 g

Ans. (D)

Sol. $Ba(OH)_2 + CO_2 \rightarrow BaCO_3 + H_2O$

$\therefore$ moles of $Ba(OH)_3$ = 5 moles of $BaCO_3$

$\therefore$ Mass of $BaCO_3$ = moles of $BaCO_3$ × molecules mass of $BaCO_3$

= 5 × 197

=958 g

17. A diatomic molecule has a dipole moment of 1.2 D. If its distance is 1.0 Å, what fraction of an electronic charge, exist on each atom?

(A) 25% of e (B) 50% of e (C) 60% of e (D) 75% of e

Ans. (A)

Sol. $\delta = \frac{\text{Dipole moment}}{d}$

$= \frac{1.2D}{1.0 \times 10^{-8} cm}$

$= \frac{1.2 \times 10^{-8} esu\,cm}{1.0 \times 10^{-8} cm}$

$= 1.2 \times 10^{-8}$ esu

The fraction of electronic charge, e is

$= \frac{1.2 \times 10^{-10} esu}{4.8 \times 10^{-8} esu}$

= 0.25e

=25% of e

18. A gas is heated through 1°C in a closed vessel and so the pressure increases by 0.4%. The initial temperature of the gas was

(A) –23°C (B) +23°C (C) 250°C (D) 523°C

Ans. (A)

Sol. Let $T_1 = T \Rightarrow T_2 = (T + 1)$

And $p_1 = p$ And $p_1 = p \Rightarrow p_2 = p + \frac{0.4p}{100} = \frac{100.4}{100}p$

Form $\frac{pV}{T} = \frac{p_2V_2}{T_2}$

$\frac{pV}{T} = \frac{100.4P}{100} \times \frac{V}{(T+1)}$

100T+ 100 = 100.4T

0.4T = 100

$T = \frac{100}{0.4} = 250$ K

= (250 – 273) °C

= –23°C

19. For 2NOBr(g) 2NO(g) + Br_2 (g) at equilibrium, $P_{Br_2} = \frac{p}{q}$ and p is the total pressure, the Ratio $\frac{Kp}{p}$ will be

(A) $\frac{1}{3}$ (B) $\frac{1}{9}$ (C) $\frac{1}{27}$ (D) $\frac{1}{81}$

Ans. (D)

Sol. 2NOB(g) □ 2NO(g)

20. The decomposition temperature is maximum for

(A) $MgCO_3$ (B) $CaCO_3$ (C) Ba CO_3 (D) $SrCO_3$

Ans. (C)

Sol. Barium salts are quite stable because of great electropositive nature of Ba. Hence, Ba compounds possess high decomposition temperature

21. When some amount of zinc is treated separately with excess of sulphuric acid and excess of sodium hydroxide solution, the ratio of volumes of hydrogen evolved is

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 2 : 3

Ans. (A)

Sol. $Zn + H_2SO \rightarrow ZnSO_4 + H_2 \uparrow$

$Zn + 2NaOH + \rightarrow Na_2ZnO_2 + H_2 \uparrow$

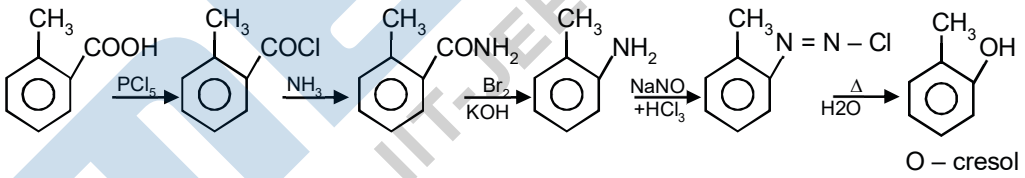
Hence, ratio of volumes of hydrogen evolved is 1:1.

22. A compound (A) when treated with PCl_5 and then ammonia gave (B). (B) when treated with bromine and caustic potash produced (C). (C) on treatment with $NaNO_2$ and HCl at 0°C and then boiling produce ortho-cresol. Compound (A)

(A) o-chlorotoluene (B) o-toluic acid (C) m-toluic acid (D) o-bromotoluene

Ans. (B)

Sol.



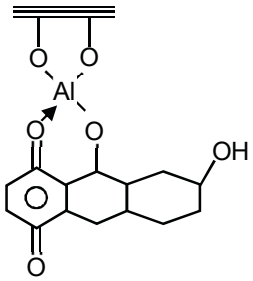
O – cresol

23. Alizarin is an example of

(A) triaryl dye (B) azo dye (C) vat dye (D) anthraquinone dye

Ans. (D)

Sol. Alizarin is an anthraquinone dye. It gives a bright red colour with aluminium and a blue colour with barium.



