

Midterm Exam #1, Part A

Exam time limit: 50 minutes. You may use a calculator and both sides of ONE sheet of notes, *handwritten only*. Closed book; no collaboration. Ignore friction and air resistance in all problems, unless told otherwise.

Part A: For each question, fill in the letter of the one best answer on your bubble answer sheet.

Physical constants: $g = 9.80 \text{ m/s}^2$

(2 pts. each) **Convert** the following quantities into the given units:

1. $430 \text{ km} = \underline{\hspace{2cm}} \text{ cm}$
A. $4.3 \times 10^{-7} \text{ cm}$ D. $4.3 \times 10^5 \text{ cm}$
B. $4.3 \times 10^{-5} \text{ cm}$ E. $4.3 \times 10^7 \text{ cm}$
C. $4.3 \times 10^{-3} \text{ cm}$

2. $3.5 \text{ mm/s} = \underline{\hspace{2cm}} \text{ m/min}$
A. 0.21 m/min D. $2.1 \times 10^3 \text{ m/min}$
B. 2.1 m/min E. $2.1 \times 10^4 \text{ m/min}$
C. $2.1 \times 10^2 \text{ m/min}$

3. $7.5 \times 10^{-4} \text{ km}^2 = \underline{\hspace{2cm}} \text{ m}^2$
A. 0.075 m^2 D. $7.5 \times 10^4 \text{ m}^2$
B. 7.5 m^2 E. $7.5 \times 10^6 \text{ m}^2$
C. 750 m^2

4. (1 pt.) How many **significant figures** does the value " $4.0050 \times 10^6 \text{ kg}$ " have?

A. 2 D. 5
B. 3 E. 6
C. 4

5. (2 pts.) How many **megabytes** are in one **terabyte**?

A. 10^3 D. 10^{12}
B. 10^6 E. 10^{15}
C. 10^9

A 110-kg basketball player can jump a vertical distance of 1.3 meters (approx. 4 feet). For this entire problem, assume that the athlete has NO horizontal motion. (Ignore air resistance.)

6. (2 pts.) What must be the player's **initial vertical velocity** as he leaves the ground?

- A. 3.4 m/s
- B. 5.0 m/s
- C. 7.6 m/s
- D. 9.2 m/s
- E. 11 m/s

7. (1 pt.) At the moment the athlete reaches his maximum height, which of the following is/are equal to **zero**?

- A. his velocity
- B. his speed
- C. his acceleration
- D. A & B only
- E. all of the above

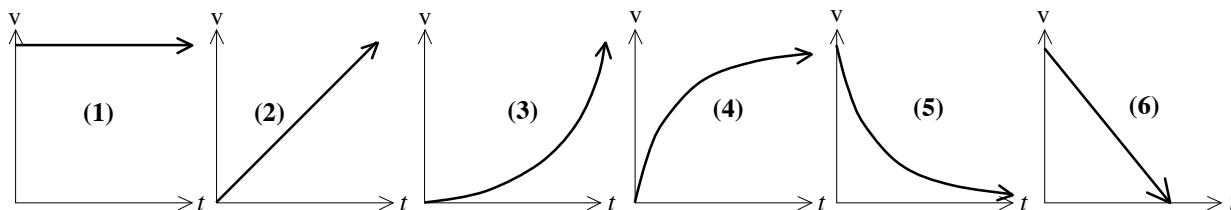
8. (2 pts.) How much **total time** elapses during his *entire* jump, from take-off to landing?

- A. 0.78 s
- B. 1.0 s
- C. 1.3 s
- D. 1.6 s
- E. 1.9 s

9. (1 pt.) Suppose that a smaller, 75-kg athlete jumps with the *same initial velocity* as the 110.-kg athlete does. Which one of the following is **TRUE**?

- A. The 75-kg athlete will reach a greater maximum height.
- B. The 75-kg athlete will reach a lower maximum height.
- C. The 75-kg athlete will be in the air for a longer period of time before landing.
- D. The 75-kg athlete will be in the air for a shorter period of time before landing.
- E. None of the above.

Six different cars move along one-dimensional tracks. The following six graphs represent their **VELOCITIES** as functions of time:



10. (1 pt.) Which of the above car(s) has a **constant speed**?

- A. (1) only
- B. (2) only
- C. (6) only
- D. (2) & (6) only
- E. (1), (2) & (6)

11. (1 pt.) Which of the above car(s) has a **constant negative acceleration**?

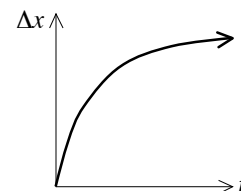
- A. (4) only
- B. (5) only
- C. (6) only
- D. (5) & (6) only
- E. (4), (5) & (6)

12. (1 pt.) Which of the above car(s) is **slowing down**?

