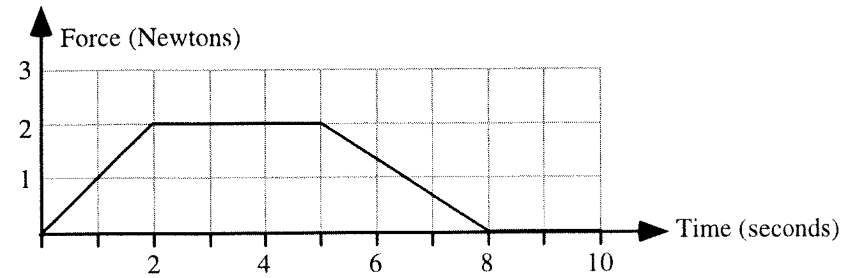
AP Physics - Unit 5
Tipper #2 - Unit 5

#1

B5-WWT19: FORCE-TIME GRAPH II—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.



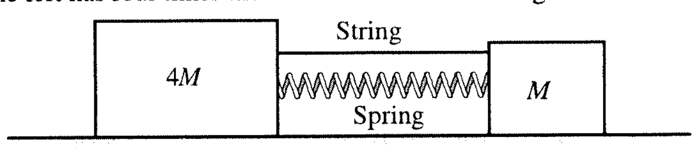
A student calculates that the impulse applied by the force during the first 2 seconds is 4 N·s and that the impulse applied during the following 3 seconds is 6 N·s.

What, if anything, is wrong with these calculations? If something is wrong, identify it and explain how to correct it. If these calculations are correct, explain why.

#2

B5-CT21: TWO BOXES ON A FRICTIONLESS SURFACE—MOMENTUM AND SPEED

Two boxes are tied together by a string and are sitting at rest on a frictionless surface. Between the two boxes is a massless compressed spring. The string tying the two boxes together is cut and the spring expands, pushing the boxes apart. The box on the left has four times the mass of the box on the right.



(a) After the string is cut and the boxes lose contact with the spring, will the magnitude of the momentum of the box on the left be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the magnitude of the momentum of the box on the right? _____
Explain your reasoning.

(b) At the instant (after the string is cut) that the boxes lose contact with the spring, will the speed of the box on the left be (i) *greater than*, (ii) *less than*, or (iii) *equal to* the speed of the box on the right? _____
Explain your reasoning.

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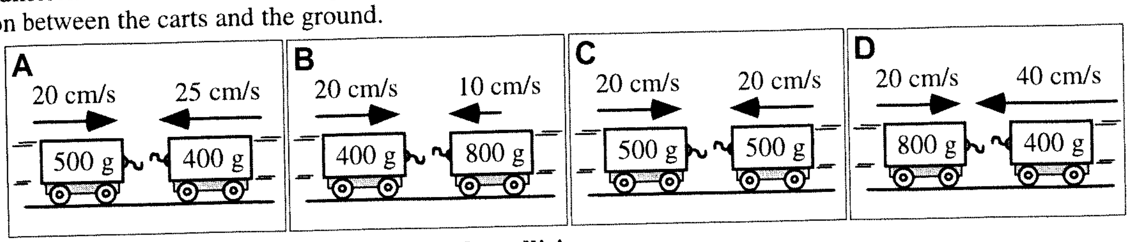
#3

B5-RT23: Colliding Carts Sticking Together—Final Speed

Two carts traveling in opposite directions are about to collide. The carts are all identical in size and shape, but they carry different loads and are traveling at different speeds. The carts stick together after the collision. There is no friction between the carts and the ground.



Rank the speed of the two-cart systems after the collision.

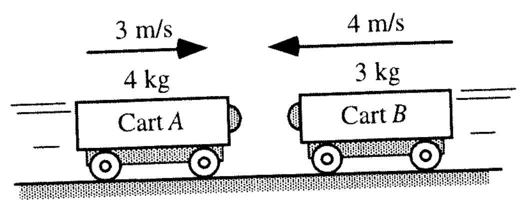
				OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

#4

B5-SCT24: Two Moving Carts—Result of Collision

Carts A and B are shown just before they collide. Four students discussing this situation make the following contentions:



Alma: *"After the collision, the carts will stick together and move off to the left. Cart B has more speed, and its speed is going to determine which cart dominates in the collision."*

Baxter: *"I think they'll stick together and move off to the right because Cart A is heavier. It's like when a heavy truck hits a car: The truck is going to win no matter which one's going fastest, just because it's heavier."*

Callie: *"I think the speed and the mass compensate, and the carts are going to be at rest after the collision."*

Dante: *"The carts must have the same momentum after the collision as before the collision, and the only way this is going to happen is if they keep the same speeds. All the collision does is change their directions, so that Cart A will be moving to the left at 3 m/s and Cart B will be moving to the right at 4 m/s."*

With which, if any, of these students do you agree?

