

# National Testing Agency

<b>Question Paper Name :</b>	B TECH 18th March 2021 Shift 2
<b>Subject Name :</b>	B TECH
<b>Creation Date :</b>	2021-03-18 19:51:24
<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>	86435163
<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>	864351373
<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>	864351373
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 1 Question Id : 8643515581 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

Consider a sample of oxygen behaving like an ideal gas. At 300 K, the ratio of root mean square (rms) velocity to the average velocity of gas molecule would be :

(Molecular weight of oxygen is 32 g/mol;  $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ )

Options :

$$\sqrt{\frac{3\pi}{8}}$$

86435116741.

$$\sqrt{\frac{8\pi}{3}}$$

86435116742.

$$\sqrt{\frac{8}{3}}$$

86435116743.

$$\sqrt{\frac{3}{3}}$$

86435116744.

Question Number : 2 Question Id : 8643515582 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

An object of mass  $m_1$  collides with another object of mass  $m_2$ , which is at rest. After the collision the objects move with equal speeds in opposite direction. The ratio of the masses  $m_2 : m_1$  is :

Options :

86435116745. 1 : 1

86435116746. 1 : 2

86435116747. 2 : 1

86435116748. 3 : 1

Question Number : 3 Question Id : 8643515583 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

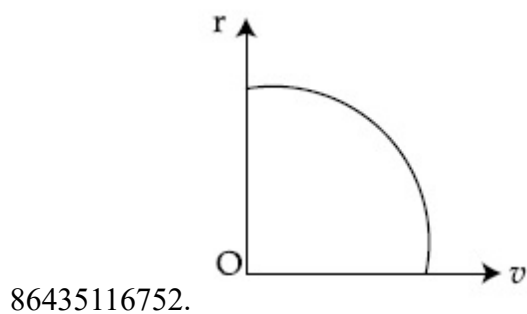
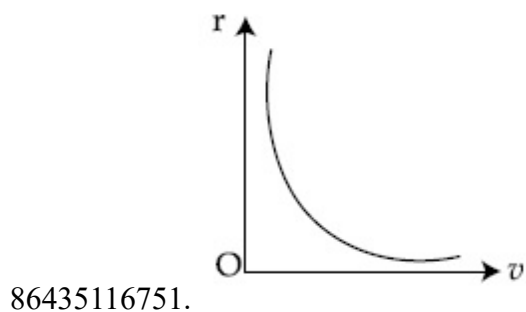
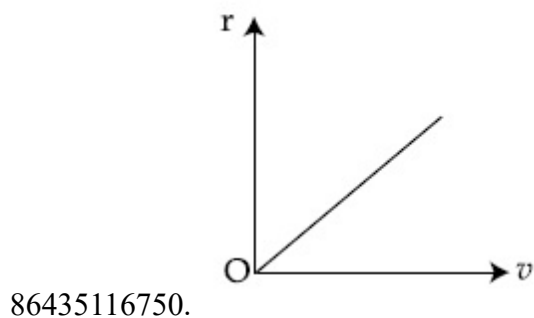
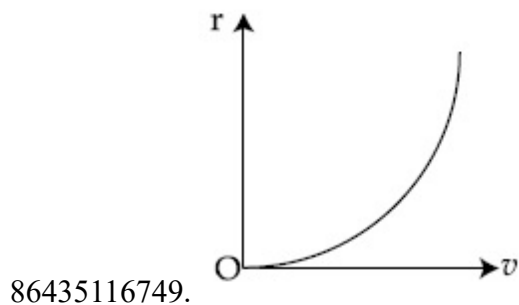
Correct Marks : 4 Wrong Marks : 1

A particle of mass  $m$  moves in a circular orbit under the central potential field,  $U(r) = -\frac{C}{r}$ ,

where  $C$  is a positive constant.