- A. (4) only
- B. (5) only
- C. (6) only
- D. (5) & (6) only
- E. (4), (5) & (6)

13. (2 pts.) Which of the above car(s) has a **displacement graph** roughly like this one:

- A. (4) only
- B. (5) only
- C. (6) only
- D. (5) & (6) only
- E. (4), (5) & (6)



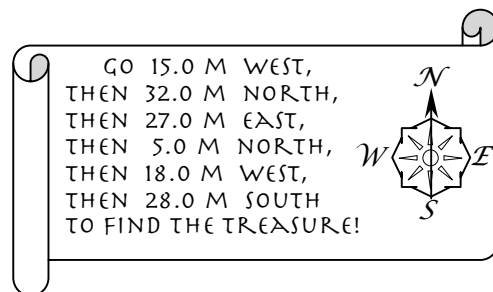
Midterm Exam #1, Part B

Part B: Show your work on all free-response questions. Be sure to use **proper units** and **significant figures** in your final answers. For any multiple-choice questions, circle the letter of the one best answer (unless more than one answer is asked for).

1. While doing a treasure hunt with a team of your friends, you receive the instructions shown at right:

a. (8 pts.) Instead of measuring out and walking along each individual segment, you convince your friends that it is faster to add together the six displacement vectors to find their sum, and then go directly to the end! Find the **magnitude** and **direction** of the **net (total) displacement** that you should travel from your starting point. *Show your work, and explain any shortcuts.*

Note: You are welcome to use compass directions in your final answer, but express your final direction explicitly and clearly. *Examples:* “30.0° to the E of N,” or “60.0° to the N of E.”



b. (6 pts.) Suppose that a different team doing the same treasure hunt does not know how to add vectors, so they traverse all of the separate path segments as given in the clue, eventually arriving at the treasure 15.0 *minutes* later. Find the magnitudes of this team's **average speed** and **average velocity**, both in [m/s]. *Show your work.*



2. A cannon at the top of a cliff always fires cannonballs with an initial velocity of 60.0 m/s . Two identical cannonballs are fired at different initial angles (ignoring air resistance):

Cannonball A is fired at 20.0° *above* the horizontal, and takes 7.56 s to land.

Cannonball B is fired at 20.0° *below* the horizontal, and takes 3.37 s to land.

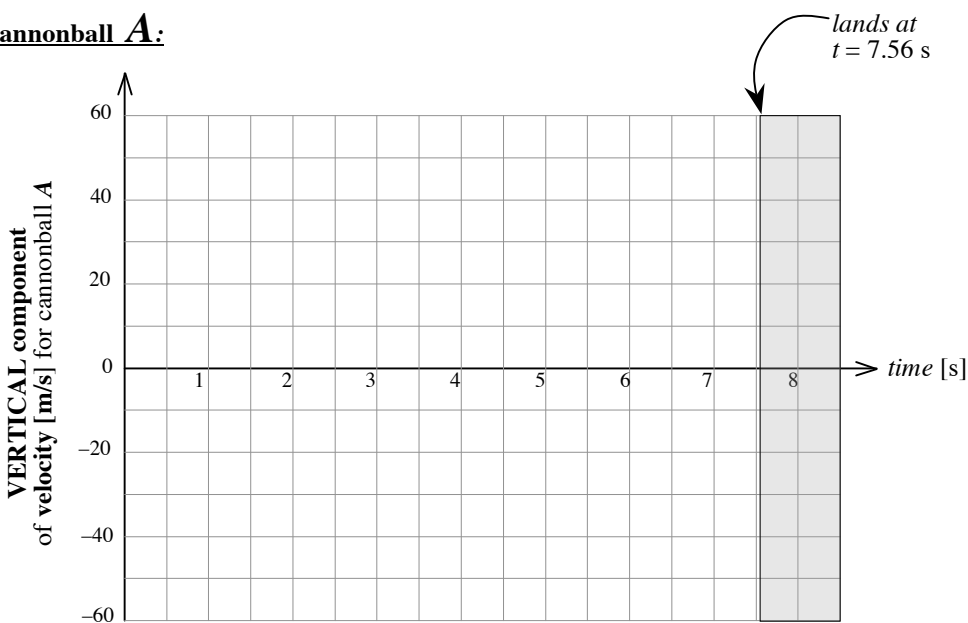
a. (6 pts.) Decompose BOTH cannonballs' initial velocities, \mathbf{v}_{A0} and \mathbf{v}_{B0} , into their **x - and y -components**. Finish by writing out both \mathbf{v}_{A0} and \mathbf{v}_{B0} in component notation. *Show your work clearly, and explain any shortcuts.*

b. (4 pts.) Using the information for *either* cannonball A or B (you don't need both), find the **height H** of the cliff. *Show your work.*

2. continued:

c. (6 pts.) On the axes provided, *carefully and accurately* graph the **VERTICAL component** of each cannonball's **velocity** versus time, from launch to landing. (You do *NOT* need to show any calculations for this part. Hint: For each cannonball, find and plot the *initial* and *final* velocities, then connect them with the appropriate mathematical curve.)

cannonball A:



cannonball B:

