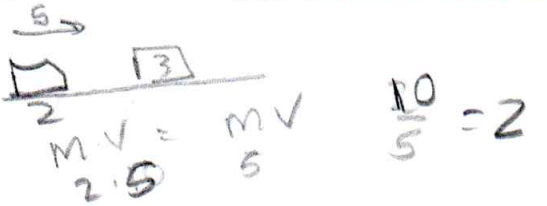
Name: _____ Class: _____ Date: _____ ID: A

Preliminary Quiz: Linear and rotational momentum

Multiple Choice
Identify the choice that best completes the statement or answers the question.

C 1. (#5-4) A 2 kg object traveling at 5 m/s on a frictionless horizontal surface collides head-on with and sticks to a 3 kg object initially at rest. Which of the following correctly identifies the change in total kinetic energy and the resulting speed of the objects after the collision?

	Kinetic Energy	speed
a.	Increases	2 m/s
b.	Increases	3.2 m/s
c.	decreases	2 m/s
d.	decreases	3.2 m/s

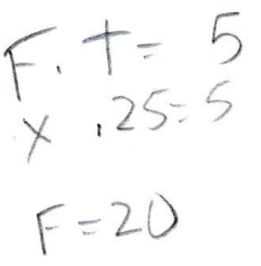


___ 2. (#5-4)A cart of mass m is moving with negligible friction along a track with known speed v1 to the right. It collides with and sticks to a cart of mass 4m moving with known speed v2 to the right. Which of the two principles, conservation of momentum and conservation of mechanical energy, must be applied to determine the final speed of the carts, and why?

a. Only conservation of momentum, because the momentum lost by one cart is gained by the other and there is only one unknown quantity.
b. Both conservation of mechanical energy and conservation of momentum, because both principles apply in any collision.
c. Both conservation of mechanical energy and conservation of momentum, because neither cart changes direction.
d. Either conservation of momentum or conservation of mechanical energy, because only one equation is required to solve for the one unknown variable.

___ 3. (#5-1)A person applies an impulse of 5.0 kg·m/s to a box in order to set it in motion. If the person is in contact with the box for 0.25 s, what is the average force exerted by the person on the box?

a. 1.25N
b. 2.0N
c. 12.5N
d. 20.0N



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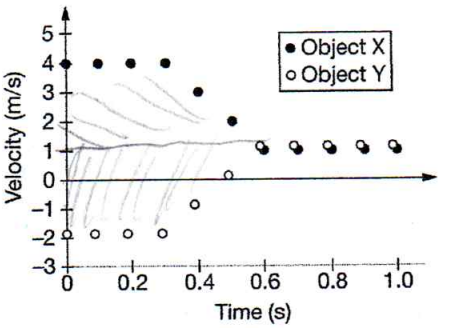


(#5-4)Object X travels across a horizontal surface and collides with object Y. The velocity as a function of time for object X and object Y before, during, and after the collision is shown in the graph. Both objects have a mass of 2kg. Which of the following correctly describes the momentum p? of the system and the kinetic energy K of the system?

a.

$\vec{p}$	K
Conserved	Conserved

b.

$\vec{p}$	K
Conserved	Not conserved

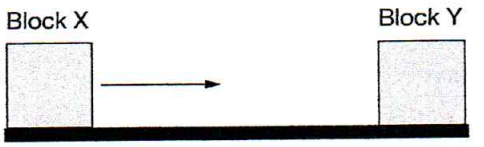
c.

$\vec{p}$	K
Not conserved	Conserved

d.

$\vec{p}$	K
Not conserved	Not conserved

5.



(#5-4)A student plans to conduct an experiment in which the momentum of a two-object system can be determined immediately before and after a collision takes place. The student slides block X at an unknown constant speed toward an identical block, block Y, that is initially at rest, as shown in the figure. There is negligible friction between the blocks and the surface.

Trial Number	Momentum of Block X Before Collision $\left(\frac{\text{kg·m}}{\text{s}}\right)$	Momentum of Block Y Before Collision $\left(\frac{\text{kg·m}}{\text{s}}\right)$	Momentum of Block X After Collision $\left(\frac{\text{kg·m}}{\text{s}}\right)$	Momentum of Block Y After Collision $\left(\frac{\text{kg·m}}{\text{s}}\right)$
1	6.1	0.0	0.1	5.2
2	5.9	0.1	−0.1	5.3
3	6.0	0.1	0.0	5.2

The student uses the data collected from the experiment to create the data table. Which of the following statements is true regarding the data?

