DPP – 5 (COM)

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Q 1. A particle of mass m is made to move with uniform speed v_0 along the perimeter of a regular hexagon. The magnitude of impulse applied at each corner of the hexagon is

(a) $2mv_0 \sin\frac{\pi}{6}$

(b) $mv_0 \sin\frac{\pi}{6}$

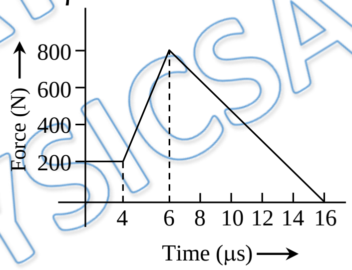
(c) $mv_0 \sin\frac{\pi}{3}$

(d) $2mv_0 \sin\frac{\pi}{3}$

Q 2. Displacement of a particle of mass 2 kg moving In a straight line varies with time as s = $(2t^3 + 2)$ m. Impulse of the force acting on the particle over a time interval between t =0 and t =1 s is:

(a) 10 N-s (b) 12 N-s (c) 8 N-s (d) 6 N-s

Q 3. The magnitude of force (in Newtons) acting on a body varies with time (in micro second) as shown in the figure. The magnitude of total impulse of the force on the body from t = 4μs to t = 16μs is –



(a) 5×10^{-2} Ns (b) 5×10^{-3} Ns

(c) 5×10^{-4} Ns (d) 5×10^{-6} Ns

Q 4. An impulse $\vec{I}$ changes the velocity of a particle from $\vec{V_1}$ to $\vec{V_2}$. Kinetic energy gained by the particle is –

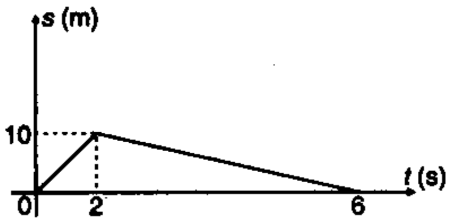
(a) $(1/2)\vec{I}\,(\vec{V_1}+\vec{V_2})$

(b) $(1/2)\,\vec{I}\,(\vec{V_1}-\vec{V_2})$

(c) $\vec{I}\,(\vec{V_2}-\vec{V_1})$

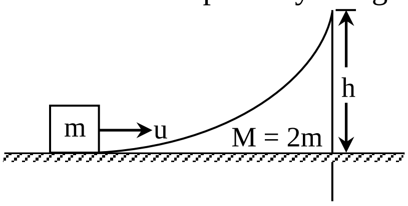
(d) $\vec{I}\,(\vec{V_2}+\vec{V_1})$

Q 5. Displacement-time graph of a particle moving in a straight line is as shown in figure. Mass of the particle is 2 kg. The total Impulse imparted to the particle in a time interval from t = 0 to t = 6 sin N-s will be



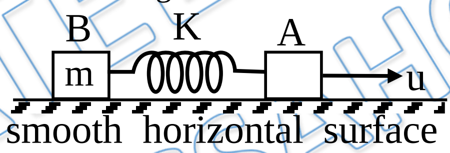
(a) 30 (b) 15 (c) – 30 (d) – 15

Q 6. A block of mass m is moved towards a movable wedge of mass M = 2m and height h with velocity u (All surfaces are smooth). If the block just reaches the top of the wedge, the magnitude of horizontal impulse by wedge on block is –



(a) mu/3 (b) mu/2
(c) 2mu/3 (d) mu

Q 7. A spring of stiffness K is attached with two blocks A and B. This spring blocks system is placed on smooth ground with spring in natural length. At t= 0, an external agent starts pulling block A with constant velocity u. Impulse by spring to block B when spring regains its natural length first time is ?

