

PHYSICS 1

Test #1

9 February 1999

Student's name _____ S.N. _____

Givens:

$$x = v \times t$$

$$v = a \times t$$

$$d = \frac{1}{2}a \times t^2$$

$$y = \frac{1}{2}g \times t^2$$

$$v = r \times \omega$$

$$a = \frac{F}{m}$$

$$g = 10m/s^2$$

Unless noted otherwise, assume friction and air resistance are zero.

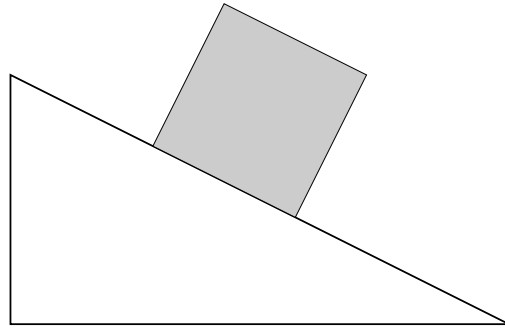
A. Short answer. Fill-in the blank. 2 points each.

1. If you drive to campus a distance of 20 miles in 30 minutes, your average speed in miles per hour (mph) is _____.
2. You drive to campus a distance of 20 miles in 30 minutes, then realize that you've forgotten your physics book, so you drive back home again in another 30 minutes. Your average **velocity** for that hour is _____.
3. A bug, standing on the edge of a record, is moving at $2 m/s$. The bug then slowly walks toward the center of the record and stops $1/2$ the way out. What is the bug's new speed?

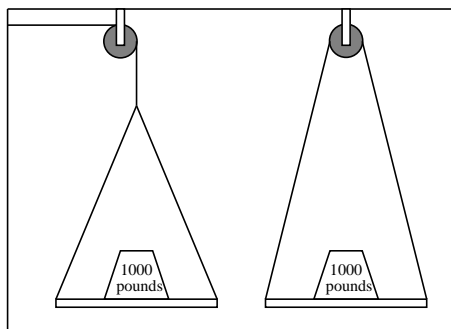
4. A $5 kg$ block is pushed across a horizontal surface with a horizontal force of $20 N$ against a friction force of $10 N$. The type of friction and the acceleration of the block in meters per second per second is _____.
5. Your car driving down the highway has various forces acting on it: friction, air resistance, weight, normal, *etc.* If your car has a constant velocity it is said to be in _____ equilibrium and the total force on the car is _____ Newtons.

B. True or false (correct if false). 2 points each.

- ___ 1) Galileo described the motion of an object moving at constant velocity as “violent motion”.
- ___ 2) An acceleration pointing in the same direction as velocity will cause the speed to increase.
- ___ 3) A block slides down an inclined plane as shown in the picture below. The acceleration of the block is 10 meters per second per second.



- ___ 4) A vector is something that has either an amount or a direction.
- ___ 5) In projectile motion, the minimum **speed** occurs at the apex (the highest point of the trajectory).
- ___ 6) Compared to the ideal case with no air resistance, air resistance will make the ball go higher and farther.
- ___ 7) The space shuttle in orbit around the earth is in free fall.
- ___ 8) The same object will have the same weight whether it is weighed on the earth or on the moon.
- ___ 9) In the picture below, the tensions in the ropes going through the pulleys is the same in both cases.



- ___ 10) When you fire a gun, the bullet feels the same force than the gun, despite the bullet having a larger acceleration.