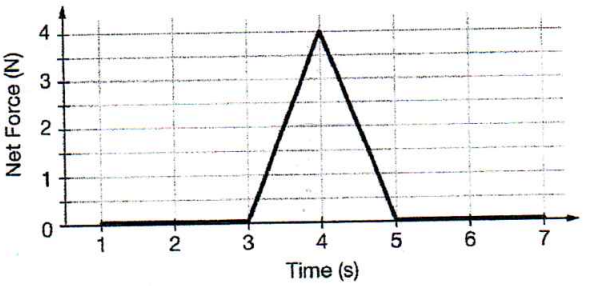
a. The student uses the data collected from the experiment to create the data table. Which of the following statements is true regarding the data?

b. The momentum of the two-block system is conserved because the final momentum of block Y is experimentally consistent for all trials.

c. The momentum of the two-block system is not conserved because the initial momentum of the system is not equal to the final momentum of the system.

d. The level of error associated with the data is too high to make a conclusion regarding the momentum of the individual blocks and the system.

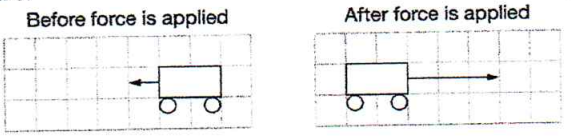
___ 6.



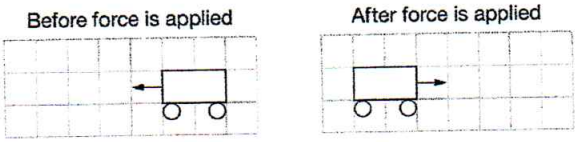
(#5-4)A cart of mass 1kg travels along a horizontal, frictionless surface. A net force is applied to the cart. A graph of the net force applied to the cart as a function of time is shown. The initial and final direction of the cart and the direction of the net force exerted on the cart is unknown. The distance of one grid unit represents a change in velocity of 1m/s. Which of the following diagrams could represent the direction and relative magnitude of the velocity of the cart before the force is applied and after the force is applied? Select two answers.

$F_{ave} \cdot t = \Delta p$
$= m\Delta v$
$2 \cdot 8\,Nm = 1\,\Delta v$
$\Delta v = 4\,m/s$

a.



b.



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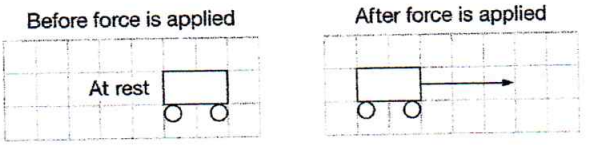
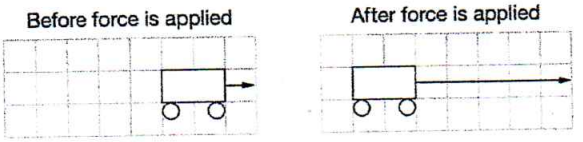


d.



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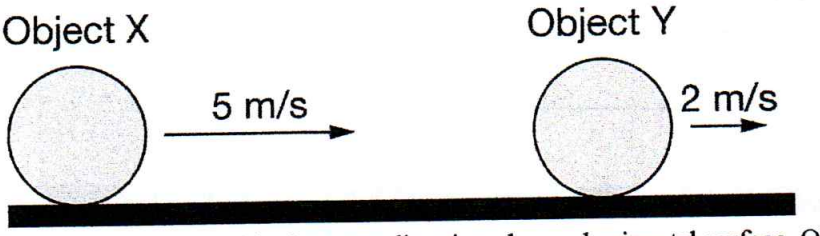


(#5-4)Two objects of the same mass travel in the same direction along a horizontal surface. Object X has a speed of 5m/s and object Y has a speed of 2m/s, as shown in the figure. After a period of time, object X collides with object Y.

Consider the situation in which the objects collide and stick together. Which of the following predictions is true about the center of mass of the two-object system immediately after the collision?

a. The center of mass does not move.
b. The velocity of the center of mass does not change.
c. The velocity of the center of mass decreases in speed.
d. The velocity of the center of mass increases in speed.

8.

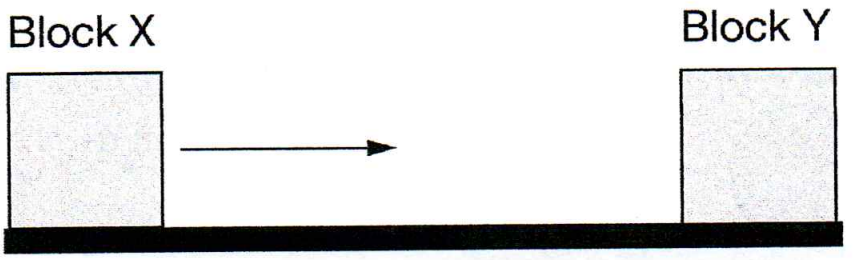
Cart 1 Mass (kg)	Cart 2 Mass (kg)	Velocity of Cart 1 Immediately Before Collision (m/s)	Velocity of Cart 2 Immediately Before Collision (m/s)	Velocity of Cart 1 Immediately After Collision(m/s)	Velocity of Cart 2 Immediately After Collision(m/s)
1	2	4	0	1	1

(#5-4) A group of students conducts an experiment in which two carts collide with each other as they travel across a horizontal surface with negligible friction. Using motion detectors and a mass balance, the students collect data about the carts immediately before and immediately after the collision, as shown in the table. Which of the following claims is true regarding the momentum and the kinetic energy of the two-cart system for the experiment? Does the data indicate that a net external force acts on the system?

