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APPENDICES

APPENDIX A

PIAGET'S SUMMARY

Piaget's summary of research from his book "A child's conception of motion and speed" (1946).

Chapter 12 The operations constituting Movement and speed

The results of the foregoing studies show that instead of being immediately apprehended, movement and speed give rise to a long elaboration of responses at first sensori-motor, then intuitive and finally operational. These operations themselves commence with a system of qualitative 'groupments' before resulting in (extensive and above all metrical) quantitative groups. The concern of these conclusions is to give a total view of this development (setting aside purely perceptual questions), and to correlate this with the other closely related evolution studied in a complimentary work: that of the conception of time.

Analysing quite genetically, with no theoretical presuppositions, how the conceptions of movement and speed are elaborated, we were in fact led to distinguish six great operational systems, operating even more closely together, of which four depend upon qualitative logic, i.e. present a structure analogous to that of relations and classes, but applied to intralogical or internal transformations within the construction of the object. These are:

1. Operations of 'placement' which engender the ideas of succession in space or of order and which thus constitute a first type of qualitative grouping, necessary for the construction of the idea of displacement.

2. Operations of 'displacement' (or change of position) which from the qualitative point of view, form one single grouping with the foregoing (although mathematically the group of displacements appears to be much more restricted than topological groups), but may however be distinguished from this as follows: in placement it is the subject who moves in order to place the objects in order, while in displacements it is actually the objects which change their position.
3. Operations of 'co-displacement', i.e. correspondence between placements or displacements, operations which simultaneously engender the ideas of succession in time, or duration and of absolute speed (i.e. relative to stationary system or placement).
4. Operations of 'relative displacement and co-displacement' permitting composition of correlative movements and their speeds.
5. Operations which are 'extensive' i.e. mathematical and no longer qualitative, but still not metrical, which permit construction of relations of ratios, or proportions between times taken and lengths travelled.
6. Finally, metrical operations permitting measurement (through the construction of repeatable units) of these distances and durations, hence of the paths traversed and the speeds.

(pp. 279 - 280)

APPENDIX B

HIERARCHIES FOR SPEED

Hierarchies as discussed by Trowbridge (1979)

In talking about hierarchies, Trowbridge referred to Bloom (1956) and Gagne (1977) for contrast. Bloom's hierarchy is based on what teachers would expect the outcomes of students should be after a course of instruction.

A hierarchy following Gagne's ideas for speed in a science curriculum is given later (Science -- A Process Approach (AAA 1968, p. 12, in Trowbridge 1979, p. 237).

Hierarchies as Developed by Trowbridge (1979)

A hierarchy of understanding of the *elementary concepts* of space and time is summarised as (pp. 241-243):

Level I

1. Ability to use spatial and temporal ordering relations.
2. Nondiscrimination between distance and spatial order.
3. Nondiscrimination between duration and temporal order of succession.

Level II

1. Discrimination between distance and spatial order of endpoints.
2. Discrimination between position and displacement; Clock reading and time interval.
3. Discrimination between displacement, distance travelled, and distance between endpoints.
4. Difficulty with the interpretation of negative values of s and t , and the interpretation of the sign as δs .

Level III

1. Discrimination between displacement, distance traveled, and distance between endpoints.

2. Ability to interpret s , δs , t , δt for arbitrary values of positions and clock readings.
3. Ability to interpret the sign of s and t , and the sign of s .

Hierarchy for velocity

Level I

1. Nondiscrimination between speed and spatial order of endpoints.
2. Nondiscrimination between speed and temporal order of arrival times.

Level II

1. Ability to compare simultaneous uniform motions according to the phenomenon of overtaking.
2. Ability to compare uniform speeds when either distance or times are equal, and motions are partly simultaneous.
3. Inability to compare successive uniform speeds or reason with ratios of distance and elapsed time.

Level III

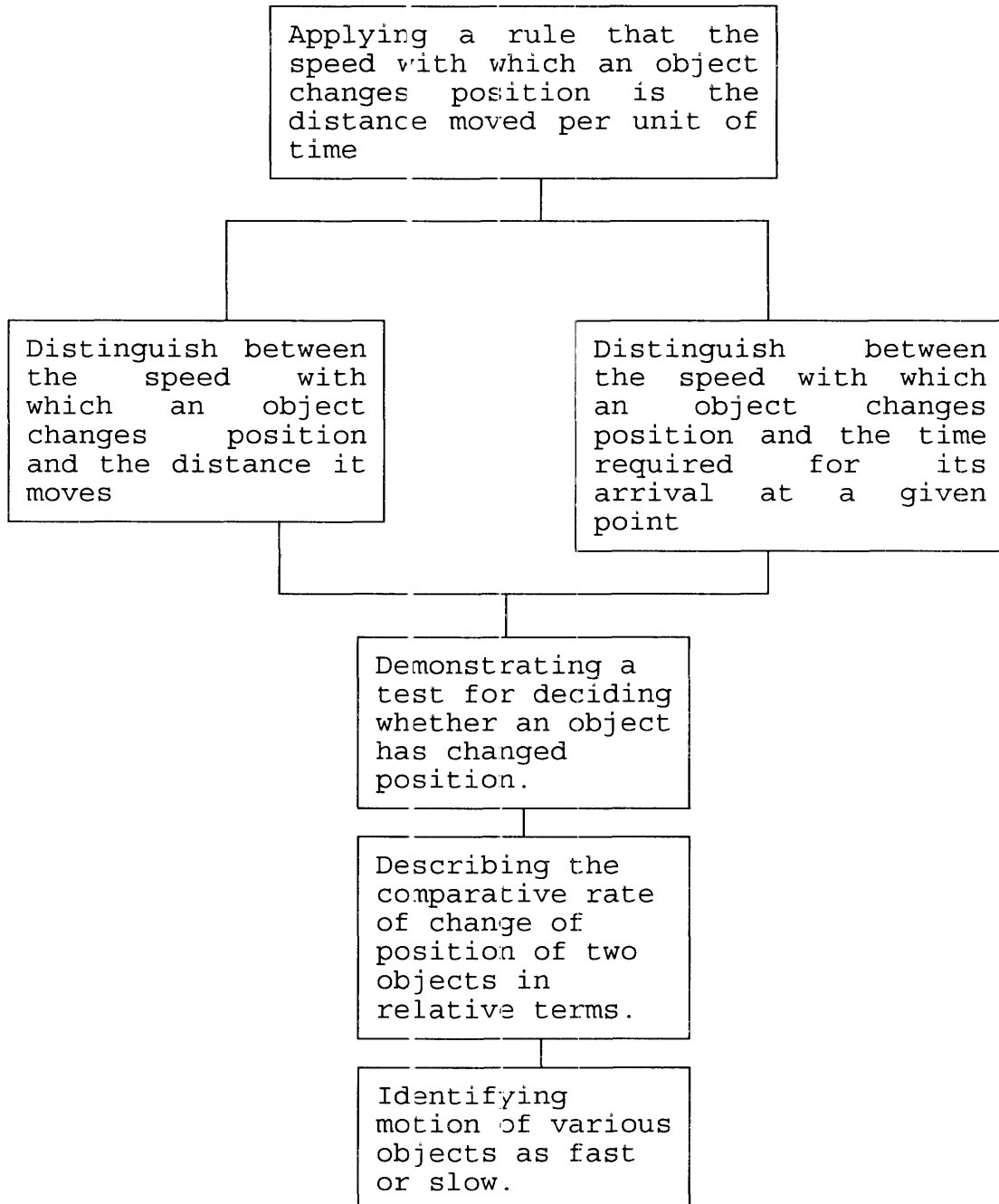
1. Ability to compare speeds using the ratio distance traveled/elapsed time.
2. Nondiscrimination between instantaneous velocity and position in situations of non-uniform motion.
3. Nondiscrimination between instantaneous velocity and average velocity in situations of non-uniform motion.
4. Nondiscrimination between instantaneous velocity and change in velocity in situations of non-uniform motion.

Level IV

1. Discrimination between instantaneous velocity and position.
2. Discrimination between instantaneous velocity and average velocity.
3. Discrimination between instantaneous velocity and change in velocity.
4. Ability to interpret the sign of v and the sign of δv .
requires an ability to imagine motion at an instant.