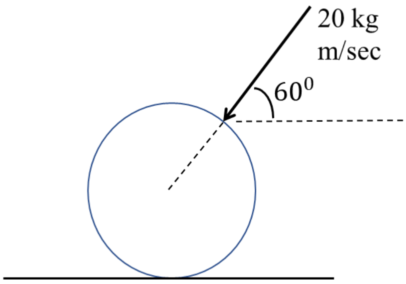


(a) 0 (b) mu (c) 2mu (d) mu/2

Q 8. A force F = Sin t , is acting on a particle. Maximum impulse that the force can supply to particle is
(a) 1 unit (b) 2 unit
(c) 3 unit (d) 4 unit

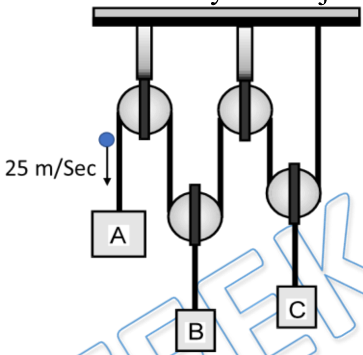
Q 9. A block of mass 1 kg is projected on rough horizontal plane with initial velocity 6 m/sec. coefficient of friction is $\mu = x/3$, where x is displacement of block. Magnitude of total impulse imparted by friction on block is
(a) 3 Kg m/sec
(b) 6 Kg m/sec
(c) 12 Kg m/sec
(d) 9 Kg m/sec

Q 10. A sphere of radius 1meter and mass 1 kg is placed on smooth ground. An impulse of 20 kg m/sec is imparted on it as shown in figure. Find velocity of sphere after imparting impulse ?(sphere is not bouncing up)



(a) 20 m/sec (b) 10 m/sec
(c) 17 m/sec (d) 8.5 m/sec

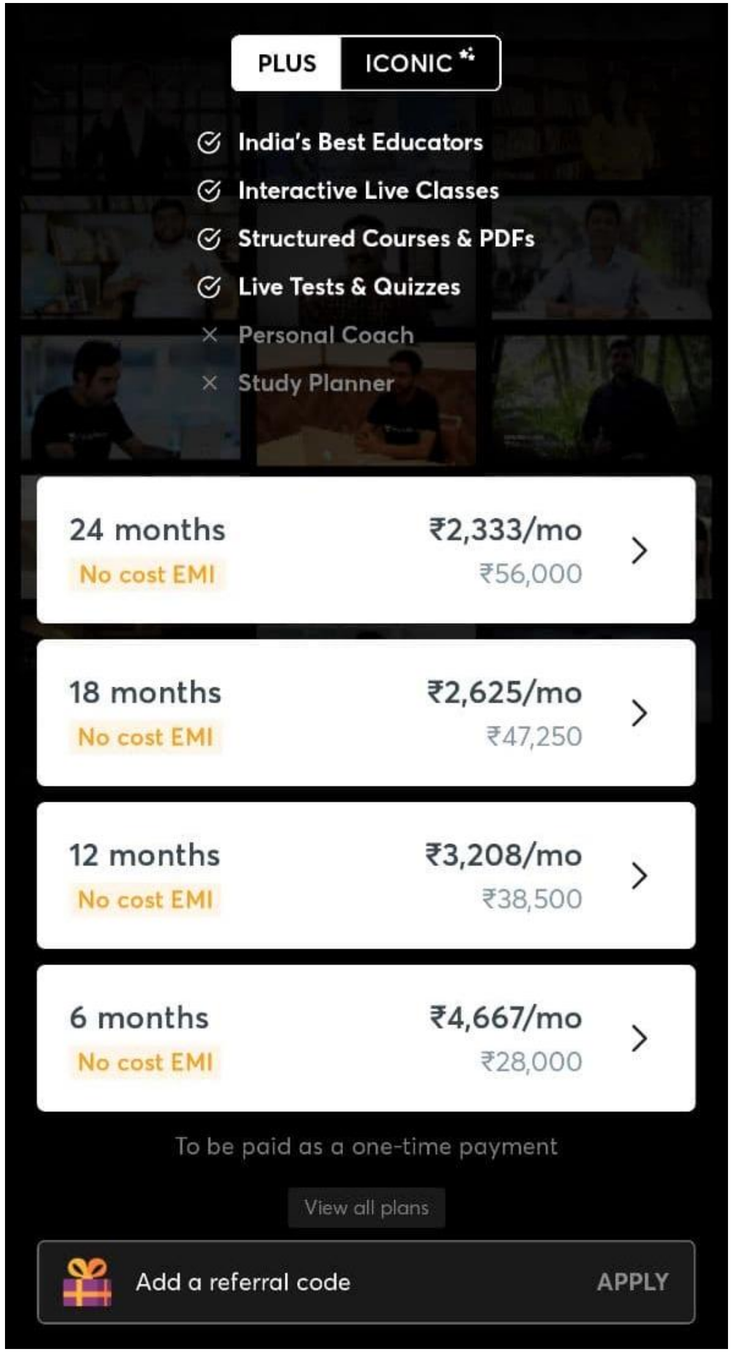
Q 11. In given figure 'B' and 'C' have equal mass 1 kg each and mass of 'A' is 2 kg. system was initially at rest. A ball of mass 1 kg hits 'A' with speed 25 m/sec as shown in figure and sticks with it. Velocity of 'A' just after hitting is



