National Testing Agency

Question Paper Name :	B Tech 1st Sep 2021 Shift 2
Subject Name :	B TECH
Creation Date :	2021-09-01 20:31:56
Duration :	180
Total Marks :	300
Display Marks:	Yes

B TECH

Group Number :	1
Group Id :	864351261
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 :	8643511004
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory

Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	8643511231
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 86435121520 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The temperature of an ideal gas in 3-dimensions is 300 K. The corresponding de-Broglie wavelength of the electron approximately at 300 K, is :

[m_e = mass of electron = 9×10^{-31} kg

h = Planck constant = 6.6×10^{-34} J s

k_B = Boltzmann constant = 1.38×10^{-23} JK^{-1}]

Options :

86435171141. 2.26 nm

86435171142. 3.25 nm

86435171143. 6.26 nm

86435171144. 8.46 nm

Question Number : 2 Question Id : 86435121521 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The half life period of a radioactive element x is same as the mean life time of another radioactive element y. Initially they have the same number of atoms. Then :

Options :

86435171145. x-will decay faster than y.

86435171146. y-will decay faster than x.

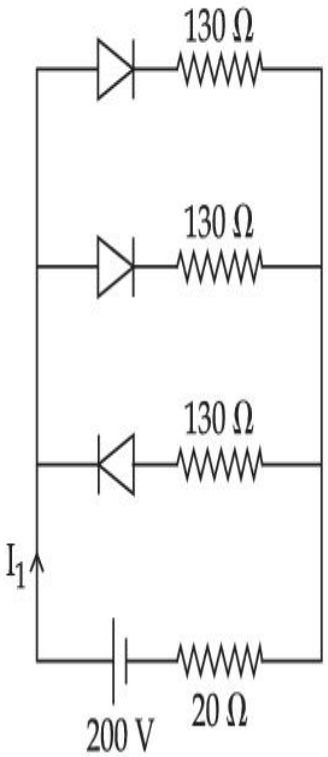
86435171147. x and y have same decay rate initially and later on different decay rate.

86435171148. x and y decay at the same rate always.

Question Number : 3 Question Id : 86435121522 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

In the given figure, each diode has a forward bias resistance of 30 Ω and infinite resistance in reverse bias. The current I_1 will be :



Options :

86435171149. 2 A

86435171150. 2.35 A

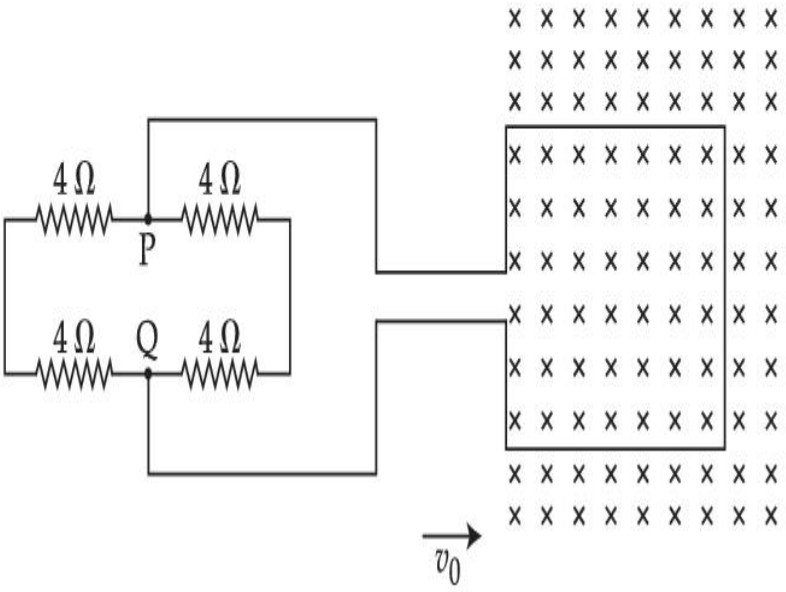
86435171151. 2.73 A

86435171152. 3.75 A

Question Number : 4 Question Id : 86435121523 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A square loop of side 20 cm and resistance 1 Ω is moved towards right with a constant speed v_0. The right arm of the loop is in a uniform magnetic field of 5 T. The field is perpendicular to the plane of the loop and is going into it. The loop is connected to a network of resistors each of value 4 Ω. What should be the value of v_0 so that a steady current of 2 mA flows in the loop ?