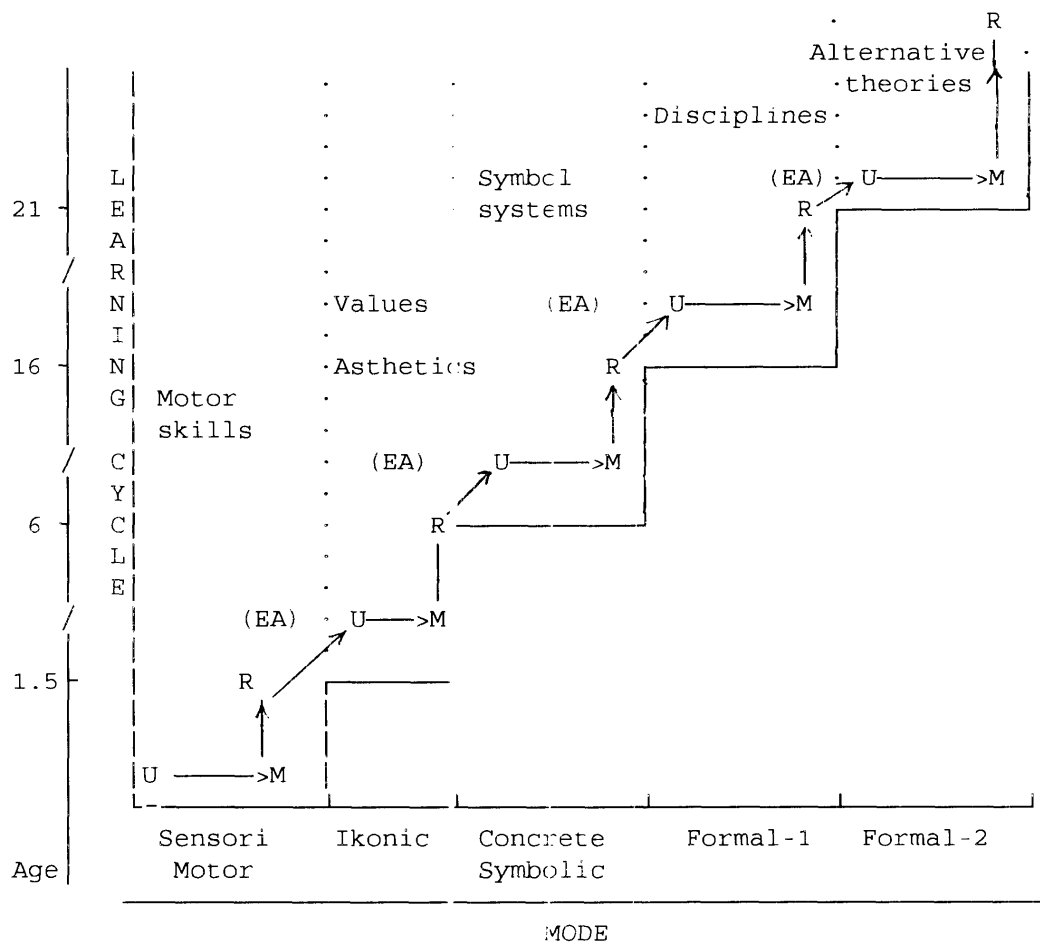
Levels III and IV include and extend Piaget's description of formal reasoning.

A hierarchy following Gagne's ideas for speed



APPENDIX C

A 1989 MODEL OF THE SOLO TAXONOMY



U = Uni-structural
 M = Multi-structural
 R = Relational
 (EA) = Extended Abstract

Figure A.1 Modes, Learning Cycle (SOLO Level) (Adapted from Biggs and Collis 1989, p. 160)

APPENDIX D

THE SPEED QUESTIONS

Note: The questions that were used in the speed test are provided in the insert in the back cover as a convenience to the reader.

PART A: SINGLE FOCUS SPEED QUESTIONS

Numerical Questions

- N1. If a car has a speed of 60 km/h, how far will it go in three hours?
- N2. A car that travels 100 km in a time of 5 hrs, what was its speed?
- N3. A boy on a pushbike rides at a speed of 20 km/hr, how many hours will it take him to ride 10km?

Variation Questions

- V1. A car goes on two journeys at the same speed. The second journey was twice as far as the first. How much more time would the second journey take?
- V2. The Smith family goes to town slowly in their old car. Their neighbor Mr. Jones drives his new car the same distance to town but at twice the speed. How much more time will it take Mr. Jones to get to town?

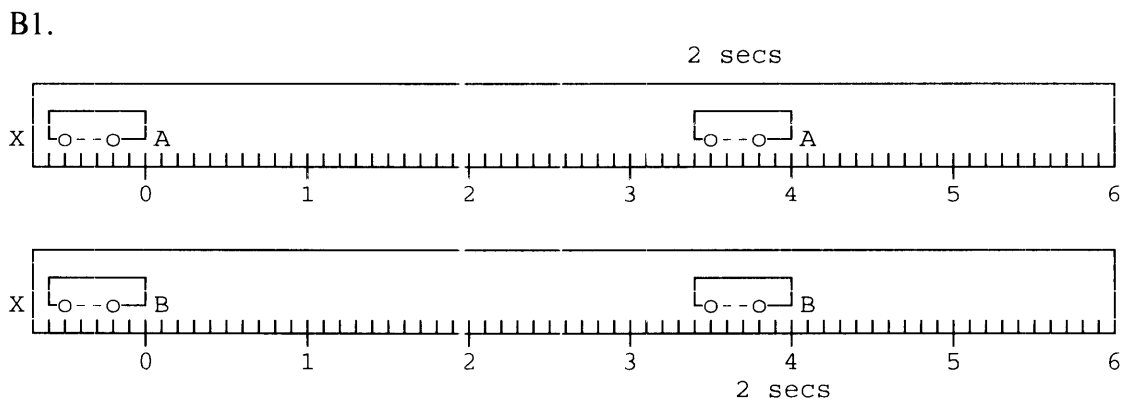
- V3. Lesley goes for a five minute ride. She can usually get around the block in five minutes. Today she races with a friend and goes twice as fast as normal. At this speed how many times will she get around the block in 5 minutes
- V4. A train travels at constant speed from station A to station B. At this same speed it takes 3 times as long to get from station B to station C. How many times bigger must this distance BC be?
- V5. Jimmy walks the same distance every morning. On Monday it takes him 10 mins for his walk. On Tuesday he had a sore leg and it took him 20 mins. How many times faster/slower was his speed on Tuesday?
- V6. Mary and Matt hired a Co-Kart for 10 mins. Matt was able to do the full circuit in his 10 mins. Mary was able to do 3 circuits in her 10 mins. How many times faster did Mary go than Matt?

PART B: DUAL FOCUS CLOSED SPEED COMPARISONS

Each problem below shows two identical carts A & B.

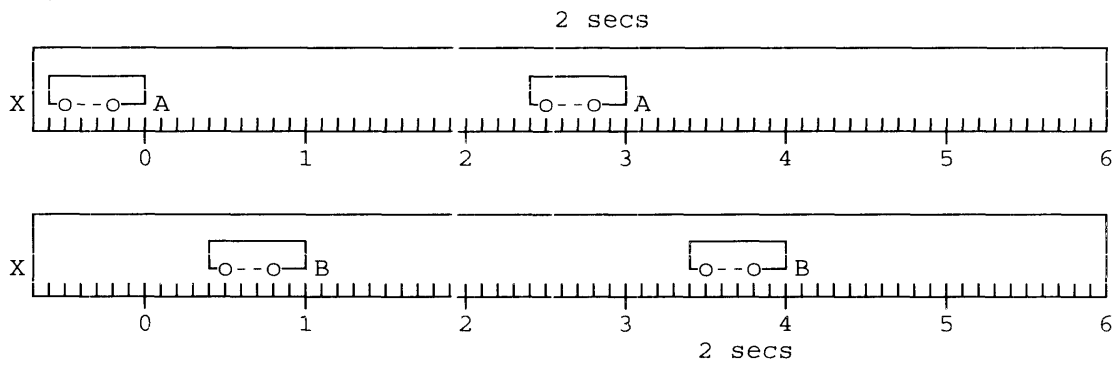
The picture on the left shows where they start from and the picture on the right shows where they end. The time for A is shown above A and the time for B is shown below B.

You must decide EITHER which cart is going the **GREATER SPEED** OR if they are going the **SAME SPEED**. Then explain your choice of answer.



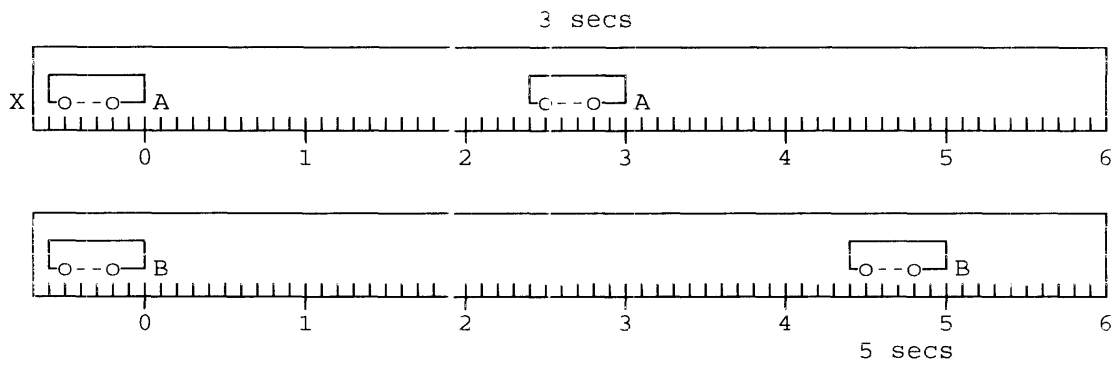
Answer: A B same speed

B2.



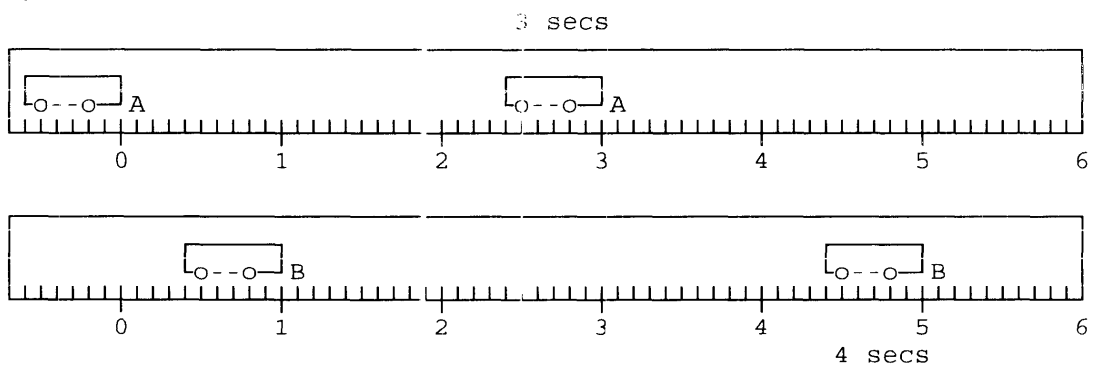
Answer: A B same speed

B3.



