

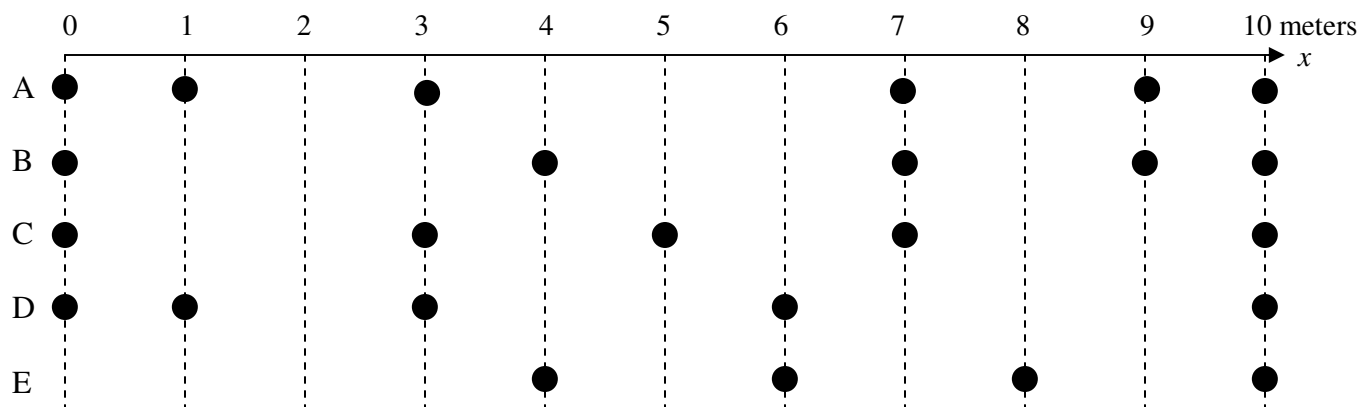
PH2100 Exam I

SPRING 2005

INSTRUCTIONS

1. Remove the answer sheet (General Purpose Data Sheet I) from the exam booklet.
2. Using a #2 pencil, write your first and last name neatly in the NAME box.
3. Under the green box labeled "ID NUMBER", write in your MTU student I.D. number (without dashes) and carefully fill in the appropriate circles corresponding to your ID number. Most of you have your Social Security number as your student I.D. number. If you have an M number, please replace the leading M with a zero. Again, do not include dashes. Leave the "SPECIAL CODES" boxes blank.
4. Be sure to fill in the circles completely and avoid stray marks on the form.
5. This is a ninety minute exam.
6. Please cover your Score Sheet at all times.
7. This is a closed book exam. You may use the PH2100 Formula Sheet that is attached to this exam, and you may find it convenient to rip the formula sheet from the exam booklet.
8. Equations may not be stored in calculators, nor may calculators be exchanged.
9. Assume all numerical data supplied with the problems have three significant figure accuracy, unless explicitly identified otherwise.
10. This exam consists of a total of 26 questions: each is worth four points. Problem 26 is a four-point bonus question. The total number of points available on the exam is 104.
11. If you have any questions during the exam, please raise your hand and wait for assistance.
12. Please turn in only your answer sheet. You may keep the exam booklet and formula sheet.

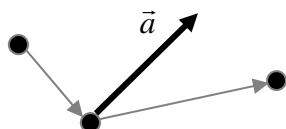
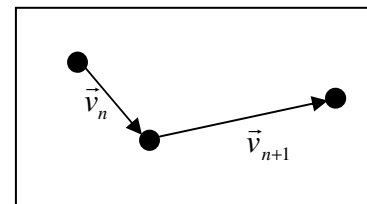
The first three questions relate to the following five motion diagrams. The diagrams have a common time interval of one second, and in each case the motion begins with the leftmost image and continues from left to right.



