Work, Energy, And Power JEE Main PYQ - 2

Total Time: 25 Minute **Total Marks:** 40

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Work, Energy, And Power

1. Velocity-time graph for a body of mass $10\,kg$ is shown in figure. Work-done on the body in first two seconds of the motion is : **(+4, -1)**

[Online April 10, 2016]

a. 12000 J

b. -12000 J

c. -4500 J

d. -9300 J

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2. A bullet looses $\left(\frac{1}{n}\right)^{th}$ of its velocity passing through one plank. The number of such planks that are required to stop the bullet can be : **(+4, -1)**

[Online April 19, 2014]

a. $\frac{n^2}{2n-1}$

b. $\frac{2n^2}{n-1}$

c. Infinite

d. n

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3. A body of mass $m = 10^{-2}\,kg$ is moving in a medium and experiences a frictional force $F = -kv^2$. Its initial speed is $v_0 = 10\,ms^{-1}$. If, after $10\,s$, its energy is $\frac{1}{8}mv_0{}^2$, the value of k will be : **(+4, -1)**

[2017]

a. $10^{-3}kg\,m^{-1}$

b. $10^{-3}kg\,s^{-1}$

c. $10^{-4}kg\,m^{-1}$

d. $10^{-1}kg\,m^{-1}s^{-1}$

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4. A time dependent force $F = 6t$ acts on a particle of mass $1\,kg$. If the particle starts from rest, the work done by the force during the first $1\,sec.$ will be : **(+4, -1)**

[2017]

a. 4.5 J

b. 22 J

c. 9 J

d. 18 J

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5. Two particles A and B of equal mass M are moving with the same speed v as shown in the figure. They collide completely inelastically and move as a single particle C. The angle θ that the path of C makes with the $X-axis$ is given by : **(+4, -1)**

[Online April 9, 2017]

a. $\tan\theta = \frac{\sqrt{3}+\sqrt{2}}{1-\sqrt{2}}$

b. $\tan\theta = \frac{\sqrt{3}-\sqrt{2}}{1-\sqrt{2}}$

c. $\tan\theta = \frac{1-\sqrt{2}}{\sqrt{2}(1+\sqrt{3})}$

d. $\tan\theta = \frac{1-\sqrt{3}}{1+\sqrt{2}}$

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6. A force acts on a $2\,kg$ object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds ? **(+4, -1)**

[9 Jan. 2019 II]

a. 850 J

b. 900 J

c. 950 J

d. 875 J

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7. A man (mass = $50\,kg$) and his son (mass = $20\,kg$) are standing on a frictionless surface facing each other. The man pushes his son so that he starts moving at a speed of $0.70\,ms^{-1}$ with respect to the man. The speed of the man with respect to the surface is : **(+4, -1)**

a. $0.20\,ms^{-1}$

[12 April 2019 I]

b. $0.14\,ms^{-1}$

c. $0.47\,ms^{-1}$

d. $0.28\,ms^{-1}$

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8. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\frac{k}{2r^2}$. Its total energy is - **(+4, -1)**

[2018]

a. $-\frac{k}{4a^2}$

b. $\frac{k}{2a^2}$

c. zero

d. $-\frac{3}{2}\frac{k}{a^2}$

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9. A body of mass $1kg$ collides head on elastically with a stationary body of mass $3kg$ After collision, the smaller body reverses its direction of motion and moves with a speed of $2m/s$ The initial speed of the smaller body before collision is ___ ms^{-1} **(+4, -1)**

[25-Jan-2023 Shift2]

