Chp 5 Little Book,
Motion Math & Work Sheet
Answers:

Be sure to show YOUR work
and the formulas for credit!

Motion Math

pages 6 & 7 in your little book

Solve the following problems. Show all your work and attach additional paper if necessary. Write the formulas in the provided boxes to help. Remember to include the correct units.

Speed & Average Speed

- *Speed Formula:*
- ***S= D/T***

1. Nascar driver, Jeff Gordon, has a car that is one of the fastest on the circuit. If it travels 600 miles in 4 hours, what is his cruising speed?

D/T = S

- **600 MILES/4 HOURS = 150 mph**

2. The fastest car on Earth, a German-made Thrust SSC, would win every Nascar race in America. If it takes 0.5 hours (30 minutes) to travel 380 miles, what is its speed?

D/T = S

- **380M / 30 min = 12.67 miles/min**

3. The fastest train on Earth, the TGV from France, can travel at faster speeds than trains in the United States. During a speed test, the train traveled 800 miles in 2.5 hours. What is its speed?

D/T = S

- **800 m / 2.5 hours = 320 mph**

4. How fast was a plane flying if it traveled 400 km in 30 min?

D/T = S

- **400 km / 30 min = 13.33 km/min**

5. A Hummer travels at a speed of 50 mi/hr for 4 hrs. How far did the car travel?

S x T = D

- **50 mph = D / 4 = 200 miles**
- **50 x 4 = 200 miles**

6. The fastest plane ever made, the Lockhead SR71, was able to travel 2200 miles per hour. Based on this speed, how far could it travel in:

a. 2 hours

S x T = D

- **2200 = D/2 = 4400 MILES**

b. 3 hours?

S/T = D

- **2200 = D/3 = 6600 MILES**

c. 5 hours?

S x T = D

- **2200 = D/5 = 11,000 MILES**
- **2200 x 5 = 11,000**

Velocity

- *Velocity Formula:*
- *V= D/T*

7. A car traveled 1025 km from El Paso to Dallas in 13.5 hr. What was its average velocity?

V= D/T

- **1025 km / 13.5 hours = 75.93 km/hr toward Dallas**

8. A student walks 10 blocks to a computer store (Assume all the blocks are equal length.)
a. How long will it take him to reach the computer store if he walks 3 blocks in 2 min?

D/V =T

- **3 blocks / 2min = 1.5 blocks per minute**
  1.5 = 10 blocks/time = 6.67 minutes

b. What is his average velocity?

V= D/T

- **1.5 blocks / minute toward the computer store**

9. A cheetah runs at a velocity of 88 ft/sec for 40 seconds. How far does this cheetah run?

D= T x V

- **88 ft/sec = D/40 D=3520 feet**

Acceleration

- *Acceleration Formula:*
- $A = \frac{V_f - V_i}{T}$

10. Twenty seconds after a soccer ball is kicked (initial velocity = 0), its velocity is 32 m/s. What is its acceleration?

$$A = \frac{V_f - V_i}{T}$$

- **A = $\frac{32 - 0 \text{ m/s}}{20}$**

32/20 = 16/10 = 1.6 m/s²

11. A driver starts his parked car and within 1 minute reaches a velocity of 30 mph as he travels east. What is his acceleration?

$$A = \frac{V_f - V_i}{T}$$

- **A = $\frac{30\text{-}0 \text{ mph}}{1 \text{ min}}$ = 60 min/ 1 hr = 1800 m/h²**

Random –
Find the missing variable
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12. V = 40 mi/hr t= 3 hrs. D=?

- **V = D / T or D= V x T**
- **40 = D/3 or D= 40 x 3**
- **120 MILES =D**

13. A = 9.8 m/s² t= 3 hr V=?

- **A = V / T or V =A x T**
- **9.8 = V/3**
- **V = 29.4 M/S**

14. t = 5 hr d= 100 m. V=?

- **V = D/T**
- **= 100 m / 5 hr**
- **= 20 meters / hr**

15. V = 100 mi/hr d= 400 mi
t= ?

- V = D/T or D/V=t
- = 100 m / hr
- = 400 miles / t
- t = 4 hrs

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A Weighty Problem

Complete this worksheet after you finish reading Chapter 5, Section 4.
Pictured below are two measurement devices, *A* and *B*.

