MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Assuming equal rates of acceleration in both cases, how much further would you travel if braking from 56 mi/h to rest than from 28 mi/h.
   A) 4.8 times farther  B) 5.2 times farther  C) 4 times farther  D) 3.2 times farther

2) A child is sitting on the outer edge of a merry-go-round that is 18 m in diameter. If the merry-go-round makes 8.3 rev/min, what is the velocity of the child in m/s?
   A) 15.6 m/s  B) 5.5 m/s  C) 7.8 m/s  D) 1.2 m/s

3) You throw a rock horizontally off a cliff with a speed of 20 m/s. After two seconds, the magnitude of the velocity of the rock is closest to
   A) 28 m/s  B) 40 m/s  C) 37 m/s  D) 20 m/s

Use Figure 2.1 to answer the following question(s).

Figure 2.1

4) The graph in Figure 2.1 shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moment in time is the speed of the object the highest?
   A) J  B) I  C) L  D) H  E) K

5) The graph in Figure 2.1 shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moment in time is the speed of the object equal to zero?
   A) H  B) J  C) I  D) K  E) L
PH201 - Exam 1 - answer key

1) \( V_f^2 - V_c^2 = 2a \Delta x \) \quad set \( V_f^2 = 0 \)

Then \( \Delta x = \frac{-V_c^2}{2a} \) so

\[
\frac{\Delta x_2}{\Delta x_1} = \frac{-V_c^2}{2a} \quad \frac{-V_c^2}{2a}
\]

You would travel 4 times as far with double the speed.

2) \( V = \frac{\Delta x}{\Delta t} = \frac{2 \pi r}{t} \) circumference of a circle or radius \( r \),

but \( d = 2 \pi \)

\[ \text{frequency} = \frac{3.3 \text{ rev min}^{-1}}{60 \text{ sec}} = 0.138 \text{ rev sec}^{-1} \]

\[ V = \frac{\pi (18 \text{ m})}{7.23 \text{ sec}} = 7.82 \text{ m/s} \]

3) \( V_{ox} = 20 \text{ m/s} \quad ax = 0 \quad \Rightarrow \quad V_x = 20 \text{ m/s} \)

\( V_{oy} = 0 \text{ m/s} \quad ay = g = -9.8 \text{ m/s}^2 \quad V_y = -gt + V_0 = -19.6 \text{ m/s} \quad \text{for } t = 2 \text{ seconds} \)

\[
V = \sqrt{V_x^2 + V_y^2} = \sqrt{20^2}
\]

\[ = \sqrt{20^2} \text{ m/s} = 1.414 \times 20 = 28.3 \text{ m/s} \]

4) Speed is the magnitude of the velocity, and velocity is the slope of the position versus time graph. The steepest portion of the graph occurs at time \( t \).

5) When the slope of the position versus time graph is zero, the object is at rest; this occurs at time \( t \).
6) Which of the following situations is impossible?
   A) An object has constant non-zero velocity and changing acceleration.
   B) An object has zero velocity but non-zero acceleration.
   C) An object has velocity directed east and acceleration directed east.
   D) An object has velocity directed east and acceleration directed west.
   E) An object has constant non-zero acceleration and changing velocity.

7) A stone is thrown vertically upwards, reaches a highest point, and returns to the ground. When the stone is at the top of its path, its acceleration
   A) is directed upwards.
   B) is directed downwards.
   C) changes direction from upwards to downwards.
   D) is zero.

8) The following conversion equivalents are given:
   \[1 \text{ gal } = 231 \text{ in}^3 \quad 1 \text{ ft } = 12 \text{ in} \quad 1 \text{ min } = 60 \text{ s}\]
   A pipe delivers water at the rate of 95 gal/min. The rate in ft$^3$/s, is closest to:
   A) 0.15\quad B) 0.17\quad C) 0.19\quad D) 0.14\quad E) 0.21

9) A marathon is 26 mi and 385 yd long. Estimate how many strides would be required to run a marathon. Assume a reasonable value for the average number of feet/stride.
   A) $4.5 \times 10^4$ strides\quad B) $4.5 \times 10^6$ strides
   C) $4.5 \times 10^5$ strides\quad D) $4.5 \times 10^3$ strides

10) The motions of a car and a truck along a straight road are represented by the velocity-time graphs in Figure 2.3. The two vehicles are initially alongside each other at time $t = 0$.

