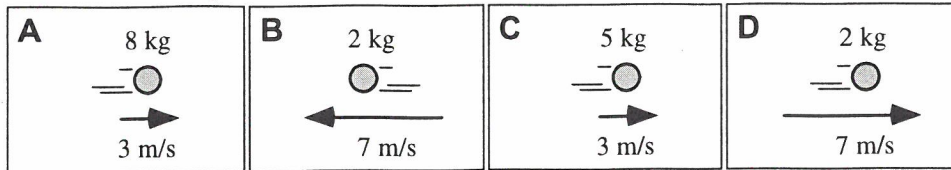


B5-RT01: MOVING BALL I—MOMENTUM AND KINETIC ENERGY

#1 In the figures below, balls are traveling in different directions. The balls have the same size and shape, but they have different masses and are traveling at different velocities as shown.



(a) Rank the magnitude of the momentum of the balls.

<input style="width: 100%; height: 20px;" type="text"/> 1 Greatest	<input style="width: 100%; height: 20px;" type="text"/> 2	<input style="width: 100%; height: 20px;" type="text"/> 3	<input style="width: 100%; height: 20px;" type="text"/> 4 Least	OR	<input style="width: 20px; height: 20px;" type="checkbox"/> All the same	<input style="width: 20px; height: 20px;" type="checkbox"/> All zero	<input style="width: 20px; height: 20px;" type="checkbox"/> Cannot determine
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Explain your reasoning.

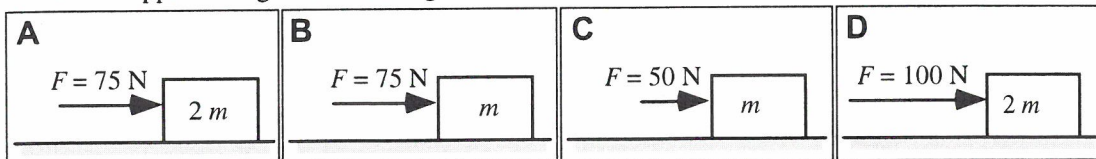
(b) Rank the kinetic energy of the balls.

<input style="width: 100%; height: 20px;" type="text"/> 1 Greatest	<input style="width: 100%; height: 20px;" type="text"/> 2	<input style="width: 100%; height: 20px;" type="text"/> 3	<input style="width: 100%; height: 20px;" type="text"/> 4 Least	OR	<input style="width: 20px; height: 20px;" type="checkbox"/> All the same	<input style="width: 20px; height: 20px;" type="checkbox"/> All zero	<input style="width: 20px; height: 20px;" type="checkbox"/> Cannot determine
--	--	--	---	----	--	--	--

Explain your reasoning.

#2 **B5-RT03: FORCE PUSHING BOX II—IMPULSE**

Identical boxes that are filled with different amounts of sand are initially at rest. A horizontal force is applied, and the boxes move across the floor. The mass of the box with its contents and the net force acting on the box while the horizontal force is applied are given in each figure.



Rank the magnitude of the impulse on each box for a 2-second time interval.

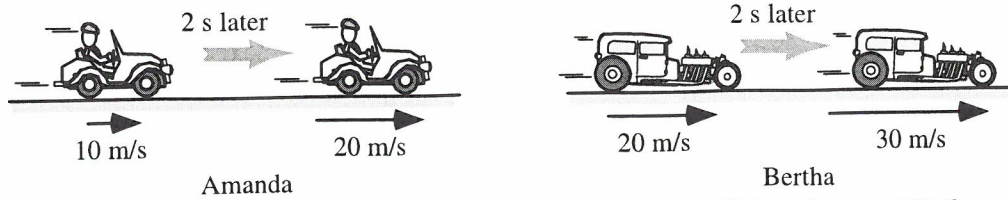
<input style="width: 100%; height: 20px;" type="text"/> 1 Greatest	<input style="width: 100%; height: 20px;" type="text"/> 2	<input style="width: 100%; height: 20px;" type="text"/> 3	<input style="width: 100%; height: 20px;" type="text"/> 4 Least	OR	<input style="width: 20px; height: 20px;" type="checkbox"/> All the same	<input style="width: 20px; height: 20px;" type="checkbox"/> All zero	<input style="width: 20px; height: 20px;" type="checkbox"/> Cannot determine
--	--	--	---	----	--	--	--

Explain your reasoning.