Weight or Mass?	Weight or Mass?
• spring scale • measure of gravitational force exerted on an object • constant on Earth • changes when gravitational force changes • expressed in newtons • six times less on the moon than on the Earth	• balance • amount of matter in an object • constant on Earth • never changes • measured in grams • remains the same when gravitational force changes

A. 
spring scale

B. 
balance

1. Determine whether each device measures *mass* or *weight*, and circle the correct term in each box.
2. The following list contains information that relates to either *mass* or *weight*. Write each of the bulleted items in the correct boxes above. Some information may go in more than one box.

- balance
- spring scale
- measure of gravitational force exerted on an object
- amount of matter in an object
- constant on Earth
- measured in grams
- changes when gravitational force changes
- never changes
- expressed in newtons
- remains the same when gravitational force changes
- six times less on the moon than on Earth

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Notes: Speed-Time Graphs

- Show an object's speed or **velocity** over time

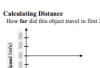
Speed & Time Graph

A. Positive Acceleration
This object is getting faster & faster.

B. Negative Acceleration
This object is getting slower & slower, or **decelerating**

C. No Acceleration
This object is maintaining a **constant** speed.

A flat line on a **position-time** graph means **The object has stopped moving.**



A flat line on a **speed-time** graph means **The object is moving at a constant speed.**

Calculating Distance

How **far** did this object travel in first 20 seconds?

D = S x T = 150 x 20 = 3000 m = 3 km

How **far** did this object travel in first 8 hours?

D = S x T = 30 x 8 = 240 miles

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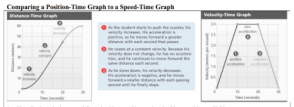
Calculating Acceleration

$$\text{Acceleration} = \frac{\text{Change in Speed (m/s)}}{\text{Time (s)}}$$

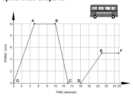
What is the object's acceleration? **2 m/s²**

Comparing a Position-Time Graph to a Speed-Time Graph



1. How far does the boy travel from the 10-second interval to the 20-second interval? **30 meters**
2. What is the boy's acceleration from the 0-second interval to the 10-second interval? **0.3 m/s²**

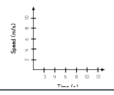
Speed-Time Graph #2



1. How far did the bus travel from point A to point B?
D = s x t = 10 x 5 = 50 m
2. What was the bus's speed at point C?
0 m/s
3. For how many seconds did the bus decelerate?
From 10-13 seconds, 3 seconds
4. What was the bus' acceleration from point D to point E?
1 m/s²

Drawing a Speed-Time Graph

Maria walks at a constant speed of 6 m/s for 5 seconds. Then, she runs at a constant speed of 10 m/s for 5 seconds. **Create a speed-time graph using her data.**



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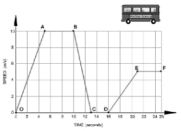
The graph below shows how the speed of a bus changes during part of a journey



Choose the correct words from the following list to describe the motion during each segment of the journey to fill in the blanks.

- accelerating
- decelerating
- constant speed
- at rest

Segment O-A The bus is _____. Its speed changes from 0 to 10 m/s in 5 seconds.

Segment A-B The bus is moving at a _____ of 10 m/s for 5 seconds.

Segment B-C The bus is _____. It is slowing down from 10 m/s to rest in 3 seconds.

Segment C-D The bus is _____. It has stopped.

Segment D-E The bus is _____.
It is gradually increasing in speed.

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- Segment O-A: accelerating
- Segment A-B: constant speed
- Segment B-C: decelerating
- Segment C-D: at rest
- Segment D-E: accelerating
- Segment E-F: constant speed

Notes: Position-Time Graphs

- Show an object's position at a given time
- Position or **distance** on **y**-axis
- Time on **x**-axis
- An object moving at a **constant** speed creates a **straight-sloped** line.
- The **faster** an object moves, the **steeper** its slope.
- A flat line means the object's position is **not changing** or the object has **stopped.**
- A line that slopes downwards means the object is **returning to its original position**.
- Most importantly, these graphs are used to calculate an object's **speed.**

$$\text{Slope} = \frac{\text{Change in Position}}{\text{Change in Time}} \qquad \text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Interpret a Distance-Time Graph: A zebra's speed will change throughout the day, especially if a hungry lion is nearby. You can use a distance-time graph to compare the zebra's speed over different time intervals.

