PHYS 201-001 **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. 3pts, each.

c 1. In 2019, the SI base unit kilogram is re-defined using these fundamental constants:

a. Planck constant, Avogadro constant, and the elementary charge.
b. Planck constant, elementary charge, and speed of light in vacuum.
c. Planck constant, hyperfine transition frequency of the cesium 133 atom, and speed of light in vacuum.
d. Planck constant, elementary charge, and the hyperfine transition frequency of the cesium 133 atom.
e. Planck constant, Boltzmann constant, and speed of light in vacuum.

d 2. What is the SI base unit for temperature?

a. ^{0}K b. ^{0}F c. ^{0}C d. K

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. Speeding tickets are issued using the,

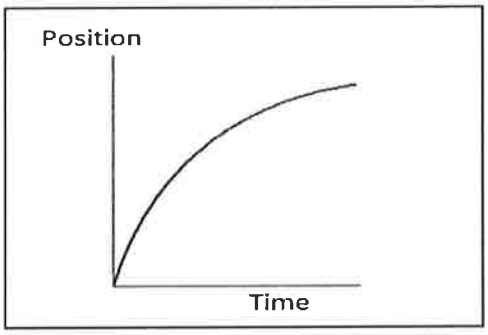
a. average speed b. average velocity c. average acceleration
d. instantaneous speed e. instantaneous velocity f. instantaneous acceleration

e 5. The slope of the position *versus* time graph gives,

a. time b. displacement c. acceleration d. position e. velocity

b 6. For the motion described in the graph, decide whether the moving object is

a) accelerating
b) decelerating
c) moving at a constant speed
d) moving at a constant velocity



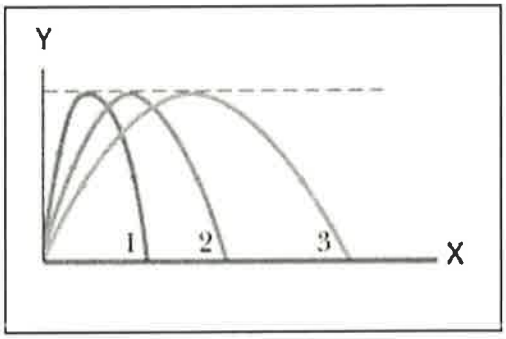
7-8) The figure below shows three paths for a football kicked from ground level. Ignore the effects of air.

c 7. Rank the paths, according to initial horizontal velocity component, greatest first.

d 8. Rank the paths, according to initial vertical velocity component, greatest first.

Answers for 7 and 8:

a. 1>2>3
b. 2>3>1
c. 3>2>1
d. All tie (1=2=3)



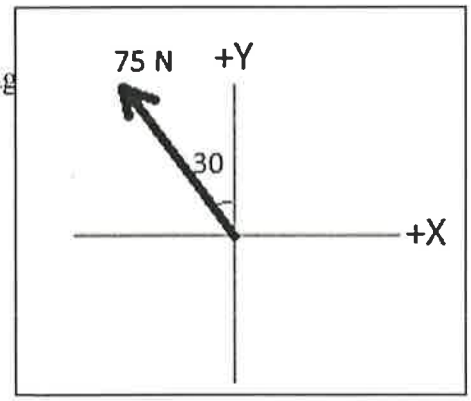
$\tan 25 = \frac{V}{5}$ $V_{RG} = 5\,m/s \downarrow$ $\vec{V}_{RT} = \vec{V}_{RG} + \vec{V}_{GT}$

$V = 5\tan 25$ $V_{RT} =$ $= \vec{V}_{RG} - \vec{V}_{TG}$

b 9. A person looking out the window of a stationary train notices that raindrops are falling vertically down at a speed of 5.0 m/s relative to the ground. When the train moves to the right at a constant velocity, the raindrops make an angle of 25 ° when they move past the window, as the drawing shows. How fast is the train moving?
(Use relative velocity principles)
a. 2.1 m/s b. 2.3 m/s c. 4.5 m/s d. 5.0 m/s

C 10. What is the angle between the vectors **A** and **–A** when they are drawn from a common origin?
a. 0^0 b. 90^0 c. 180^0 d. 270^0 e. 360^0

C 11. What is the +X component of the force 75N shown in the diag which is in the 2nd quadrant and makes 30^0 with the +Y axis?
a. 37.5 N b. 65 N c. -37.5 N
d. -65 N e. 75N f. -75 N



e 12. Which one of the following is a scalar?
a. velocity b. displacement c. acceleration
d. weight e. time interval

C 13. Which one of the following is a vector?
a. speed b. distance c. acceleration
d. temperature e. pressure

C 14. Imagine you measure the length of a stick 5 times and obtain the following measurements: 4.40 m, 4.43m, 4.47m, 4.39m, and 4.30m. The stick's actual length is 5.80 m. 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

b 15. The speed limit on a college campus is 25 MPH. When a student drives her car at the speed limit, how far she will go in two seconds? (1 M = 1609 m and 1 H = 3600 s)
a. 11 m b. 22 m c. 25 m d. 50 m e. 56 m

$25\,MPH = 25 \times \frac{M}{H} \times \frac{1609\,m}{M} \times \frac{1\,H}{3600\,s}$
$= 11.17\,m/s$

C 16. A tree is 6 feet 5 inches tall. Express this height in cm.
(1 inch = 2.54 cm and 1 ft = 12 inch)
a. 216 cm b. 183 cm c. 196 cm d. 198 cm e. 210 cm

d 17. In the revised SI, the Planck constant *h* is equal to exactly $6.626\,070\,15 \times 10^{-34}$ J.s. Express it with only 5 significant figures:
a. 6.626×10^{-34} b. 6.62607×10^{-34} c. 6.6260×10^{-34} d. 6.6261×10^{-34}

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.

