

Q:1

Topic Name:Mathematics-Section A

|                                                                                                                                                                                                                                                                         |                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| ItemCode:101461                                                                                                                                                                                                                                                         |                              |
| Let a circle C touch the lines $L_1 : 4x - 3y + K_1 = 0$ and $L_2 : 4x - 3y + K_2 = 0$ , $K_1, K_2 \in \mathbf{R}$ . If a line passing through the centre of the circle C intersects $L_1$ at $(-1, 2)$ and $L_2$ at $(3, -6)$ , then the equation of the circle C is : |                              |
| Question:                                                                                                                                                                                                                                                               |                              |
| A                                                                                                                                                                                                                                                                       | $(x - 1)^2 + (y - 2)^2 = 4$  |
| B                                                                                                                                                                                                                                                                       | $(x + 1)^2 + (y - 2)^2 = 4$  |
| C                                                                                                                                                                                                                                                                       | $(x - 1)^2 + (y + 2)^2 = 16$ |
| D                                                                                                                                                                                                                                                                       | $(x - 1)^2 + (y - 2)^2 = 16$ |

Q:2

Topic Name:Mathematics-Section A

|                                                                                                                 |                   |
|-----------------------------------------------------------------------------------------------------------------|-------------------|
| ItemCode:101462                                                                                                 |                   |
| The value of $\int_0^{\pi} \frac{e^{\cos x} \sin x}{(1 + \cos^2 x)(e^{\cos x} + e^{-\cos x})} dx$ is equal to : |                   |
| Question:                                                                                                       |                   |
| A                                                                                                               | $\frac{\pi^2}{4}$ |
| B                                                                                                               | $\frac{\pi^2}{2}$ |
| C                                                                                                               | $\frac{\pi}{4}$   |
| D                                                                                                               | $\frac{\pi}{2}$   |

Q:3

Topic Name:Mathematics-Section A

|                                                                                                                   |               |
|-------------------------------------------------------------------------------------------------------------------|---------------|
| ItemCode:101463                                                                                                   |               |
| Let a, b and c be the length of sides of a triangle ABC such that $\frac{a+b}{7} = \frac{b+c}{8} = \frac{c+a}{9}$ |               |
| If r and R are the radius of incircle and radius of circumcircle of the triangle ABC, respectively,               |               |
| then the value of $\frac{R}{r}$ is equal to :                                                                     |               |
| Question:                                                                                                         |               |
| A                                                                                                                 | $\frac{5}{2}$ |

C  $\frac{3}{2}$

D 1

Q:4

Topic Name: Mathematics-Section A

ItemCode: 101464

Let  $f : \mathbf{N} \rightarrow \mathbf{R}$  be a function such that  $f(x+y) = 2f(x)f(y)$  for natural numbers  $x$  and  $y$ . If  $f(1) = 2$ , then the value of  $\alpha$  for which

$$\sum_{k=1}^{10} f(\alpha + k) = \frac{512}{3} (2^{20} - 1)$$

Question: holds, is :

A 2

B 3

C 4

D 6

Q:5

Topic Name: Mathematics-Section A

ItemCode: 101465

Let  $A$  be a  $3 \times 3$  real matrix such that

$$A \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}; A \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix} \text{ and } A \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}.$$

If  $X = (x_1, x_2, x_3)^T$  and  $I$  is an identity matrix of order 3, then the system  $(A - 2I)X = \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix}$

Question: has :

A no solution

B infinitely many solutions

C unique solution

D exactly two solutions

Q:6

Topic Name: Mathematics-Section A

$$f(x) = x^3 + x - 5$$

**Question:** If  $g(x)$  is a function such that  $f(g(x)) = x, \forall 'x' \in \mathbf{R}$ , then  $g'(63)$  is equal to \_\_\_\_\_.

A  $\frac{1}{49}$

B  $\frac{3}{49}$

C  $\frac{43}{49}$

D  $\frac{91}{49}$

Q:7

Topic Name: Mathematics-Section A

ItemCode:101467

Consider the following two propositions :

$$P1 : \sim(p \rightarrow \sim q)$$

$$P2 : (p \wedge \sim q) \wedge ((\sim p) \vee q)$$

**Question:** If the proposition  $p \rightarrow ((\sim p) \vee q)$  is evaluated as FALSE, then :

A P1 is TRUE and P2 is FALSE

B P1 is FALSE and P2 is TRUE

C Both P1 and P2 are FALSE

D Both P1 and P2 are TRUE

Q:8

Topic Name: Mathematics-Section A

ItemCode:101468

**Question:** If  $\frac{1}{2 \cdot 3^{10}} + \frac{1}{2^2 \cdot 3^9} + \dots + \frac{1}{2^{10} \cdot 3} = \frac{K}{2^{10} \cdot 3^{10}}$ , then the remainder when K is divided by 6 is :

A 1

B 2

C 3

D 5

Q:9

Topic Name: Mathematics-Section A

ItemCode:101469

Let  $f(x)$  be a polynomial function such that  $f(x) + f'(x) + f''(x) = x^5 + 64$ . Then, the value of

**Question:**  $\lim_{x \rightarrow 1} \frac{f(x)}{x-1}$  is equal to :

- A -15  
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B -60  
C 60  
D 15

Q:10  
Topic Name:Mathematics-Section A

ItemCode:101470

Let  $E_1$  and  $E_2$  be two events such that the conditional probabilities  $P(E_1|E_2) = \frac{1}{2}$ ,  
 $P(E_2|E_1) = \frac{3}{4}$  and  $P(E_1 \cap E_2) = \frac{1}{8}$ . Then :

- Question:
- A  $P(E_1 \cap E_2) = P(E_1) \cdot P(E_2)$   
 B  $P(E'_1 \cap E'_2) = P(E'_1) \cdot P(E_2)$   
 C  $P(E_1 \cap E'_2) = P(E_1) \cdot P(E_2)$   
 D  $P(E'_1 \cap E_2) = P(E_1) \cdot P(E_2)$

Q:11  
Topic Name:Mathematics-Section A

ItemCode:101471

Let  $A = \begin{bmatrix} 0 & -2 \\ 2 & 0 \end{bmatrix}$ . If M and N are two matrices given by  $M = \sum_{k=1}^{10} A^{2k}$  and  $N = \sum_{k=1}^{10} A^{2k-1}$   
 Question: then  $MN^2$  is :

