

# National Testing Agency

<b>Question Paper Name :</b>	B TECH 17th March 2021 Shift 1
<b>Subject Name :</b>	B TECH
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<b>Duration :</b>	180
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<b>Total Marks :</b>	300
<b>Display Marks:</b>	Yes

## B TECH

<b>Group Number :</b>	1
<b>Group Id :</b>	86435138
<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>	864351223
<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>	864351223
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 1 Question Id : 8643513331 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

A car accelerates from rest at a constant rate  $\alpha$  for some time after which it decelerates at a constant rate  $\beta$  to come to rest. If the total time elapsed is  $t$  seconds, the total distance travelled is :

Options :

8643519991.  $\frac{2 \alpha \beta}{(\alpha + \beta)} t^2$

8643519992.  $\frac{\alpha \beta}{2(\alpha + \beta)} t^2$

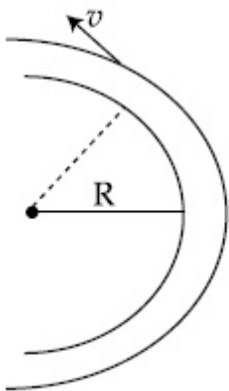
8643519993.  $\frac{4 \alpha \beta}{(\alpha + \beta)} t^2$

8643519994.  $\frac{\alpha \beta}{4(\alpha + \beta)} t^2$

Question Number : 2 Question Id : 8643513332 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A modern grand - prix racing car of mass  $m$  is travelling on a flat track in a circular arc of radius  $R$  with a speed  $v$ . If the coefficient of static friction between the tyres and the track is  $\mu_s$ , then the magnitude of negative lift  $F_L$  acting downwards on the car is : (Assume forces on the four tyres are identical and  $g$  = acceleration due to gravity)



Options :

8643519995.  $m \left( \frac{v^2}{\mu_s R} + g \right)$

8643519996.  $m\left(g - \frac{v^2}{\mu_s R}\right)$

8643519997.  $m\left(\frac{v^2}{\mu_s R} - g\right)$

8643519998.  $-m\left(g + \frac{v^2}{\mu_s R}\right)$

**Question Number : 3 Question Id : 8643513333 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A Carnot's engine working between 400 K and 800 K has a work output of 1200 J per cycle. The amount of heat energy supplied to the engine from the source in each cycle is :

**Options :**

8643519999. 2400 J

86435110000. 1600 J

86435110001. 3200 J

86435110002. 1800 J

**Question Number : 4 Question Id : 8643513334 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A solenoid of 1000 turns per metre has a core with relative permeability 500. Insulated windings of the solenoid carry an electric current of 5 A. The magnetic flux density produced by the solenoid is : (permeability of free space =  $4\pi \times 10^{-7}$  H/m)

**Options :**

86435110003.  $10^{-4}\pi$  T

86435110004.  $2 \times 10^{-3}\pi$  T

86435110005.  $\frac{\pi}{5} T$

86435110006.  $\pi T$

**Question Number : 5 Question Id : 8643513335 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

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

A current of 10 A exists in a wire of crosssectional area of 5 mm<sup>2</sup> with a drift velocity of  $2 \times 10^{-3} \text{ ms}^{-1}$ . The number of free electrons in each cubic meter of the wire is \_\_\_\_\_.

