Name: _____ Period: _____

Instructor: Mr. Rodriguez Course: Conceptual Physics A

Term: Winter 2024-25

Midterm Exam

Be sure to show your work, include units when appropriate, and box your answers.

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) $3\,\text{L}$ _____ $300\,\text{mL}$
   (b) $1.2\,\text{km}$ _____ $1200\,\text{m}$
   (c) $0.02\,\text{kg}$ _____ $200\,\text{g}$
   (d) $0.000\,000\,001\,\text{m}$ _____ $1\,\text{nm}$

2. (2 points) Fill in the blank with the correct number.
   (a) $5\,\text{kg} =$ _____ g
   (b) $750\,\text{g} =$ _____ kg
   (c) $0.71\,\text{km} =$ _____ m
   (d) $10\,000\,\text{m} =$ _____ cm

3. (2 points) Express each of the following in scientific notation:
   (a) $0.000023 =$ _____
   (b) $5210000 =$ _____

4. (2 points) Express each of the following in decimal (expanded) form:
   (a) $9.2119 \times 10^{10} =$ _____
   (b) $5.7 \times 10^{-4} =$ _____

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 $3\,\text{m/s}^2$ indefinitely. If he runs for 35 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 raise his speed from $0\,\text{m/s}$ to $30\,\text{m/s}$ (which is approximately 65 mph). If the Lincoln can accelerate at $a = 3.5\,\text{m/s}^2$, how long does he need to keep the gas pedal floored to reach freeway speed?

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

9. (1 point) Acceleration is defined as a change in _____ divided by a change in _____.

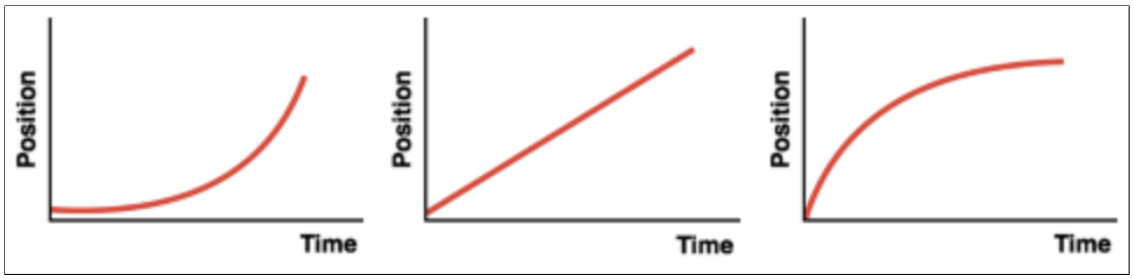

Figure 1: Position vs. Time Data for Three Trials (*from left to right*: **a, b, c**)

10. (2 points) For each of the position vs time graphs above, draw what you would expect the corresponding ticker tape data to look like:

(a)

(b)

(c)

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. An object will only change its state of motion or rest if acted upon by an external force.
    B. All objects move in straight lines forever.
    C. The force exerted on an object is equal to its mass times its acceleration.
    D. For every action, there is an equal and opposite reaction.

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

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

    (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. Explain in **2-3 complete sentences** how you can perform a simple experiment while exploiting Newton's Second Law to determine which box is full of feathers and which box is full of lead.

16. (2 points) An 18-wheeler truck coasting along on the freeway collides head on with a mosquito.
    (a) How do the **forces** on the truck and the mosquito compare?

    (b) What about their **accelerations**?

Learning Standard 4

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

Relevant Equations

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

17. (1 point) In which of the following scenarios is **momentum** 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 billiard/pool balls.

19. (2 points) Give one example of an inelastic collision **other than** a car crash.

20. (2 points) How fast would a 0.001 kg fly have to be moving in order to have the same momentum as a 400 000 kg jumbo jet airplane moving at 250 m/s?

Figure 2: Elijah Wood Riding a Lime Scooter

21. (3 points) Elijah Wood, with a mass of 65 kg, is riding a Lime scooter (mass = 15 kg) while cruising along at 6 m/s. Suddenly, Elijah spots the One Ring and jumps **backwards** off of the scooter at 3 m/s. How fast will the Lime scooter be going after Elijah jumps off?
(*Hint:* Conservation of momentum)