

# National Testing Agency

<b>Question Paper Name :</b>	B Tech 22072021 S2
<b>Subject Name :</b>	B TECH
<b>Creation Date :</b>	2021-07-22 13:24:33
<b>Duration :</b>	180
<b>Total Marks :</b>	300
<b>Display Marks:</b>	Yes

## B TECH

<b>Group Number :</b>	1
<b>Group Id :</b>	864351219
<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>	864351752
<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>Enable Mark as Answered Mark for Review and Clear Response :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351979
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 1 Question Id : 86435117740 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

What should be the height of transmitting antenna and the population covered if the television telecast is to cover a radius of 150 km ? The average population density around the tower is  $2000/\text{km}^2$  and the value of  $R_e = 6.5 \times 10^6$  m.

**Options :**

86435159801. Height = 1600 m  
Population Covered =  $2 \times 10^5$

86435159802. Height = 1241 m  
Population Covered =  $7 \times 10^5$

86435159803. Height = 1731 m  
Population Covered =  $1413 \times 10^5$

86435159804. Height = 1800 m  
Population Covered =  $1413 \times 10^8$

Question Number : 2 Question Id : 86435117741 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Choose the correct option :

Options :

86435159805. True dip is always greater than the apparent dip.

86435159806. True dip is always equal to apparent dip.

86435159807. True dip is less than the apparent dip.

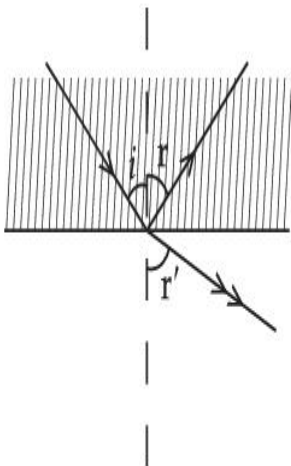
86435159808. True dip is not mathematically related to apparent dip.

Question Number : 3 Question Id : 86435117742 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A ray of light passes from a denser medium to a rarer medium at an angle of incidence  $i$ . The reflected and refracted rays make an angle of  $90^\circ$  with each other. The angle of reflection and refraction are respectively  $r$  and  $r'$ . The critical angle is given by :



Options :

86435159809.  $\tan^{-1}(\sin i)$

86435159810.  $\sin^{-1}(\tan r')$

86435159811.  $\sin^{-1}(\tan r)$

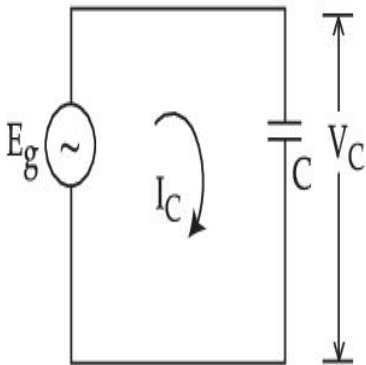
86435159812.  $\sin^{-1}(\cot r)$

**Question Number : 4 Question Id : 86435117743 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

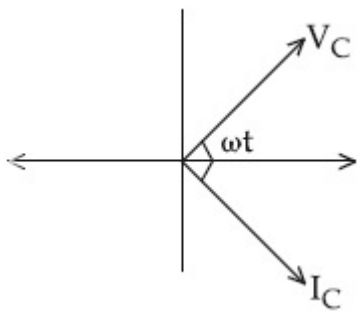
**Correct Marks : 4 Wrong Marks : 1**

In a circuit consisting of a capacitance and a generator with alternating emf  $E_g = E_{g_0} \sin \omega t$ ,

$V_C$  and  $I_C$  are the voltage and current. Correct phasor diagram for such circuit is :