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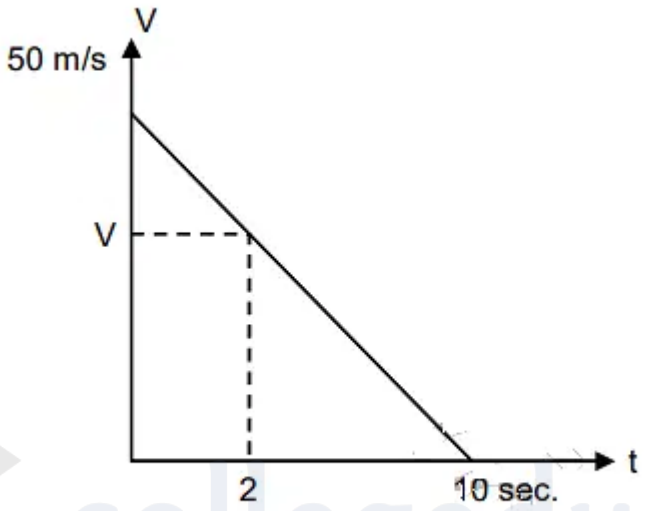
10. A spherical body of mass $2\,kg$ starting from rest acquires a kinetic energy of $10000\,J$ at the end of 5^{th} second The force acted on the body is ___N **(+4, -1)**

[24-Jan-2023 Shift1]

Answers

1. **Answer: c**

Explanation:



Concepts:

1. **Work, Energy and Power:**

Work:

- Work is correlated to force and the displacement over which it acts. When an object is replaced parallel to the force's line of action, it is thought to be doing work. It is a force-driven action that includes movement in the force's direction.
- The work done by the force is described to be the product of the elements of the force in the direction of the displacement and the magnitude of this displacement.

Energy:

- A body's energy is its potential to do tasks. Anything that has the capability to work is said to have energy. The unit of energy is the same as the unit of work, i.e., the Joule.
- There are two types of mechanical energy such as; Kinetic and potential energy.

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Power:

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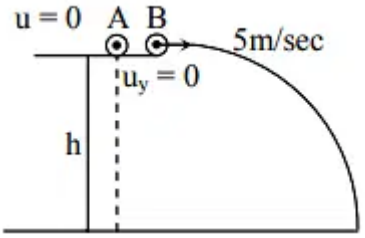
2. Answer: a

Explanation:



$\left(1-\frac{1}{n}\right)^2 V^2 = V^2 - 2as$

$2as = V^2\left(1-\left(\frac{n-1}{n}\right)^2\right) = V^2\left(\frac{2n-1}{n^2}\right)$

$O = V^2 - 2ans$

$n = \frac{V^2}{2as} = \frac{V^2}{V^2\left(\frac{2n-1}{n^2}\right)} = \frac{n^2}{2n-1}$

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3. Answer: c

Explanation:

$\frac{k_f}{k_i} = \frac{\frac{1}{8}mv_0^2}{\frac{1}{2}mv_0^2} = \frac{1}{4}$
$\frac{v_f}{v_i} = \frac{1}{2}$
$v_f = \frac{v_0}{2}$
$-kv^2 = \frac{mdv}{dt}$
$\int_\limits{v_{0}}^{\frac{v_{0}}{2}} \frac{d v}{v^{2}}=\int_\limits{0}^{t_{0}} \frac{-k d t}{m}$
$\left[-\frac{1}{v}\right]_{v_0}^{\frac{v_0}{2}} = \frac{-k}{m}t_0$
$\frac{1}{v_0} - \frac{2}{v_0} = -\frac{k}{m}t_0$

$-\frac{1}{v_0} = -\frac{k}{m}t_0$
$k = \frac{m}{v_0 t_0}$
$= \frac{10^{-2}}{10 \times 10}$
$= 10^{-4}\, kg\, m^{-1}$

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4. Answer: a

Explanation:

$6t = 1 \cdot \frac{dv}{dt}$
$\int_\limits{0}^{v} d v=\int 6t\, d t$
$v = 6\left[\frac{t^2}{2}\right]_0^1$
$= 3\, ms^{-1}$
$W = \Delta KE = \frac{1}{2} \times 1 \times 9 = 4.5\, J$

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5. **Answer: a**

Explanation:

$2\,mv'\,sin\,\theta = \frac{mv}{\sqrt{2}} + \frac{mv\sqrt{3}}{2}$

$3\,mv'\,cos\,\theta = \frac{mv}{2} - \frac{mv}{\sqrt{2}}$

$sin\,\theta = \frac{\frac{1}{\sqrt{2}} + \frac{\sqrt{3}}{2}}{\frac{1}{2} - \frac{1}{\sqrt{2}}}$

$= \frac{\sqrt{2}+\sqrt{3}}{1-\sqrt{2}}$

$\text{The Correct Option is (A): } \tan\theta = \frac{\sqrt{3}+\sqrt{2}}{1-\sqrt{2}}$

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6. Answer: b

Explanation:

$x = 3t^2 + 5$
$v = \frac{dx}{dt}$
$v = 6t + 0$
at $t = 0\, v = 0$
$t = 5\, sec\ v = 30\, m/s$
W.D. = ΔKE
W.D. $= \frac{1}{2}mv^2 - 0 = \frac{1}{2}(2)(30)^2 = 900J$

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7. Answer: a

Explanation:

$\Rightarrow 0 = 50V_1 - 20V_2$ and $V_1 + V_2 = 0.7$
$\Rightarrow V_1 = 0.2$

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---

8. Answer: c

Explanation:

$F = \frac{-dU}{dr} \quad \left[U = -\frac{k}{2r^2}\right]$
$\frac{mv^2}{r} = \frac{k}{r^3}$ [This force provides necessary centripetal force]
$\Rightarrow mv^2 = \frac{k}{r^2}$
$\Rightarrow K.E = \frac{k}{2r^2}$
$\Rightarrow P.E = -\frac{k}{2r^2}$
Total energy $=$ Zero

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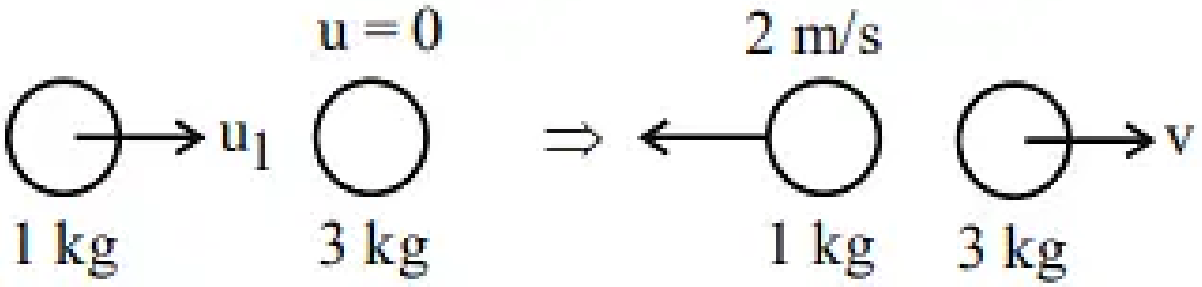
9. **Answer: 4 - 4**

Explanation:

The correct answer is 4.



$$1 \times u_1 = -2 + 3v \quad \Rightarrow \quad u_1 = -2 + 3v \quad \ldots\ldots (1)$$

$$1 = \frac{v+2}{u_1} \quad \Rightarrow \quad v + 2 = u_1 \quad \ldots\ldots (2)$$

Solving (1) and (2)

$$u_1 = 4 \text{ m/s}$$

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10. Answer: 40 - 40

Explanation:

The correct answer is 40.

$\frac{1}{2} \times 2 \times v^2 = 10000$

$\Rightarrow v^2 = 10000$

$\Rightarrow v = 100\, m/s$

$\Rightarrow v = at = a \times 5 = 100$

$\Rightarrow a = 20\, m/s^2$

$F = ma = 2 \times 20 = 40\, N$

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