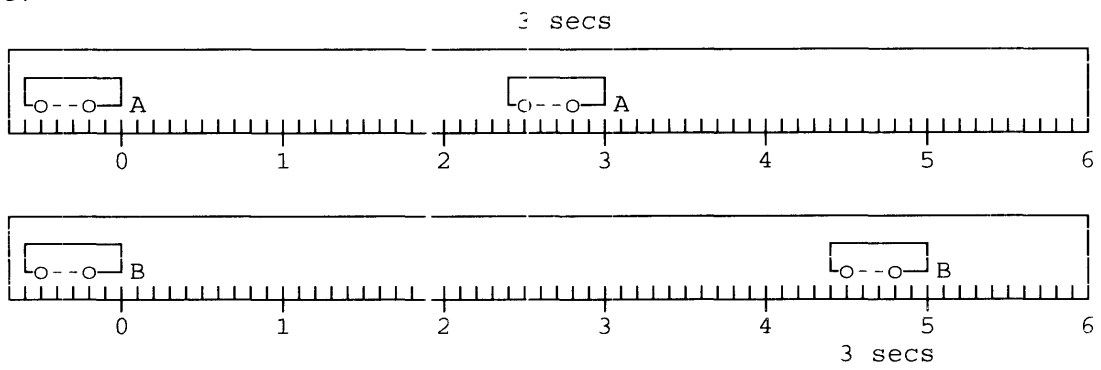
Answer: A B same speed

B4.



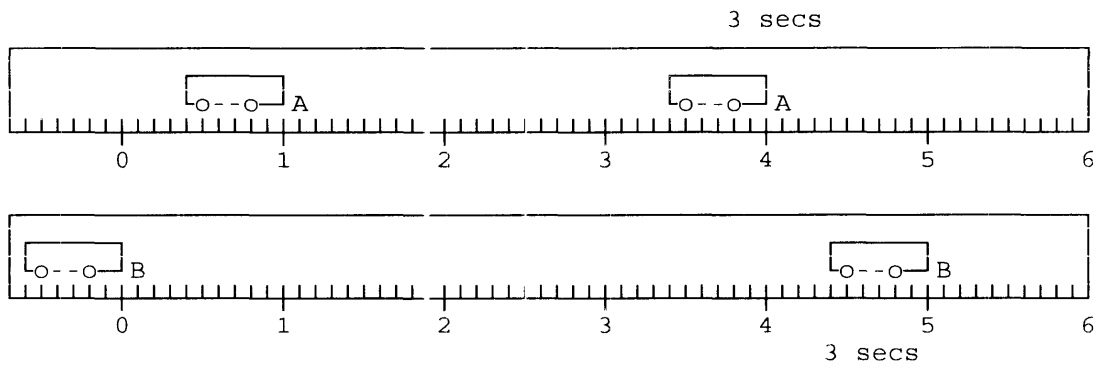
Answer: A B same speed

B5.



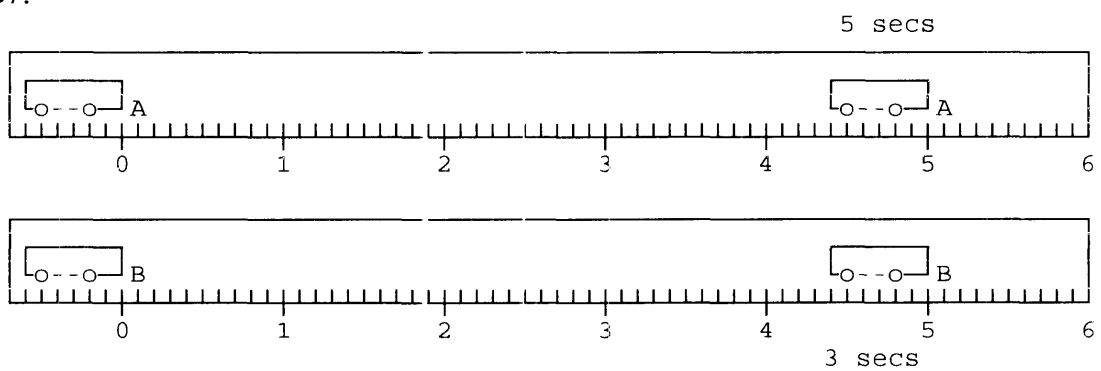
Answer: A B same speed

B6.



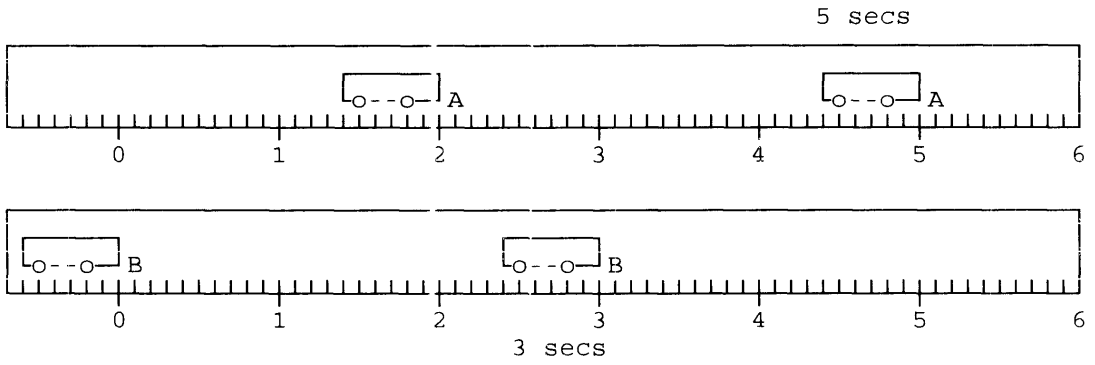
Answer: A B same speed

B7.



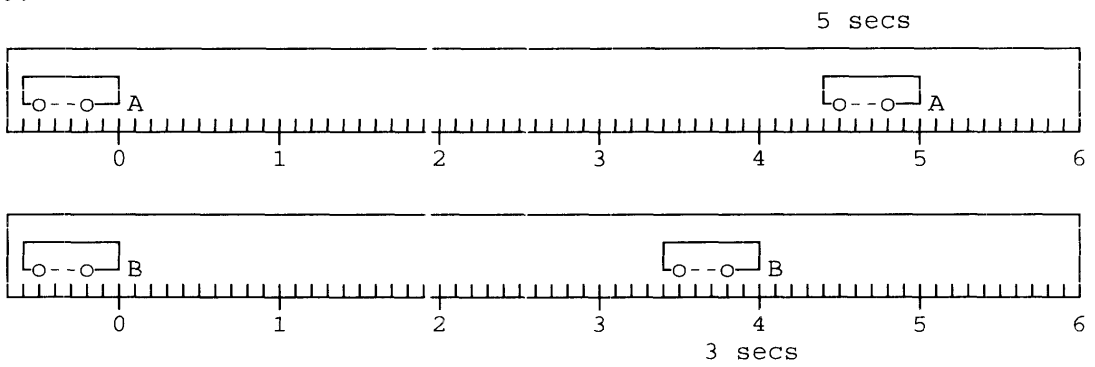
Answer: A B same speed

B8.



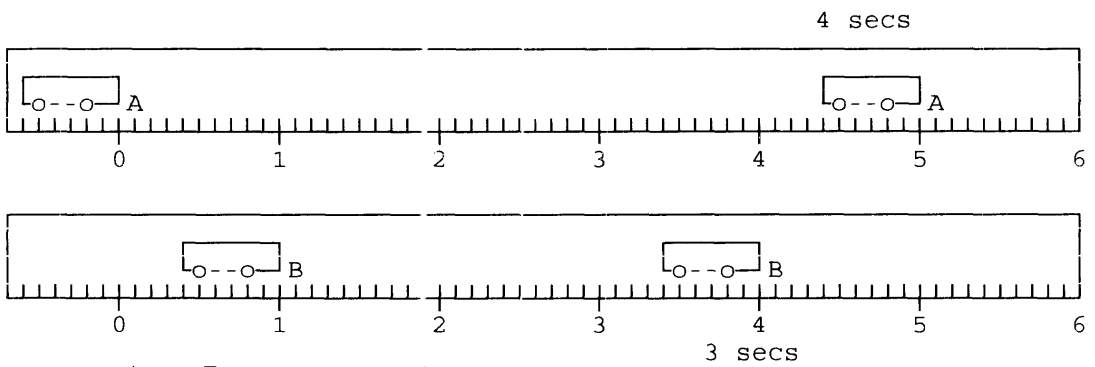
Answer: A B same speed

B9.



Answer: A B same speed

B10.

