Year 11 Physics 2011

Set 1

Q&A 1.1

1.1 In a cricket match a bowler bowls a ball from one end of the pitch to the other, a distance of 20.1 m, in 0.750 s. Calculate the ball's average speed:

[a] in metres per second.

[b] in kilometres per hour.

1.1	(a)	$v_{av} = \frac{s}{t} = \frac{20.1\,m}{0.75\,s} = 26.8\,m\,s^{-1}$
	(b)	$\frac{26.8 \times 3600}{1000} = 96.5\ km\ h^{-1}$

Q&A 1.2

1.2 The distance between two towns is 165 km. If Jane can drive this distance in 1.50 hours:

[a] Calculate Jane's average speed for the journey.

[b] When Jane calculated her average velocity for the trip, she found it was 20 km h^{-1} less than her average speed. Explain.

1.2	(a)	$v_{av} = \frac{165\ \text{km}}{1.5\ \text{h}} = 110\ \text{km h}^{-1}$

Q&A 1.3

1.3 A passenger jet takes approximately 3.5 hours to fly from Perth to another city at a constant speed of 850 km h^{-1}. Assuming that there are no wind effects on its motion, calculate the distance the jet flies.

1.3		$s = v_{av}t = 850 \text{ km h}^{-1} \times 3.5 \text{ h} = 3000 \text{ km}$

Q&A 1.4

1.4 A triathlete pedalled her bicycle due east at a constant velocity. At 6:45 am she passed the 255 km peg. At 7:15 am she passed the 270 km peg.
[a] Calculate the triathlete's displacement.
[b] Hence, calculate her velocity.

1.4	(a)	$s = x_f - x_i = 270 \text{ km E} - 255 \text{ km E} = 15 \text{ km E}$
	(b)	$v = \frac{s}{t} = \frac{15 \text{ km E}}{0.5 \text{ h}} = 30 \text{ km h}^{-1} \text{ E}$

Q&A 1.5

1.5 Miriam and Molly are participating in a survival course. They hope that fully loaded with their packs, they can cover 1.0 km every 15 min. Estimate their displacement if they walk due west for 1.25 h before setting up camp.

$$15 \text{ min} = 0.25 \text{ h}$$

$$v_{av} = \frac{s}{t} = \frac{1.0 \text{ km W}}{0.25 \text{ h}} = 4.0 \text{ km h}^{-1} \text{ W}$$

$$s = v_{av} t = 4.0 \text{ km h}^{-1} \text{ W} \times 1.25 \text{ h} = 5.0 \text{ km W}$$

Q&A 1.6

1.6 An experimental rocket travels through space at a speed of 6.40×10^3 m s^{-1}. How long will the rocket take to travel to the Moon, a journey of 3.84×10^5 km?

$$3.84 \times 10^5 \text{ km} = (3.84 \times 10^5 \times 1000) \text{ m} = 3.84 \times 10^8 \text{ m}$$

$$v_{av} = \frac{s}{t}$$

$$t = \frac{s}{v_{av}} = \frac{3.84 \times 10^8 \text{ m}}{6.40 \times 10^3 \text{ m s}^{-1}} = 6.00 \times 10^4 \text{ s}$$

Q&A 1.7

1.7 A hot air balloon drifted 280 km south-east. If the balloon's average velocity was 8.2 m s^{-1} south-east, how long did the journey take?

3.84×10^5 km $= (3.84 \times 10^5 \times 1000)$ m $= 3.84 \times 10^8$ m

$$v_{av} = \frac{s}{t}$$

$$t = \frac{s}{v_{av}} = \frac{3.84 \times 10^8 \text{ m}}{6.40 \times 10^3 \text{ m s}^{-1}} = 6.00 \times 10^4 \text{ s}$$

Q&A 1.8

1.8 Rebecca is one of her school's best sprinters and decides to work out exactly what her top speed is. How could Rebecca calculate her top speed?

Have timers standing at 10 m intervals who then record Rebecca's time as she passes them during one of her sprints. Time differences can then be calculated for each 10 m interval and hence her speed during each interval can be determined.

Q&A 1.9

1.9 After you receive a speeding ticket you decide to check the accuracy of your speedometer. Describe how you would do this.

Have a passenger time how long it takes you to travel a known distance while your speedometer indicates a constant steady speed. Calculate your actual speed (distance ÷ time) and compare this to your speedometer reading.