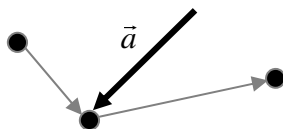
- In which diagram does the particle undergo the greatest displacement during the first three seconds of its motion? Select A, B, C, D, or E.
- Considering diagram C, what is the average velocity of the particle during the first two seconds of its motion?
 - −5.00 m/s
 - −2.50 m/s
 - 1.00 m/s
 - 2.50 m/s
 - 5.00 m/s
- In which diagram does the acceleration change in sign from positive to negative? Select A, B, C, D, or E.

- A satellite in geosynchronous orbit moves in a circular orbit around the earth once every 24 hours. Assume the satellite moves with constant speed. True or false: The satellite is not accelerating.
 - True
 - False
- An object has a velocity directed to the right, and the acceleration directed to the left. Which statement below is true?
 - The position of the object is not changing in time.
 - The position of the object is increasing to the right with time, and its speed is decreasing.
 - The position of the object is increasing to the left with time, and its speed is increasing.
 - The position of the object is increasing to the right with time and its speed is increasing.
- Compute the following sum to the appropriate number of significant figures, assuming that each number is written as to properly reflect its significant figures: $7.462 \times 10^1 + 20.3 =$
 - 0.9492
 - 9.50×10^1
 - 9.492×10^1
 - 9.49×10^1

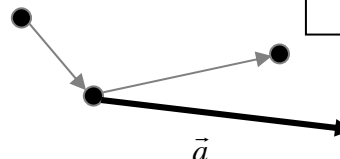
7. Two consecutive velocity vectors from a motion diagram are shown in the box at the right. Which of the diagrams below shows the best representation of the acceleration vector at the middle point?



(A)

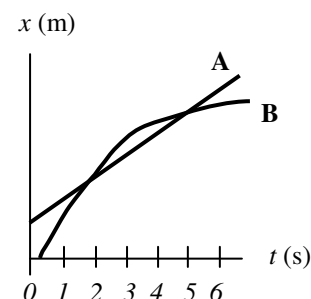


(B)



(C)

8. The motion of particles A and B are represented in the position-versus-time curve shown at the right. Do particles A and B ever have the same speed? If so, at what time(s)?



- (A) Yes, at 1s and 6s.
 (B) Yes, at 2s and 5s.
 (C) Yes, at 3s.
 (D) No.

The next three questions use the following information:

The position of an object is given by $x = bt^2 - ct$, where $b = 2.00 \text{ m/s}^2$, and $c = 6.70 \text{ m/s}$.

9. What is the instantaneous velocity when $t = 3.80 \text{ s}$?

- (A) 8.50 m/s
 (B) 6.80 m/s
 (C) 9.40 m/s
 (D) 11.1 m/s
 (E) 12.6 m/s

10. What is the acceleration when $t = 3.80 \text{ s}$?

- (A) 8.00 m/s^2
 (B) 4.00 m/s^2
 (C) 2.00 m/s^2
 (D) 1.40 m/s^2
 (E) 1.00 m/s^2

11. What is the magnitude of the average velocity of the object over the time interval from 0 s to 3.80 s?

- (A) 0.000 m/s
 (B) 0.670 m/s
 (C) 0.900 m/s
 (D) 1.80 m/s
 (E) 2.67 m/s

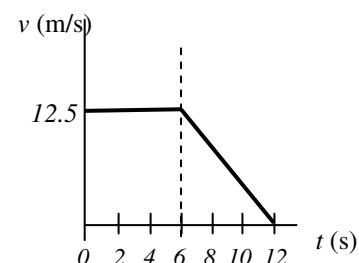
12. Generic Man is jumping up and down on a trampoline. During the lowest point of his motion, what is the direction of his acceleration?

- (A) Up.
 (B) Down.
 (C) His acceleration is zero at the lowest point of the motion.



The following information applies to the next three problems:

A car moves with constant speed 12.5 m/s in the positive direction along a horizontal surface and slows down uniformly for a stop sign. The velocity-versus-time curve for time 0 to 12.0 seconds is shown at the right.



