Shedding Light on Motion Episode 1: Speed   Name: _____

Average speed = distance / time $v_{ave} = d/t$
(v_{ave} = average velocity or average speed, d = distance, t= time)
speed in metres/second (m/s) or kilometres/hour (km/hr), distance in metres (m) or kilometres (km), time in seconds (s) or hours (hr).

Part A

1. Explain why the study of forces and of motion is so important.
   _____
   _____
   _____

Part B

2. Calculate the average speed of
   (a)   a car travelling 300 km in 4 hours:

   (b)   world-record holder Usain Bolt running his 100 m race in 9.58 s:

   (c)   world-record holder Wayde van Niekerk running his 400 m race in 43.03 s:

3. There are _____ seconds in a minute, _____ minutes in an hour, and _____ seconds in an hour.

4. Fill in the tables below.

Time in Minutes	Time in Hours	
	as a Fraction	as a Decimal
45	45/60 or 3/4	0.75
30		
15		
10		

Time in Hours	Time in Minutes	Time in Seconds
1	60	3600
2		
2.5		
2hr: 10min		
24		

5. By converting the information below into consistent units, calculate the average speed (in m/s or km/hr) of
   (a)   a cyclist travelling 200 km in 3 hrs 30 minutes.

   (b)   a car travelling 40 km in 30 minutes. (HINT: 30 minutes = _____ hours)

   (c)   a marathon runner running 42 km in 2 hours 10 minutes. (HINT: 10 minutes = _____ hours)

6. The dots below show the presenter's position every second in two 100 m sprints (one running and one on a bike). Describe the way his speed changed in both sprints. Indicate the position of where the highest speed was reached in both sprints.

   _____
   _____
   _____
   _____
   _____
   _____
   _____

   _____

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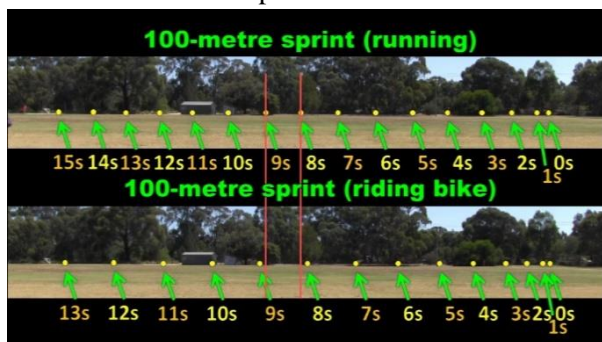
7. What is the difference between <u>average</u> speed and <u>actual</u> (also called "<u>instantaneous</u>") speed?

_____
_____
_____

8. A 20 km car trip takes half an hour. What is the car's average speed in the trip and how might the car's instantaneous speed have changed over the half hour?

_____
_____
_____

9. A bike is moving at a **speed of 8 m/s**. Fill in the table below.

Time (seconds)	Distance Travelled (metres)
0	0
1	
2	
3	
10	
20	

10. Technically, to specify an object's velocity, you need to say its _____ and its _____.

11. If $v_{ave} = d/t$, then d = _____.

12. If $v_{ave} = d/t$ then t = _____.

13. Calculate the distance you would travel if you moved at:

(a)   100 km/hr for 8 hours

(b)   6 m/s for 2 seconds

(c)   6 m/s for 2 minutes

(d)   6 m/s for 2 hours

(e)   50 km/hr for 30 minutes (Hint: 1500 km is wrong)

(f)   60 km/hr for 2 hours

(g)   60 km/hr for 1 hour

(h)   60 km/hr for 1 minute

(i)   60 km/hr for 1 second

14. Calculate the time it would take:
(a)   a car to travel 900 km at 100 km/hr.

(b)   a boat to travel 200 m at a speed of 20 m/s.

(c)   a 300,000 km/s light beam to get to the moon 378,000 km away.

(d)   a 330 m/s sound wave to travel 1 km.

(e)   a 300,000 km/s light wave to travel 1 km.

15. Calculate…
(a)   The speed of a Melbourne Cup horse which runs the 3200 m horse race in 3 minutes and 16 seconds. (write down the appropriate equation and then perform the calculations)
Equation: _____

(b)   The time that it will take a truck to travel 60 km at 40 km/hr.
Equation: _____

(c)   The distance a helicopter will travel if it moves at a speed of 30 m/s for 20 seconds.
Equation: _____

16. (a) 10 kilometres = _____ metres. 1 hour =_____ seconds therefore…

(b) 10 kilometres per hour = _____metres per _____seconds

= _____m/s

17. Fill in the graphic on the right and then convert the following speeds from km/hr to m/s or vice versa:

m/s ⟷ km/hr
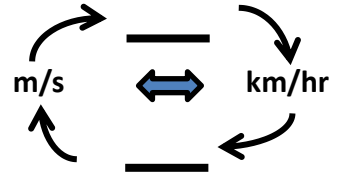
(a)   100 km/hr

(b)   20 m/s

(c)   60 km/hr

(d)   10 m/s

(e)   6 m/s

(f)   330 m/s (the speed of sound in 0°C air)

(g)   263 km/hr (the fastest ever tennis serve)

(h)   1 m/s

18. A car is travelling at 70 km/hr when the driver sees a person step out onto the road in front. If the driver's reaction time is 0.22 seconds, calculate the distance that the driver travels during this time period. (Hint: watch your units.)

19. What are some of the things you should and shouldn't do while driving to maximise your chance of avoiding accidents.

_____

_____

_____

20. Describe how you can use a digital camera to measure the duration of an event.

_____

_____

_____

21. How does a bike speedometer work?

_____

_____

_____

22. A BMX bike wheel with a diameter of 50 cm takes exactly 0.4 seconds to make one complete rotation as it rolls along.

(a) What is the circumference of the wheel in metres? ($C = 2\pi r = \pi d$)

(b) Your answer above is the distance that the wheel will roll during one rotation. How fast is the bike going?

23. Simple Practical Activity.

Using a tape measure or a trundle wheel, measure out a distance of 10 metres and then time how long it takes to walk the 10-metre distance. Do two trials. Calculate your average walking speed in m/s and in km/hr.

Distance: 10 metres

Time (Trial 1): _____ seconds

Time (Trial 2): _____ seconds

Average Time: _____ seconds

$v =$

_____ m/s	_____ km/hr

Question: Calculate the time (in minutes and seconds) that it would take you to walk…

(a) 1 km. $v =$ _____ m/s $d =$ _____ m $t = d/v =$

(b) 3 km.