PHYS 101H Summer 2016 Test #1 Name: KEY

2 pt each

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

e 1. Today, the standard kilogram is defined in terms of
b 2. Today, the standard meter is defined in terms of

Answers for 1 & 2

a. the distance from the earth's equator to the north pole.
b. the length traveled by light in vacuum during the time interval of 1/299792458 of a second.
c. the electromagnetic waves emitted by cesium atoms
d. the standard bar made of platinum-iridium alloy
e. the standard cylinder made of platinum-iridium alloy
f. the speed of sound

e 3. The number of base units in SI:

a. 3 b. 4 c. 5 d. 6 e. 7 f. 8

d 4. Which one of the following is not a SI base unit?

a. second b. ampere c. kilogram d. killometer e. mole

d 5. What does a car speedometer measure?
c 6. What does a car odometer measure?

Answers for 5 & 6

a. average velocity b. average speed c. distance
d. instantaneous speed e. instantaneous velocity f. displacement

e 7. The slope of the position *versus* time graph gives,
c 8. The slope of the velocity *versus* time graph gives,

Answers for 7 & 8

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

b 9. 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

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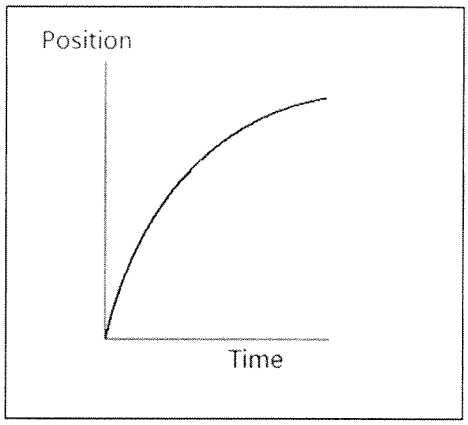
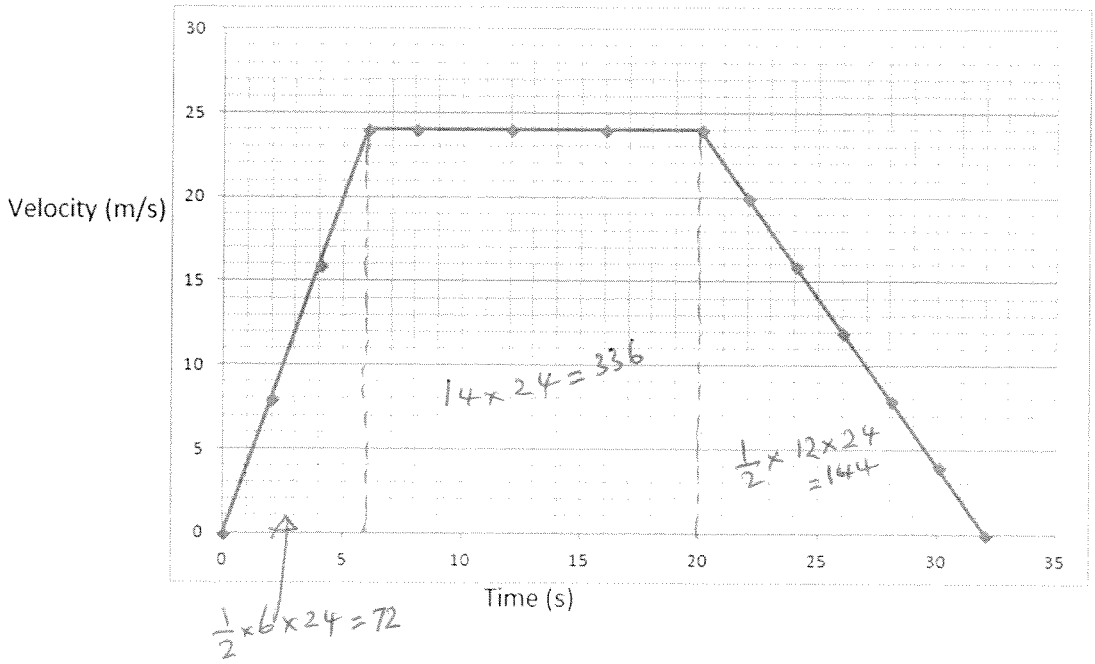


b 10. Which one of the following is a vector?

