

# National Testing Agency

<b>Question Paper Name :</b>	B TECH 17th March 2021 Shift 2
<b>Subject Name :</b>	B TECH
<b>Creation Date :</b>	2021-03-18 10:47:33
<b>Duration :</b>	180
<b>Number of Questions :</b>	90
<b>Total Marks :</b>	300
<b>Display Marks:</b>	Yes

## B TECH

<b>Group Number :</b>	1
<b>Group Id :</b>	86435140
<b>Group Maximum Duration :</b>	0
<b>Group Minimum Duration :</b>	180
<b>Show Attended Group? :</b>	No
<b>Edit Attended Group? :</b>	No
<b>Break time :</b>	0
<b>Group Marks :</b>	300
<b>Is this Group for Examiner? :</b>	No

## Physics Section A

<b>Section Id :</b>	864351235
<b>Section Number :</b>	1
<b>Section type :</b>	Online
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	20
<b>Number of Questions to be attempted :</b>	20
<b>Section Marks :</b>	80
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351235
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 1 Question Id : 8643513511 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

A carrier signal  $C(t) = 25 \sin(2.512 \times 10^{10}t)$  is amplitude modulated by a message signal  $m(t) = 5 \sin(1.57 \times 10^8 t)$  and transmitted through an antenna. What will be the bandwidth of the modulated signal ?

Options :

86435110531. 50 MHz

86435110532. 8 GHz

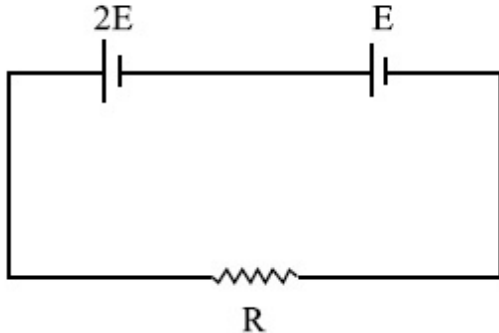
86435110533. 2.01 GHz

86435110534. 1987.5 MHz

Question Number : 2 Question Id : 8643513512 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Two cells of emf  $2E$  and  $E$  with internal resistance  $r_1$  and  $r_2$  respectively are connected in series to an external resistor  $R$  (see figure). The value of  $R$ , at which the potential difference across the terminals of the first cell becomes zero is



Options :

86435110535.  $\frac{r_1}{2} - r_2$

86435110536.  $\frac{r_1}{2} + r_2$

86435110537.  $r_1 - r_2$

86435110538.  $r_1 + r_2$

**Question Number : 3 Question Id : 8643513513 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A sound wave of frequency 245 Hz travels with the speed of  $300 \text{ ms}^{-1}$  along the positive  $x$ -axis. Each point of the wave moves to and fro through a total distance of 6 cm. What will be the mathematical expression of this travelling wave ?

**Options :**

86435110539.  $Y(x, t) = 0.03 [ \sin 5.1x - (0.2 \times 10^3)t ]$

86435110540.  $Y(x, t) = 0.03 [ \sin 5.1x - (1.5 \times 10^3)t ]$

86435110541.  $Y(x, t) = 0.06 [ \sin 5.1x - (1.5 \times 10^3)t ]$

86435110542.  $Y(x, t) = 0.06 [ \sin 0.8x - (0.5 \times 10^3)t ]$

**Question Number : 4 Question Id : 8643513514 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A geostationary satellite is orbiting around an arbitrary planet 'P' at a height of  $11R$  above the surface of 'P',  $R$  being the radius of 'P'. The time period of another satellite in hours at a height of  $2R$  from the surface of 'P' is \_\_\_\_\_. 'P' has the time period of 24 hours.

**Options :**

86435110543. 5

86435110544.  $6\sqrt{2}$

86435110545. 3

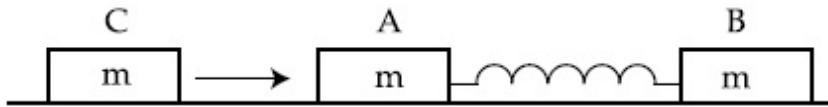
86435110546.  $\frac{6}{\sqrt{2}}$

**Question Number : 5 Question Id : 8643513515 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Two identical blocks A and B each of mass  $m$  resting on the smooth horizontal floor are connected by a light spring of natural length  $L$  and spring constant  $K$ . A third block C of mass  $m$  moving with a speed  $v$  along the line joining A and B collides with A. The maximum compression in the spring is



Options :

86435110547.  $\sqrt{\frac{m}{2K}}$

86435110548.  $v\sqrt{\frac{m}{2K}}$

86435110549.  $\sqrt{\frac{mv}{K}}$

86435110550.  $\sqrt{\frac{mv}{2K}}$

Question Number : 6 Question Id : 8643513516 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Two particles A and B of equal masses are suspended from two massless springs of spring constants  $K_1$  and  $K_2$  respectively. If the maximum velocities during oscillations are equal, the ratio of the amplitude of A and B is

Options :

86435110551.  $\frac{K_1}{K_2}$

86435110552.  $\sqrt{\frac{K_1}{K_2}}$

86435110553.  $\frac{K_2}{K_1}$

86435110554.  $\sqrt{\frac{K_2}{K_1}}$

**Question Number : 7 Question Id : 8643513517 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

**Match List - I with List - II**

**List - I**

**List - II**

- |   |  |
|---|--|
| (a) Phase difference between current and voltage in a purely resistive AC circuit | (i) $\frac{\pi}{2}$ ; current leads voltage      |
| (b) Phase difference between current and voltage in a pure inductive AC circuit   | (ii) zero  |
| (c) Phase difference between current and voltage in a pure capacitive AC circuit  | (iii) $\frac{\pi}{2}$ ; current lags voltage     |
| (d) Phase difference between current and voltage in an LCR series circuit         | (iv) $\tan^{-1}\left(\frac{X_C - X_L}{R}\right)$ |

Choose the most appropriate answer from the options given below :

**Options :**

86435110555. (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

86435110556. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

86435110557. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

86435110558. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

**Question Number : 8 Question Id : 8643513518 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

What happens to the inductive reactance and the current in a purely inductive circuit if the frequency is halved ?

**Options :**

86435110559. Inductive reactance will be doubled and current will be halved.

86435110560. Inductive reactance will be halved and current will be doubled.

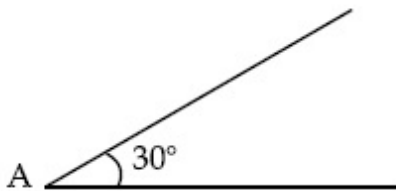
86435110561. Both, inductive reactance and current will be halved.

86435110562. Both, inducting reactance and current will be doubled.

**Question Number : 9 Question Id : 8643513519 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A sphere of mass 2 kg and radius 0.5 m is rolling with an initial speed of  $1 \text{ ms}^{-1}$  goes up an inclined plane which makes an angle of  $30^\circ$  with the horizontal plane, without slipping. How long will the sphere take to return to the starting point A ?



**Options :**

86435110563. 0.60 s

86435110564. 0.57 s

86435110565. 0.52 s

86435110566. 0.80 s

**Question Number : 10 Question Id : 8643513520 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A rubber ball is released from a height of 5 m above the floor. It bounces back repeatedly, always rising to  $\frac{81}{100}$  of the height through which it falls. Find the average speed of the ball.

