Ch2 HW2 (1395034)

Current Score: 0/38 **Due:** Wed Sep 8 2010 09:00 AM EDT

Question	1	2	3	4	5	6	7	8	9	10	11	Total
Points	0/2	0/3	0/1	0/1	0/4	0/3	0/3	0/3	0/3	0/6	0/9	0/38

Description

Updating position with changing momentum; Momentum change with changing force; Iterative prediction of motion

Instructions

Reading: Sec 2.3 (pages 57-60), Sec 2.4, Sec. 2.5

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1. 0/2 points MI3 2.3.X.010. [1250490]

You're driving on a straight road (in the +*x* direction) at a constant speed of 33 m/s. In 11 seconds, you speed up to 48 m/s to pass a truck.

(a) Assuming your car speeds up at a constant rate (constant force by the road on the tires), what is your average *x* component of velocity $v_{avg,x}$ during this maneuver?

$v_{avg,x}$ = [ ] 40.5 m/s

(b) How far do you go during this maneuver?

total distance = [ ] 446 m

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2. 0/3 points MI3 2.3.X.009. [1250478]

On a straight road (taken to be in the +*x* direction) you drive for an hour at 40 km per hour, then quickly speed up to 100 km per hour and drive for an additional two hours.

(a) How far do you go (Δx)?

total distance = [ ] 240 km

(b) What is your average *x* component of velocity ($v_{avg,x}$)

$v_{avg,x}$ = [ ] 80 km/hr

(c) Why isn't $v_{avg,x}$ equal to the arithmetic average of your initial and final values of v_x, (40+100)/2 = 70 km per hour?

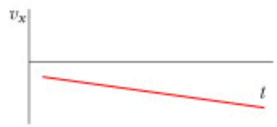
- The initial velocity isn't zero.
- The arithmetic mean is not a valid way to calculate the average in this situation.
- The velocity isn't constant.

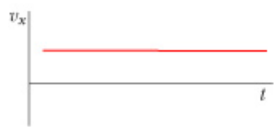
3. 0/1 points MI3 2.3.X.045. [1250512]

For each graph of v_x vs. t in the left column, choose the letter (a-i) corresponding to the appropriate description of motion. Not all descriptions will be used. Assume the usual coordinate system (+x to the right, +y up, +z out of the page).

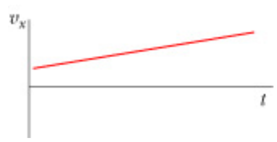
– f


– h


– b


– i


– g


– e


a. A cart remains stationary and does not move.

b. A cart moves to the left, gradually speeding up.

c. A cart moves to the right, gradually slowing down.

d. A cart moves to the left, gradually slowing down.

e. A cart moves to the right, gradually speeding up.

f. A cart moves to the right, gradually slowing down, stops, and moves to the left, speeding up.

g. A cart moves to the left at constant speed.

h. A cart moves to the left, gradually slowing down, stops, and moves to the right, speeding up.

i. A cart moves to the right at constant speed.

4. 0/1 points MI3 2.4.X.011. [1250499]

The x component of the momentum of an object is observed to increase with time:
At $t = 0$ s, = 30 kg · m/s
At $t = 1$ s, = 40 kg · m/s
At $t = 2$ s, = 50 kg · m/s
At $t = 3$ s, = 60 kg · m/s
What can you conclude about the x component of the net force acting on the object during this time?

- $F_{net,x}$ is decreasing with time.
- $F_{net,x}$ is zero.
- $F_{net,x}$ is constant.
- Not enough information is given.
- $F_{net,x}$ is increasing with time.

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5. 0/4 points MI3 2.6.X.050. [1250493]

(a) A runner starts from rest and in 2 s reaches a speed of 6 m/s. If we assume that the speed changed at a constant rate (constant net force), what was the average speed during this 2 s interval?
average speed = ______ 3 m/s
(b) How far did the runner go in this 2 s interval?
distance = ______ 6 m

(c) The driver of a car traveling at a speed of 30 m/s slams on the brakes and comes to a stop in 5 s. If we assume that the speed changed at a constant rate (constant net force), what was the average speed during this 5 s interval?
average speed = ______ 15 m/s
(d) How far did the car go in this 5 s interval?
distance = ______ 75 m

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6. 0/3 points MI3 2.6.X.051. [1250469]

On a straight road with the $+x$ axis chosen to point in the direction of motion, you drive for 3 hours at a constant 20 miles per hour, then in a few seconds you speed up to 60 miles per hour and drive at this speed for 1 hour.
(a) What was the x component of average velocity for the 4-hour period, using the fundamental definition of average velocity, which is the displacement divided by the time interval?
$v_{avg,x}$ = ______ 30 miles per hour
(b) Suppose instead you use the formula $v_{avg,x} = \frac{v_{ix} + v_{fx}}{2}$. What do you calculate for the x component of average velocity?
$v_{avg,x} = \frac{v_{ix} + v_{fx}}{2}$ = ______ 40 miles per hour
(c) Why does the formula used in part (b) give the wrong answer?

