PHYS 201 Fall 2025 Test #1 Name:_________________________

2 pts each

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 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. F f. C

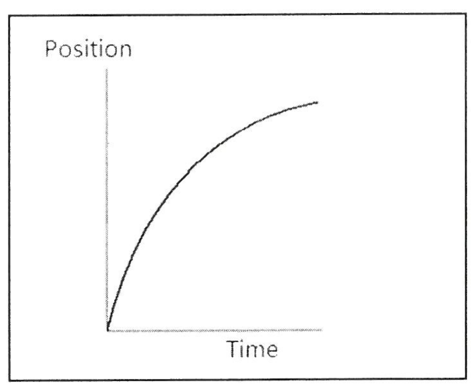
_e_ 3. Which one of the following is a SI derived unit?
a. kg b. cm^3 c. mol d. A e. m^3

_c_ 4. 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

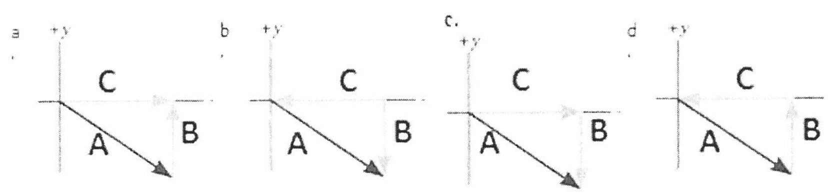
_e_ 5. Which one of the following is a scalar?
a. displacement b. acceleration c. velocity d. weight e. pressure

_a_ 6. 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_ 7. 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



_a_ 8. Three vectors **A, B,** and **C** are shown below in each of the diagrams.
Which one represents the relationship: **C = A + B ?**



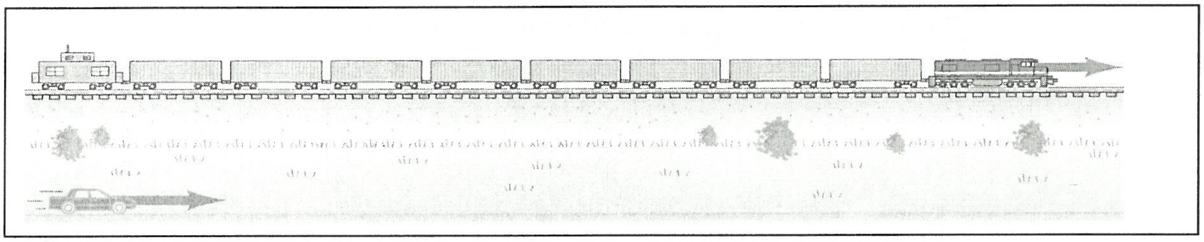
C 9. A ball (I) is rolled along the surface of a table and leaves the edge horizontally. At the same instant the ball I leaves the table, a second ball (II) is dropped from rest at the edge of the table. In the absence of air resistance, which ball will strike the ground first?

a. I b. II c. both at the same time

b 10. 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

11-12) A car traveling at 65 km/h, overtakes a 0.26 km long train traveling in the same direction on a track parallel to the road. The velocity of the train is 52 km/h, eastward.



f 11. What is the velocity of the car relative to the train?

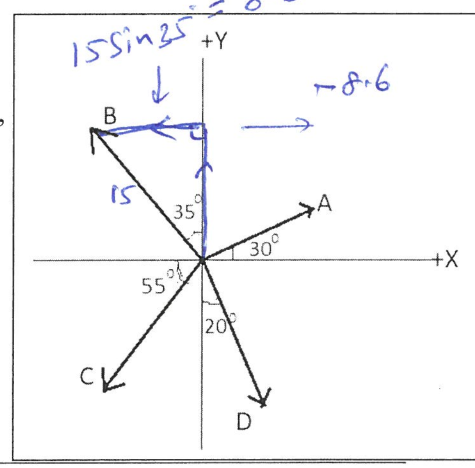
a. 65 km/h eastward b. 52 km/h eastward c. 13 km/h westward
d. 117 km/h eastward e. 117 km/h westward f. 13 km/h eastward

d 12. How long does it take the car to pass the train?

a. 12 s b. 14 s c. 18 s d. 72 s

e 13. Four vectors are shown in the cartesian coordinate System. (Magnitudes are: A = 8.00 m, B = 15.0 m, C = 12.0 m, and D = 10.0 m). What is the +X component of the vector B?

a. 8.6 m
b. 6.9 m
c. 9.8 m
d. 12.3 m
e. – 8.6 m
f. – 6.9 m
g. – 9.8 m
h. – 12.3 m



