

Physics 5A - Winter 2021 Midterm 1

ZOE GLEASON

TOTAL POINTS

100 / 100

QUESTION 1

11 4 / 4

- ✓ - 0 pts Correct
- 2 pts Correct with one answer
- 4 pts Incorrect

QUESTION 2

2 2 4 / 4

- ✓ - 0 pts Correct
- 4 pts Incorrect

QUESTION 3

3 3 4 / 4

- ✓ - 0 pts Correct
- 4 pts Incorrect

QUESTION 4

4 4 4 / 4

- ✓ - 0 pts Correct
- 4 pts Incorrect

QUESTION 5

5 5a 22 / 22

- ✓ - 0 pts Correct
- 3 pts Fx
- 3 pts Fy
- 3 pts Tx
- 3 pts Ty
- 3 pts Bx
- 3 pts By
- 4 pts Incorrect units

QUESTION 6

6 5b 22 / 22

- ✓ - 0 pts Correct
- 3 pts Incorrect units for magnitude

- 3 pts Incorrect value for magnitude
- 5 pts Incorrect process for magnitude
- 6 pts Incorrect value for direction
- 5 pts Incorrect units for direction
- 2 pts Correct direction showed in the process but not in the answer

QUESTION 7

7 6 40 / 40

- ✓ + 40 pts Correct
- + 5 pts $x(t) = v_0 t \cos\theta$
- + 5 pts $y(t) = v_0 t \sin\theta - \frac{1}{2}gt^2$
- + 10 pts $y(t^*) = 0$ therefore $t^* = \frac{2v_0 \sin\theta}{g}$
- + 5 pts $L = x(t^*)$
- + 10 pts $L(v_0) = \frac{v_0^2 \sin^2\theta}{g}$
- + 0 pts Incorrect

Midterm 1 Solutions

Physics 5A, Winter 2021

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There is only one correct answer for each multiple-choice question. Clearly write all answers in the boxes below each question.

On free-answer questions, it is not sufficient to just present the final answer on any given problem. **You need to show all of your work** in your solution to justify your steps so that another person can understand how you arrived at the final answer.

All work must be your own and do not communicate with anyone about the exam. Be prepared to defend anything you write down in a potential follow-up oral examination.

Your submitted exam on Gradescope must contain the same number of pages as the original exam packet and your solutions must be clearly written in the spaces below each question with your final answer clearly boxed or circled. (You may want to work on the problems on scratch paper, and when you are happy with your solution, write down your final solution in the space provided on the exam packet. But, do not turn in scratch paper on Gradescope – we will only grade what is written in the proper sections on the exam packet.)

Have fun! Good luck!

Multiple-choice/Short-answer Section – Each question only has one correct answer. These questions are either correct or incorrect, you do not need to show your work.

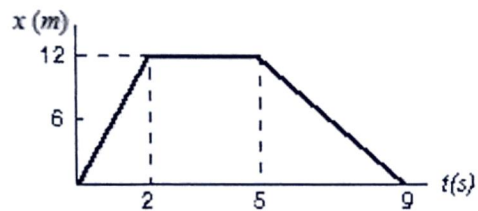
1. During a short time interval the speed v in m/s of a car is given by $v = at^4 - b$, where the time t is in seconds. The units of a and b are respectively:

A: m/s^5

B: m/s

2. This graph shows the position of a particle as a function of time. What is its average velocity between $t = 0s$ and $t = 9s$?

$0 m/s$



3. Throughout a time interval, while the speed of a particle increases as it moves along the x axis, its acceleration and velocity could be:

- A. negative and negative, respectively
- B. positive and negative, respectively
- C. negative and positive, respectively
- D. positive and zero, respectively

A

4. A stone is thrown horizontally and follows the path XYZ shown. The direction of the acceleration of the stone at point Y is:

- A. ↓
- B. →
- C. ↘
- D. ✓
- E. ↗



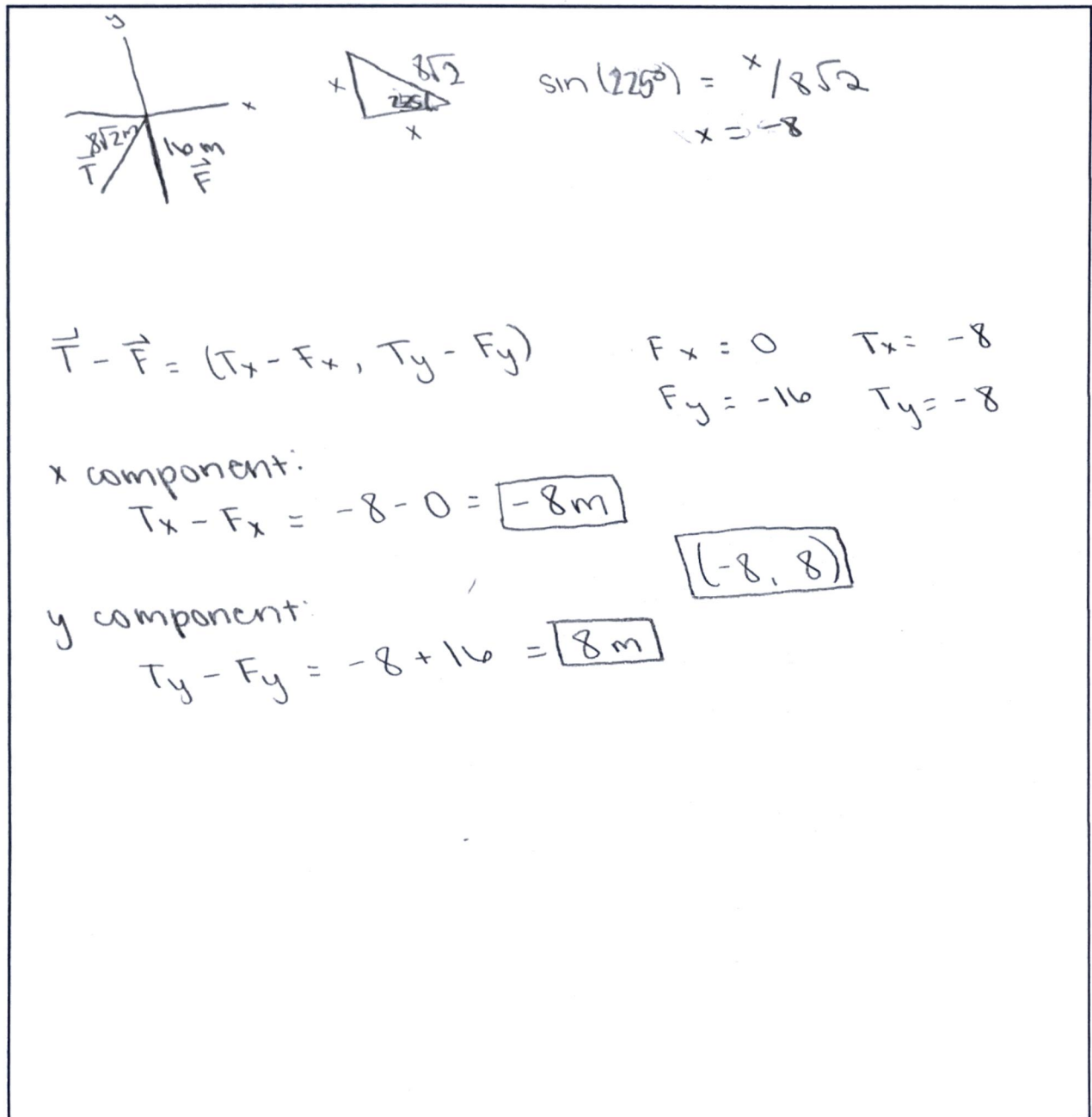
A

Free Answer Section – Show all of your work for full credit. Partial credit will be awarded where warranted.

5. A 2-dimensional vector \vec{F} has a magnitude of 16 meters and direction 270° . Another 2-dimensional vector \vec{T} has a magnitude of $8\sqrt{2}$ meters and direction of 225° . All of the given angles are measured counter-clockwise from the positive x-axis.

We define a new vector $\vec{B} = \vec{T} - \vec{F}$.

- 5a) Find the x and y components of \vec{B} .



$\vec{T} - \vec{F} = (T_x - F_x, T_y - F_y)$

$F_x = 0$ $T_x = -8$
 $F_y = -16$ $T_y = -8$

x component:
 $T_x - F_x = -8 - 0 = \boxed{-8\text{ m}}$

y component:
 $T_y - F_y = -8 + 16 = \boxed{8\text{ m}}$

$\boxed{(-8, 8)}$

- 5b) Find the magnitude and direction of \vec{B} .

$$\vec{B} \quad (-8, 8)$$

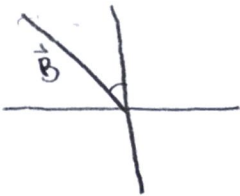
magnitude:

$$c^2 = -8^2 + 8^2$$

$$\sqrt{c^2} = \sqrt{128}$$

$$c = 8\sqrt{2} \quad \boxed{\text{magnitude} = 8\sqrt{2} \text{ m}}$$

direction:



$$\tan \theta = \text{opposite} / \text{adjacent}$$

$$\tan \theta = -8/8$$

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

$$\theta = -45^\circ$$

↓

$$45^\circ + 90^\circ = 135^\circ$$

$\boxed{\text{direction} = 135^\circ \text{ CCW from positive x axis}}$

direction

6. A nerdy physics-loving-soon-to-be husband builds and sets up a cannon to launch an engagement ring aimed his fiancé's dinner table. In a test run, the engagement ring (which is now a projectile) is fired from the "love cannon" on level ground with initial velocity \vec{v}_0 at an angle θ above horizontal and lands on the ground a distance L from the launch point. The first trial results ends up with the ring landing embarrassingly short. 😞 In an attempt to increase the range of the ring, the "love cannon" is modified to launch the engagement ring with four times the initial velocity, $4\vec{v}_0$ (at the same angle). Where does the second shot land, relative to the first?

[Hint: v_0, θ are known values, and you also know g for the acceleration of gravity. First, solve for the range L of the initial launch in terms of these known quantities. Then, analyze what happens in your solution if/when $\vec{v}_0 \rightarrow 4\vec{v}_0$, and compare the new range to the first.]

Show all of your work for full credit.

$$x = v_{0x}t + x_0 \quad L = v_0 \cos \theta t + 0$$

$$L = \frac{2v_0^2 \cos \theta \sin \theta}{g} = \frac{v_0^2 \sin(2\theta)}{g}$$

Trial One:

$$L = \frac{v_0^2 \sin(2\theta)}{g} = L$$

Trial Two:

$$L = \frac{(4v_0)^2 \sin(2\theta)}{g} = 16L$$

The new range is 16 times longer than the original.

Extra space for problem 6, if needed.

(To make sure your exam solutions have the same of pages in the same order as the original exam packet, please attach this page to your exam solutions, even if it is blank and you did not use the extra space.)