   Figure 2.3

   ![Figure 2.3](image)

   At time T, what is true of the distances travelled by the vehicles since time $t = 0$?
   A) They will have travelled the same distance.
   B) The truck will have travelled further than the car.
   C) The car will have travelled further than the truck.
   D) The truck will not have moved.
11) An object is dropped from rest into a pit, and accelerates due to gravity at roughly 10 m/s². It hits the ground in 5 seconds. A rock is then dropped from rest into a second pit, and hits the ground in 10 seconds. How much deeper is the second pit, compared to the first pit? Neglect air resistance.
   A) three times deeper  
   B) five times deeper  
   C) four times deeper  
   D) two times deeper

12) A child standing on a bridge throws a rock straight down. The rock leaves the child's hand at \( t = 0 \). Which of the graphs shown here best represents the velocity of the stone as a function of time?

A) 

B) 

C) 

D) 

E)
not possible to have a constant non-zero velocity and
a changing acceleration.

If \( \dot{V} \) were constant, then \( \ddot{a} \) would be zero, which is
impossible since \( \ddot{a} \) is always changing

whenever an object is in free fall, its acceleration is directed downwards.

\[
(95 \text{ gal/min})(231 \text{ in}^3/\text{gal})(1 \text{ min}/60 \text{ sec})(1 \text{ ft}/12 \text{ in})^3 = 21 \frac{ft^3}{sec}
\]

9) Assume each stride is 3 ft = 1 yard

\[1 \text{ mile} = 5280 \text{ ft} \]

\[
\text{thus } 26 	ext{ miles} = (26 \text{ miles})(5280 \text{ ft/mile}) = 137,280 \text{ ft} \\
385 \text{ yards} = (385 \text{ yards})(3 \text{ ft/yd}) = 1155 \text{ ft} \\
\]

Therefore

\[\frac{138,435 \text{ ft}}{3 \text{ ft/stride}} = 46,145 = 4.6 \times 10^4 \text{ strides}\]

distance traveled is the area beneath the \( V(t) \) versus time graph. Clearly the area beneath the truck's \( V(t) \) is greater than that of the car's. \( V(t) \) has a constant value. From \( t = 0 \) to \( t = T \) the car is accelerating, but only has \( V = \frac{V_{\text{truck}}}{2} \), therefore it can't travel as far.

\[y_{\text{max}} = \frac{1}{2} g t^2\]

so \[\frac{y}{y_1} = \frac{\frac{1}{2} g t^2}{\frac{1}{2} g t_1^2} = \left(\frac{t}{t_1}\right)^2 = \left(\frac{10}{5}\right)^2 = 4\]

it falls 4 times as far in twice the time

if it is thrown downward \( V_0 \) is negative, and since \( ay = -g \)
the slope must also be negative,
13) Which of the following is an accurate statement about vectors?
   A) Even though two vectors have unequal magnitudes, it is possible that their vector sum is zero.
   B) The magnitude of a vector is positive even if all of its components are negative.
   C) The magnitude of a vector can be zero even though one of its components is not zero.
   D) Rotating a vector about an axis passing through the tip of the vector does not change the vector.
   E) It is possible to add a scalar quantity to a vector.