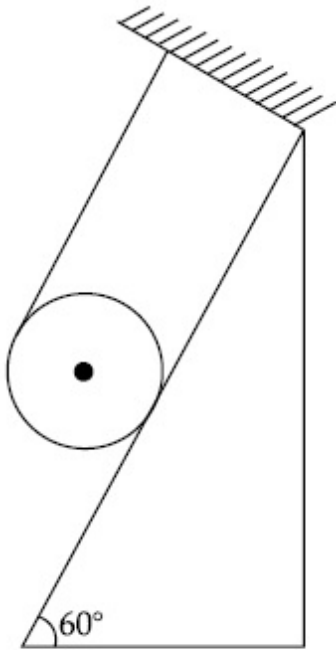
The correct radius – velocity graph of the particle's motion is :

Options :



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

A solid cylinder of mass  $m$  is wrapped with an inextensible light string and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is :



[The coefficient of static friction,  $\mu_s$  is 0.4]

**Options :**

86435116753.  $\frac{mg}{5}$

86435116754.  $5 mg$

86435116755.  $\frac{7}{2} mg$

86435116756.  $0$

**Question Number : 5 Question Id : 8643515585 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

If the angular velocity of earth's spin is increased such that the bodies at the equator start floating, the duration of the day would be approximately :

[Take  $g = 10 \text{ ms}^{-2}$ , the radius of earth,  $R = 6400 \times 10^3 \text{ m}$ , Take  $\pi = 3.14$ ]

**Options :**

86435116757. does not change

86435116758. 1200 minutes

86435116759. 60 minutes

86435116760. 84 minutes

**Question Number : 6 Question Id : 8643515586 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

Consider a uniform wire of mass  $M$  and length  $L$ . It is bent into a semicircle. Its moment of inertia about a line perpendicular to the plane of the wire passing through the centre is :

**Options :**

86435116761.  $\frac{ML^2}{\pi^2}$

86435116762.  $\frac{1}{2} \frac{ML^2}{\pi^2}$

86435116763.  $\frac{1}{4} \frac{ML^2}{\pi^2}$

86435116764.  $\frac{2}{5} \frac{ML^2}{\pi^2}$

**Question Number : 7 Question Id : 8643515587 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The speed of electrons in a scanning electron microscope is  $1 \times 10^7 \text{ ms}^{-1}$ . If the protons having the same speed are used instead of electrons, then the resolving power of scanning proton microscope will be changed by a factor of :

**Options :**

86435116765.  $1837$

86435116766.  $\frac{1}{1837}$

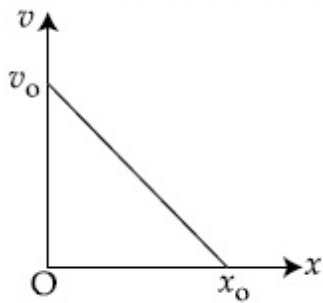
86435116767.  $\frac{1}{\sqrt{1837}}$

86435116768.  $\sqrt{1837}$

Question Number : 8 Question Id : 8643515588 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

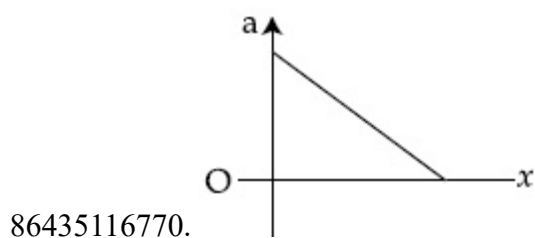
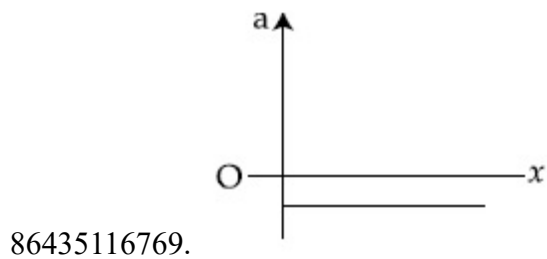
Correct Marks : 4 Wrong Marks : 1

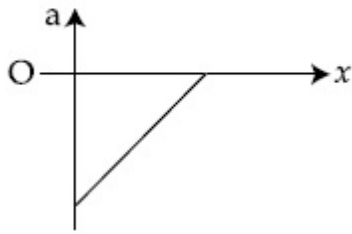
The velocity - displacement graph of a particle is shown in the figure.



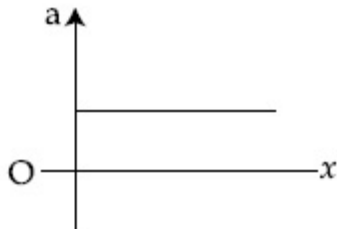
The acceleration - displacement graph of the same particle is represented by :

Options :





86435116771.



86435116772.