a. Distance b. Displacement c. Speed d. Time e. Mass

b 11. 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

12-18) Deal with the one-dimensional motion of an object, which is graphed below.



b 12. The above graph is,
a. time *versus* velocity b. velocity *versus* time

b 13. What is the instantaneous velocity of the object at 6 s?
a. 20 m/s b. 24 m/s c. 25 m/s d. 30 m/s e. 38 m/s

e 14. What is the instantaneous acceleration of the object at 5 s?
a 15. What is the instantaneous acceleration of the object at 15 s?
h 16. What is the instantaneous acceleration of the object at 25 s?
Answers for 14-16
a. 0 m/s^2 b. 1.0 m/s^2 c. 2.0 m/s^2 d. 3.0 m/s^2 e. 4.0 m/s^2
f. -0.5 m/s^2 g. -1.0 m/s^2 h. -2.0 m/s^2 i. -3.0 m/s^2 j. -4.0 m/s^2

a 17. How far the object travels during the first 6 s?
d 18. How far the object travels during the entire trip?
Answers for 17-18
a. 72 m b. 144 m c. 336 m d. 552 m e. 768 m

B. A park ranger wanted to measure the height of a tall tree. The ranger stood 9.50 m from the base of the tree; and he observed that his line of sight made an angle of 65.2° above the horizontal as he looked at the top of the tree. The park ranger's eyes are 1.80 m above the ground. What is the height of the tree?