#3

B5-QRT05: AMANDA AND BERTHA'S CAR RACE—WORK AND IMPULSE

Amanda and Bertha are driving cars in a race. Their two cars, including Amanda and Bertha, have the same mass. At one point in the race, they both change their speeds by 10 m/s in 2 seconds. Ignore air friction.



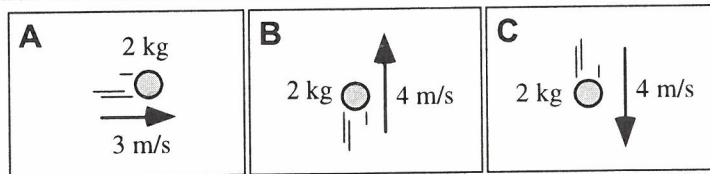
(a) Is the work done on Amanda's car while speeding up (i) *greater than*, (ii) *less than*, or (iii) *the same as* the work done on Bertha's car while speeding up? _____
 Explain your reasoning.

(b) Is the impulse on Amanda's car while speeding up (i) *greater than*, (ii) *less than*, or (iii) *the same as* the work done on Bertha's car does while speeding up? _____
 Explain your reasoning.

#4

B5-RT06: MOVING BALL II—MOMENTUM AND KINETIC ENERGY

In the figures below, balls are traveling in different directions. The balls have the same size, mass and shape, but they are traveling with different velocities as shown.



(a) Rank the magnitude of the momentum of the balls.

<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3		All	All	Cannot
Greatest		Least		the same	zero	determine

Explain your reasoning.

(b) Rank the kinetic energy of the balls.

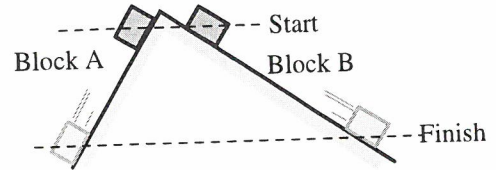
<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3		All	All	Cannot
Greatest		Least		the same	zero	determine

Explain your reasoning.

#5

B5-QRT07: BLOCKS SLIDING DOWN FRICTIONLESS RAMPS—WORK AND MOMENTUM

Two blocks are released from rest at the same height. Block A slides down a steeper ramp than Block B. Both ramps are frictionless. The blocks reach the same final height indicated by the lower dashed line. Block B weighs more than Block A.



(a) Is the work done by the gravitational force on Block A (i) *greater than*, (ii) *less than*, or (iii) *the same as* the work done by the gravitational force on Block B? _____
 Explain your reasoning.

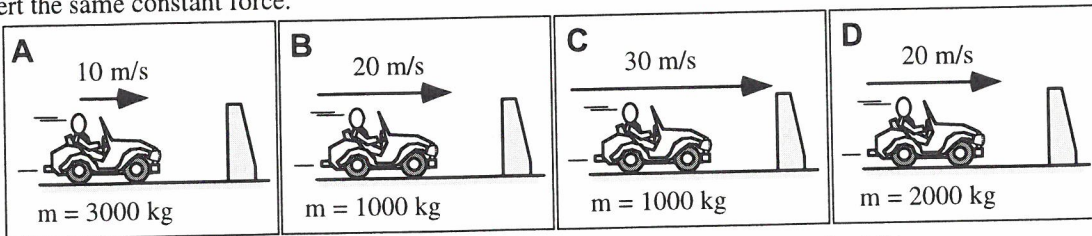
(b) Is the speed of Block A (i) *greater than*, (ii) *less than*, or (iii) *the same as* the speed of Block B? _____
 Explain your reasoning.

(c) Is the momentum of Block A (i) *greater than*, (ii) *less than*, or (iii) *the same as* the momentum of Block B? _____
 Explain your reasoning.

#6

B5-RT08: CARS STOPPED BY CONSTANT FORCE BARRIERS—STOPPING TIME

Cars moving along horizontal roads are about to be stopped when they hit a protective barrier. All of the cars are the same size and shape, but they are moving at different speeds and have different masses. The barriers are all identical and exert the same constant force.