**Question Number : 9 Question Id : 8643515589 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

For an adiabatic expansion of an ideal gas, the fractional change in its pressure is equal to (where  $\gamma$  is the ratio of specific heats) :

**Options :**

$$-\gamma \frac{dV}{V}$$

86435116773.

$$-\gamma \frac{V}{dV}$$

86435116774.

$$-\frac{1}{\gamma} \frac{dV}{V}$$

86435116775.

$$\frac{dV}{V}$$

86435116776.

**Question Number : 10 Question Id : 8643515590 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The angular momentum of a planet of mass  $M$  moving around the sun in an elliptical orbit is  $\vec{L}$ . The magnitude of the areal velocity of the planet is :

Options :

86435116777.  $\frac{L}{M}$

86435116778.  $\frac{L}{2M}$

86435116779.  $\frac{2L}{M}$

86435116780.  $\frac{4L}{M}$

Question Number : 11 Question Id : 8643515591 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

An ideal gas in a cylinder is separated by a piston in such a way that the entropy of one part is  $S_1$  and that of the other part is  $S_2$ . Given that  $S_1 > S_2$ . If the piston is removed then the total entropy of the system will be :

Options :

86435116781.  $S_1 \times S_2$

86435116782.  $S_1 - S_2$

86435116783.  $S_1 + S_2$

86435116784.  $\frac{S_1}{S_2}$

Question Number : 12 Question Id : 8643515592 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1



The function of time representing a simple harmonic motion with a period of  $\frac{\pi}{\omega}$  is :

**Options :**

86435116785.  $\sin(\omega t) + \cos(\omega t)$

86435116786.  $\sin^2(\omega t)$

86435116787.  $3 \cos\left(\frac{\pi}{4} - 2\omega t\right)$

86435116788.  $\cos(\omega t) + \cos(2\omega t) + \cos(3\omega t)$

**Question Number : 13 Question Id : 8643515593 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

In a series LCR circuit, the inductive reactance ( $X_L$ ) is  $10 \Omega$  and the capacitive reactance ( $X_C$ ) is  $4 \Omega$ . The resistance ( $R$ ) in the circuit is  $6 \Omega$ .

The power factor of the circuit is :

**Options :**

86435116789.  $\frac{1}{\sqrt{2}}$

86435116790.  $\frac{\sqrt{3}}{2}$

86435116791.  $\frac{1}{2}$

86435116792.  $\frac{1}{2\sqrt{2}}$

**Question Number : 14 Question Id : 8643515594 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

Which of the following statements are correct ?

- (A) Electric monopoles do not exist whereas magnetic monopoles exist.
- (B) Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and confined.
- (C) Magnetic field lines are completely confined within a toroid.
- (D) Magnetic field lines inside a bar magnet are not parallel.
- (E)  $\chi = -1$  is the condition for a perfect diamagnetic material, where  $\chi$  is its magnetic susceptibility.

Choose the correct answer from the options given below :

**Options :**

86435116793. (B) and (D) only

86435116794. (B) and (C) only

86435116795. (A) and (B) only

86435116796. (C) and (E) only

**Question Number : 15 Question Id : 8643515595 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

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

The correct relation between  $\alpha$  (ratio of collector current to emitter current) and  $\beta$  (ratio of collector current to base current) of a transistor is :

**Options :**

86435116797. 
$$\beta = \frac{\alpha}{1 + \alpha}$$

86435116798. 
$$\alpha = \frac{\beta}{1 - \alpha}$$

86435116799. 
$$\beta = \frac{1}{1 - \alpha}$$

$$\alpha = \frac{\beta}{1 + \beta}$$

86435116800.

**Question Number : 16 Question Id : 8643515596 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A proton and an  $\alpha$ -particle, having kinetic energies  $K_p$  and  $K_\alpha$  respectively, enter into a magnetic field at right angles.

The ratio of the radii of trajectory of proton to that of  $\alpha$ -particle is 2 : 1. The ratio of  $K_p : K_\alpha$  is :

**Options :**

86435116801. 1 : 4

86435116802. 4 : 1

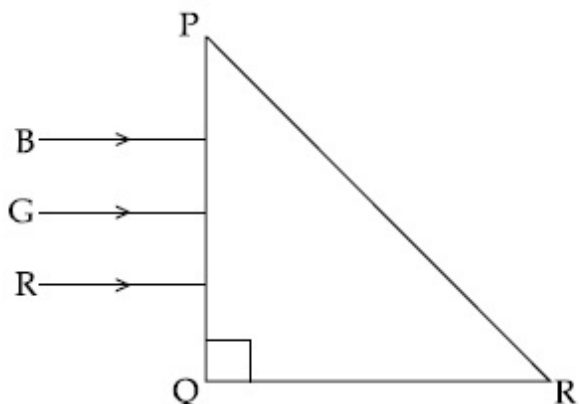
86435116803. 8 : 1

86435116804. 1 : 8

**Question Number : 17 Question Id : 8643515597 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

Three rays of light, namely red (R), green (G) and blue (B) are incident on the face PQ of a right angled prism PQR as shown in the figure.