Q&A 10

1.10 Two competitors in an orienteering competition knew that the next check point was some distance due north of their location. To avoid crossing some very difficult terrain, the competitors decided to get to the check point by jogging: north 800 m; then west for 600 m; then north for 1.0 km; then east for 600 m; and finally 200 m north. The competitors found that this journey took them 20 minutes.

[a] Calculate the total distance they travelled between the starting position and the check point.

[b] Calculate their average speed for this journey.

[c] Calculate the location of the check point, relative to their starting position. Give both the distance and the direction.

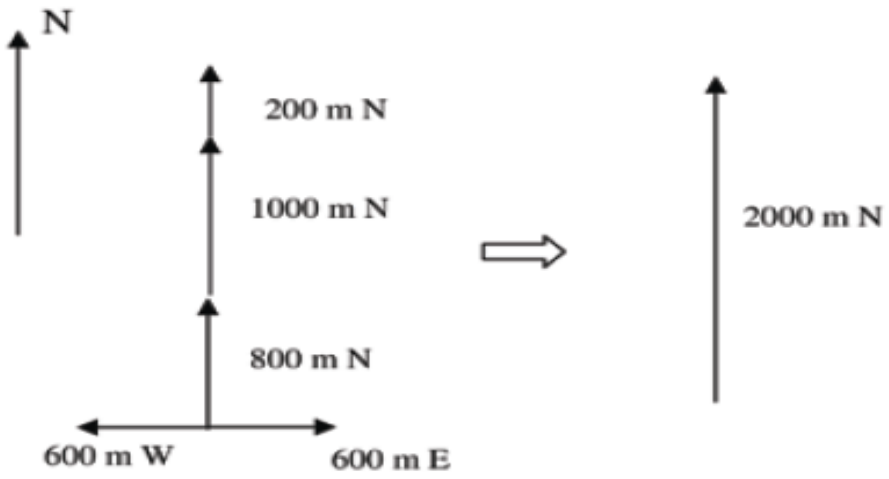
[d] Hence, calculate the average velocity for the journey between the starting position and the check point.

1.10 (a) **Total distance = 800 m + 600 m + 1000 m + 600 m + 200 m = 3200 m**

(b)

$$v_{av} = \frac{s}{t} = \frac{3200\ \text{m}}{(20 \times 60)\ \text{s}} = \frac{3200\ \text{m}}{1200\ \text{s}} = 2.67\ \text{m s}^{-1}$$

(c)



(d)

$$v_{av} = \frac{s}{t} = \frac{2000\ \text{m N}}{(20)(60)\ \text{s}} = \frac{2000\ \text{m N}}{1200\ \text{s}} = 1.67\ \text{m s}^{-1}\ \text{N}$$

Q&A 11

1.11 Colin drove from one township to another at an average speed of 92 km h^{-1}. Before he started his journey he noted that the car's odometer reading was 26 455 km and on reaching his destination it displayed 26 708 km. The only time Colin stopped was to pull over to the side of the road to eat lunch. If the journey took exactly three hours, how long did Colin take for lunch?

Distance travelled = 26 708 km – 26 455 km = 253 km

at 92 km h^{-1} travelling time must have been $t = \frac{s}{v_{av}} = \frac{253 \text{ km}}{92 \text{ km h}^{-1}} = 2.75 \text{ h}$

total time = 3 h

$\therefore$ lunch time = (3 - 2.75) h = 0.25 h (or 15 mins)

Q&A 12

1.12 Marvin takes 20 minutes to paddle his canoe 800 m upstream.

[a] Calculate Marvin's speed, relative to the bank.

If Marvin can paddle his canoe at 4.0 m s^{-1} in still water:

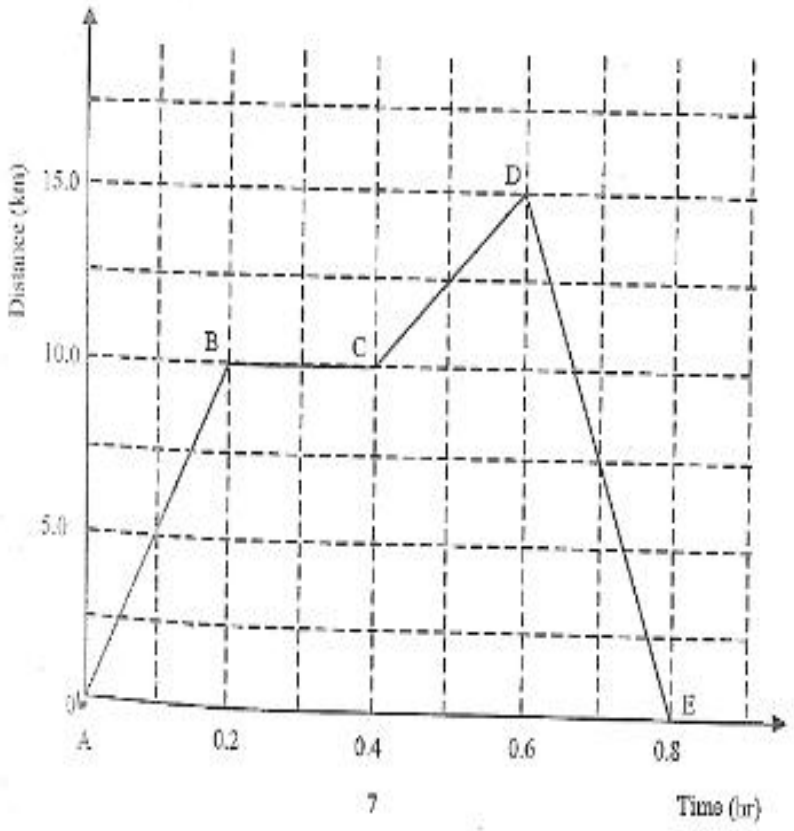
[b] Calculate the stream's speed, relative to the bank.

[c] How long will Marvin take to paddle 10 km upstream?

[d] How long will Marvin take to paddle 10 km downstream?

(a)	$v_{av} = \frac{s}{t} = \frac{800\ m}{(20 \times 60)s} = \frac{800\ m}{1200\ s} = 0.67\ m\ s^{-1}$
(b)	Stream speed must be $v_s = (4 - 0.67)\ m\ s^{-1} = 3.33\ m\ s^{-1}$
(c)	$v_{av} = \frac{s}{t}$ $t = \frac{s}{v_{av}} = \frac{10\ 000\ m}{0.67\ m\ s^{-1}} = 15\ 000\ s$ or 4.17 h
(d)	Speed downstream must be $v_s = (4 + 3.33)\ m\ s^{-1} = 7.33\ m\ s^{-1}$ $v_{av} = \frac{s}{t}$ $t = \frac{s}{v_{av}} = \frac{10000\ m}{7.33\ m\ s^{-1}} = 1364\ s$ or 0.38 h or 23 mins

Q13



1.13 The graph (*left*) shows a motorcyclist's distance from her starting point, plotted against time. Use the graph to answer the questions that follow. Explain your choice in each case.

[a] Between which points did she travel at the greatest speed?

[b] Between which points was the motor bike stationary?

[c] At which point did the rider turn around to go back to her starting point?

[d] Calculate the total distance travelled by the motor cyclist.

[e] Calculate the motorcyclist's average speed for the journey.

[f] What extra information would you need to know in order to calculate the motorcyclist's average velocity for the journey?

A13

1.13	(a)	Greatest speed is when the gradient is steepest, ie between D and E.
	(b)	Speed was zero when the gradient was zero ie between B and C.
	(c)	She turned back when the gradient became negative, ie at D.
	(d)	Total distance was 15 km out and 15 km back = 30 km.
	(e)	$v_{av} = \frac{s}{t} = \frac{30\ \text{km}}{0.8\ \text{h}} = 37.5\ \text{km h}^{-1}$
	(f)	The direction of travel.

Q&A 14

1.14 A duck can paddle at 2.0 m s^{-1} in still water. If the duck takes 1.2 x 10^3 s to travel 0.60 km upstream, calculate:
[a] the stream's velocity;
[b] how long the duck will take to paddle 8.4 km downstream.

1.14	(a)	$v_{av} = \frac{s}{t} = \frac{600 \text{ m upstream}}{1200 \text{ s}} = 0.50 \text{ m s}^{-1} \text{ upstream}$ Stream speed must be $v_s = (2.0 - 0.50) \text{ m s}^{-1} = 1.5 \text{ m s}^{-1}$
	(b)	Downstream speed must be $v_d = (2.0 + 0.50) \text{ m s}^{-1}$ downstream = 2.5 m s^{-1} downstream $v_{av} = \frac{s}{t}$ $t = \frac{s}{v_{av}} = \frac{8400 \text{ m}}{2.50 \text{ m s}^{-1}} = 3360 \text{ s or } 0.93 \text{ h}$