PHY 110 Old Exam 1

For questions 1 and 2, assume the following values were reported by an experimenter (ignore the units for now). x = 1.23 y = 5.007 z = 4.761×10^{-3}

1. (7 pts) What is $\frac{y^2 z}{x}$ to the correct number of significant figures? ~~0.0970~~ 0.0970

2. (7 pts) What is $x - z$ to the correct number of significant figures? 1.23

3. (12 pts) A certain paint manufacturer claims that one gallon of their paint will cover 375 ft^2 of wall area. How many square meters will one liter (1 L) of this paint cover? 1 ft = 12 in, 1 in = 2.54 cm, 1 gal = 3.785 L.

Answer: 9.20 m^2/L

4. (7 pts) The quantity $\sqrt{\frac{\hbar G}{c^5}}$ is well known to string theorists. In that expression, $\hbar$ has units of $\frac{kg \cdot m^2}{s}$, G has units of $\frac{m^3}{kg \cdot s^2}$, and c is the speed of light. What is $\sqrt{\frac{\hbar G}{c^5}}$?

a) a length b) a time c) a velocity d) a volume

5. (7 pts) A car slows down from 100 ft/s to a stop with constant deceleration in 7 s. How far does it move in this time?

a) 150 ft b) 280 ft c) 350 ft d) 420 ft e) 560 ft

6. (7 pts) A block slides up a 30° incline. If $\mu_k = 0.4$ and the block's initial speed up the incline is 2 m/s, how far up the incline will the block move before coming to rest?

a) 0.12 m b) 0.24 m c) 0.36 m d) 0.48 m

7. (7 pts) What is the displacement vector $\overrightarrow{r_{AB}}$ that extends from point A (with [x,y,z,] coordinates of [–3, 4, –6]) to point B (with coordinates [–4, –10, 8])? Express in terms of the appropriate unit vectors $\hat{i}$, $\hat{j}$, and $\hat{k}$. What is the distance between these two points?

$\overrightarrow{r_{AB}} = -\hat{i} - 14\hat{j} + 14\hat{k}$ and the distance is 19.8 units

8. (7 pts) A sniper rifle with a muzzle velocity of 700 m/s is tilted at an angle 1° above the horizontal. What is the maximum vertical displacement of the bullet above its initial level during its flight? Ignore air resistance.

a) 0.51 m b) 2.48 m c) 4.99 m d) 7.61 m e) 10.4 m

9. (7 pts) An airplane can fly 150 mph in still air. If it tries to land on a north-going runway with a 30 mph wind blowing from the northwest, what heading should the pilot set for the plane?

a) 8° W of N b) 12° E of N c) 23° W of N d) 16° E of N

10. (7 pts) If an object has non-zero acceleration, mark all the statements below that must be true.

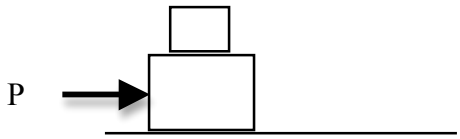
a) The object's speed must change with time.
b) The object's speed and position must change with time.
c) The object's speed or direction must change with time.
d) The object's speed and direction must change with time.

11. (12 pts) A home run (in baseball, a ball that is hit over the boundary of the playing field) flies a horizontal distance of 420 ft and is caught by a fan in the stands 30 ft above the level where the ball was struck by the bat. The ball is in the air for 6 s. With what velocity did the ball leave the bat?

Answer: ~~78 m/s The launch angle is 26.2°~~

You get the above answer if you use g = 9.81
If you use g = 32.2, you get
123.4 ft/s at 55.4°

12. (12 pts) A 5 kg box sits on the floor, and a 3 kg box rests on top of that box. The coefficient of static friction between the two boxes is 0.8, and a horizontal force P acts on the bottom box. If there is no friction between the 5 kg box and the floor, what is the maximum value of P for which both boxes move together as a unit (i.e., the top box doesn't slip)?



Answer: P_{max} = 62.8 N