The refractive indices of the material of the prism for red, green and blue wavelength are 1.27, 1.42 and 1.49 respectively. The colour of the ray(s) emerging out of

**Options :**

86435116805. blue and green

86435116806. blue

86435116807. green

86435116808. red

**Question Number : 18 Question Id : 8643515598 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

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

The time taken for the magnetic energy to reach 25% of its maximum value, when a solenoid of resistance R, inductance L is connected to a battery, is :

**Options :**

86435116809.  $\frac{L}{R} \ln 2$

86435116810.  $\frac{L}{R} \ln 5$

86435116811.  $\frac{L}{R} \ln 10$

86435116812. infinite

**Question Number : 19 Question Id : 8643515599 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

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

A plane electromagnetic wave propagating along  $y$ -direction can have the following pair of electric field  $(\vec{E})$  and magnetic field  $(\vec{B})$  components.

**Options :**

86435116813.  $E_y, B_y$  or  $E_z, B_z$

86435116814.  $E_x, B_y$  or  $E_y, B_x$

86435116815.  $E_x, B_z$  or  $E_z, B_x$

86435116816.  $E_y, B_x$  or  $E_x, B_y$

**Question Number : 20 Question Id : 8643515600 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The decay of a proton to neutron is :

**Options :**

86435116817. not possible as proton mass is less than the neutron mass

86435116818. possible only inside the nucleus

86435116819. always possible as it is associated only with  $\beta^+$  decay

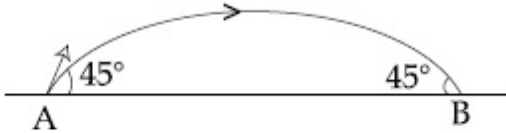
86435116820. not possible but neutron to proton conversion is possible

## Physics Section B

<b>Section Id :</b>	864351374
<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>	864351374
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 21 Question Id : 8643515601 Question Type : SA Correct Marks : 4 Wrong Marks : 0**

The projectile motion of a particle of mass 5 g is shown in the figure.



The initial velocity of the particle is  $5\sqrt{2} \text{ ms}^{-1}$  and the air resistance is assumed to be negligible.

The magnitude of the change in momentum between the points A and B is  $x \times 10^{-2} \text{ kgms}^{-1}$ .

The value of  $x$ , to the nearest integer, is \_\_\_\_\_.

**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 :** 8643515602 **Question Type :** SA

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

An infinite number of point charges, each carrying  $1 \mu\text{C}$  charge, are placed along the  $y$ -axis at  $y = 1 \text{ m}, 2 \text{ m}, 4 \text{ m}, 8 \text{ m} \dots\dots\dots$ .

The total force on a  $1 \text{ C}$  point charge, placed at the origin, is  $x \times 10^3 \text{ N}$ .

The value of  $x$ , to the nearest integer, is \_\_\_\_\_.

[Take  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$ ]

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

**Question Number :** 23 **Question Id :** 8643515603 **Question Type :** SA

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



Two wires of same length and thickness having specific resistances  $6 \Omega \text{ cm}$  and  $3 \Omega \text{ cm}$  respectively are connected in parallel. The effective resistivity is  $\rho \Omega \text{ cm}$ . The value of  $\rho$ , to the nearest integer, 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 :** 8643515604 **Question Type :** SA

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

A ball of mass  $4 \text{ kg}$ , moving with a velocity of  $10 \text{ ms}^{-1}$ , collides with a spring of length  $8 \text{ m}$  and force constant  $100 \text{ Nm}^{-1}$ . The length of the compressed spring is  $x \text{ m}$ . The value of  $x$ , to the nearest integer, is \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

