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

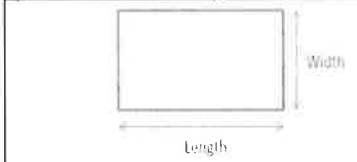
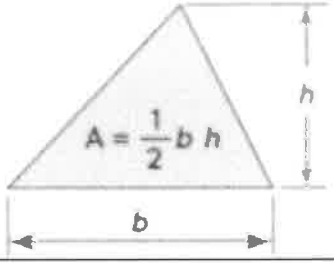
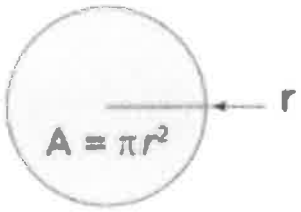
1. Equations of kinematics:

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

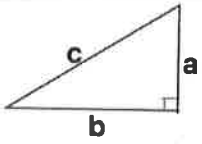
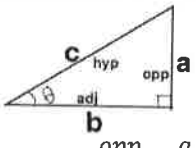
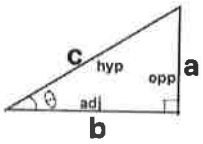
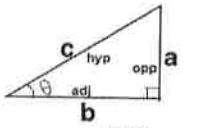
Acceleration due to gravity = g = 9.8 m/s^2, down

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

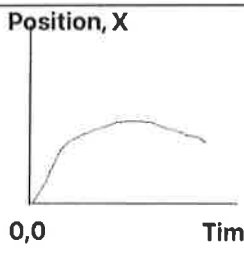
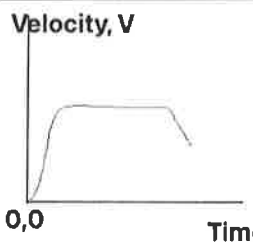
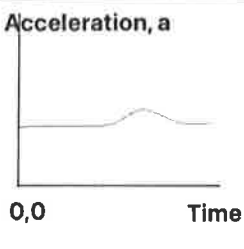
3. Areas:

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:

			
Slope	Velocity	Acceleration	XXXXXXXXXXXXXX
Area	XXXXXXXXXXXX	Displacement	Change in Velocity

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

PHYS 201 Fall 2021 Test #1 Name: Key

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

f 1. In 2019, the SI base unit mole was re-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.

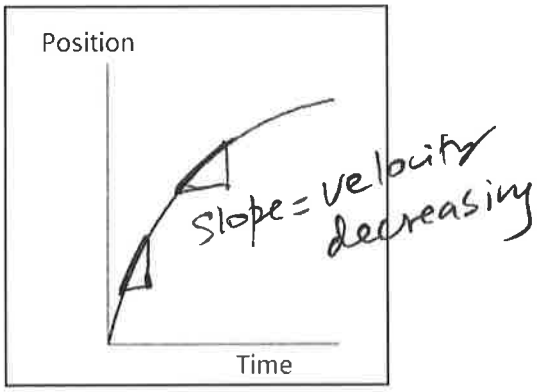
a 2. What is the SI base unit for temperature?
a. K b. ^{0}F c. ^{0}C d. ^{0}K e. F f. C

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

e 4. Which one of the following is a scalar?
a. displacement b. acceleration c. velocity d. weight e. distance

c 5. 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

b 6. For the motion described in the graph, decide whether the moving object is
a) accelerating
b) decelerating
c) moving at a constant velocity
d) moving at a constant speed

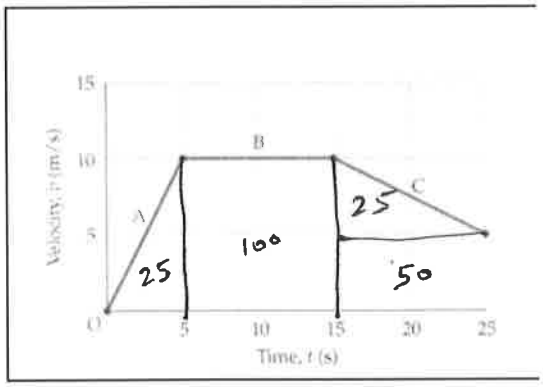


d 7. Velocity is defined as,
b 8. Acceleration is defined as,
Answers for 7 & 8
a. Rate at which the speed changes
b. Rate at which the velocity changes
c. Rate at which the distance changes
d. Rate at which the displacement changes

d 9. Speeding tickets are issued using the,
a. average speed b. average velocity c. average acceleration
d. instantaneous speed e. instantaneous velocity f. instantaneous acceleration

b 10. Which pair of the following physical quantities are zero at the highest point of the trajectory of a two-dimensional projectile motion?
a. horizontal velocity and vertical velocity
b. horizontal acceleration and vertical velocity
c. vertical acceleration and vertical velocity
d. horizontal velocity and horizontal acceleration

