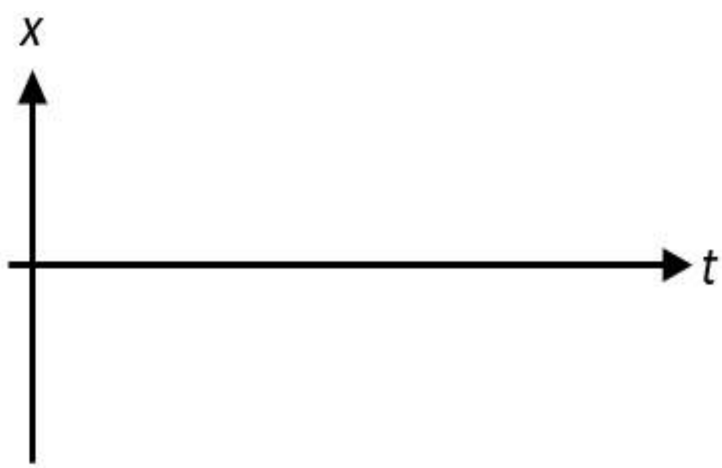
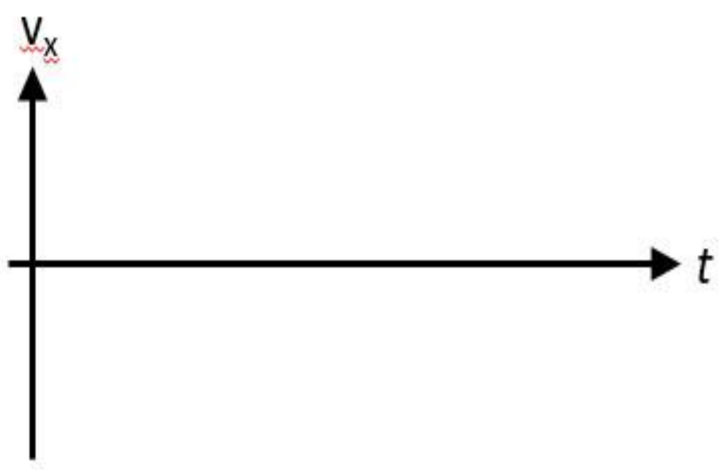
**Physics P20f19: Exam 1. Practice** Name:________________________________

Write directly on these sheets. Show your work. You may use a calculator. You may use the 3×5 card if you brought one; staple it to the exam. The exam ends with word “END”. The total score is 40pts.

**Problem 1** (8 pts): Agnes makes a straight-line, uniform trip to the grocery store, 1500m from her house, in 3 minutes. She immediately turns around (without shopping) and comes back home in 6 minutes. Let the positive x-axis point in the direction from her home to the grocery store.

a) Sketch the position- and velocity- graphs of her trip below. *Place some numbers with units* on all axes.



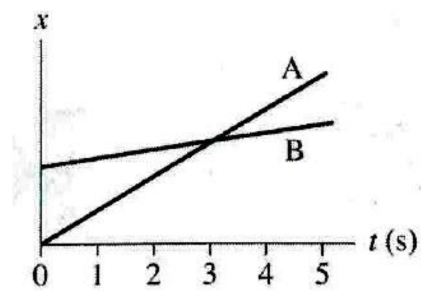

b) What is her average velocity on the way to the store (home-to-store)? Answer in m/s, with sign.

c) What is her average velocity on the way back (store-to-home)? Answer in m/s, with sign.

d) What is her average speed for the round trip? Answer in m/s.

**Problem 2** (7pts) The figure shows a position-versus-time graph for the motion of objects A and B that are moving along the same axis.

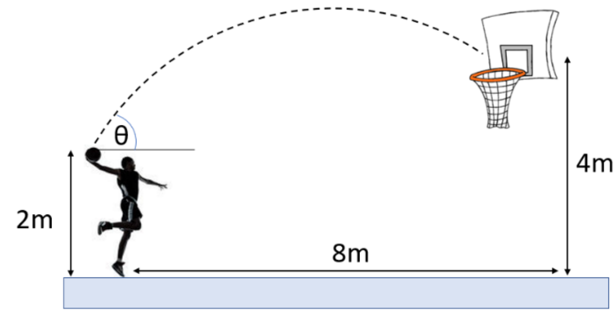
a) At the instant $t$=1s, is the speed of A *greater* than, *less* than, or *equal* to the speed of B? Circle one and explain.




b) Do objects A and B ever have the *same* speed? If so, at what time or times? Explain. If not, why not?

