ABRHS PHYSICS (CP) NAME: KEY

# Acceleration Problems

*Basic Concepts*

1. What is meant by the term *acceleration*?

   its the rate at which your velocity changes

2. What is the mathematical definition of *acceleration*?

   $a = \frac{v_f - v_i}{t}$

3. What are three ways you can accelerate?

   1. Speed up 2. Slow Down 3. Go in a circle

4. If you have an acceleration of 0, what must you be doing?

   constant velocity !!

*Problems*

1. If you are driving along and the speedometer always reads 20 mph, could you be accelerating? Explain.

   On a straight road, but if the road is curvy, yes because you could be changing the direction you are traveling in

2. What must be happening to your velocity for you to be experiencing a constant acceleration?

   It has to speed up (or slow down) by the same amount every second.

3. If a cheetah can maintain a constant velocity of 25 m/s, what is the cheetah's acceleration?

   0 $m/s^2$ [because there is no change in the velocity]

4. A car initially at rest speeds up by 3.0 m/s every second for 15 seconds.
   a. What is the acceleration of the car?

      3 $m/s^2$

   b. What will be the car's final velocity at the end of the 15 seconds?

      $a = \frac{v_f - v_i}{t}$ $3 = \frac{v_f - 0}{15}$ $v_f = (3)(15) = 45\ m/s$

5. A car is traveling at 11 m/s. If it slows down at the rate of 2 m/s every second, how fast will it be going after 3.0 s?

   $v_i = 11\ m/s$
   $a = -2\ m/s^2$
   $t = 3\ s$

   $a = \frac{v_f - v_i}{t}$ $-2 = \frac{v_f - 11}{3}$ $-6 = v_f - 11$ $v_f = 5\ m/s$

6. Jack accelerates his car from 50 km/hr to 65 km/hr in 5 seconds. Sue accelerates her car from rest to 15 km/hr in the same time. Which one undergoes the greatest acceleration? Explain.

   Same acceleration! Each sped up 15 kph in 5 seconds

   [@ $a = \frac{15}{5} = 3\ \frac{kph}{s}$]

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7. Monica is walking to her hairdresser at 1.3 m/s when she glances at her watch and realizes that she is going to be late for her appointment. Monica gradually quickens her pace at a rate of 0.09 m/s$^2$. What is Monica's speed after 10 seconds? Is Monica walking, jogging or running very fast?

$v_i = 1.3$ m/s  $t = 10$  $a = \frac{v_f - v_i}{t}$  $.09 = \frac{v_f - 1.3}{10}$

$a = 0.09$ m/s$^2$  $v_f = ?$  $.9 = v_f - 1.3$

$v_f = 2.2$ m/s

8. A police car is driving at 25 m/s for 60 seconds* when a stolen car flies by it. To catch it, the police speeds up to 45 m/s in only 2.5 seconds. What was the acceleration of the police car?

$v_i = 25$ m/s  $a = \frac{v_f - v_i}{t} = \frac{45 - 25}{2.5}$  $a = 8$ m/s$^2$

$v_f = 45$ m/s

$t = 2.5$ s

9. Starting from rest, you speed up on your bike with a constant rate of 0.8 m/s/s.

* 60 seconds is useless information

a. How long will it take you to reach a speed of 4 m/s?

$a = 0.8$ m/s$^2$  $a = \frac{v_f - v_i}{t}$  $.8t = 4$

$v_f = 4$ m/s  $.8 = \frac{4 - 0}{t}$  $t = 5$ sec.

$v_i = 0$ m/s

b. How fast will you be going after 12 seconds?

$a = 0.8$ m/s$^2$  $a = \frac{v_f - v_i}{t}$  $.8 = \frac{v_f - 0}{12}$

$v_f = ?$  $v_i = 0$ m/s  $v_f = 9.6$ m/s

$t = 12$ s

10. A plane is flying at 300 m/s. It slows down at a rate of 2.5 m/s/s.

a. How fast is it going after 20 seconds?

$v_i = 300$ m/s  $a = \frac{v_f - v_i}{t}$  $-50 = v_f - 300$

$a = -2.5$ m/s$^2$  $-2.5 = \frac{v_f - 300}{20}$  $v_f = 250$ m/s

$t = 20$ s

b. How long will it take to reach a speed of 180 m/s?

$v_i = 300$ m/s  $a = \frac{v_f - v_i}{t}$  $-2.5 = \frac{-120}{t}$

$a = -2.5$ m/s  $-2.5 = \frac{180 - 300}{t}$  $2.5t = 120$

$t = ?$  $v_f = 180$ m/s  $t = 48$ s

11. A car has an initial speed of 20 km/h and undergoes a constant acceleration of 4 km/h/s.

a. How fast is it going after 3 seconds?

$v_i = 20$ kph  $a = \frac{v_f - v_i}{t}$  $12 = v_f - 20$

$a = 4$ kph/s  $4 = \frac{v_f - 20}{3}$  $v_f = 32$ kph

$t = 3$  $v_f = ?$

b. How much total time would it take to reach a speed of 80 km/h?

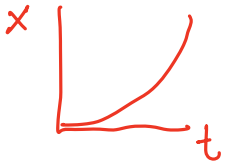
$v_i = 20$ kph  $a = \frac{v_f - v_i}{t}$  $4t = 80 - 20$

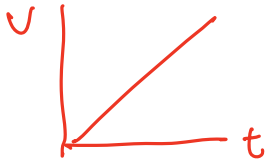
$v_f = 80$ kph  $4 = \frac{80 - 20}{t}$  $4t = 60$

$t = ?$  $t = 15$ sec

$a = 4$ kph/s

12. Sketch position vs. time and velocity vs. time graphs that would show someone speeding up.



# Acceleration Problems

*Answers to Problems*

*1) yes*

*2) change same amount @ second*

*3) 0 m/s/s*

*4 a) 3 m/s/s*

*b) 45 m/s*

*5) 5 m/s*

*6) same*

*7) 2.2 m/s*

*8) 8 m/s/s*

*9 a) 5 s*

*b) 9.6 m/s*

*10 a) 250 m/s*

*b) 48 s*

*11 a) 32 km/h*

*b) 15 s*