24. What will be the main product when acetylene with hypochlorous acid?

(A) Trichloro acetaldehyde (B) Acetaldehyde

(C) Dichloro acetaldehyde (D) Chloro acetaldehyde

Ans. (C)

Sol. $CH \equiv CH + HO^- Cl^+ \rightarrow \underset{\text{unstable}}{\overset{HO}{\underset{OH}{CH}} - \overset{Cl}{\underset{Cl}{CH}}} \xrightarrow{-H_2O} \underset{\text{2,2-dichloroacetaldehyde}}{\overset{Cl}{\underset{Cl}{CH}} - CHO}$

25. Barium titanate has the periovskite structure, i.e., a cubic lattice with Ba^{2+} ions at the corners of the unit cell, oxide ions at the face centres and titanium ions at the body centre. The molecular formula of barium titanate is

(A) $BaTiO_3$ (B) $BaTiO_4$ (C) $BaTiO_2$ (D) $BaTiO$

Ans. (A)

Sol. Number of Ba^{2+} ions at the corner of unit cell

$$= 8 \times \frac{1}{8} = 1$$

Number of O^{2-} ions at the face centre

$$= 6 \times \frac{1}{2} = 3$$

Number of Ti^{4+} ions at the body centre = 1

$\therefore$ Molecular formula of barium titanate

= $BaTiO_3$

26. Which of the following hormone, is responsible for the growth of animals?

(A) Auxin (B) Insulin (C) Adrenaline (D) Somatotropin

Ans. (D)

Sol. Somatotropin is the harmone, secreted by anterior lobe of pituitary gland. It is also called growth harmone as it stimulates protein synthesis, glycogenesis and some other biological activities. It deficiency causes midgets or dwarfism.

27. Which of the following have the largest ionic size?

(A) F^- (B) O^{2-} (C) Na^+ (D) Mg^{2+}

Ans. (B)

Sol. Number of electrons in F^- = 9 +1 = 10

Number of electrons in O^{2-} = 8 + 2 = 10

Number of electrons in Na+ = 11 – 1 =10

Number of electrons in Mg^{2+} = 12 – 2 =10

Since, F^-, O^{2-}, Na^+, Mg^{2+} are isoelectric and the size of isoelectric species decreases with increase in nuclear charge (i.e., number of protons), Hence correct order of size is $O^{2-} > f^- > Na^+ < Mg^{2+}$

28. If the radius of H is 0.53 Å then what will be the radius of $_3Li^{2+}$?

(A) 0.17 Å (B) 0.36 Å (C) 0.53 Å (D) 0.59 Å

Ans. (A)

Sol. The radius of hydrogen atom = 0.53 Å.$_3Li^{2+}$ ion also has only one electron but it has 3 protons in nucleus, hence, its electron feels three times more attraction from nucleus in comparison of hydrogen atom. Thus, the radius of $_3Li^{2+}$ will be

$$= \frac{0.53}{3} = 0.17\text{Å}$$

29. Which of the following will have highest value of pK_a?

(A) $FCH_{22}CH_2COOH$ (B) $CH_3CH \bullet F \bullet COOH$

(C) $CH_3CH \bullet Br \bullet COOH$ (D) CH_3CH_2COOH

Ans. (D)

Sol. $pK_a \propto \frac{1}{K_a}$

Stronger the acid, higher the K_a values and lower the pK_a value.

The order of acidity of given acids is as follows

$CH_3 < H \bullet F \bullet COOH > CH_3 \bullet CH \bullet Br \bullet COOH > FCH_2CH_2COOH > CH_3CH_2COOH$

Since, CH_3CH_2COOH is the weakest acid among the given, therefore its value will be highest.

30. $Gas(A) + NaOH \rightarrow B \xrightarrow{\Delta} C \xrightarrow{\Delta} D$ C and D decolourises acidified $KMnO_4$. Identify C and D.

(A) Na_2CO_3, NaOH

(B) $(COOH)_2$, $(COONa)_2$

(C) $(COONa)_2$, $(COOH)_2$

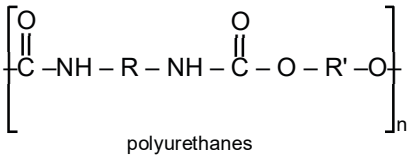
Ans. (C)

Sol. $\underset{A}{CO} + NaOH \rightarrow \underset{B}{HCOONa} \xrightarrow[-H_2]{\Delta} \underset{C}{(COONa)_2} \xrightarrow{H^+} \underset{D}{(COOH)_2}$

31. The polymer polyurethanes are formed by treating di-isocyanate with

(A) butadiene (B) isoprene (C) glycol (D) acrylonitrile

Ans. (C)

Sol. $O = C = N - R - N = C = O + HO - R' - OH \rightarrow$ 

di-isocyanate glycol polyurethanes

32. What will be the volume of O_2 at NTP liberated by 5 A current flowing for 193 s through acidulated water?

(A) 56 mL (B) 112 mL (C) 158 mL (D) 965 mL

Ans. (A)

Sol. $w = \frac{C \times t \times E}{F}$

$= \frac{5 \times 193 \times 8}{96500}$

$\therefore$ At NTP, volume of

$\therefore$ Volume of $0.08 g O_2 = \frac{22400 \times 0.08}{32}$

= 56 mL

33. CO_2 goes to air, causes green house effect and gets dissolved in water. What will be the effect on soil fertility and pH of the water?

(A) Increase (B) Decrease (C) Remain same (D) None of these

Ans. (B)

Sol. $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightarrow H^+ + HCO_3^-$

Here $[H^+]$ increases hence, pH decreases due to which soil fertility will also decreases.

34. $2N_2O_5 \rightarrow 4NO_2 + O_2$

If rate and rate constant for above reaction are 2.40×10^{-5} mol L^{-1} s^{-1} and $3 \times 10^{-5} s^{-1}$ respectively, then calculate the concentration of N_2O_5.