- A a non-identity symmetric matrix  
 B a skew-symmetric matrix  
 C neither symmetric nor skew-symmetric matrix  
 D an identity matrix

Q:12  
Topic Name:Mathematics-Section A

ItemCode:101472

Let  $g : (0, \infty) \rightarrow \mathbf{R}$  be a differentiable function such that  

$$\int \left( \frac{x(\cos x - \sin x)}{e^x + 1} + \frac{g(x)(e^x + 1 - xe^x)}{(e^x + 1)^2} \right) dx = \frac{x g(x)}{e^x + 1} + c, \text{ for all } x > 0, \text{ where } c \text{ is an}$$
  
 arbitrary constant. Then :

- Question:
- A  $g$  is decreasing in  $\left(0, \frac{\pi}{4}\right)$

|   |                                                           |
|---|-----------------------------------------------------------|
| B | $g$ is increasing in $\left(0, \frac{\pi}{4}\right)$      |
| C | $g + g'$ is increasing in $\left(0, \frac{\pi}{2}\right)$ |
| D | $g - g'$ is increasing in $\left(0, \frac{\pi}{2}\right)$ |

Q:13

Topic Name: Mathematics-Section A

ItemCode: 101473

Let  $f: \mathbf{R} \rightarrow \mathbf{R}$  and  $g: \mathbf{R} \rightarrow \mathbf{R}$  be two functions defined by  $f(x) = \log_e(x^2 + 1) - e^{-x} + 1$  and

$g(x) = \frac{1 - 2e^{2x}}{e^x}$ . Then, for which of the following range of  $\alpha$ , the inequality

$$f\left(g\left(\frac{(\alpha - 1)^2}{3}\right)\right) > f\left(g\left(\alpha - \frac{5}{3}\right)\right) \text{ holds ?}$$

Question:

|   |            |
|---|------------|
| A | $(2, 3)$   |
| B | $(-2, -1)$ |
| C | $(1, 2)$   |
| D | $(-1, 1)$  |

Q:14

Topic Name: Mathematics-Section A

ItemCode: 101474

Let  $\vec{a} = a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k}$   $a_i > 0, i = 1, 2, 3$  be a vector which makes equal angles with the coordinate axes OX, OY and OZ. Also, let the projection of  $\vec{a}$  on the vector  $3\hat{i} + 4\hat{j}$  be 7.

Let  $\vec{b}$  be a vector obtained by rotating  $\vec{a}$  with  $90^\circ$ . If  $\vec{a}$ ,  $\vec{b}$  and x-axis are coplanar, then

projection of a vector  $\vec{b}$  on  $3\hat{i} + 4\hat{j}$  is equal to :

Question:

|   |            |
|---|------------|
| A | $\sqrt{7}$ |
| B | $\sqrt{2}$ |
| C | 2          |
| D | 7          |

Q:15

Topic Name: Mathematics-Section A

Let  $y = y(x)$  be the solution of the differential equation  $(x+1)y' - y = e^{3x}(x+1)^2$ , with  $y(0) = \frac{1}{3}$ .

Then, the point  $x = -\frac{4}{3}$  for the curve  $y = y(x)$  is :

Question:

- A not a critical point
- B a point of local minima
- C a point of local maxima
- D a point of inflection

Q:16

Topic Name: Mathematics-Section A

ItemCode:101476

If  $y = m_1x + c_1$  and  $y = m_2x + c_2$ ,  $m_1 \neq m_2$  are two common tangents of circle  $x^2 + y^2 = 2$  and parabola  $y^2 = x$ , then the value of  $8|m_1m_2|$  is equal to :

Question:

- A  $3 + 4\sqrt{2}$
- B  $-5 + 6\sqrt{2}$
- C  $-4 + 3\sqrt{2}$
- D  $7 + 6\sqrt{2}$

Q:17

Topic Name: Mathematics-Section A

ItemCode:101477

Let Q be the mirror image of the point P(1, 0, 1) with respect to the plane S :  $x + y + z = 5$ . If a line L passing through (1, -1, -1), parallel to the line PQ meets the plane S at R, then  $QR^2$  is equal to :

Question:

- A 2
- B 5
- C 7
- D 11

Q:18

Topic Name: Mathematics-Section A

ItemCode:101478

If the solution curve  $y = y(x)$  of the differential equation  $y^2dx + (x^2 - xy + y^2)dy = 0$ , which passes through the point (1, 1) and intersects the line  $y = \sqrt{3}x$  at the point  $(\alpha, \sqrt{3}\alpha)$ , then value of  $\log_e(\sqrt{3}\alpha)$  is equal to :

Question:

- A  $\frac{\pi}{3}$

C

$$\frac{\pi}{12}$$

D

$$\frac{\pi}{6}$$

Q:19

Topic Name:Mathematics-Section A

ItemCode:101479

Let  $x = 2t$ ,  $y = \frac{t^2}{3}$  be a conic. Let S be the focus and B be the point on the axis of the conic such that  $SA \perp BA$ , where A is any point on the conic. If k is the ordinate of the centroid of the  $\Delta SAB$ , then  $\lim_{t \rightarrow 1} k$  is equal to :

Question:

A

$$\frac{17}{18}$$

B

$$\frac{19}{18}$$

C

$$\frac{11}{18}$$

D

$$\frac{13}{18}$$

Q:20

Topic Name:Mathematics-Section A

ItemCode:101480

Let a circle C in complex plane pass through the points  $z_1 = 3 + 4i$ ,  $z_2 = 4 + 3i$  and  $z_3 = 5i$ . If  $z (\neq z_1)$  is a point on C such that the line through z and  $z_1$  is perpendicular to the line through  $z_2$  and  $z_3$ , then  $\arg(z)$  is equal to :

Question:

A

$$\tan^{-1}\left(\frac{2}{\sqrt{5}}\right) - \pi$$

B

$$\tan^{-1}\left(\frac{24}{7}\right) - \pi$$

C

$$\tan^{-1}(3) - \pi$$

D

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

Q:21

Topic Name:Mathematics-Section B

Let  $C_r$  denote the binomial coefficient of  $x^r$  in the expansion of  $(1+x)^{10}$ . If for  $\alpha, \beta \in \mathbb{R}$ ,

$$C_1 + 3 \cdot 2 C_2 + 5 \cdot 3 C_3 + \dots \text{ upto 10 terms} = \frac{\alpha \times 2^{11}}{2^\beta - 1} \left( C_0 + \frac{C_1}{2} + \frac{C_2}{3} + \dots \text{ upto 10 terms} \right)$$

then the value of  $\alpha + \beta$  is equal to \_\_\_\_\_.