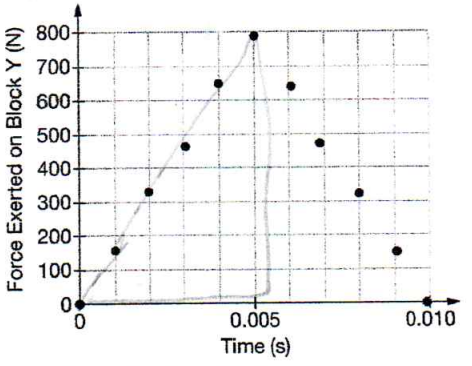
a. The momentum is the same and the total kinetic energy of the system is the same immediately before the collision and immediately after the collision. This indicates that a net external force is not exerted on the system.
b. The momentum is different and the total kinetic energy of the system is the same immediately before the collision and immediately after the collision. This indicates that a net external force is exerted on the system.
c. The momentum is the same and the total kinetic energy of the system is different immediately before the collision and immediately after the collision. This indicates that a net external force is not exerted on the system.
d. The momentum is different and the total kinetic energy of the system is different immediately before the collision and immediately after the collision. This indicates that a net external force is exerted on the system.

$1 \cdot 4 = 4$ | $1 \cdot 1 = 1$ $1 \cdot 2 = 2$ | $KE = 1 \cdot 1^2 = 1$ $2 \cdot 1^2 = 2$

$KE = \frac{1}{2} 1 \cdot 4^2 = 8$



___ 9. A student plans to conduct an experiment in which the momentum of a two-object system can be determined immediately before and after a collision takes place. The student slides block X at an unknown constant speed toward an identical block, block Y, that is initially at rest, as shown in the figure. There is negligible friction between the blocks and the surface.



$\frac{1}{2}(.005)(.860) = 2\,N{\cdot}S \times 2$

$F \cdot t = 4\,N{\cdot}S$

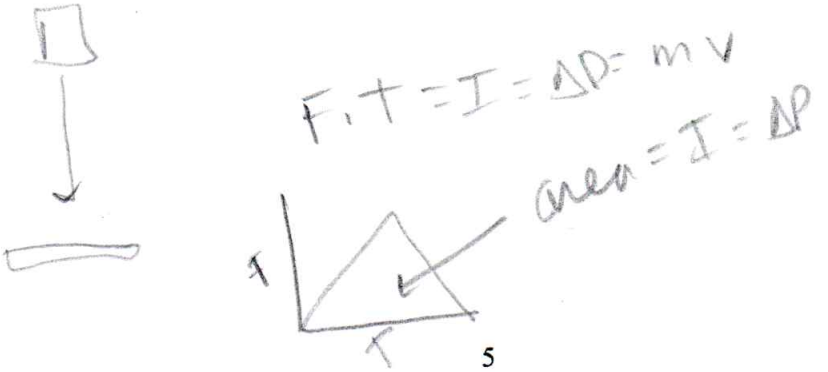
$F \cdot .02 = ?$ $\quad F = 200N$

(#5-1) The student conducts a second experiment in which the magnitude of the force exerted on block X from block Y is measured over the time in which the collision takes place. A graph of the force as a function of time is shown. In a third experiment, the student creates a collision such that the force exerted on block X from block Y is constant for 0.020s. Which of the following constant forces, if exerted on block X from block Y, would produce the same change in momentum as is shown by the graph?

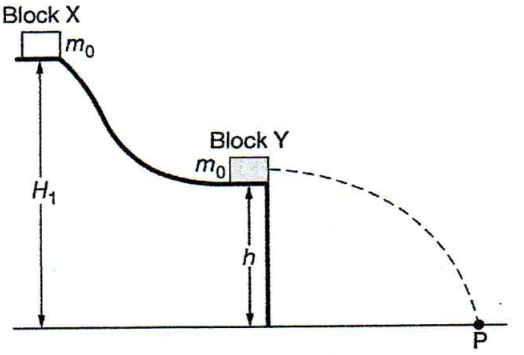
a. 100N
b. 200N
c. 400N
d. 800N

___ 10. (#5-1)A student drops an object from rest above a force plate that records information about the force exerted on the object as a function of time during the time interval in which the object is in contact with the force plate. Which of the following measurements should the student take, in addition to the measurements from the force plate, to determine the change in momentum of the object from immediately before the collision to immediately after the collision?

a. The mass of the object
b. The final speed of the object
c. The distance fallen by the object
d. The student has enough information to make the determination.



