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

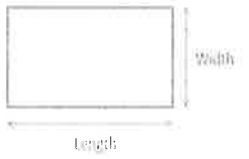
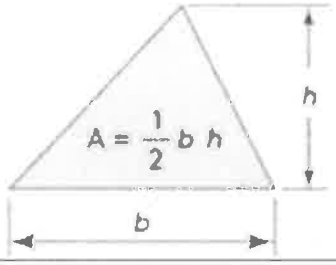
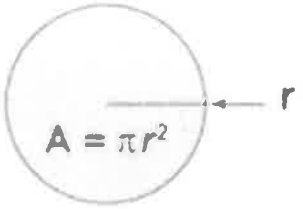
1. Equations of kinematics: PHYS 201 F2022

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

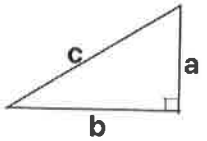
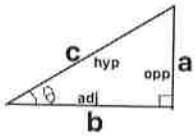
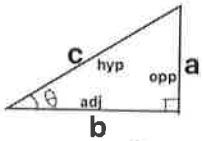
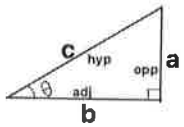
Acceleration due to gravity = g = 9.8 m/s^2, down

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

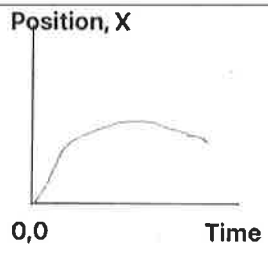
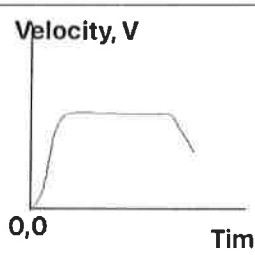
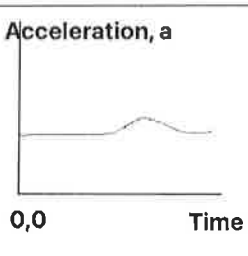
3. Areas:

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	XXXXXXXXXXXX	Displacement	Change in Velocity

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

PHYS 201 Fall 2022 Test #1 Name: KEY

2.5/10

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

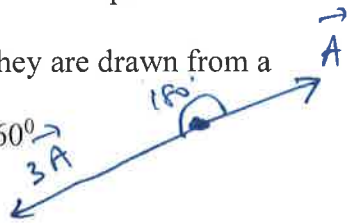
C 5. The speed of light is given below. Express it with 4 significant figures.
C=299792458 m/s
a. 2.99792458×10^8 b. 2.997×10^8 c. 2.998×10^8 d. 2.9979×10^8

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

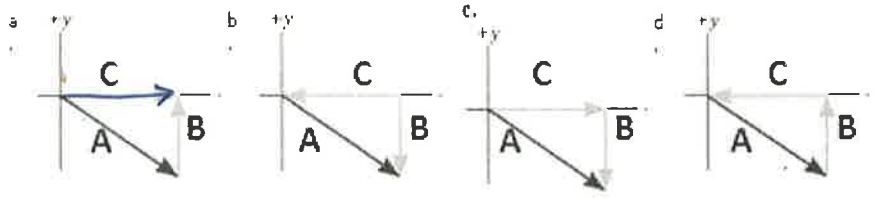
a 8. Which one of the following is a scalar?
a. distance b. acceleration c. velocity d. weight e. displacement

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

d 11. Three vectors **A, B,** and **C** are shown below in each of the diagrams. Which one represents the relationship: **A + B + C = 0 ?**



5.3 m/s 4.2 m/s 3.5 m/s
C B A
51 m 45 m 250 m

12-13) Near the end of a marathon race, three runners (A, B, and C) are close to the finish line. The first two runners (A,B) are separated by a distance of 45 m and the front runner, A is 250 m from finish line. The third runner, C is 51 m behind the second runner, B. Front runner has a velocity of 3.5 m/s, the second runner has a velocity of 4.2 m/s, and the third runner has a velocity of 5.3 m/s. Runners' velocities stay constant.