11-14) Deal with the one-dimensional motion of a race, duration of 25 s, where the velocity is graphed as a function of time, shown on the right.



b 11. What is the instantaneous velocity of the runner at 5 s?
a. 5 m/s b. 10 m/s c. 7.5 m/s d. -7.5 m/s

d 12. What is the instantaneous acceleration of the runner at 20 s?
a. 0 m/s^2 b. 2.0 m/s^2 c. 0.5 m/s^2 d. -0.5 m/s^2 e. -2 m/s^2

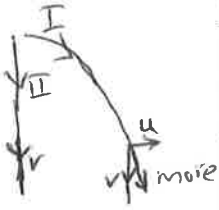
$\frac{5}{25} = \frac{1}{5} = 0.2$

b 13. What is the average acceleration for the race?
a. 0 m/s^2 b. 0.2 m/s^2 c. 0.5 m/s^2 d. 2.0 m/s^2 e. 5.0 m/s^2

$a = \frac{\Delta v}{t} = \frac{5-0}{25} = \frac{1}{5} = 0.2$

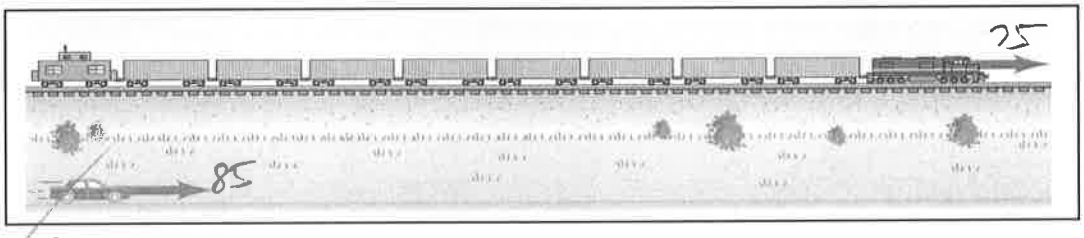
d 14. How far is the race?
a. 25 m b. 50 m c. 100 m d. 200 m e. 250 m

C 15. A ball (I) is rolled along the surface of a table and leaves the edge horizontally. At the same instant the ball I leaves the table, a second ball (II) is dropped from rest at the edge of the table. In the absence of air resistance, which ball will strike the ground first?
a. I b. II c. both at the same time



b 16. In the above question which ball will have the lower speed at the ground level?
a. I b. II c. both will have the same speed

17-18) A car traveling at 85 km/h overtakes a 0.75 km long train traveling in the same direction on a track parallel to the road. The velocity of the train is 75 km/h, eastward.



f 17. What is the velocity of the car relative to the train?
a. 85 km/h eastward b. 75 km/h eastward c. 160 km/h westward
d. 160 km/h eastward e. 10 km/h westward f. 10 km/h eastward

d 18. How long does it take the car to pass the train?
a. 0.53 min b. 0.75 min c. 3.3 min d. 4.5 min e. 5.4 min

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 following kinematic equation using the kinematic equations 2 & 3.

$x = vt - \frac{1}{2}at^2$

5

no V_0, so need to eliminate V_0.