Options :

86435171153. 1 cm/s

86435171154. 1 m/s

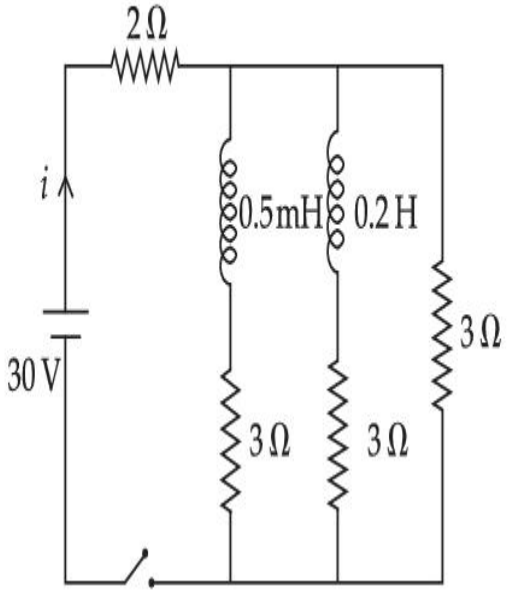
86435171155. 10^2 m/s

86435171156. 10^{-2} cm/s

Question Number : 5 Question Id : 86435121524 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

For the given circuit the current i through the battery when the key in closed and the steady state has been reached is _____.



Options :

86435171157. 0 A

86435171158. 6 A

86435171159. 10 A

86435171160. 25 A

Question Number : 6 Question Id : 86435121525 Question Type : MC

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Electric field of a plane electromagnetic wave propagating through a non-magnetic medium is given by $E = 20\cos(2\times10^{10}\,t - 200x)$ V/m. The dielectric constant of the medium is equal to :

(Take $\mu_r = 1$)

Options :

86435171161. 3

86435171162. 9

86435171163. $\frac{1}{3}$

86435171164. 2

Question Number : 7 Question Id : 86435121526 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A glass tumbler having inner depth of 17.5 cm is kept on a table. A student starts pouring water ($\mu = 4/3$) into it while looking at the surface of water from the above. When he feels that the tumbler is half filled, he stops pouring water. Up to what height, the tumbler is actually filled ?

Options :

86435171165. 8.75 cm

86435171166. 7.5 cm

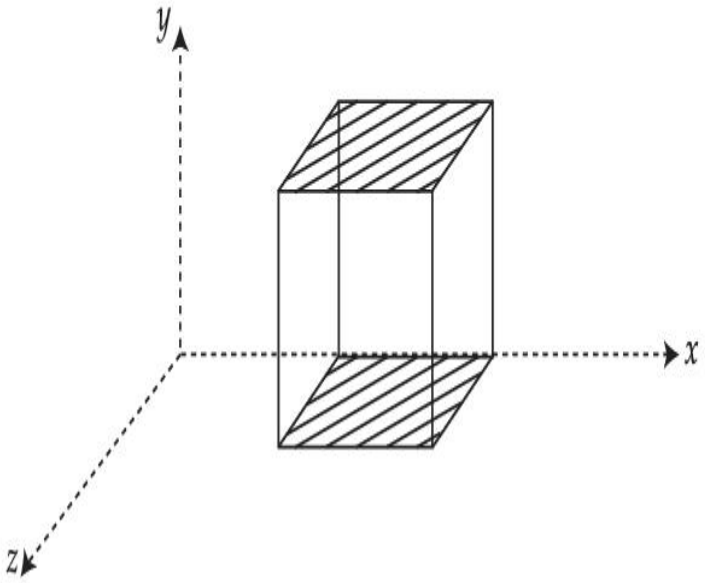
86435171167. 11.7 cm

86435171168. $10\ \text{cm}$

Question Number : 8 Question Id : 86435121527 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A cube is placed inside an electric field, $\vec{E}=150y^2\hat{j}$. The side of the cube is 0.5 m and is placed in the field as shown in the given figure. The charge inside the cube is :



Options :

86435171169. $8.3\times10^{-11}\ \text{C}$

86435171170. $3.8\times10^{-11}\ \text{C}$

86435171171. $8.3\times10^{-12}\ \text{C}$

86435171172. $3.8\times10^{-12}\ \text{C}$

Question Number : 9 Question Id : 86435121528 Question Type : MC

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Due to cold weather a 1 m water pipe of cross-sectional area 1 cm^2 is filled with ice at $-10°C$. Resistive heating is used to melt the ice. Current of 0.5 A is passed through 4 kΩ resistance. Assuming that all the heat produced is used for melting, what is the minimum time required ?

