On the Scantron, fill out your student ID, leaving the first column empty and starting in the second column. Also write your name, class time (11:30 or 12:30), and “Test 1” at the bottom. There are 20 equally-weighted questions on this test. There is only one correct answer per question. **Mark your answer on the Scantron.** The second to last page is blank for extra space if needed. The formulas are on the last page so you can separate it for easy access. The key will be posted online after all make-up tests are completed.

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1. Estimate the total mass of all the people in the world. The current population is approximately 7 billion people.

   a) $10^2$ kg  
   b) $10^5$ kg  
   c) $10^{11}$ kg  
   d) $10^{16}$ kg  
   e) $10^{21}$ kg

2. You want new carpet for your apartment’s living room, which is a room measuring 10 ft in width and 20 ft in length. How many square meters of carpet do you need to purchase to cover the whole floor?

   a) 5.0 m$^2$  
   b) 19 m$^2$  
   c) 22 m$^2$  
   d) 31 m$^2$  
   e) 56 m$^2$
3. A person is pulled over for driving 27.5 m/s on a highway with a 55 mi/h speed limit. By how much was that person exceeding the speed limit?

a) 1.3 mi/h  
b) 3.6 mi/h  
c) 6.5 mi/h  
d) 9.2 mi/h  
e) The person was not exceeding the speed limit.

4. A race car starting at rest accelerates at a constant rate of 5.50 m/s$^2$. What is the velocity of the car after it has traveled 32 meters?

a) 14.7 m/s  
b) 18.8 m/s  
c) 21.2 m/s  
d) 24.6 m/s  
e) 27.3 m/s
5. A cheetah is jogging at 5 m/s in a straight line towards an antelope who is eating grass 150 m away. The cheetah needs to speed up if it’s going to catch the antelope before it notices the cheetah coming. What is the minimum constant acceleration that the cheetah must use to catch the antelope within 20 seconds?

a) 0.0 m/s²
b) 0.25 m/s²
c) 0.5 m/s²
d) 1.0 m/s²
e) 10 m/s²

6. If the cheetah from the previous problem instead accelerated at 2 m/s², what would its velocity be when it reached the antelope?

a) 10 m/s
b) 15 m/s
c) 25 m/s
d) 50 m/s
e) 900 m/s
7. In celebration, a cowboy shoots a bullet straight up in the air at a velocity of 670 m/s. How long does it take the bullet to come back down to the same point from which it was shot?

a) 16 seconds  
b) 30 seconds  
c) 32 minutes  
d) 4.6 minutes  
e) 2.3 minutes

8. If a ball thrown upward with initial velocity, $v_0$, reaches a maximum height, $h$, what height will the ball reach if it is thrown 3 times faster?

a) $2h$  
b) $3h$  
c) $4h$  
d) $8h$  
e) $9h$
9. I hit the brakes as I pull up to a stop light, but then it turns green and I speed up again. What is true about my acceleration and velocity vectors before and after the light turns green?

a) **Before:** my $a$ and $v$ vectors point the same way.
   **After:** my $a$ and $v$ vectors still point the same way.

b) **Before:** my $a$ and $v$ vectors point in opposite directions.
   **After:** my $a$ and $v$ vectors point in the same direction.

c) **Before:** my $a$ and $v$ vectors point the same way.
   **After:** my $a$ and $v$ vectors point in opposite directions.

d) **Before and after,** my $v$ vector does not change and $a = 0$.

e) None of the above.

10. The velocity vs. time graph shown describes the motion of an object. Which acceleration vs. time graph best matches this motion? Select the letter that appears under the correct graph.
11. A velocity vs. time graph for an object is shown. Find the average acceleration for the object from \( t = 100 \) s to \( t = 400 \) s.

\[
\begin{align*}
\text{a)} & \quad -0.25 \text{ m/s}^2 \\
\text{b)} & \quad -0.33 \text{ m/s}^2 \\
\text{c)} & \quad -0.50 \text{ m/s}^2 \\
\text{d)} & \quad -0.67 \text{ m/s}^2 \\
\text{e)} & \quad -0.72 \text{ m/s}^2 
\end{align*}
\]