(a) 4 m/Sec (b) 6 m/Sec
(c) 16 m/Sec (d) 8 m/Sec

Answer Key

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



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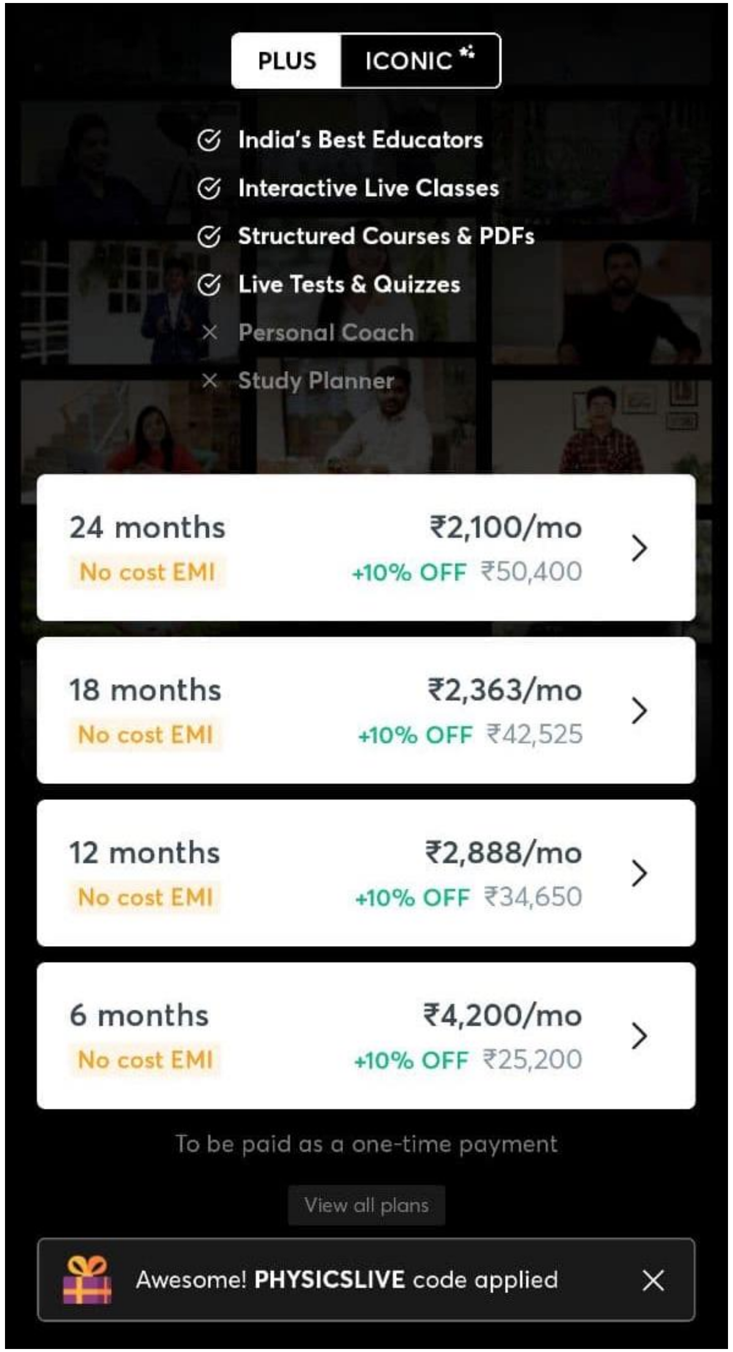