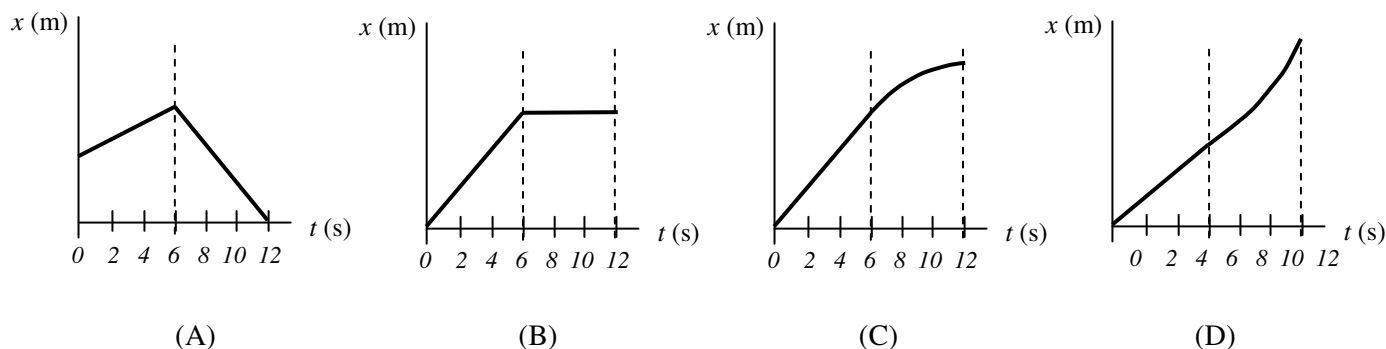
13. What is the acceleration of the car during the final 6 seconds of the motion?

- (A) 2.08 m/s^2
 (B) 4.16 m/s^2
 (C) 0.00 m/s^2
 (D) -2.08 m/s^2
 (E) -4.16 m/s^2

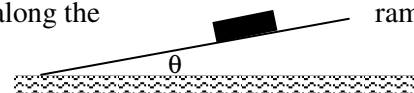
14. How far did the car travel during the time interval from 0 to 12 s?

- (A) 58.0 m
 (B) 87.3 m
 (C) 92.1 m
 (D) 104 m
 (E) 113 m

15. Which of the following is the appropriate position-versus-time curve corresponding to the car's motion, assuming that it starts from the origin?



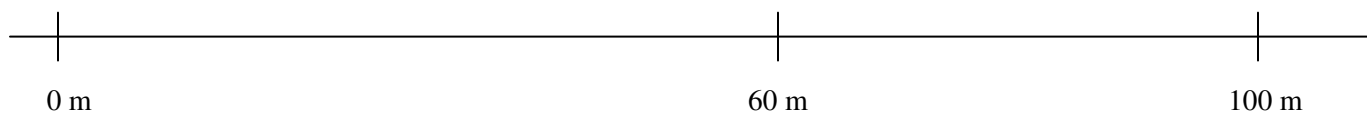
16. A puck is sliding under the influence of the earth's gravity down a frictionless ramp that is inclined $\theta = 35^\circ$ with respect to the horizontal. What is the magnitude of the acceleration of the puck along the ramp?



- (A) -8.02 m/s^2
- (B) -5.62 m/s^2
- (C) 5.62 m/s^2
- (D) 8.02 m/s^2
- (E) 9.8 m/s^2

The following information applies to the next two questions.

Achilles challenges the tortoise to a race. Achilles must run 100 m from beginning to end, but he gives the tortoise a head start of 60 m. Achilles starts from rest and runs with a constant acceleration of 0.028 m/s^2 , while the tortoise manages a constant speed of 0.12 m/s .