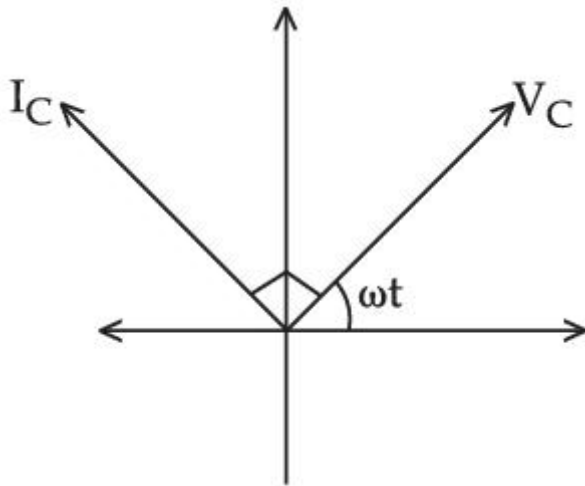
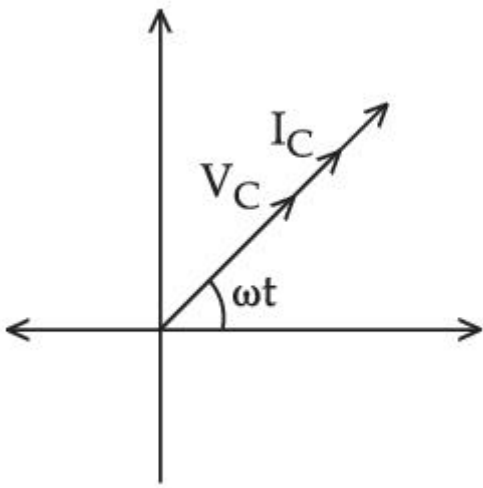


**Options :**

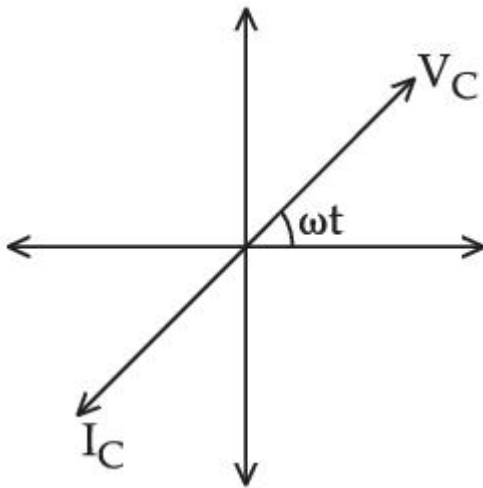


86435159813.

86435159814.



86435159815.



86435159816.

Question Number : 5 Question Id : 86435117744 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

What will be the average value of energy for a monoatomic gas in thermal equilibrium at temperature  $T$  ?

**Options :**

86435159817.  $k_B T$

86435159818.  $\frac{1}{2} k_B T$

86435159819.  $\frac{3}{2} k_B T$

86435159820.  $\frac{2}{3} k_B T$

**Question Number : 6 Question Id : 86435117745 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

**Statement I :** The ferromagnetic property depends on temperature. At high temperature, ferromagnet becomes paramagnet.

**Statement II :** At high temperature, the domain wall area of a ferromagnetic substance increases.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

**Options :**

86435159821. Both **Statement I** and **Statement II** are true

86435159822. Both **Statement I** and **Statement II** are false

86435159823. **Statement I is true but Statement II is false**

86435159824. **Statement I is false but Statement II is true**

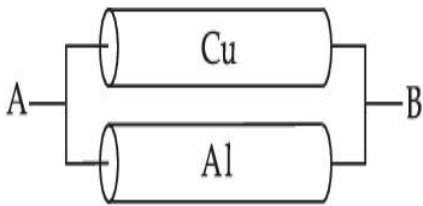
**Question Number : 7 Question Id : 86435117746 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A Copper (Cu) rod of length 25 cm and cross-sectional area  $3 \text{ mm}^2$  is joined with a similar Aluminium (Al) rod as shown in figure. Find the resistance of the combination between the ends A and B.

(Take Resistivity of Copper =  $1.7 \times 10^{-8} \Omega\text{m}$ )

Resistivity of Aluminium =  $2.6 \times 10^{-8} \Omega\text{m}$ )



**Options :**

86435159825. **1.420 mΩ**

86435159826. **0.858 mΩ**

86435159827. **0.0858 mΩ**

86435159828. **2.170 mΩ**

**Question Number : 8 Question Id : 86435117747 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

An electric dipole is placed on  $x$ -axis in proximity to a line charge of linear charge density  $3.0 \times 10^{-6} \text{ C/m}$ . Line charge is placed on  $z$ -axis and positive and negative charge of dipole is at a distance of 10 mm and 12 mm from the origin respectively. If total force of 4 N is exerted on the dipole, find out the amount of positive or negative charge of the dipole.