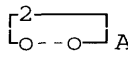


Answer: A B same speed

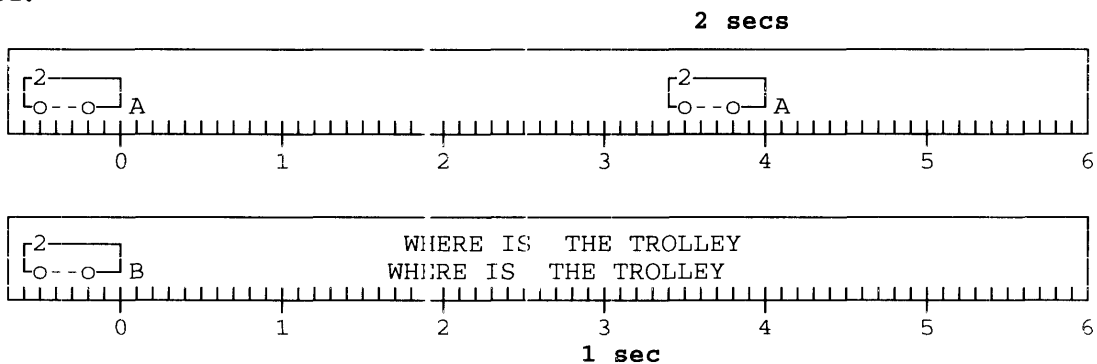
PART C: DUAL FOCUS OPEN QUESTIONS

Find the missing variable:

In the following questions the first diagram gives all the information but the second diagram has things changed (in **bold print**) and one bit missing. By comparing diagrams, or otherwise, find the missing information required. (Note: the speed of the trolley is on the speedo on the trolley)

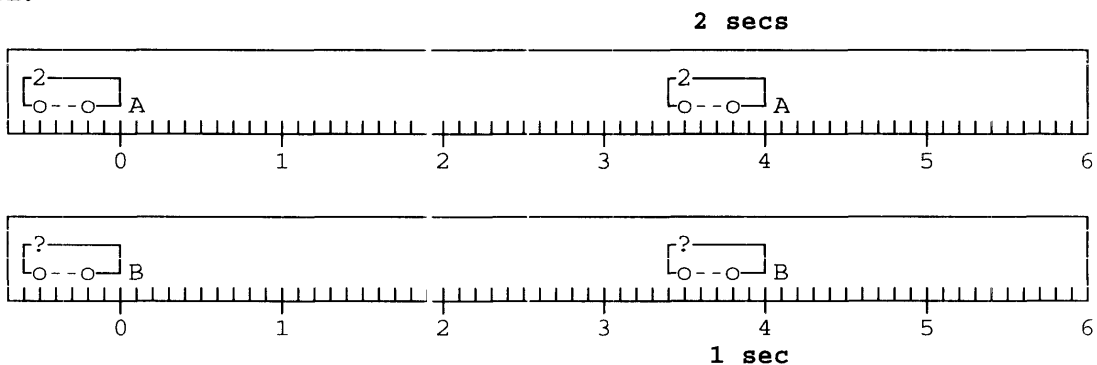
This trolley has a speed of 2 units per second. 

C1.



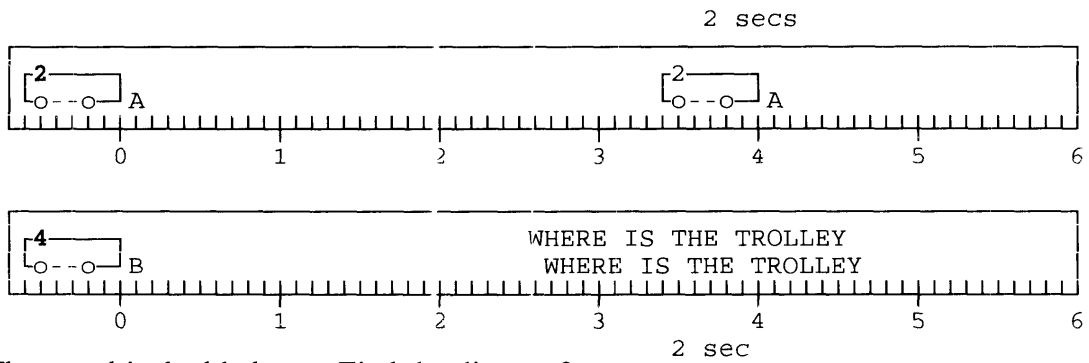
The time is halved, Find the distance?

C2.



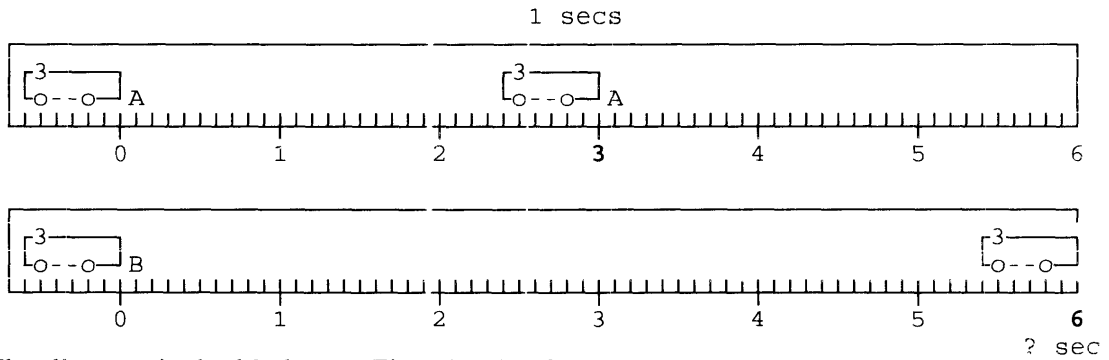
The time is halved. Find the speed?

C3.



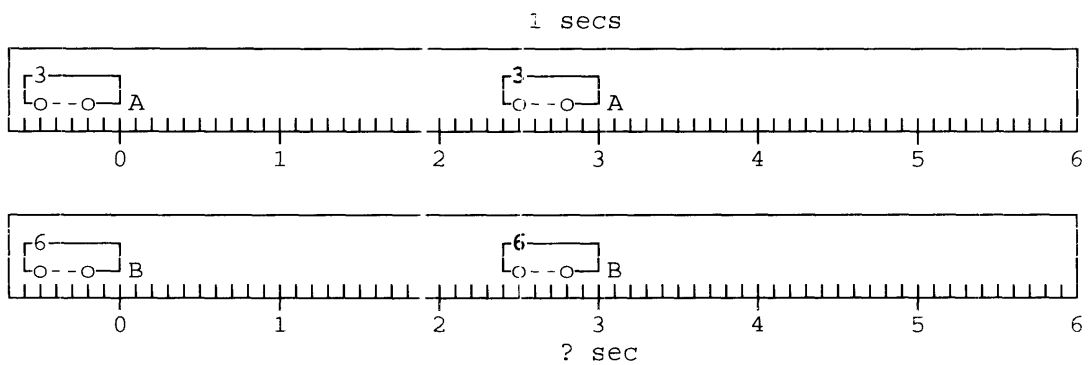
The speed is doubled. Find the distance?

C4.



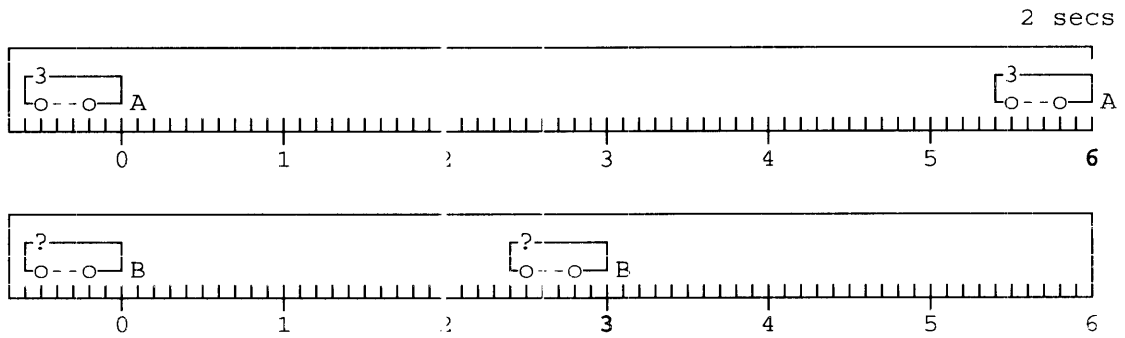
The distance is doubled. Find the time?

C5.



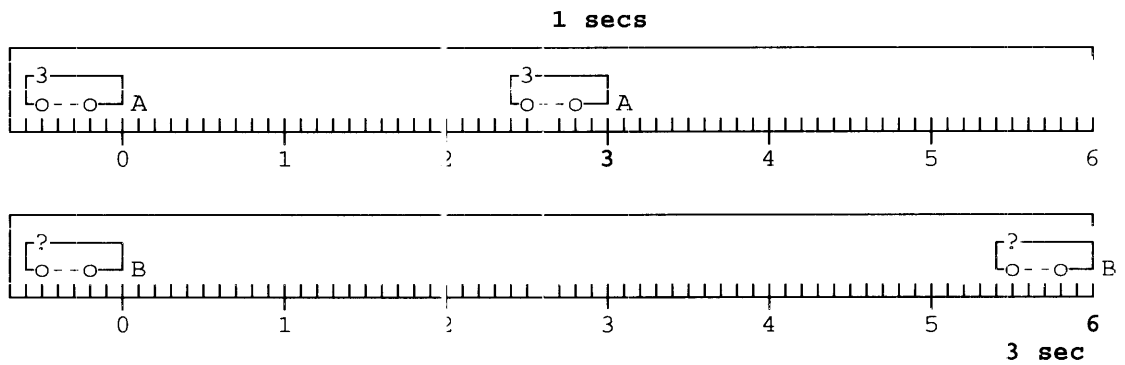
The speed is doubled. Find the time?

C6.