Rank the time that it takes to stop the cars as the barriers apply the same constant force.

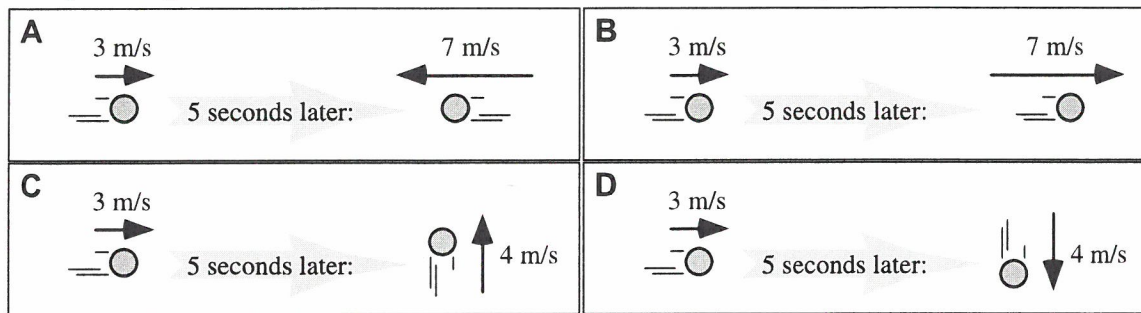
1	2	3	4	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest			Least		All the same	All zero	Cannot determine

Explain your reasoning.

#7

B5-QRT09: OBJECT CHANGING VELOCITY—DIRECTION OF THE IMPULSE

An object changes its velocity as forces act on it for 5 seconds in various ways shown below.

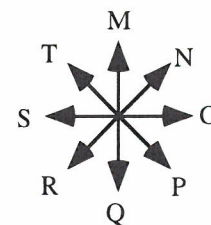


For the question below, use the directions indicated by the arrows in the direction rosette, or use **J** for no direction, **K** for into the page, or **L** for out of the page.

(a) Identify the closest directional match for the direction of the impulse on the ball for these cases.

Explain your reasoning.

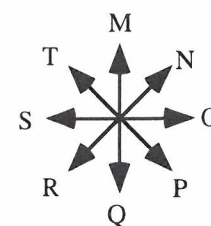
A	B
C	D



(b) Identify the closest directional match for the direction of the change in the momentum for the ball for these cases.

Explain your reasoning.

A	B
C	D

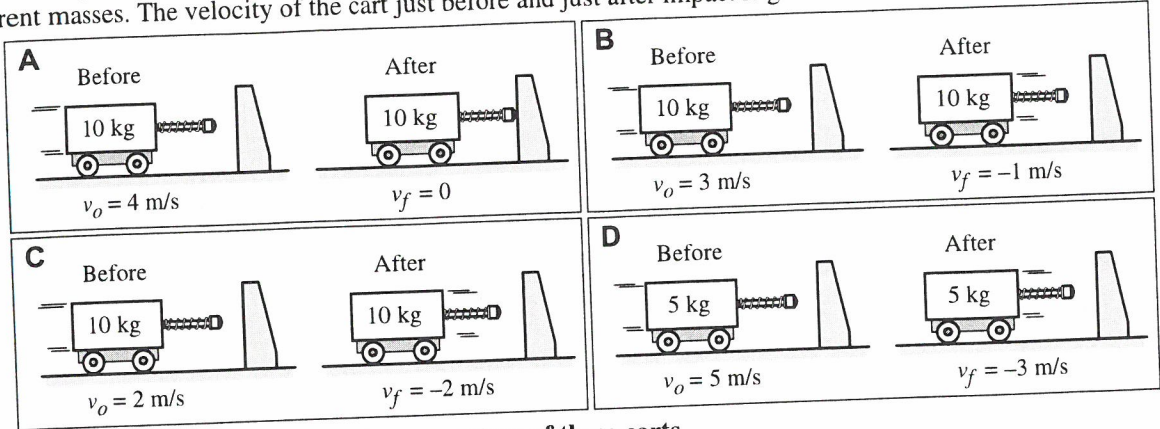


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#8

B5-RT10: BOUNCING CART I—CHANGE IN MOMENTUM

Carts with spring plungers run into fixed barriers. The carts are identical but are carrying different loads and so have different masses. The velocity of the cart just before and just after impact is given.