(A) 1.4 (B) 1.2 (C) 0.04 (D) 0.8

Ans. (D)

Sol. The reaction is of first order and for a first order reaction,

Rate, $R = k [N_2O_5]$

$2.4 \times 10^{-5} = 3 \times 10^{-5} \times [N_2O_5]$

$[N_2O_5] = \frac{2.4 \times 10^{-5}}{3 \times 10^{-5}}$

= 0.8 mol L^{-1}

35. The molecule BF_3 and NF_3 both are covalent compounds, but BF_3 is non-polar and NF_3 is polar. The reason is that

(A) boron is a metal and nitrogen is a gas in uncombined state.

(B) BF_3 bonds no dipole moment whereas NF_3 bond have dipole moment.

(C) atomic size of boron is smaller than that of nitrogen

(D) BF_3 is symmetrical molecule whereas NF_3 is unsymmetrical.

Ans. (D)

Sol. BF_3 is symmetrical planar, although it has polar bonds but resultant dipole moment is zero. In , NF_3 ,lone pair cause distortion, hence polarity arises.

36. 1.2 % NaCl solution is isotonic with 7.2% glucose solution. What will be the van't Hoff factor, i?

(A) 0.5 (B) 1 (C) 2 (D) 6

Ans. (C)

Sol. For NaCl pV=nST × i

$$pi \times \frac{100}{1000} = \frac{1.2}{58.5} \times 0.0821 \times T \ldots(i)$$

For glucose, pV = nST

$$p_2 \times \frac{100}{1000} = \frac{7.2}{180} \times 0.0821 \times T \ldots(ii)$$

$\therefore$ NaCl and glucose solutions are isotonic

$\therefore p_1 = p_2$

On dividing Eq. (i) by (ii), we have

$$i = \frac{7.2}{180} \times \frac{58.5}{1.2} = 1.95 = 2$$

37. Green vitriol is

(A) ferrous sulphate (B) tin oxide (C) zinc oxide (D) ferrous carbonate

Ans. (A)

Sol. $FeSO_4 \cdot 7H_2O$ is known as green vitriol.

38. 2-bromopentane with alcoholic KOH yields a mixture of three alkenes. Which of the following alkene is predominant?

(A) 1-pentene (B) Cis-2-pentene (C) Trans-2-pentene (D) Cis-1-pentene

Ans. (C)

Sol. $CH_3CH_2CH_2\underset{\underset{Br}{|}}{CH}\,CH_3 \xrightarrow{C_2H_5OK} CH_3CH_2CH_2CH = CH_2 + CH_3CH_2\,CH = CHCH_3$

By Sautzeff's rule, substituted alkenes are more stable. Hence, out of cis and trans forms, trans product is more stable.

39. In which of the following compounds, the bond length between hybridized carbon atom and other carbon atom is minimum?

(A) Butane (B) Propyne (C) Propene (D) Butane

Ans. (B)

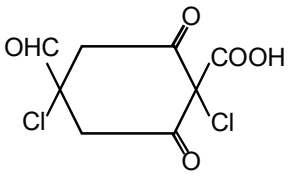
Sol. We know C – C bond length = 1.54 Å

That C = C bond length = 1.34 Å

C ≡ C bond length = 1.20 Å

Since, propyne has triple bond, therefore, it has minimum bond length.

40. Which of the following IUPAC name of compound?



(A) 1, 4-dichloro-2, 6-dioxo-4-carbonyl-1-oic acid

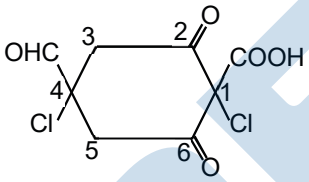
(B) 2,4-dioxo-1, 4-dichlorohexane-1-carboxylic acid

(C) 1-,-dichloro-2, 4, 6-dioxocyclohexane-1-carboxylic acid

(D) 1, 4-dichloro-4-formyl-2, 6-dioxy-cyclohexane-1-carboxylic acid

Ans. (D)

Sol. Hence IUPAC name is 1, 4-dichloro-4-formuyl 2, 6-dioxy –cyclohexane-1-carboxylic acid.



PHYSICS

Single correct answer type:

1. A straight wire of mass 200 g and length 1.5 m carries a current of 2A. It is suspended in mid-air by a uniform horizontal magnetic field B. The magnitude of B (in tesla) is (assume g = 9.8 ms^{-2})

(A) 2 (B) 1.5 (C) 0.55 (D) 0.65

Ans. (D)

Sol. Magnetic force on straight wire

$F = BiL \sin\theta = BiL \sin 90° = BiL$

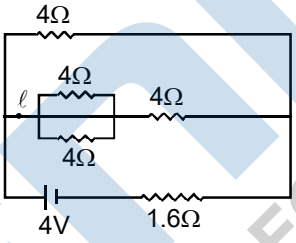
For equilibrium of wire in mid-air,

$F = mg$

$BiL = mg$

$$\therefore B = \frac{mg}{BiL} = \frac{200\times10 - 3\times9.8}{2\times1.5} = 0.65\,T$$

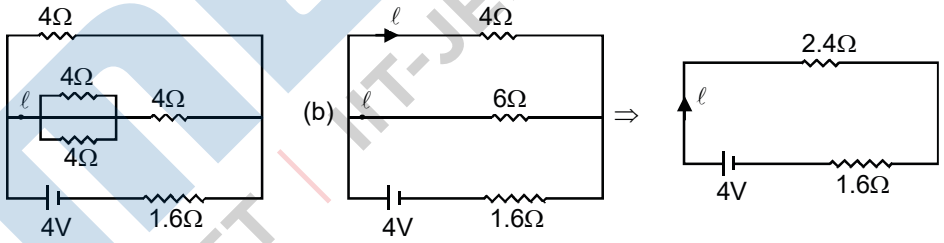
2. In the circuit shown the value of in ampere is



(A) 1 (B) 0.60 (C) 0.4 (D) 1.5

Ans. (C)

Sol.