Question:

Q:22

Topic Name: Mathematics-Section B

ItemCode:101482

The number of 3-digit odd numbers, whose sum of digits is a multiple of 7, is \_\_\_\_\_.

Question:

Q:23

Topic Name: Mathematics-Section B

ItemCode:101483

Let  $\theta$  be the angle between the vectors  $\vec{a}$  and  $\vec{b}$ , where  $|\vec{a}| = 4$ ,  $|\vec{b}| = 3$  and  $\theta \in \left( \frac{\pi}{4}, \frac{\pi}{3} \right)$ .

Then

$$\left| (\vec{a} - \vec{b}) \times (\vec{a} + \vec{b}) \right|^2 + 4(\vec{a} \cdot \vec{b})^2 \text{ is equal to } \underline{\hspace{2cm}}.$$

Question:

Q:24

Topic Name: Mathematics-Section B

ItemCode:101484

Let the abscissae of the two points P and Q be the roots of  $2x^2 - rx + p = 0$  and the ordinates of P and Q be the roots of  $x^2 - sx - q = 0$ . If the equation of the circle described on PQ as diameter is  $2(x^2 + y^2) - 11x - 14y - 22 = 0$ , then  $2r + s - 2q + p$  is equal to \_\_\_\_\_.

Question:

Q:25

Topic Name: Mathematics-Section B

ItemCode:101485

The number of values of  $x$  in the interval  $\left( \frac{\pi}{4}, \frac{7\pi}{4} \right)$  for which

$$14 \operatorname{cosec}^2 x - 2 \sin^2 x = 21 - 4 \cos^2 x \text{ holds, is } \underline{\hspace{2cm}}.$$

Question:

Q:26

Topic Name: Mathematics-Section B

ItemCode:101486

For a natural number  $n$ , let  $\alpha_n = 19^n - 12^n$ . Then, the value of  $\frac{31\alpha_9 - \alpha_{10}}{57\alpha_8}$  is \_\_\_\_\_.

Question:

Q:27

Topic Name: Mathematics-Section B

Let  $f: \mathbf{R} \rightarrow \mathbf{R}$  be a function defined by  $f(x) = \left( 2 \left( 1 - \frac{x^{25}}{2} \right) (2 + x^{25}) \right)^{\frac{1}{50}}$ . If the function

**Question:**  $g(x) = f(f(f(x))) + f(f(x))$ , then the greatest integer less than or equal to  $g(1)$  is \_\_\_\_\_.

Q:28

Topic Name: Mathematics-Section B

ItemCode:101488

Let the lines

$$L_1 : \vec{r} = \lambda (\hat{i} + 2\hat{j} + 3\hat{k}), \lambda \in \mathbf{R}$$

$$L_2 : \vec{r} = (\hat{i} + 3\hat{j} + \hat{k}) + \mu (\hat{i} + \hat{j} + 5\hat{k}); \mu \in \mathbf{R},$$

intersect at the point S. If a plane  $ax + by - z + d = 0$  passes through S and is parallel to both the lines  $L_1$  and  $L_2$ , then the value of  $a + b + d$  is equal to \_\_\_\_\_.

**Question:**

Q:29

Topic Name: Mathematics-Section B

ItemCode:101489

Let A be a  $3 \times 3$  matrix having entries from the set  $\{-1, 0, 1\}$ . The number of all such matrices A having sum of all the entries equal to 5, is \_\_\_\_\_.

**Question:**

Q:30

Topic Name: Mathematics-Section B

ItemCode:101490

The greatest integer less than or equal to the sum of first 100 terms of the sequence

$$\frac{1}{3}, \frac{5}{9}, \frac{19}{27}, \frac{65}{81}, \dots \text{ is equal to } \underline{\hspace{2cm}}.$$

**Question:**

Q:31

Topic Name: Physics-Section A

ItemCode:101401

If  $Z = \frac{A^2 B^3}{C^4}$ , then the relative error in Z will be :

**Question:**

|   |                                                                      |
|---|----------------------------------------------------------------------|
| A | $\frac{\Delta A}{A} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$       |
| B | $\frac{2 \Delta A}{A} + \frac{3 \Delta B}{B} - \frac{4 \Delta C}{C}$ |
| C | $\frac{2 \Delta A}{A} + \frac{3 \Delta B}{B} + \frac{4 \Delta C}{C}$ |

Q:32  
Topic Name:Physics-Section A

ItemCode:101402

$\vec{A}$  is a vector quantity such that  $|\vec{A}| = \text{non - zero constant}$ . Which of the following expression is true for  $\vec{A}$  ?

- A  $\vec{A} \cdot \vec{A} = 0$
- B  $\vec{A} \times \vec{A} < 0$
- C  $\vec{A} \times \vec{A} = 0$
- D  $\vec{A} \times \vec{A} > 0$

Q:33  
Topic Name:Physics-Section A

ItemCode:101403

Which of the following relations is true for two unit vector  $\hat{A}$  and  $\hat{B}$  making an angle  $\theta$  to each other ?

- A  $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \tan \frac{\theta}{2}$
- B  $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \tan \frac{\theta}{2}$
- C  $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \cos \frac{\theta}{2}$
- D  $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \cos \frac{\theta}{2}$

Q:34  
Topic Name:Physics-Section A

ItemCode:101404

If force  $\vec{F} = 3\hat{i} + 4\hat{j} - 2\hat{k}$  acts on a particle having position vector  $2\hat{i} + \hat{j} + 2\hat{k}$  then, the torque about the origin will be :

- A  $3\hat{i} + 4\hat{j} - 2\hat{k}$
- B  $-10\hat{i} + 10\hat{j} + 5\hat{k}$
- C  $10\hat{i} + 5\hat{j} - 10\hat{k}$
- D  $10\hat{i} + \hat{j} - 5\hat{k}$

Q:35

Topic Name: Physics-Section A

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ItemCode:101405

The height of any point P above the surface of earth is equal to diameter of earth. The value of acceleration due to gravity at point P will be : (Given  $g$  = acceleration due to gravity at the surface of earth).