17. How much time does Achilles require to run the 100 m race?

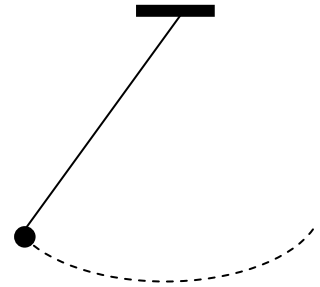
- (A) 10.2 s
- (B) 15.7 s
- (C) 61.1 s
- (D) 75.0 s
- (E) 84.5 s

18. How far does Achilles run before passing the tortoise?

- (A) 10.0 m
- (B) 62.2 m
- (C) 68.4 m
- (D) 73.7 m
- (E) 90.3 m

19. Consider a pendulum swinging back and forth on a string. At the end of its arc, when the pendulum is at the highest point on the left or the right, its

(A) velocity and acceleration are zero.
(B) velocity is zero, but its acceleration is nonzero.
(C) velocity is nonzero, but its acceleration is zero.
(D) velocity and acceleration are both nonzero.



The following information applies to the next two questions:

On the way home from Christmas break a student is driving at speed of 14.0 m/s when she sees a deer in the road ahead. After a 0.230 s reaction time, she slams on the breaks and uniformly slows to a complete stop, just barely avoiding hitting the deer. Assume that she slowed down with an acceleration of constant magnitude 1.30 m/s^2 .

20. How far was the student away from the deer when she slammed on the breaks?

(A) 35.6 m
(B) 41.0 m
(C) 55.3 m
(D) 65.8 m
(E) 75.4 m

21. How much time did it take the student to stop after she saw the deer?

(A) 9.35 s
(B) 11.0 s
(C) 12.5 s
(D) 13.1 s
(E) 15.2 s

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22. A ball is thrown vertically upward and then comes back down. During the ball's flight up and down, its velocity and acceleration vectors are:

(A) always in the same direction.
(B) always in opposite directions.
(C) first in the same direction and then in opposite directions.
(D) first in opposite directions and then in the same direction.

23. True or false: The magnitude of a vector cannot be smaller than the magnitude of any of its components.

(A) True
(B) False

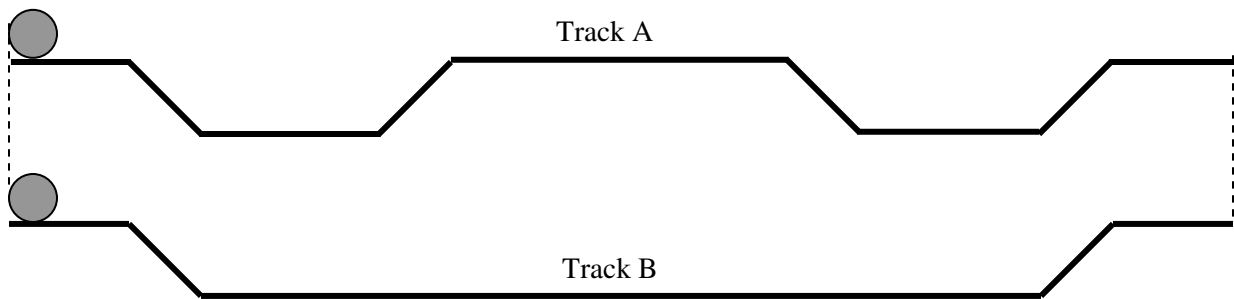
24. Given $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = 2\hat{i} - 2\hat{j}$, find the magnitude of $\vec{C} = \vec{A} + 4\vec{B}$.

- (A) 11.7
- (B) 16.1
- (C) 20.0
- (D) 8.20
- (E) 6.09

25. A vector $\vec{A}$ of length 4.00 units is directed at 20.0° clockwise from the positive x-axis. Find the y-component, A_y .

- (A) 2.65 units
- (B) 1.37 units
- (C) 0.0 units
- (D) -2.65 units
- (E) -1.37 units

26. **BONUS:** Consider the two side-by-side tracks shown below, which are drawn to scale relative to one another. Identical balls are released with identical initial velocities at the left edge of each track. Both balls are influenced by gravity, but stay on their respective track at all times.



On which track does the ball first arrive at the right-hand end?

- (A) A
- (B) B
- (C) The balls arrive at the same time.