So, net resistance,

$R = 2.4 + 1.6 = 4.0\ \Omega$

Therefore, current from the battery

$$i = \frac{V}{R} = \frac{4}{4} = 1A$$

Now, from the circuit (b)

$4\ell' = 6\ell$

$$\Rightarrow I' = \frac{3}{2}\ell$$

But $i = I + I' - I + \frac{3}{2}I = \frac{5}{2}I$

$$\therefore 1 = \frac{5}{2}I$$

$$\Rightarrow I = \frac{5}{2} - 0.4\,A$$

3. When light of wavelength 300 nm falls on a photoelectric emitter, photoelectrons are liberated. For another emitter, light of wavelength 600 nm is sufficient for liberating photoelectrons. The ratio of the work function of the two emitters is

(A) 1 : 2 (B) 2 : 1 (C) 4 : 1 (D) 1 : 4

Ans. (B)

Sol. Work function is given by

$$\phi = \frac{hc}{\lambda} \text{ or } \phi \propto \frac{1}{\lambda}$$

$$\because \frac{\phi_1}{\phi_2} = \frac{\lambda_2}{\lambda_1}$$

$$= \frac{600}{300} = \frac{2}{1}$$

4. A monatomic gas is suddenly compressed to $\left(\frac{1}{8}\right)$ th of its initial volume adiabatically. The ratio of its final pressure to the initial pressure is (Given, the ratio of the specific heats of the given gas to be 5/3)

(A) 32 (B) 40/3 (C) 24/5 (D) 8

Ans. (A)

Sol. In an adiabatic process,

$$PV^{\gamma} = \text{constant}$$

$$\Rightarrow \frac{p_1}{p_2} = \left(\frac{v_2}{v_1}\right)^{\gamma}$$

$$\Rightarrow \frac{p_1}{p_2} = \left(\frac{1}{8}\right)^{5/3}$$

$$\Rightarrow \frac{p_1}{p_2} = \left(\frac{1}{2^3}\right)^{5/3}$$

$$= \frac{1}{32}$$

$$\therefore \frac{p_2}{p_1} = 32$$

5. The intensity of the magnetic induction field at the centre of a single turn circular coil of radius 5 cm carrying current of 0.9 A is

(A) $36\pi \times 10^{-7}$ T (B) $9\pi \times 10^{-7}$ T (C) $36\pi \times 10^{-6}$ T (D) $9\pi \times 10^{-6}$ T

Ans. (A)

Sol. The intensity of magnetic induction field

$$B = \frac{\mu_0 i}{2r}$$

$$= \frac{4\pi \times 10^{-7} \times 0.9}{2 \times 5 \times 10^{-2}}$$

$$B = 36\pi \times 10^{-7} \text{ T}$$

6. A capacitor of capacity of 0.1 μF connected in series to a resistor of 10 m Ω is charged to a certain potential and then made to discharge through resistor. The time in which the potential will take to fall to half its original value is

(Given, $\log_{10} 2 = 0.3010$)

(A) 2s (B) 0.693 s (C) 0.5 s (D) 1.0 s

Ans. (B)

Sol. By equation of charging,

$$q = q_0(1 - e^{-t/CR})$$

According to question,

$$\frac{q}{q_0} = \frac{1}{2} = 0.50$$

$$\therefore 0.50 = 1 - e^{-t/CR}$$

$$e^{-t/CR} = 1 - 0.50 = 0.50$$

$$e^{-t/CR} = 2$$

$$\text{or } \frac{1}{CR} \log_e 2$$

$$\text{or } \frac{t}{CR} = 2.3026 \log_{10} 2$$

$$\text{or } t = CR \times 2.3026 \log_{10} 2$$

$$\text{or } t = CR \times 2.3026 \log_{10} 2$$

$$\text{or } t = 0.1 \times 10^{-6} \times 10 \times 10^{6} \times 2.3026 \log_{10} 2$$

$$\text{or } t = 2.3026 \times 0.3010$$

$$\text{or } t = 0.693 \text{ s}$$

7. If the force is given by $F = at + bt^2$ with t as time. The dimensions of a and b are

(A) $[MLT^{-4}]$ $[MLT^{-2}]$ (B) $[MLT^{-3}]$ $[MLT^{-4}]$ (C) $[ML^2T^{-3}]$ $[ML^2T^{-2}]$ (D) $[ML^2T^{-3}]$ $[ML^3T^{-4}]$

Ans. (B)

Sol. Dimension of at =Dimension of F

$[at] = [F]$

$$[a] = \left[\frac{F}{t}\right]$$

$$[a] = \left[\frac{MLT^{-2}}{T}\right]$$

$[a] = [MLT^{-3}]$

Dimension of bt^2 = Dimension of F

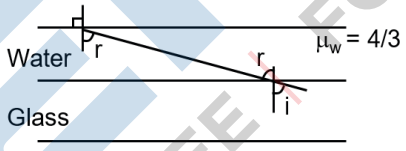
$[bt^2]$ $[F]$

$$[b] = \left[\frac{F}{t^2}\right]$$

$$[b] = \left[\frac{MLT^{-2}}{T^2}\right]$$

$[b] = [MLT^{-4}]$

8. A ray of light is incident on the interface between water and glass at an angle I and refracted parallel to the water surface, then value of μg will be



