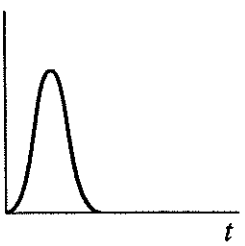
1. A 25 kg object is moving due north at 33 m/s. If an impulse of 330 N · s is applied at 45° N of W to this object, what is the final velocity of this object?

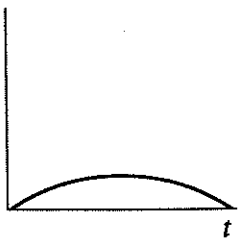
	SPEED	DIRECTION
A.	33 m/s	45° N of W
B.	33 m/s	78° N of W
C.	43 m/s	45° N of W
D.	43 m/s	78° N of W

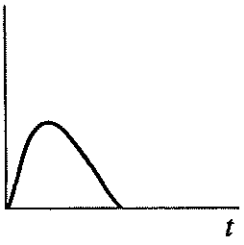
2. A small rubber ball moving at high speed strikes a stationary cart. As a result of the collision, the rubber ball rebounds and the cart rolls forward. Which object experienced the greater magnitude of impulse?

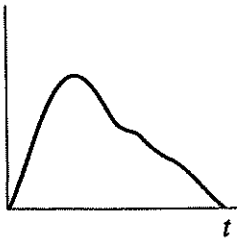
A. Cart
B. Rubber ball
C. Both experienced the same magnitude of impulse.
D. It depends on whether the collision was elastic or inelastic.

3. An object experiences a varying force as shown in the following *F*-*t* graphs. Which graph shows the largest change in momentum?

A. 

B. 

C. 

D. 

4. Identify momentum and kinetic energy as scalar or vector quantities.

	MOMENTUM	KINETIC ENERGY
A.	scalar	scalar
B.	scalar	vector
C.	vector	scalar
D.	vector	vector

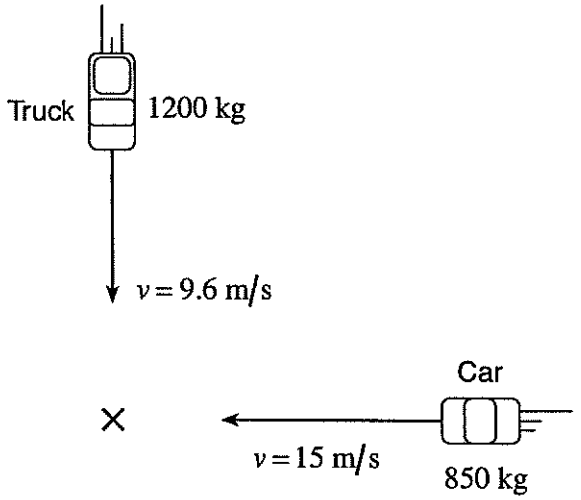
5. A 1.0 kg cart moves to the right at 6.0 m/s and strikes a stationary 2.0 kg cart. After the head-on collision, the 1.0 kg cart moves back to the left at 2.0 m/s and the 2.0 kg cart moves to the right at 4.0 m/s. In this collision

A. only momentum is conserved.
B. only kinetic energy is conserved.
C. both momentum and kinetic energy are conserved.
D. neither momentum nor kinetic energy is conserved.

6. A 12.0 kg shopping cart rolls due south at 1.50 m/s. After striking the bumper of a car, it travels at 0.80 m/s, 30° E of S. What is the magnitude of the change in momentum sustained by the shopping cart?

A. 8.4 kg·m/s
B. 9.7 kg·m/s
C. 11 kg·m/s
D. 27 kg·m/s

7. A 1200 kg truck travelling at 9.6 m/s due south runs into a 850 kg car travelling at 15 m/s due west. The two vehicles stick together after they collide.



With what speed does the combined mass move immediately after the collision?

A. 0.60 m/s
B. 2.7 m/s
C. 8.4 m/s
D. 12 m/s

8. A 10 kg rock is at rest when a boulder of unknown mass collides with it. After the collision the 10 kg rock travels at 3.0 m/s south. What is the boulder's change in momentum due to the collision?

A. 15 kg m/s south
B. 15 kg m/s north
C. 30 kg m/s south
D. 30 kg m/s north

9. A 1.5 kg physics block is sliding at 8.0 m/s north when it is hit by a 0.40 kg ball of putty going 20 m/s west. The putty sticks to the block. What is the magnitude of their combined momentum after the collision?

A. 4.0 kg m/s
B. 8.9 kg m/s
C. 14 kg m/s
D. 20 kg m/s

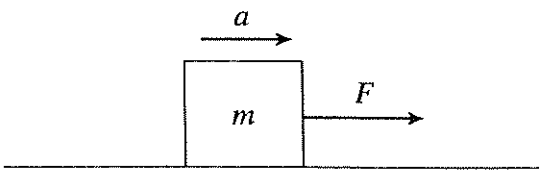
10. A 200 kg object moving at 15 m/s due east collides with a 100 kg block moving at 15 m/s due north. The objects stick together following the collision. What is the speed of the 200 kg object immediately after the collision?

A. 5.0 m/s
B. 11 m/s
C. 15 m/s
D. 21 m/s

11. Outside the International Space Station, a 60 kg astronaut holding a 4.0 kg object (both initially at rest) throws the object at 10 m/s relative to the space station. A 50 kg astronaut, initially at rest, catches the object. What is the speed of separation of the two astronauts?

A. 0.67 m/s
B. 0.80 m/s
C. 1.4 m/s
D. 1.5 m/s

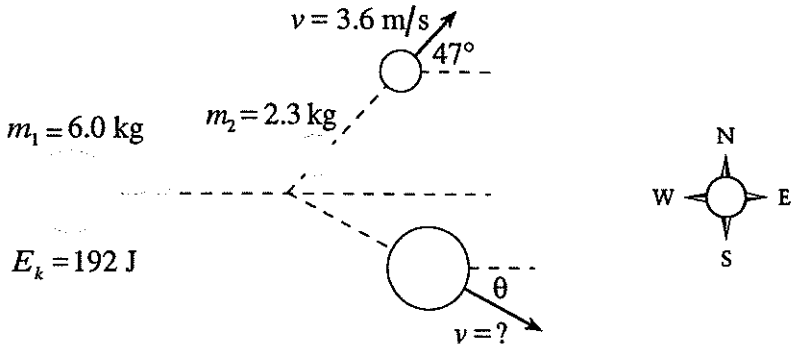
12. The force F shown below is pulling the mass m over a frictionless surface with an acceleration of a.



Which of the following is equal to the mass's rate of change of momentum?

A. F
B. $\frac{F}{a}$
C. $\frac{F}{m}$
D. $F \cdot a$

1. A 6.0 kg ball having a kinetic energy of 192 J was travelling due east when it underwent an oblique collision with a stationary 2.3 kg ball. The 2.3 kg ball travelled at 3.6 m/s at an angle of 47° north of east after the collision.



(Diagram not to scale.)

What was the velocity (magnitude and direction) of the 6.0 kg ball after the collision?

(7 marks)

2. A 4300 kg truck travelling at 21 m/s in the direction of 31° north of east collides with a stationary 1500 kg car. After the collision, the car has a speed of 15 m/s due east. What is the resulting speed of the truck? **(7 marks)**