

Midterm Physics 105-002
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(#1 to #10) (3 marks each)

1. If $X = \frac{Y}{Z+P}$ where Y has units of (m²) and P has units of (m/s) what units should Z and X have for the equation to dimensionally consistent?

2. Is (tera m) / (pico m) = yocto m ?

3. If you multiply a scalar time a vector what kind of quantity do you get?

4. Newton's second law is a a) vector law or b) scalar law ?

5. A ball 2 m above an elevator floor is thrown horizontally from one side of an elevator 2 m wide at speed of 1 m/s at just the instant that the elevator support breaks and elevator falls freely. How far does the ball drop relative to the elevator floor before it hits the other wall?

6. Three strings are tied together with a knot. A force of 4 N due north is applied to one string and forces of 3 N and 3 N are applied to the other two. Find the directions of the forces applied to the other two strings if the net force on the knot is to be zero?

7. The inertia of an object is measured by:
a) the mass of the object, b) the coefficient of static friction c) density of the object

8. John travels to a location 6.0 km away in 20 min, what is his average velocity in m/s?

9. Give an example of a dimensionless unit.

10. A worker has the option of either pulling upwards a crate at an angle of 30 degrees to the horizontal or pushing downward a crate at an angle of 30 degrees below the horizontal. Which should the worker chose and why?

11. (10 marks) Show from the definition of average velocity and average acceleration that for a constant acceleration motion in the x direction that

$$v^2 - v_0^2 = 2a\Delta x$$

where v -velocity at time t , v_0 velocity at time t_0 , a - acceleration, Δx is change in position between time t and t_0 .

12. (20 marks) At what angle (to 3 significant figures) should a projectile of initial velocity V be released so that its range R is twice the maximum achieved height H during the motion. Similarly what are the special angles for $R=.5H$, $R=3H$, and $R=8H$? How would these results change on the moon? (i.e. gravity $g_{\text{moon}} = g_{\text{earth}}/6$)

13. (20 marks) Two blocks are sliding along a incline plane that makes an angle of 50 degrees with the horizontal. A rope is attached between the masses. If the coefficient of kinetic friction between the lower block (5 kg) and the plane is $\mu_1 = .10$ and coefficient of kinetic friction between the higher block(10 kg) and plane is $\mu_2 = .25$ what is the tension in the rope between the blocks? Also use limit/special case analysis to verify that your symbolic solution makes physical sense.

14. (20 marks) Mary and Sally are racing. Mary can accelerate at 4.0m/s^2 , and has a maximum speed of 5.9m/s . Sally can accelerate at only 3.0m/s^2 but has a maximum speed of 6.0m/s . Given that Mary and Sally have equally good reaction times to the starting gun, it should be clear that in a sufficiently short race Mary will win over Sally. What should the distance of the race be so that Mary and Sally have about an equal chance of winning?