## Particle Models in Two Dimensions Worksheet 1:
Free-Fall Kinematics

1. A ball is thrown downward with an initial speed of 20 m/s on Earth.
   a. Make a labeled diagram (specify the (+) direction), then make a motion map of the situation.

   b. What is the acceleration of the ball?

   c. Calculate the displacement during the first 4 s.

   d. Calculate the time required to reach a speed of 50 m/s.

   e. Calculate the time required to fall 300 m (Hint: factor the quadratic or use the quadratic formula).

   f. Calculate the speed after falling 100 m.

2. A rock is thrown upward with an initial speed of 15 m/s on Earth.

a. Make a well-labeled diagram of the situation.

b. Make a list of given quantities and quantities to find, labeled with units and appropriate algebraic signs (+, -).

c. What is the acceleration of the rock?

d. Calculate the rock's height after 1 sec.

e. Calculate the time required to reach an upward speed of 3 m/s.

f. Calculate the time required to reach a downward speed of 5 m/s.

3. A ball punted vertically has a hang time of 3.8 seconds. What was its initial velocity? Make a well-labeled diagram of the situation. Make a list of given quantities and quantities to find, labeled with units and appropriate algebraic signs (+, -).

4. A rock is thrown straight up with an initial speed of 22 m/s. How long will it be in the air before it returns to the thrower? Graph the vertical position, velocity, and acceleration of the rock on the axes provided. Make a well-labeled diagram of the situation. Make a list of given quantities and quantities to find, labeled with units and appropriate algebraic signs (+, -).

x

0 ————————————— t

+
v
0 ————————————— t
-

+
a
0 ————————————— t
-
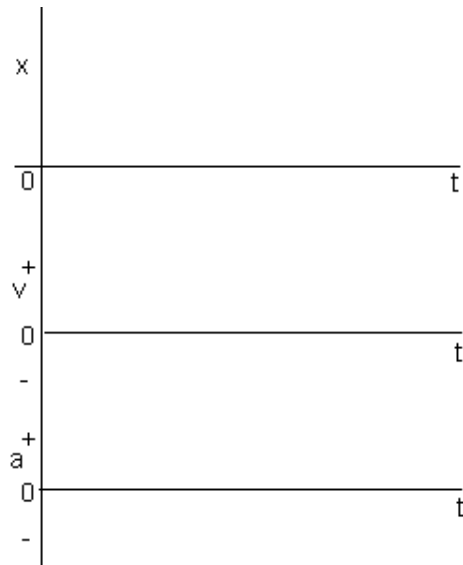
b. Draw a velocity and an acceleration motion map for the trip.

5. A student throws a baseball off a 120 m high bridge with an initial downward speed of 10 m/s
   a. How long does it take the ball to hit the ground below?

   b. How fast is the ball going at the moment of impact?

6. When a kid drops a rock off the edge of a cliff, it takes 4.0 s to reach the ground below. When she throws the rock down, it strikes the ground in 3.0 s. What initial speed did she give the rock?