14) The components of vector $\vec{A}$ are given as follows:

   $A_x = +4.8$
   $A_y = -9.4$

   The magnitude of $\vec{A}$ is closest to:
   A) 13
   B) 9.5
   C) 8.4
   D) 11
   E) 12

15) The magnitude of $\vec{A}$ is 5.5. Vector $\vec{A}$ lies in the second quadrant and forms an angle of 34 degrees with the y-axis. The components, $A_x$ and $A_y$, are closest to:

   A) $A_x = -4.6$, $A_y = +3.1$
   B) $A_x = -4.6$, $A_y = -3.1$
   C) $A_x = +4.6$, $A_y = -3.1$
   D) $A_x = +3.1$, $A_y = -4.6$
   E) $A_x = -3.1$, $A_y = +4.6$
The magnitude of a vector is always positive, since

\[ |\vec{A}| = \sqrt{A_x^2 + A_y^2} \]

Ax and Ay can both be negative, but upon squaring they become positive.

\[ A_x = 4.8 \]
\[ A_y = -9.4 \]
\[ |\vec{A}| = \sqrt{A_x^2 + A_y^2} \]
\[ = \sqrt{(4.8)^2 + (-9.4)^2} \]
\[ = \sqrt{23.04 + 88.36} \]
\[ = \sqrt{111.4} \approx 10.55 \]

\[ \square \]

\[ 11 \]

In the 2nd quadrant, Ay > 0
Ax < 0

Therefore:

\[ A_x = A \cos 124 \]
\[ = (5.5)(-0.559) = -3.07 \]

\[ A_y = A \sin 124 \]
\[ = (5.5)(0.824) = 4.56 \]

\[ \theta = 90 + 34 = 124^\circ \]

Therefore:

\[ A_x = -3.01 \]
\[ A_y = 4.66 \]
16) A soccer ball is released from rest at the top of a grassy incline. After 7.6 seconds, the ball travels 33 meters. One second later, the ball reaches the bottom of the incline.

a) What was the ball's acceleration? (Assume that the acceleration was constant.)

b) How long was the incline?

\[ t = 0 \]
\[ t = 7.6 \text{ sec} \]
\[ 33 \text{ meters} \]
\[ t = 8.6 \text{ sec} \]

**Ball starts from rest, thus \( v_0 = 0 \)**

a) \( a = \frac{2 \Delta x}{t^2} \)

\[ t_1 = 7.6 \text{ sec} \]
\[ x_1 = 33 \text{ meters} \]

\[ x = \frac{1}{2} a t^2 + v_0 t + x_0 \]

Thus:

\[ a = \frac{2 \times (33 \text{ meters})}{(7.6 \text{ sec})^2} \]

\[ a = 1014 \text{ m/s}^2 \]

b) Now, with a known, we can determine the distance.

The ball rolls in \( t_2 = 3.6 \text{ seconds} \)

\[ x = \frac{1}{2} a t^2 + v_0 t + x_0 \]

\[ x_2 = \frac{1}{2} a t^2 = \frac{1}{2} \left(1014 \text{ m/s}^2 \right) (3.6 \text{ sec})^2 \]

\[ x_2 = 42 \text{ meters} \]
17) A projectile is thrown upward at 24.0° with the vertical and returns to the horizontal ground 12.5 s later with no air drag. (a) How fast was it thrown? (b) How far from its original position did it land? (c) How high above its original position did it go?

a) Time of flight $t_{total} = 12.5$ sec, thus time to reach the apex is $t = \frac{v_y}{g} = \frac{6.25 \text{ m/s}}{9.8 \text{ m/s}^2} = 0.635 \text{ sec}$

At the apex, $v_y = 0$, so $v_y = g t = (9.8 \text{ m/s}^2)(6.25 \text{ sec})$

$v_y = 61.25 \text{ m/s}$

$b) x = \frac{1}{2} a t^2 + v_{xt} t + x_0 = v_{xt} t = v_x \cos 66^\circ t$

$x = (67 \text{ m/s}) \times 0.4067 \times (12.5 \text{ sec}) = 340.6 \text{ m}$

$c) v_{fy}^2 - v_{oy}^2 = 2ay \quad \text{at apex}$

$0 = -\frac{v_{oy}^2}{-2g} = \frac{(61.25 \text{ m/s})^2}{2(9.8 \text{ m/s}^2)} = 196.4 \text{ m}$