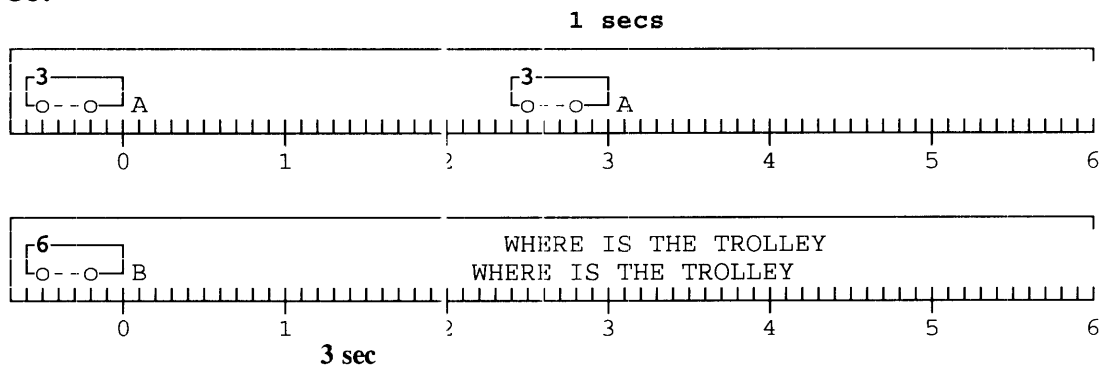
The distance is halved. Find the speed?

C7.



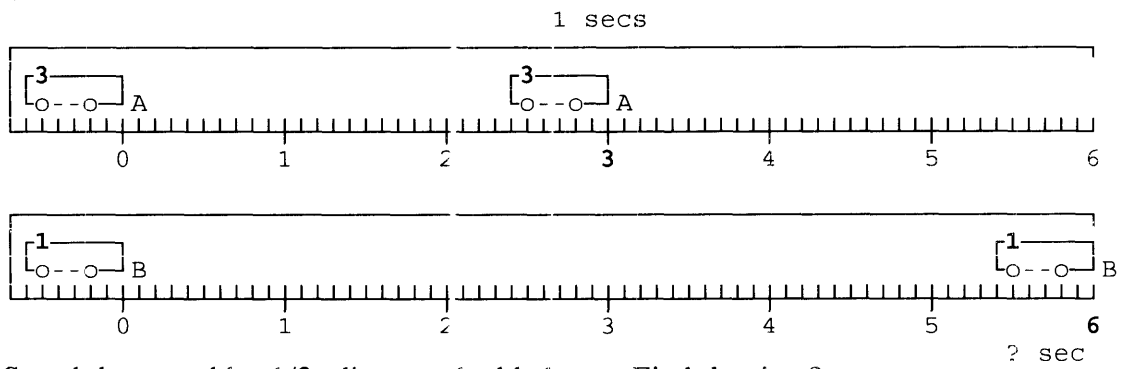
Time is increased by 3 times and the distance doubled. Find the speed?

C8.



Speed is doubled and time increased by 3 times. Find the distance?

C9.



APPENDIX E

OUTCOMES OF PILOT STUDY ON YEAR 10 STUDENTS

This section presents the outcomes from the speed questions that were given in a small Pilot Study to a group of Year 10 students. The outcomes for each section of the test are presented, namely, the Single Focus Questions of Part A, the Dual Focus Closed Questions of Part B and, finally, the Dual Focus Open Questions of Part C. The discussion of these outcomes and implications for the main study are presented in Chapter 3.

PART A QUESTIONS

Method

Series of Speed Tests: Year 10

At the end of the school year eleven student volunteers were asked to try a series of Speed Tests that covered all speed questions (not just the Single Focus ones). Since there were more questions to be asked than could be reasonably done in thirty minutes, a series of Speed Tests were developed with eleven questions in each one. These tests covered all the different types of speed questions and were carefully coded so that the data could be collated for each question from any test. Also, this method allowed a study of Pilot issue number four which was: to investigate the implications of using subsets of the items on different students.

Table A.1 shows a matrix of how the questions were split into the different tests. (Note the questions coded B and C are yet to be discussed in more detail)

Table A.1
Matrix of speed Tests

	TEST NO.				
ques. no.	1	2	3	4	5
1	N1	N1	N1	N2	N1
2	N2	N3	N2	N3	N3
3	V4	V3	V1	V6	V4
4	V2	V5	V2	V5	V2
5	B1	B2	B3	B1	B2
6	B8	B5	B7	B5	B6
7	B5	B6	B8	B4	B7
8	B10	B10	B10	B9	B9
9	C3	C5	C6	C3	C5
10	C7	C8	C9	C9	C7
11	C4	C2	C1	C4	C1

Outcomes

Series of Speed Tests: Year 10

The Year 10 students were able to complete the eleven questions in the 30 minutes allowed for the tests.

The responses of the students to the Single Focus Questions are given in Table A.2. This table indicates the number of correct and incorrect responses to the question and typical methods used by the students to solve the problem.

Table A.2
Responses of Year 10 students to Single Focus Speed Questions,
using the series of Speed Tests

Question No.	Number Correct	Number wrong	methods of solution and comments
N1	11		did simple multiplication
N2	10		did division
N3	8		used ratio approach
V1	2		ratio
V2	4		inverse variation
V3	3		see inverse variation v and d
V4	6		some saw direct dist versus speed others used diagram
V5	4	1	took it as A to C not B to C inverse t and v
V6	2	1	direct dist versus speed ???

PART B AND C QUESTIONS

Method

Series of speed tests Year 10

Table A.1 showed a matrix of speed questions that were made into five different Speed tests. The Dual Focus Questions, both Open and Closed, were given to some Year 10 students at the same time as the Single Focus Questions.

Outcomes

A summary of types of responses from the Year 10 students to the Dual Focus Closed Comparison Questions are given in Table A.3.

A summary of types of responses from the Year 10 students to the Dual Focus Open Comparison Questions are given in Table A.4.

Table A.3
Responses of Year 10 students to
Dual Focus Closed Comparison Speed Questions, using the series of Speed Tests

Qu. No.	Number Correct	Number wrong	comments on methods used
B1	6	0	- recognised similarity
B2	4	0	- compensate by 'pulling back' - same dist in same time
B3	3	0	- find speed of each one - compare dist and time - make proportions
B4	1	2	? - focus on front one - ignored start position
B5	8		- one in front? - proportions - further in same time
B6	5	0	- further in same time - proportion
B7	4	1	- less time same d - proportion ?
B8	5	0	- less t same d - proportional
B9	2	3	- found actual speed - one in front/??/??
B10	6	2	- proportions - actual speeds - comparison (2 cm more in 1 sec problem with fractions /???)

Table A.4
Responses of Year 10 students to Dual Focus Open Comparison Speed Questions,
using the series of Speed Tests

Qu. No.	Number Correct	Number wrong	comments on methods used
C1	4	1	- direct variation - used a formula - ignored the time
C2	3	1	- used the formula - used direct t and v
C3	4	1	- direct variation of v and d - proportion - ??
C4	4		- direct variation of a and t - used formula
C5	4	1	- inverse variation of v and t - ignored change in speed
C6			- inverse variation of v and t
C7	2	2	- formula to calculate speed - ignored time used direct ??
C8	2	1	- formula - ignored the time
C9	4	2	- formula - ??

APPENDIX F

PILOT STUDY ON YEAR 8 AND YEAR 11 STUDENTS.

To obtain some preliminary results before the main study, a pilot study was trialed on two classes. The Year 8 class that was selected was available at a convenient time and the teacher was willing to allow the students to do the questions. This class was characterised for having behaviour problems and was not noted for its academic achievement.

The Year 11 class in contrast was those students who had elected to do Physics. Out of a Year 11 population of 280 only 22 have chosen Physics (only 21 students present on day of testing). This class is noted for its academic achievements and is highly motivated. The questions on speed were given to this class just before they started class work on speed and acceleration. The intention was that this would invoke less typical rote replies of recently learned definitions.

It was anticipated that from these two classes that a range of responses would be forthcoming.

Subtest: Year 8, 11

A subset of questions was developed for piloting on Year 8 and 11 students. In this subset of questions an attempt was made to have at least one of each type of question at a suitable level for that year group. Compromises had to be made so that the questions could be completed by most students in forty minutes.

Table A.5 indicates the questions that were used for these two different tests, with some questions common to both tests.

TABLE A.5
Speed Questions selected for trial
on Years 8 and 11 students

Questions	Year Levels	
	8	11
Meaning of speed and vel	X	X
N1	X	
N2		
N3	X	X
V1	X	
V2	X	
V3		X
V4		
V5		X
V6		
B1	X	X
B2	X	
B3	X	
B4		X
B5	X	X
B6		
B7		
B8	X	X
B9		
B10	X	X
C1	X	X
C2	X	X
C3		
C4		X
C5		
C6		
C7	X	X
C8		
C9		X

13

14

OUTCOMES

The descriptions of the students' meanings for the term speed were categorised in Chapter 3 and the distribution of those categories is displayed in Table A.6 for both the Year 8 and 11 students.

Table A.6
Frequency Distribution of description Categories for Speed by Year 8 and 11

Category	Freq	
	Year 8	Year 11
A	0	3
B	0	6
C	5	4
D	10	8
E	4	0
F	1	0
G	1	0
	21	21

Most of the Year 8 students gave a D category response, that is, speed means 'how fast or slow you go'. Over half the Year 11 students gave a higher category of response though about 40% did give a D category response, that is, they could not relate speed to the variables distance and time.