**Options :**

86435110007.  $2 \times 10^6$

86435110008.  $1 \times 10^{23}$

86435110009.  $625 \times 10^{25}$

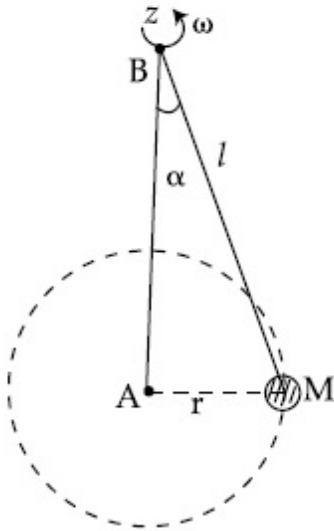
86435110010.  $2 \times 10^{25}$

**Question Number : 6 Question Id : 8643513336 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No**

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

A mass  $M$  hangs on a massless rod of length  $l$  which rotates at a constant angular frequency. The mass  $M$  moves with steady speed in a circular path of constant radius. Assume that the system is in steady circular motion with constant angular velocity  $\omega$ . The angular momentum of  $M$  about point  $A$  is  $L_A$  which lies in the positive  $z$  direction and the angular momentum of  $M$  about point  $B$  is  $L_B$ . The correct statement for this system is :



**Options :**

86435110011.  $L_A$  and  $L_B$  are both constant in magnitude and direction
86435110012.  $L_A$  is constant, both in magnitude and direction
86435110013.  $L_B$  is constant, both in magnitude and direction
86435110014.  $L_B$  is constant in direction with varying magnitude

**Question Number : 7 Question Id : 8643513337 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

An AC current is given by  $I = I_1 \sin \omega t + I_2 \cos \omega t$ . A hot wire ammeter will give a reading :

**Options :**

86435110015.  $\frac{I_1 + I_2}{\sqrt{2}}$
86435110016.  $\frac{I_1 + I_2}{2\sqrt{2}}$

$$86435110017. \sqrt{\frac{I_1^2 + I_2^2}{2}}$$

$$86435110018. \sqrt{\frac{I_1^2 - I_2^2}{2}}$$

**Question Number : 8 Question Id : 8643513338 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A polyatomic ideal gas has 24 vibrational modes. What is the value of  $\gamma$  ?

**Options :**

$$86435110019. 10.3$$

$$86435110020. 1.30$$

$$86435110021. 1.03$$

$$86435110022. 1.37$$

**Question Number : 9 Question Id : 8643513339 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

When two soap bubbles of radii  $a$  and  $b$  ( $b > a$ ) coalesce, the radius of curvature of common surface is :

**Options :**

$$86435110023. \frac{ab}{b - a}$$

$$86435110024. \frac{ab}{a + b}$$

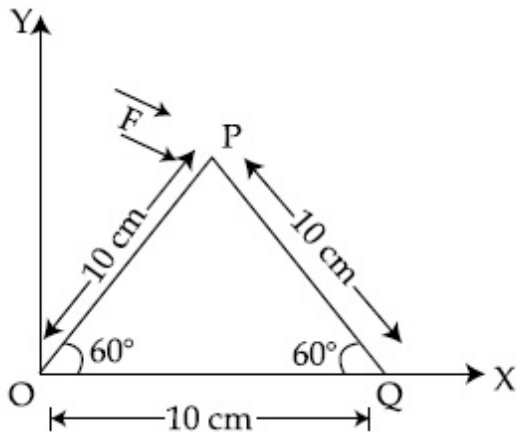
$$86435110025. \frac{b - a}{ab}$$

$$86435110026. \frac{a + b}{ab}$$

Question Number : 10 Question Id : 8643513340 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A triangular plate is shown. A force  $\vec{F} = 4\hat{i} - 3\hat{j}$  is applied at point P. The torque at point P with respect to point 'O' and 'Q' are :



Options :

86435110027.  $-15 - 20\sqrt{3}, 15 - 20\sqrt{3}$

86435110028.  $15 + 20\sqrt{3}, 15 - 20\sqrt{3}$

86435110029.  $15 - 20\sqrt{3}, 15 + 20\sqrt{3}$

86435110030.  $-15 + 20\sqrt{3}, 15 + 20\sqrt{3}$

Question Number : 11 Question Id : 8643513341 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Two identical metal wires of thermal conductivities  $K_1$  and  $K_2$  respectively are connected in series. The effective thermal conductivity of the combination is :

Options :

86435110031.  $\frac{K_1 K_2}{K_1 + K_2}$

$$86435110032. \frac{2K_1 K_2}{K_1 + K_2}$$

$$86435110033. \frac{K_1 + K_2}{2K_1 K_2}$$

$$86435110034. \frac{K_1 + K_2}{K_1 K_2}$$

**Question Number : 12 Question Id : 8643513342 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

A boy is rolling a 0.5 kg ball on the frictionless floor with the speed of  $20 \text{ ms}^{-1}$ . The ball gets deflected by an obstacle on the way. After deflection it moves with 5% of its initial kinetic energy. What is the speed of the ball now ?