(Take  $g = 10 \text{ ms}^{-2}$ )

**Options :**

86435110567.  $2.0 \text{ ms}^{-1}$

86435110568.  $2.50 \text{ ms}^{-1}$

86435110569.  $3.0 \text{ ms}^{-1}$

86435110570.  $3.50 \text{ ms}^{-1}$

**Question Number : 11 Question Id : 8643513521 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The velocity of a particle is  $v = v_0 + gt + Ft^2$ . Its position is  $x = 0$  at  $t = 0$ ; then its displacement after time ( $t = 1$ ) is :

**Options :**

86435110571.  $v_0 + \frac{g}{2} + F$

86435110572.  $v_0 + 2g + 3F$

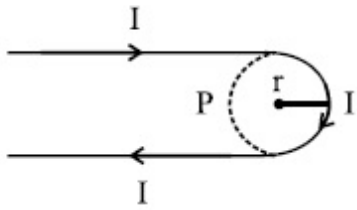
86435110573.  $v_0 + \frac{g}{2} + \frac{F}{3}$

86435110574.  $v_0 + g + F$

**Question Number : 12 Question Id : 8643513522 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point P which lies on the centre of the semicircle ?



Options :

86435110575.  $\frac{\mu_0 I}{2\pi r}(2 - \pi)$

86435110576.  $\frac{\mu_0 I}{2\pi r}(2 + \pi)$

86435110577.  $\frac{\mu_0 I}{4\pi r}(2 + \pi)$

86435110578.  $\frac{\mu_0 I}{4\pi r}(2 - \pi)$

Question Number : 13 Question Id : 8643513523 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The atomic hydrogen emits a line spectrum consisting of various series. Which series of hydrogen atomic spectra is lying in the visible region ?

Options :

86435110579. Paschen series

86435110580. Balmer series

86435110581. Lyman series

86435110582. Brackett series

Question Number : 14 Question Id : 8643513524 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No



**Correct Marks : 4 Wrong Marks : 1**

Two identical photocathodes receive the light of frequencies  $f_1$  and  $f_2$  respectively. If the velocities of the photo-electrons coming out are  $v_1$  and  $v_2$  respectively, then

**Options :**

86435110583. 
$$v_1 - v_2 = \left[ \frac{2h}{m}(f_1 - f_2) \right]^{\frac{1}{2}}$$

86435110584. 
$$v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$$

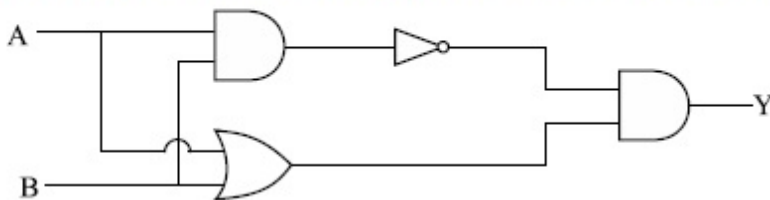
86435110585. 
$$v_1 + v_2 = \left[ \frac{2h}{m}(f_1 + f_2) \right]^{\frac{1}{2}}$$

86435110586. 
$$v_1^2 + v_2^2 = \frac{2h}{m}[f_1 + f_2]$$

**Question Number : 15 Question Id : 8643513525 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Which one of the following will be the output of the given circuit ?



**Options :**

86435110587. AND Gate

86435110588. NAND Gate

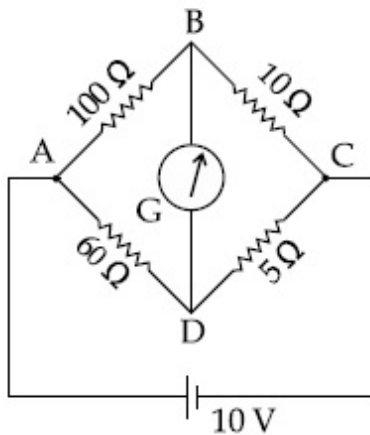
86435110589. XOR Gate

86435110590. NOR Gate

**Question Number : 16 Question Id : 8643513526 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The four arms of a Wheatstone bridge have resistances as shown in the figure. A galvanometer of  $15\ \Omega$  resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of  $10\ \text{V}$  is maintained across AC.



Options :

86435110591.  $2.44\ \mu\text{A}$

86435110592.  $2.44\ \text{mA}$

86435110593.  $4.87\ \mu\text{A}$

86435110594.  $4.87\ \text{mA}$

Question Number : 17 Question Id : 8643513527 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A block of mass  $1\ \text{kg}$  attached to a spring is made to oscillate with an initial amplitude of  $12\ \text{cm}$ . After 2 minutes the amplitude decreases to  $6\ \text{cm}$ . Determine the value of the damping constant for this motion. ( take  $\ln 2 = 0.693$  )

Options :

86435110595.  $1.16 \times 10^2\ \text{kg s}^{-1}$

86435110596.  $0.69 \times 10^2\ \text{kg s}^{-1}$

86435110597.  $5.7 \times 10^{-3}\ \text{kg s}^{-1}$

86435110598.  $3.3 \times 10^2\ \text{kg s}^{-1}$

Question Number : 18 Question Id : 8643513528 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If one mole of the polyatomic gas is having two vibrational modes and  $\beta$  is the ratio of molar

specific heats for polyatomic gas  $\left( \beta = \frac{C_P}{C_V} \right)$  then the value of  $\beta$  is :

Options :

86435110599. 1.25

86435110600. 1.2

86435110601. 1.35

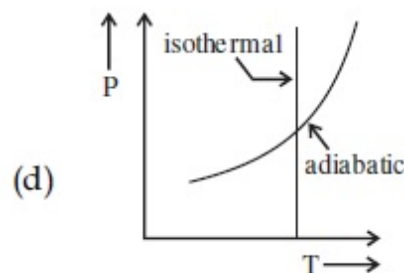
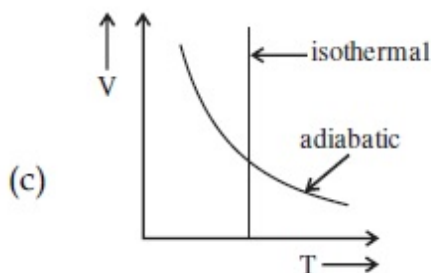
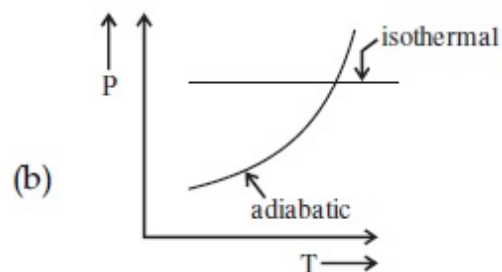
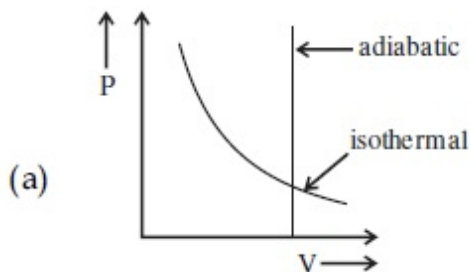
86435110602. 1.02

Question Number : 19 Question Id : 8643513529 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Which one is the correct option for the two different thermodynamic processes ?



Options :

86435110603. (a) only

86435110604. (b) and (c)

86435110605. (c) and (a)

86435110606. (c) and (d)

**Question Number : 20 Question Id : 8643513530 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

An object is located at 2 km beneath the surface of the water. If the fractional compression

$\frac{\Delta V}{V}$  is 1.36%, the ratio of hydraulic stress to the corresponding hydraulic strain will be

\_\_\_\_\_.