1. When the zebra is walking, the line on the graph slants as position increases. You can see this motion on the graph as a climbing line.
2. When the zebra stops to eat, the line on the graph stays at its distance from the starting point. Time, however, continues to pass. Therefore, the graph shows a flat, or horizontal, line.
3. As soon as the zebra notices the lion, it immediately starts to run for its life. The zebra is covering a greater distance in each time interval than it was before the chase started, so the line is steeper.

1. How far does the zebra walk in the first 20 seconds? **40 meters**
2. How long does the zebra rest for? **20 seconds**
3. What total distance does the zebra travel? **280 meters**
4. During what time interval did the zebra travel the fastest? **From 40-60 seconds**
5. What is the speed of the zebra during the time interval from 0 seconds to 20 seconds? **2 m/s**
6. What is the speed of the zebra during the time interval from 40 seconds to 60 seconds? **6 m/s**

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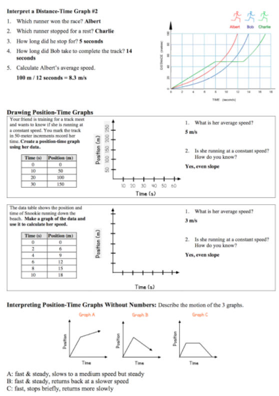


Interpret a Distance-Time Graph #2

1. Which runner won the race? **Albert**
2. Which runner stopped for a rest? **Charlie**
3. How long did he stop for? **5 seconds**
4. How long did Bob take to complete the track? **14 seconds**
5. Calculate Albert's average speed.

   100 m / 12 seconds = 8.3 m/s

Drawing Position-Time Graphs

Your friend is training for a track meet and wants to know if she is running at a constant speed. You mark the track in 50-meter increments record her time. **Create a position-time graph using her data.**

Time (s)	Position (m)
0	0
10	50
20	100
30	150

1. What is her average speed?

   5 m/s

2. Is she running at a constant speed? How do you know?

   Yes, even slope

The data table shows the position and time of Snookie running down the beach. **Make a graph of the data and use it to calculate her speed.**

Time (s)	Position (m)
0	0
2	6
4	9
6	12
8	15
10	18

1. What is her average speed?

   3 m/s

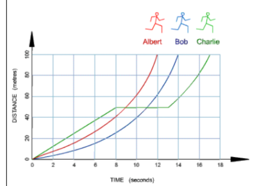
2. Is she running at a constant speed? How do you know?

   Yes, even slope

Interpreting Position-Time Graphs Without Numbers: Describe the motion of the 3 graphs.

A: fast & steady, slows to a medium speed but steady
B: fast & steady, returns back at a slower speed
C: fast, stops briefly, returns more slowly

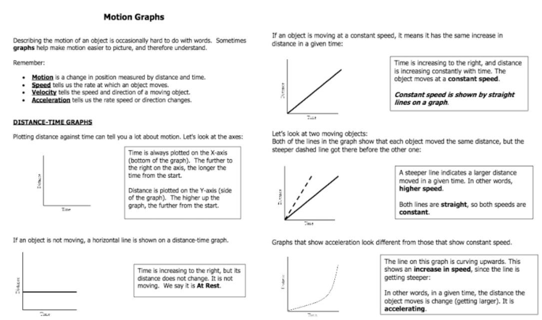
PG16: THE RUNNERS IN DEPTH



1. Which runner won the race?
   -Albert won the race. He reached 100 meters first.
2. Which runner stopped for a rest?
   -Charlie stopped for a rest at 50m.
3. How long did he stop for?
   -Charlie stopped for 5 seconds. (13-8)
4. How long did Bob take to finish?
   -14 seconds
5. Calculate Albert's average speed
   Avg speed = Total Distance / Total time

   100m / 12s = 8.33m/s

Motion Graphs



Motion Graphs

Describing the motion of an object is occasionally hard to do with words. Sometimes **graphs** help make motion easier to picture, and therefore understand.

