

Constants and Formulae for Physics 2010-003

Exam 1

Useful Constants

$$c = 3.00 \times 10^8 \text{ m/s} \quad g = 9.80 \text{ m/s}^2$$

$$1 \text{ mm} = 10^{-3} \text{ m} \quad 1 \text{ cm} = 10^{-2} \text{ m}$$

$$1 \text{ km} = 10^3 \text{ m} \quad 1 \text{ mi} = 5280 \text{ ft}$$

$$1 \text{ mi} = 1.609 \text{ km} \quad 1 \text{ inch} = 2.54 \text{ cm}$$

$$1 \text{ foot} = 0.3048 \text{ m} \quad 1 \mu\text{m} = 10^{-6} \text{ m}$$

$$1 \text{ min} = 60 \text{ s} \quad 1 \text{ hr} = 3600 \text{ s}$$

$$1 \text{ day} = 8.64 \times 10^4 \text{ s} \quad 1 \text{ yr} = 365.242 \text{ days}$$

Useful Formulae

$$\sin \theta = \text{opposite/hypotenuse}$$

$$\cos \theta = \text{adjacent/hypotenuse}$$

$$\tan \theta = \text{opposite/adjacent}$$

$$r^2 = x^2 + y^2$$

$$1 = \cos^2 \theta + \sin^2 \theta$$

$$v_x = v \cos \theta$$

$$v_y = v \sin \theta$$

$$\tan \theta = v_y/v_x = R_y/R_x$$

$$v = |\vec{v}| = \sqrt{v_x^2 + v_y^2}$$

$$\vec{v} = \Delta \vec{r} / \Delta t$$

$$\vec{a} = \Delta \vec{v} / \Delta t$$

$$v = v_o + a(t - t_o)$$

$$x = x_o + v_o(t - t_o) + \frac{1}{2}a(t - t_o)^2$$

$$v^2 = v_o^2 + 2a(x - x_o)$$

$$x = x_o + v_{ox}(t - t_o)$$

$$v_x = v_{ox}$$

$$y = y_o + v_{oy}(t - t_o) - \frac{1}{2}g(t - t_o)^2$$

$$v_y = v_{oy} - g(t - t_o)$$

$$v_y^2 = v_{oy}^2 - 2g(y - y_o)$$

$$t_f = 2 t_{1/2}$$

$$\Sigma \vec{F} = m \vec{a}$$

$$\vec{w} = m \vec{g}$$

Exam 1A – 23 September 2024

Part A: Hard Multiple Choice (10 points total, 2 points each). (Circle the best answer.)

1. Your professor discovered Luttermoser's Law which states that $a = Bmx/vt^2$. What are the SI units for B , is m is mass, x is displacement, v is velocity, t is time, and a is acceleration?

- a) $\text{kg}^{-1}\text{m s}^{-1}$ b) kg m/s^2 c) kg d) s/m^2 e) m/s

2. A ball travels in a linear path and has an initial velocity of 32.7 m/s at 45.6 minutes and a final velocity of 24.9 m/s at 98.0 minutes. What is the average acceleration of this ball?

- a) 0.0 m/s^2 b) -0.15 m/s^2 c) $-2.5 \times 10^{-3} \text{ m/s}^2$
d) 9.8 m/s^2 e) 1.3 m/s^2

3. A golf ball is hit with an initial velocity of 67.2 m/s at an angle of 32.6° with respect to the ground. It reaches its maximum height in 2.66 s. What is the vertical velocity of this ball at that maximum height?

- a) 179 m/s b) 56.6 m/s c) 36.2 m/s d) 25.3 m/s e) 0.00 m/s

4. Let $\vec{A} = 16\hat{x} - 13\hat{y}$ and $\vec{B} = 7\hat{x} + 4\hat{y}$. If $\vec{R} = \vec{A} + \vec{B}$, what is θ (*i.e.*, the angle that $\vec{R}$ makes to the x axis) equal to?