[ Given : density of water is  $1000 \text{ kgm}^{-3}$  and  $g = 9.8 \text{ ms}^{-2}$ .]

**Options :**

86435110607.  $1.96 \times 10^7 \text{ Nm}^{-2}$

86435110608.  $1.44 \times 10^7 \text{ Nm}^{-2}$

86435110609.  $2.26 \times 10^9 \text{ Nm}^{-2}$

86435110610.  $1.44 \times 10^9 \text{ Nm}^{-2}$

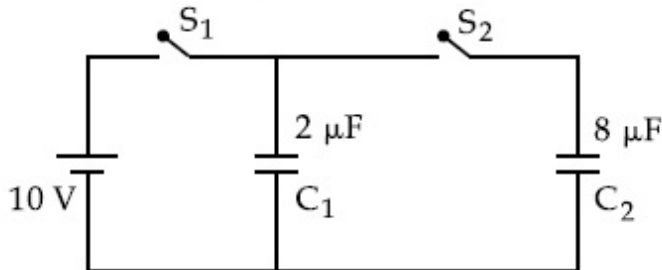
## Physics Section B

<b>Section Id :</b>	864351236
<b>Section Number :</b>	2
<b>Section type :</b>	Online
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	10
<b>Number of Questions to be attempted :</b>	5
<b>Section Marks :</b>	20
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351236
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 21 Question Id : 8643513531 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A  $2 \mu\text{F}$  capacitor  $C_1$  is first charged to a potential difference of  $10 \text{ V}$  using a battery. Then the battery is removed and the capacitor is connected to an uncharged capacitor  $C_2$  of  $8 \mu\text{F}$ . The charge in  $C_2$  on equilibrium condition is \_\_\_\_\_  $\mu\text{C}$ . (Round off to the Nearest Integer)



**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

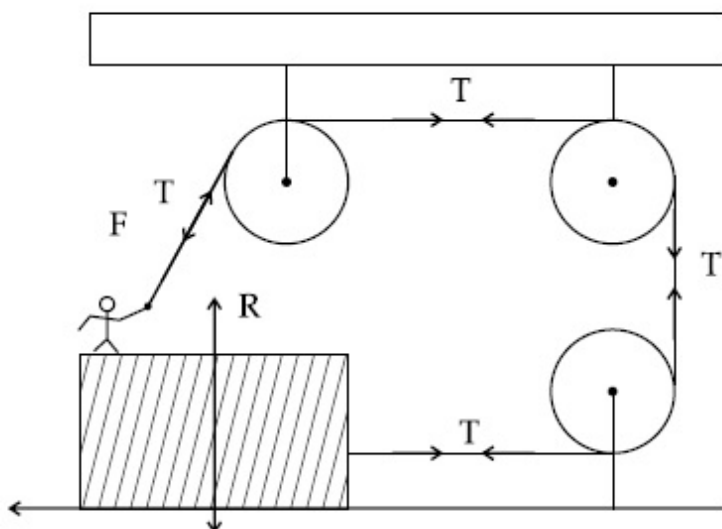
100

**Question Number : 22 Question Id : 8643513532 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A boy of mass  $4 \text{ kg}$  is standing on a piece of wood having mass  $5 \text{ kg}$ . If the coefficient of friction between the wood and the floor is  $0.5$ , the maximum force that the boy can exert on the rope so that the piece of wood does not move from its place is \_\_\_\_\_  $\text{N}$ . (Round off to the Nearest Integer)

[Take  $g = 10 \text{ ms}^{-2}$ ]



**Response Type :** Numeric**Evaluation Required For SA :** Yes**Show Word Count :** Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

**Question Number :** 23 **Question Id :** 8643513533 **Question Type :** SA**Correct Marks :** 4 **Wrong Marks :** 0

The image of an object placed in air formed by a convex refracting surface is at a distance of

10 m behind the surface. The image is real and is at  $\frac{2}{3}$  of the distance of the object from

the surface. The wavelength of light inside the surface is  $\frac{2}{3}$  times the wavelength in air. The

radius of the curved surface is  $\frac{x}{13}$  m. The value of 'x' is \_\_\_\_\_.

**Response Type :** Numeric**Evaluation Required For SA :** Yes**Show Word Count :** Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

**Question Number :** 24 **Question Id :** 8643513534 **Question Type :** SA**Correct Marks :** 4 **Wrong Marks :** 0

The electric field intensity produced by the radiation coming from a 100 W bulb at a distance of 3 m is E. The electric field intensity produced by the radiation coming from 60 W at the same distance is

$\sqrt{\frac{x}{5}}$  E. Where the value of x = \_\_\_\_\_.

**Response Type :** Numeric**Evaluation Required For SA :** Yes**Show Word Count :** Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

**Question Number : 25 Question Id : 8643513535 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Seawater at a frequency  $f=9 \times 10^2$  Hz, has permittivity  $\epsilon=80\epsilon_0$  and resistivity  $\rho=0.25 \Omega\text{m}$ . Imagine a parallel plate capacitor is immersed in seawater and is driven by an alternating voltage source  $V(t)=V_0 \sin(2\pi ft)$ . Then the conduction current density becomes  $10^x$  times the displacement current density after time  $t = \frac{1}{800}$  s. The value of  $x$  is

\_\_\_\_\_.

(Given :  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$ )

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

**Question Number : 26 Question Id : 8643513536 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

The electric field in a region is given by  $\vec{E} = \frac{2}{5}E_0\hat{i} + \frac{3}{5}E_0\hat{j}$  with  $E_0 = 4.0 \times 10^3 \frac{\text{N}}{\text{C}}$ . The flux of this field through a rectangular surface area  $0.4 \text{ m}^2$  parallel to the Y-Z plane is \_\_\_\_\_  $\text{Nm}^2 \text{C}^{-1}$ .

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

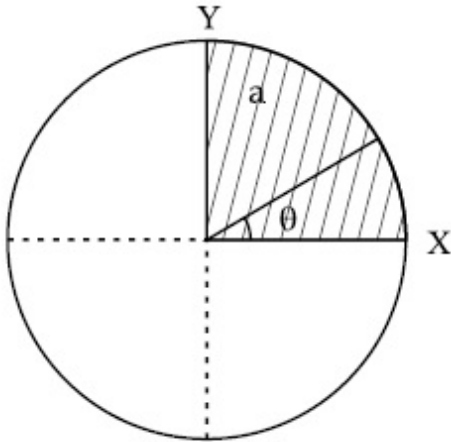
**Possible Answers :**

100

**Question Number : 27 Question Id : 8643513537 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

The disc of mass  $M$  with uniform surface mass density  $\sigma$  is shown in the figure. The centre of mass of the quarter disc (the shaded area) is at the position  $\frac{x}{3} \frac{a}{\pi}, \frac{x}{3} \frac{a}{\pi}$  where  $x$  is \_\_\_\_\_. (Round off to the Nearest Integer)  
 [a is an area as shown in the figure ]



**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number :** 28 **Question Id :** 8643513538 **Question Type :** SA

**Correct Marks :** 4 **Wrong Marks :** 0

A body of mass 1 kg rests on a horizontal floor with which it has a coefficient of static friction  $\frac{1}{\sqrt{3}}$ . It is desired to make the body move by applying the minimum possible force

F N. The value of F will be \_\_\_\_\_. (Round off to the Nearest Integer)

[ Take  $g = 10 \text{ ms}^{-2}$  ]

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100



**Question Number : 29 Question Id : 8643513539 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A particle of mass  $m$  moves in a circular orbit in a central potential field  $U(r) = U_0 r^4$ . If Bohr's quantization conditions are applied, radii of possible orbitals  $r_n$  vary with  $n^{\frac{1}{\alpha}}$ , where  $\alpha$  is \_\_\_\_\_.