Table A.7 shows a summary of the responses to the Questions. The column headed N (for Number) indicates how many students attempted the question. The second figure gives an indication of the "Student difficulty ratio" (SDR) to one decimal place. The "Student difficulty ratio" was calculated in the following way. For each response that was correct with a good explanation two points were given. If the answer was correct one point was given. If the response was wrong but the explanation showed that some worthwhile thinking had taken place then 0.5 points was given. Thus if the "Student difficulty ratio" was 2 then all responses were correct with good explanations. A ratio of about one or greater indicates a reasonable response. Anything below one was considered to be a poor response for that question. A zero indicates that none of the students were able to answer that question correctly.

Table A.7
Summary of Year 8 and 11 speed responses

Question codes	Year 8		Year 11	
	N	SDR	N	SDR
N1	23	1.6	-	-
N3	22	1.0	21	1.9
V1	21	0.8	-	-
V2	17	0.8	-	-
V3	-	-	21	1.7
V5	-	-	21	1.3
B1	23	1.1	20	1.9
B2	22	0.4	-	-
B3	22	0.2	-	-
B4	-	-	20	1.6
B5	22	0.9	20	1.7
B8	21	0.3	20	1.6
B10	21	0.8	20	1.3
C1	11	0.8	19	1.8
C2	11	0	18	1.7
C4	-	-	17	1.8
C7	8	0	18	1.5
C9	-	-	18	1.6

N = Number of responses

SDR = Student Difficulty ratio.

2 = perfect response

≥ 1 = Satisfactory response

< 1 = poor response.

A summary of the statistics of the student scores is given in Table A.8 which indicates the mean, median, standard deviation (sd), the highest and lowest scores and the total score possible for the test.

Table A.8
Descriptive statistics of speed tests on student scores

	mean	median	sd	lowest	highest	Possible
Year 8	8.0	7	4.0	3	22	26
Year 11	19.9	21.5	4.6	8	26	28

From Table A.7 it can be seen that most of the Year 11 students were able to complete the questions in the required time.

The Year 8 students had difficulty in completing the questions. While observing the students during the test it was apparent that the less able students were

having difficulty in reading and comprehending the instructions and the questions. This was not necessarily a fault of the test but a reading problem associated with the students. This problem slowed these students down so that they could not complete the test. Some students had problems expressing themselves in writing which also hindered their progress. When students were observed to have a reading difficulty the question was read to them and a brief explanation was given so that they were able to proceed with the questions. Five students were advised to discontinue answering the Single Focus Questions of Part A and were asked to continue with the Closed Comparison Questions of Part B.

APPENDIX G

SCRIPTS OF STUDENTS IN THE PROFILES OF CHAPTER 9

Copies of the original scripts of students presented in the profile are given on the following pages in the following order. The quality of some of the copies are poor due to the type of pen or pencil students used and how dark they wrote on the paper.

The students are:

LUKE	Student 610	Year 6
KRISTY	Student 622	Year 6
LEISA	Student 910	Year 9
ANTHONY	Student 906	Year 9
HEATHER	Student 110	Year 12
RICHARD	Student 113	Year 12

610

Student 610

SPEED QUESTIONNAIRE

YEAR 6

Name: Luke

Year Level 6 Date of Birth 28 / 1 / 97

Male / female male

For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED

speed means you go over
the limit of that Race or
Track.

VELOCITY

I Don't NO

For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your ANSWER and an EXPLANATION of how you got it.

Ques No.	Answer	Explanation
1.	4 Km	
2.	5 Km	
3.	2 Km	

Ques No.	Answer	Explanation
3.	24	
4.	$\frac{1}{2} \frac{D}{t_{me}}$	
5.	Same	Because they started at the same place
6.	D	it started a fastest ^{and stops} _{comparision}
7.	B	They started at the same place and B went
8.	Same	
9.	B	
10.	D	
11.	A 2.	it was ^{moving}
12.	B	
13.	A 6.	2 wisa ^{on} the same
		speed

You may ask for more paper if you need it

Student 622

SPEED QUESTIONNAIRE

YEAR 6

Name: Kristy

Year Level 6E

Date of Birth 9/11/1981

Male / female Female

For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED

It's going as fast as you can.

VELOCITY

I DON'T KNOW! NEVER HEARD OF IT!

For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your ANSWER and an EXPLANATION of how you got it.

Ques No.	Answer	Explanation
1.	4860 km	It times 60 + 180.
2.	30 mins	Because he is going 20 km/hr.

622

Student 622

page 2

Ques No.	Answer	Explanation
3.	twice as much as the first	Because the see second one is TWICE as long as the first one.
4.	the half of the Smith's car	Because he went twice as fast as the Smith car.
5.	Same	They stopped at the same time
6.	Same	They went went the same distance
7.	B	It went more further than (A)
8.	B	It had a different speed than the (A)
9.	Same	Went the same distance
10.	A	It went further than (B)
11.	2	Because it is half the speed of (A) so it will go half the distance
12.	4	If they went the same distance & the time is halved, the speed of (B) is (4)
13.	6	Because on (A) it's (3) and (B) went twice as far so it has to be (6)

You may ask for more paper if you need it

SPEED QUESTIONNAIRE

Student no. ✓

YEAR 9

Name: LOISH

Year Level 9

Date of Birth 21 / 5 / 78

Male / female Female

For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED

speed means how fast you go and if you can go faster or slower.

VELOCITY

how fast you go in a direction.

For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your ANSWER and an EXPLANATION of how you got it.

Ques No.	Answer	Explanation
1.	180km	Times by 3.
2.	Info.	direction
3.	double	

Ques No.	Answer	Explanation
4.	None None	
5.	Same	Because they both did it in 2 sec.
6.	B	it stopped ^{was} first ^{at} from A
7.	None Same	They both together and had the same speed it started further up and B had longer speed
8.	B	it started further up and B had the longer speed.
9.	1	it was in front in front for a second.
10.	3	the meter was between.
11.	B	B some of the time not at
12.	E	not at all
13.	5	—
14.		

You may ask for more paper if you need it

I found it interesting and good.

SPEED QUESTIONNAIRE

YEAR 9

Student 906 ✓

Name: Anthony

Year Level 9.8 Date of Birth 11 / 7 / 78

Male / ~~female~~ MALE

=====
For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED - Don't know

VELOCITY - How fast an object is going.

=====
For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your **ANSWER** and an **EXPLANATION** of how you got it.

Ques No.	Answer	Explanation
1.	180 km	multiplied 60 by 3.
2.	30 mins $\frac{1}{2}$ hour	divide 20 by 10.
3.	twice as much time	take the first journey time & multiply it by 2

Ques No.	Answer	Explanation
4.	2 times	If she goes twice as fast, she is halving her speed, which means she does it in half the time, so so she goes around twice.
5.	Same	because they finish at the same spot at the same time.
6.	Same	Because it took A 3 seconds to go 3 units & it took B 5 seconds to go 5 units
7.	B	Because it took A 3 secs to go 3 units & B 3 secs to go 5 units.
8.	B	Because A took 5 secs to go 3 units & it took B 3 secs to go 3 units
9.	A	Because A is going just over 1 unit per sec, but B is going only 1 unit per sec
10.	B at 2 units	Because speed is the same, but time is halved so distance is halved! $4 \div 2$.
11.	4	Distance is the same but time is halved so B would have to be going 2x as fast.
12.	2	Divide the units by the secs.
13.	6	If the speed is doubled it becomes 2 units per sec Time is increases increased by three times, it becomes 3 secs $2 \text{ units} \times 3 \text{ secs} = 6 \text{ units}$ -
14.	6 sec	if the speed goes down by $\frac{1}{3}$ it makes it 1 unit per sec, multiply $6 \text{ units} \times$ by speed $1 = 6 \text{ secs}$

You may ask for more paper if you need it

Student 110

SPEED QUESTIONNAIRE

YEAR 12

Name: Heather

Year Level 12

Date of Birth 20/5/75

~~Male~~ / female _____

Circle the subjects that you do.

Maths I

Maths II

Physics

Multi Sci

For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED

The distance an object travels in a particular time.

VELOCITY

The direction + distance an object travels in a particular time.

For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your ANSWER and an EXPLANATION of how you got it.

Ques No.	Answer	Explanation
1.	$\frac{1}{2}$ hour ie 30min	10 km/hr $\times \frac{2}{1} = 20 \text{ km/hr}$ $\frac{1}{2}$ hour
2.	twice as long.	$\times 2$ because is twice as far
3.	twice.	$5 \div 2 = 2.5$ $2.5 \sqrt{2}$ \therefore 2 times (twice)

Interesting

Ques No.	Answer	Explanation
4.	2 x slower	$10 \times x = 20$ $x = 2$
5.	same	both going same distance in same time.
6.	same	as above but extra sec needed to go one centimetre further but if A had to go further would take same time.
7.	B is faster	because traveling further in same time.
8.	B faster	because takes a longer to travel same distance.
9.	A faster	travels further in less time than if B travelled same distance.
10.	8 cm.	twice as fast \therefore twice as far.
11.	$\frac{1}{2}$ sec.	twice as fast so less time to reach same distance.
12.	12	B go 6cm in 1sec. $\frac{6}{3} = 2$
13.	18 cm.	$3 \times 2 \times 3 = 18$
14.	6	6 cm in 1 sec 18 cm in 3 sec
15.	2 cm.	A went to 4 in 2 sec. so B will go to 2 in 1 sec.

20

SPEED QUESTIONNAIRE

YEAR 12

Name: Richard

Year Level 12.3

Date of Birth 24 / 9 / 75

Male / female _____

Circle the subjects that you do.

Maths I

Maths II

Physics

Multi Sci

For each of the following words try and explain what they mean, as if you were going to give a dictionary meaning. Please give it your best shot.