$t_A = \frac{250}{3.5} = 71.4$

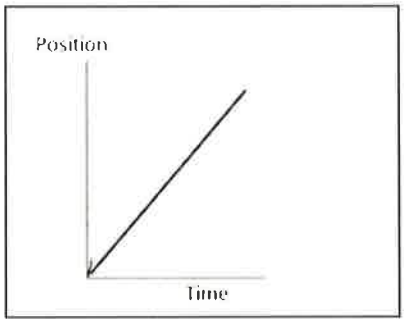
$t_B = \frac{295}{4.2} = 70.2$

$t_C = \frac{346}{5.3} = 65.3$

C 12. What is the velocity of runner B relative to the runner A?
a. 3.5 m/s b. 4.2 m/s c. 0.7 m/s d. 7.7 m/s e. 1.8 m/s f. 1.1 m/s

f 13. Which of the following correctly shows the order in which the runners win the race?
a. A,B,C b. A,C,B c. B,A,C d. B,C,A e. C,A,B f. C,B,A

C 14. For the motion described in the graph, decide whether the moving object is
a) accelerating
b) decelerating
c) moving at a constant velocity



C 15. Speed is defined as,
d 16. Velocity is defined as,
b 17. Acceleration is defined as,

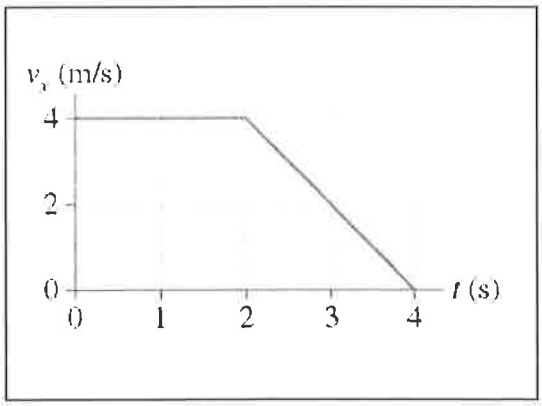
Answers for 15-17
a. Rate at which the speed changes
b. Rate at which the velocity changes
c. Rate at which the distance changes
d. Rate at which the displacement changes

18-20) Deal with the one-dimensional motion of a toy car, where the velocity is graphed as a function of time.

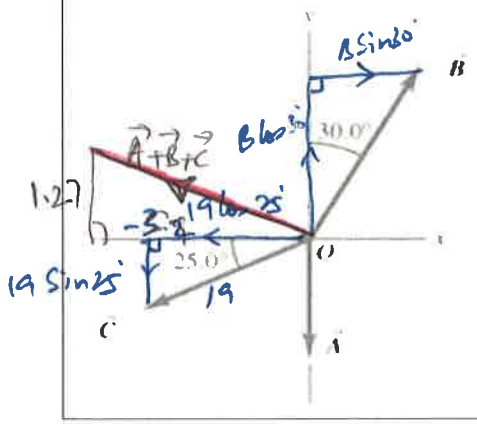
d 18. What is the instantaneous velocity at 2 s?
a. 0 m/s b. 1 m/s c. 2 m/s d. 4 m/s

g 19. What is the instantaneous acceleration at 3 s?
a. 0 m/s^2 b. 1 m/s^2 c. 2 m/s^2 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

d 20. How far the car travels from 0-4s?
a. 2 m b. 4 m c. 8 m d. 12 m



9 B. For the three vectors shown below (magnitudes: A = 15, B = 28, C = 19) complete the table:



Vector	X-component	Y-component
A=15	0	−15
B=28	28 sin 60 = 14	28 Cos 30 = 24.3
C=19	−19 cos 25 = −17.2	−19 Sin 25 = −8.03
A + B + C	−3.2	1.2

Also show the vector **A+B+C** in the diagram.

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

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

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

5 has no time, t. Need to eliminate t between 2 & 3.

