Q1.
An 800 kg car is traveling at velocity $\left(12\,\hat{i}\right)$m/s. When the brakes are applied, the car changes its velocity to $\left(12\,\hat{j}\right)$m/s in 4.0 s. What is the change in kinetic energy of the car in this time period?

A) 0 J
B) 2.9×10^{4} J
C) $5.8\times 10^{4}\left(\hat{j}-\hat{i}\right)$ J
D) 4.8×10^{4} J
E) $\left(12\hat{i}-12\hat{j}\right)$ J

Q2.
An ideal spring is hung vertically from the ceiling. When a 2.0 kg mass hangs at rest from it, the spring is extended 6.0 cm from its relaxed length. A downward external force is now applied to the mass to extend the spring an additional 10 cm. While the spring is being extended by the external force, the work done by the spring is:

A) −3.6 J
B) −3.3 J
C) −1.0 J
D) 1.8 J
E) 3.6 J

Q3.
A single force acts on a 5.0 kg object in such a way that the position of the object as a function of time is given by $x = 10.0t - 5.0t^{2}$, with *x* is in meters and *t* is in seconds. Find the work done on the object from *t* = 0 to *t* = 4.0 s.

A) 2000 J
B) 900 J
C) 4000 J
D) 400 J
E) 500 J

Q4.
A 2000 kg elevator moves 20 m upward in 4.9 sec at a constant speed. At what average rate does the force from the cable do the work on the elevator?

A) 80000 W
B) 25000 W
C) 75000 W
D) 10000 W
E) 150 W

Q5.
A 10.0 kg block is released from rest 100 m above the ground. When it has fallen 50 m, its kinetic energy is:

A) 4900 J
B) 9800 J
C) 1200 J
D) 120 J
E) 60 J

Q6.
A 4.0 kg block is initially moving to the right on a horizontal frictionless surface at a speed of 5.0 m/s. It then compresses a horizontal spring of spring constant 200 N/m. At the instant when the kinetic energy of the block is equal to the potential energy of the spring, the mechanical energy of the block-spring system is:

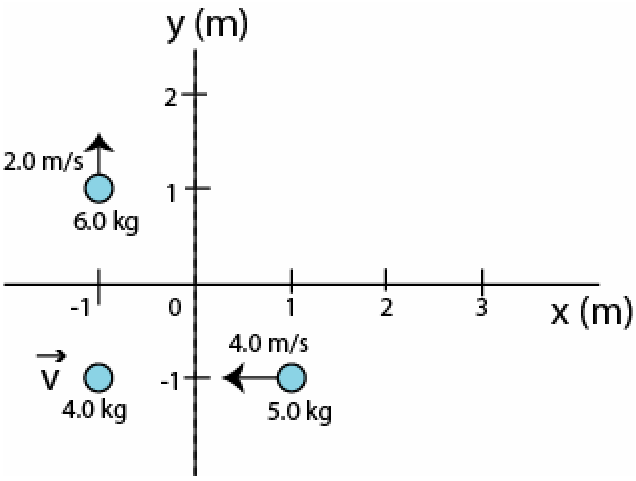
A) 50 J
B) 10 J
C) 25 J
D) 75 J
E) 15 J

Q7.
A 5.0 kg block starts up a 30° incline with 198 J of kinetic energy. The block slides up the incline and stops after traveling 4.0 m. The work done by the force of friction between the block and the incline is:

A) -100 J
B) -198 J
C) -98 J
D) -298 J
E) 0 J

Q8.
Two velocities of the three-particle system are shown in the Fig. 1. If the velocity of the center of mass is zero, find the velocity $\vec{v}$ of the 4.0 kg mass.

Fig#



A) $\left(5.0\hat{i} - 3.0\hat{j}\right)$ m/s

B) $\left(3.0\hat{i} - 4.0\hat{j}\right)$ m/s

C) $\left(5.0\hat{i}\right)$ m/s

D) $\left(-4.0\hat{i} + 5.0\hat{j}\right)$ m/s

E) $\left(4.0\hat{i} - 20\hat{j}\right)$ m/s

Q9.
A 4.0 kg object moving with velocity $\left(9.0\hat{i}\right)$ m/s explodes into two pieces, one with mass 1.0 kg and velocity $\left(6.0\hat{j}\right)$ m/s and the other with mass 3.0 kg and velocity $\vec{v}$. Determine $\vec{v}$.

A) $\left(12\hat{i} - 2.0\hat{j}\right)$ m/s

B) $\left(10\hat{i}\right)$ m/s

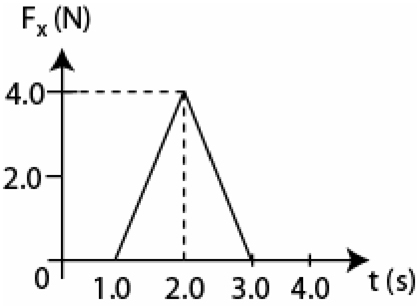
C) $\left(6.0\hat{i} + 2.0\hat{j}\right)$ m/s

D) $\left(5.0\hat{i}\right)$ m/s

E) $\left(10\hat{j}\right)$ m/s

Q10.
A 5 kg object moving along the x axis is subjected to a force F_x in the positive x direction. A graph of F_x as a function of time t is shown in Fig. 2. Find the magnitude of the change in the velocity of the object during the time the force is being applied.