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

**Question Number : 30 Question Id : 8643513540 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Suppose you have taken a dilute solution of oleic acid in such a way that its concentration

becomes  $0.01 \text{ cm}^3$  of oleic acid per  $\text{cm}^3$  of the solution. Then you make a thin film of this

solution (monomolecular thickness) of area  $4 \text{ cm}^2$  by considering 100 spherical drops of

radius  $\left(\frac{3}{40\pi}\right)^{\frac{1}{3}} \times 10^{-3} \text{ cm}$ . Then the thickness of oleic acid layer will be  $x \times 10^{-14} \text{ m}$ .

Where  $x$  is \_\_\_\_\_.

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

## Chemistry Section A

**Section Id :**

864351237

**Section Number :**

3

<b>Section type :</b>	Online
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	20
<b>Number of Questions to be attempted :</b>	20
<b>Section Marks :</b>	80
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351237
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 31 Question Id : 8643513541 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Amongst the following, the linear species is :

**Options :**

86435110621.  $\text{N}_3^-$

86435110622.  $\text{NO}_2$

86435110623.  $\text{O}_3$

86435110624.  $\text{Cl}_2\text{O}$

**Question Number : 32 Question Id : 8643513542 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

During which of the following processes, does entropy decrease ?

- (A) Freezing of water to ice at  $0^\circ\text{C}$
- (B) Freezing of water to ice at  $-10^\circ\text{C}$
- (C)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- (D) Adsorption of  $\text{CO}(\text{g})$  on lead surface.
- (E) Dissolution of  $\text{NaCl}$  in water

Choose the correct answer from the options given below :

**Options :**

86435110625. (A), (B), (C) and (D) only

86435110626. (A), (C) and (E) only

86435110627. (A) and (E) only

86435110628. (B) and (C) only

**Question Number : 33 Question Id : 8643513543 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

For the coagulation of a negative sol, the species below, that has the highest flocculating power is :

**Options :**

86435110629.  $\text{Ba}^{2+}$

86435110630.  $\text{Na}^{+}$

86435110631.  $\text{PO}_4^{3-}$

86435110632.  $\text{SO}_4^{2-}$

**Question Number : 34 Question Id : 8643513544 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The set of elements that differ in mutual relationship from those of the other sets is :

**Options :**

86435110633. Be - Al

86435110634. B - Si

86435110635. Li - Na

86435110636. Li - Mg

**Question Number : 35 Question Id : 8643513545 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Match List - I with List - II :

List - I	List - II
(a) Haematite	(i) $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
(b) Bauxite	(ii) $\text{Fe}_2\text{O}_3$
(c) Magnetite	(iii) $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
(d) Malachite	(iv) $\text{Fe}_3\text{O}_4$

Choose the correct answer from the options given below :

**Options :**

86435110637. (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

86435110638. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

86435110639. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

86435110640. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

**Question Number : 36 Question Id : 8643513546 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are :

**Options :**

86435110641.  $-\text{SO}_3\text{H}$  and  $-\text{NH}_2$

86435110642.  $-\text{NH}_2$  and  $-\text{COOH}$

86435110643.  $-\text{NH}_2$  and  $-\text{SO}_3\text{H}$

86435110644.  $-\text{SO}_3\text{H}$  and  $-\text{COOH}$

**Question Number : 37 Question Id : 8643513547 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

One of the by-products formed during the recovery of  $\text{NH}_3$  from Solvay process is :

**Options :**

86435110645.  $\text{NH}_4\text{Cl}$

86435110646.  $\text{Ca}(\text{OH})_2$

86435110647.  $\text{CaCl}_2$

86435110648.  $\text{NaHCO}_3$

**Question Number : 38 Question Id : 8643513548 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The set that represents the pair of neutral oxides of nitrogen is :

**Options :**

86435110649.  $\text{NO}$  and  $\text{N}_2\text{O}$

86435110650.  $\text{N}_2\text{O}$  and  $\text{NO}_2$

86435110651.  $\text{NO}$  and  $\text{NO}_2$

86435110652.  $\text{N}_2\text{O}$  and  $\text{N}_2\text{O}_3$

**Question Number : 39 Question Id : 8643513549 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The common positive oxidation states for an element with atomic number 24, are :

**Options :**

86435110653. +1 to +6

86435110654. +2 to +6

86435110655. +1 and +3 to +6

86435110656. +1 and +3

**Question Number : 40 Question Id : 8643513550 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

**Match List - I with List - II :**

List - I	List - II
(a) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$	(i) Linkage isomerism
(b) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$	(ii) Solvate isomerism
(c) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$	(iii) Co-ordination isomerism
(d) $\text{cis-}[\text{CrCl}_2(\text{ox})_2]^{3-}$	(iv) Optical isomerism

Choose the correct answer from the options given below :

**Options :**

86435110657. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

86435110658. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

86435110659. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

86435110660. (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

**Question Number : 41 Question Id : 8643513551 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Which of the following statement(s) is (are) incorrect reason for eutrophication ?

- (A) excess usage of fertilisers
- (B) excess usage of detergents
- (C) dense plant population in water bodies
- (D) lack of nutrients in water bodies that prevent plant growth

Choose the most appropriate answer from the options given below :

**Options :**

86435110661. (A) only

86435110662. (B) and (D) only

86435110663. (C) only

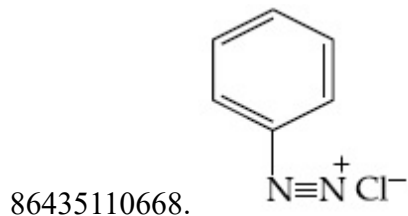
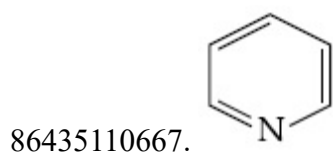
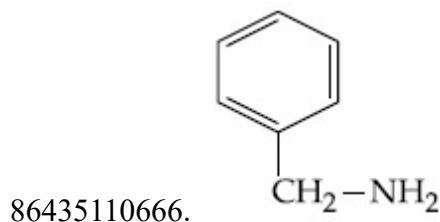
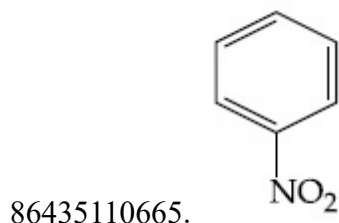
86435110664. (D) only

Question Number : 42 Question Id : 8643513552 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Nitrogen can be estimated by Kjeldahl's method for which of the following compound ?