- That formula isn't valid unless v_x changes at a constant rate (constant force).
- That formula can only be used for projectile motion, such as a baseball that has been hit.
- That formula only applies at high speeds.

7. 0/3 points MI3 2.6.X.053. [1250460]

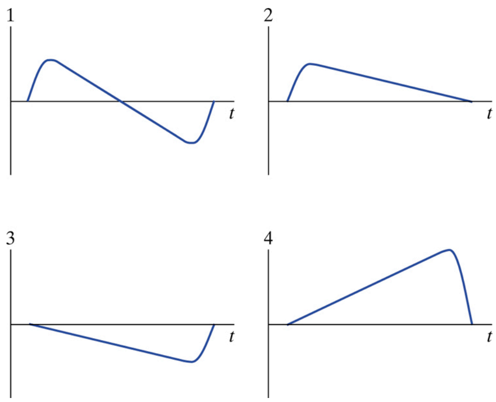
A cart rolls with low friction on a track. A fan is mounted on the cart, and when the fan is turned on, there is a constant force acting on the cart. Three different experiments are performed:

(a) Fan off: The cart is originally at rest. You give it a brief push, and it coasts a long distance along the track in the $+x$ direction, slowly coming to a stop.

(b) Fan forward: The fan is turned on, and you hold the cart stationary. You then take your hand away, and the cart moves forward, in the $+x$ direction. After traveling a long distance along the track, you quickly stop and hold the cart.

(c) Fan backward: The fan is turned on facing the "wrong" way, and you hold the cart stationary. You give it a brief push, and the cart moves forward, in the $+x$ direction, slowing down and then turning around, returning to the starting position, where you quickly stop and hold the cart.

The figure displays graphs of p_x, the x component of momentum, vs. time. The graphs start when the cart is at rest, and end when the cart is again at rest. Match the experiment with the correct graph.



Match to the graphs of p_x vs t

Fan off: ---Select--- 2

Fan forward: ---Select--- 4

Fan backward: ---Select--- 1

8. 0/3 points mi3 2.6.x.054.nva [1250504]

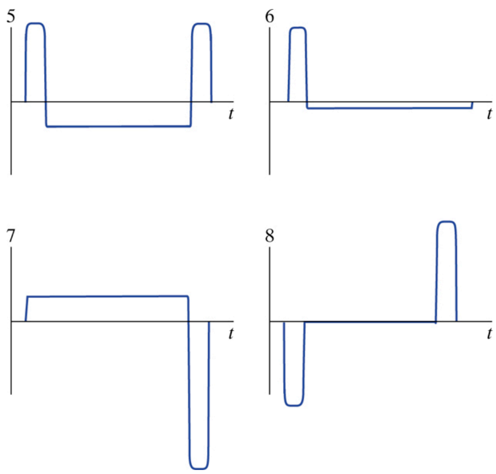
A cart rolls with low friction on a track. A fan is mounted on the cart, and when the fan is turned on, there is a constant force acting on the cart. Three different experiments are performed:

(a) Fan off: The cart is originally at rest. You give it a brief push, and it coasts a long distance along the track in the $+x$ direction, slowly coming to a stop.

(b) Fan forward: The fan is turned on, and you hold the cart stationary. You then take your hand away, and the cart moves forward, in the $+x$ direction. After traveling a long distance along the track, you quickly stop and hold the cart.

(c) Fan backward: The fan is turned on facing the "wrong" way, and you hold the cart stationary. You give it a brief push, and the cart moves forward, in the $+x$ direction, slowing down and then turning around, returning to the starting position, where you quickly stop and hold the cart.

The figure displays graphs of $F_{net,x}$, the x component of the net force acting on the cart, vs. time. The graphs start when the cart is at rest, and end when the cart is again at rest. Match the experiment with the correct graph.