**Options :**

$$86435110035. 1.00 \text{ ms}^{-1}$$

$$86435110036. 4.47 \text{ ms}^{-1}$$

$$86435110037. 14.41 \text{ ms}^{-1}$$

$$86435110038. 19.0 \text{ ms}^{-1}$$

**Question Number : 13 Question Id : 8643513343 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The thickness at the centre of a plano convex lens is 3 mm and the diameter is 6 cm. If the speed of light in the material of the lens is  $2 \times 10^8 \text{ ms}^{-1}$ . The focal length of the lens is \_\_\_\_\_.

**Options :**

$$86435110039. 30 \text{ cm}$$

$$86435110040. 15 \text{ cm}$$

$$86435110041. 1.5 \text{ cm}$$



86435110042. 0.30 cm

**Question Number : 14 Question Id : 8643513344 Question Type : MCQ Option Shuffling : Yes Is****Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**

Which level of the single ionized carbon has the same energy as the ground state energy of hydrogen atom ?

**Options :**

86435110043. 1

86435110044. 4

86435110045. 6

86435110046. 8

**Question Number : 15 Question Id : 8643513345 Question Type : MCQ Option Shuffling : Yes Is****Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**

Two ideal polyatomic gases at temperatures  $T_1$  and  $T_2$  are mixed so that there is no loss of energy. If  $F_1$  and  $F_2$ ,  $m_1$  and  $m_2$ ,  $n_1$  and  $n_2$  be the degrees of freedom, masses, number of molecules of the first and second gas respectively, the temperature of mixture of these two gases is :

**Options :**86435110047. 
$$\frac{n_1 F_1 T_1 + n_2 F_2 T_2}{n_1 + n_2}$$
86435110048. 
$$\frac{n_1 F_1 T_1 + n_2 F_2 T_2}{F_1 + F_2}$$
86435110049. 
$$\frac{n_1 F_1 T_1 + n_2 F_2 T_2}{n_1 F_1 + n_2 F_2}$$
86435110050. 
$$\frac{n_1 T_1 + n_2 T_2}{n_1 + n_2}$$

**Question Number : 16 Question Id : 8643513346 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

For what value of displacement the kinetic energy and potential energy of a simple harmonic oscillation become equal ?

**Options :**

86435110051.  $x = \pm A$

86435110052.  $x = 0$

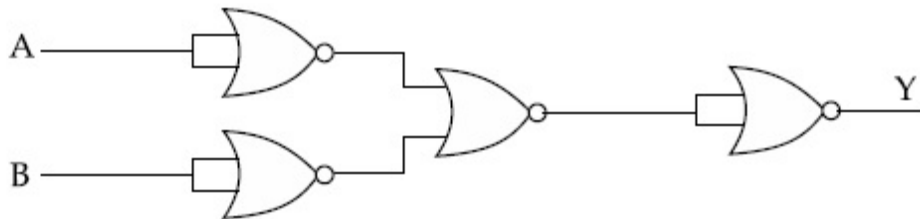
86435110053.  $x = \pm \frac{A}{\sqrt{2}}$

86435110054.  $x = \frac{A}{2}$

**Question Number : 17 Question Id : 8643513347 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The output of the given combination gates represents :



