Name: _____

PHYSICS 1050 Test 1
University of Wyoming
14 February 2008

This test is closed-note and closed-book. No written, printed, or recorded material is permitted, with the exception of one 3"×5" note card which may bear writing on both sides. Turn your note card in with your test when you are finished.

Calculators are permitted but computers are not. No collaboration, consultation, or communication with other people (other than the administrator) is allowed by any means, including but not limited to verbal, written, or electronic methods. Sharing of materials, such as calculators and note cards, is prohibited.

If you have a question about the test, please raise your hand. If that does not get the administrator's attention, perhaps he will notice if you turn up the console microphone so that it feeds back.

Please do not open this test booklet until everyone has received a booklet and the test administrator has indicated for you to begin. While you are waiting, make sure that your name is written clearly at the top of this page and on your note card.

A

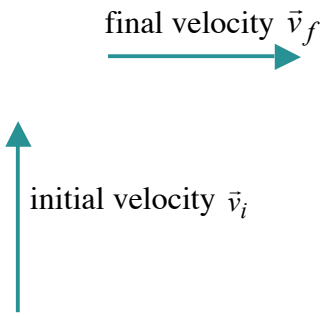
Scenario Problems

Four scenarios, 20 questions, 4 points each.

Please circle the correct answer from the choices given. For each question, only one choice is correct.

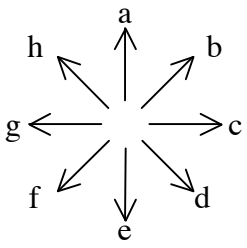
Scenario 1: Struck Puck Amuck

A hockey puck initially sides along frictionless ice at 10 m/s in the forward (↑) direction. A hockey stick then applies a force upon it for a short time. After the force stops, the puck travels rightward (→), exactly perpendicular to its initial direction of travel. Its speed does not change. The arrows below graphically illustrate the puck's initial and final velocities.



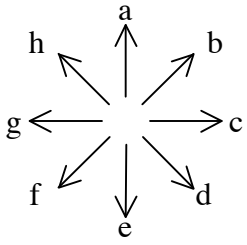
1. What is the direction of the puck's *change in velocity*? This is the vector $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$.

a. Direction a.
b. Direction b.
c. Direction c.
d. Direction d.
e. Direction e.
f. Direction f.
g. Direction g.
h. Direction h.



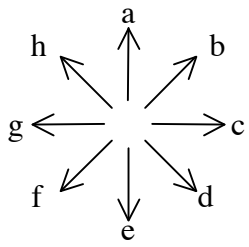
2. What is the direction of the puck's *acceleration* while the force was being applied?

a. Direction a.
b. Direction b.
c. Direction c.
d. Direction d.
e. Direction e.
f. Direction f.
g. Direction g.
h. Direction h.



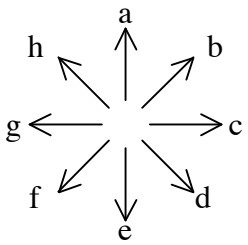
3. What is the direction of the *net force* that accelerated the puck?

a. Direction a.
b. Direction b.
c. Direction c.
d. Direction d.
e. Direction e.
f. Direction f.
g. Direction g.
h. Direction h.



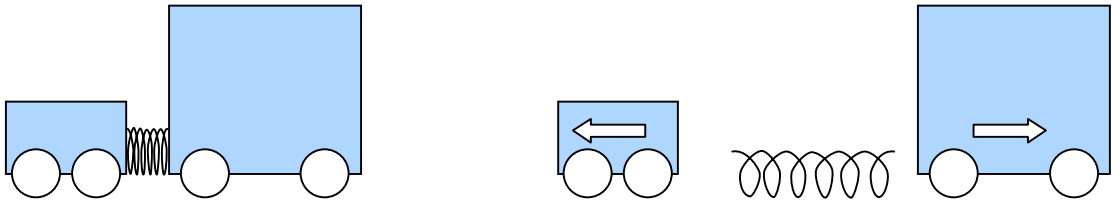
4. What is the direction of the force that the puck applied *to the stick*?

a. Direction a.
b. Direction b.
c. Direction c.
d. Direction d.
e. Direction e.
f. Direction f.
g. Direction g.
h. Direction h.



Scenario 2: Spring Carts

Two carts with different masses sit motionless on a level, frictionless track with a spring compressed between them. When the spring is released, it pushes the carts apart.



before after

5. While the carts coast after being pushed apart by the spring, which has the greater *speed*?

a. The cart with the greatest mass.
b. The cart with the least mass.
c. Both carts have the same speed.