SPEED

Speed is the distance travelled by an object in a given amount of time eg 20m/s, 20 km/hr, 100 ft/s etc.
Speed is a non-vector quantity.

VELOCITY

Velocity is much like speed but it is a vector quantity meaning that a ~~distance~~^{direction} is given with the speed, eg 20m/s while travelling north, 20km/hr DUE East, 100ft/s 30° N of W etc.

For the remainder of the questions please place your answer in the spaces provided below and on the BACK of this sheet. More paper is available if you need it. (YOU MAY TEAR OFF THIS PAGE FROM THE QUESTIONS)

Please give your ANSWER and an EXPLANATION of how you got it.

Ques No.	Answer	Explanation
1.	$\frac{1}{2}$ hr.	$d=vt$ rearrange formula to obtain t and subs.
2.	2 times more.	$d=vt$ while letting the first journey be ^{the value} (9) rearrange and subs.
3.	twice.	let d = the value of d subs & rearrange formula to find. Normal journey = $\frac{d}{s}$ Running time = $\frac{d}{s}$... faster

Ques No.	Answer	Explanation
4.	2 times slower.	$d=vt$ as $t \propto \frac{1}{v}$ $t = \frac{d}{v}$ \therefore as t gets larger v gets smaller as d is constant.
5.	SAME	SAME distance & time.
6.	SAME	- From the equation $v = \frac{d}{t}$ both speeds are 1cm/s.
7.	B is faster	- from the eqn $v = \frac{d}{t}$ the $A = 1\text{cm/s}$ $B = \frac{5}{3}\text{cm/s} \therefore B$ faster
8.	B is faster	- From the eqn $v = \frac{d}{t}$ $A = \frac{3}{5}\text{cm/s}$ $B = 1\text{cm/s}$
9.	A is faster	- from the eqn $v = \frac{d}{t}$ $A = \frac{5}{4}\text{cm/s}$ $B = 1\text{cm/s}$.
10.	d = 4cm d = 8cm	$[d=vt]$ $v = 2\text{m/s}$ $t = 2\text{sec}$ $\therefore d = 4\text{cm}$ $v = 4\text{m/s}$ $t = 2\text{sec}$ $[$ from the eqn $d=vt]$ $\therefore d = 8\text{cm}$.
11.	$t = \frac{1}{2}\text{sec}$.	$[d=vt]$ - working out from the eqn $v = 6\text{cm/s}$ $d = 3\text{cm}$ $\therefore t = \frac{d}{v} = \frac{3}{6} = \frac{1}{2}$
12	$v = 2\text{cm/s}$.	$[d=vt]$ $t = 3\text{sec}$ $d = 6\text{cm}$ $\therefore v = \frac{d}{t} = 2\text{cm/s}$.
13.	$d = 18\text{cm}$.	$[d=vt]$ $t = 3\text{sec}$ $v = 6\text{cm/s}$ $\therefore d = vt = 18\text{cm}$
14.	$t = 6\text{sec}$	$[d=vt]$ $d = 6\text{cm}$ $v = 1\text{cm/s}$ $\therefore t = \frac{d}{v} = 6\text{sec}$.
15.	$d = 2\text{cm}$.	$[d=vt]$ $t = 1\text{sec}$ $v = 2\text{cm/s}$ $\therefore d = vt = 2\text{cm}$.

SPEED QUESTIONS

USED IN THE SPEED TESTS

Years 6, 9, 12

The following questions are those that were used in the Speed Test questionnaire.

They are reproduced here so that the reader has ready access to the questions without having to turn to the Appendix every time a question is referred to in the thesis. Chapter 3 provides an analysis of the questions.

The questions are divided into four sections:

1. A description of speed (page 1)
2. The Single Focus Straight-forward questions of Part A (page 2)
Numerical-type and variation-type.
3. The Dual Focus Closed Comparison Questions of Part B (page 3)
4. The Dual Focus Open Comparison Questions of Part C (page 6)

Each Question required an answer and an explanation for how the student arrived at the answer.

Description

What is Speed? Write your best description of what you think speed is.

PART A

SINGLE FOCUS STRAIGHT-FORWARD SPEED QUESTIONS

Numerical Questions

N1. (Year 6, 9)

If a car has a speed of 60 km/h, how far will it go in three hours?

N3. (Year 6, 9, 12)

A boy on a pushbike rides at a speed of 20 km/hr, how many hours will it take him to ride 10km?

Variation Questions

V1. Year 6, 9, 12)

A car goes on two journeys at the same speed. The second journey was twice as far as the first. How much more time would the second journey take?

V2. (Year 6)

The Smith family goes to town slowly in their old car. Their neighbor Mr. Jones drives his new car the same distance to town but at twice the speed. How much more time will it take Mr. Jones to get to town?

V3. (Years 9, 12)

Lesley goes for a five minute ride. She can usually get around the block in five minutes. Today she races with a friend and goes twice as fast as normal. At this speed how many times will she get around the block in 5 minutes

V5. (Year 12)

Jimmy walks the same distance every morning. On Monday it takes him 10 mins for his walk. On Tuesday he had a sore leg and it took him 20 mins. How many times faster/slower was his speed on Tuesday?

PART B

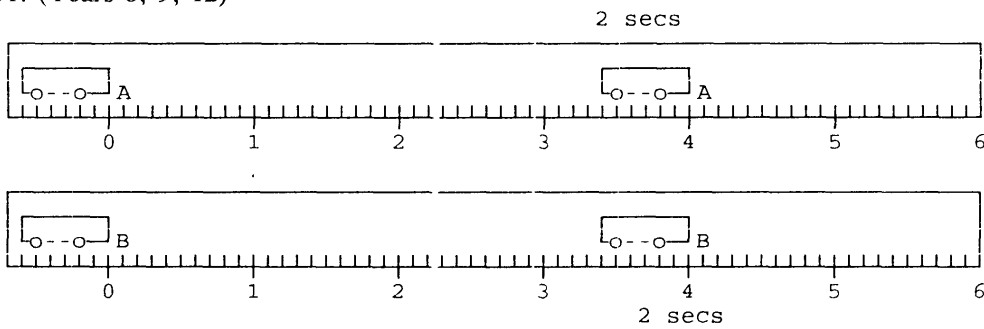
DUAL FOCUS CLOSED COMPARISONS QUESTIONS

Each problem below shows two identical carts A & B.

The picture on the left shows where they start from and the picture on the right shows where they end. The time for A is shown above A and the time for B is shown below B.

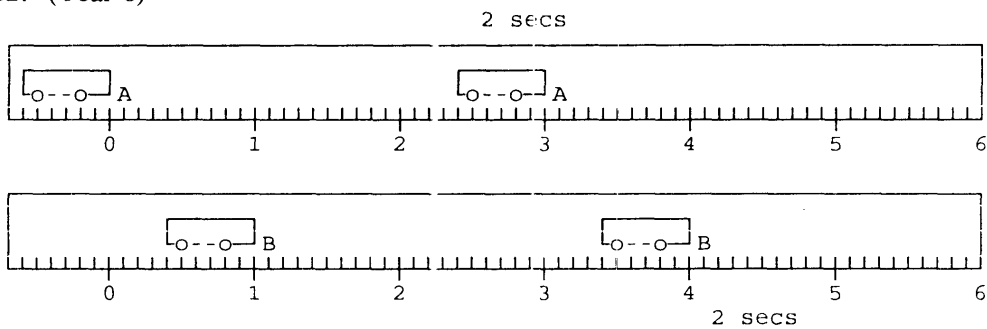
You must decide EITHER which cart is going the **GREATER SPEED**
OR if they are going the **SAME SPEED**.
Then explain your choice of answer.

B1. (Years 6, 9, 12)



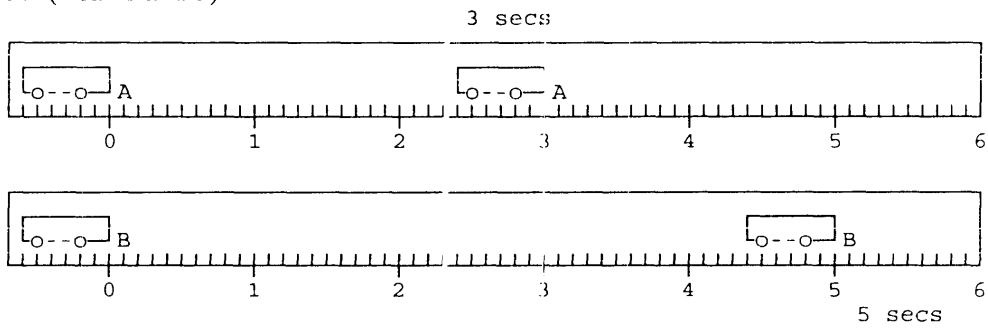
Answer: A B same speed

B2. (Year 6)



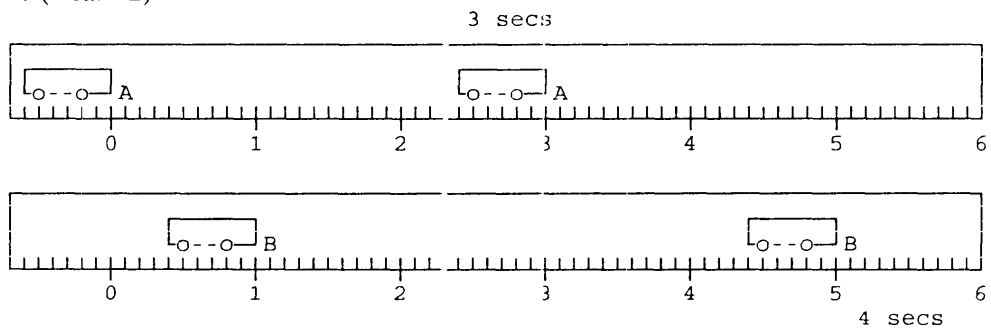
Answer: A B same speed

B3. (Year 6 and 9)