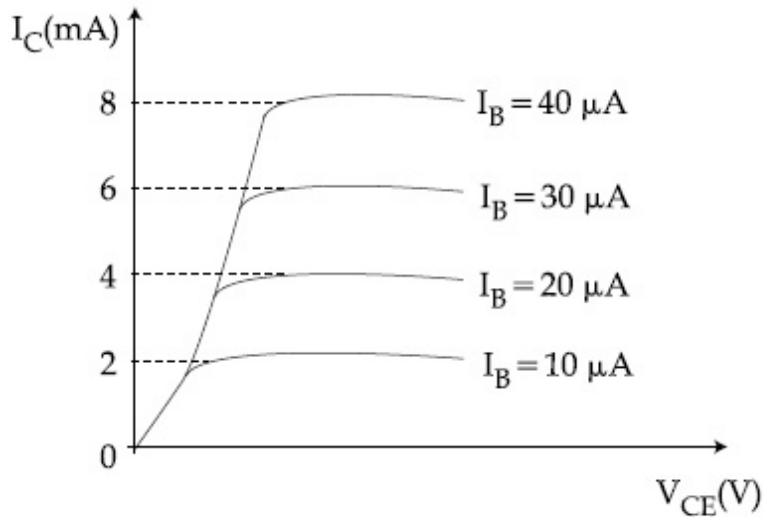
**Possible Answers :**

100

**Question Number :** 25 **Question Id :** 8643515605 **Question Type :** SA

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

The typical output characteristics curve for a transistor working in the common-emitter configuration is shown in the figure.



The estimated current gain from the figure is \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

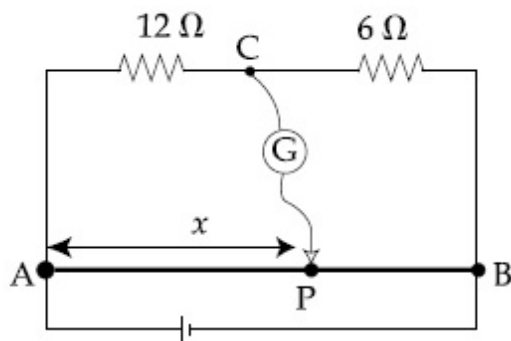
**Possible Answers :**

100

**Question Number :** 26 **Question Id :** 8643515606 **Question Type :** SA

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

Consider a 72 cm long wire AB as shown in the figure. The galvanometer jockey is placed at P on AB at a distance  $x$  cm from A. The galvanometer shows zero deflection.



The value of  $x$ , to the nearest integer, is \_\_\_\_\_.

**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 : 8643515607 Question Type : SA**

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

A galaxy is moving away from the earth at a speed of  $286 \text{ kms}^{-1}$ . The shift in the wavelength of a redline at  $630 \text{ nm}$  is  $x \times 10^{-10} \text{ m}$ .

The value of  $x$ , to the nearest integer, is \_\_\_\_\_.

[Take the value of speed of light  $c$ , as  $3 \times 10^8 \text{ ms}^{-1}$ ]

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

**Possible Answers :**

100

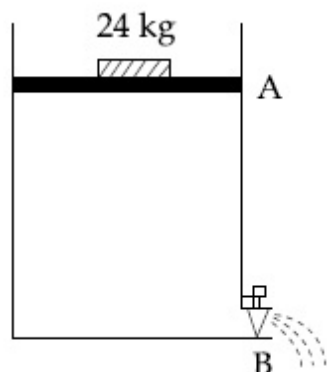
**Question Number : 28 Question Id : 8643515608 Question Type : SA**

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

Consider a water tank as shown in the figure. It's cross-sectional area is  $0.4 \text{ m}^2$ . The tank has an opening B near the bottom whose cross-section area is  $1 \text{ cm}^2$ . A load of  $24 \text{ kg}$  is applied on the water at the top when the height of the water level is  $40 \text{ cm}$  above the bottom, the velocity of water coming out the opening B is  $v \text{ ms}^{-1}$ .

The value of  $v$ , to the nearest integer, is \_\_\_\_\_.

[Take value of  $g$  to be  $10 \text{ ms}^{-2}$ ]



**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 : 8643515609 Question Type : SA**

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

A TV transmission tower antenna is at a height of 20 m. Suppose that the receiving antenna is at.

(i) ground level

(ii) a height of 5 m.

The increase in antenna range in case (ii) relative to case (i) is  $n\%$ .

The value of  $n$ , to the nearest integer, 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 : 8643515610 Question Type : SA**

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

The radius of a sphere is measured to be  $(7.50 \pm 0.85)$  cm. Suppose the percentage error in its volume is  $x$ .

The value of  $x$ , to the nearest  $x$ , is \_\_\_\_\_.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100