(Given latent heat of fusion for water/ice $= 3.33 \times 10^5$ J kg^{-1},
specific heat of ice $= 2 \times 10^3$ J kg^{-1} and
density of ice $= 10^3$ kg/m^3)

Options :

86435171173. 0.353 s

86435171174. 35.3 s

86435171175. 70.6 s

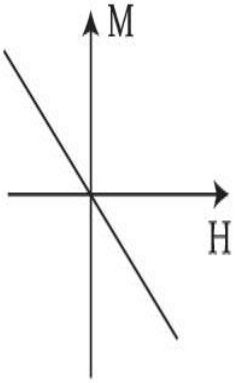
86435171176. 3.53 s

Question Number : 10 Question Id : 86435121529 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

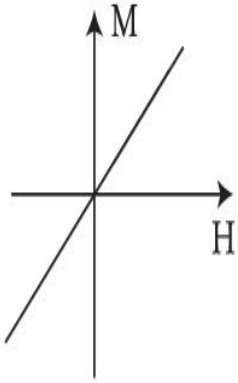
Correct Marks : 4 Wrong Marks : 1

Following plots show Magnetization (M) vs Magnetising field (H) and Magnetic susceptibility (χ) vs Temperature (T) graph :

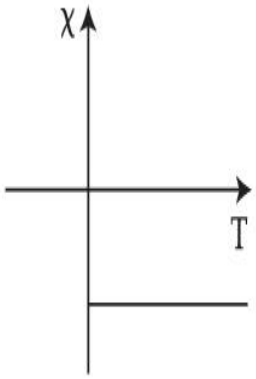
(a)



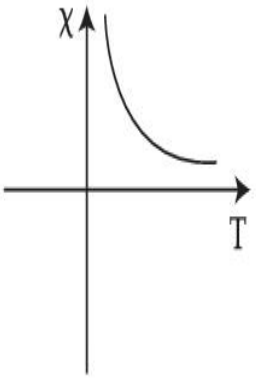
(b)



(c)



(d)



Which of the following combination will be represented by a diamagnetic material ?

Options :

86435171177. (a), (c)

86435171178. (a), (d)

86435171179. (b), (c)

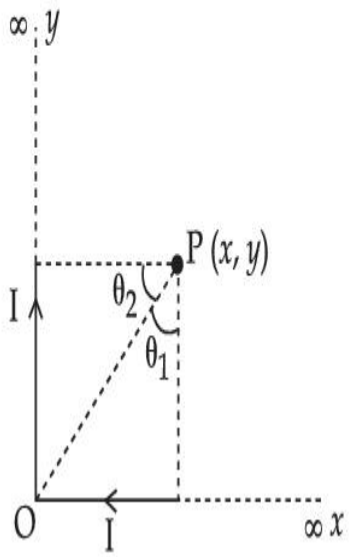
86435171180. (b), (d)

Question Number : 11 Question Id : 86435121530 Question Type : M

Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

There are two infinitely long straight current carrying conductors and they are held at right angles to each other so that their common ends meet at the origin as shown in the figure given below. The ratio of current in both conductors is 1 : 1. The magnetic field at point P is _____.



Options :

86435171181. $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}+(x+y)\right]$

86435171182. $\frac{\mu_0 I\, xy}{4\pi}\left[\sqrt{x^2+y^2}+(x+y)\right]$

86435171183. $\frac{\mu_0 I\, xy}{4\pi}\left[\sqrt{x^2+y^2}-(x+y)\right]$

86435171184. $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}-(x+y)\right]$

Question Number : 12 Question Id : 86435121531 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option :

Options :

86435171185. $R_1 = R_2$ and $H_1 < H_2$

86435171186. $R_1 > R_2$ and $H_1 = H_2$

86435171187. $R_1 < R_2$ and $H_1 < H_2$

86435171188. $R_1 = R_2$ and $H_1 = H_2$

Question Number : 13 Question Id : 86435121532 Question Type : MCQ Option Shuffling : Yes