Question:

|   |       |
|---|-------|
| A | $g/2$ |
| B | $g/4$ |
| C | $g/3$ |
| D | $g/9$ |

Q:36

Topic Name: Physics-Section A

ItemCode:101406

The terminal velocity ( $v_t$ ) of the spherical rain drop depends on the radius ( $r$ ) of the spherical rain drop as :

Question:

|   |           |
|---|-----------|
| A | $r^{1/2}$ |
| B | $r$       |
| C | $r^2$     |
| D | $r^3$     |

Q:37

Topic Name: Physics-Section A

ItemCode:101407

The relation between root mean square speed ( $v_{\text{rms}}$ ) and most probable speed ( $v_p$ ) for the molar mass  $M$  of oxygen gas molecule at the temperature of 300 K will be :

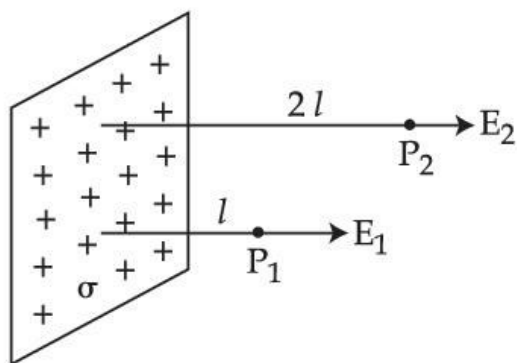
Question:

|   |                                           |
|---|-------------------------------------------|
| A | $v_{\text{rms}} = \sqrt{\frac{2}{3}} v_p$ |
| B | $v_{\text{rms}} = \sqrt{\frac{3}{2}} v_p$ |
| C | $v_{\text{rms}} = v_p$                    |
| D | $v_{\text{rms}} = \sqrt{\frac{1}{3}} v_p$ |

Q:38

Topic Name: Physics-Section A

In the figure, a very large plane sheet of positive charge is shown.  $P_1$  and  $P_2$  are two points at distance  $l$  and  $2l$  from the charge distribution. If  $\sigma$  is the surface charge density, then the magnitude of electric fields  $E_1$  and  $E_2$  at  $P_1$  and  $P_2$  respectively are :



Question:

- A  $E_1 = \sigma/\epsilon_0$ ,  $E_2 = \sigma/2\epsilon_0$
- B  $E_1 = 2\sigma/\epsilon_0$ ,  $E_2 = \sigma/\epsilon_0$
- C  $E_1 = E_2 = \sigma/2\epsilon_0$
- D  $E_1 = E_2 = \sigma/\epsilon_0$

Q:39

Topic Name: Physics-Section A

ItemCode:101409

Match List - I with List - II.

List - I

- (A) AC generator
- (B) Galvanometer
- (C) Transformer
- (D) Metal detector

List - II

- (I) Detects the presence of current in the circuit
- (II) Converts mechanical energy into electrical energy
- (III) Works on the principle of resonance in AC circuit
- (IV) Changes an alternating voltage for smaller or greater value

Choose the **correct** answer from the options given below :

Question:

- A (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
- B (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
- C (A) - (III), (B) - (IV), (C) - (II), (D) - (I)
- D (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

Q:40

Topic Name: Physics-Section A

ItemCode:101410

A long straight wire with a circular cross-section having radius  $R$ , is carrying a steady current  $I$ . The current  $I$  is uniformly distributed across this cross-section. Then the variation of magnetic field due to current  $I$  with distance  $r$  ( $r < R$ ) from its centre will be :

Question:

- A  $B \propto r^2$

Q:41

Topic Name: Physics-Section A

ItemCode: 101411

Question: If wattless current flows in the AC circuit, then the circuit is :

A Purely Resistive circuit

B Purely Inductive circuit

C LCR series circuit

D RC series circuit only

Q:42

Topic Name: Physics-Section A

ItemCode: 101412

The electric field in an electromagnetic wave is given by  $E = 56.5 \sin \omega(t - x/c) \text{ NC}^{-1}$ . Find the intensity of the wave if it is propagating along  $x$ -axis in the free space.

(Given  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )

Question:

A  $5.65 \text{ Wm}^{-2}$

B  $4.24 \text{ Wm}^{-2}$

C  $1.9 \times 10^{-7} \text{ Wm}^{-2}$

D  $56.5 \text{ Wm}^{-2}$

Q:43

Topic Name: Physics-Section A

ItemCode: 101413

The two light beams having intensities  $I$  and  $9I$  interfere to produce a fringe pattern on a screen. The phase difference between the beams is  $\pi/2$  at point P and  $\pi$  at point Q. Then the difference between the resultant intensities at P and Q will be :

Question:

A  $2I$

B  $6I$

C  $5I$

D  $7I$

Q:44

Topic Name: Physics-Section A

A light wave travelling linearly in a medium of dielectric constant 4, incidents on the horizontal interface separating medium with air. The angle of incidence for which the total intensity of incident wave will be reflected back into the same medium will be :

(Given : relative permeability of medium  $\mu_r = 1$ )

Question:

A  $10^\circ$

B  $20^\circ$

C  $30^\circ$

D  $60^\circ$

Q:45

Topic Name:Physics-Section A

ItemCode:101415

Given below are two statements :

**Statement I :** Davisson-Germer experiment establishes the wave nature of electrons.

**Statement II :** If electrons have wave nature, they can interfere and show diffraction.

In the light of the above statements choose the **correct answer** from the option given below :

Question:

A Both **Statement I** and **Statement II** are true.

B Both **Statement I** and **Statement II** are false.

C **Statement I** is true but **Statement II** is false.

D **Statement I** is false but **Statement II** is true.