Alma _____ Baxter _____ Callie _____ Dante _____ None of them_____

Explain your reasoning.

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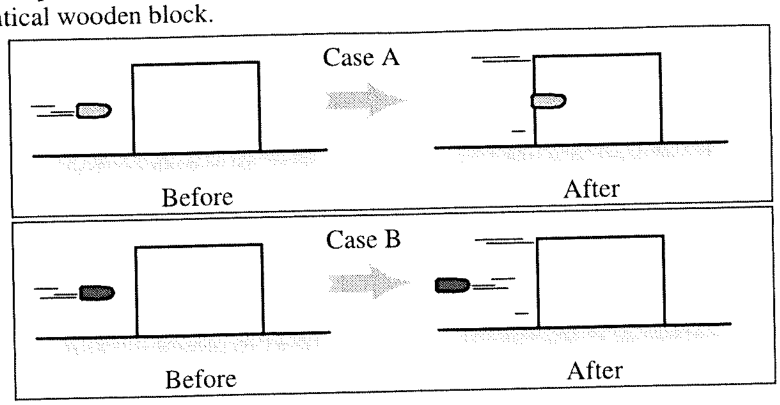
#5

B5-CT25: BULLET STRIKES A WOODEN BLOCK—BLOCK AND BULLET SPEED AFTER IMPACT

In Case A, a metal bullet penetrates a wooden block. In Case B, a rubber bullet with the same initial speed and mass bounces off of an identical wooden block.



(a) Will the speed of the wooden block after the collision be (i) *greater* in Case A, (ii) *greater* in Case B, or (iii) *the same* in both cases? _____

Explain your reasoning.

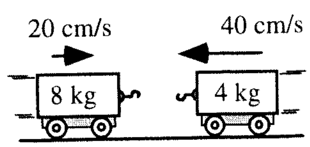
(b) In Case B, will the speed of the bullet after the collision be (i) *greater than*, (ii) *less than*, or (iii) *the same as* the speed of the bullet just before the collision? _____

Explain your reasoning.

#6

B5-SCT26: COLLIDING CARTS THAT STICK TOGETHER—FINAL KINETIC ENERGY

Two identical carts traveling in opposite directions are shown just before they collide. The carts carry different loads and are initially traveling at different speeds. The carts stick together after the collision.



Three physics students discussing this situation make the following contentions:

Alex: *"These carts will both be at rest after the collision since the initial momentum of the system is zero, and the final momentum has to be zero also."*

Belinda: *"If that were true it would mean that they would have zero kinetic energy after the collision, and that would violate conservation of energy. Since the right-hand cart has more kinetic energy, the combined carts will be moving slowly to the left after the collision."*

Chano: *"I think that after the collision the pair of carts will be traveling left at 20 cm/s. That way conservation of momentum and conservation of energy are both satisfied."*

With which, if any, of these students do you agree?

Alex _____ Belinda _____ Chano _____ None of them_____

Explain your reasoning.

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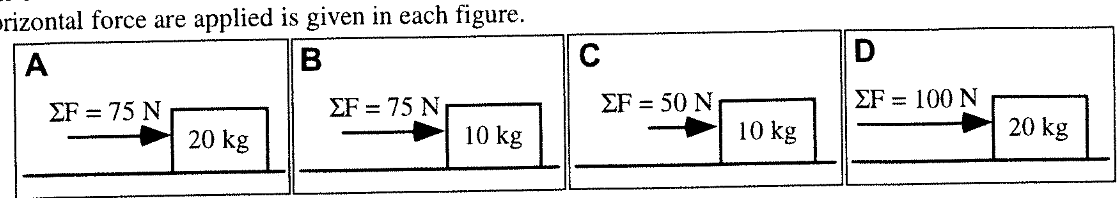
#7

B5-RT02: Force Pushing Box I—Change in Momentum

Identical boxes that are filled with different objects are initially at rest. A horizontal force is applied for 10 seconds, 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 are applied is given in each figure.



Rank the magnitude of the change in momentum during a 10-second interval for each box.

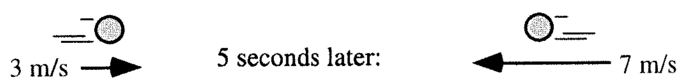
				OR	☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

#8

B5-SCT14: Object Changing Velocity I—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.