(A) (4/3) sin i (B) $\frac{1}{\sin i}$ (C) $\frac{4}{3}$ (D) 1

Ans. (B)

Sol. $${}_g\mu_w = \frac{\sin i}{\sin r}$$

$${}_g\mu_a = \frac{\sin r}{\sin 90^\circ}$$

$$\Rightarrow {}_g\mu_w = \times \quad {}_w\mu_a = \frac{\sin i}{\sin r} \times \frac{\sin r}{\sin 90^\circ} = \sin i$$

$$\text{or } \frac{\mu_w}{\mu_g} \times \frac{\mu_a}{\mu_w} = \sin i$$

$$\Rightarrow \mu_g = \frac{1}{\sin i}$$

9. A body is moved in straight line by constant power of machine. What will be the relation between the travelling distance and time?

(A) $s^2 \propto t^3$ (B) $s^2 \propto t$ (C) $s^3 \propto t^2$ (D) $s \propto t^3$

Ans. (A)

Sol. Power = $[ML_2T^{-3}]$ = constant

$$\therefore \left[\frac{ML^2}{T^2}\right] = \text{constant}$$

$\therefore [L^2] \propto [T^3]$

Or $S^2 \propto t^3$

10. Magnetic moment of bar magnet is M. The work done to turn the magnet by 90° of magnet in direction of magnetic field B will be

(A) Zero (B) $\frac{1}{2}$MB (C) 2MB (D) MB

Ans. (D)

Sol. Work done,

$W = MB(1 - \cos\theta)$

$\theta = 90°$

$\therefore W = MB$

11. Voltage V and current I in AC circuit are given by

$V = 50\sin(50t)$ volt

$$i = 50\sin\left(50t + \frac{\pi}{3}\right)\text{mA}$$

The power dissipated in circuit is

(A) 5.0 W (B) 2.5 W (C) 1.25 W (D) zero

Ans. (C)

Sol. Given, $V = 50\sin(50t)$ V

Maximum voltage, $V_0 = 50$ V

$$i = i_0\sin\left(50t + \frac{\pi}{3}\right)\text{mA}$$

Maximum current, $i_0 = 50\text{mA} = 50 \times 10^{-3}$ A

Power dissipated, $p = \frac{i_0}{\sqrt{2}} \times \frac{v_0}{\sqrt{2}}$

$$= \frac{50 \times 50 \times 10^{-3}}{2}$$

$$= \frac{2500 \times 10^{-3}}{2} = 1.25\,\text{W}$$

12. A simple wave motion represents by $y = 5\left(\sin 4\pi t + \sqrt{3}\cos 4\pi t\right)$. Its amplitude is

(A) 5 (B) $5\sqrt{3}$ (C) $10\sqrt{3}$ (D) 10

Ans. (D)

Sol. $y = 5\left(\sin 4\pi t + \sqrt{3}\cos 4\pi t\right)$

$y = 5\left(\sin 4\pi t + 5\sqrt{2}\cos 4\pi t\right)$

$A = \sqrt{A_1^2 + A_2^2}$

$A = \sqrt{(5)^2 + \left(5\sqrt{3}\right)^2}$

$= \sqrt{25+75} = \sqrt{100} = 10$

13. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantities or water flowing out per second from the two holes are the same. Then, the value of R is

(A) $\frac{L}{\sqrt{2\pi}}$ (B) $2\pi L$ (C) $L\sqrt{\frac{2}{\pi}}$ (D) $\frac{L}{2\pi}$

Ans. (A)

Sol. By the principle of continuity

$A_1v_1 = A_2v_2$

According to question, $A_1 = L^2$

$v_1 = \sqrt{2gy}$

And $A_2 = \pi R^2$

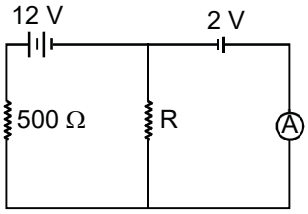
$v_2 = \sqrt{2g4y}$

$\therefore L^3\sqrt{2gy} = \pi R^2\sqrt{2g4y}$

Or $L^2 = 2\pi R^2$

or $R = \frac{L}{\sqrt{2\pi}}$

14. In the circuit shown below, the ammeter reading is zero. Then, the value of the resistance R is



(A) 50 Ω (B) 100 Ω (C) 200 Ω (D) 400 Ω

Ans. (B)

Sol. Given that

In loop (1)

$12 - 500i_1 - Ri_1 = 0$

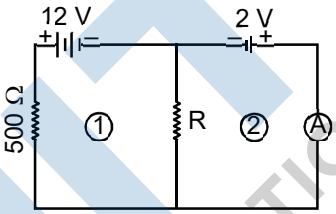
$\Rightarrow 12 = i1\,(500 + R)$ ...(i)

In loop (2)

$12 - 500i_1 - 2 = 0$

$\Rightarrow 10 = 500i_1$

$\text{or } i_1 = \frac{1}{50}A$ ...(ii)



From equations (i) and (ii)

$12 \times \frac{1}{i_1} = (500 + R)$

$\Rightarrow 12 \times 50 = 500 + R$

$\Rightarrow R = 100\ \Omega$

15. The dimensional formula for inductance is

(A) $[ML^2T^{-2}A^{-2}]$ (B) $[ML^2TA^{-2}]$ (C) $[ML^2T^{-1}A^{-2}]$ (D) $[ML^2T^{-2}A^{-2}]$

Ans. (A)