C. Multiple choice. Check the box of the correct answer. 2 points each.

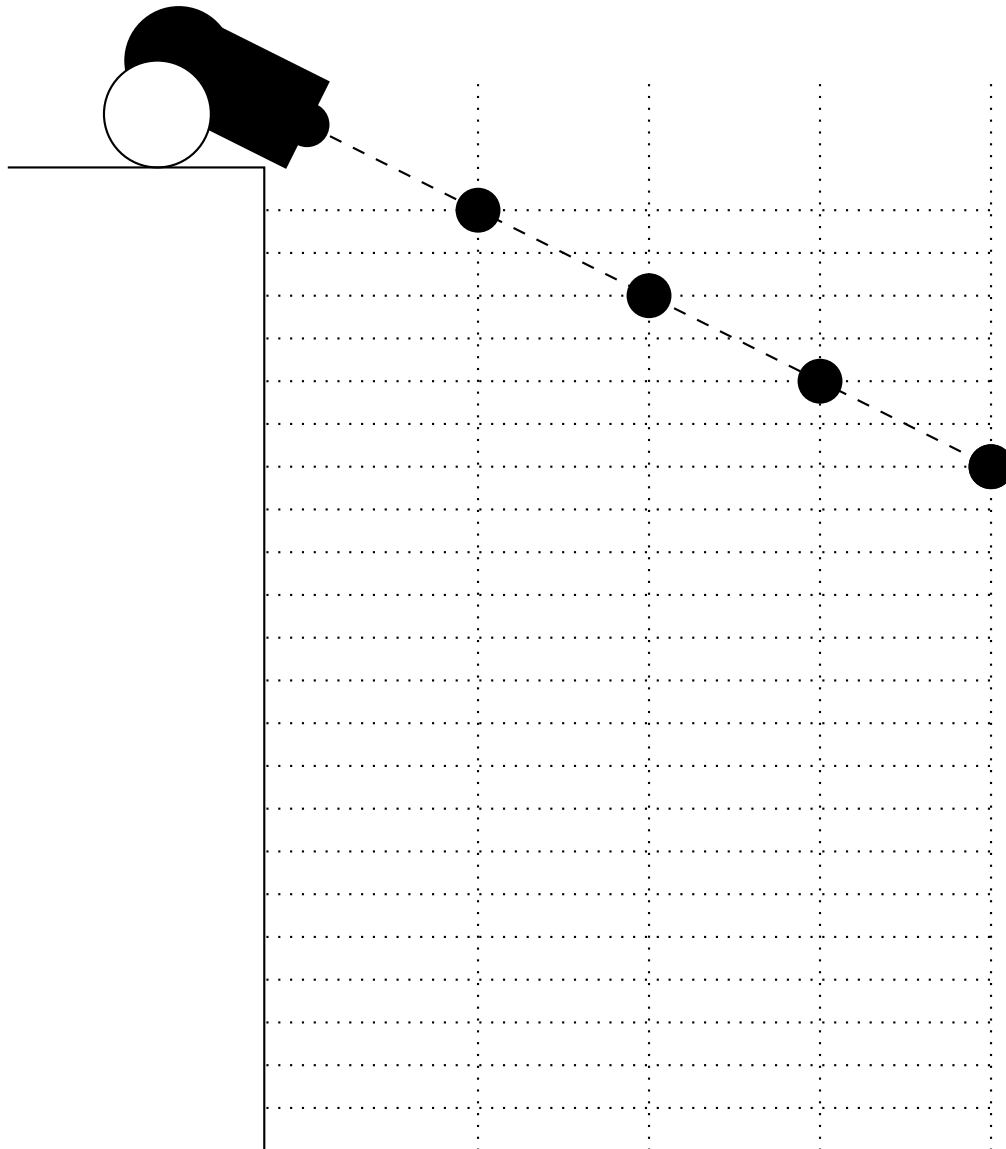
1. In science, an educated guess is
 - a) hypothesis.
 - b) speculation.
 - c) both of these.
2. The average speed of a bicyclist who travels a distance of 15 kilometers in a time of 30 minutes is
 - a) 7.5 *km/h*.
 - b) 15 *km/h*.
 - c) 30 *km/h*.
 - d) 45 *km/h*.
 - e) more than 45 *km/h*.
3. 5 seconds after starting from rest, a freely-falling object will have a speed of about
 - a) 10 *m/s*.
 - b) 50 *m/s*.
 - c) 100 *m/s*.
 - d) more than 10 *m/s*.
4. A ball is thrown upwards and caught when it comes back down. Neglecting air resistance, its speed when caught is
 - a) more than the speed it had when thrown upwards.
 - b) less than the speed it had when thrown upwards.
 - c) the same speed it had when thrown upwards.
5. 1 second after starting from rest (constant acceleration), a car has traveled 3 *m*. How far has the car traveled after 3 seconds?
 - a) 3 *m*.
 - b) 6 *m*.
 - c) 9 *m*.
 - d) 27 *m*.
 - e) more than 27 *m*.
6. What is the acceleration of a car that maintains a constant velocity of 100 *km/h* for 10 seconds?
 - a) 0.
 - b) 10 *km/hr/s*.
 - c) 10 *m/s/s*.
 - d) 1000 *km/h/s*.

