National Testing Agency

Question Paper Name :   B TECH 17th March 2021 Shift 2
Subject Name :   B TECH
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Total Marks :   300
Display Marks: Yes

B TECH

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

Physics Section A

Section Id :   864351235
Section Number :   1
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 :   864351235
Question Shuffling Allowed :   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 :

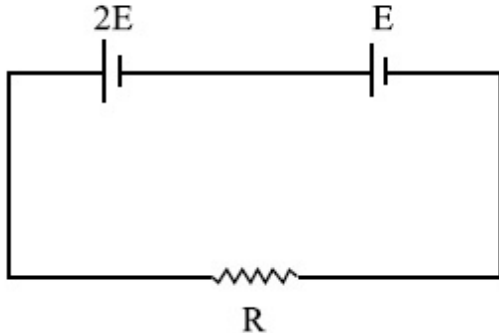86435110531. 50 MHz

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. $\dfrac{r_1}{2} - r_2$

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

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 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 arbitary 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. $6\sqrt{2}$
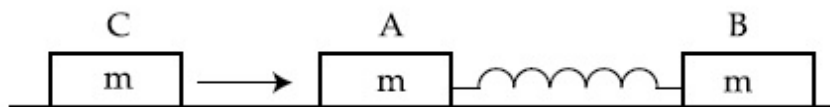
86435110545. 3

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

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. $\sqrt{\dfrac{m}{2K}}$

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

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

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

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. $\dfrac{K_1}{K_2}$

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

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

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

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)	$\dfrac{\pi}{2}$; 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)	$\dfrac{\pi}{2}$; current lags voltage
(d)	Phase difference between current and voltage in an LCR series circuit	(iv)	$\tan^{-1}\left(\dfrac{X_C - X_L}{R}\right)$

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 ms^{-1} goes up an inclined plane which makes an angle of 30° with the horizontal plane, without slipping. How long will the sphere take to return to the starting point A ?
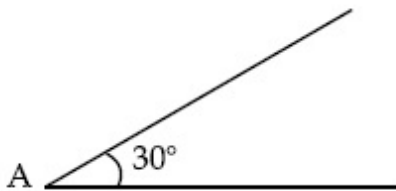
Options :

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 ms^{-1}

86435110568. 2.50 ms^{-1}

86435110569. 3.0 ms^{-1}

86435110570. 3.50 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. $v_0 + \dfrac{g}{2} + F$
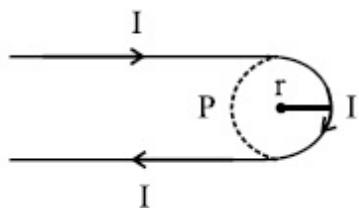
86435110572. $v_0 + 2g + 3F$

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

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

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

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

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

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 Sh
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. $$v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{\frac{1}{2}}$$
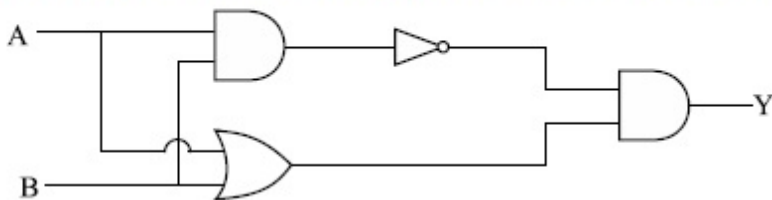
86435110584. $$v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$$

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 Ω resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of 10 V is maintained across AC.
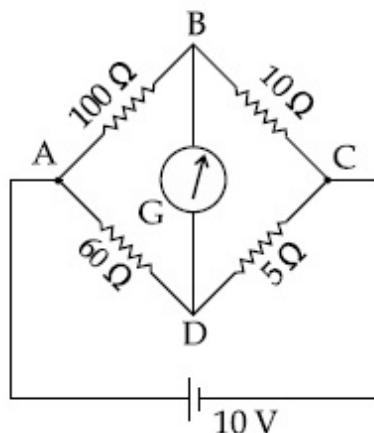
Options :

86435110591. 2.44 μA

86435110592. 2.44 mA

86435110593. 4.87 μA

86435110594. 4.87 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 kg attached to a spring is made to oscillate with an initial amplitude of 12 cm. After 2 minutes the amplitude decreases to 6 cm. Determine the value of the damping constant for this motion. (take ln 2 = 0.693)

Options :

86435110595. 1.16×10^2 kg s^{-1}

86435110596. 0.69×10^2 kg s^{-1}

86435110597. 5.7×10^{-3} kg s^{-1}

86435110598. 3.3×10^2 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 β is the ratio of molar specific heats for polyatomic gas $\left(\beta = \dfrac{C_P}{C_V}\right)$ then the value of β is :

Options :

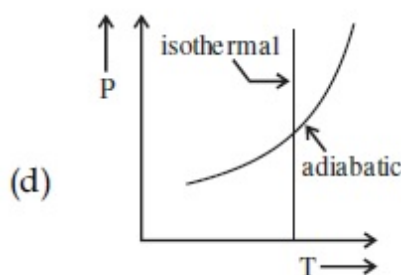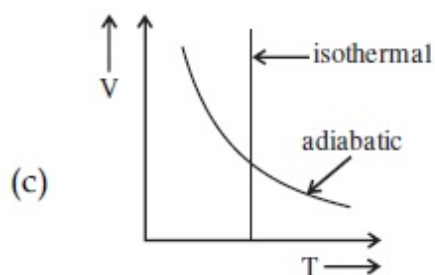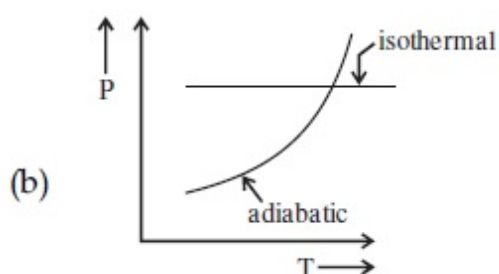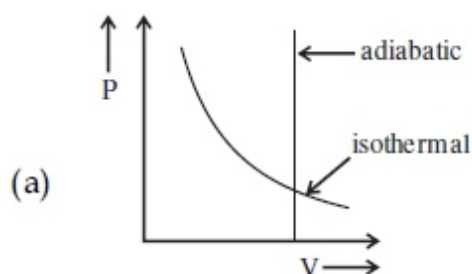86435110599. 1.25

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 ?