**Options :**

86435159829. 815.1 nC

86435159830. 0.485 mC

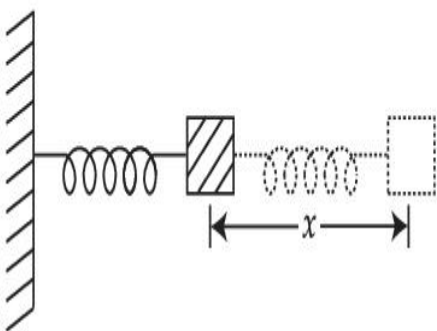
86435159831. 8.8  $\mu\text{C}$

86435159832. 4.44  $\mu\text{C}$

**Question Number : 9 Question Id : 86435117748 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The motion of a mass on a spring, with spring constant  $K$  is as shown in figure.



The equation of motion is given by  $x(t) = A\sin\omega t + B\cos\omega t$  with  $\omega = \sqrt{\frac{K}{m}}$

Suppose that at time  $t=0$ , the position of mass is  $x(0)$  and velocity  $v(0)$ , then its displacement can also be represented as  $x(t) = C\cos(\omega t - \phi)$ , where  $C$  and  $\phi$  are :

**Options :**

86435159833.



$$C = \sqrt{\frac{2v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1}\left(\frac{v(0)}{x(0)\omega}\right)$$

86435159834.

$$C = \sqrt{\frac{v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1}\left(\frac{v(0)}{x(0)\omega}\right)$$

86435159835.

$$C = \sqrt{\frac{v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1}\left(\frac{x(0)\omega}{v(0)}\right)$$

86435159836.

$$C = \sqrt{\frac{2v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1}\left(\frac{x(0)\omega}{2v(0)}\right)$$

**Question Number : 10 Question Id : 86435117749 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

An electron of mass  $m_e$  and a proton of mass  $m_p$  are accelerated through the same potential difference. The ratio of the de-Broglie wavelength associated with the electron to that with the proton is :

**Options :**

86435159837. 1

86435159838.  $\frac{m_p}{m_e}$

86435159839.  $\frac{m_e}{m_p}$

86435159840.  $\sqrt{\frac{m_p}{m_e}}$

**Question Number : 11 Question Id : 86435117750 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

What will be the projection of vector  $\vec{A} = \hat{i} + \hat{j} + \hat{k}$  on vector  $\vec{B} = \hat{i} + \hat{j}$  ?

**Options :**

86435159841.  $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$

86435159842.  $(\hat{i} + \hat{j})$

86435159843.  $\sqrt{2}(\hat{i} + \hat{j})$

86435159844.  $2(\hat{i} + \hat{j} + \hat{k})$

**Question Number : 12 Question Id : 86435117751 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

A body is projected vertically upwards from the surface of earth with a velocity sufficient enough to carry it to infinity. The time taken by it to reach height  $h$  is \_\_\_\_\_ s.

**Options :**

$$\frac{1}{3} \sqrt{\frac{R_e}{2g}} \left[ \left( 1 + \frac{h}{R_e} \right)^{3/2} - 1 \right]$$

86435159845.

$$\frac{1}{3} \sqrt{\frac{2R_e}{g}} \left[ \left( 1 + \frac{h}{R_e} \right)^{3/2} - 1 \right]$$

86435159846.

$$\sqrt{\frac{R_e}{2g}} \left[ \left( 1 + \frac{h}{R_e} \right)^{3/2} - 1 \right]$$

86435159847.

$$\sqrt{\frac{2R_e}{g}} \left[ \left( 1 + \frac{h}{R_e} \right)^{3/2} - 1 \right]$$

86435159848.

**Question Number : 13 Question Id : 86435117752 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

Consider a situation in which a ring, a solid cylinder and a solid sphere roll down on the same inclined plane without slipping. Assume that they start rolling from rest and having identical diameter.

The correct statement for this situation is :

**Options :**

86435159849.

The cylinder has the greatest and the sphere has the least velocity of the centre of mass at the bottom of the inclined plane.

86435159850. The sphere has the greatest and the ring has the least velocity of the centre of mass at the bottom of the inclined plane.

86435159851. All of them will have same velocity.

86435159852. The ring has the greatest and the cylinder has the least velocity of the centre of mass at the bottom of the inclined plane.

**Question Number : 14 Question Id : 86435117753 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

A porter lifts a heavy suitcase of mass 80 kg and at the destination lowers it down by a distance of 80 cm with a constant velocity. Calculate the workdone by the porter in lowering the suitcase.