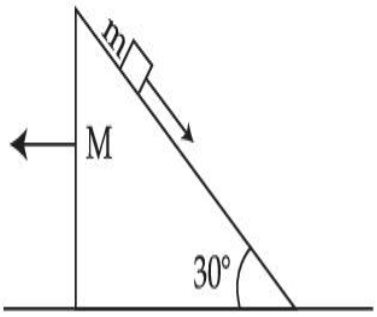
Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A block of mass m slides on the wooden wedge, which in turn slides backward on the horizontal surface. The acceleration of the block with respect to the wedge is :

Given m = 8 kg, M = 16 kg

Assume all the surfaces shown in the figure to be frictionless.



Options :

86435171189. $\frac{4}{3}$ g

86435171190.

$\frac{2}{3}$ g

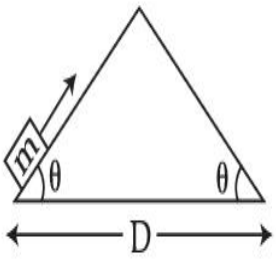
86435171191. $\frac{3}{5}$ g

86435171192. $\frac{6}{5}$ g

Question Number : 14 Question Id : 86435121533 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

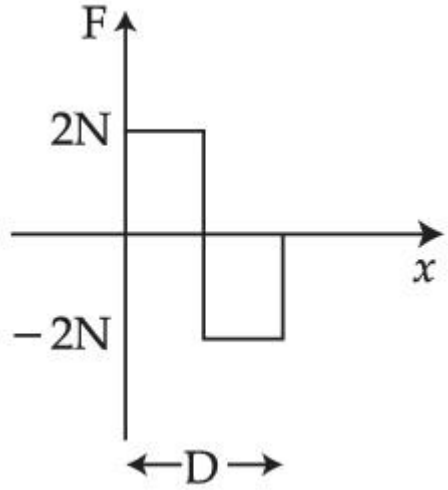
An object of mass 'm' is being moved with a constant velocity under the action of an applied force of 2N along a frictionless surface with following surface profile.



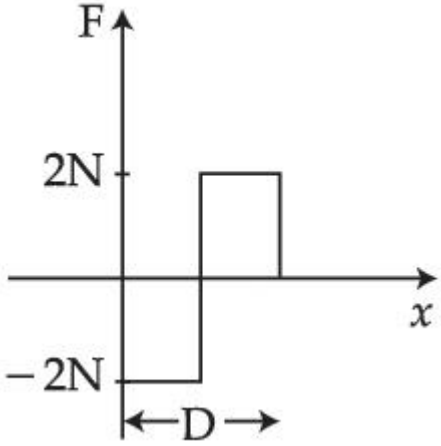
The correct applied force vs distance graph will be :

Options :

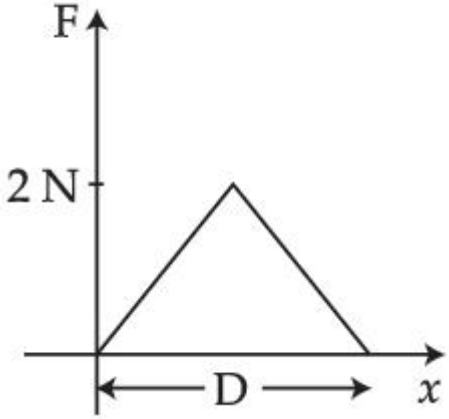
86435171193.



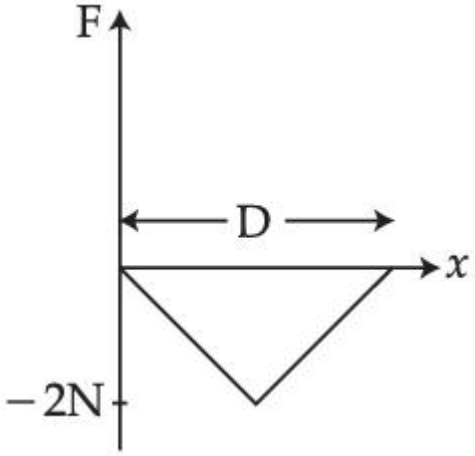
86435171194.