Remember:

- **Motion** is a change in position measured by distance and time.
- **Speed** tells us the rate at which an object moves.
- **Velocity** tells the speed and direction of a moving object.
- **Acceleration** tells us the rate speed or direction changes.

DISTANCE-TIME GRAPHS

Plotting distance against time can tell you a lot about motion. Let's look at the axes:

Time is always plotted on the X-axis (bottom of the graph). The further to the right on the axis, the longer the time from the start.

Distance is plotted on the Y-axis (side of the graph). The higher up the graph, the further from the start.

If an object is not moving, a horizontal line is shown on a distance-time graph.

Time is increasing to the right, but its distance does not change. It is not moving. We say it is **At Rest**.

If an object is moving at a constant speed, it means it has the same increase in distance in a given time:

Time is increasing to the right, and distance is increasing constantly with time. The object moves at a **constant speed**.

Constant speed is shown by straight lines on a graph.

Let's look at two moving objects:
Both of the lines in the graph show that each object moved the same distance, but the steeper dashed line got there before the other one:

A steeper line indicates a larger distance moved in a given time. In other words, **higher speed**.

Both lines are **straight**, so both speeds are **constant**.

Graphs that show acceleration look different from those that show constant speed.

The line on this graph is curving upwards. This shows an **increase in speed**, since the line is getting steeper:

In other words, in a given time, the distance the object moves is change (getting larger). It is **accelerating**.

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Summary:

A distance-time graph tells us how far an object has moved with time.

- The steeper the graph, the faster the motion.
- A horizontal line means the object is not changing its position - it is not moving, it is at rest.
- A downward sloping line means the object is returning to the start.

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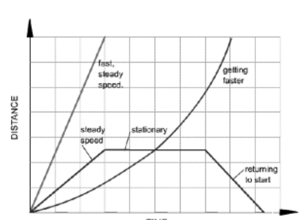

(Graph from:
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)

In which of the following graphs below are both runners moving at the same speed?
Explain your answer.

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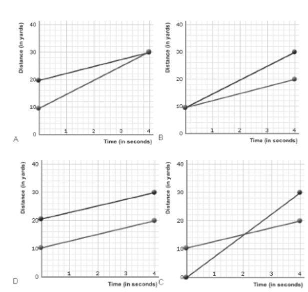
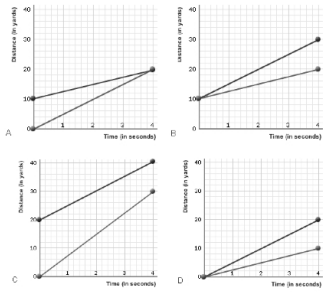


ANSWER:
Graph D

Examine the graphs below.



Which of the graphs shows that one of runners started 10 yards further ahead of the other? Explain your answer.

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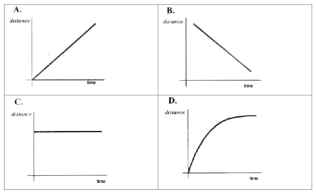
ANSWER:
Graph A

The distance-time graphs below represent the motion of a car. Match the descriptions with the graphs. **Explain your answers.**

Descriptions:

1. The car is stopped.
2. The car is traveling at a constant speed.
3. The speed of the car is decreasing.
4. The car is coming back.



Graph A matches description ____ because _____.

Graph B matches description ____ because _____.

Graph C matches description ____ because _____.

Graph D matches description ____ because _____.

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Graph A matches #2:
The car is traveling at a constant speed

Graph B matches #3
The speed of the car is decreasing

Graph C matches #1
The car is stopped. (no additional distance is occurring)

Graph D matches #4
The car is coming back

SPEED-TIME GRAPHS

Speed-Time graphs are also called Velocity-Time graphs.