Q:46

Topic Name:Physics-Section A

ItemCode:101416

The ratio for the speed of the electron in the 3<sup>rd</sup> orbit of  $\text{He}^+$  to the speed of the electron in the 3<sup>rd</sup> orbit of hydrogen atom will be :

Question:

A 1 : 1

B 1 : 2

C 4 : 1

D 2 : 1

Q:47

Topic Name:Physics-Section A

ItemCode:101417

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

Question:

A fractional change in majority carriers produce higher forward bias current

B fractional change in majority carriers produce higher reverse bias current

C fractional change in minority carriers produce higher forward bias current

Q:48

Topic Name: Physics-Section A

ItemCode: 101418

Question: A signal of 100 THz frequency can be transmitted with maximum efficiency by :

- A Coaxial cable
- B Optical fibre
- C Twisted pair of copper wires
- D Water

Q:49

Topic Name: Physics-Section A

ItemCode: 101419

The difference of speed of light in the two media A and B ( $v_A - v_B$ ) is  $2.6 \times 10^7$  m/s. If the refractive index of medium B is 1.47, then the ratio of refractive index of medium B to medium A is : (Given : speed of light in vacuum  $c = 3 \times 10^8$  ms<sup>-1</sup>)

- A 1.303
- B 1.318
- C 1.13
- D 0.12

Q:50

Topic Name: Physics-Section A

ItemCode: 101420

A teacher in his physics laboratory allotted an experiment to determine the resistance (G) of a galvanometer. Students took the observations for  $\frac{1}{3}$  deflection in the galvanometer.

Question: Which of the below is **true** for measuring value of G ?

- A  $\frac{1}{3}$  deflection method cannot be used for determining the resistance of the galvanometer.
- B  $\frac{1}{3}$  deflection method can be used and in this case the G equals to twice the value of shunt resistance(s).
- C  $\frac{1}{3}$  deflection method can be used and in this case, the G equals to three times the value of shunt resistance(s).
- D  $\frac{1}{3}$  deflection method can be used and in this case the G value equals to the shunt resistance(s).

ItemCode:101421

A uniform chain of 6 m length is placed on a table such that a part of its length is hanging over the edge of the table. The system is at rest. The co-efficient of static friction between the chain and the surface of the table is 0.5, the maximum length of the chain hanging from the table is \_\_\_\_\_m.

Question:

Q:52  
Topic Name:Physics-Section B

ItemCode:101422

A 0.5 kg block moving at a speed of  $12 \text{ ms}^{-1}$  compresses a spring through a distance 30 cm when its speed is halved. The spring constant of the spring will be

Question: \_\_\_\_\_  $\text{Nm}^{-1}$ .

Q:53  
Topic Name:Physics-Section B

ItemCode:101423

The velocity of upper layer of water in a river is  $36 \text{ kmh}^{-1}$ . Shearing stress between horizontal layers of water is  $10^{-3} \text{ Nm}^{-2}$ . Depth of the river is \_\_\_\_\_ m. (Co-efficient of viscosity of water is  $10^{-2} \text{ Pa.s}$ )

Question:

Q:54  
Topic Name:Physics-Section B

ItemCode:101424

A steam engine intakes 50 g of steam at  $100^\circ\text{C}$  per minute and cools it down to  $20^\circ\text{C}$ . If latent heat of vaporization of steam is  $540 \text{ cal g}^{-1}$ , then the heat rejected by the steam engine per minute is \_\_\_\_\_  $\times 10^3 \text{ cal}$ .

Question: (Given : specific heat capacity of water :  $1 \text{ cal g}^{-1} ^\circ\text{C}^{-1}$ )

Q:55  
Topic Name:Physics-Section B

ItemCode:101425

The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. If the length of the closed organ pipe is 20 cm. The length of the open organ pipe is \_\_\_\_\_ cm.

Question:

Q:56  
Topic Name:Physics-Section B

ItemCode:101426

The equivalent capacitance between points A and B in below shown figure will be \_\_\_\_\_  $\mu\text{F}$ .



Question:

Q:57  
Topic Name:Physics-Section B

A resistor develops 300 J of thermal energy in 15 s, when a current of 2 A is passed through it. If the current increases to 3 A, the energy developed in 10 s is \_\_\_\_\_ J.

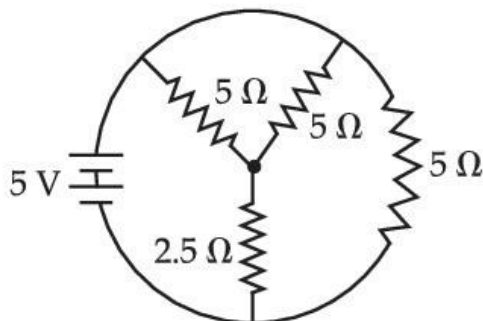
Question:

Q:58

Topic Name:Physics-Section B

ItemCode:101428

The total current supplied to the circuit as shown in figure by the 5 V battery is \_\_\_\_\_ A.



Question:

Q:59

Topic Name:Physics-Section B

ItemCode:101429

The current in a coil of self inductance 2.0 H is increasing according to  $I = 2 \sin(t^2)$  A. The amount of energy spent during the period when current changes from 0 to 2 A is \_\_\_\_\_ J.

Question:

Q:60

Topic Name:Physics-Section B

ItemCode:101430

A force on an object of mass 100 g is  $(10\hat{i} + 5\hat{j})$  N. The position of that object at  $t = 2$  s is

$(a\hat{i} + b\hat{j})$  m after starting from rest. The value of  $\frac{a}{b}$  will be \_\_\_\_\_.

Question:

Q:61

Topic Name:Chemistry-Section A

ItemCode:101431

Bonding in which of the following diatomic molecule(s) become(s) stronger, on the basis of MO Theory, by removal of an electron ?

- (A) NO
- (B)  $N_2$
- (C)  $O_2$
- (D)  $C_2$
- (E)  $B_2$

Choose the **most appropriate** answer from the options given below :

Question:

A (A), (B), (C) only

B (B), (C), (E) only

Q:62

Topic Name: Chemistry-Section A

ItemCode: 101432

Question: **Incorrect** statement for Tyndall effect is :

- A The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.
- B The diameter of the dispersed particles is much smaller than the wavelength of the light used.
- C During projection of movies in the cinemas hall, Tyndall effect is noticed.
- D It is used to distinguish a true solution from a colloidal solution.