86435171195.



86435171196.



Question Number : 15 Question Id : 86435121534 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A body of mass 'm' dropped from a height 'h' reaches the ground with a speed of $0.8\sqrt{gh}$.

The value of workdone by the air-friction is :

Options :

86435171197. mgh

86435171198. $-0.68\ mgh$

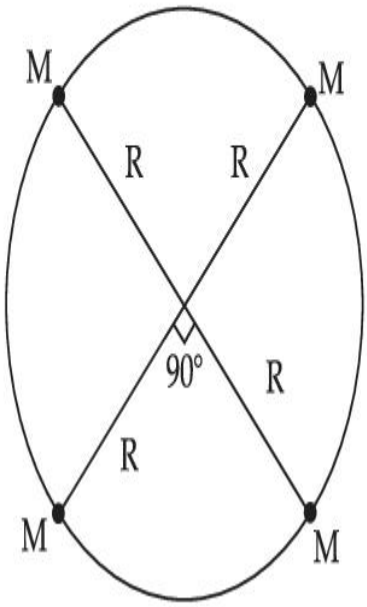
86435171199. $0.64\ mgh$

86435171200. $1.64\ mgh$

Question Number : 16 Question Id : 86435121535 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Four particles each of mass M, move along a circle of radius R under the action of their mutual gravitational attraction as shown in figure. The speed of each particle is :



Options :

86435171201. $\frac{1}{2}\sqrt{\frac{GM}{R}(2\sqrt{2}+1)}$

86435171202.

$\frac{1}{2}\sqrt{\frac{GM}{R}(2\sqrt{2}-1)}$

86435171203. $\frac{1}{2}\sqrt{\frac{GM}{R(2\sqrt{2}+1)}}$

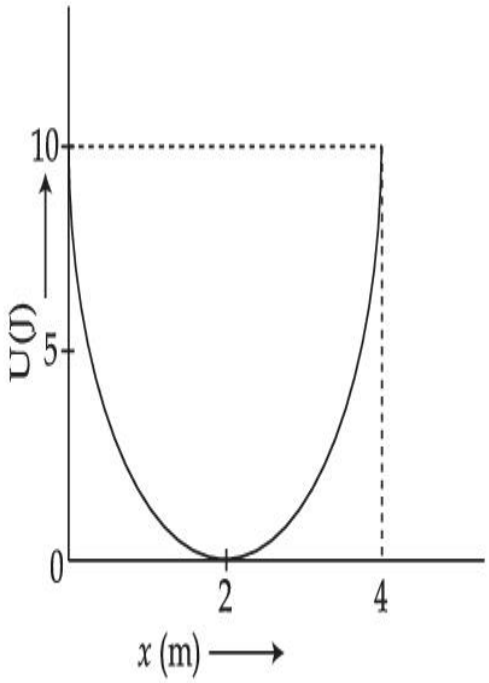
86435171204. $\sqrt{\frac{GM}{R}}$

Question Number : 17 Question Id : 86435121536 Question Type : MCQ Option Shuffling : Yes

Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A mass of 5 kg is connected to a spring. The potential energy curve of the simple harmonic motion executed by the system is shown in the figure. A simple pendulum of length 4 m has the same period of oscillation as the spring system. What is the value of acceleration due to gravity on the planet where these experiments are performed ?



Options :

86435171205. $9.8\ m/s^2$

86435171206. $10\ m/s^2$

86435171207. $5\ m/s^2$

86435171208. $4\ m/s^2$

Question Number : 18 Question Id : 86435121537 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A capacitor is connected to a 20 V battery through a resistance of 10 Ω. It is found that the potential difference across the capacitor rises to 2 V in 1 μs. The capacitance of the capacitor is _____ μF.

Given $\ln\left(\frac{10}{9}\right) = 0.105$

Options :

86435171209. 1.85

86435171210. 0.95

86435171211. 9.52

86435171212. 0.105

Question Number : 19 Question Id : 86435121538 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s^2, without any significant error, his observation are as following.

