

This 17-question test (each question is worth approximately 5.88 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.

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

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

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

$$v_x^2 - v_{ox}^2 = 2a(x - x_o) \quad \text{etc.} \quad \text{average } v_x = \frac{x}{t} \quad \text{etc.}$$

$$x = x_o + \frac{1}{2}(v_o + v)t \quad \text{etc.} \quad \text{average } \mathbf{a} = \frac{\mathbf{v}}{t} \quad \text{and etc. for each component}$$

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

$$\mathbf{F} = m\mathbf{a} \quad \mathbf{F} \text{ of } A \text{ on } B = -\mathbf{F} \text{ of } B \text{ on } A$$

1) Vectors  $\mathbf{A} + \mathbf{B} = \mathbf{C}$ , where  $\mathbf{A} = (-500, 300)$  and  $\mathbf{C} = (800, 1300)$ . What is the y component of vector  $\mathbf{B}$ ?

- a) 1600
- b) 1300
- c) 1000
- d) 300
- e) 700

2) Vectors  $\mathbf{D} + \mathbf{E} = \mathbf{F}$  where  $\mathbf{D}$  is 3 m long and points  $135^\circ$  from the +x axis (it's in the 2d quadrant) and  $\mathbf{E}$  is 4m long and points  $270^\circ$  from the +x axis (i.e. it points along -y). How long is the vector  $\mathbf{F}$  ?

- a) 4.5m
- b) 3.5m
- c) 2.1m
- d) 3.9m
- e) 2.8m

3) A car going 50 km/hr in the +x direction hits a haystack and comes to rest in a distance of 3m. What is the car's (assumed constant) acceleration, in  $\text{m/s}^2$ ? (Try to pick the equation that gives you the answer in one step.)

- a)  $-8 \text{ m/s}^2$
- b)  $-16 \text{ m/s}^2$
- c)  $-32 \text{ m/s}^2$
- d)  $-64 \text{ m/s}^2$
- e)  $-128 \text{ m/s}^2$

4 In the above example, how long does it take the car to come to rest after it hits the haystack? (Try to pick a different equation that gives you this answer in one step -- then you should cross-check your answers to 3) and 4) by seeing if the change in velocity does equal (average acceleration) times (time interval), which it had better do!)

- a) 0.43s
- b) 0.23s
- c) 0.66s
- d) 1.20s
- e) 1.86s

5) A boat tries to cross a 3 km wide river which is flowing at 5 km/hr. The boat's engine permits a water speed of 11 km/hr. At what angle,  $\theta$ , should the boat point upstream (relative to a line directly across the river) in order to reach the other side exactly opposite its starting point?

- a)  $45^\circ$
- b)  $35^\circ$
- c)  $31^\circ$
- d)  $27^\circ$
- e)  $23^\circ$

6) How long does it take this boat to cross the river (in minutes)?

- a) 16 min
- b) 18
- c) 21
- d) 29
- e) 36

7) A bullet is shot straight upwards. It takes 18 seconds to reach the highest point in its trajectory. What was the bullet's initial speed? (Neglect air resistance.)

- a) 176m/s
- b) 98m/s
- c) 88m/s
- d) 18m/s
- e) 32m/s

8) How high does the bullet of question 7 rise?

- a) 1.59 km
- b) 1.87km
- c) 2.42km
- d) 2.82km
- e) 3.48km

9) A different gun shoots a faster bullet aimed  $30^\circ$  above horizontal. This bullet still takes 18 seconds to reach maximum height. What is this bullet's initial speed (2-D, NOT just the y-component of its initial velocity)? (Neglect air resistance, and remember that y "does its thing" independently of x, so to speak.)

- a) 146 m/s
- b) 192 m/s
- c) 278 m/s
- d) 313 m/s
- e) 353 m/s

10) How long after launching do both of these bullets hit the ground (assumed to be level ground)?

- a) 18s
- b) 24s
- c) 30s
- d) 36s
- e) 45s

11) How far from its launching point does the second bullet strike the ground?

- a) 9 km
- b) 11 km
- c) 13 km
- d) 15 km
- e) 17 km

12) A baseball is thrown in the x direction at 25 m/s. There is a 10 m/s cross wind blowing in the y direction. What is the **airspeed** of the baseball, that is, its speed relative to the air?

- a) 10m/s
- b) 15 m/s
- c) 25 m/s
- d) 27 m/s
- e) 36 m/s

13) A 50 kg dog jumps off a 250 kg boat (unanchored and at rest) in the middle of a lake. The dog's sideways acceleration during the jumpoff is  $10 \text{ m/s}^2$ . What is the boat's recoil acceleration?

- a)  $10 \text{ m/s}^2$
- b)  $5 \text{ m/s}^2$
- c)  $2 \text{ m/s}^2$
- e)  $1 \text{ m/s}^2$
- f)  $50 \text{ m/s}$

14) A 0.7 kg rock is thrown sideways with a force of 150 N. What is its sideways acceleration while being speeded up?

- a)  $214 \text{ m/s}^2$
- b)  $150 \text{ m/s}^2$
- c)  $105 \text{ m/s}^2$
- d)  $6.9 \text{ m/s}^2$
- e) 429

15) A ball rolls off a 2m high table at a speed of 4 m/s. What is the ball's speed (its full speed in 2-D) when it hits the floor?

- a) 5.0 m/s
- b) 6.3 m/s
- c) 7.4 m/s
- d) 10.3 m/s
- e) 9.8 m/s

16) Two cars start from the origin at  $t = 0$ . The first car accelerates from rest at a rate  $a_x = 5 \text{ m/s}^2$ . The second car passes the origin at  $t = 0$ , and continues, with constant velocity  $v_x = 20 \text{ m/s}$ . At what time will the first car overtake the second car?

- a) 1 s
- b) 2 s
- c) 4 s
- d) 6 s
- e) 8 s

17) What distance have they covered when the first car overtakes the second car?

- a) 160 m
- b) 240 m
- c) 320 m
- d) 480 m
- e) 640 m

1. c
2. e
3. c
4. a
5. d
6. b
7. a
8. a
9. e
10. d
11. b
12. d
13. c
14. a
15. c
16. e
17. a