**Options :**

86435110055. AND Gate

86435110056. NOR Gate

86435110057. NAND Gate

86435110058. XOR Gate

**Question Number : 18 Question Id : 8643513348 Question Type : MCQ Option Shuf Question Mandatory : No**

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

An electron of mass  $m$  and a photon have same energy  $E$ . The ratio of wavelength of electron to that of photon is : ( $c$  being the velocity of light)

**Options :**

86435110059.  $\left(\frac{E}{2m}\right)^{1/2}$

86435110060.  $c(2mE)^{1/2}$

86435110061.  $\frac{1}{c}\left(\frac{2m}{E}\right)^{1/2}$

86435110062.  $\frac{1}{c}\left(\frac{E}{2m}\right)^{1/2}$

**Question Number : 19 Question Id : 8643513349 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

The vernier scale used for measurement has a positive zero error of 0.2 mm. If while taking a measurement it was noted that '0' on the vernier scale lies between 8.5 cm and 8.6 cm, vernier coincidence is 6, then the correct value of measurement is \_\_\_\_\_ cm. (least count = 0.01 cm)

**Options :**

86435110063. 8.58 cm

86435110064. 8.56 cm

86435110065. 8.54 cm

86435110066. 8.36 cm

**Question Number : 20 Question Id : 8643513350 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

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

If an electron is moving in the  $n^{\text{th}}$  orbit of the hydrogen atom, then its velocity ( $v_n$ ) for the  $n^{\text{th}}$  orbit is given as :

**Options :**

86435110067.  $v_n \propto n^2$

86435110068.  $v_n \propto n$

86435110069.  $v_n \propto \frac{1}{n^2}$

86435110070.  $v_n \propto \frac{1}{n}$

## Physics Section B

<b>Section Id :</b>	864351224
<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>	864351224
<b>Question Shuffling Allowed :</b>	Yes

**Question Number : 21 Question Id : 8643513351 Question Type : SA**

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

For VHF signal broadcasting, \_\_\_\_\_  $\text{km}^2$  of maximum service area will be covered by an antenna tower of height 30 m, if the receiving antenna is placed at ground. Let radius of the earth be 6400 km. (Round off to the Nearest Integer) (Take  $\pi$  as 3.14)

**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 : 8643513352 Question Type : SA**

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

If  $2.5 \times 10^{-6}$  N average force is exerted by a light wave on a non - reflecting surface of  $30 \text{ cm}^2$  area during 40 minutes of time span, the energy flux of light just before it falls on the surface is \_\_\_\_\_  $\text{W/cm}^2$ . (Round off to the Nearest Integer)

(Assume complete absorption and normal incidence conditions are there)

**Response Type : Numeric**

**Evaluation Required For SA : Yes**

**Show Word Count : Yes**

**Answers Type : Equal**

**Text Areas : PlainText**

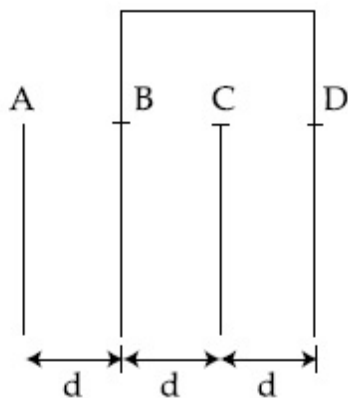
**Possible Answers :**

100

**Question Number : 23 Question Id : 8643513353 Question Type : SA**

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

Four identical rectangular plates with length,  $l = 2 \text{ cm}$  and breadth,  $b = \frac{3}{2} \text{ cm}$  are arranged as shown in figure. The equivalent capacitance between A and C is  $\frac{x\epsilon_0}{d}$ . The value of  $x$  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 : 24 Question Id : 8643513354 Question Type : SA**

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

The equivalent resistance of series combination of two resistors is 's'. When they are connected in parallel, the equivalent resistance is 'p'. If  $s = np$ , then the minimum value for n 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 : 25 Question Id : 8643513355 Question Type : SA**

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

A parallel plate capacitor whose capacitance C is 14 pF is charged by a battery to a potential difference  $V = 12$  V between its plates. The charging battery is now disconnected and a porcelain plate with  $k = 7$  is inserted between the plates, then the plate would oscillate back and forth between the plates with a constant mechanical energy of \_\_\_\_\_ pJ.