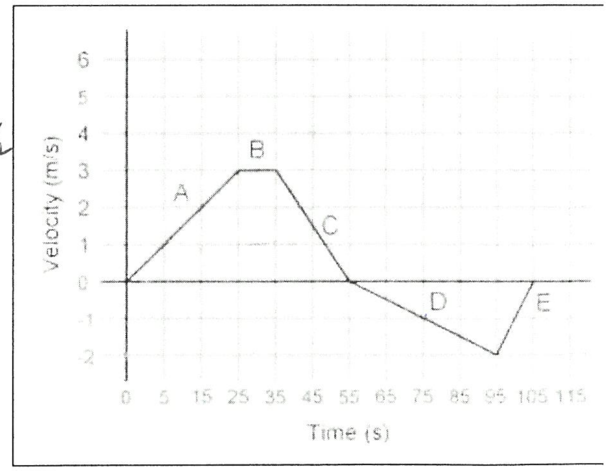
End of MC questions

B. Deal with the one-dimensional motion, duration of 105 s, where the velocity is graphed as a function of time.

3 a. What is the instantaneous velocity at 75 s? −1 m/s

5 b. What is the instantaneous acceleration at 75 s?

5 c. What is the displacement from 55 s to 105 s?



b. (55, 0), (95, −2) slope = $\frac{(-2-0)}{(95-55)} = \frac{-2}{40} = -0.05\ m/s^2$

c. $\frac{1}{2} \times (105-55) \times (-2)$

$= -50$ m

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

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

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1. Derive the 5[th] equations using the equations 2 & 3.

$2 \rightarrow \quad x = \frac{1}{2}(v_0 + v)t \qquad v = v_0 + at \leftarrow 3$

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

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

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

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

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

$\boxed{v^2 = v_0^2 + 2ax}$

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.

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a. How long is the stuntman in the air?

$v_0 = 0$
$y = 3\text{ m}$
$a = 9.8\text{ m/s}^2$
$t = ?$

$y = v_0 t + \frac{1}{2}at^2$

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

$3 = 4.9t^2$

$t^2 = \frac{3}{4.9} = 0.612$

$\boxed{t = 0.78\text{ s}}$

10

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

For the horse
$v_0 = 10\text{ m/s}$
$t = 0.78\text{ s}$
$a = 4.0\text{ m/s}^2$

$x = v_0 t + \frac{1}{2}at^2$

$= 10 \times 0.78 + \frac{1}{2} \times 4 \times 0.78^2$

$= 7.8 + 1.22$

$\boxed{x = 9.0\text{ m}}$

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

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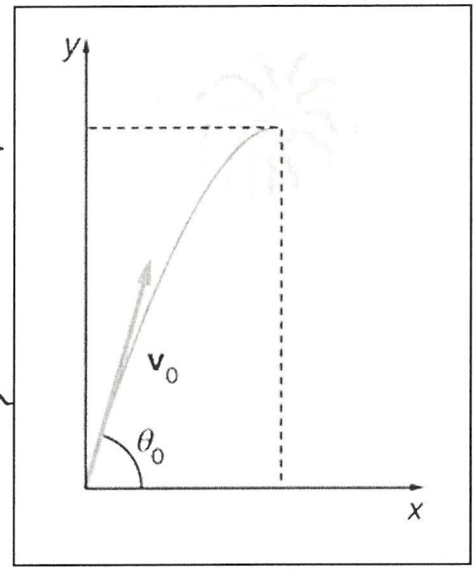
D. During a fireworks display, a shell is shot into the air with an initial speed of 60.0 m/s at an angle of 65.0° above the horizontal, as illustrated in the figure. The fuse is timed to ignite the shell just as it reaches its highest point above the ground. Ignore air resistance. The acceleration due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



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

$V_{ox} = V_0 \cos\theta_0 = 60 \cos 65° = 25.4$ m/s

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$V_{oy} = V_0 \sin\theta_0 = 60 \sin 65° = 54.4$ m/s

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

$y = ?\quad V_y = 0,\quad V_{oy} = 54.4$ m/s, $a = -9.8$ m/s²

$V_y^2 = V_{oy}^2 + 2ay$

4

$0 = 54.4^2 + 2(-9.8) \times y$

$19.6y = 2959.4 \rightarrow$ $y = 151$ m

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

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

$0 = 54.4 - 9.8t$

4

$9.8t = 54.4$

$t = 54.4/9.8 = 5.55$ sec, $t = 5.6$ s

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

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

4

$x = 25.4 \times 5.55 + 0$

$x = 141$ m

(e) Plot the vertical velocity as a function of time from the time it is shot till it explodes.

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