Physical Quantity	Least count of the Equipment used for measurement	Observed Value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is :

Options :

86435171213. 0.0083

86435171214. 0.083

86435171215. 0.0155

86435171216. 0.155

Question Number : 20 Question Id : 86435121539 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Two resistors $R_1 = (4 \pm 0.8)\ \Omega$ and $R_2 = (4 \pm 0.4)\ \Omega$ are connected in parallel. The equivalent resistance of their parallel combination will be :

Options :

86435171217. $(4 \pm 0.4)\ \Omega$

86435171218. $(2 \pm 0.3)\ \Omega$

86435171219. $(2 \pm 0.4)\ \Omega$

86435171220. $(4 \pm 0.3)\ \Omega$

Physics Section B

Section Id :	8643511005
Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	8643511232
Question Shuffling Allowed :	Yes

Question Number : 21 Question Id : 86435121540 Question Type : S

Correct Marks : 4 Wrong Marks : 0

The temperature of 3.00 mol of an ideal diatomic gas is increased by 40.0°C without changing the pressure of the gas. The molecules in the gas rotate but do not oscillate. If the ratio of change in internal energy of the gas to the amount of workdone by the gas is $\frac{x}{10}$. Then the value of x (round off to the nearest integer) is _____.

(Given $R = 8.31\ J\ mol^{-1}\ K^{-1}$)

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 : 86435121541 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

A uniform heating wire of resistance 36 Ω is connected across a potential difference of 240 V. The wire is then cut into half and a potential difference of 240 V is applied across each half separately. The ratio of power dissipation in first case to the total power dissipation in the second case would be 1 : x, where 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 : 86435121542 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

The width of one of the two slits in a Young's double slit experiment is three times the other slit. If the amplitude of the light coming from a slit is proportional to the slit-width, the ratio of minimum to maximum intensity in the interference pattern is $x : 4$ where 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 : 24 Question Id : 86435121543 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

A carrier wave with amplitude of 250 V is amplitude modulated by a sinusoidal base band signal of amplitude 150 V. The ratio of minimum amplitude to maximum amplitude for the amplitude modulated wave is $50 : x$, then 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 : 25 Question Id : 86435121544 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Two satellites revolve around a planet in coplanar circular orbits in anticlockwise direction. Their period of revolutions are 1 hour and 8 hours respectively. The radius of the orbit of nearer satellite is 2×10^3 km. The angular speed of the farther satellite as observed from the nearer satellite at the instant when both the satellites are closest is $\frac{\pi}{x}$ rad h^{-1} where 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 : 26 Question Id : 86435121545 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

When a body slides down from rest along a smooth inclined plane making an angle of 30° with the horizontal, it takes time T. When the same body slides down from the rest along a rough inclined plane making the same angle and through the same distance, it takes time αT, where α is a constant greater than 1. The co-efficient of friction between the body and the rough plane is $\frac{1}{\sqrt{x}}\left(\frac{\alpha^2-1}{\alpha^2}\right)$ where x = _____.

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 : 86435121546 Question Type : S

Correct Marks : 4 Wrong Marks : 0

An engine is attached to a wagon through a shock absorber of length 1.5 m. The system with a total mass of 40,000 kg is moving with a speed of 72 kmh^{-1} when the brakes are applied to bring it to rest. In the process of the system being brought to rest, the spring of the shock absorber gets compressed by 1.0 m. If 90% of energy of the wagon is lost due to friction, the spring constant is _____ $\times 10^5$ N/m.

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 : 86435121547 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

The average translational kinetic energy of N_2 gas molecules at _____ °C becomes equal to the K.E. of an electron accelerated from rest through a potential difference of 0.1 volt. (Given $k_B = 1.38 \times 10^{-23}$ J/K) (Fill the nearest integer).

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 : 86435121548 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

A steel rod with $y = 2.0 \times 10^{11}$ Nm^{-2} and $\alpha = 10^{-5}$ °C^{-1} of length 4 m and area of cross-section 10 cm^2 is heated from 0°C to 400°C without being allowed to extend. The tension produced in the rod is $x \times 10^5$ N where 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 : 86435121549 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

A 2 kg steel rod of length 0.6 m is clamped on a table vertically at its lower end and is free to rotate in vertical plane. The upper end is pushed so that the rod falls under gravity. Ignoring the friction due to clamping at its lower end, the speed of the free end of rod when it passes through its lowest position is _____ ms^{-1}.
(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 :

1