PHYS 1050
Tutorial 3

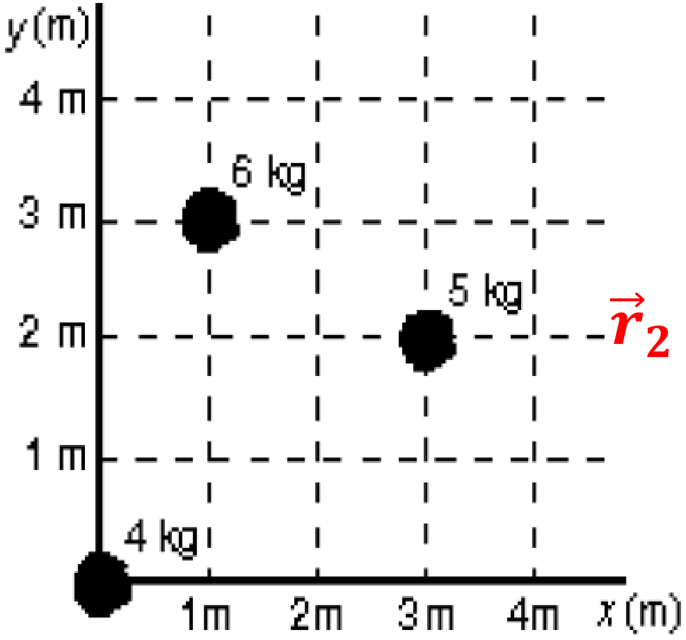
Yutong Zhao

Dec 5th 2018

1. The x and y coordinates in meters of the center of mass of the three-particle system shown below are:

$$\vec{R}_{cm} = \frac{1}{M}\sum_{i}^{n} m_i \vec{r}_i$$

$\vec{r}_3 = (1, 3)$



$\vec{r}_2 = (3, 2)$

$\vec{r}_1 = (0, 0)$

$$M = M_1 + M_2 + M_3$$
$$= 4 + 5 + 6 = 15kg$$

A) 0 m, 0 m
B) 1.3 m, 1.7 m
C) $\boxed{\text{1.4 m, 1.9 m}}$
D) 1.9 m, 2.5 m
E) 1.4 m, 2.5 m

$$\vec{R}_{cm} = \frac{1}{15}(0 + 15 + 6, 0 + 10 + 18) = \left(\frac{21}{15}, \frac{28}{15}\right)$$

$$\approx (1.4, 1.867)$$

2. A 2.5-kg stone is released from rest and falls toward Earth. After 4.0 s, the magnitude of its momentum is:

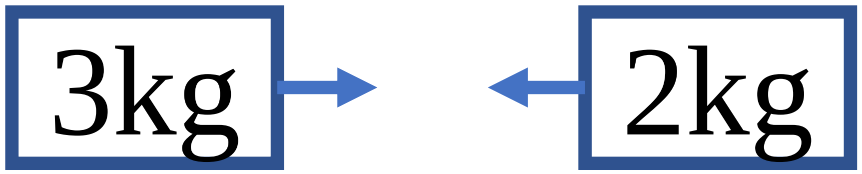
A) 98 kg·m/s
B) 78 kg·m/s
C) 39 kg·m/s
D) 24 kg·m/s
E) 0 kg·m/s

$$v = gt = 9.8m/s^2 \times 4s = 39.2m/s$$

$$I = mv = 2.5kg \times 39.2m/s = 98m/s$$

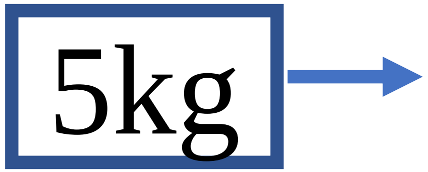
$= 10$

$$I = mv = 2.5kg \times 9.8m/s^2 \times 4s = 98m/s$$



3. A 3.0-kg cart and a 2.0-kg cart approach each other on a horizontal air track. They collide and stick together. After the collision their total kinetic energy is 40 J. The speed of their center of mass is:

A) 0 m/s
B) 2.8 m/s
C) 4.0 m/s
D) 5.2 m/s
E) 8.0 m/s

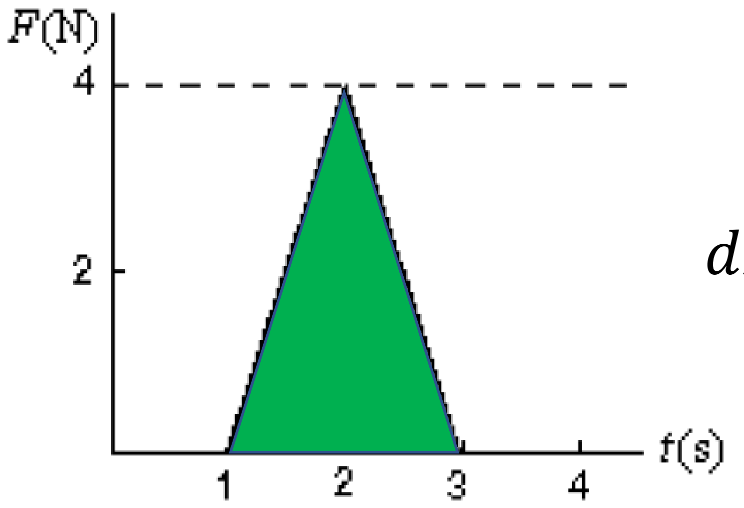


$$E = \frac{1}{2}mv^2$$

$$M_{cm} = 2kg + 3kg = 5kg$$

$$v = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2 \times 40J}{5kg}} = \sqrt{16}$$

4. The plot shows the force acting on an object as a function of time. Over the time the force is applied, the total impulse is:



$$dI = \int_{t_i}^{t_f} F dt = Area(F)$$

A) 0 N·s
B) 2 N·s
C) 4 N·s
D) 8 N·s
E) cannot be determined without knowing the mass of the object

$$Area = \frac{4 \times 2}{2} = 4N \cdot s$$

$$\alpha = \frac{d\omega}{dt} = 6.0 \times t^2$$

$$\omega = \int \alpha \, dt = 2t^3$$

5. A wheel starts from rest and has an angular acceleration that is given by $\alpha(t) = (6.0 \text{ rad/s}^4)t^2$. After it has turned through 10 rev its angular velocity is:

A) 63 rad/s

$\boxed{\text{B) 75 rad/s}}$

C) 89 rad/s

D) 130 rad/s

E) 210 rad/s

$$\theta = \int \omega \cdot dt = 10\, rev$$

$$\frac{1}{2}t^4 = 10 \times 2\pi$$

$$t^4 = 10 \times 4\pi$$

$$t = 3.348s$$

$$\omega = 2 \times 3.348^3 \approx 75.056$$

6. The rotational inertia of a disk about its axis is 0.70 kg·m^2. When a 2.0 kg weight is added to its rim, 0.40 m from the axis, the rotational inertia becomes:

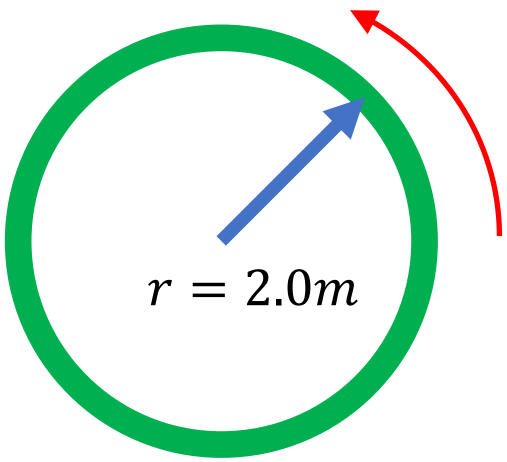
A) 0.32 kg·m^2
B) 0.54 kg·m^2
C) 0.70 kg·m^2
D) 0.86 kg·m^2
E) $\boxed{1.02 \text{ kg·m}^2}$

$$I = \sum_{i}^{n} m_i r_i^2$$

$$I = I_0 + mr^2 = 0.70 + 2 \times 0.4^2 = 1.02 kg \cdot m^2$$

$$I = \sum mr^2 = 1.0kg \times 2.0m = 4kg \cdot m^2$$

7. A thin circular hoop of mass 1.0 kg and radius 2.0 m is rotating about an axis through its center and perpendicular to its plane. It is slowing down at the rate of 7.0 rad/s^2. The net torque acting on it is:
   A) 7.0 N·m
   B) 14 N·m
   C) 28 N·m
   D) 44 N·m
   E) none of these



$m = 1.0kg$

$$\tau = I\alpha = 4kg \cdot m^2 \times 7.0\,rad/s^2 = 28N \cdot m$$

$$\tau = I\alpha = Fr \qquad \alpha = \frac{Fr}{I} = \frac{1.0N \times 0.10m}{0.02kg \cdot m^2} = 5\, rad/s^2$$

8. A cylinder is 0.10 m in radius and 0.20 m in length. Its rotational inertia, about the cylinder axis on which it is mounted, is 0.020 kg · m^2. A string is wound around the cylinder and pulled with a force of 1.0 N. The angular acceleration of the cylinder is:
   A) 2.5 rad/s^2
   B) 5.0 rad/s^2
   C) 10 rad/s^2
   D) 15 rad/s^2
   E) 20 rad/s^2