Rank the magnitude of the change in momentum of these carts.

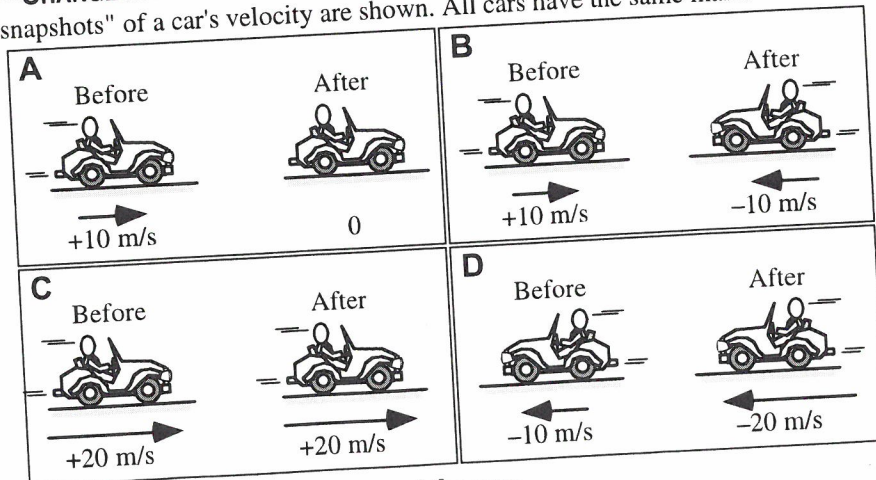
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4		All the same	All zero	Cannot determine
Greatest			Least				

Explain your reasoning.

#9

B5-RT13: CARS—CHANGE IN MOMENTUM DURING A CHANGE OF VELOCITY

Before and after "snapshots" of a car's velocity are shown. All cars have the same mass.



Rank the magnitude of the change in momentum of the cars.

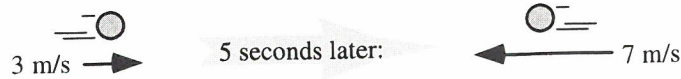
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4		All the same	All zero	Cannot determine
Greatest			Least				

Explain your reasoning.

#10

B5-WWT16: OBJECT CHANGING VELOCITY III—IMPULSE

A 2-kg object accelerates as a net external force is applied to it. During the 5-second interval that the force is applied, the object's velocity changes from 3 m/s to the right to 7 m/s to the left.



A student states:

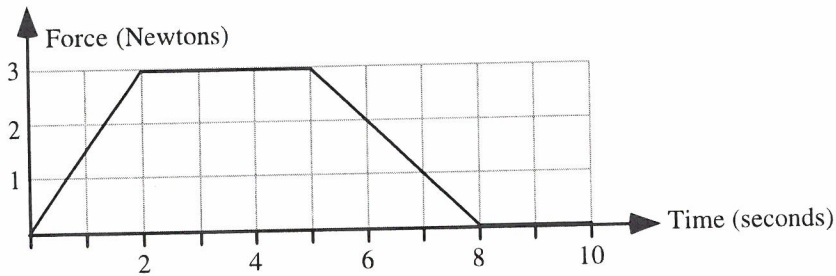
"The change in velocity for this 2 kg object was 4 m/s, so the change in momentum, and also the impulse, was 8 kg·m/s."

What, if anything, is wrong with this statement? If something is wrong, identify it and explain how to correct it. If this statement is correct, explain why.

#11

B5-RT18: FORCE-TIME GRAPH I—IMPULSE APPLIED TO BOX

A 10-kg box, initially at rest, moves along a frictionless horizontal surface. A horizontal force to the right is applied to the box. The magnitude of the force changes as a function of time as shown.



Rank the impulse applied to the box by this force during each 2-second interval indicated below.

A. 0 to 2 s	B. 2 to 4 s	C. 4 to 6 s	D. 6 to 8 s	E. 8 to 10 s	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR <input type="checkbox"/>
1	2	3	4	5	All
Greatest				Least	the same
					<input type="checkbox"/>
					All
					zero
					<input type="checkbox"/>
					Cannot
					determine

Explain your reasoning.