6. While the carts coast after being pushed apart by the spring, which has the greater magnitude of *momentum*?

a. The cart with the greatest mass.

b. The cart with the least mass.

c. Both carts have the same magnitude of momentum.

7. While the carts coast after being pushed apart by the spring, which has the greatest *kinetic energy*?

a. The cart with the greatest mass.

b. The cart with the least mass.

c. Both carts have the same kinetic energy.

8. During the time that the spring was pushing on the carts, which had the larger magnitude of *acceleration*?

a. The cart with the greatest mass.

b. The cart with the least mass.

c. Both carts had the same magnitude of acceleration.

9. During the time that the spring was pushing on the carts, which had the larger magnitude of *force* acting on it?

a. The cart with the greatest mass.

b. The cart with the least mass.

c. Both carts had the same magnitude of force act on them.

10. During the time that the spring was pushing on the carts, which had the most *work* done on it?

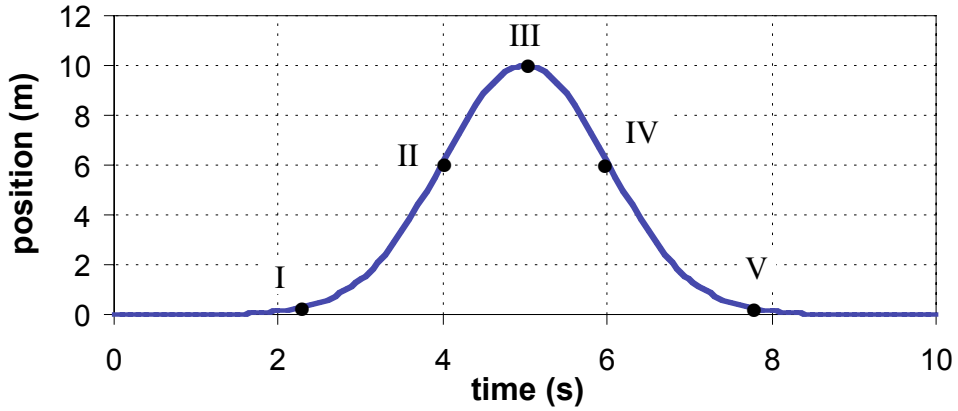
a. The cart with the greatest mass.

b. The cart with the least mass.

c. Both carts had the same amount of work done on them.

Scenario 3: Curved Position-Time Graph

The plot below is a position-time graph showing the position of a ball at different times during a physics demonstration. Five events, I through V, are marked on the plot.



11. At which event(s) is the ball the *greatest distance* from zero?

a. At events I and V.
b. At events II and IV.
c. At event III.
d. The ball's distance from zero is the same at all five events.

12. At which event(s) is the ball's *velocity* zero?

a. At events I and V.
b. At events II and IV.
c. At event III.
d. The ball's velocity is zero at all five events.
e. The ball's velocity is not zero at any of the five events.

13. At which event(s) is the ball's *acceleration negative* (less than zero)?

a. At events I and V.
b. At events II and IV.
c. At event III.
d. The ball's acceleration is negative at all five events.
e. The ball's acceleration is not negative at any of the five events.

