PHYS 201 Equations Sheet Test #1 Chapters 1, 2, & 3. Fall 2024

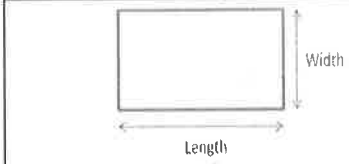
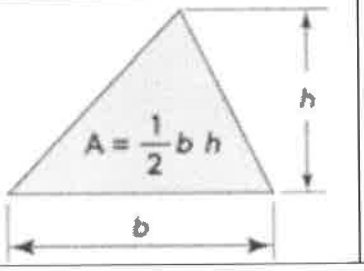
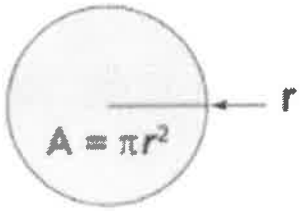
1. Equations of kinematics:

1.	2.	3.	4.	5.
$x = \bar{v}\, t$	$x = \frac{1}{2}(v_0 + v)t$	$v = v_0 + at$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$

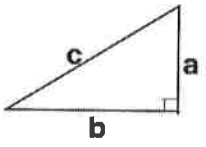
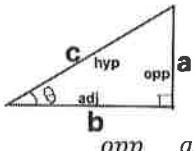
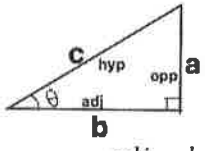
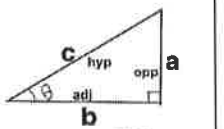
Acceleration due to gravity = g = 9.8 m/s^2, down

2. Conversion factors:
1 H = 3600 s, 1 Mile = 1608 m, 1 inch = 2.54 cm, 1 foot = 12 inch, 1 m = 3.281 ft.
1 m = 100 cm, 1 cm = 10 mm, 1 m = 1000 mm, 1 km = 1000 m

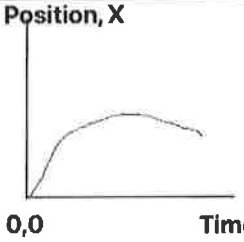
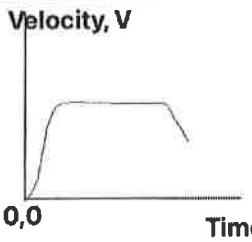
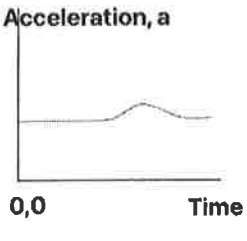
3. Areas:

Rectangle	Triangle	Circle
 Area of rectangle = *Length X Width*		

4. Pythagorean theorem and Trigonometry:

Pythagorean Theorem	*sin θ*	*cos θ*	*tan θ*	Components of a vector:
 $c^2 = b^2 + a^2$	 $Sin\ \theta = \frac{opp}{hyp} = \frac{a}{c}$	 $Cos\ \theta = \frac{adj}{hyp} = \frac{b}{c}$	 $Tan\ \theta = \frac{opp}{adj} = \frac{a}{b}$	Adjacent component = Cos Opposite component = Sin

5. Graphical analysis of motion:

	Position, X	Velocity, V	Acceleration, a
			
Slope	Velocity	Acceleration	XXXXXXXXXXXXXX
Area	XXXXXXXXXXXXX	Displacement	Change in Velocity

6. Addition of velocities: $\overrightarrow{V_{PG}} = \overrightarrow{V_{PT}} + \overrightarrow{V_{TG}}$

PHYS 201 Fall 2024 Test #1 Name: Answer Key

A. Select the correct answer for the following multiple-choice questions and write your answer in the line next to the question number.

C 1. In 2019, the SI base unit second was defined using this fundamental constant:

a. Planck constant.
b. Elementary charge.
c. Hyperfine transition frequency of the cesium 133 atom.
d. Boltzmann constant.
e. Speed of light in vacuum.
f. Avogadro constant.

C 2. What is the SI base unit for mass?
a. mg b. g c. kg d. lb e. N

e 3. Which one of the following is a SI derived unit?
a. kg b. cm^3 c. mol d. A e. m^3

d 4. Which one of the following is not a SI base unit?
a. second b. ampere c. killogram d. killometer e. mole

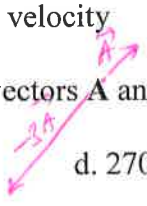
d 5. The speed of light is given below. Express it with 5 significant figures.
C=299792458 m/s
a. 2.99792458×10^8 b. 2.99792×10^8 c. 2.998×10^8 d. 2.9979×10^8

a 6. Imagine you measure the length of a paper 3 times and obtain the following measurements: 11.1 inch, 11.2 inch, and 10.9 inch. The actual length is 11 inch. How would you characterize the accuracy and precision of your measurements?
a. high accuracy, high precision b. high accuracy, low precision
c. low accuracy, high precision d. low accuracy, low precision

C 7. The speed limit on a college campus is 15 MPH. Express this speed in kmPH. (1 M = 1609 m = 1.609 km)
a. 6.7 kmPH b. 16 kmPH c. 24 kmPH d. 34 kmPH

a 8. Which one of the following is a scalar?
a. distance b. acceleration c. velocity d. weight e. displacement

C 9. What is the angle between the vectors **A** and -3**A** when they are drawn from a common origin?

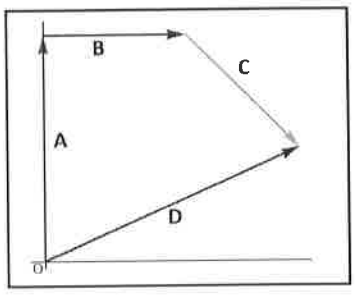


a. 0^0 b. 90^0 c. 180^0 d. 270^0 e. 360^0

a 10. A car odometer measures
a. Distance b. Displacement c. speed d. velocity e. acceleration

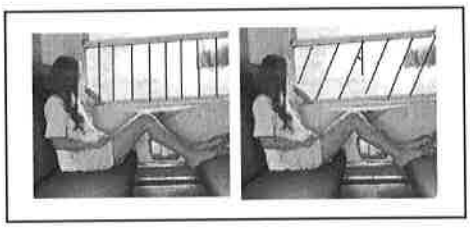
b 11. Which one of the following vector addition equations correctly shows the vector addition shown in the diagram?

a. **A + B + C + D = 0** b. **A + B + C = D**
c. **A + B = C + D** d. **A = B + C + D**



b 12. On a rainy day, a student riding a train notices the rain falling vertically at a speed of 15 MPH, when the train is at rest, as shown in the first figure. When the train moves, if the falling rain makes an angle of 24^0 as shown in the second figure, what is the speed of the train?

a. 6.1 MPH b. 6.7 MPH c. 14 MPH
d. 15 MPH e. 24 MPH f. 32 MPH



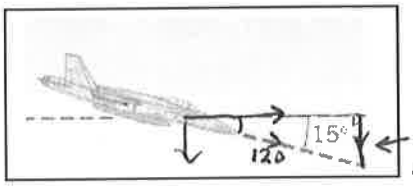
$\tan 24 = \frac{V}{15}$

$V = 15 \tan 24$

$V = 6.7$ MPH

b 13. A plane is diving as shown below with a velocity of 120 m/s at an angle of 15^0 below horizontal. What is the vertical component of the plane's velocity?

a. 31 m/s, up. b. 31 m/s, down
c. 116 m/s, up. d. 116 m/s, down



opp.

$120 \sin 15 = 31$

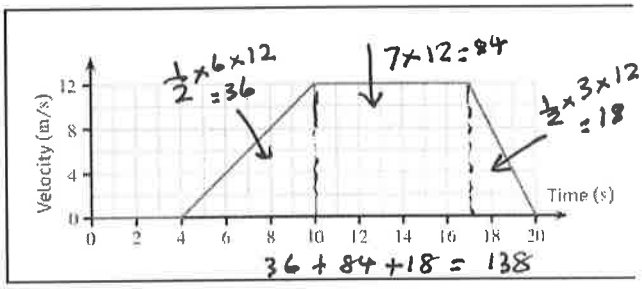
c 14. Speed is defined as,
d 15. Velocity is defined as,
b 16. Acceleration is defined as,

Answers for 14-16

a. Rate at which the speed changes b. Rate at which the velocity changes
c. Rate at which the distance changes d. Rate at which the displacement changes

17-20) Deal with the one-dimensional motion of a toy car, where the velocity is graphed as a function of time, as shown below.

d 17. At what time the car starts to move?
a. 0 s b. 1 s c. 2 s d. 4 s



a 18. Describe the motion from 4 – 10 s?
a) moving with constant acceleration
b) moving with constant deceleration
c) moving with constant speed
d) moving with constant velocity

h 19. What is the instantaneous acceleration at 18 s?
a. 0 m/s^2 b. 1 m/s^2 c. 2 m/s d. 4 m/s^2 e. 3 m/s^2 f. -1 m/s^2 g. - 2 m/s^2 h. - 4 m/s^2

e 20. How far the car travels from 0-20s?
a. 18 m b. 36 m c. 84 m d. 120 m e. 138 m f. 183 m

B. Equations of Kinematics for constant acceleration are given below:

1.	2.	3.	4.	5.
$x = \bar{v}\,t$	$x = \frac{1}{2}(v_0 + v)t$	$v = v_0 + at$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$

1. Derive the 5th equation using the equations 2 & 3.

5th eqⁿ has no t, so we need to eliminate t.

$v = v_0 + at$

$v - v_0 = at$

$\frac{v - v_0}{a} = t$

$x = \frac{1}{2}(v + v_0)t$

$x = \frac{1}{2}(v + v_0)\frac{(v - v_0)}{a}$

$2ax = (v + v_0)(v - v_0)$

$2ax = v^2 - vv_0 + v_0v - v_0^2$

$2ax = v^2 - v_0^2$

$v_0^2 + 2ax = v^2$

2. Starting from rest, a car accelerates with constant acceleration along a straight ramp of length 125-m and reaches the traffic speed of 25 m/s to merge in a freeway.

a. What is the acceleration of the car?

$v_0 = 0$

$a = ?$

$x = 125\,m$

$v = 25\,m/s$

$v^2 = v_0^2 + 2ax$

$25^2 = 0^2 + 2 \times a \times 125$

$a = \frac{25 \times 25}{250} = 2.5\,m/s^2$

$a = 2.5\,m/s^2$

b. How much time does it take the car to travel the length of the ramp?

$t = ?$

$v = v_0 + at$

$25 = 0 + 2.5t$

$2.5t = 25$

$t = 10\,s$

c. If the traffic on the freeway is moving at a constant speed of 25 m/s, what distance does the traffic travel while the car is moving the length of the ramp?

$\bar{v} = 25\,m/s$

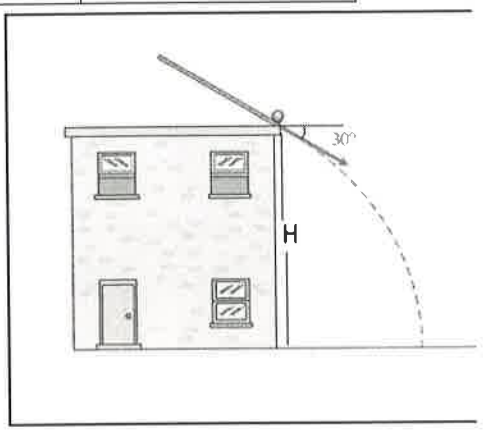
$t = 10\,s$

$x = \bar{v}t = 25 \times 10 = 250\,m$

$x = 250\,m$

1.	2.	3.	4.	5.
$y = \overline{v_y}\, t$ $x = \overline{v_x}\, t$	$y = \frac{1}{2}(v_{0y} + v_y)t$	$v_y = v_{0y} + a_y t$	$y = v_{0y}t + \frac{1}{2}a_y t^2$	$v_y{}^2 = v_{0y}^2 + 2a_y y$

C. A ball is rolling down the roof of a building of height, H, with a velocity of 14 m/s at 30^0 below the horizontal as shown. Ignore air resistance. The acceleration due to gravity = 9.8 m/s^2, down.



1. Find the horizontal and vertical components of the initial velocity of the ball?

$V_{0x} = 14\cos 30^\circ = 12.1$ m/s

$V_{0y} = 14 \sin 30 = 7$ m/s

2. If the ball is in the air for 4.5 seconds, what is the height, H of the building?

$V_{0y} = 7$ m/s
$t = 4.5$ s
$a = +9.8$ m/s^2
$H = y = ?$

$y = V_{0y}t + \frac{1}{2}at^2$

$= 7 \times 4.5 + \frac{1}{2} \times 9.8 \times 4.5^2$

$y = 31.5 + 99.23$

$y = 130.7$ m

3. How far horizontally away from the building the ball will strike the ground?

$X = V_{0x}t + \frac{1}{2}a_x t^2$

$X = 12.1 \times 4.5 + 0$

$X = 12.1 \times 4.5 = 54.5$ m

$X = 54.5$ m

4. What is the vertical component of the velocity when it strikes the ground?

$V_y = V_{0y} + a_y t$

$V_y = 7 + 9.8 \times 4.5$

$V_y = 7 + 44.1 = 51.1$ m/s

$V_y = 51.1$ m/s

5. Sketch a graph for the horizontal velocity as a function of time during the fall?