Sol. EMF induced in an electrical circuit

$e = L\frac{dI}{dt}$ (numerically)

$\text{or } L = e\frac{dt}{dI}$

$\frac{W}{Q} \cdot \frac{dt}{dI} \quad \left(\therefore e = V = \frac{w}{Q}\right)$

$= \frac{Wdt}{It \cdot d\ell} = \frac{[ML^2T - 2][T]}{[A][T][A]}$

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

16. The maximum current that can be measured by a galvanometer of resistance 40 Ω is 10 mA. It is converted into a voltmeter that can read upto 50V. The resistance to be connected in series with the galvanometer (in ohms) is

(A) 2010 (B) 4050 (C) 5040 (D) 4960

Ans. (D)

Sol. To convert a galvanometer into voltmeter, the necessary value of resistance to be connected in series with the galvanometer is

$$R = \frac{V}{I_g} - G$$

$$= \frac{50}{10 \times 10^{-3}} - 40$$

$= 5000 - 40 = 4960\ \Omega$

17. For a given velocity, a projectile has the same range R for two angles of projection if t_1 and t_2 are the time of flight in the two case, then

(A) $t_1 t_2 \propto R$ (B) $t_1 t_2 \propto R^2$ (C) $t_2 t_2 \propto \frac{1}{R^2}$ (D) $t_1 t_2 \propto \frac{1}{R}$

Ans. (A)

Sol. $t_1 = \frac{2u\sin g\alpha}{g}$

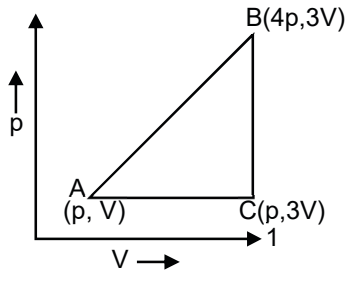
$$t_2 = \frac{2u\sin(90° - \alpha)}{g}$$

$$So, t_1 \times t_2 = 2\frac{u^2}{g^2}\sin 2\alpha$$

$$or, t_1 \times t_2 = \frac{2R}{g} \quad \left(\therefore R = \frac{u^2 \sin 2\alpha}{g}\right)$$

$t_1 \times t_2 \propto R$

18. A sample of ideal monoatomic gas is taken round the cycle ABCA as shown in the figure. The work done during the cycle is



(A) 3 pV (B) zero (C) 9 pV (D) 6 pV

Ans. (A)

Sol. The work done = area of p-V graph

= area of triangle ABC

$$= \frac{1}{2} \times 3p \times 2V = 3pV$$

19. A sound source is moving towards stationary listener with $\frac{1}{20}$th of the speed of sound. The ratio of apparent to real frequency is

(A) $\left(\frac{9}{10}\right)^2$ (B) $\frac{10}{9}$ (C) $\frac{11}{10}$ (D) $\left(\frac{11}{10}\right)^2$

Ans. (B)

Sol. Given, $n_s = \frac{n}{10}$

Apparent frequency $n' = n\left(\frac{v}{v - v_s}\right)$

Where, n = real frequency of source

v =velocity of sound

v_s = velocity of source

So, $\frac{n'}{n} = \frac{v}{v\frac{v}{10}} = \frac{10}{9}$

20. A satellite is in a circular orbit round the earth at an altitude R above the earth's surface, where R is the radius of the earth. If g is the acceleration due to gravity on the surface of the earth, the speed of the satellite is

(A) $\sqrt{2Rg}$ (B) $\sqrt{Rg}$ (C) $\sqrt{\frac{Rg}{2}}$ (D) $\sqrt{\frac{Rg}{4}}$

Ans. (C)

Sol. Orbital velocity (v_0) at a height h above the earth's surface is given by

$$v_0 = R_e\sqrt{\frac{g}{R_e + h}}$$

Given, $h = R_e$

$$\therefore v_0 = R\sqrt{\frac{g}{2R}}$$

$$= \sqrt{\frac{2g}{2}}$$

21. A 10 kg stone is suspended with a rope of breaking strength 30 kg.wt. The minimum time in which the stone can be raised through a height 10 m starting from rest is

(Taking g = 10 Nkg $^{-1}$)

(A) 0.5 s (B) 1.0 s (C) $=\sqrt{\frac{2}{3}}s$ (D) 2.0 s

Ans. (B)

Sol. Tension in the string, T= mg

= 30 × 10

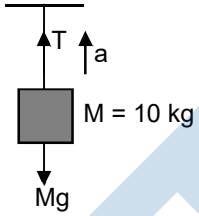
= 300 N

T – Mg = Ma

From the figure

300 – 10 × 10 = 10a

$\therefore$ a = 20 ms^{-2}



Thus, the maximum acceleration with which the stone can be raised is 20 ms^{-2}.