Q:63

Topic Name: Chemistry-Section A

ItemCode: 101433

Question: The pair, in which ions are isoelectronic with  $\text{Al}^{3+}$  is :

- A  $\text{Br}^-$  and  $\text{Be}^{2+}$
- B  $\text{Cl}^-$  and  $\text{Li}^+$
- C  $\text{S}^{2-}$  and  $\text{K}^+$
- D  $\text{O}^{2-}$  and  $\text{Mg}^{2+}$

Q:64

Topic Name: Chemistry-Section A

ItemCode: 101434

Leaching of gold with dilute aqueous solution of NaCN in presence of oxygen gives complex [A], which on reaction with zinc forms the elemental gold and another complex [B]. [A] and [B], respectively are :

- A  $[\text{Au}(\text{CN})_4]^-$  and  $[\text{Zn}(\text{CN})_2(\text{OH})_2]^{2-}$
- B  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{OH})_4]^{2-}$
- C  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{CN})_4]^{2-}$
- D  $[\text{Au}(\text{CN})_4]^{2-}$  and  $[\text{Zn}(\text{CN})_6]^{4-}$

Q:65

Topic Name: Chemistry-Section A

ItemCode: 101435

Number of electron deficient molecules among the following  $\text{PH}_3$ ,  $\text{B}_2\text{H}_6$ ,  $\text{CCl}_4$ ,  $\text{NH}_3$ ,  $\text{LiH}$  and  $\text{BCl}_3$  is

- A 0

Q:66  
Topic Name:Chemistry-Section A

|                                                                                                               |                  |
|---------------------------------------------------------------------------------------------------------------|------------------|
| ItemCode:101436                                                                                               |                  |
| Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution ? |                  |
| Question:                                                                                                     |                  |
| A                                                                                                             | $\text{Be}^{2+}$ |
| B                                                                                                             | $\text{Mg}^{2+}$ |
| C                                                                                                             | $\text{Ca}^{2+}$ |
| D                                                                                                             | $\text{Sr}^{2+}$ |

Q:67  
Topic Name:Chemistry-Section A

|                                                                                       |                                              |
|---------------------------------------------------------------------------------------|----------------------------------------------|
| ItemCode:101437                                                                       |                                              |
| White precipitate of AgCl dissolves in aqueous ammonia solution due to formation of : |                                              |
| Question:                                                                             |                                              |
| A                                                                                     | $[\text{Ag}(\text{NH}_3)_4]\text{Cl}_2$      |
| B                                                                                     | $[\text{Ag}(\text{Cl})_2(\text{NH}_3)_2]$    |
| C                                                                                     | $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$        |
| D                                                                                     | $[\text{Ag}(\text{NH}_3)\text{Cl}]\text{Cl}$ |

Q:68  
Topic Name:Chemistry-Section A

|                                                                                                          |                                                                      |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| ItemCode:101438                                                                                          |                                                                      |
| Cerium (IV) has a noble gas configuration. Which of the following is <b>correct</b> statement about it ? |                                                                      |
| Question:                                                                                                |                                                                      |
| A                                                                                                        | It will not prefer to undergo redox reactions.                       |
| B                                                                                                        | It will prefer to gain electron and act as an oxidizing agent        |
| C                                                                                                        | It will prefer to give away an electron and behave as reducing agent |
| D                                                                                                        | It acts as both, oxidizing and reducing agent.                       |

Q:69  
Topic Name:Chemistry-Section A

|                                                               |                  |
|---------------------------------------------------------------|------------------|
| ItemCode:101439                                               |                  |
| Among the following, which is the strongest oxidizing agent ? |                  |
| Question:                                                     |                  |
| A                                                             | $\text{Mn}^{3+}$ |
| B                                                             | $\text{Fe}^{3+}$ |
| C                                                             | $\text{Ti}^{3+}$ |

Q:70

Topic Name:Chemistry-Section A

ItemCode:101440

Question: The eutrophication of water body results in :

- A loss of Biodiversity.
- B breakdown of organic matter.
- C increase in biodiversity.
- D decrease in BOD.

Q:71

Topic Name:Chemistry-Section A

ItemCode:101441

Question: Phenol on reaction with dilute nitric acid, gives two products. Which method will be most efficient for large scale separation ?

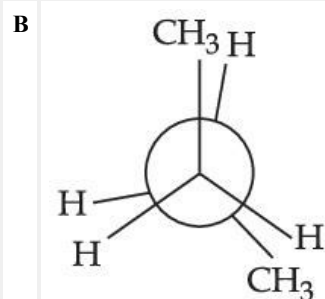
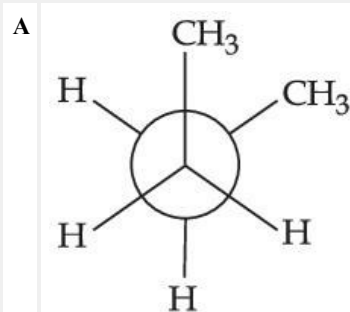
- A Chromatographic separation
- B Fractional Crystallisation
- C Steam distillation
- D Sublimation

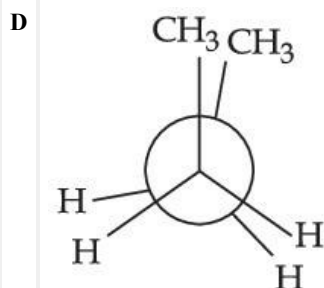
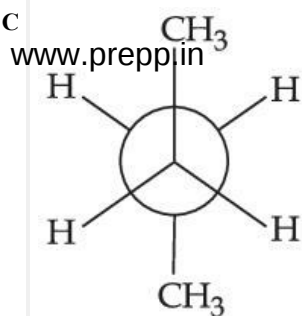
Q:72

Topic Name:Chemistry-Section A

ItemCode:101442

Question: In the following structures, which one is having staggered conformation with maximum dihedral angle ?

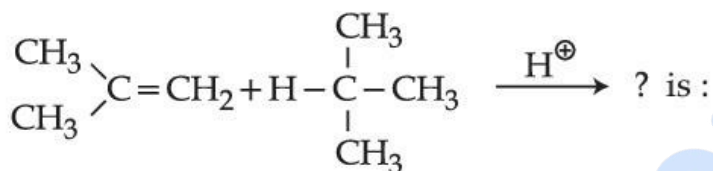




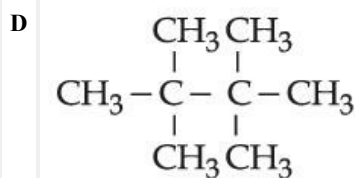
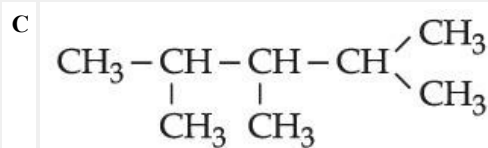
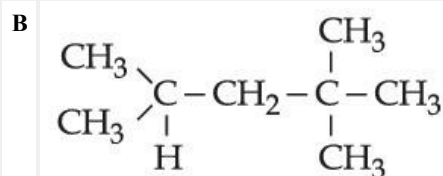
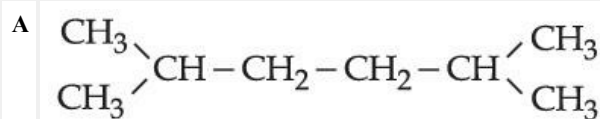
Q:73  
Topic Name: Chemistry-Section A

ItemCode: 101443

The product formed in the following reaction.