- a) 162° b) 23° c) -39° d) 339° e) 90°

5. Convert 5280 ft/hour to SI units.

- a) 214 cm/s b) 980 cm/s c) 0.447 m/s d) 32.0 m/s e) 90.0 m/s
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Part B: Easy Multiple Choice (10 points total, 1 point each). (Circle the best answer.)

6. Mathematical relationships between physical quantities are called what in physics?

- a) Principles b) Laws c) Models d) Theories e) Hypotheses

7. Who is considered to be the father of experimental physics?

- a) Einstein b) Newton c) Kepler d) Galileo e) Luttermoser

8. For projectile motion, the motion of a projectile is called a

- a) triangle b) hadron c) trajectory d) streamline e) circle

9. In scientific notation (*e.g.*, 2.64×10^{16}), the front number (*e.g.*, 2.64) is called the

- a) exponent b) ordinate c) abscissa d) mantissa e) none of these

10. Which of the following is a basic unit of mass?

- a) lb b) s c) N d) mm e) kg

11. Which of the following areas of physics does not belong in the class of modern physics?

- a) condensed matter b) quantum mechanics c) special relativity
d) general relativity e) electromagnetism

12. For the one-dimensional equations of motion developed in class, which parameter is assumed to be constant?

- a) displacement b) time c) velocity
d) acceleration e) all of these

13. Which of the following is not a vector?

- a) force b) mass c) acceleration d) displacement e) velocity

14. Which of the following is not part of the scientific method?

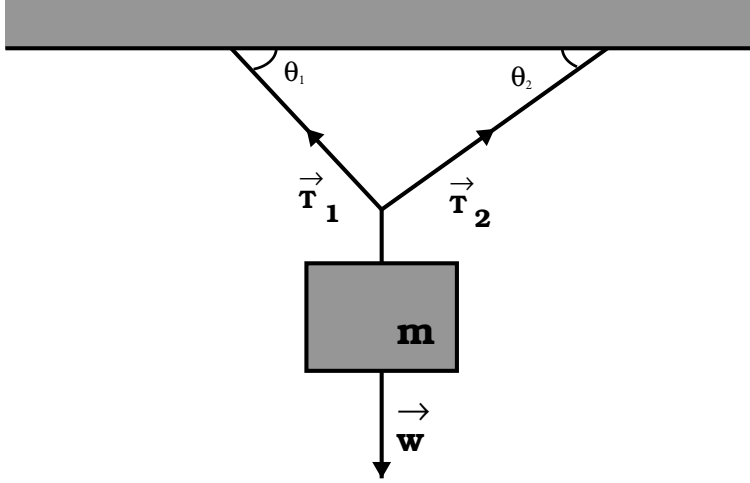
- a) An authority figure in science dictates what is real.
- b) If a hypothesis is confirmed by repeated experiments and/or observations, it becomes a theory.
- c) A model is tested via repeated experiment and/or observation.
- d) A hypothesis is developed from every day experiences or from an instant of insight.
- e) All of these are part of the scientific method.

15. What is the name of the x - y coordinate system?

- a) spherical b) hyperbolic c) orthogonal d) Galilean e) elliptical
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Part C: Problems (20 points total, 10 points each).

16. A block hangs motionless from two ropes as shown in the diagram below. The tension on rope 2 is 154 N. The angles the ropes make with the ceiling are $\theta_1 = 48.2^\circ$ and $\theta_2 = 32.6^\circ$. (a) What is the tension on rope 1? (b) What is the weight of the block? (c) What is the mass of the block? (**Show all work including a free-body diagram!**)



17. A model rocket leaves the ground at an angle of 63.6° to the horizontal and at a speed of 49.2 m/s. (a) What is the maximum height reached? (b) How long will the flight last? (c) How far down range does the rocket hit the ground? (**Show all work including a diagram with a defined coordinate system!**)

Extra Credit Problem (5 points, do this only if you have time).

18. Two people are pulling a boat through the water with ropes. Each exerts a force of 722 N on the rope directed at a 36.2° angle with respect to the forward motion of the boat. If the boat moves at a constant velocity of 2.24 m/s, find the magnitude of the resistive force $\vec{f}$ exerted by the water on the boat. (**Show all work!**)