Given, s = 10 m

And u = 0

$\therefore 10=\frac{1}{2}(20)t^2$

$\Rightarrow$ t = 1s

22. How much work must be done by a force on 50 kg body in order to accelerate it from rest to 20 m/s in 10s?

(A) 10^3J (B) 10^4j (C) 2×10^3J (D) 5×10^4J

Ans. (B)

Sol. Now, $s=ut+\frac{1}{2}at^2$

$s=0+\frac{1}{2}\times 10\times 10$

S = 100 m

Hence, work done

W = F × s

W =ma × s

$\therefore$ W = 50 × 2 × 100

W = 10000 = 10^4J

23. A and B are two metals with threshold frequencies 1.8×10^{14} Hz and 2.2×10^{14}Hz. Two identical photons of energy 0.825 eV are incident on them. Then photoelectrons are emitted by

(Taking h = 6.6×10^{-34} J-s)

(A) B alone (B) A alone (C) Neither A nor B (D) Both A and B

Ans. (B)

Sol. Threshold energy of A is

$E_A = hv_A$

$= 6.6 \times 10^{-34} \times 1.8 \times 10^{14}$

$= 11.88 \times 10^{-20}$J

$= \frac{11.88 \times 10^{-20}}{1.6 \times 10^{-19}}$eV

=0.74 eV

Similarly, E_B=0.91 eV

Since, the incident photons have energy greater than E_A but less than E_B.

So, photoelectrons will be emitted from metal A only.

24. The square of resultant of two equal forces is three times their product. Angle between the forces is

(A) π (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$

Ans. (D)

Sol. Let be the angle between vectors P and B

Whose resultant is R.

Hence, P = Q and $R^2 = 3PQ = 3P^2$

As $R^2 = P^2 + Q^2 + 2PQ \cos\theta$

$\therefore 3P^2 + P^2 + P^{2+} 2P^2 \cos\theta$

or $3P^2 - 2P^2 = 2P^2 \cos\theta$

or $P^2 = 2P^2 \cos\theta$

or $1 = 2\cos\theta$

$\therefore \cos\theta = \frac{1}{2}, \text{thus} \cos\theta = \cos 60°$

or $\theta = 60° = \frac{\pi}{3}$

25. An object placed on a ground is in stable equilibrium. If the objects is given a slight push, then initially the position of centre of gravity

(A) moves nearer to ground (B) rises higher above the ground

(C) Remains as such (D) May remain at same level

Ans. (B)

Sol. In stable equilibrium, the centre of gravity of object, lies at minimum height from ground. As the object is given a slight push, its centre of gravity rises because it comes in unstable equilibrium.

26. The maximum height attained by a projectile when thrown at an angle with the horizontal is found to be half the horizontal range. Then, θ is equal to

(A) $\tan^{-1}(2)$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\tan^{-1}\left(\frac{1}{2}\right)$

Ans. (A)

Sol. Minimum height, $H_0 = \frac{u^2 \sin^2\theta}{2g}$

Range, $R = \frac{u^2 \sin 2\theta}{g}$

Given, $H_0 = \frac{R}{2}$

$\therefore \frac{u^2 \sin^2\theta}{2g} = \frac{u22\sin\theta\cos\theta}{2g}$

$\Rightarrow \sin\theta = 2\cos\theta$

$\Rightarrow \tan\theta = 2$

$\therefore \theta = \tan^{-1}(2)$

27. A shell of mass 20 kg at rest explodes into two fragments whose masses are in the ratio 2 : 3. The smaller fragment moves with a velocity of 6 ms^{-1}. The kinetic energy of the larger fragment is

(A) 96 J (B) 216 J (C) 144 J (D) 360 J

Ans. (A)

Sol. Total mass of the shell =20 kg

Ratio of the masses of the fragments = 2 : 3

$\therefore$ Masses of the fragments are 8 kg and 12 kg

Now, according to the conservation of momentum

$m_1v_1 = m_2v_2$

$\therefore 8 \times 6 = 12 \times v$

v (velocity of the larger fragment) =4 m/s

Kinetic energy $= \frac{1}{2}mv^2$

$= \frac{1}{2} \times 12 \times (4)^2 = 96J$

28. If the displacement of simple pendulum at any time is 0.02 m and acceleration is 2 m/s^2, then in this time angular velocity will be

(A) 100 rad/s (B) 10 rad/s (C) 1 rad/s (D) 0.1 rad/s

Ans. (B)

Sol. Acceleration $|a|=\omega^2 x$

or $\omega = \sqrt{\frac{a}{x}}$

$= \sqrt{\frac{2}{0.002}}$

= 10 rad/s

29. Which is constant, the earth revolving around the sun?

(A) Angular momentum (B) Linear momentum

(C) Rotational kinetic energy (D) Kinetic energy

Ans. (A)

Sol. Kepler's second law

$\frac{dA}{dt} = \frac{L}{2m}$

$\frac{dA}{dt} = \text{constant}$

L = constant

30. In non-elastic collision,

(A) momentum is conserved (B) energy is conserved

(C) momentum and energy are conserved (D) momentum and energy are non-conserved

Ans. (D)

Sol. Momentum is conserved is non-elasticity collision but kinetic energy is not conserved.

31. A mica slit of thickness t and refractive index μ is introduced in the ray from the first source S_1. By how much distance of fringes pattern will be displaced?

(A) $\frac{d}{D}(\mu-1)t$ (B) $\frac{D}{d}(\mu-1)t$ (C) $\frac{d}{(\mu-1)D}$ (D) $\frac{D}{t}(\mu-1)$

Ans. (B)

Sol. Fringe displacement $x_0 = \frac{D(\mu-1)t}{d}$

32. The refractive index of water is 4/3 and that of glass is 4/3. What will be the critical angle for the ray of light entering water from the glass?