Question:



Q:74  
Topic Name: Chemistry-Section A

ItemCode: 101444

The IUPAC name of ethylidene chloride is :

Question:

A 1-Chloroethene

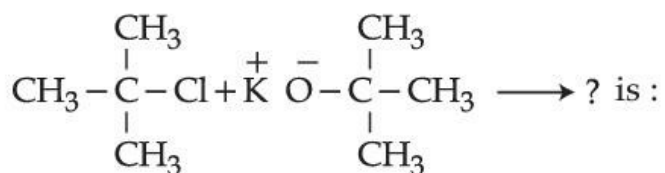
B 1-Chloroethyne

C 1,2-Dichloroethane

D 1,1-Dichloroethane

ItemCode:101445

The major product in the reaction

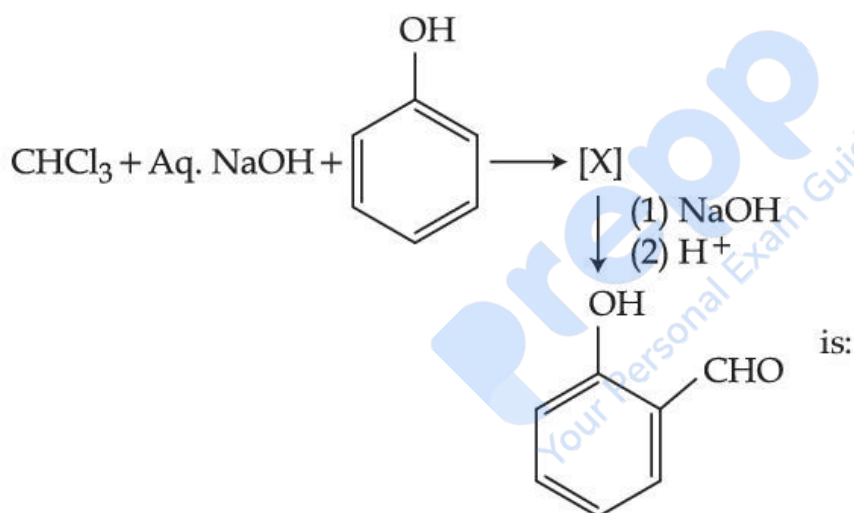


Question:

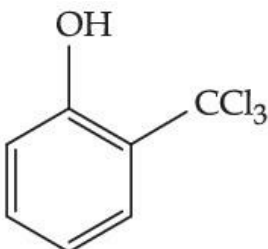
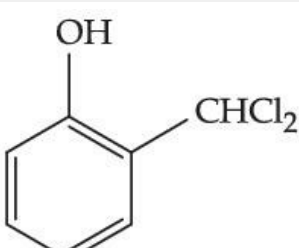
- A *t*-Butyl ethyl ether
- B 2,2-Dimethyl butane
- C 2-Methyl pent-1-ene
- D 2-Methyl prop-1-ene

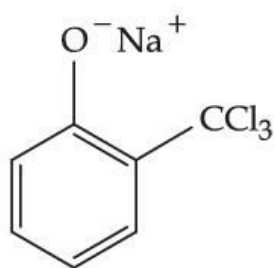
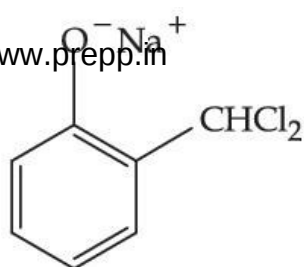
ItemCode:101446

The intermediate X, in the reaction :



Question:

- A 
- B 

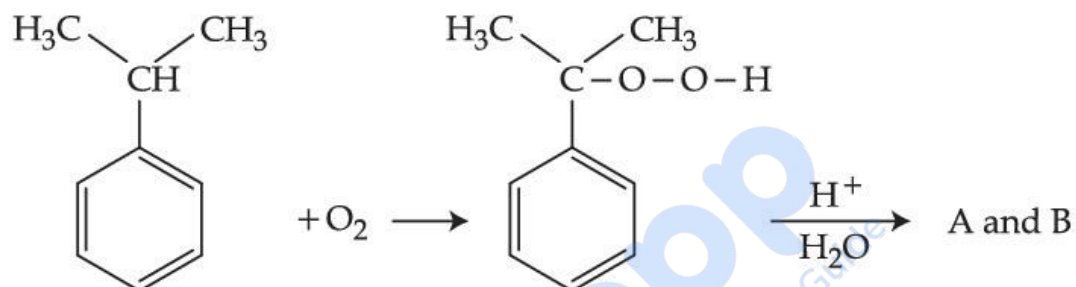


Q:77

Topic Name: Chemistry-Section A

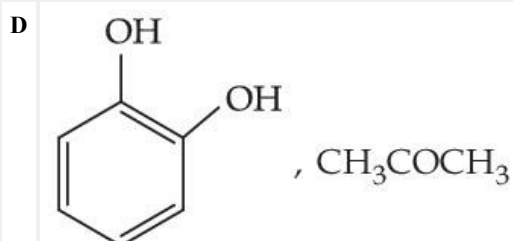
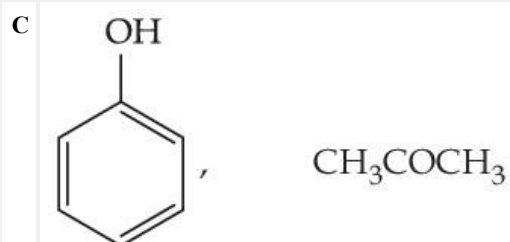
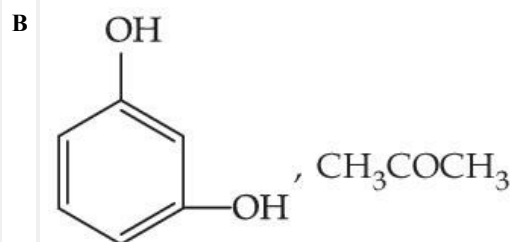
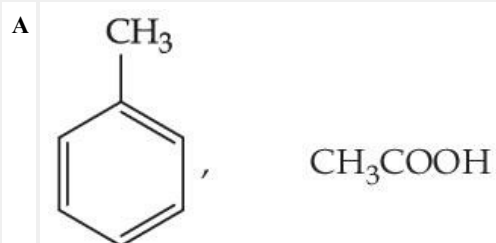
ItemCode: 101447