(5)

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

$at = v - v_0$

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

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

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

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

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

2. A car traveling at 18 m/s hits a bridge abutment. A passenger in the car moves forwards a distance of 0.95 m while being brought to rest by an inflated air bag. Determine the deceleration of the passenger?

(5)

$v_0 = 18$ m/s $\quad v = 0$, $\quad x = 0.95$ s

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

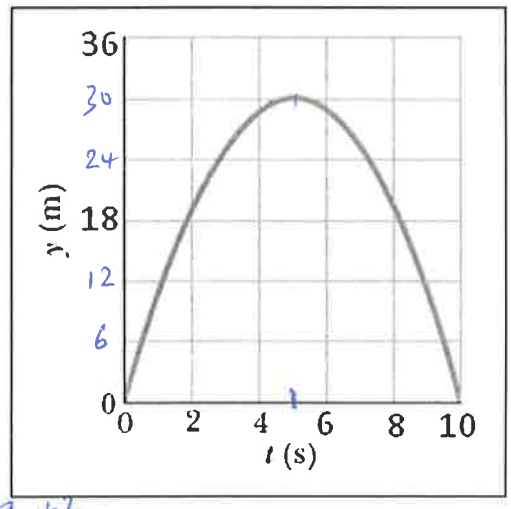
$0 = 18^2 + 2a \times 0.95$

$0 = 324 + 1.9a$

$1.9a = -324$

$a = -324/1.9 = -171$ m/s^2

3. A ball is shot vertically upward from the surface of another planet. A plot of y versus t for the ball is shown below, where y is the height of the ball above its starting point and $t = 0$ at the instant the ball is shot.



(3) a. What is the highest height reached by the ball? 30 m

(3) b. How long it took to reach the highest point? 5 s

c. Determine the initial velocity of the ball?

$V_{oy} = ?$ $\quad a_y = ?$ $\quad V_y = 0$, $\quad y = 30$m, $\quad t = 5$s

(5)

$y = \frac{1}{2}(V_{oy} + V_y)t$

$30 = \frac{1}{2}(V_{oy} + 0) \times 5$

$30 = 2.5\,V_{oy} \rightarrow V_{oy} = \frac{30}{2.5} = 12$ m/s

d. Determine the free-fall acceleration on the planet?

Method I

(5)

$V_y = V_{oy} + a_y t$

$0 = 12 + a_y \times 5$

$a_y = -12/5 = -2.4$ m/s^2

Method II

$y = V_{oy} t + \frac{1}{2} a_y t^2$

$30 = 12 \times 5 + \frac{1}{2} a_y \times 5^2$

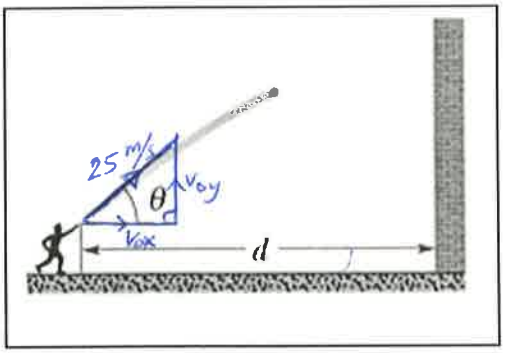
$30 = 60 + 12.5\,a_y$

$-30 = 12.5\,a_y \rightarrow a_y = -2.4$ m/s^2

Equations of Kinematics for constant acceleration are given below: g = 9.8 m/s^2, down.

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

C. You throw a ball toward a wall at speed 25.0 m/s and at angle $\theta = 34.0^0$ above the horizontal as shown below. The wall is distance $d = 22.0$ m from the release point of the ball.



(4) (a) Determine the horizontal and vertical components of the initial velocity.

$V_{ox} = 25 \cos 34 = 20.73$ m/s

$V_{oy} = 25 \sin 34 = 13.99$ m/s

(4) (b) How much time the ball takes to hit the wall?

(4) (c) How far above the release point does the ball hit the wall?

$V_{ox} = 20.73$ m/s

$a_x = 0$

$d = x = 22$ m

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

$22 = 20.73t$ $\quad t = \frac{22}{20.73} = 1.06$ s

$V_{oy} = 13.99$ m/s, $y = ?$

$a_y = -9.8$ m/s^2

$t = 1.06$ s

$y = V_{oy}t + \frac{1}{2}a_y t^2$

$y = 13.99 \times 1.06 + \frac{1}{2}(-9.8)(1.06^2)$

$y = 14.83 - 5.51 = 9.32$ m

(6) (d) What are the (1) horizontal and (2) vertical components of its velocity as it hits the wall?

$V_x = V_{ox} + a_x t$ ($a_x = 0$)

$V_x = V_{ox} = 20.73$ m/s

$V_x = 20.73$ m/s

$V_y = V_{oy} + a_y t$

$= 13.99 - 9.8 \times 1.06$

$V_y = 13.99 - 10.39$

$V_y = 3.60$ m/s

(5) (e) When it hits, has it passed the highest point on its trajectory? Explain your answer.

NO. Since $V_y = +3.60$ m/s, it is going up. It has not passed the highest point.