1. Aliens from another planet land their spaceship in the middle of the North Oval. They tell us that their unit of length is a quirdle (q) which is equal to 2.60 meters. If their spaceship has a living area of 21.0 q^2 how many square meters is that?

A) 6.76 m^2
B) 54.6 m^2
C) 142 m^2
D) 1150 m^2
E) 2980 m^2

$$(21.0\,q^2)\left(\frac{2.60\,m}{1\,q}\right)^2 = 142\ m^2$$

2. Which of the statements below is *not true*?

A) Physics is based on experimental observations.
B) The mathematical equations used in physics have a physical meaning.
C) The special theory of relativity cannot be accurate because it is only a theory.
D) Physics is considered a fundamental science because the ideas and concepts of physics are an important part of the foundation of many other science and engineering field.
E) Even something described as a *law* of physics, like Newton's laws, *might* not be applicable to all circumstances.

After 20th century theory = law
All have realms of applicability

3. If I write you a check for 15 Mega-dollars how many dollars would you have? (Assume the check doesn't bounce.)

A) 1.5×10^{6}
(B) 1.5×10^{7}
C) 1.5×10^{3}
D) 1.5×10^{-6}
E) 1.5×10^{-5}

$15\times10^{6} = 1.5\times10^{7}$

4. You drive for 2.5 **hours** at an average speed of 55 **mi/hr**. What distance did you travel in **km**?

A) 73 km
B) 86 km
C) 140 km
(D) 220 km
E) 340 km

$s = \frac{d}{t}$

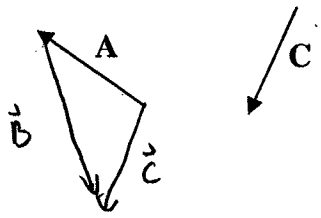
$d = st = (55\ mi/hr)(2.5\ hr) = 137.5\ mi$

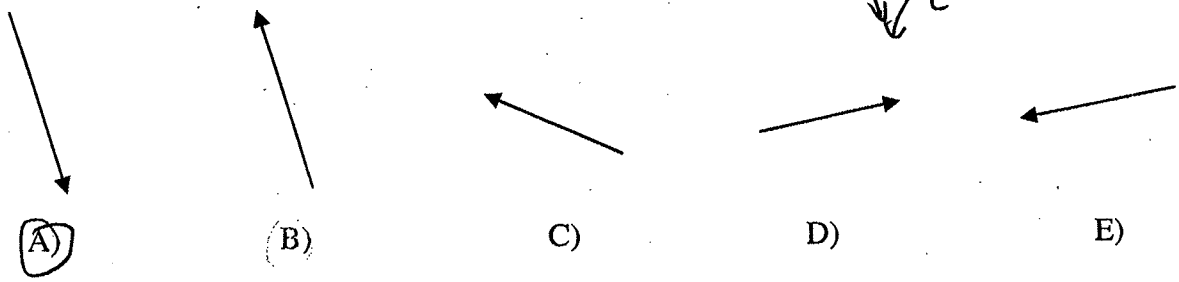
$(137.5\ mi)\left(\frac{1609\ m}{mi}\right)\left(\frac{1\ km}{1000\ m}\right) = 220\ km$

5. Which of the following is true?

A) A car cannot have both a constant speed and a constant velocity.
B) Both a car traveling at a constant velocity and a car traveling at a constant speed can turn.
C) Neither a car traveling at a constant velocity nor a car traveling at a constant speed can turn.
D) A car traveling at a constant velocity can turn but a car traveling at a constant speed cannot.
(E) A car traveling at a constant speed can turn but a car traveling at a constant velocity cannot.

6. Two vectors, **A** and **C** are shown to the right. What vector, **B**, can be added to **A**, so that **C** = **A** + **B**? The vectors are drawn to scale.





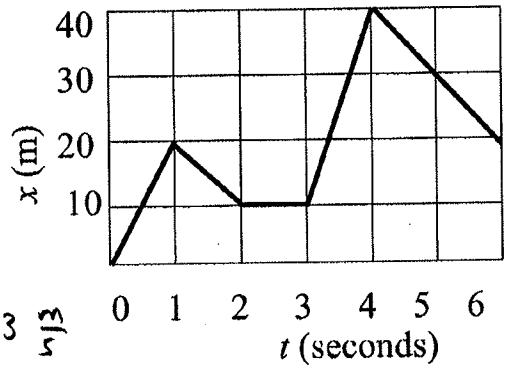
7. A motorcycle traveling with an unknown initial speed accelerates for 4.5 s at a constant rate of 3.5 m/s^2 until reaching a faster speed of 28 m/s. What was the motorcycle's initial speed?

(A) 12 m/s
B) 14 m/s
C) 16 m/s
D) 20 m/s
E) 24 m/s

$a = 3.5\ m/s^2$
$t = 4.5\ s$
$V = 28\ m/s$

$V = V_0 + at$
$V_0 = V - at = 28\ m/s - (3.5\ m/s^2)(4.5\ s)$
$= 12\ m/s$

8. Consider the graph of position vs time for an object moving along a straight line as shown in the figure to the right. What was the object's average speed during the six seconds shown?