In the following reaction :



The compounds A and B respectively are :

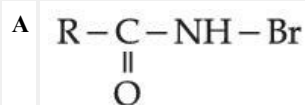
Question:



ItemCode:101448

The reaction of  $\text{R}-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{NH}_2$  with bromine and KOH gives  $\text{RNH}_2$  as the end product. Which

Question: one of the following is the intermediate product formed in this reaction ?



Q:79  
Topic Name: Chemistry-Section A

ItemCode:101449

Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes, because :

A soap particles remain floating in water as ions.

B the hydrophobic part of soap is not able to take away grease.

C the micelles are not formed due to concentration of soap, below its CMC value.

D colloidal structure of soap in water is completely disturbed.

Q:80  
Topic Name: Chemistry-Section A

ItemCode:101450

Question: Which one of the following is an example of artificial sweetner ?

A Bithional

B Alitame

C Salvarsan

D Lactose

Q:81  
Topic Name: Chemistry-Section B

ItemCode:101451

The number of N atoms in 681 g of  $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$  is  $x \times 10^{21}$ . The value of x is \_\_\_\_\_.

Question: ( $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ ) (Nearest Integer)

Q:82  
Topic Name: Chemistry-Section B

The distance between  $\text{Na}^+$  and  $\text{Cl}^-$  ions in solid  $\text{NaCl}$  of density  $4.31 \text{ g cm}^{-3}$  is \_\_\_\_\_  $\times 10^{-10} \text{ m}$ . (Nearest Integer)

(Given :  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ )

Question:

Q:83

Topic Name:Chemistry-Section B

ItemCode:101453

The longest wavelength of light that can be used for the ionisation of lithium atom ( $\text{Li}$ ) in its ground state is  $x \times 10^{-8} \text{ m}$ . The value of  $x$  is \_\_\_\_\_. (Nearest Integer)

(Given : Energy of the electron in the first shell of the hydrogen atom is  $-2.2 \times 10^{-18} \text{ J}$  ;  $h = 6.63 \times 10^{-34} \text{ Js}$  and  $c = 3 \times 10^8 \text{ ms}^{-1}$ )

Question:

Q:84

Topic Name:Chemistry-Section B

ItemCode:101454

The standard entropy change for the reaction

$4\text{Fe(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Fe}_2\text{O}_3\text{(s)}$  is  $-550 \text{ J K}^{-1}$  at  $298 \text{ K}$ .

[Given : The standard enthalpy change for the reaction is  $-165 \text{ kJ mol}^{-1}$ ]. The temperature in  $\text{K}$  at which the reaction attains equilibrium is \_\_\_\_\_. (Nearest Integer)

Question:

Q:85

Topic Name:Chemistry-Section B

ItemCode:101455

1 L aqueous solution of  $\text{H}_2\text{SO}_4$  contains  $0.02 \text{ m mol H}_2\text{SO}_4$ . 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A),  $0.01 \text{ m mol}$  of  $\text{H}_2\text{SO}_4$  are added. Total  $\text{m mols}$  of  $\text{H}_2\text{SO}_4$  in the final solution is \_\_\_\_\_  $\times 10^3 \text{ m mols}$ .

Question:

Q:86

Topic Name:Chemistry-Section B

ItemCode:101456

The standard free energy change ( $\Delta G^\circ$ ) for 50% dissociation of  $\text{N}_2\text{O}_4$  into  $\text{NO}_2$  at  $27^\circ\text{C}$  and  $1 \text{ atm}$  pressure is  $-x \text{ J mol}^{-1}$ . The value of  $x$  is \_\_\_\_\_. (Nearest Integer)

[Given :  $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 1.33 = 0.1239$   $\ln 10 = 2.3$ ]

Question:

Q:87

Topic Name:Chemistry-Section B

ItemCode:101457

In a cell, the following reactions take place

$\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$   $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^\circ = 0.77 \text{ V}$

$2\text{I}^- \rightarrow \text{I}_2 + 2\text{e}^-$   $E_{\text{I}_2/\text{I}^-}^\circ = 0.54 \text{ V}$

The standard electrode potential for the spontaneous reaction in the cell is  $x \times 10^{-2} \text{ V}$   $298 \text{ K}$ .

The value of  $x$  is \_\_\_\_\_. (Nearest Integer)

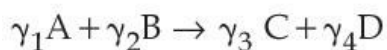
Question:

Q:88

Topic Name: Chemistry-Section B

ItemCode:101458

For a given chemical reaction



Concentration of C changes from  $10 \text{ mmol dm}^{-3}$  to  $20 \text{ mmol dm}^{-3}$  in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be  $9 \text{ mmol dm}^{-3} \text{ s}^{-1}$ . Therefore the rate of reaction is \_\_\_\_\_  $\text{mmol dm}^{-3} \text{ s}^{-1}$ .

(Nearest Integer)

Question:

Q:89

Topic Name: Chemistry-Section B

ItemCode:101459

If  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$  absorbs a light of wavelength 600 nm for d-d transition, then the value of octahedral crystal field splitting energy for  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  will be \_\_\_\_\_  $\times 10^{-21} \text{ J}$ .

[Nearest integer]

(Given :  $h = 6.63 \times 10^{-34} \text{ Js}$  and  $c = 3.08 \times 10^8 \text{ ms}^{-1}$ )

Question:

Q:90

Topic Name: Chemistry-Section B

ItemCode:101460

Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is

\_\_\_\_\_  $\times 10^{-2} \text{ g}$ . (Atomic mass of Br = 80 g/mol) [Nearest integer]

Question: