DPP – 2 (Work, Energy & Power)

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Q 1. If velocity of a body is twice of previous velocity, then kinetic energy will become

(a) 2 times (b) $\frac{1}{2}$ times
(c) 4 times (d) 1 time

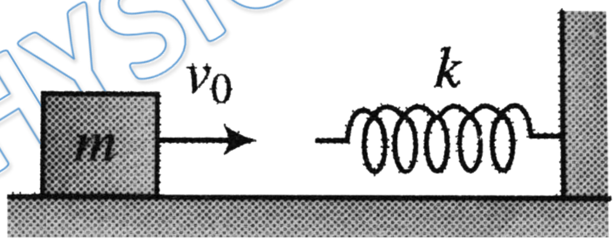
Q 2. A spring 40 mm long is stretched by the application of a force. If 10 N force required to stretch the spring through 1 mm, then work done in stretching the spring through 40 mm is

(a) 84 J (b) 68 J
(c) 23 J (d) 8 J

Q 3. A block of mass 0.1 kg attached to a spring of spring constant 400 N/m is putted rightward from $x_o = 0$ to $x_1 = 15$ mm. Find the work done by spring force

(a) 0.045 J (b) – 0.045 J
(c) 0.45 J (d) – 0.45 Js

Q 4. A block of mass m is moving with an initial velocity V_o towards a stationary spring of stiffness k attached to the wall as shown in figure. Find the maximum compression in the spring



(a) $\left(\sqrt{\frac{m}{k}}\right)v_o$ (b) $\left(\sqrt{\frac{k}{m}}\right)v_o$
(c) $\left(\sqrt{\frac{1}{mk}}\right)v_o$ (d) $\left(\sqrt{\frac{mv_o}{k}}\right)$

Q 5. When a spring is stretched by 2 cm, magnitude of work done by spring is 100 J. If it is stretched further by 2 cm, the magnitude of work done by spring will be

(a) 100 J (b) 200 J
(c) 300 J (d) 400 J

Q 6. A mass of 0.5kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be

(a) 0.15 m (b) 0.12 m
(c) 1.5 m (d) 0.5 m

Q 7. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to

(a) x^2 (b) e^x
(c) x (d) $\ln x$

Q 8. Natural length of a spring is 60 cm, and its spring constant is 4000 N/m. A mass of 20 kg is hung from it. The extension produced in the spring is ($g = 9.8\ m/s^2$)

(a) 4.9 cm (b) 0.49 cm
(c) 9.4 cm (d) 0.94 cm

Q 9. A body of mass 8kg is moved by a force F = (3x)N, where x is the distance covered Initial position is x = 2m and final position is x = 10m. If initially the body is at rest find the final speed

(a) 12 m/s (b) 4 m/s
(c) 6 m/s (d) 2 m/s

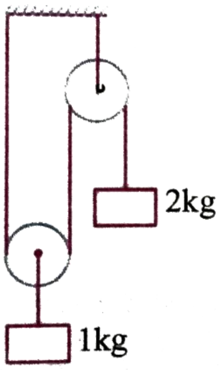
Q 10. A block is initially at rest on a horizontal frictionless surface when a horizontal force in the positive direction of an axis is applied to the block. The force is given by $\vec{F} = (1 - x^2)\hat{\imath}$ N, where x is in meters and the initial position of the block is x = 0. The maximum kinetic energy of the block is $\frac{2}{n}$ J in between x = 0 and x = 2m. Find the value of n?

(a) 1 (b) 2
(c) 3 (d) 4

Q 11. A block of mass 5.0 kg slides down an incline of inclination 30^0 and length 10m. Find the work done by the force of gravity

(a) 300 J (b) 245 J
(c) -145 J (d) 65 J

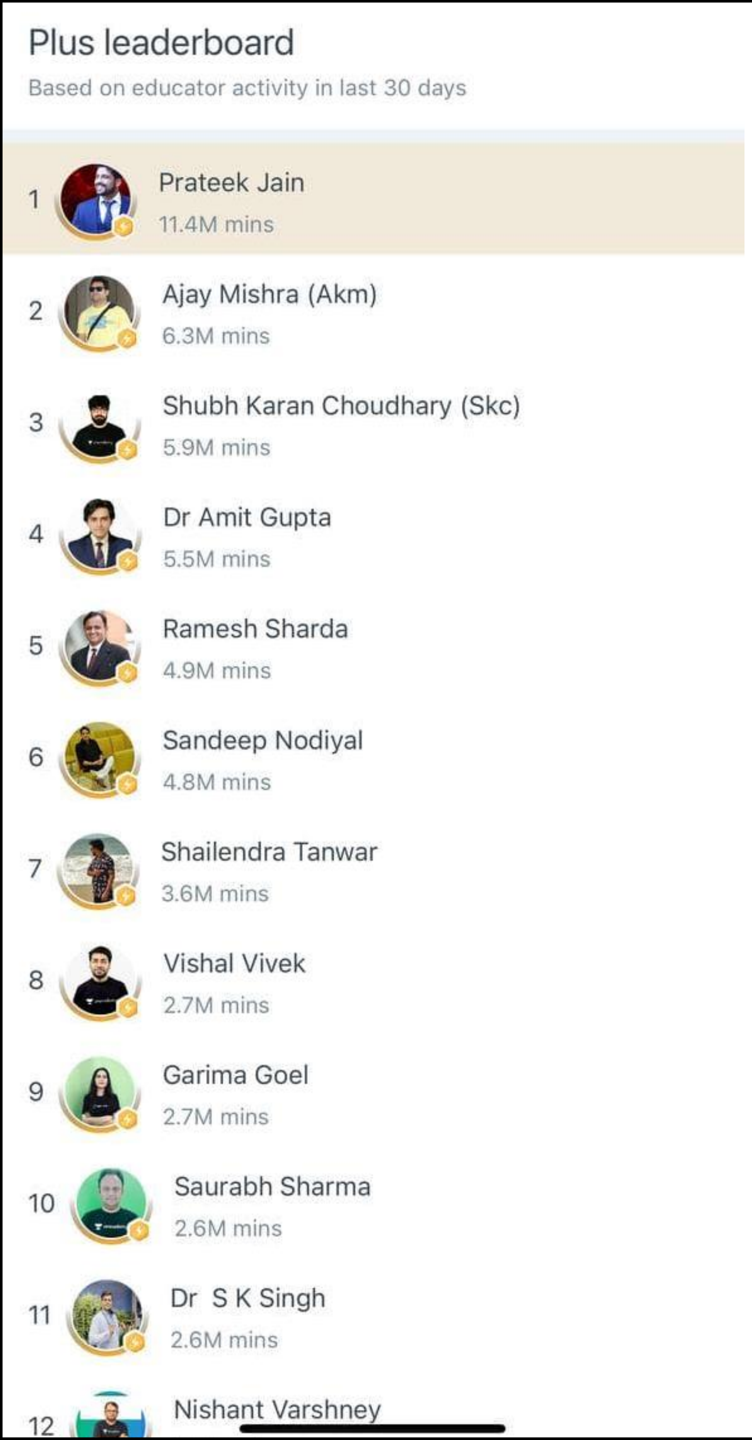
Q 12. In the pulley-block system shown in figure, strings are light. Pulleys are massless and smooth. System is released from rest. In 0.3 seconds work done by tension on block of mass 2kg? ($g = 10\ m/s^2$)



(a) 2 J (b) 6 J
(c) -1.5 J (d) -2 J

Answer Key

Q.1 c	**Q.2 d**	**Q.3 b**	**Q.4 a**	**Q.5 c**
Q.6 a	**Q.7 a**	**Q.8 a**	**Q.9 c**	**Q.10 c**
Q.11 b	**Q.12 d**			



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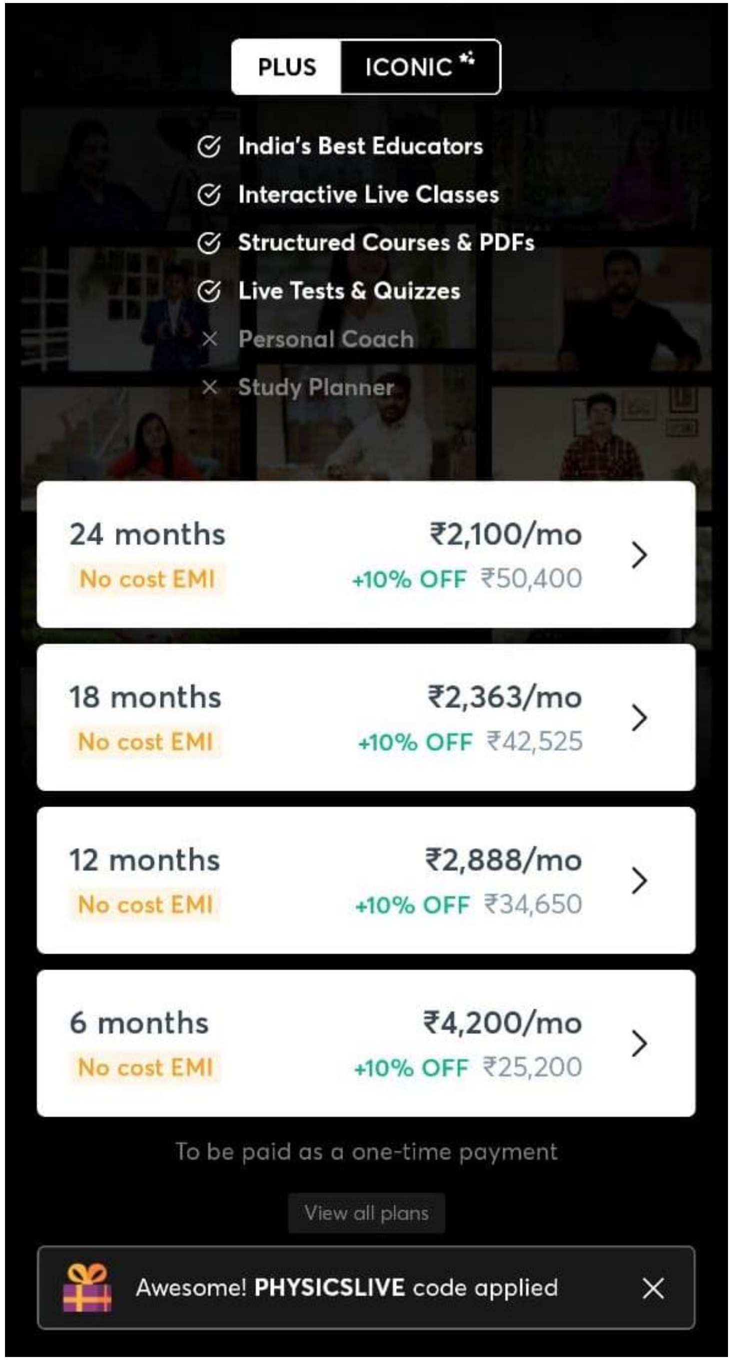


Physics DPP

DPP-2 WEP: Kinetic Energy, Work Done by Spring Force, Work Energy Theorem

By Physicsaholics Team

Solution: 1

$KE = \frac{1}{2} m v^2$

$KE \propto v^2$

$\frac{KE_1}{KE_2} = \left(\frac{v}{2v}\right)^2 = \frac{1}{4}$

$\boxed{KE_2 = 4\, KE_1}$ Ans.

Ans. c

Solution: 2

$F = kx$

$10 = k\,(1\,mm)$ — ① $\Rightarrow k = \frac{10}{10^{-3}\,m} \Rightarrow \boxed{k = 10^4\ N/m}$

$\therefore\ w = \frac{1}{2}kx^2$

$w = \frac{1}{2} \times 10^4 \times (40 \times 10^{-3})^2 = \frac{1}{2} \times 10^4 \times 1600 \times 10^{-6}$

$\boxed{w = 8\,J}$ Ans.

Ans. d

Solution: 3

$k = 400\ N/m$

$w = \frac{1}{2}k\left(x_i^2 - x_f^2\right) = -\frac{1}{2}k\left(x_f^2 - x_i^2\right)$

$w = -\frac{1}{2}k\left[(15\times10^{-3})^2 - 0^2\right]$

$w = -\frac{1}{2}\times 400 \times 225\times10^{-6}$

$w = -450\times10^{-4}$

$\boxed{w = -0.045\ J}$ Ans.

Ans. b

Solution: 4

Let, max compression = x_0

so; From Work Energy theorem

$W_{Total} = \Delta KE \Rightarrow W_{spring} + W_N + W_{mg} = \Delta K$

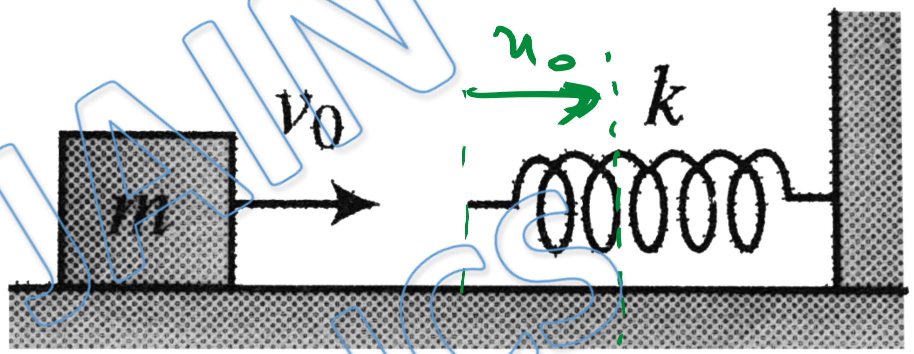
$W_{spring} = KE_f - KE_i$

$-\frac{1}{2}kx_0^2 = 0 - \frac{1}{2}mv_0^2$

$\frac{1}{2}kx_0^2 = \frac{1}{2}mv_0^2$

$x_0^2 = \frac{m}{k}v_0^2$

$x_0 = \sqrt{\frac{m}{k}}\,v_0$ Ans.



at max compression : speed = 0

Ans. a

Solution: 5

$$w = -\frac{1}{2}k(x_f - x_i)^2$$

$$|w| = \frac{1}{2}k(x_f - x_i)^2$$

$$\frac{|w_1|}{|w_2|} = \frac{\frac{1}{2}k((2\times10^{-2})^2 - 0^2)}{\frac{1}{2}k((4\times10^{-2})^2 - (2\times10^{-2})^2)} = \frac{4\times10^{-4}}{16\times10^{-4} - 4\times10^{-4}}$$

$$\frac{100}{|w_2|} = \frac{1}{4-1}$$

$$\boxed{|w_2| = 300\ \text{J}}\ \text{Ans.}$$

Ans. c

Solution: 6

$W_T = \Delta KE$

at max compression; $v = 0$

$W_{spring} = KE_f - KE_i$

$-\frac{1}{2}kx^2 = 0 - \frac{1}{2}mv^2$

$kx^2 = mv^2$

$x^2 = \frac{m}{k}v^2 = \frac{0.5}{50} \times (1.5)^2 = \frac{(1.5)^2}{100}$

$x = \frac{1.5}{10}$

$\boxed{x = 0.15\ m}$ Ans.

Ans. a

Solution: 7

$a \propto -x$

$a = -kx$ (k = Proportional constant)

$F = ma$

$F = -kmx$

$W_T = \Delta KE$

$\Delta KE = \int F \cdot dx$

$= -km \int x \, dx$

$\Delta KE = -km \dfrac{x^2}{2}$

$\boxed{\Delta KE \propto x^2}$ Ans.

or

$\boxed{\text{Loss of kinetic Energy} \propto x^2}$ Ans.

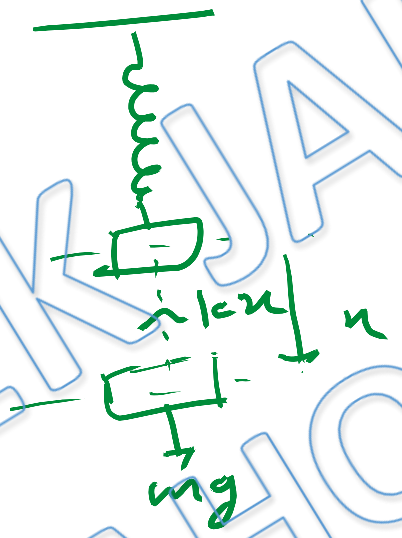
Ans. a

Solution: 8

$l = 60\ cm$

$K = 4000\ N/m$

$m = 20\ kg$



$kx = mg$

$$x = \frac{mg}{K}$$

$$x = \frac{20 \times 9.8}{4000}$$

$$x = \frac{98}{2000} = \frac{49}{1000} = 0.049\ m$$

$\boxed{x = 4.9\ cm}$ Ans.

Ans. a

Solution: 9

$F = 3x$

$W_T = \Delta KE$

$\int_{x_1}^{x_2} F \cdot dx = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \to 0$

$\int_2^{10} (3x)\,dx = \frac{1}{2} 8 (v^2) \Rightarrow \left[\frac{3x^2}{2}\right]_2^{10} = 4 \times v^2$

$4 \times v^2 = 3 \times \left[\frac{10^2}{2} - \frac{2^2}{2}\right] \Rightarrow 4 \times v^2 = 3 \times \frac{96}{2}$

$v^2 = \frac{3 \times 96}{4 \times 2} = 36$

$\boxed{v = 6\ m/s}$ Ans.

Ans. c

Solution: 10

$\vec{F} = (1-x^2)\hat{i}$

when $F = +ve$

$a = +ve$

$\Rightarrow v \uparrow \Rightarrow KE \uparrow$

for $x \in [0, 2]$

$F \geq 0 \Rightarrow 1 - x^2 \geq 0$

$1 \geq x^2$

$-1 \leq x \leq 1$

but for $x \in [0, 2]$

K.E. is maximum at $x = 1$

$W_T = \Delta KE$

$\int_0^1 (1-x^2)\,dx = KE_1 - 0$

$\left[x - \frac{x^3}{3}\right]_0^1 = KE_{max} - 0$

$\left[1 - \frac{1}{3} - 0\right] = \frac{1}{2}mv^2 \Rightarrow \frac{2}{3} = KE$

$\boxed{KE_{max} = \frac{2}{3} J} \Rightarrow \frac{2}{3} = \frac{2}{n} \Rightarrow \boxed{n = 3}$ Ans.