$X = \frac{1}{2}(V_0 + V)t$

$V = V_0 + at$

$V - at = V_0$

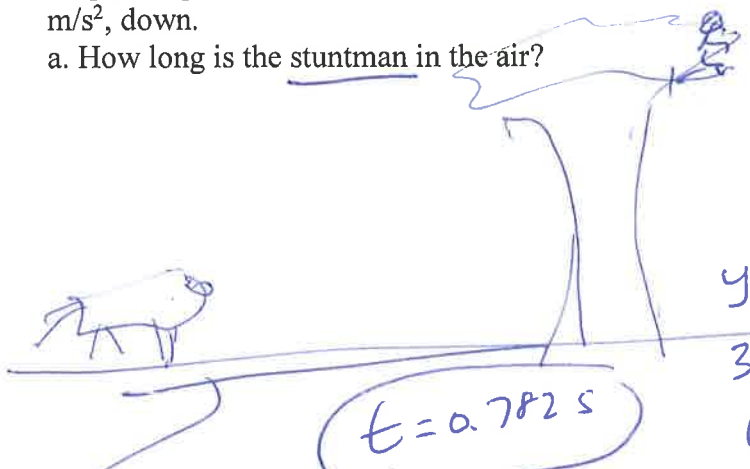
$X = \frac{1}{2}(V - at + V)t$

$X = \frac{1}{2}(2V - at)t$

$X = Vt - \frac{1}{2}at^2$

2. A stuntman sitting on a tree limb wishes to drop vertically onto a horse galloping under the tree. The initial speed of the horse is 10.0 m/s and the man is initially 3.00 m above the level of the saddle. Due to the rustling noise of the leaves, the moment the stuntman drops, the panicked horse accelerates at 4.0 m/s^2. The acceleration due to gravity = 9.8 m/s^2, down.

a. How long is the stuntman in the air?



9

$V_0 = 0$

$y = 3.00\,m$

$a = +9.8\,m/s^2$

$t = ?$

$y = V_0 t + \frac{1}{2}at^2$

$3 = 0 + \frac{1}{2} \times 9.8t^2$

$6 = 9.8t^2 \rightarrow t^2 = \frac{6}{9.8} \rightarrow t = 0.782\,s$

$t = 0.782\,s$

b. What must be the horizontal distance between the saddle and the limb when the man makes his move, to accomplish the stunt?

9

$X = ?$

$V_0 = 10\,m/s$

$a = 4.0\,m/s^2$

$t = 0.782\,s$

$X = V_0 t + \frac{1}{2}at^2$

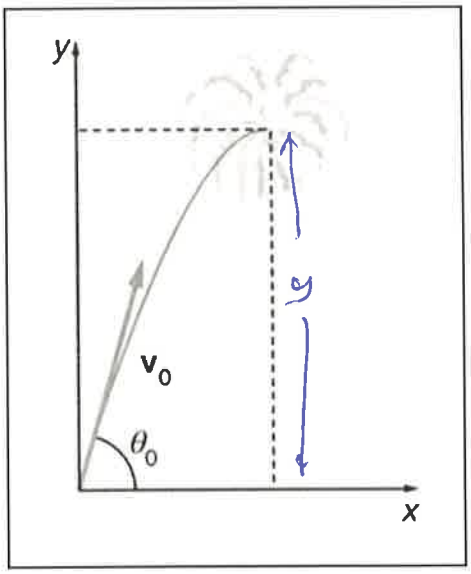
$X = 10 \times 0.782 + \frac{1}{2} \times 4.0 \times 0.782^2$

$X = 7.82 + 1.22$

$X = 9.04\,m$

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. During a fireworks display, a shell is shot into the air with an initial speed of 60.0 m/s at an angle of 65.0° above the horizontal, as illustrated in the figure. The fuse is timed to ignite the shell just as it reaches its highest point above the ground. Ignore air resistance. The acceleration due to gravity = 9.8 m/s², down.



(a) Find the horizontal and vertical components of the initial velocity, V_{ox} and V_{oy}.

$V_{0x} = V_0 \cos 65^\circ = 60 \cos 65^\circ = 25.4$ m/s

$V_{oy} = V_0 \sin 65^\circ = 60 \sin 65^\circ = 54.4$ m/s

4

(b) Calculate the height at which the shell explodes.

$y = ?$

$V_{oy} = 54.4$ m/s

$V_y = 0$

$a_y = -9.8$ m/s²

$V_y^2 + V_{oy}^2 + 2a_y y$

$0 = 54.4 + 2(-9.8)y$

$0 = 2957 - 19.6y$

$19.6y = 2957$

$y = \frac{2957}{19.6} = 150.8 \simeq$ **151 m = y**

7

(c) How much time passed between the launch of the shell and the explosion?

$t = ?$ $\quad V_y = V_{0y} + a_y t$

$0 = 54.4 - 9.8t$

$9.8t = 54.4$

$t = \frac{54.4}{9.8} =$ **5.55 sec = t**

6

(d) What is the horizontal displacement of the shell when it explodes?

$x = ?$

$V_{ox} = 25.4$ m/s

$t = 5.55$ s

$a_x = 0$

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

$x = 25.4 \times 5.55 + 0$

x = 141 m

6