Several students discussing the impulse on this object state the following:

Andre: *"The impulse is equal to the change in momentum, which is (2 kg)(3 m/s + 7 m/s) = 20 kg·m/s."*

Bela: *"But the change in velocity is 4 m/s. We multiply by the mass to get the change in momentum, and also the impulse, which is 8 kg·m/s."*

Carleton: *"The change in momentum of this object during these 5 seconds was 8 kg·m/s so the impulse applied to this object during these 5 seconds was 8/5 kg·m/s."*

Dylan: *"The impulse is the force F times the time t, and since we don't know the force, we can't find the impulse for this situation."*

With which, if any, of these students do you agree?

Andre _____ Bela _____ Carleton _____ Dylan _____ None of them_____

Explain your reasoning.

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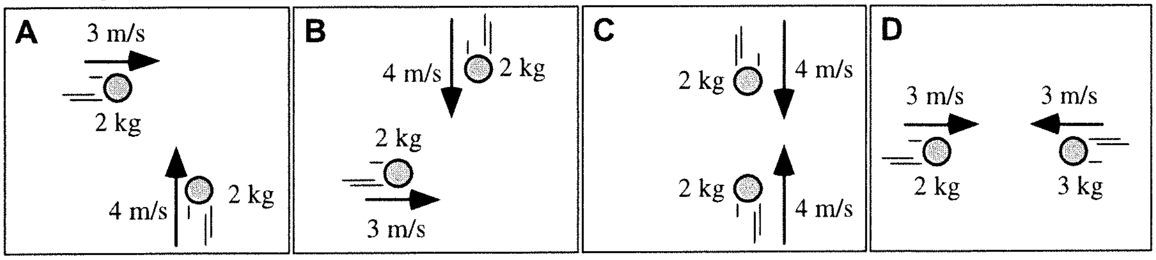
#9

B5-QRT29: COLLIDING BALL SYSTEMS—MOMENTUM DIRECTION BEFORE AND AFTER COLLIDING

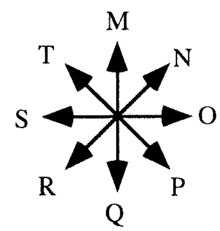
In the figures below, two balls traveling in different directions are about to collide. The balls have the same size and shape, but they have different masses and are traveling at different velocities as shown.



For the questions 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 momentum of the two-ball systems before they collide.

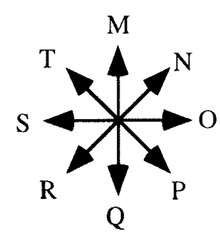
A	B
C	D



Explain your reasoning.

(b) Identify the closest directional match for the direction of the momentum of the two-ball systems after they collide if the balls stick together.

A	B
C	D



Explain your reasoning.

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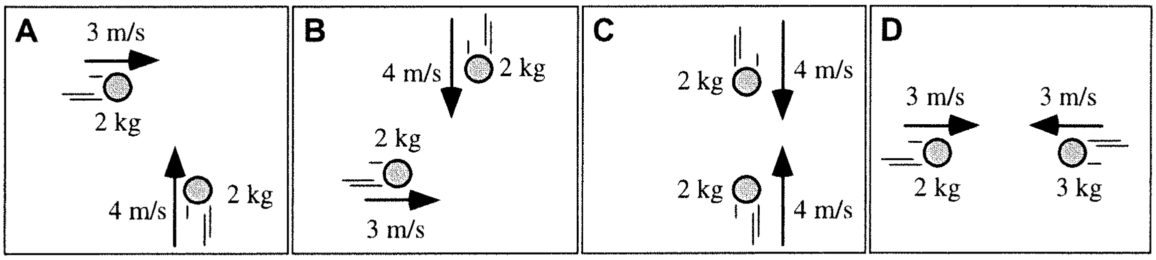
#10

B5-RT28: COLLIDING BALL SYSTEMS—MOMENTUM BEFORE AND AFTER COLLIDING

In the figures below, two balls traveling in different directions are about to collide. The balls are identical in 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 two-ball systems before they collide.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answr: A = B > D > C.

Since we add these vectorially giving 10 (kg)(m)/s at an angle for A and B, C is zero, and D is 3 (kg)(m)/s.

(b) Rank the magnitude of the momentum of the two-ball systems after they collide if the balls stick together.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answr: A = B > D > C.

Same as (a) since momentum of the system is conserved.

(c) Rank the magnitude of the momentum of the two-ball systems after they collide elastically (energy conserved).

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Answr: A = B > D > C.

Same as (a) since momentum of the system is conserved