7. Roll a bowling ball off the edge of a table. As it falls, its horizontal velocity
- a) decreases.
 - b) remains constant.
 - c) increases.
8. You twirl a string with 2 rocks attached, one in the middle and one at the outer edge. How does the linear speed of the inner rock compare to that of the outer rock?
- a) half as fast.
 - b) twice as fast.
 - c) exactly the same.
9. A bullet is fired horizontally with an initial velocity of 50 m/s from a tower that is 45 m high. Ignoring air resistance, what horizontal distance does the bullet travel before hitting the ground? (you first need to know how long it takes for the bullet to drop to the ground)
- a) 50 m .
 - b) 100 m .
 - c) 150 m .
 - d) 300 m .
 - e) more than 300 m .
10. A projectile is launched at an angle of 15 degrees above the horizontal and lands some distance away. For what other projection angle, at the same speed, would the projectile travel the same distance?
- a) 10 degrees.
 - b) 45 degrees.
 - c) 50 degrees.
 - d) 75 degrees.
 - e) 90 degrees.
11. A tablecloth can be withdrawn from under a plate, without the plate **appearing** to move, if the tablecloth is jerked quickly. This best demonstrates that
- a) the plate has no acceleration.
 - b) there is an action-reaction pair of forces.
 - c) gravity tends to hold the plate secure.
 - d) the plate has inertia.
 - e) none of these.

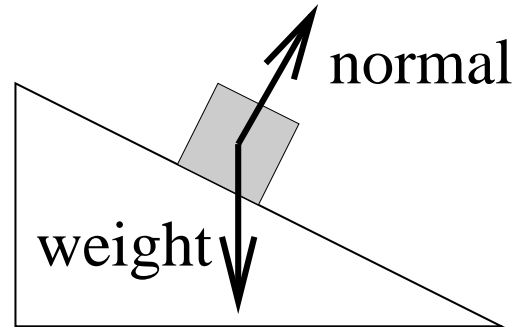
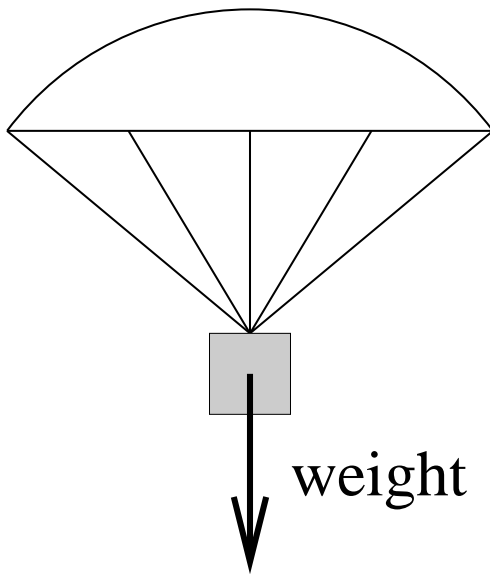
12. A car has a mass of 1000 kg and accelerates at $1\text{ meters per second per second}$. What is the magnitude of the force exerted on the car?
- a) 500 N .
 - b) 1000 N .
 - c) 1500 N .
 - d) 2000 N .
 - e) none of these.
13. You are driving your car due north at a constant speed of 55 mph . Then, a new force, directed towards the east, is applied to the car. What happens to the velocity?
- a) It remains unchanged.
 - b) The speed increases, but the direction is unchanged.
 - c) The speed decreases, but the direction is unchanged.
 - d) The direction of the velocity must change.
14. You pull with a force of 1000 N on a rope attached to a wall, giving a tension in the rope of 1000 N . Later you are involved in a tug-of-war, where you and your opponent pull with 1000 N of force on the two ends of the rope. The tension in this rope is
- a) 0 N .
 - b) 500 N .
 - c) 1000 N .
 - d) 2000 N .
 - e) none of these.
15. A sack of potatoes weighing 200 N falls from an airplane. As the velocity increases, air resistance also increases. When air resistance equals 200 N , the sack's acceleration in meters per second per second is
- a) 0 .
 - b) 5 .
 - c) 10 .
 - d) infinite.
 - e) none of these.

D. Complete the pictures as requested. 10 points each.

1. On the picture below, I show the path of the cannonball if gravity was turned off in 1 second intervals. Sketch the actual position of the cannonball assuming $g = 10m/s^2$; the horizontal, dotted lines are 5 meters apart.



2. In both pictures, the box is in equilibrium; in each case, there is one additional force acting on the box. Sketch and label the missing force.



- E. While creating her latest masterpiece, a sculptor uses a variety of different hammers. At the start, when she's removing large chunks of stone, she uses a heavy hammer; when she's putting on the finishing touches, she uses a very small hammer. Explain the physics of the situation, in terms of some concepts we've recently discussed in lecture. 20 points.