

## General Physics: Class Exam I

18 September 2023

Name: \_\_\_\_\_

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### Instructions

- There are 9 questions on 6 pages.
- Show your reasoning and calculations and always explain your answers.

### Physical constants and useful formulae

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

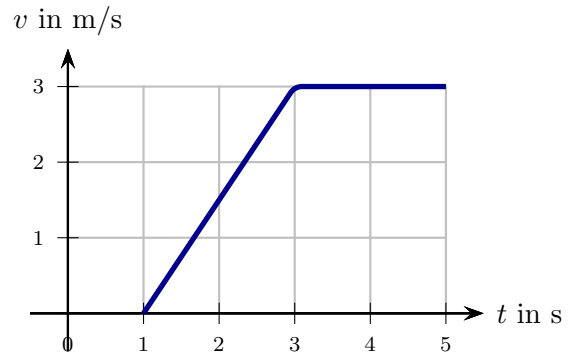
### Question 1

At *one instant (first instant)* a mouse passes a piece of cheese while running left with speed 14.0 m/s. At *another instant (second instant)* 3.0 s later the mouse is still moving left but with a speed of 2.0 m/s. Determine the average acceleration of the mouse between the first and second instant.

### Question 2

An ant walks along one direction and the graph of the ant's velocity vs. time is as illustrated. Which of the following (choose one) is true regarding the ant's acceleration?

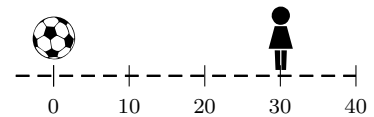
- i) Acceleration is larger at 4 s than at 2 s.
- ii) Acceleration is smaller at 4 s than at 2 s.
- iii) Acceleration is the same, but not zero, at 4 s as at 2 s.
- iv) Acceleration is zero at 4 s and at 2 s.



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### Question 3

A person runs left passing the 30 m mark toward a ball at the 0 m mark. The person runs at a constant speed, turns around at the ball and runs right passing the 30 m mark at the same speed and reaching it 6.0 s after she first passed it. Let  $a_{av}$  be the average acceleration from the moment she first passes the 30 m mark until she passes it again. Which of the following (choose one) is true?



- i)  $a_{av} = 0$
- ii)  $a_{av}$  is positive.
- iii)  $a_{av}$  is negative.

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### Question 4

A cat walks along a straight line. Its velocity is recorded at equally spaced intervals. According to the data in the table, is the acceleration of the cat constant or not? Explain your answer.

Time in s	Velocity in m/s
0.00	-0.60
0.10	-0.30
0.20	0.00
0.30	0.30
0.40	0.60
0.50	0.90
0.60	1.20

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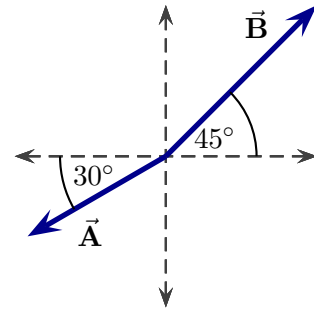
### Question 5

One construction worker standing on the ground throws a brick toward another worker standing above the ground on scaffolding. The worker on the ground throws the brick in such a way that its speed is exactly  $0.0\text{ m/s}$  when it reaches the hand of the worker on the scaffolding. The brick travels vertically and the distance that it travels from the moment that it leaves the hand of the lower worker until it reaches the hand of the upper worker is exactly  $4.0\text{ m}$ . Determine the speed with which the brick leaves the hand of the lower worker.

**Question 6**

Two displacement vectors are illustrated. The magnitude of  $\vec{A}$  is 50 m and that of  $\vec{B}$  is 100 m. Let  $\vec{C} = \vec{A} + \vec{B}$ .

- a) Determine the components of  $\vec{C}$  and the magnitude of  $\vec{C}$ .



- b) Is it possible to find any number  $\alpha$  so that  $\vec{B} = \alpha\vec{A}$ ? Explain your answer.

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### Question 7

Various bugs wander around on a flat horizontal table. Each moves at a constant speed. Some move in straight lines without changing direction, and others move along curved paths. Which of the following (choose one) is true?

- i) The acceleration of every one of these bugs must be zero.
- ii) The acceleration of every one of these bugs must be non-zero.
- iii) Some bugs have zero acceleration, others have non-zero acceleration.

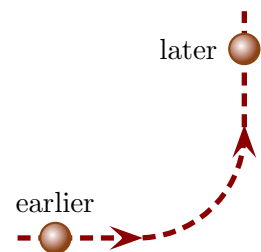
**Briefly explain your answer.**

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### Question 8

An asteroid passes a (hidden) planet and its trajectory is as illustrated. Its locations at two instants are as illustrated and, at these instants it has the same speed. Which of the following is true regarding its average acceleration from the earlier to the later instant?

- i)  $\vec{a} = 0$
- ii)  $\vec{a} \neq 0$ , pointing  $\uparrow$
- iii)  $\vec{a} \neq 0$ , pointing  $\downarrow$
- iv)  $\vec{a} \neq 0$ , pointing  $\nearrow$
- v)  $\vec{a} \neq 0$ , pointing  $\nwarrow$
- vi)  $\vec{a} \neq 0$ , pointing  $\searrow$
- vii)  $\vec{a} \neq 0$ , pointing  $\swarrow$



**Explain your choice.**

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**Question 9**

A bug jumps from the ground with a speed of 5.0 m/s; the bug leaves the ground at an angle of  $60^\circ$  from the ground. Ignore air resistance in this problem.

a) Determine the highest point reached by the bug above the ground.

b) Determine the speed of the bug at its highest point.

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