Written Solution

DPP- 5 : Impulse , Impulse Momentum Theorem

By Physicsaholics Team

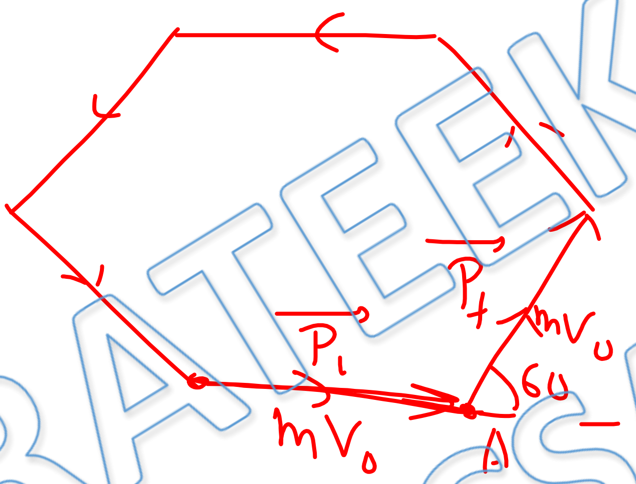
Q.1) A particle of mass m is made to move with uniform speed v_0 along the perimeter of a regular hexagon. The magnitude of impulse applied at each corner of the hexagon is

(a) $2mv_0 \sin\frac{\pi}{6}$

(b) $mv_0 \sin\frac{\pi}{6}$

(c) $mv_0 \sin\frac{\pi}{3}$

(d) $2mv_0 \sin\frac{\pi}{3}$



$$I = |\Delta \vec{P}| = |\vec{P_f} - \vec{P_i}| = 2(mv_0)\sin\left(\frac{60}{2}\right)$$

$$= 2mv_0 \sin\left(\pi/6\right)$$

Q.2) Displacement of a particle of mass 2 kg moving In a straight line varies with time as s = $(2t^3 + 2)$ m . Impulse of the force acting on the particle over a time interval between t =0 and t =1 s is:

$I = \Delta P = mV_f - mV_i$, $V = \frac{ds}{dt} = 6t^2$

$= m(V_f - V_i)$ at t = 0, V = 0

$= 2(6 - 0) = 12$ N-s at t = 1, V = 6

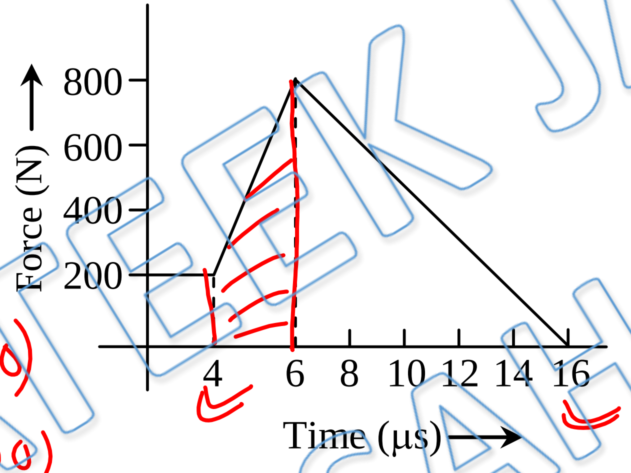
(a) 10 N-s (b) 12 N-s (c) 8 N-s (d) 6 N-s

Q.3) The magnitude of force (in Newtons) acting on a body varies with time (in micro second) as shown in the figure. The magnitude of total impulse of the force on the body from t = 4μs to t = 16μs is –

$\vec{I} = \int \vec{F}\, dt$

$I = \int F\, dt = \text{Area}$

$= \frac{1}{2} \times (6-4)(800+200) + \frac{1}{2}(16-6)(800)$



(a) 5×10^{-2} Ns
(b) 5×10^{-3} Ns
(c) 5×10^{-4} Ns
(d) 5×10^{-6} Ns

$I = \frac{1}{2} \times 2 \times 1000 + \frac{1}{2} \times 10 \times 800$

$= 5000\ \mu\ N\text{-}s = 5 \times 10^{-3}$ Ns

Q.4) An impulse $\vec{I}$ changes the velocity of a particle from $\vec{V}_1$ to $\vec{V}_2$. Kinetic energy gained by the particle is –

$(\vec{V_2}+\vec{V_1})\cdot(\vec{V_2}-\vec{V_1})$

$= \vec{V_2}\cdot\vec{V_2} - \vec{V_2}\cdot\vec{V_1} + \vec{V_1}\cdot\vec{V_2} - \vec{V_1}\cdot\vec{V_1}$

