

This 12-question test (each question is worth approximately 8.33 points) is worth 100 points, each question is weighted equally. Please fill out the answer sheet with soft lead pencil. Be sure to give your name, student ID #, date, Course #, Test 1, and \*\*\*\*SIGN\*\*\*\* the answer sheet. Be prepared to present your Student picture ID card when handing in your answer sheet. You may keep the sheets with the questions and your work.

Pick the nearest value for your answer (there may be slight round-off errors). If your answer is significantly different from all possible answers, you have made some mistake.

Don't get hung up too long over any one question until you have tried all of them.

You are expected to bring your own sheet of equations and words explaining the equations. Here are a few possibly useful equations. You will need to know when they are valid and when they are not.

$$g = 9.8 \text{ m/s}^2 \quad G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

$$v = v_0 + a t \text{ for each vector component of } v \text{ and } a$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2 \quad \text{and ditto for } y \text{ and } z \text{ components}$$

$$v_x^2 - v_{0x}^2 = 2a(x - x_0) \quad \text{etc.} \quad \text{average } v_x = \Delta x / \Delta t \quad \text{etc.}$$

$$x = x_0 + \frac{1}{2} (v_0 + v) t \quad \text{etc.} \quad \text{average } a = \Delta v / \Delta t \quad \text{and etc. for each component}$$

$$x = r \cos(\theta) \quad y = r \sin(\theta) \quad \tan(\theta) = y/x$$

$$F = ma \quad F \text{ of } A \text{ on } B = -F \text{ of } B \text{ on } A$$

1) An electric auto with light Lithium-ion storage batteries made the news last month. It can accelerate from zero to 60 mph (26.8 m/s) in 3.7 seconds. What is this acceleration in SI (MKS) units of  $\text{m/s}^2$ ?

- a) 9.80
- b) 7.24
- c) 6.31
- d) 4.90
- e) 2.68

2. A skier on level ground slows with constant acceleration from +20.5 m/s to +8.9 m/s while traveling a distance of 85 m in the +x direction. What is her acceleration, in  $\text{m/s}^2$ ?

- a) 2.68
- b) 2.01
- c) -2.68
- d) -2.01
- e) -3.85

3) A man in a train corridor walks towards the rear of the train at  $-4$  mi/hr. The train is moving at  $+55$  mi/hr. A car going  $+70$  mi/hr on a road parallel to the tracks is overtaking the train. What is the velocity of the man with respect to the car?

- a) 51 mi/hr
- b) 66 mi/hr
- c)  $-19$  mi/hr
- d)  $-15$  mi/hr
- e)  $-70$  mi/hr

4) A boat which can go at a speed of  $30$  km/hr starts from one bank and aims its bow directly across a river which is  $0.8$  km wide and is flowing at  $16$  km/hr. Thus the boat's velocity relative to the water is exactly at right angles to the water-flow direction. What is the boat's speed relative to the river bank?

- a)  $16$  km/hr
- b)  $30$  km/hr
- c)  $60$  km/hr
- d)  $34$  km/hr
- e)  $48$  km/hr

5) In the above problem, how long does it take the boat to cross the stream?

- a) 96 s
- b) 32 s
- c) 60 s
- d) 34 s
- e) 48 s

6) In the above problem, how far downstream is the boat from its starting point when it lands on the opposite bank? [Hint: if you aren't sure, you can also cross-check your answer by constructing the vector path of the boat relative to the ground, using what you know about the boat's velocity components.]

- a) 166 m
- b) 300 m
- c) 427 m
- d) 582 m
- e) 666 m

7) An airplane flies level at a steady speed of 200 m/s and drops a bomb from a height of 900 m. What is the speed just before the bomb hits the ground? Hint: keep track of both components of the vector velocity.

- a) 130 m/s
- b) 200 m/s
- c) 330 m/s
- d) 70 m/s
- e) 240 m/s

8) A baseball of mass 0.3 kg is struck by a bat and its velocity is changes from  $-40$  m/s (as it arrives from the pitch) to  $+80$  m/s? Assuming the change in velocity took place in 0.08 seconds at constant acceleration, what was the force of the bat on the ball during this time?

- a) 150 N
- b) 300 N
- c) 450 N
- d) 600 N
- e) 900 N

9) Neglecting air resistance, what is the range of a bullet fired at  $30^\circ$  above the horizontal at 500 m/s on level ground?

- a) 11.1 km
- b) 15.6 km
- c) 22.1 km
- d) 27.8 km
- e) 33.5 km

10) How high above the ground does this bullet rise, at the top of its trajectory?

- a) 3.19 km
- b) 2.02 km
- c) 1.15 km
- d) 6.50 km
- e) 5.81 km

11) How long after being fired does it take for the bullet to rise to its highest point?

- a) 25.5 s
- b) 12.3 s
- c) 51.1 s
- d) 43.8 s
- e) 6.7 s

12) A 30 kg kangaroo jumps off a 300 kg boat (unanchored and at rest) in the middle of a swimming pool. The kangaroo's sideways acceleration during the jump-off is  $4.0 \text{ m/s}^2$ . What is the boat's recoil acceleration? [Hint: use N2 as well as N3.]

- a)  $9.8 \text{ m/s}^2$
- b)  $1.0 \text{ m/s}^2$
- c)  $0.8 \text{ m/s}^2$
- d)  $0.5 \text{ m/s}^2$
- e)  $0.4 \text{ m/s}^2$

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1. B
2. D
3. C
4. D
5. A
6. C
7. E
8. C
9. C
10. A
11. A
12. E