Options :



Question Number : 43 Question Id : 8643513553 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The correct pair(s) of the ambident nucleophiles is (are) :

- (A) AgCN/KCN
- (B) RCOOAg/RCOOK
- (C) AgNO<sub>2</sub>/KNO<sub>2</sub>
- (D) AgI/KI

Options :

86435110669. (A) only

86435110670. (B) only

86435110671. (A) and (C) only

86435110672. (B) and (C) only

**Question Number : 44 Question Id : 8643513554 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Given below are two statements :

**Statement I :** 2-methylbutane on oxidation with  $\text{KMnO}_4$  gives 2-methylbutan-2-ol.

**Statement II :** n-alkanes can be easily oxidised to corresponding alcohols with  $\text{KMnO}_4$ .

Choose the correct option :

**Options :**

86435110673. Both statement I and statement II are correct

86435110674. Both statement I and statement II are incorrect

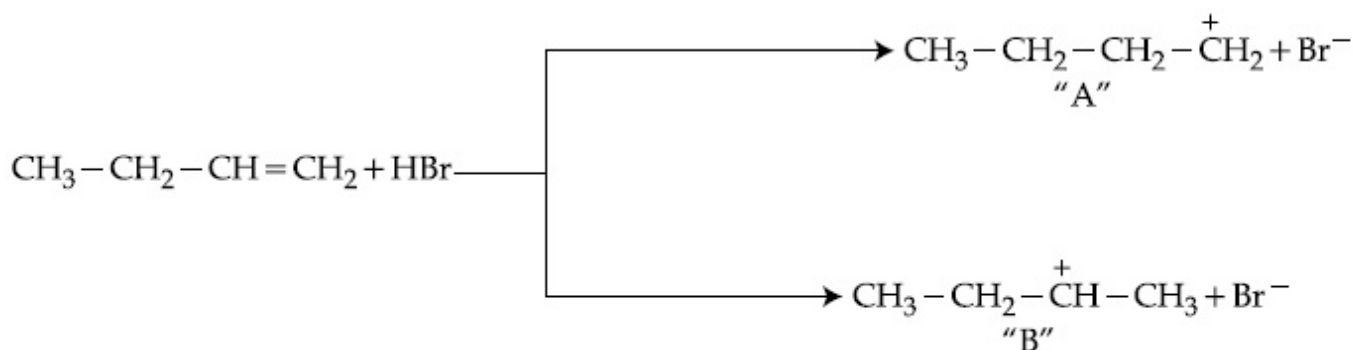
86435110675. Statement I is correct but statement II is incorrect

86435110676. Statement I is incorrect but statement II is correct

**Question Number : 45 Question Id : 8643513555 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Choose the correct statement regarding the formation of carbocations A and B given.



**Options :**

86435110677. Carbocation A is more stable and formed relatively at slow rate

86435110678. Carbocation B is more stable and formed relatively at slow rate

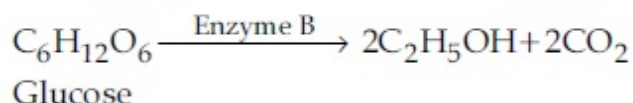
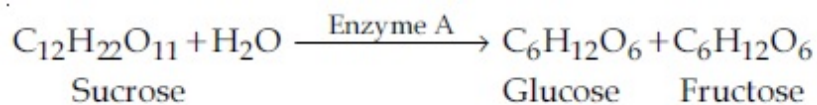


86435110679. Carbocation A is more stable and formed relatively at faster rate

86435110680. Carbocation B is more stable and formed relatively at faster rate

**Question Number : 46 Question Id : 8643513556 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**



In the above reactions, the enzyme A and enzyme B respectively are :

**Options :**

86435110681. Invertase and Zymase

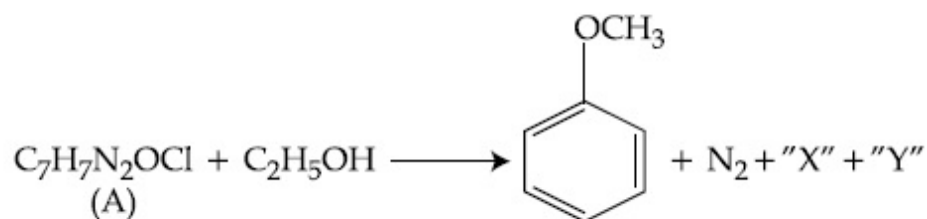
86435110682. Zymase and Invertase

86435110683. Invertase and Amylase

86435110684. Amylase and Invertase

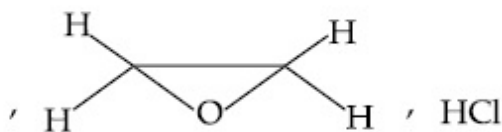
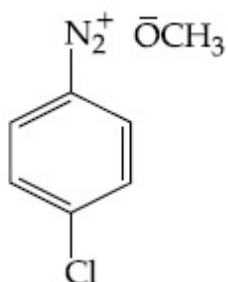
**Question Number : 47 Question Id : 8643513557 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

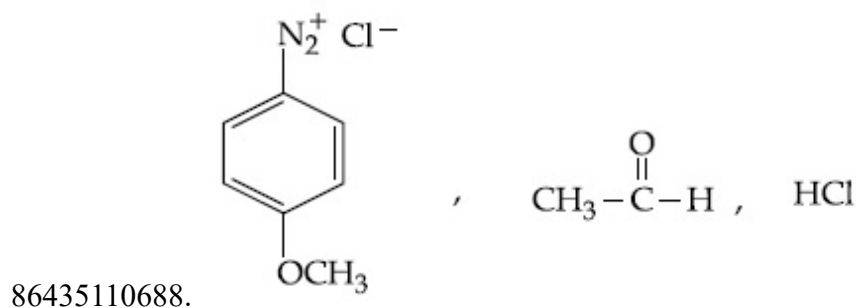
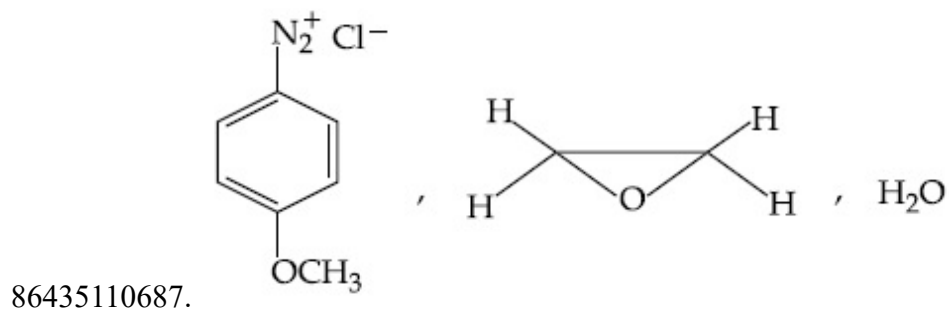
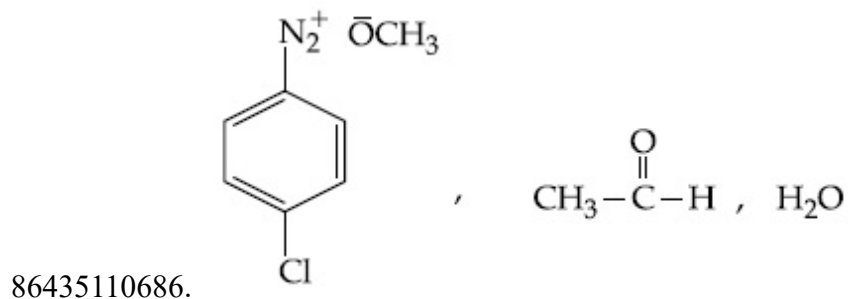


In the above reaction, the structural formula of (A), "X" and "Y" respectively are :

**Options :**



86435110685.



