NAME: KEY

Linear Motion I Review

The test will include multiple choice, short answer and open response. For the open response, you will have to show your work. It will be done on paper, so bring something to write with and bring a calculator. The front page of the test will include the following information:

Equations & Constants:

$$\bar{v} = \frac{d}{t} \qquad a = \frac{v_f - v_i}{t}$$

1 m = 100 cm *1 km = 1000 m* *1 hr = 3600 s*

1. The slope of a position-time graph is called velocity.
2. The slope of a velocity-time graph is called acceleration.
3. What are the standard metric units of velocity? m/s
   Give at least 3 other units of velocity:
   mph $\frac{km}{s}$ $\frac{cm}{min}$ --> anything that is a $\frac{distance}{time}$
4. What are the standard metric units of acceleration? m/s^2 or $m/s/s$ ← same thing, just written 2 different ways
   Give at least 3 other units of acceleration:
   mph/s ft/s^2 mph/min --> anything that is $\frac{\frac{distance}{time}}{time}$ or $\frac{distance}{time^2}$
5. What does it mean to have a constant speed?
   Every second you travel the exact same distance; You don't speed up or slow down.
6. What does it mean to have a constant velocity?
   A constant speed (see #5) in the exact same direction.
7. Is it possible to have a constant speed, yet your velocity be changing? Explain.
   Sure. As long as your direction changes (i.e. turning left or right) your velocity would change.
8. What does it mean to have a constant acceleration?
   Every second your velocity changes the same amount. (i.e. You speed up or slow down the same amount each second.)
   ↳ and in the same direction!
9. If you have a constant acceleration of 15 km/h/s, what is happening?
   Every second, you add 15 kph to your velocity.
10. What is the difference between speed and velocity?
    while they both tell you how fast you are going - velocity tells you the direction as well.

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11. Is it possible to have a constant speed and still be accelerating? How about a constant velocity? Explain.

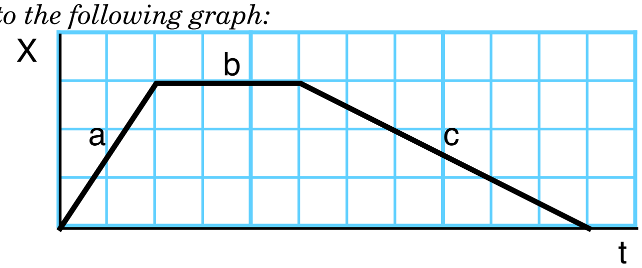
constant speed going in a circle would be accelerating - because the direction you are moving in changes. So yes, it is possible

we will study going in circles in a few months, so we will do the math then.

12. Which of the following should be considered an "accelerator" in an automobile?
   a. Brake pedal. b. Gas pedal. c. Steering wheel. d. All of these.

speed up / slow down / change direction

Questions 12 to 14 refer to the following graph:



13. Over which interval(s) is the object moving forwards (or in the positive direction)? How about backwards (or in the negative direction)?

A - Forward (b/c + slope, so + velocity)

C - Backward (b/c - slope, so - velocity)

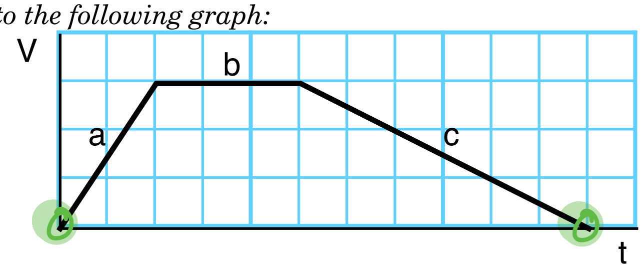
14. Over which interval(s) is the object slowing down? How about speeding up?

None & None! Straight lines on a position graph indicate constant velocity.

15. Over which interval(s) does the object have a constant velocity?

All of them! (though B is a constant velocity of 0)

Questions 15 to 18 refer to the following graph:



16. Over which interval(s) is the object moving forwards (or in the positive direction)? How about the backwards (or in the negative direction)?

All of them! They are all + numbers!

17. Over which interval(s) is the object slowing down? How about speeding up?

Slowing down - C notice this section starts at some positive velocity and goes down to zero.

Speeding up - A notice this section starts at 0 m/s and goes up to some positive velocity up to some positive velocity.

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18. Over which interval(s) does the object have a constant velocity?

B notice this section is flat - so the velocity is always the same number.

19. Does the object have a velocity of zero over any interval?

Only at the start and end - just those two points.
→ circled on the graph. So NO, there is no interval where its velocity stays at 0 m/s

19. How long will it take a child running with a constant velocity of 3 m/s to cover a distance of 40 meters? What is the child's acceleration over this distance?

$v = 3$ m/s
$d = 40$ m

$v = \frac{d}{t}$ $3 = \frac{40}{t}$

$3t = 40$

$\boxed{t = 13.3 \text{ s}}$

20. If you travel 100 meters in 12 seconds, what is your average speed? Can you say anything about your instantaneous speed at exactly 4 seconds or at exactly the 75 m position?

$d = 100$ m
$t = 12$ s

$v = \frac{d}{t} = \frac{100}{12}$

$\boxed{v = 8.3 \text{ m/s}}$

Can't assume its a constant speed - so it could be changing. So sometimes it could be faster and sometimes it could be slower, but we don't know where or when.

21. Sound travels at 340 m/s through the air. How long would it take you to hear a thunder clap that occurred 2 km away?

$v = 340$ m/s
$d = 2$ km $= 2000$ m

$v = \frac{d}{t}$ $340 = \frac{2000}{t}$

$340t = 2000$

$\boxed{t = 5.9 \text{ s}}$

22. A car constantly accelerates from rest to 30 m/s in 6 seconds.
   a. What was its acceleration?

$v_i = 0$ m/s
$v_f = 30$ m/s
$t = 6$ s

$a = \frac{v_f - v_i}{t} = \frac{30 - 0}{6}$

$\boxed{a = 5 \text{ m/s}^2}$

   b. How many <u>more</u> seconds would it take to reach a speed of 50 m/s?

Now $v_f = 50$ m/s
$v_i = 30$ m/s
$a = 5$ m/s^2

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

$5 = \frac{50 - 30}{t}$

$5t = 50 - 30$
$5t = 20$
$\boxed{t = 4 \text{ s}}$

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23. If a skateboarder is moving with a speed of 10 m/s and slows down at a rate of 1.6 m/s^2.
    a. How fast is the skateboarder moving 2 seconds later?

$v_i = 10$ m/s

"–" because slowing down! → $a = -1.6$ m/s^2

$t = 2$ s

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

$-1.6 = \frac{v_f - 10}{2}$

$-3.2 = v_f - 10$

$\boxed{v_f = 6.8 \text{ m/s}}$

    b. How many total seconds will it take the skateboarder to come to rest?

Now $v_i = 10$ m/s

$v_f = 0$ m/s

$a = -1.6$ m/s^2

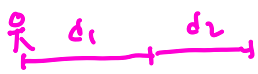
$a = \frac{v_f - v_i}{t}$

$-1.6 = \frac{0 - 10}{t}$

$-1.6t = -10$

$\boxed{t = 6.25 \text{ s}}$

24. A friend walks straight down a hallway. She first walks 100 meters at a constant speed of 1.5 m/s. Then she runs at 3 m/s for 30 seconds. What was her average speed for the entire motion?



$d_1 = 100$ m $d_2 = ?$

$v_1 = 1.5$ m/s $v_2 = 3$ m/s

$t_1 = ?$ $t_2 = 30$ s

To find average speed for whole trip, we need the total distance & time!

$\bar{v} = \frac{d_1 + d_2}{t_1 + t_2}$ ← So find t_1 & d_2 first!

① $v = \frac{d}{t}$ → $1.5 = \frac{100}{t_1}$ → $t_1 = 66.7$ s

② $v = \frac{d}{t}$ → $3 = \frac{d_2}{30}$ → $d_2 = 90$ m

③ $v = \frac{d}{t} = \frac{100 + 90}{66.7 + 30}$

$v = \frac{190}{96.7} = \boxed{1.97 \text{ m/s}}$

25. Starting from rest, a bike speeds up at a constant rate of 3 m/s every second for 4 seconds.
    a. What is the acceleration of the bike?

$a = 3$ m/s/s

$t = 4$ s

$v_i = 0$ m/s

So $\boxed{a = 3 \text{ m/s/s}}$

    b. How fast is the bike going at the end of the 4 seconds?

$a = \frac{v_f - v_i}{t}$ $3 = \frac{v_f - 0}{4}$ $\boxed{v_f = 12 \text{ m/s}}$

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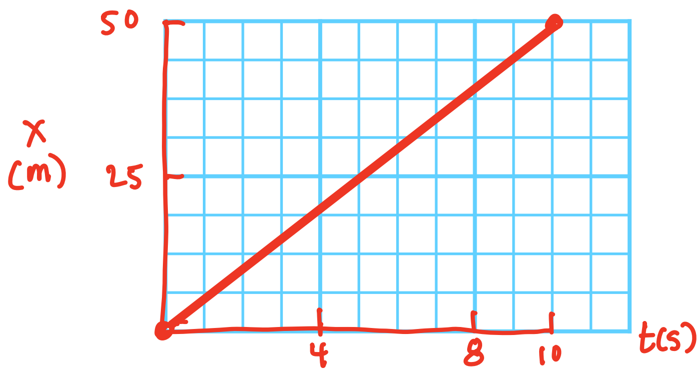
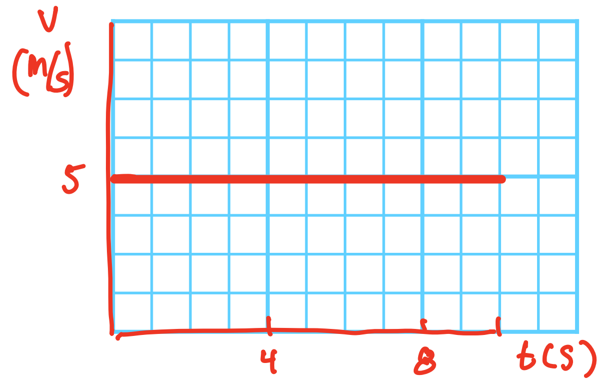
26. Make the position and velocity graphs for each of the following situations:

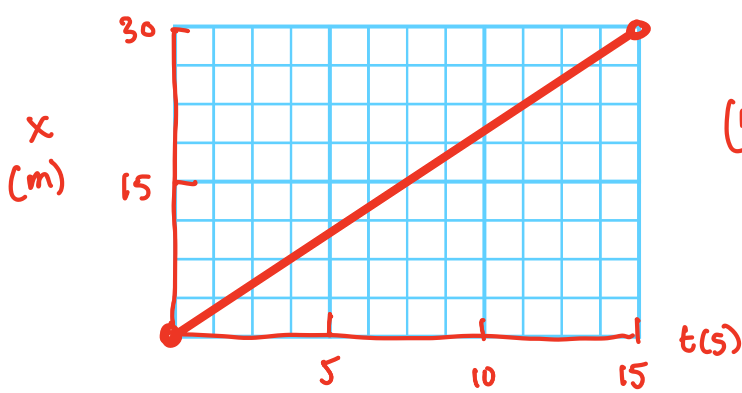
a. A bike moves 50 meters in 10 seconds with a constant velocity.

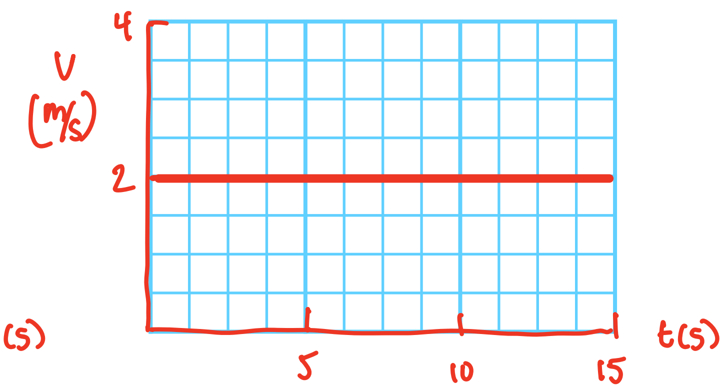




So $v = \frac{d}{t} = \frac{50}{10} = 5\ \frac{m}{s}$

b. A person jogs 2 meters every second for 15 seconds.





So $v = 2\ m/s$

$t = 15\ s$ $\rightarrow$

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

$2 = \frac{d}{15}$

$d = 30\ m$

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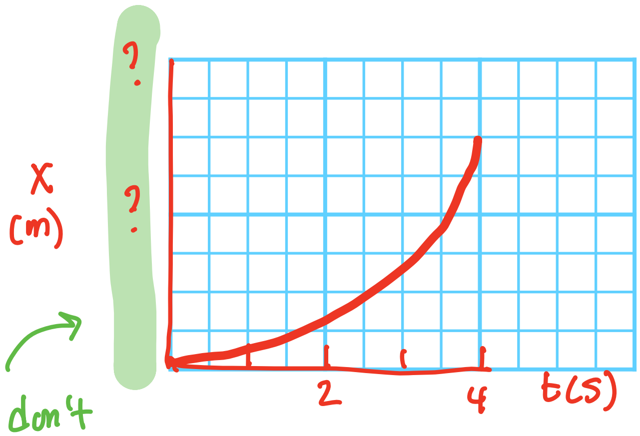
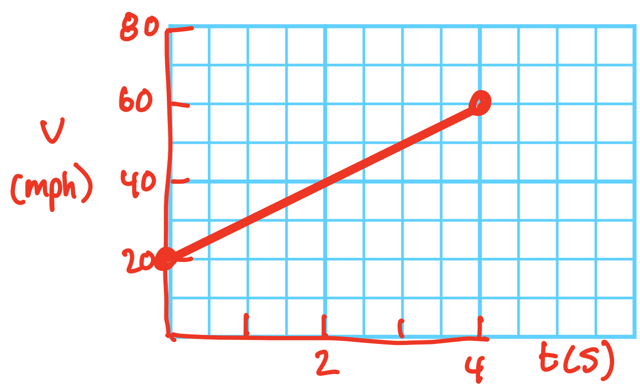
c. Starting from 20 mph, a car speeds up at a constant rate of 10 mph/s for 4 seconds. (On this one, you do not need any numbers on the distance graph - just show the shape.)





You don't know how to calculate this yet. (That will be the next unit actually.)

You should be able to say the shape of the position graph though!

So $v_i = 20$ mph

$a = 10$ mph/s

$t = 4$ s

→

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

$10 = \frac{v_f - 20}{4}$

$40 = v_f - 20$

$\underline{v_f = 60 \text{ mph}}$