(take  $g = 9.8 \text{ ms}^{-2}$ )

**Options :**

86435159853. 784.0 J

86435159854. - 62720.0 J

86435159855. - 627.2 J

86435159856. + 627.2 J

Question Number : 15 Question Id : 86435117754 Question Type : MCQ Option Shuffling : Yes

Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A bullet of '4 g' mass is fired from a gun of mass 4 kg. If the bullet moves with the muzzle speed of  $50 \text{ ms}^{-1}$ , the impulse imparted to the gun and velocity of recoil of gun are :

Options :

86435159857.  $0.4 \text{ kg ms}^{-1}, 0.1 \text{ ms}^{-1}$

86435159858.  $0.2 \text{ kg ms}^{-1}, 0.1 \text{ ms}^{-1}$

86435159859.  $0.2 \text{ kg ms}^{-1}, 0.05 \text{ ms}^{-1}$

86435159860.  $0.4 \text{ kg ms}^{-1}, 0.05 \text{ ms}^{-1}$

Question Number : 16 Question Id : 86435117755 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) $\omega L > \frac{1}{\omega C}$ | (i) Current is in phase with emf         |
| (b) $\omega L = \frac{1}{\omega C}$ | (ii) Current lags behind the applied emf |
| (c) $\omega L < \frac{1}{\omega C}$ | (iii) Maximum current occurs             |
| (d) Resonant frequency              | (iv) Current leads the emf               |

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

**Options :**

86435159861. (a)-(iv); (b)-(iii); (c)-(ii); (d)-(i)

86435159862. (a)-(ii); (b)-(i); (c)-(iv); (d)-(iii)

86435159863. (a)-(iii); (b)-(i); (c)-(iv); (d)-(ii)

86435159864. (a)-(ii); (b)-(i); (c)-(iii); (d)-(iv)

**Question Number : 17 Question Id : 86435117756 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

Intensity of sunlight is observed as  $0.092 \text{ Wm}^{-2}$  at a point in free space. What will be the peak value of magnetic field at that point ? ( $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )

**Options :**

86435159865.  $1.96 \times 10^{-8} \text{ T}$

86435159866.  $5.88 \text{ T}$

86435159867.  $2.77 \times 10^{-8} \text{ T}$

86435159868.  $8.31 \text{ T}$

**Question Number : 18 Question Id : 86435117757 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

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

Consider a situation in which reverse biased current of a particular P-N junction increases when it is exposed to a light of wavelength  $\leq 621$  nm. During this process, enhancement in carrier concentration takes place due to generation of hole-electron pairs. The value of band gap is nearly.

**Options :**

86435159869. 4 eV

86435159870. 2 eV

86435159871. 1 eV

86435159872. 0.5 eV

**Question Number : 19 Question Id : 86435117758 Question Type : MCQ Option Shuffling : Yes  
Is Question Mandatory : No**

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

A nucleus with mass number 184 initially at rest emits an  $\alpha$ -particle. If the Q value of the reaction is 5.5 MeV, calculate the kinetic energy of the  $\alpha$ -particle.

**Options :**

86435159873. 0.12 MeV

86435159874. 5.38 MeV

86435159875. 5.0 MeV

86435159876. 5.5 MeV

**Question Number : 20 Question Id : 86435117759 Question Type : MCC**

**Is Question Mandatory : No**

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

$T_0$  is the time period of a simple pendulum at a place. If the length of the pendulum is reduced to  $\frac{1}{16}$  times of its initial value, the modified time period is :

**Options :**

86435159877.  $4 T_0$

86435159878.  $\frac{1}{4} T_0$

86435159879.  $8\pi T_0$

86435159880.  $T_0$

## Physics Section B

<b>Section Id :</b>	864351753
<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>Enable Mark as Answered Mark for Review and Clear Response :</b>	Yes
<b>Sub-Section Number :</b>	1
<b>Sub-Section Id :</b>	864351980



Question Shuffling Allowed :

Yes

Question Number : 21 Question Id : 86435117760 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Three particles P, Q and R are moving along the vectors  $\vec{A} = \hat{i} + \hat{j}$ ,  $\vec{B} = \hat{j} + \hat{k}$  and  $\vec{C} = -\hat{i} + \hat{j}$  respectively. They strike on a point and start to move in different directions.