Match to the graphs of $F_{net,x}$ vs t

Fan off: ---Select--- 6

Fan forward: ---Select--- 7

Fan backward: ---Select--- 5

9. 0/3 points mi3 2.6.x.055.nva [1250482]

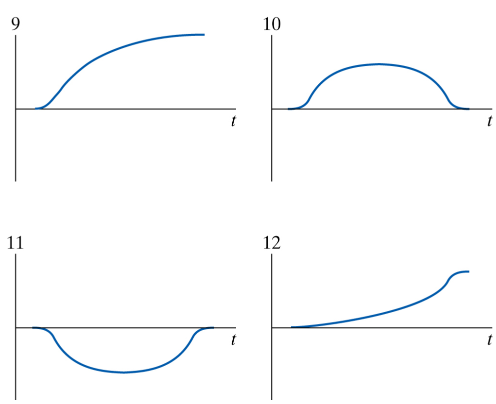
A cart rolls with low friction on a track. A fan is mounted on the cart, and when the fan is turned on, there is a constant force acting on the cart. Three different experiments are performed:

(a) Fan off: The cart is originally at rest. You give it a brief push, and it coasts a long distance along the track in the $+x$ direction, slowly coming to a stop.

(b) Fan forward: The fan is turned on, and you hold the cart stationary. You then take your hand away, and the cart moves forward, in the $+x$ direction. After traveling a long distance along the track, you quickly stop and hold the cart.

(c) Fan backward: The fan is turned on facing the "wrong" way, and you hold the cart stationary. You give it a brief push, and the cart moves forward, in the $+x$ direction, slowing down and then turning around, returning to the starting position, where you quickly stop and hold the cart.

The figure displays graphs of x, position along the track, vs. time. The graphs start when the cart is at rest, and end when the cart is again at rest. Match the experiment with the correct graph.



Match to the graphs of x vs t

Fan off: ---Select--- 9

Fan forward: ---Select--- 12

Fan backward: ---Select--- 10

10. 0/6 points MI3 2.6.X.056. [1544771]

A ball of mass 0.4 kg flies through the air at low speed, so that air resistance is negligible.

What is the net force acting on the ball while it is in motion?

$\vec{F}_{\text{net}}$ = $< 0, -3.92, 0 >$ N

Which components of the ball's momentum will be changed by this force?

---Select--- y only

What happens to the *x* component of the ball's momentum during its flight?

---Select--- It doesn't change.

What happens to the *y* component of the ball's momentum during its flight?

---Select--- It decreases.

What happens to the *z* component of the ball's momentum during its flight?

---Select--- It doesn't change.

In this situation, why is it legitimate to use the formula for average y component of velocity, $v_{\text{avg},y} = \dfrac{v_{yi} + v_{yf}}{2}$, to update the *y* component of position? Check all that apply.

- [ ] The ball's velocity changes at a constant rate because the net force on the ball is constant.
- [ ] This formula for average velocity is always valid.
- [ ] The ball's speed is small compared to the speed of light.

11. 0/9 points MI3 2.6.P.058. [1544848]

A ball is kicked from a location < 6, 0, -7 > (on the ground) with initial velocity < -11, 17, -3 > m/s. The ball's speed is low enough that air resistance is negligible.

What is the velocity of the ball 0.5 seconds after being kicked? (Use the Momentum Principle!)

$\vec{v}$ = [ ] $< -11.0, 12.1, -3.00 >$ m/s

In this situation (constant force), which velocity will give the most accurate value for the location of the ball 0.5 seconds after it is kicked?

- The arithmetic average of the initial and final velocities.
- The initial velocity of the ball.
- The final velocity of the ball.

What is the average velocity of the ball over this time interval?

$\vec{v}_{avg}$ = [ ] $< -11.0, 14.6, -3.00 >$

Use the average velocity to find the location of the ball 0.5 seconds after being kicked:

$\vec{r}$ = [ ] $< 0.500, 7.28, -8.50 >$ m

Now consider a different time interval: the interval between the initial kick and the moment when the ball reaches its highest point. We want to find how long it takes for the ball to reach this point, and how high the ball goes.

What is the *y*-component of the ball's velocity at the instant when the ball reaches its highest point (the end of this time interval)?

v_{yf} = [ ] 0 m/s.

Fill in the missing numbers in the equation below (update form of the Momentum Principle):

$mv_{yf} = mv_{yi} + F_{net,y}\Delta t$

m [ ] 0 = m [ ] 17 + $-mg\Delta t$

How long does it take for the ball to reach its highest point?

Δt = [ ] 1.73 s.

Knowing this time, first find the *y*-component of the average velocity during *this* time interval, then use it to find the maximum height attained by the ball:

y_{max} = [ ] 14.7 m.

Now take a moment to reflect on the reasoning used to solve this problem. You should be able to do a similar problem on your own, without prompting. Note that the only equations needed were the Momentum Principle and the expression for the arithmetic average velocity.

Assignment Details