**Problem 3** (6pts): A basketball player is standing on the floor 8m from the basket, as shown. The height of the basket is 4m and he shoots the ball from a height of 2m. It takes 1.5s for the ball to reach and make the basket.

a) At what angle $\theta$ has the player thrown the ball? Hint: it may be helpful to calculate the components of the initial velocity vector first.




b) What is the acceleration of the basketball at the highest point in the trajectory? (Magnitude in $m/s^2$ and direction).

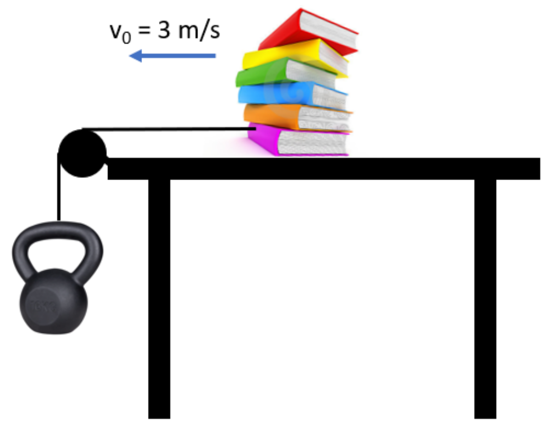
c) Calculate the speed of the ball at the basket (the magnitude of the velocity vector). Answer in $m/s^2$.

**Problem 4** (7pts) A package is dropped at time $t$ = 0s from a helicopter that is rising steadily at a speed of 4m/s.

a) What is the speed of the package 3s after the release?

b) What vertical distance is it from the helicopter 3s after the release?

**Problem 5** (7 pts): A stack of books is sliding along the table surface. There is friction between the stack and the table surface. The stack is tied to a hanging weight by a massless rope running over a massless pulley. The initial velocity $v_0$ =3m/s; the coefficient of kinetic friction between the books and the table is 0.05; the mass of the books is 2kg and the mass of the hanging weight is 3kg.




a) Draw the FBD for the hanging weight (mark the coordinate axis). Label all forces.

b) Draw the FBD for the stack of books (mark the coordinate axes). Label all forces.

c) Write down the equations for Newton's second law for the *x*- and *y*-directions for both, the hanging weight and the books.

d) Calculate the acceleration of the books. Answer in $m/s^2$.

e) Calculate the tension in the rope. Answer in Newtons.

**Multiple Choice** (1pt each):

1. An automobile moving along a straight track changes its velocity from 40 m/s to 80 m/s in a distance of 400 m. What is the (constant) acceleration of the vehicle during this time?

A 6 $m/s^2$
B 8 $m/s^2$
C 12 $m/s^2$
D 14$m/s^2$
E 16 $m/s^2$

2. A bullet is fired through a board, 14.0 cm thick, with its line of motion perpendicular to the face of the board. If it enters with a speed of 400 m/s and emerges with a speed of 220 m/s, what is the bullet's acceleration as it passes through the board?

A −500 $km/s^2$
B −550 $km/s^2$
C −360 $km/s^2$
D −520 $km/s^2$
E −399 $km/s^2$

3. A car travels north at 30 m/s for one half hour. It then travels south at 40 m/s for 10 minutes. The total distance the car has traveled and its displacement are:

A 18 km; 18 km S.
B 36 km; 36 km S.
C 78 km; 30 km N.
D 90 km; 18 km N.
E 90 km; 36 km N.

4. A toy rocket, launched from the ground, rises vertically with an acceleration of 20 m/s2 for 6.0 s until its motor stops. Disregarding any air resistance, what maximum height above the ground will the rocket achieve?

A 1.1 km
B 1.6 km
C 0.5 km
D 0.19 km
E 1.9 km

5. A 35-kg child rides on a circus Ferris wheel that takes her around a vertical circular path with a radius of 30 m every 28 s. What is the magnitude of the resultant force on the child at the highest point on this trajectory?

A 76 N
B 34 N
C 43 N
D 56 N
E 53 N

- End --