$= V_2^2 - V_1^2$

$\vec{I} = m(\vec{V_2} - \vec{V_1})$

$\Delta K = \frac{1}{2}m(V_2^2 - V_1^2)$

$= \frac{1}{2}m(\vec{V_2}+\vec{V_1})\cdot(\vec{V_2}-\vec{V_1})$

$= \frac{1}{2}\vec{I}\cdot(\vec{V_2}+\vec{V_1})$

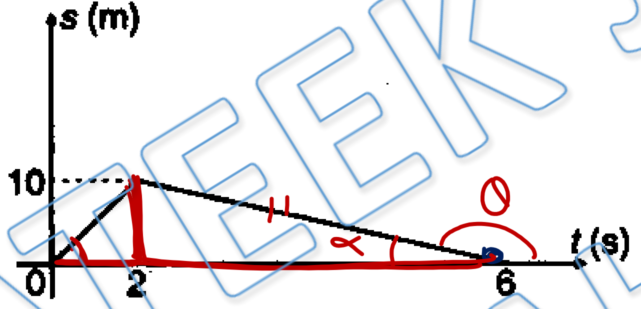
(a) $(1/2)\vec{I}\cdot(\vec{V}_1+\vec{V}_2)$

(b) $(1/2)\vec{I}\cdot(\vec{V}_1-\vec{V}_2)$

(c) $\vec{I}\cdot(\vec{V}_2-\vec{V}_1)$

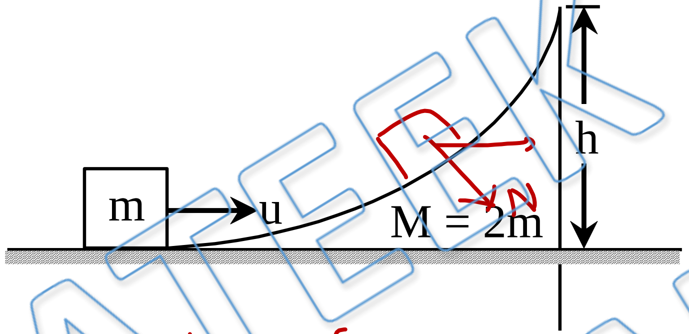
(d) $\vec{I}\cdot(\vec{V}_2+\vec{V}_1)$

Q.5) Displacement-time graph of a particle moving in a straight line is as shown in figure. Mass of the particle is 2 kg. The total Impulse imparted to the particle in a time interval from t = 0 to t = 6 sin N-s will be



(a) 30 (b) 15 (c) – 30 (d) – 15

Q.6) A block of mass m is moved towards a movable wedge of mass M = 2m and height h with velocity u (All surfaces are smooth). If the block just reaches the top of the wedge, the magnitude of horizontal impulse by wedge on block is –



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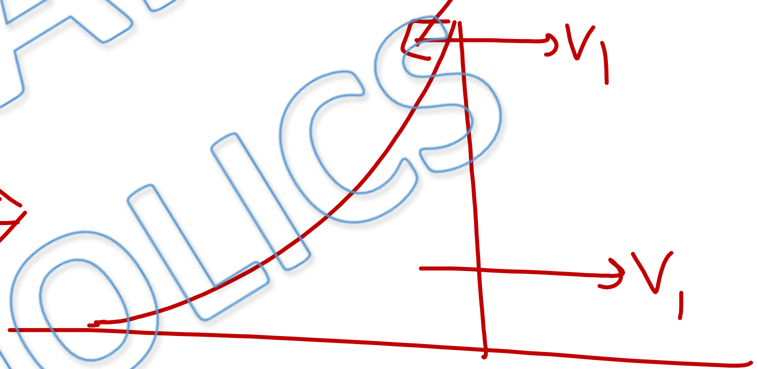


