Name: _____ Period: _____

Instructor: Mr. Rodriguez Course: Conceptual Physics A

Term: Winter 2024-25

Midterm Exam v2

Be sure to **show your work** and **include units** in your final answers to receive full credit.

Learning Standard 1

Scientific Measurement and Estimation **Score:** _____ /10 **Grade:**

Prefix	Symbol	Meaning	Expanded Form	Scientific Form
giga-	G	one billion	1,000,000,000	$\times 10^{9}$
mega-	M	one million	1,000,000	$\times 10^{6}$
kilo-	k	one thousand	1,000	$\times 10^{3}$
hecto-	h	one hundred	100	$\times 10^{2}$
–	–	one	1	$\times 10^{0}$
centi-	c	one hundredth	0.01	$\times 10^{-2}$
milli-	m	one thousandth	0.001	$\times 10^{-3}$
micro-	μ	one millionth	0.000001	$\times 10^{-6}$
nano-	n	one billionth	0.000000001	$\times 10^{-9}$

Table 1: Metric Prefixes Conversion Chart

1. (2 points) Place either a $<$, $>$, or $=$ sign in the blank.
   (a) $2500\,\text{mL}$ _____ $2.5\,\text{L}$
   (b) $0.8\,\text{km}$ _____ $800\,\text{m}$
   (c) $150\,\text{g}$ _____ $0.15\,\text{kg}$
   (d) $0.000\,001\,\text{m}$ _____ $1\,\mu\text{m}$

2. (2 points) Fill in the blank with the correct number.
   (a) $8\,\text{kg} =$ _____ g
   (b) $920\,\text{g} =$ _____ kg
   (c) $0.45\,\text{km} =$ _____ m
   (d) $5000\,\text{m} =$ _____ cm

3. (2 points) Express each of the following in scientific notation:
   (a) $0.000089 =$ _____
   (b) $7340000 =$ _____

4. (2 points) Express each of the following in decimal (expanded) form:
   (a) $3.142 \times 10^{8} =$ _____
   (b) $6.2 \times 10^{-5} =$ _____

5. (2 points) In your own words, provide at least **two** reasons as to why the metric system is useful to scientists.

Learning Standard 2

Linear Motion **Score:** _____ /10 **Grade:**

Relevant Equations

$$x = \frac{1}{2}at^2 \quad \text{(position equation)}$$

$$v = at \quad \text{(velocity equation)}$$

6. (3 points) Sonic the Hedgehog is running a marathon. Once he starts running, he is capable of accelerating at $1.75\,\mathrm{m/s^2}$ indefinitely. If he runs for 27 minutes, how **far** will he travel? (*Hint:* Convert minutes to seconds)

7. (3 points) Mr. Rodriguez is driving a 2007 Lincoln Town Car. To merge onto the freeway, he needs to accelerate at $a = 2.5\,\mathrm{m/s^2}$. If he keeps accelerating at this same rate for $t = 11\,\mathrm{s}$ how **fast** will he be going once he takes his foot off of the gas pedal?

8. (1 point) **Acceleration** (a) is defined as a change in _____ divided by a change in _____.

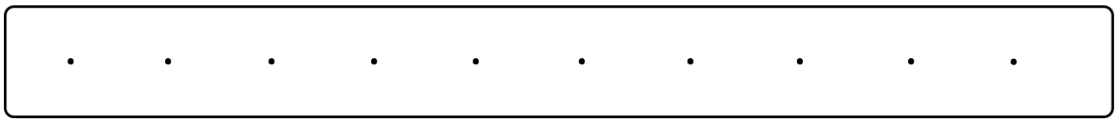
9. (1 point) **Displacement** (Δx) is defined as a change in _____ and has units of _____.

10. (2 points) For each of the ticker-tape data below, **draw a corresponding curve** on a position vs. time graph that captures the motion qualitatively:

Figure 1: Ticker-Tape Trial **A**

(a) Draw the curve corresponding to Ticker-Tape Trial **A** in the space provided below:

Figure 2: Ticker-Tape Trial **B**



(b) Draw the curve corresponding to Ticker-Tape Trial **B** in the space provided below:

Figure 3: Ticker-Tape Trial **C**

(c) Draw the curve corresponding to Ticker-Tape Trial **C** in the space provided below:

Learning Standard 3

Newton's Laws and Forces **Score:** _____ /10 **Grade:**

Relevant Equations

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

11. (1 point) What is Newton's **First** Law?
    A. For every action, there is an equal and opposite reaction.
    B. An object at rest stays at rest, and an object in motion stays in motion unless acted upon by an unbalanced external force.
    C. All objects move in straight lines forever.
    D. The force exerted on an object is equal to its mass times its acceleration.

12. (1 point) What is Newton's **Second** Law?
    A. All objects move in straight lines forever.
    B. An object at rest stays at rest, and an object in motion stays in motion unless acted upon by an unbalanced external force.
    C. The net force exerted on an object is equal to its mass times its acceleration.
    D. For every action, there is an equal and opposite reaction.

13. (1 point) What is Newton's **Third** Law?
    A. The force exerted on an object is equal to its mass times its acceleration.
    B. An object at rest stays at rest, and an object in motion stays in motion unless acted upon by an unbalanced external force.
    C. All objects move in straight lines forever.
    D. For every action, there is an equal and opposite reaction.

14. (2 points) (a) Is your **mass** the same on the planet **Mars** as it would be on the planet **Venus**?

    (b) What about your **weight**? Why or why not?

15. (3 points) You are on a spaceship deep in outer space, far away from any planets or stars (*i.e.*, there is **no gravity**). In your large and otherwise empty spaceship, there are two unmarked, equally sized boxes floating next to you. One box is full of feathers, and the other is full of solid lead. Using Newton's Second Law, describe a simple experiment to determine which box is full of feathers and which box is full of lead. You cannot open the boxes.

16. (2 points) You are on planet Earth. In a gleeful mood, you decide to jump up into the air.

    (a) While you are in the air, how do the gravitational **forces** between you and planet Earth compare?

    (b) While you are in the air, how do the magnitudes of the **accelerations** of you and planet Earth compare?

Learning Standard 4

Momentum **Score:** _____ /10 **Grade:**

Relevant Equations

$$\mathbf{p} = m\mathbf{v}$$

17. (1 point) Choose ***one***: In which of the following types of collisions is momentum always conserved?

    A. An elastic collision.

    B. A partially inelastic collision

    C. A perfectly inelastic collision.

    D. Momentum is conserved in all collisions, assuming no external forces.

18. (2 points) Give one example of an elastic collision **other than** colliding balls of any kind.

19. (2 points) Give one example of an inelastic collision **other than** a car crash or a paper towel hitting a wall.

20. (2 points) How **fast** would a 0.005 kg minnow have to be swimming in order to have the same momentum as a 135 000 kg blue whale swimming at 15 m/s?

Figure 4: Elijah Wood Riding a Lime Scooter

21. (3 points) Elijah Wood, with a mass of 55 kg, is riding a Lime scooter (mass = 20 kg) while cruising along at 5 m/s. Suddenly, Elijah spots the One Ring and jumps **backwards** off of the scooter at 2 m/s. How **fast** will the Lime scooter be going after Elijah jumps off?
(*Hint:* Use conservation of momentum)