3. $V = V_0 + at \rightarrow V - V_0 = at \rightarrow t = \frac{V - V_0}{a}$

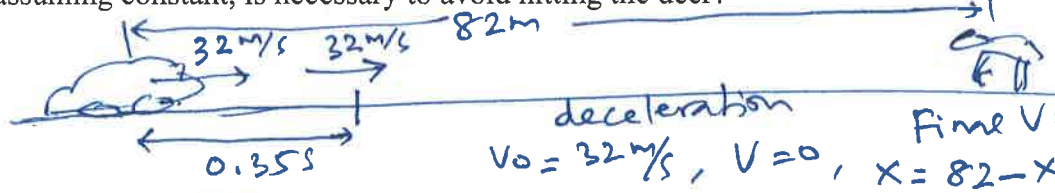
2. $X = \frac{1}{2}(V_0 + V)t = \frac{1}{2}(V + V_0)\left(\frac{V - V_0}{a}\right) = X$

$(V + V_0)(V - V_0) = 2ax$

$V^2 - V_0^2 + V_0V - VV_0 = 2ax$

$V^2 - V_0^2 = 2ax \rightarrow \boxed{V^2 = V_0^2 + 2ax}$

8 2. A driver travelling at 32 m/s and sees a deer 82 m ahead in the middle of the road. After a reaction time of 0.35 s, she applies the brakes. What minimum deceleration, assuming constant, is necessary to avoid hitting the deer?



$x_0 = \bar{v}t$

$x_0 = 32 \times 0.35$

$= 11.2\text{ m}$

deceleration

$V_0 = 32\text{ m/s}$, $V = 0$, $X = 82 - X_0$

Final $V = 0$, not to hit the deer

$X = 82 - 11.2 = 70.8\text{ m}$

$V^2 = V_0^2 + 2ax$

$0 = 32^2 + 2a(70.8)$

$0 = 1024 + 141.6a$

$141.6a = -1024$

$a = \frac{-1024}{141.6} = -7.2\text{ m/s}^2$

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

25
5 each

D. A projectile is launched, and it reaches a maximum height of 35 m and a range of 110 m. Ignore air resistance. The acceleration due to gravity = 9.8 m/s^2, down.

1. Find the initial vertical velocity of the projectile?

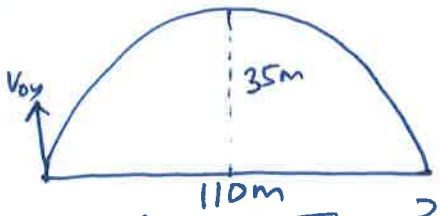
$V_{oy} = ?$ $V_y = 0$, $y = 35$, $a_y = -9.8\ m/s^2$

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

$0 = V_{oy}^2 + 2(-9.8)y$

$0 = V_{oy}^2 - 19.6y$

$0 = V_{oy}^2 - 19.6 \times 35 \longrightarrow V_{oy}^2 = 686 \rightarrow V_{oy} = \sqrt{686} = 26.2\ m/s$



2. How long it took to reach the maximum height?

$t = ?$ $V_y = V_{oy} + a_y t$

$0 = 26.2 - 9.8t$

$9.8t = 26.2$

$t = \frac{26.2}{9.8} = 2.67$ sec

3. Find the initial horizontal velocity of the projectile?

2.67 s to reach the max height.

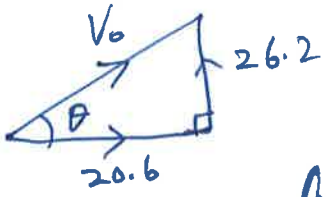
For the entire motion, $t = 2 \times 2.67 = 5.34$ sec

$x = V_{ox}t + \frac{1}{2}a_x t^2$ ($a_x = 0$)

$110 = V_{ox} \times 5.34$

$\frac{110}{5.34} = V_{ox} = 20.6\ m/s$

4. What is the launch angle of the projectile?



$\tan\theta = \frac{26.2}{20.6} = 1.272$

$\theta = \tan^{-1}(1.272) = 52^\circ$

$\theta = 52^\circ$

5. Sketch a graph for the vertical velocity as a function of time.