by Conservation of momentum

(a) mu/3

(b) mu/2

(c) 2mu/3

(d) mu

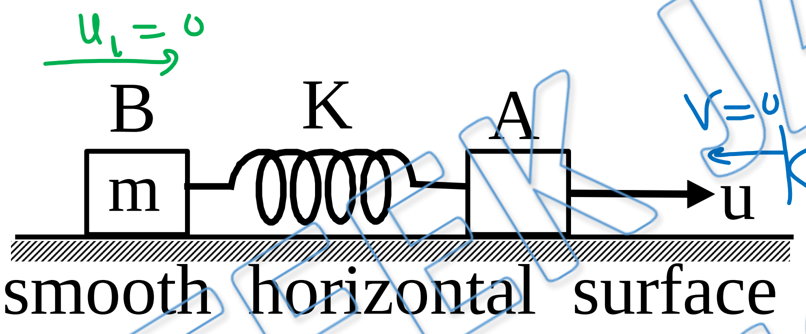
$mu = mV_1 + 2mV_1$

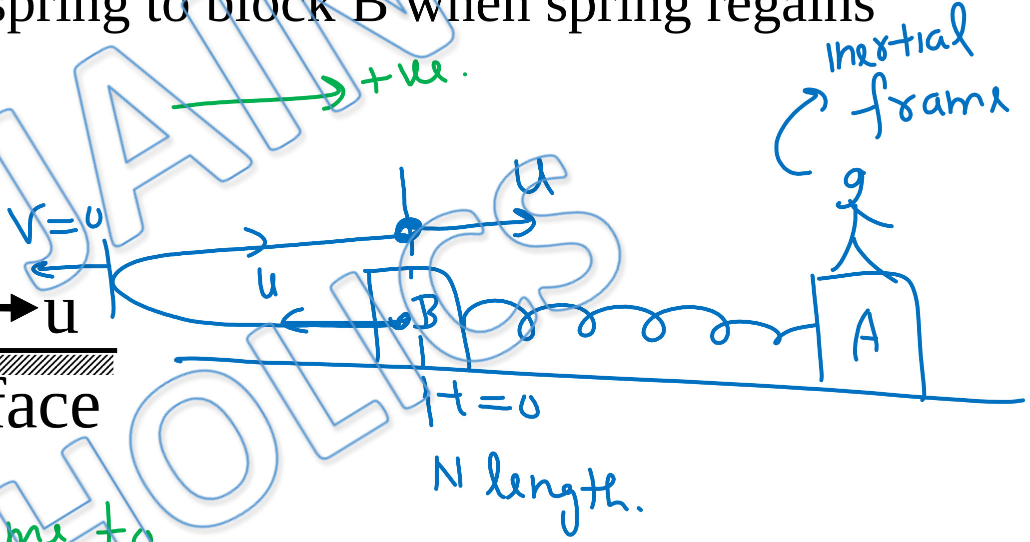
$V_1 = u/3$

$I_{horizontal} = \Delta P_{hor} = mV_1 - mu = \frac{mu}{3} - mu$

$= -\frac{2mu}{3} \Rightarrow |\Delta P_{hor}| = \frac{2mu}{3}$

Q.7) A spring of stiffness K is attached with two blocks A and B . This spring blocks system is placed on smooth ground with spring in natural length. At t= 0 , an external agent starts pulling block A with constant velocity u. Impulse by spring to block B when spring regains its natural length first time is ?





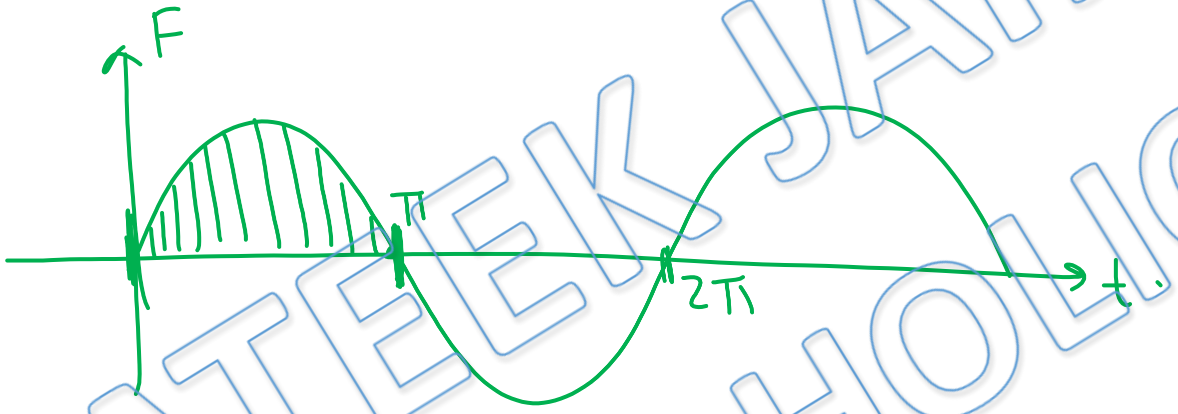
when block B returns first time to position of natural length of spring →