___ 11.



(#5-3)Block X of mass m0 is at rest at the top of a ramp, and the block's center of mass is at a height H1 above the ground. Block X is then released from rest, and it slides down the ramp and collides with block Y of mass m0, which is initially at rest and has its center of mass at a height h above the ground. At the moment before the collision, block X has a speed of v0. After the collision, block Y travels such that it lands at point P.

Consider the block X-block Y system from the moment in time that block X is released from rest to the moment immediately after block X collides with block Y. Which of the following claims best describes the system?

a. Because the total momentum of the system does not remain constant, the system is open.
b. Because the total kinetic energy of the system does not remain constant, the system is open.
c. Because the total momentum of the system remains constant, the system is closed.
d. Because the total kinetic energy of the system remains constant, the system is closed.

- open system

- Closed system

Energy increases, but you need to include more then KE

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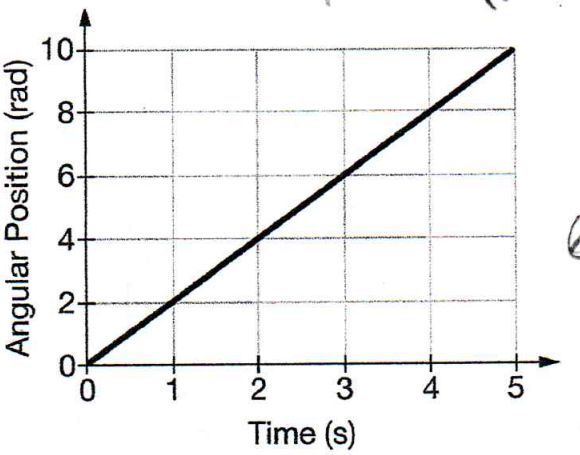
____ 12.



(#7-1) A disk of radius 50cm rotates about a center axle. The angular position as a function of time for a point on the edge of the disk is shown. Which two of the following quantities of the point on the edge of the disk can be correctly mathematically determined from the graph using the methods described? Justify your selections

A) The angular velocity, because this quantity can be determined by calculating the slope of the graph.

B) Translational speed, because $v = r\omega$.

C) The angular acceleration, because this quantity can be determined by calculating the area bound by the curve and the horizontal axis from 0s to 5s.

D) The translation acceleration, because

a. A and B
b. B and C
c. C and D
d. A and D

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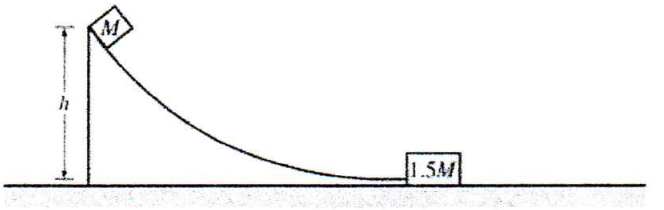
hort Answer

13.



A small block of mass M is released from rest at the top of the curved frictionless ramp shown above. The block slides down the ramp and is moving with a speed 3.5v0 when it collides with a larger block of mass 1.5M at rest at the bottom of the incline. The larger block moves to the right at a speed 2v0 immediately after the collision. Express your answers to the following questions in terms of the given quantities and fundamental constants.

(a) Determine the height h of the ramp from which the small block was released.

(b) Determine the speed of the small block after the collision.

(c) The larger block slides a distance D before coming to rest. Determine the value of the coefficient of kinetic friction μ between the larger block and the surface on which it slides.

(d) Indicate whether the collision between the two blocks is elastic or inelastic. Justify your answer.

a) $PE = KE$

$mgh = \frac{1}{2}m(3.5v)^2$

$h = \frac{12.25v^2}{2g} = \boxed{6.125v^2/g}$

b) $P_1 = P_2$

$m_1 3.5v = m_1 v_2 + 1.5M\,2v$

↑ solve

$3.5v = v_2 + 3v$

$.5v_0 = v_{New}$

c) $KE = TE$

$\frac{1.5M(2v^2)}{2} = mgud$

$3v^2 = gud$

$\boxed{u = \frac{3v^2}{gd}}$

$KE_{Before} - KE_{After}$

$\frac{1}{2}M\,3.5v^2 - Before$

$after$

$\frac{1}{2}M(.5v)^2 + 1.5M\,4v^2$

Not equal