**Question Number : 48 Question Id : 8643513558 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Primary, secondary and tertiary amines can be separated using :

**Options :**

86435110689. Chloroform and KOH

86435110690. Benzene sulphonic acid

86435110691. para-Toluene sulphonyl chloride

86435110692. Acetyl amide

**Question Number : 49 Question Id : 8643513559 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Match List - I with List - II.

List - I	List - II
Chemical Compound	Used as
(a) Sucralose	(i) Synthetic detergent
(b) Glyceryl ester of stearic acid	(ii) Artificial sweetener
(c) Sodium benzoate	(iii) Antiseptic
(d) Bithionol	(iv) Food preservative

Choose the correct match :

**Options :**

86435110693. (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

86435110694. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

86435110695. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

86435110696. (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

**Question Number : 50 Question Id : 8643513560 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Fructose is an example of :

**Options :**

86435110697. Aldohexose

86435110698. Ketohexose

86435110699. Pyranose

86435110700. Heptose

## Chemistry Section B

**Section Id :**

864351238

**Section Number :**

4

**Section type :**

Online

<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	10
<b>Number of Questions to be attempted :</b>	5
<b>Section Marks :</b>	20
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351238
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 51 Question Id : 8643513561 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

The number of chlorine atoms in 20 mL of chlorine gas at STP is \_\_\_\_\_  $10^{21}$ . (Round off to the Nearest Integer).

[Assume chlorine is an ideal gas at STP

$R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$ ,  $N_A = 6.023 \times 10^{23}$ ]

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

**Question Number : 52 Question Id : 8643513562 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

KBr is doped with  $10^{-5}$  mole percent of  $\text{SrBr}_2$ . The number of cationic vacancies in 1 g of KBr crystal is \_\_\_\_\_  $10^{14}$ . (Round off to the Nearest Integer).

[Atomic Mass : K : 39.1 u, Br : 79.9 u

$N_A = 6.023 \times 10^{23}$ ]

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

**Question Number : 53 Question Id : 8643513563 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

In the ground state of atomic Fe( $Z=26$ ), the spin-only magnetic moment is \_\_\_\_\_  $\times 10^{-1}$  BM. (Round off to the Nearest Integer).

[Given :  $\sqrt{3} = 1.73$ ,  $\sqrt{2} = 1.41$ ]

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 54 Question Id : 8643513564 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

A 1 molal  $K_4Fe(CN)_6$  solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non electrolytic solute A. The molar mass of A is \_\_\_\_\_ u. (Round off to the Nearest Integer).

[Density of water =  $1.0 \text{ g cm}^{-3}$ ]

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 55 Question Id : 8643513565 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Consider the reaction  $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ . The temperature at which  $K_C = 20.4$  and  $K_P = 600.1$ , is \_\_\_\_\_ K. (Round off to the Nearest Integer).

[Assume all gases are ideal and  $R = 0.0831 \text{ L bar K}^{-1} \text{ mol}^{-1}$ ]

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 56 Question Id : 8643513566 Question Type : SA

**Correct Marks : 4 Wrong Marks : 0**

A KCl solution of conductivity  $0.14 \text{ S m}^{-1}$  shows a resistance of  $4.19 \text{ } \Omega$  in a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops to  $1.03 \text{ } \Omega$ . The conductivity of the HCl solution is \_\_\_\_\_  $\times 10^{-2} \text{ S m}^{-1}$ . (Round off to the Nearest Integer).

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 57 Question Id : 8643513567 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

The reaction  $2A + B_2 \rightarrow 2AB$  is an elementary reaction.

For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of \_\_\_\_\_. (Round off to the Nearest Integer).

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 58 Question Id : 8643513568 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

On complete reaction of  $\text{FeCl}_3$  with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is \_\_\_\_\_. (Round off to the Nearest Integer).

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 59 Question Id : 8643513569 Question Type : SA**

Correct Marks : 4 Wrong Marks : 0

The total number of C-C sigma bond/s in mesityl oxide ( $C_6H_{10}O$ ) is \_\_\_\_\_. (Round off to the Nearest Integer).

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

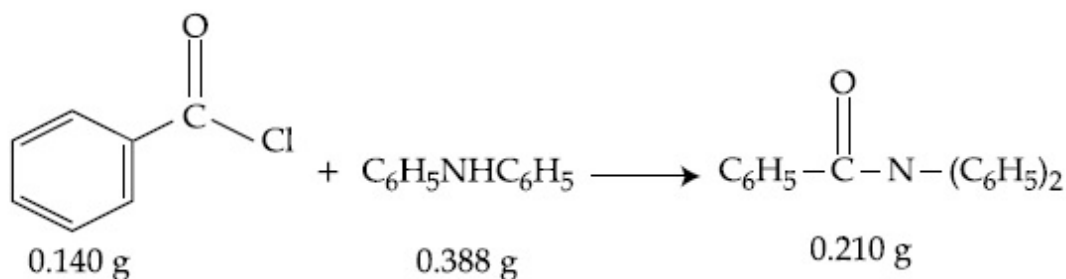
Text Areas : PlainText

Possible Answers :

100

Question Number : 60 Question Id : 8643513570 Question Type : SA

Correct Marks : 4 Wrong Marks : 0



Consider the above reaction. The percentage yield of amide product is \_\_\_\_\_. (Round off to the Nearest Integer).

(Given : Atomic mass : C : 12.0 u, H : 1.0 u, N : 14.0 u, O : 16.0 u, Cl : 35.5 u)

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

## Mathematics Section A

Section Id :	864351239
Section Number :	5
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Mark As Answered Required? :	Yes

**Sub-Section Number :** 1  
**Sub-Section Id :** 864351239  
**Question Shuffling Allowed :** Yes

**Question Number : 61 Question Id : 8643513571 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

The number of solutions of the equation  $\sin^{-1}\left[x^2 + \frac{1}{3}\right] + \cos^{-1}\left[x^2 - \frac{2}{3}\right] = x^2$ , for  $x \in [-1, 1]$ , and  $[x]$  denotes the greatest integer less than or equal to  $x$ , is :

**Options :**

86435110711. 0

86435110712. 2

86435110713. 4

86435110714. Infinite

**Question Number : 62 Question Id : 8643513572 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

If the Boolean expression  $(p \wedge q) \oplus (p \otimes q)$  is a tautology, then  $\oplus$  and  $\otimes$  are respectively given by :

**Options :**

86435110715.  $\wedge, \vee$

86435110716.  $\vee, \rightarrow$

86435110717.  $\rightarrow, \rightarrow$

86435110718.  $\wedge, \rightarrow$

**Question Number : 63 Question Id : 8643513573 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**



Let O be the origin. Let  $\vec{OP} = x\hat{i} + y\hat{j} - \hat{k}$  and  $\vec{OQ} = -\hat{i} + 2\hat{j} + 3x\hat{k}$ ,  $x, y \in \mathbf{R}$ ,  $x > 0$ , be such that  $|\vec{PQ}| = \sqrt{20}$  and the vector  $\vec{OP}$  is perpendicular to  $\vec{OQ}$ . If  $\vec{OR} = 3\hat{i} + z\hat{j} - 7\hat{k}$ ,  $z \in \mathbf{R}$ , is coplanar with  $\vec{OP}$  and  $\vec{OQ}$ , then the value of  $x^2 + y^2 + z^2$  is equal to :

**Options :**

86435110719. 1

86435110720. 2

86435110721. 7

86435110722. 9

**Question Number : 64 Question Id : 8643513574 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

If  $x, y, z$  are in arithmetic progression with common difference  $d$ ,  $x \neq 3d$ , and the determinant

of the matrix  $\begin{bmatrix} 3 & 4\sqrt{2} & x \\ 4 & 5\sqrt{2} & y \\ 5 & k & z \end{bmatrix}$  is zero, then the value of  $k^2$  is :