Fig#



A) 0.8 m/s
B) 1.1 m/s
C) 1.6 m/s
D) 2.3 m/s
E) 4.0 m/s

Q11.
A block of mass m = 500 g moving on a frictionless track at an initial speed of 3.20 m/s undergoes an elastic collision with an initially stationary block of mass M. After collision, the first block moves opposite to its original direction at 0.500 m/s. The mass M is:

A) 685 g
B) 500 g
C) 450 g
D) 750 g
E) 823 g

Q12.
Two bodies , *A* and *B* each of mass 2.0 kg moving with velocities $\vec{v}_A = \left(2.0\hat{i} + 5.0\hat{j}\right)$ m/s and $\vec{v}_B = \left(1.0\hat{i} - 5.0\hat{j}\right)$ m/s collide and stick together after collision. After the collision, the velocity of the composite object is:

A) $\left(1.5\,\hat{i}\right)$ m/s
B) $\left(1.5\,\hat{i} + 10\,\hat{j}\right)$ m/s
C) $\left(3.0\,\hat{i} + 10\,\hat{j}\right)$ m/s
D) $\left(5.0\,\hat{j}\right)$ m/s
E) $\left(2.0\,\hat{j}\right)$ m/s

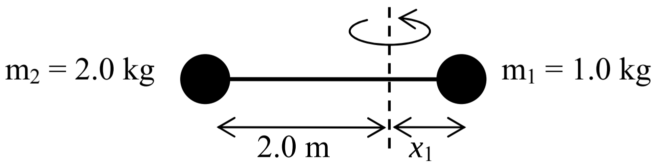
Q13.
Each wheel of a car has a radius of 0.30 m. If the car starts from rest and its wheels roll smoothly with a constant angular acceleration of 0.80 rad/s^2, what is the distance the car travels in 20 s?

A) 48 m

B) 96 m
C) 24 m
D) 2.4 m
E) 160 m

Q14.
A rigid body consists of two particles attached to a rod of negligible mass. The rotational inertia of the system about the axis shown in Fig. 3 is 10 kg m^2. What is x_1?

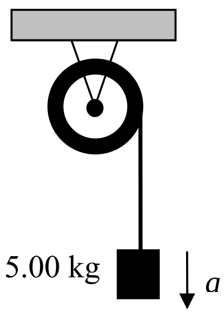
Fig#



A) 1.4 m
B) 1.0 m
C) 2.0 m
D) 2.4 m
E) 0 m.

Q15.
A 5.00 kg block hangs from a cord which is wrapped around the rim of a frictionless pulley as shown in Fig. 4. What is the acceleration, *a*, of the block as it moves down? (The rotational inertia of the pulley is 0.200 kg·m^2 and its radius is 0.100 m.)

Fig#

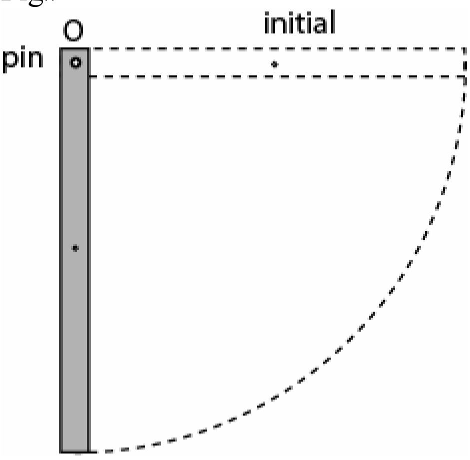


A) 1.96 m/s^2
B) 9.80 m/s^2
C) 2.17 m/s^2
D) 4.90 m/s^2

E) 0 m/s^2

Q16.
Fig. 5 shows a 1.0 m thin uniform rod of mass 2.0 kg, which is free to rotate about a frictionless pin passing through one end O. The rod is released from rest in the horizontal position. As the rod swings through its lowest position, its kinetic energy is:

Fig#



A) 9.8 J
B) 29 J
C) 1.0 J
D) 4.9 J
E) 0 J

Q17.
A uniform ball, of mass M = 80.0 kg and radius R = 0.250 m, rolls smoothly from rest down a 30° incline. The ball descends a vertical height h to reach the bottom of the incline with a speed of 9.80 m/s. Find the value of h.

A) 6.86 m
B) 2.05 m
C) 10.3 m
D) 5.10 m
E) 9.80 m

Q18.
A horizontal disk has a radius of 3.0 m and a rotational inertia of 600 kg·m^2 about its axis. It is initially spinning at 0.80 rad/s when a 20 kg child is at the center of the disk. The child then walks to the rim (edge) of the disk. When the child reaches the rim, the angular velocity of the disk is (Treat the child as a point mass):

A) 0.62 rad/s
B) 0.73 rad/s
C) 0.80 rad/s
D) 0.89 rad/s

E) 1.1 rad/s

Q19.

At an instant, a particle of mass 2.0 kg has a position of $\vec{r} = \left(9.0\hat{i} + 15.0\hat{j}\right)$ m and acceleration of $\vec{a} = \left(-3.0\hat{i}\right)$ m/s^2. What is the net torque on the particle at this instant about the point having the position vector: $\vec{r}_o = \left(9.0\hat{i}\right)$ m ?

A) $\left(90\hat{k}\right)$ N·m
B) $\left(24\hat{k}\right)$ N·m
C) $\left(-10\hat{k}\right)$ N·m
D) $\left(-30\hat{k}\right)$ N·m
E) 0

Q20.

A thin rod of mass M = 2.0 kg and length L = 1.0 m is rotating about an axis O located a 25 cm from one end. Find the angular momentum of the rod about O, if its angular velocity is 120 rev/min.

A) 3.7 kg·m^2/s
B) 77 kg·m^2/s
C) 1.5 kg·m^2/s
D) 20 kg·m^2/s
E) 110 kg·m^2/s