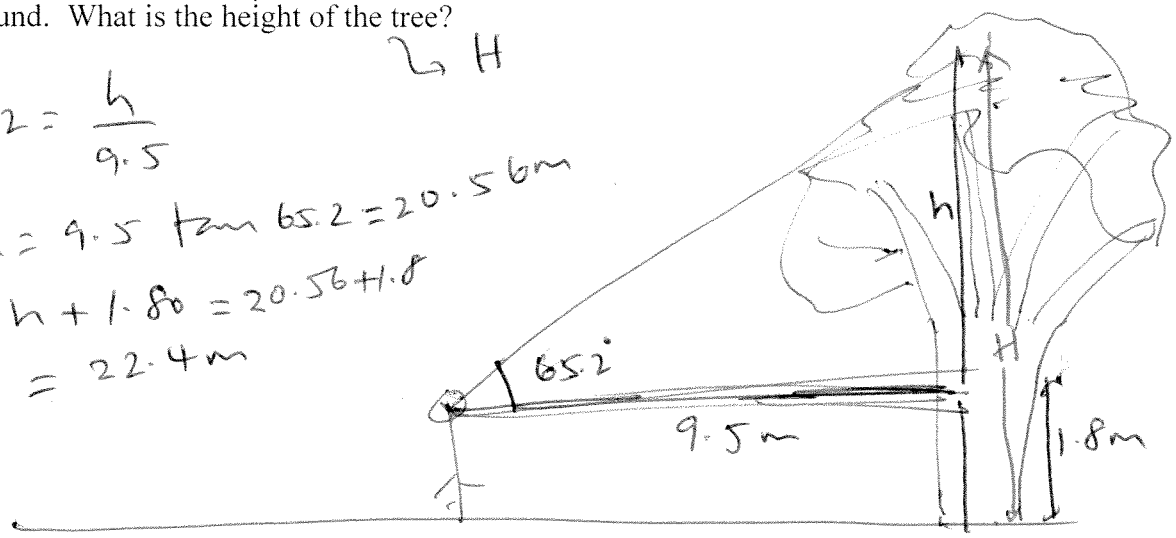
6

$\tan 65.2 = \frac{h}{9.5}$ → H

$h = 9.5 \tan 65.2 = 20.56\text{m}$

$H = h + 1.80 = 20.56 + 1.8$

$H = 22.4\text{m}$



C. For the three vectors shown below, (A = 30, B = 10, C = 15) complete the table:

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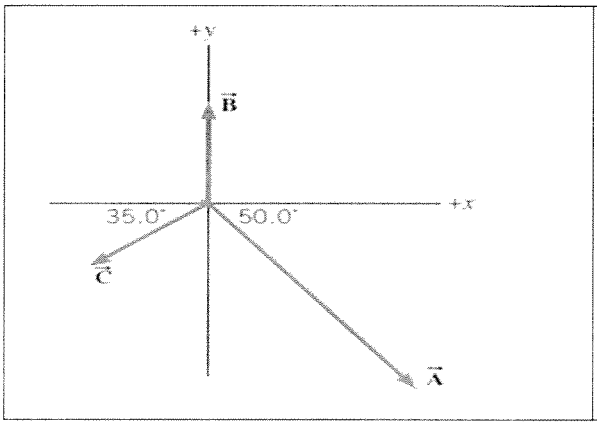
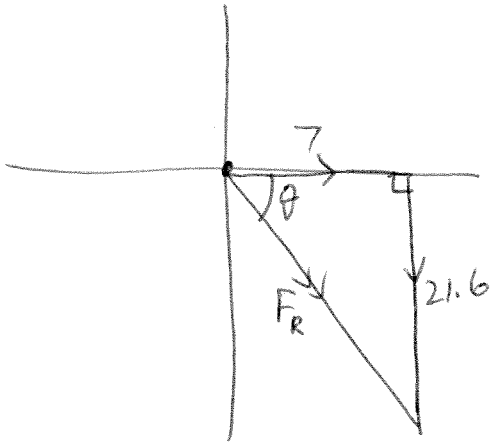


Vector	+X component	+Y component
A	$30\cos 50°$ 19.3	$-30\sin 50°$ -23.0
B	0	10
C	$-15\cos 35°$ -12.3	$-15\sin 35°$ -8.60
A + B + C	7.00	−21.6

D. Find the magnitude and direction of the resultant vector, **A + B + C.**

6



$\tan\theta = \frac{21.6}{7} = 3.09$

$\theta = 72°$

$F_R = \sqrt{7^2 + 21.6^2}$

$= 22.7$

22.7 @ 72° South of East

22.7 @ 288°

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

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

1. Derive the 5th equations using the first two.

6

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

$$v = at$$

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

$$x = \frac{1}{2}(2v - at)t$$

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

3. A car is traveling at 20.0 m / s, and the driver sees a traffic light turn red. After 0.530 s (the reaction time), the driver applies the brakes, and the car decelerates at $7.00\ m/s^2$. What is the stopping distance of the car, as measured from the point where the driver first sees the red light?

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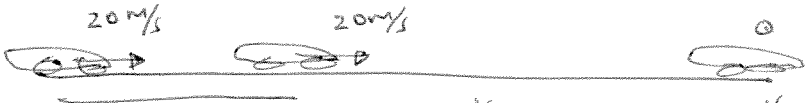


0.53 s

$x_1 = vt$

$= 20 \times 0.53$

$= 10.6\ m$

$v_0 = 20\ m/s$, $v = 0$, $a = -7\ m/s^2$

$v^2 = v_0^2 + 2ax_2$

$0 = 20^2 - 2 \times 7 \times x_2$

$14x_2 = 20^2 = 400$ $\quad x_2 = 28.6$

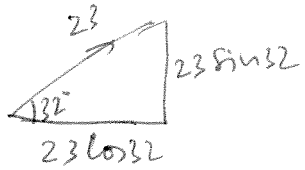
stopping dist. $= 10.6 + 28.6$

$= 39.2\ m$

2. A football is kicked with an initial velocity of 23 m/s at an angle of 32^0 above ground.
a. What are the horizontal and vertical components of the initial velocity?
b. What is the hang-time of the football?
c. What is the range (horizontal distance) of the football?

7

a.



$V_{ox} = 19.5\ m/s$

$V_{oy} = 12.2\ m/s$

b. ↑ $y = 0$, $V_{oy} = 12.2\ m/s$, $a = -9.8\ m/s^2$

$0 = V_{oy}t + \frac{1}{2}a_y t^2$

$0 = 12.2t - 4.9t^2$

$4.9t = 12.2$

$t = \frac{12.2}{4.9}$

$t = 2.49$ sec

c. → $x = v_{ox}t + \frac{1}{2}a_x t^2$

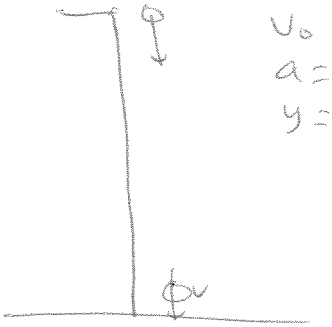
$x = 19.5 \times 2.49 +$

$x = 48.5\ m$

F. Equations of Kinematics for constant acceleration are given below:
(Earth's acceleration due to gravity = 9.8 m/s^2, down. Ignore air resistance).

1.	2.	3.	4.
$v = v_0 + at$	$y = \frac{1}{2}(v + v_0)t$	$y = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0{}^2 + 2ay$

1. A penny is dropped from rest from the top of a high-rise building, 325-m high. Find the speed at which the penny will strike the ground.



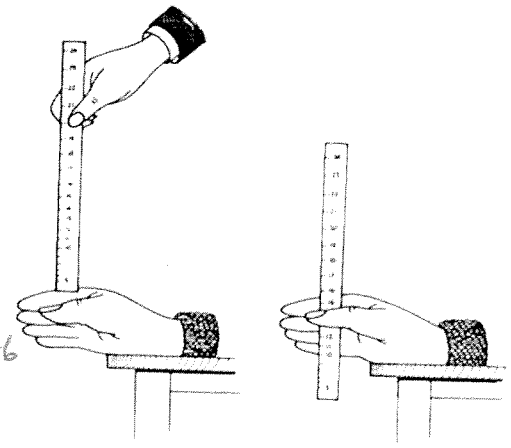
$V_0 = 0$
$a = 9.8\ m/s^2$
$y = 325\ m$

$V^2 = V_0^2 + 2ay$
$V^2 = 0^2 + 2 \times 9.8 \times 325$
$V^2 = 6370$
$V = 79.8\ m/s$

2. In an effort to measure the reaction time, a ruler is dropped vertically as shown below. Initially the 0-cm mark is between the thumb and fingers of the catcher. If the ruler is caught at 14 cm, calculate the reaction time of the catcher.

$V_0 = 0$
$y = 14cm = 0.14m$
$a = 9.8\ m/s^2$
$t = ?$

$y = v_0 t + \frac{1}{2}at^2$
$0.14 = \frac{1}{2} \times 9.8\, t^2$
$t^2 = \frac{2 \times 0.14}{9.8} = 0.0286$
$t = 0.17\ s$



3. An astronaut on a distant planet wants to determine its acceleration due to gravity. The astronaut throws a rock straight up with a velocity of + 14.0 m/s and measures a time of 27.6 s before the rock returns to his hand.
a. What is the acceleration due to gravity on this planet?
b. Sketch the velocity VS. time graph, for the motion.

$t = 27.6\ s$
$V_0 = 14\ m/s$
$y = 0$
$a = ?$

$y = V_0 t + \frac{1}{2}at^2$
$0 = 14 \times 27.6 + \frac{1}{2}a\, 27.6^2$
$a = -\frac{2 \times 14 \times 27.6}{27.6^2} =$
$a = -1.01\ m/s^2$