**Options :**

86435110723. 6

86435110724. 12

86435110725. 36

86435110726. 72

**Question Number : 65 Question Id : 8643513575 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The value of the limit  $\lim_{\theta \rightarrow 0} \frac{\tan(\pi \cos^2 \theta)}{\sin(2\pi \sin^2 \theta)}$  is equal to :

Options :

86435110727.  $\frac{1}{4}$

86435110728.  $-\frac{1}{2}$

86435110729.  $-\frac{1}{4}$

86435110730. 0

Question Number : 66 Question Id : 8643513576 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the integral  $\int_0^{10} \frac{[\sin 2\pi x]}{e^x - [x]} dx = \alpha e^{-1} + \beta e^{-\frac{1}{2}} + \gamma$ , where  $\alpha, \beta, \gamma$  are integers and  $[x]$  denotes

the greatest integer less than or equal to  $x$ , then the value of  $\alpha + \beta + \gamma$  is equal to :

Options :

86435110731. 0

86435110732. 10

86435110733. 20

86435110734. 25

Question Number : 67 Question Id : 8643513577 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the curve  $y=y(x)$  is the solution of the differential equation

$$2(x^2 + x^{5/4}) dy - y(x + x^{1/4}) dx = 2x^{9/4} dx, \quad x > 0 \text{ which passes through the point}$$

$\left(1, 1 - \frac{4}{3} \log_e 2\right)$ , then the value of  $y(16)$  is equal to :

**Options :**

86435110735.  $4\left(\frac{31}{3} - \frac{8}{3} \log_e 3\right)$

86435110736.  $\left(\frac{31}{3} - \frac{8}{3} \log_e 3\right)$

86435110737.  $\left(\frac{31}{3} + \frac{8}{3} \log_e 3\right)$

86435110738.  $4\left(\frac{31}{3} + \frac{8}{3} \log_e 3\right)$

**Question Number : 68 Question Id : 8643513578 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Let  $y=y(x)$  be the solution of the differential equation

$$\cos x(3\sin x + \cos x + 3) dy = (1 + y \sin x(3\sin x + \cos x + 3))dx, \quad 0 \leq x \leq \frac{\pi}{2}, \quad y(0) = 0. \text{ Then, } y\left(\frac{\pi}{3}\right) \text{ is}$$

equal to :

**Options :**

86435110739.  $2 \log_e \left(\frac{3\sqrt{3} - 8}{4}\right)$

86435110740.  $2 \log_e \left(\frac{\sqrt{3} + 7}{2}\right)$

$$2 \log_e \left( \frac{2\sqrt{3} + 9}{6} \right)$$

86435110741.

$$2 \log_e \left( \frac{2\sqrt{3} + 10}{11} \right)$$

86435110742.

**Question Number : 69 Question Id : 8643513579 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

Consider the function  $f: \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = \begin{cases} \left(2 - \sin\left(\frac{1}{x}\right)\right) |x|, & x \neq 0 \\ 0, & x = 0 \end{cases}$ . Then  $f$  is :

**Options :**

86435110743. monotonic on  $(0, \infty)$  only

86435110744. monotonic on  $(-\infty, 0)$  only

86435110745. monotonic on  $(-\infty, 0) \cup (0, \infty)$

86435110746. not monotonic on  $(-\infty, 0)$  and  $(0, \infty)$

**Question Number : 70 Question Id : 8643513580 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

The value of

$$\lim_{n \rightarrow \infty} \frac{[r] + [2r] + \dots + [nr]}{n^2},$$

where  $r$  is a non-zero real number and  $[r]$  denotes the greatest integer less than or equal to  $r$ , is equal to :

**Options :**

86435110747.  $r$

86435110748.  $\frac{r}{2}$

86435110749.  $2r$

86435110750.  $0$

**Question Number : 71 Question Id : 8643513581 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Let a computer program generate only the digits 0 and 1 to form a string of binary numbers with probability of occurrence of 0 at even places be  $\frac{1}{2}$  and probability of occurrence of 0 at the odd place be  $\frac{1}{3}$ . Then the probability that '10' is followed by '01' is equal to :

**Options :**

86435110751.  $\frac{1}{9}$

86435110752.  $\frac{1}{6}$

86435110753.  $\frac{1}{3}$

86435110754.  $\frac{1}{18}$

**Question Number : 72 Question Id : 8643513582 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

If the sides AB, BC and CA of a triangle ABC have 3, 5 and 6 interior points respectively, then the total number of triangles that can be constructed using these points as vertices, is equal to :

**Options :**

86435110755.  $360$

86435110756. 364

86435110757. 333

86435110758. 240

**Question Number : 73 Question Id : 8643513583 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Let the tangent to the circle  $x^2 + y^2 = 25$  at the point  $R(3, 4)$  meet  $x$ -axis and  $y$ -axis at points  $P$  and  $Q$ , respectively. If  $r$  is the radius of the circle passing through the origin  $O$  and having centre at the incentre of the triangle  $OPQ$ , then  $r^2$  is equal to :

**Options :**

86435110759.  $\frac{125}{72}$ 86435110760.  $\frac{625}{72}$ 86435110761.  $\frac{529}{64}$ 86435110762.  $\frac{585}{66}$ 

**Question Number : 74 Question Id : 8643513584 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Let  $S_1, S_2$  and  $S_3$  be three sets defined as

$$S_1 = \{z \in \mathbb{C} : |z - 1| \leq \sqrt{2}\}$$

$$S_2 = \{z \in \mathbb{C} : \operatorname{Re}((1 - i)z) \geq 1\}$$

$$S_3 = \{z \in \mathbb{C} : \operatorname{Im}(z) \leq 1\}$$

Then the set  $S_1 \cap S_2 \cap S_3$

**Options :**

86435110763. has exactly two elements

86435110764. has exactly three elements

86435110765. is a singleton

86435110766. has infinitely many elements

**Question Number : 75 Question Id : 8643513585 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be defined as  $f(x) = e^{-x}\sin x$ . If  $F: [0, 1] \rightarrow \mathbb{R}$  is a differentiable function suchthat  $F(x) = \int_0^x f(t) dt$ , then the value of  $\int_0^1 (F'(x) + f(x))e^x dx$  lies in the interval**Options :**86435110767.  $\left[ \frac{330}{360}, \frac{331}{360} \right]$ 86435110768.  $\left[ \frac{327}{360}, \frac{329}{360} \right]$ 86435110769.  $\left[ \frac{331}{360}, \frac{334}{360} \right]$ 86435110770.  $\left[ \frac{335}{360}, \frac{336}{360} \right]$ **Question Number : 76 Question Id : 8643513586 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**The value of  $\sum_{r=0}^6 \left( {}^6C_r \cdot {}^6C_{6-r} \right)$  is equal to :**Options :**

86435110771. 924

86435110772. 1024

86435110773. 1124

86435110774. 1324

**Question Number : 77 Question Id : 8643513587 Question Type : MCQ Option Shuffling : Yes Is****Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**

If the equation of plane passing through the mirror image of a point  $(2, 3, 1)$  with respect to

line  $\frac{x+1}{2} = \frac{y-3}{1} = \frac{z+2}{-1}$  and containing the line  $\frac{x-2}{3} = \frac{1-y}{2} = \frac{z+1}{1}$  is