(a) 0
(b) mu
(c) 2mu
(d) mu/2

$$V_{B,g} = V_{BA} + V_{A,g} = +u + u = 2u$$

$$I = \Delta P \text{ of } B = 2mu - 0 = 2mu$$

Q.8) A force F = Sin t , is acting on a particle. Maximum impulse that the force can supply to particle is



(a) 1 unit

(b) 2 unit ✓

(c) 3 unit

(d) 4 unit

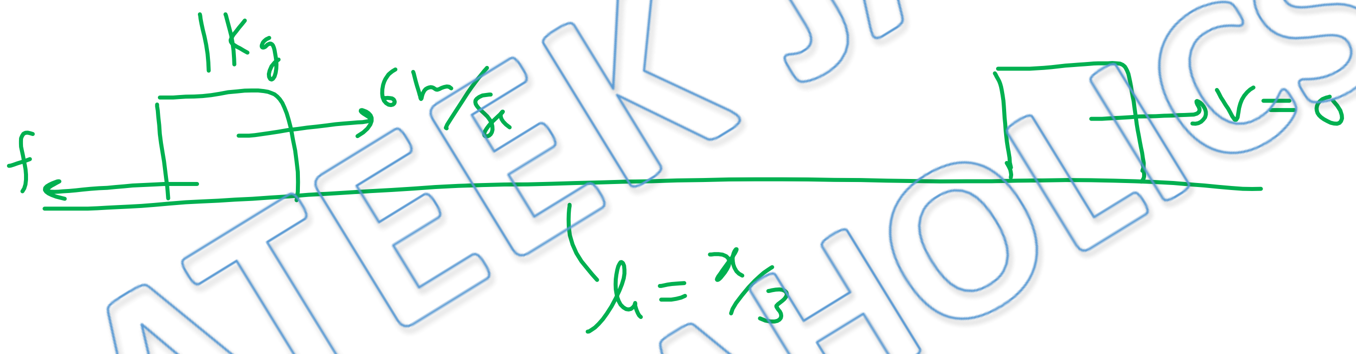
$I = \int F\,dt$ = Area under Curve.

$I_{max} = \int F\,dt = \int_0^{\pi} \sin t\,dt$

$= \left[-\cos t\right]_0^{\pi} = (-\cos\pi) - (-\cos 0)$

$= 1 + 1 = 2$

Q.9) A block of mass 1 kg is projected on rough horizontal plane with initial velocity 6 m/sec. coefficient of friction is μ = x/3 ,where x is displacement of block. Magnitude of total impulse imparted by friction on block is