(Assume no friction)

**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 : 8643513356 Question Type : SA**

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

The radius in kilometer to which the present radius of earth ( $R = 6400$  km) to be compressed so that the escape velocity is increased 10 times 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 : 8643513357 Question Type : SA**

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

The angular speed of truck wheel is increased from 900 rpm to 2460 rpm in 26 seconds. The number of revolutions by the truck engine during this time is \_\_\_\_\_.

(Assuming the acceleration to be uniform).

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100

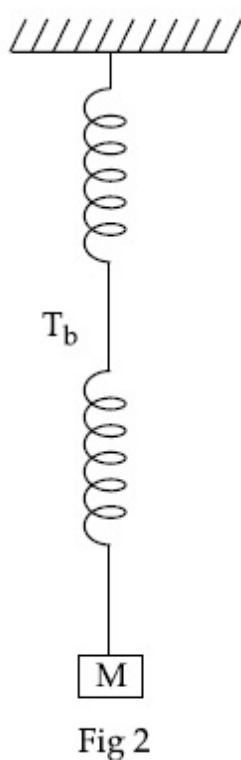
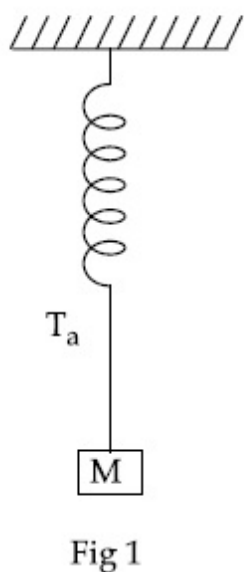
**Question Number :** 28 **Question Id :** 8643513358 **Question Type :** SA

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

Consider two identical springs each of spring constant  $k$  and negligible mass compared to the mass  $M$  as shown. Fig. 1 shows one of them and Fig. 2 shows their series combination.

The ratios of time period of oscillation of the two SHM is  $T_b/T_a = \sqrt{x}$ , where value of  $x$  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 : 29 Question Id : 8643513359 Question Type : SA**

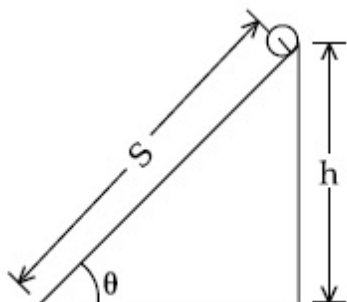
**Correct Marks : 4 Wrong Marks : 0**

The following bodies,

- (1) a ring
- (2) a disc
- (3) a solid cylinder
- (4) a solid sphere,

of same mass ' $m$ ' and radius ' $R$ ' are allowed to roll down without slipping simultaneously from the top of the inclined plane. The body which will reach first at the bottom of the inclined plane is \_\_\_\_\_.

[Mark the body as per their respective numbering given in the question]



**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

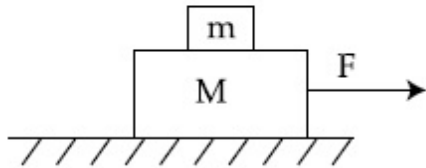
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**Question Number : 30 Question Id : 8643513360 Question Type : SA**

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



Two blocks ( $m=0.5$  kg and  $M=4.5$  kg) are arranged on a horizontal frictionless table as shown in figure. The coefficient of static friction between the two blocks is  $\frac{3}{7}$ . Then the maximum horizontal force that can be applied on the larger block so that the blocks move together is \_\_\_\_\_ N. (Round off to the Nearest Integer) [Take  $g$  as  $9.8$   $\text{ms}^{-2}$ ]



**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

100