$\alpha x + \beta y + \gamma z = 24$ , then  $\alpha + \beta + \gamma$  is equal to :

**Options :**

86435110775. 21

86435110776. 20

86435110777. 19

86435110778. 18

**Question Number : 78 Question Id : 8643513588 Question Type : MCQ Option Shuffling : Yes Is****Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**

Two tangents are drawn from a point P to the circle  $x^2 + y^2 - 2x - 4y + 4 = 0$ , such that the

angle between these tangents is  $\tan^{-1}\left(\frac{12}{5}\right)$ , where  $\tan^{-1}\left(\frac{12}{5}\right) \in (0, \pi)$ . If the centre of the

circle is denoted by C and these tangents touch the circle at points A and B, then the ratio of

the areas of  $\Delta PAB$  and  $\Delta CAB$  is :

**Options :**

86435110779. 9 : 4



86435110780. 3 : 1

86435110781. 2 : 1

86435110782. 11 : 4

**Question Number : 79 Question Id : 8643513589 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The number of solutions of the equation  $x + 2 \tan x = \frac{\pi}{2}$  in the interval  $[0, 2\pi]$  is :

**Options :**

86435110783. 2

86435110784. 3

86435110785. 4

86435110786. 5

**Question Number : 80 Question Id : 8643513590 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Let L be a tangent line to the parabola  $y^2 = 4x - 20$  at  $(6, 2)$ . If L is also a tangent to the ellipse

$\frac{x^2}{2} + \frac{y^2}{b} = 1$ , then the value of b is equal to :

**Options :**

86435110787. 11

86435110788. 14

86435110789. 16

86435110790. 20

## Mathematics Section B

<b>Section Id :</b>	864351240
<b>Section Number :</b>	6
<b>Section type :</b>	Online
<b>Mandatory or Optional :</b>	Mandatory
<b>Number of Questions :</b>	10
<b>Number of Questions to be attempted :</b>	5
<b>Section Marks :</b>	20
<b>Mark As Answered Required? :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351240
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 81 Question Id : 8643513591 Question Type : SA**  
**Correct Marks : 4 Wrong Marks : 0**

Let  $I_n = \int_1^e x^{19} (\log|x|)^n dx$ , where  $n \in \mathbb{N}$ . If  $(20)I_{10} = \alpha I_9 + \beta I_8$ , for natural numbers  $\alpha$  and  $\beta$ , then  $\alpha - \beta$  equals to \_\_\_\_\_.

**Response Type :** Numeric  
**Evaluation Required For SA :** Yes  
**Show Word Count :** Yes  
**Answers Type :** Equal  
**Text Areas :** PlainText  
**Possible Answers :**  
 100

**Question Number : 82 Question Id : 8643513592 Question Type : SA**  
**Correct Marks : 4 Wrong Marks : 0**

Let  $\tan\alpha, \tan\beta$  and  $\tan\gamma$ ;  $\alpha, \beta, \gamma \neq \frac{(2n-1)\pi}{2}$ ,  $n \in \mathbb{N}$  be the slopes of three line segments OA, OB and OC, respectively, where O is origin. If circumcentre of  $\Delta ABC$  coincides with origin and its orthocentre lies on y-axis, then the value of  $\left( \frac{\cos 3\alpha + \cos 3\beta + \cos 3\gamma}{\cos \alpha \cos \beta \cos \gamma} \right)^2$  is equal to \_\_\_\_\_.

**Response Type :** Numeric  
**Evaluation Required For SA :** Yes

**Show Word Count : Yes****Answers Type : Equal****Text Areas : PlainText****Possible Answers :**

100

**Question Number : 83 Question Id : 8643513593 Question Type : SA****Correct Marks : 4 Wrong Marks : 0**

If 1,  $\log_{10}(4^x - 2)$  and  $\log_{10}\left(4^x + \frac{18}{5}\right)$  are in arithmetic progression for a real number  $x$ , then

the value of the determinant  $\begin{vmatrix} 2\left(x - \frac{1}{2}\right) & x - 1 & x^2 \\ 1 & 0 & x \\ x & 1 & 0 \end{vmatrix}$  is equal to :

**Response Type : Numeric****Evaluation Required For SA : Yes****Show Word Count : Yes****Answers Type : Equal****Text Areas : PlainText****Possible Answers :**

100

**Question Number : 84 Question Id : 8643513594 Question Type : SA****Correct Marks : 4 Wrong Marks : 0**

Consider a set of  $3n$  numbers having variance 4. In this set, the mean of first  $2n$  numbers is 6 and the mean of the remaining  $n$  numbers is 3. A new set is constructed by adding 1 into each of first  $2n$  numbers, and subtracting 1 from each of the remaining  $n$  numbers. If the variance of the new set is  $k$ , then  $9k$  is equal to \_\_\_\_\_.

**Response Type : Numeric****Evaluation Required For SA : Yes****Show Word Count : Yes****Answers Type : Equal****Text Areas : PlainText****Possible Answers :**

100

**Question Number : 85 Question Id : 8643513595 Question Type : SA****Correct Marks : 4 Wrong Marks : 0**

Let  $f: [-1, 1] \rightarrow \mathbb{R}$  be defined as  $f(x) = ax^2 + bx + c$  for all  $x \in [-1, 1]$ , where  $a, b, c \in \mathbb{R}$  such that  $f(-1) = 2, f'(-1) = 1$  and for  $x \in (-1, 1)$  the maximum value of  $f''(x)$  is  $\frac{1}{2}$ . If  $f(x) \leq \alpha, x \in [-1, 1]$ , then the least value of  $\alpha$  is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number :** 86 **Question Id :** 8643513596 **Question Type :** SA

**Correct Marks :** 4 **Wrong Marks :** 0

Let the coefficients of third, fourth and fifth terms in the expansion of  $\left(x + \frac{a}{x^2}\right)^n, x \neq 0$ , be

in the ratio 12 : 8 : 3. Then the term independent of  $x$  in the expansion, is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number :** 87 **Question Id :** 8643513597 **Question Type :** SA

**Correct Marks :** 4 **Wrong Marks :** 0

Let  $f: [-3, 1] \rightarrow \mathbb{R}$  be given as

$$f(x) = \begin{cases} \min \{(x+6), x^2\}, & -3 \leq x \leq 0 \\ \max \{\sqrt{x}, x^2\}, & 0 \leq x \leq 1. \end{cases}$$

If the area bounded by  $y=f(x)$  and  $x$ -axis is  $A$ , then the value of  $6A$  is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 88 Question Id : 8643513598 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Let P be an arbitrary point having sum of the squares of the distances from the planes  $x + y + z = 0$ ,  $lx - nz = 0$  and  $x - 2y + z = 0$ , equal to 9. If the locus of the point P is  $x^2 + y^2 + z^2 = 9$ , then the value of  $l - n$  is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 89 Question Id : 8643513599 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Let  $\vec{x}$  be a vector in the plane containing vectors  $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$  and  $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ . If the vector  $\vec{x}$  is perpendicular to  $(3\hat{i} + 2\hat{j} - \hat{k})$  and its projection on  $\vec{a}$  is  $\frac{17\sqrt{6}}{2}$ , then the value of

$|\vec{x}|^2$  is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number : 90 Question Id : 8643513600 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Let  $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  and  $B = \begin{bmatrix} \alpha \\ \beta \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \end{bmatrix}$  such that  $AB = B$  and  $a + d = 2021$ , then the value of  $ad - bc$  is equal to \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100