(A) $\sin^{-1}\left(\frac{4}{5}\right)$ (B) $\sin^{-1}\left(\frac{5}{4}\right)$ (C) $\sin^{-1}\left(\frac{1}{2}\right)$ (D) $\sin^{-1}\left(\frac{2}{1}\right)$

Ans. (A)

Sol. $\mu = \frac{\mu_1}{\mu_2} = \frac{5/3}{4/3} = \frac{5}{4}$

$\sin C = \frac{1}{\mu} = \frac{4}{5}$

33. The produced rays in sonography are

(A) microwaves (B) infrared wave (C) sound waves (D) ultra sound

Ans. (D)

Sol. The produced rays in sonography ultra sound.

34. The ratio of secondary of primary turns of step up transformer is 4 : 1. If a current of 4A is applied to the primary, the induced current in secondary will be

(A) 8 A (B) 2 A (C) 1 A (D) 0.5 A

Ans. (C)

Sol. $\frac{I_s}{I_p} = \frac{N_p}{N_s} = \frac{1}{4}$

$I_s = \frac{1}{4} \times 4 = 1A$

35. The minimum force required to move a body up an inclined plane is three times the minimum force required to prevent it from sliding down the plane. If the coefficient of friction between the body and the inclined plane is $\frac{1}{2\sqrt{3}}$, the angle of the inclined plane is

(A) 60° (B) 45° (C) 30° (D) 15°

Ans. (C)

Sol. Minimum force required to move a body up a rough inclined plane

$F_1 = mg(\sin\theta + \mu\cos\theta)$

Minimum force required to prevent the body from sliding down the rough inclined plane.

$F_2 = \mu mg\cos\theta$

According to question,

$F_1 = 3F_2$

$\therefore$ mg (sin θ + μ cos θ) = 3 (μ cos θ)

sin θ + μ cos θ = 3μ cos θ

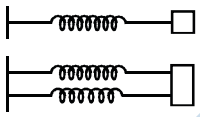
sin θ = 2μ cos θ

$= 2 \times \frac{1}{2\sqrt{3}} = \frac{1}{\sqrt{3}}$

= tan 30°

θ = 30°

36. If k_s and k_p respectively are effective spring constant in series and parallel combination of springs as shown in figure, find $\frac{k_s}{k_p}$



(A) $\frac{9}{2}$ (B) $\frac{3}{7}$ (C) $\frac{2}{9}$ (D) $\frac{7}{3}$

Ans. (C)

Sol. The effective spring constant k_s of this arrangement is

$\frac{1}{k_s} = \frac{1}{k} + \frac{1}{2k}$

$\frac{1}{k_s} = \frac{2+1}{2k} = \frac{3}{2k}$

$k_s = \frac{2k}{3}$

The effective spring constant k_s of this arrangement is

$k_p = k_1 + k_2$

= k + 2k = 3k

$\therefore \frac{k_s}{k_p} = \frac{2k/3}{3k} = \frac{9}{3}$

37. The power dissipated across resistance R which is connected across a battery of potential V is P. If resistance is doubled, then the power becomes

(A) 1/2 (B) 2 (C) 1/4 (D) 1

Ans. (A)

Sol. Electric power

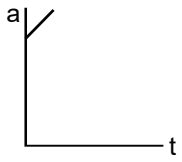
$p = \frac{v^2}{R}$

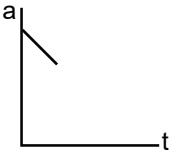
Or $p \propto \frac{1}{R}$

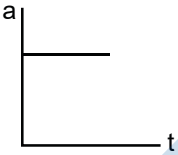
Or $\frac{P_2}{P_1} = \frac{R_1}{R_2} = \frac{R}{2_R}$

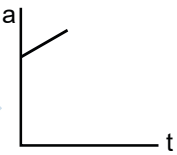
$P_2 = \frac{P}{2}$

38. A body moves with uniform acceleration then which of the following graph is correct?

(A) 

(B) 

(C) 

(D) 

Ans. (C)

Sol. An object is said to be moving with a uniform acceleration, if its velocity change by equal amount in equal intervals of time. The velocity-time graph of uniformly accelerated motion is a straight line inclined to time axis. Acceleration of an object in a uniformly accelerated motion in one dimension is equal to the slope of the velocity-time graph with time axis.

39. The rate at which a black body emits radiation at a temperature T is proportional to

(A) $\frac{1}{T}$ (B) T (C) T^3 (D) T^4

Ans. (D)

Sol. From Stefan's law the rate of emission of energy per unit surface area of a black body is inversely proportional to the fourth power of absolute temperature (T) of the body.

$E = \sigma T^4$ (σ = Stefan's constant)

40. Two equal charges q are kept fixed at a and +a along the x-axis. A particle of mass m and charge is brought to the origin and given a small displacement along the x-axis, then

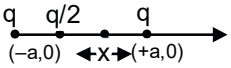
(A) the particle executes oscillatory motion (B) the particle remains stationary

(C) the particle executes SHM along x-axis (D) the particle executes SHM along y-axis

Ans. (C)

Sol. From Coulomb's law

$F = \frac{1}{4\pi\varepsilon_0} = \frac{q_1 q_2}{r^2}$



$F = \frac{1}{4\pi\varepsilon_0} = \frac{q \times \frac{q}{2}}{(a+x)^2} - \frac{1}{4\pi\varepsilon_0} \cdot \frac{q \times \frac{q}{2}}{(a-x)^2}$

$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{2}\left[-\frac{4ax}{\left(a^2 - x^2\right)^2}\right]$$

When << a, then

$$F \propto = -\frac{2q^2}{4\pi\varepsilon_0 a^3} x$$

$\Rightarrow F \propto -x$

Hence, SHM along x-axis