(a) [P vs V graph: adiabatic, isothermal]

(b) [P vs T graph: isothermal, adiabatic]

(c) [V vs T graph: isothermal, adiabatic]

(d) [P vs T graph: isothermal, adiabatic]

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 kgm^{-3} and g = 9.8 ms^{-2}.]

Options :

86435110607. 1.96×10^7 Nm^{-2}

86435110608. 1.44×10^7 Nm^{-2}

86435110609. 2.26×10^9 Nm^{-2}

86435110610. 1.44×10^9 Nm^{-2}

Physics Section B

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

Question Number : 21 Question Id : 8643513531 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

A 2 μF capacitor C_1 is first charged to a potential difference of 10 V using a battery. Then the battery is removed and the capacitor is connected to an uncharged capacitor C_2 of 8 μF. The charge in C_2 on equilibrium condition is _____ μC. (Round off to the Nearest Integer)
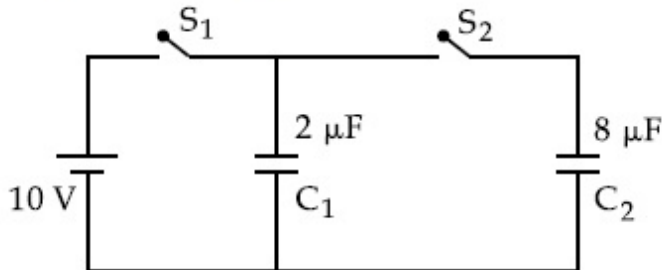
Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
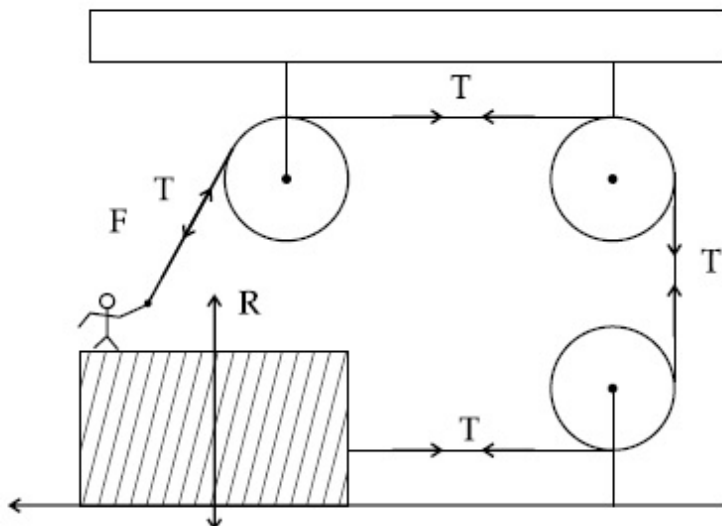**Possible Answers :**

100

Question Number : 22 Question Id : 8643513532 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

A boy of mass 4 kg is standing on a piece of wood having mass 5 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 _____ N. (Round off to the Nearest Integer)

[Take $g = 10$ 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 $\frac{2}{3}^{rd}$ 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 $\varepsilon = 80\varepsilon_0$ and resistivity

$\rho = 0.25$ Ωm. Imagine a parallel plate capacitor is immersed in seawater and is driven by an

alternating voltage source $V(t) = V_0 \sin(2\pi f t)$. Then the conduction current density

becomes 10^x times the displacement current density after time $t = \dfrac{1}{800}$ s. The value of x is

_____.

$\left(\text{Given} : \dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}\right)$

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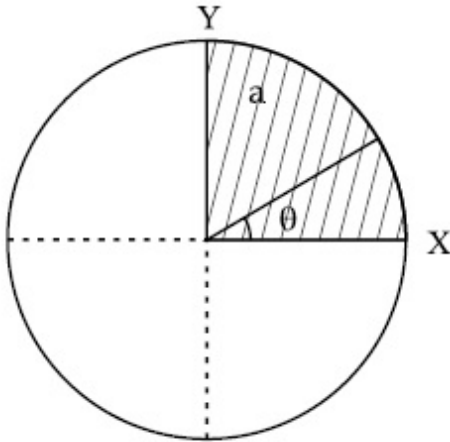**Correct Marks : 4 Wrong Marks : 0**

The electric field in a region is given by $\vec{E} = \dfrac{2}{5}E_0\,\hat{i} + \dfrac{3}{5}E_0\,\hat{j}$ with $E_0 = 4.0 \times 10^3\,\dfrac{\text{N}}{\text{C}}$. The

flux of this field through a rectangular surface area 0.4 m^2 parallel to the Y$-$Z plane is
_____ Nm^2 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 σ is shown in the figure. The centre of mass of the quarter disc (the shaded area) is at the position $\dfrac{x}{3}\dfrac{a}{\pi}, \dfrac{x}{3}\dfrac{a}{\pi}$ 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 $\dfrac{1}{\sqrt{3}}$. 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 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 α 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 cm³ of oleic acid per cm³ of the solution. Then you make a thin film of this solution (monomolecular thickness) of area 4 cm² by considering 100 spherical drops of

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