14. Between which two events is the ball's velocity the *most different*?

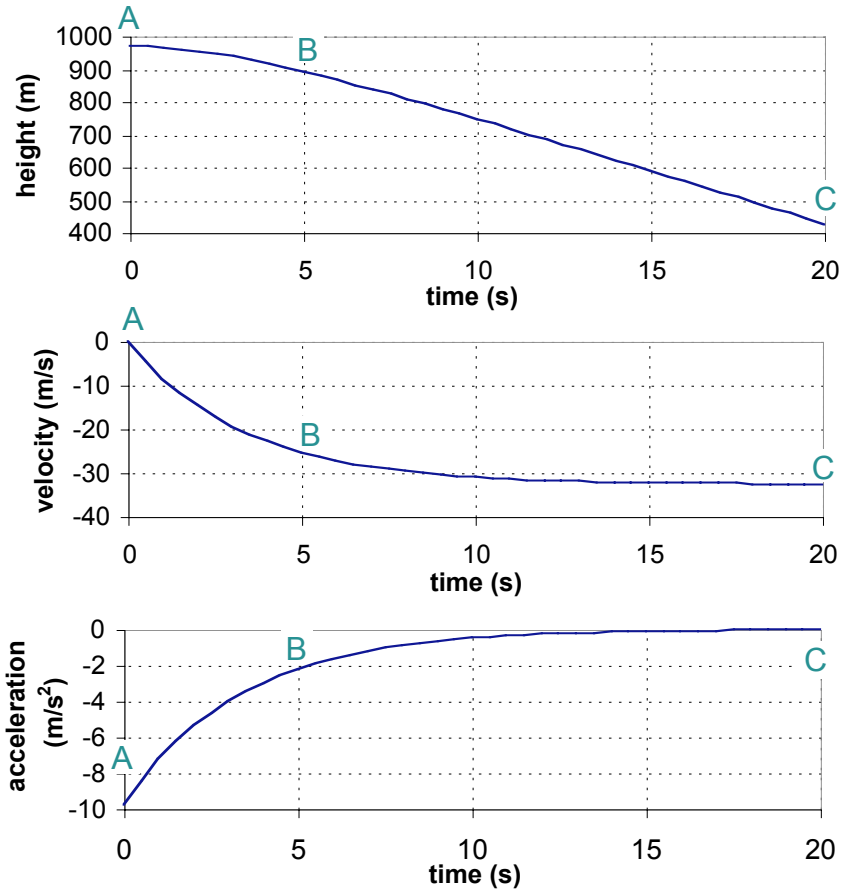
a. Between events II and III.

b. Between events I and III.

c. Between events II and IV.

Scenario 4: Skydiving is a Drag

The plots below are distance-time, velocity-time, and acceleration-time graphs for a skydiver beginning with when she jumps out of the plane. In these graphs, up (_) is positive and down (_) is negative. The questions refer to three times in this process: time A (0 s), time B (5 s) and time C (20 s).



15. Which ranking below sorts the three events by the force of *gravity* acting on the skydiver, from least magnitude to greatest magnitude?

a. $A < B < C$.
b. $A < C < B$.
c. $B < A < C$.
d. $B < C < A$.
e. $C < A < B$.
f. $C < B < A$.
g. $A = B = C$.

16. Which ranking below sorts the three events by the force of *drag* acting on the skydiver, from least magnitude to greatest magnitude?

a. $A < B < C$.
b. $A < C < B$.
c. $B < A < C$.
d. $B < C < A$.
e. $C < A < B$.
f. $C < B < A$.
g. $A = B = C$.

17. Which ranking below sorts the three events by the *potential energy* of the skydiver, from least to greatest?

a. $A < B < C$.
b. $A < C < B$.
c. $B < A < C$.
d. $B < C < A$.
e. $C < A < B$.
f. $C < B < A$.
g. $A = B = C$.

18. Which ranking below sorts the three events by the *kinetic energy* of the skydiver, from least to greatest?

a. $A < B < C$.
b. $A < C < B$.
c. $B < A < C$.
d. $B < C < A$.
e. $C < A < B$.
f. $C < B < A$.
g. $A = B = C$.

19. At which event is the skydiver's *speed* closest to terminal speed?

a. Event A (0 s).
b. Event B (5 s).
c. Event C (20 s).

20. At which event is the skydiver's *acceleration* closest to gravitational acceleration g?

a. Event A (0 s).
b. Event B (5 s).
c. Event C (20 s).

Short answer

2 questions, 10 points each.

Please provide complete answers to each question. Show all work so that partial credit can be assigned.

21. You know from Newton's second law that acceleration is given by the formula $\vec{a} = \vec{F}/m$, you know that the definition of acceleration is $\vec{a} = \Delta\vec{v}/\Delta t$, and you know that momentum is $\vec{p} = m\vec{v}$. Show that net force is given by the formula $\vec{F} = \Delta\vec{p}/\Delta t$.

22. An antelope running across the prairie has both momentum (mv) and kinetic energy ($\frac{1}{2}mv^2$). If it stops, however, it has zero momentum and zero kinetic energy. Suppose an antelope runs for a while across the flat, level ground and then stops. Knowing that both momentum and energy are conserved, explain what has happened to its momentum and to its kinetic energy.

Momentum:

Kinetic energy:

Extra credit

23. (5 points) In class, when I sang

> "What's a guy gotta do to change his motion around?
> Well, according to the laws that Isaac Newton found
> Any mass will resist speeding up or slowing down
> So a guy needs a force to change his motion around!"

I was stating Newton's second law, [$\times$]. However, the phrasing of this quatrain does not completely describe acceleration. What is missing? (It is included earlier in the song, just not right here.)