A) 3.33 m/s
B) 6.66 m/s
C) 8.33 m/s
(D) 13.3 m/s
E) 16.7 m/s

$d = 80\ m$
$t = 6\ s$
$s = \frac{d}{t} = \frac{80\ m}{6\ s} = 13.3\ \frac{m}{s}$

9. For the same graph as in the previous problem, where is the object moving the slowest?

A) Between 0 and 1 s.
(B) Between 2 and 3 s. Not moving
C) Both between 1 and 2 s and between 4 and 6 s.
D) At 0 s.
E) At 4 s.

10. A bicyclist starts from rest and accelerates at a constant rate for 3.5 s until he reaches a speed of 8.0 m/s. How far did he travel in that time?

A) 2.3 m
(B) 14 m
C) 18 m
D) 28 m
E) 56 m

$V_0 = 0$
$t = 3.5\ s$
$V = 8\ m/s$

Use $V = V_0 + at$ to find a
$V = 0 + at = at$
$a = \frac{V}{t} = \frac{8\ m/s}{3.5\ s} = 2.29\ m/s^2$

Now find d
$d = V_0 t + \frac{1}{2}at^2 = 0 + \frac{1}{2}at^2$
$= \frac{1}{2}(2.29\ m/s^2)(3.5\ s)^2 = 14\ m$

11. Two cars start from rest and accelerate at the same rate. The second car accelerates for twice as much time as the first car. How much farther does the second car travel?

A) Half as far
B) The same distance.
C) $\sqrt{2}$ times farther.
D) 2 times farther
(E) 4 times farther

$V_0 = 0$ for both
a is same for both $t_2 = 2t_1$
$d = v_0 t + \frac{1}{2} a t^2 = 0 + \frac{1}{2} a t^2$
$d = \frac{1}{2} a t^2$ when time doubles, t^2 quadruples

12. A boat is sailing on a lake. In which of the following scenarios is the boat accelerating?

A) Only when the boat is speeding up
B) Only when the boat is slowing down
C) Only when the boat is turning with a constant speed
D) Both (A) and (B)
(E) All of the above

velocity is a vector
acceleration is change in velocity

13. A ball is thrown horizontally off a 9.8 m high cliff with a speed of 24 m/s. Neglecting air resistance how long is the ball in the air?

A) 0.41 s
B) 0.64 s
(C) 1.4 s
D) 2.0 s
E) There is not enough information given to answer this question.

look at vertical direction only
$v_{y0} = 0$ $d_y = 9.8\,m$ $a_y = -g = -10$
$d_y = v_{y0} t - \frac{1}{2} g t^2 = 0 - \frac{1}{2} g t^2$
$t^2 = \frac{-2 d_y}{g}$
$t = \sqrt{\frac{-2 d_y}{g}} = \sqrt{\frac{-2(9.8\,m)}{-10\,m/s^2}} = 1.4\,s$

14. A basketball player shoots the ball toward the hoop. While the ball is in the air, which of the following is true, neglecting air resistance?

(A) The acceleration of the ball does not change.
B) The speed of the ball does not change.
C) The acceleration of the ball at the highest point is zero.
D) The speed of the ball is zero at the highest point.
E) None of the above. They are all false.

15. A ball is thrown straight down from the top of a building. Which of the following is *not true* about the motion of the ball while it is falling, neglecting air resistance?

A) The velocity of the ball always points down.
B) The ball continually speeds up.
C) The speed of the ball does not depend on its mass.
D) The acceleration of the ball always points down.
E) The acceleration of the ball increases as the ball falls.

acceleration is constant

16. Two rocks are thrown straight up. The first rock is thrown with twice the velocity of the second rock. How much time does the first rock take to reach its highest point compared to the time the second rock takes to reach its highest point?

A) Half as long.
B) The same time
C) $\sqrt{2}$ times longer.
D) 2 times longer
E) 4 times longer

$V_{01} = 2V_{02}$

$V = 0$ for both
a is same for both

$V = V_0 + at$

$0 = V_0 + at$

$t = \frac{-V_0}{a}$

when V_0 doubles, t doubles

17. You throw a ball straight down from the top of a building with an initial speed of 12 m/s. The ball hits the ground 3.2 s later. Neglecting air resistance, how tall is the building?

A) 13 m
B) 42 m
C) 51 m
D) 70 m
E) 90 m

$V_0 = -12\ m/s$

$a = -10\ m/s^2$

$t = 3.2\ s$

$d = V_0 t + \frac{1}{2}at^2$

$= (-12\ m/s)(3.2\ s) + \frac{1}{2}(-10\ m/s^2)(3.2\ s)^2$

$= -38.4\ m - 51.2\ m = 89.6\ m = 90\ m$