Speed-Time graphs look much like Distance-Time graphs. Be sure to read the labels!! Time is plotted on the X-axis. Speed or velocity is plotted on the Y-axis.

A straight horizontal line on a speed-time graph means that speed is constant. It is not changing over time.

A straight line does not mean that the object is not moving!

This graph shows increasing speed. The moving object is **accelerating.**

This graph shows decreasing speed. The moving object is **decelerating.**

What about comparing two moving objects at the same time?

Both the dashed and solid line show increasing speed.

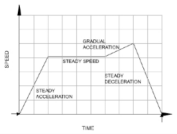
Both lines reach the same top speed, but the solid one takes longer.

The dashed line shows a greater acceleration.

Summary:

A speed - time graph shows us how the speed of a moving object changes with time.

- The steeper the graph, the greater the acceleration.
- A horizontal line means the object is moving at a constant speed.
- A downward sloping line means the object is slowing down.



(Graph from: http://www.bbc.co.uk/schools/gcsebitesize/physica/forces/speedvelocityacceleration1rev2.shtml)

- **Speed, Distance, Time Worksheet. Pgs 23-24**
  SHOW THE FORMULA & YOUR WORK!

I've shown you the answers.
You show me HOW you set it up!

- 1. Jared rides his bike for 3 hrs at a speed of 40 km/h. What distance did he travel? 120km
- 2. The Surf- Rider Train travels at a speed of 30 mph and travel a distance of 240 miles. How long did it take the train to complete it's journey? 8 hours
- 3. Mrs. Gillum in her mini travels a distance of 540 km in 6 hours. What speed did she travel at? 90km/h

- 4. Samuel is a runner. He runs the 100 m sprint in 10.6 s. What speed did he travel at? (in m/s) 9.4 m/s
- 5. Mr.Lulay travels on his Harley 20 km in 4 hrs. What speed did the Mr.Lulay travel at? 5km/h
- 6. The distance between two cities is 144 km, it takes Mr. Power 3 hours to travel between these cities. What speed did I travel at? 48km/h

- 7. A train travels from the downtown San Diego to Long Beach, a distance of 576 km away in 6 hrs. The coach is only allowed to travel at a maximum speed of 90km/h. Did the coach break the speed limit?
  Yes, it traveled at 96km/h
- 8. At the equator, the earth spins a distance of 25,992miles every day. What speed does the Earth spin at in mph? (a hint… how many hours in a day?)
  1083 mph
- 9. Lauren walks 100 m in half a minute. What must her speed have been to travel this distance?
  3.33 m/s

- 10. A mouse runs a distance of 2 meters in 15 seconds. What is it's speed? 0.13 m/s

- 11. Jim travelled at a speed of 18km/h for 2 hours. What was the distance covered? 36 km

- 12. Mr. Bill was told his dinner would be ready at 6:00pm. He left the job site at (noon) 12:00pm and traveled in his car at an average speed of 45 mph to his house 300 miles away. Did Mr. Bill make it home in time for the dinner Mrs G had waiting for him?
  NOPE! HE ARRIVED AT 18:40 (6:40pm) ARG!!!
  A COLD dinner was waiting for him! ☹
  Next time he'll need to drive a little faster! ☺

- 13. A whale swims at a constant speed of 8m/s for 17s. What distance did it travel? 136m

- 14. Sebastian writes down his jog times for each day.

Mon:15 min Tue:10 min Wed:12 min Thu:5 min Fri:No jog

He jogs at a constant speed of 9km/h. Work out the distance he jogs each day. On which day did he jog the furthest?
Mon – 2.25km Tue – 1.5km Wed – 1.8km Thu – 0.75km.
He travelled furthest on Monday

- 15. How long does it take to drive a distance of 260 miles at a speed of 65mph? 4 hours

- 16. How long does it take to travel a distance of 672km at a speed of 96km/h?
  7 hours
- 17. Scripps Ranch is a distance of 135 miles away from Joshua Tree National Park. If I travelled at a constant speed of 45mph. How long would it take me to get there?
  3 hours

- 18. A beetle travels at a speed of 9cm/s., it travels a distance of 108 cm before it is caught in a jar.
  How long did the beetle run for?
  12s