Ans. c

Solution: 11

$$W = FS\cos\theta \qquad (\theta = 60^\circ)$$

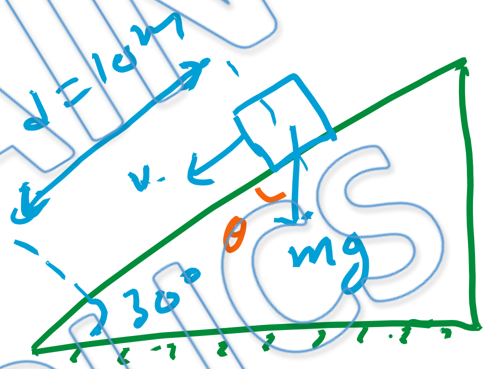
$$W = (mg)\, d\cos\theta$$

$$W = (5 \times 9.8) \times 10 \times \cos 60^\circ$$

$$W = 5 \times 98 \times \frac{1}{2}$$

$$W = 5 \times 49$$

$$\boxed{W = 245\ \text{J}}$$



Ans. b

Solution: 12

$2g - T = 2a$ —①

$2T - g = 1(a/2)$ —②

From eqⁿ ① & ②

$4g - 2T = 4a$

$2T - g = a/2$

$3g = 9a/2$

$a = \frac{2g}{3}$

Put 'a' in eqⁿ ①

$2g - T = 2 \times \frac{2g}{3}$

$T = 2g/3$

Displacement of 2kg in 0.3 sec

$S = \frac{1}{2}at^2$

$= \frac{1}{2} \times \frac{2g}{3}(0.3)^2$

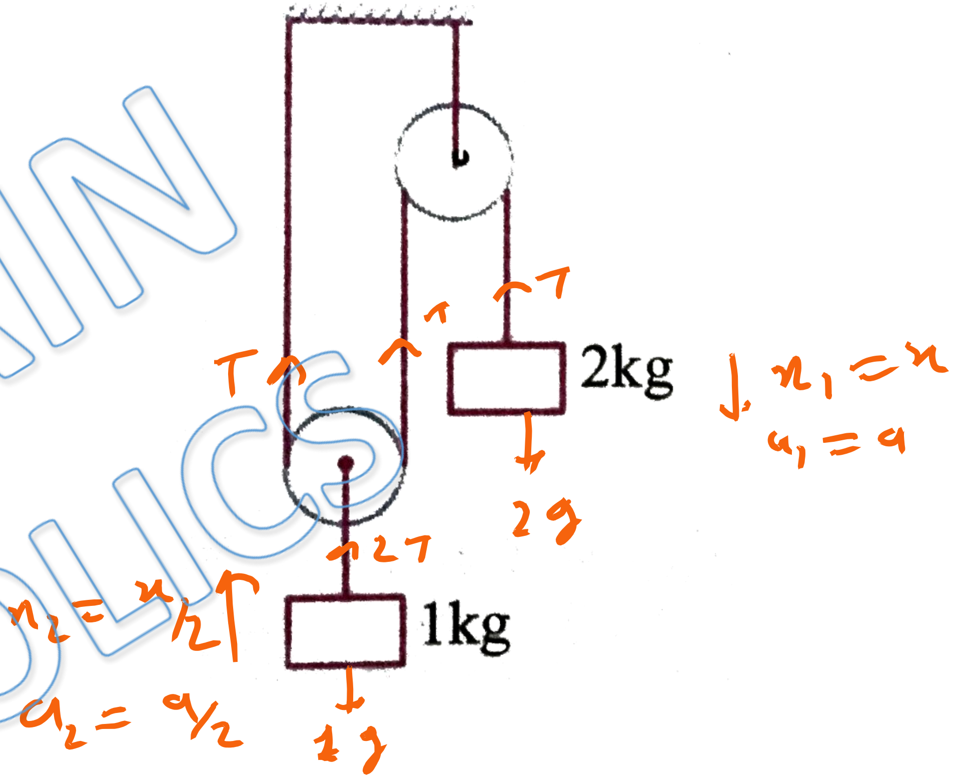
$S = 0.03g$

$\therefore W = -TS$

$W = -\frac{2g}{3} \times 0.03g$

$W = -\frac{2 \times 0.03}{3} \times g^2 = \frac{-2 \times 0.03 \times 10^2}{3}$

$W = -2\ J$ Ans.



Ans. d

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Chalo Niklo