12. You throw a ball to your friend. If we define positive \( y \) as up, what does the acceleration versus time graph look like for its motion during the time after it leaves your hand and before it gets to your friend’s hand?

\[
\begin{align*}
\text{a) } & \quad \text{Graph showing acceleration as a function of time with increasing acceleration up.} \\
\text{b) } & \quad \text{Graph showing acceleration as a function of time with decreasing acceleration down.} \\
\text{c) } & \quad \text{Graph showing constant upward acceleration.} \\
\text{d) } & \quad \text{Graph showing constant downward acceleration.} \\
\text{e) } & \quad \text{Graph showing no change in acceleration.}
\end{align*}
\]
13. You're parked in front of a restaurant in downtown Morgantown. Your friends call and want you to pick them up in front of the Chestnut Hotel. Because Morgantown has only one way streets, you drive south 150m, go 75m west on Walnut, and travel 100m north up Chestnut Street to get your friends. What is the magnitude of your displacement vector from your original parking location?

a) 53 m  
b) 90 m  
c) 100 m  
d) 325 m  
e) 1 km

14. A rescue plane drops a package of supplies to stranded hikers on the ground. The plane continues traveling at the same velocity after dropping the package. Neglecting air resistance, at the instant the package lands on the ground, the plane will have traveled

a) a larger horizontal displacement than the package.  
b) the same horizontal displacement as the package.  
c) a smaller horizontal displacement than the package.  

15. A cargo plane is flying in a horizontal direction with a large $v_x$. Someone drops a bowling ball out of its cargo bay. As observed by a person standing on the ground and viewing the plane as in the figure below, which of the paths would the bowling ball most closely follow after leaving the plane? Neglect air resistance, and remember to consider the ball’s $v_x$ and $v_y$.

![Diagram of paths](image)
16. A ball is kicked with an initial velocity of 18.0 m/s with an angle of 15.0° from the ground. Find the \( x \) (horizontal) component of the initial velocity.

a) 4.66 m/s  
b) 8.13 m/s  
c) 12.3 m/s  
d) 17.4 m/s  
e) 19.7 m/s

17. A rock is thrown from a 150 m cliff with an initial velocity of 7.0 m/s at an angle of 18° above the horizontal. How long will it take to hit the ground?

a) 2.3 s  
b) 5.8 s  
c) 7.4 s  
d) 10 s  
e) 13 s
18. A missile is designed to explode 7 seconds after launch. One of these missiles is launched at a speed of 60.0 m/s at an angle of 55.0° off the ground. At what horizontal distance from its point of launch will it explode?

a) 15.0 m  
b) 34.3 m  
c) 60.4 m  
d) 241 m  
e) 5.03 km

19. For the missile in the previous problem, at what vertical height above the ground will it explode?

a) It will already be on the ground  
b) 13.0 m  
c) 56.2 m  
d) 104 m  
e) 236 m
20. A ball rolls *horizontally* off of a desk that is 2.0 m high with a speed of 4.0 m/s. Calculate the magnitude of the velocity just before the ball hits the ground.

a) 4.0 m/s
b) 5.2 m/s
c) 6.3 m/s
d) 7.4 m/s
e) 9.7 m/s
POTENTIALLY USEFUL INFORMATION:

1 m = 3.281 ft  
1 mile = 1609 m  
g = 9.8 m/s²

\[ v_{\text{avg}} = \frac{(x_f - x_i)}{(t_f - t_i)} \quad a_{\text{avg}} = \frac{(v_f - v_i)}{(t_f - t_i)} \quad \Delta x = x_f - x_i \]

\[ v = v_o + at \quad \Delta x = v_o t + \frac{1}{2}at^2 \quad v^2 = v_o^2 + 2a \Delta x \]

\[ x = x_o + v_{\text{avg}} t \quad \sin \theta = \frac{\text{opp}}{\text{hyp}}, \cos \theta = \frac{\text{adj}}{\text{hyp}}, \tan \theta = \frac{\text{opp}}{\text{adj}}, \quad V^2 = V_x^2 + V_y^2 \]

1 kg = 2.2 pounds

quadratic: \( ax^2 + bx + c = 0 \quad x = \frac{-b \pm (b^2 - 4ac)^{\frac{1}{2}}}{2a} \)