Now particle P is moving normal to the plane which contains vector  $\vec{A}$  and  $\vec{B}$ . Similarly particle Q is moving normal to the plane which contains vector  $\vec{A}$  and  $\vec{C}$ . The angle between

the direction of motion of P and Q is  $\cos^{-1}\left(\frac{1}{\sqrt{x}}\right)$ . Then 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 :

1

Question Number : 22 Question Id : 86435117761 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

The position of the centre of mass of a uniform semi-circular wire of radius 'R' placed in

$x$ - $y$  plane with its centre at the origin and the line joining its ends as  $x$ -axis is given by  $\left(0, \frac{xR}{\pi}\right)$ .

Then, 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 :**

1

**Question Number : 23 Question Id : 86435117762 Question Type : SA**

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

In 5 minutes, a body cools from  $75^{\circ}\text{C}$  to  $65^{\circ}\text{C}$  at room temperature of  $25^{\circ}\text{C}$ . The temperature of body at the end of next 5 minutes is \_\_\_\_\_  $^{\circ}\text{C}$ .

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 24 Question Id : 86435117763 Question Type : SA**

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

A ray of light passing through a prism ( $\mu = \sqrt{3}$ ) suffers minimum deviation. It is found that the angle of incidence is double the angle of refraction within the prism. Then, the angle of prism is \_\_\_\_\_ (in degrees).

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 25 Question Id : 86435117764 Question Type : SA**

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

The area of cross-section of a railway track is  $0.01 \text{ m}^2$ . The temperature variation is  $10^\circ\text{C}$ . Coefficient of linear expansion of material of track is  $10^{-5}/^\circ\text{C}$ . The energy stored per meter in the track is \_\_\_\_\_ J/m.

(Young's modulus of material of track is  $10^{11} \text{ Nm}^{-2}$ )

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

1

**Question Number : 26 Question Id : 86435117765 Question Type : SA**

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

The total charge enclosed in an incremental volume of  $2 \times 10^{-9} \text{ m}^3$  located at the origin is \_\_\_\_\_ nC, if electric flux density of its field is found as

$$D = e^{-x} \sin y \hat{i} - e^{-x} \cos y \hat{j} + 2z \hat{k} \text{ C/m}^2.$$

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

1

**Question Number : 27 Question Id : 86435117766 Question Type : SA**

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

In an electric circuit, a cell of certain emf provides a potential difference of 1.25 V across a load resistance of  $5 \Omega$ . However, it provides a potential difference of 1 V across a load resistance of  $2 \Omega$ . The emf of the cell is given by  $\frac{x}{10}$  V. Then the value of  $x$  is \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

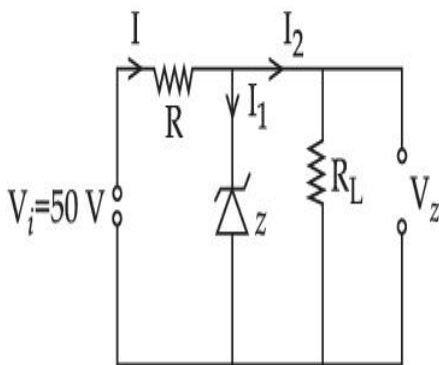
**Possible Answers :**

1

**Question Number : 28 Question Id : 86435117767 Question Type : SA**

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

In a given circuit diagram, a 5 V zener diode along with a series resistance is connected across a 50 V power supply. The minimum value of the resistance required, if the maximum zener current is 90 mA will be \_\_\_\_\_  $\Omega$ .



**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 29 Question Id : 86435117768 Question Type : SA**

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

The centre of a wheel rolling on a plane surface moves with a speed  $v_0$ . A particle on the rim of the wheel at the same level as the centre will be moving at a speed  $\sqrt{x} v_0$ . Then 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 :**

1

**Question Number : 30 Question Id : 86435117769 Question Type : SA**

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

Three students  $S_1, S_2$  and  $S_3$  perform an experiment for determining the acceleration due to gravity ( $g$ ) using a simple pendulum. They use different lengths of pendulum and record time for different number of oscillations. The observations are as shown in the table.

Student No.	Length of Pendulum (cm)	No. of oscillations (n)	Total time for n oscillations	Time period (s)
1	64.0	8	128.0	16.0
2	64.0	4	64.0	16.0
3	20.0	4	36.0	9.0

(Least count of length = 0.1 cm

least count for time = 0.1 s)

If  $E_1, E_2$  and  $E_3$  are the percentage errors in ' $g$ ' for students 1, 2 and 3 respectively, then the minimum percentage error is obtained by student no. \_\_\_\_\_.

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1