(a) 3 Kg m/sec

(b) 6 Kg m/sec

(c) 12 Kg m/sec

(d) 9 Kg m/sec

$I_f = \Delta P_{hori} = 0 - 1\times 6$

$= -6$

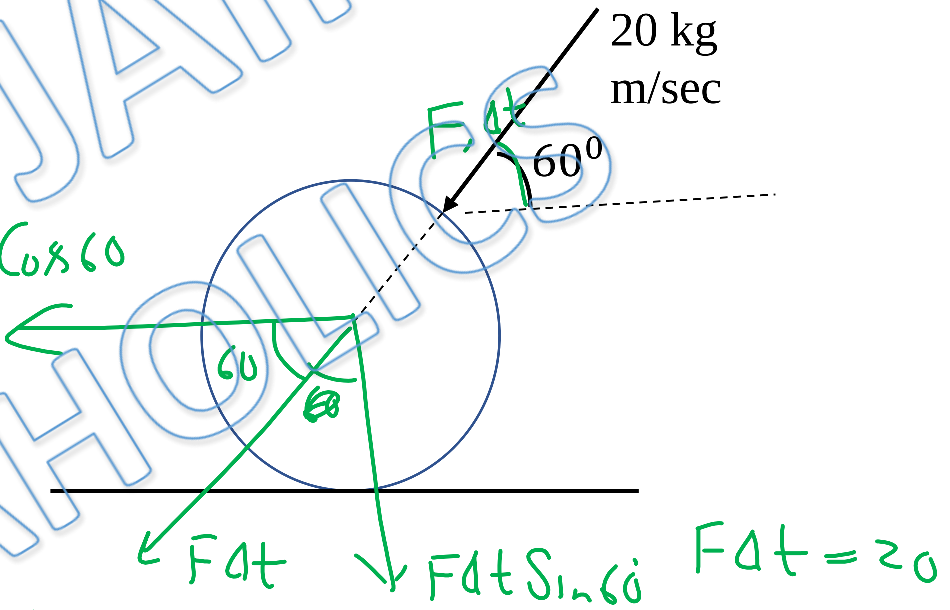
$|I_f| = 6$ Kg m/sec

Q.10) A sphere of radius 1meter and mass 1 kg is placed on smooth ground. An impulse of 20 kg m/sec is imparted on it as shown in figure. Find velocity of sphere after imparting impulse ?(sphere is not bouncing up)

$F\Delta t \cos 60 = 1 \times V - 0$

$20 \times \frac{1}{2} = V$

$V = 10 \, m/sec$



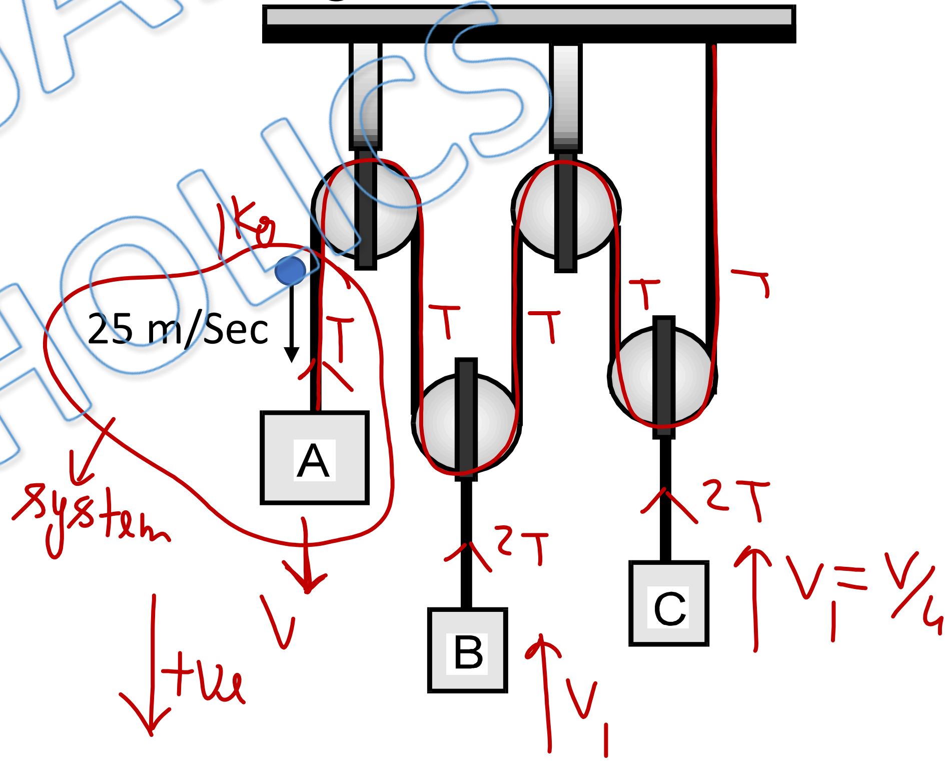
(a) 20 m/sec

(b) 10 m/sec ✓

(c) 17 m/sec

(d) 8.5 m/sec

Q.11) In given figure 'B' and 'C' have equal mass 1 kg each and mass of 'A' is 2 kg. system was initially at rest. A ball of mass 1 kg hits 'A' with speed 25 m/sec as shown in figure and sticks with it. Velocity of 'A' just after hitting is



$-TV + 2TV_1 + 2TV_1 = 0$

$TV = 4TV_1$

$V_1 = V/4$

for (A + ball) system →

$-T\Delta t = 3V - 1 \times 25$ --- (1)

(a) 4 m/Sec

(b) 6 m/Sec

(c) 16 m/Sec

(d) 8 m/Sec

for B →

$-2T\Delta t = (-1 \times V/4)$

$T\Delta t = V/8$

$-V/8 = 3V - 25 \Rightarrow 25 = 3V + V/8 \Rightarrow V = 8\ m/sec$

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