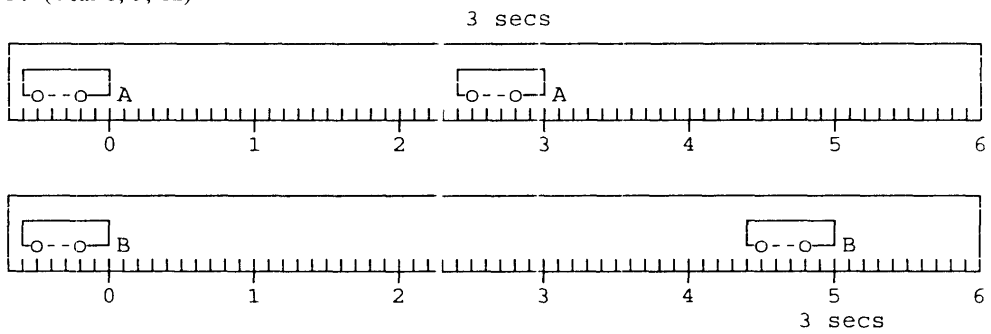
Answer: A B same speed

B4. (Year 12)



Answer: A B same speed

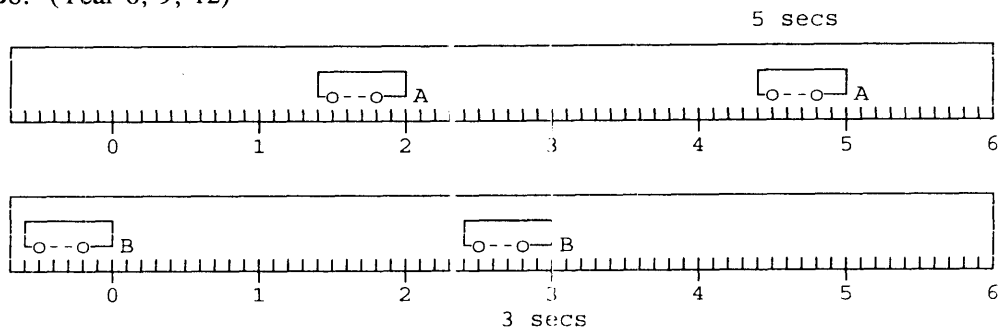
B5. (Year 6, 9, 12)



Answer: A B same speed

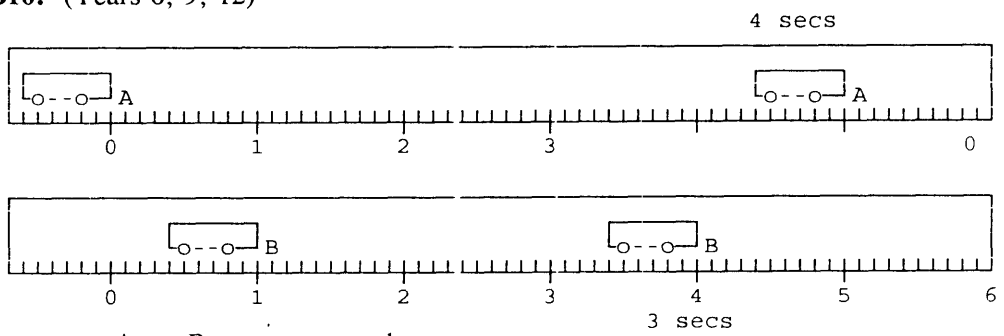
Insert - Speed Questions

B8. (Year 6, 9, 12)



Answer: A B same speed

B10. (Years 6, 9, 12)



Answer: A B same speed

1

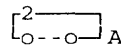
PART C

DUAL FOCUS OPEN COMPARISON QUESTIONS

Find the missing variable

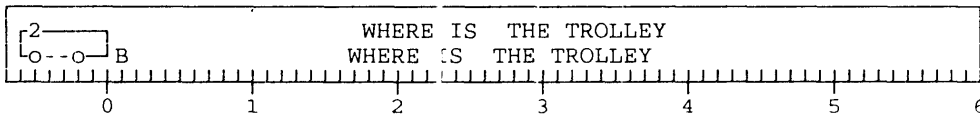
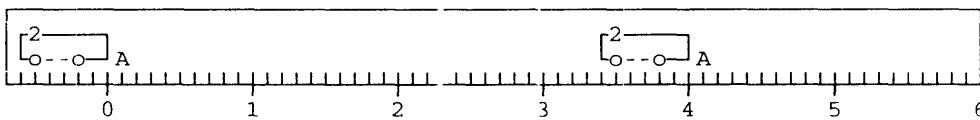
In the following questions the first diagram gives all the information but the second diagram has things changed (in **bold print**) and one bit missing. By comparing diagrams or otherwise find the missing information required. (Note: the speed of the trolley is on the speedo on the trolley)

The speed on this trolley is 2 units/sec



C1. (Years 6, 9, 12)

2 secs

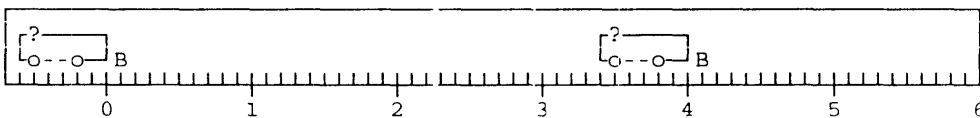
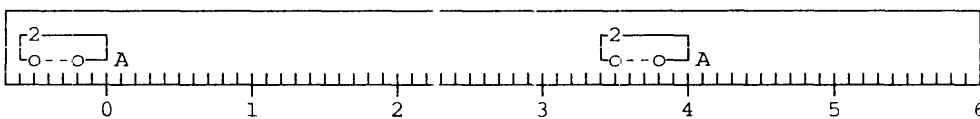


1 sec

The time is halved, Find the distance?

C2. (Year 6, 9)

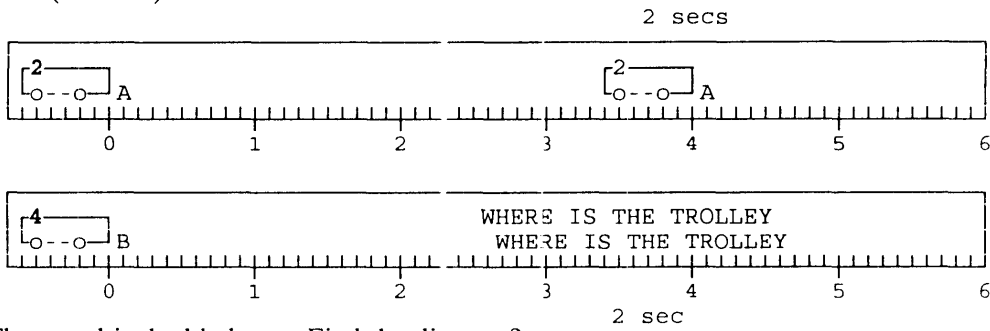
2 secs



1 sec

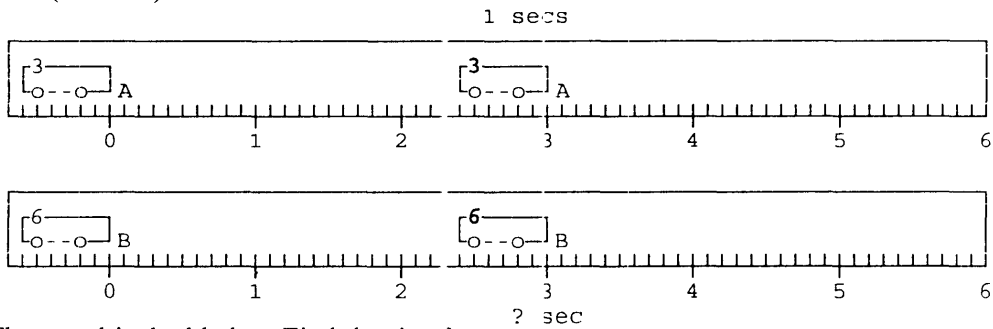
The time is halved. Find the speed?

C3. (Year 12)



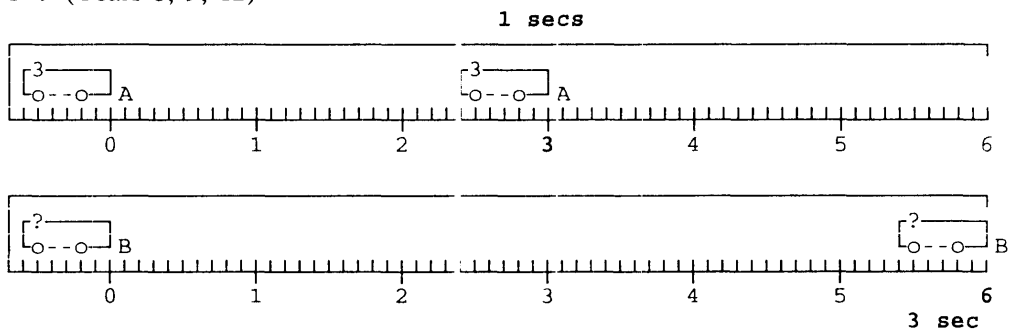
The speed is doubled. Find the distance?

C5. (Year 12)



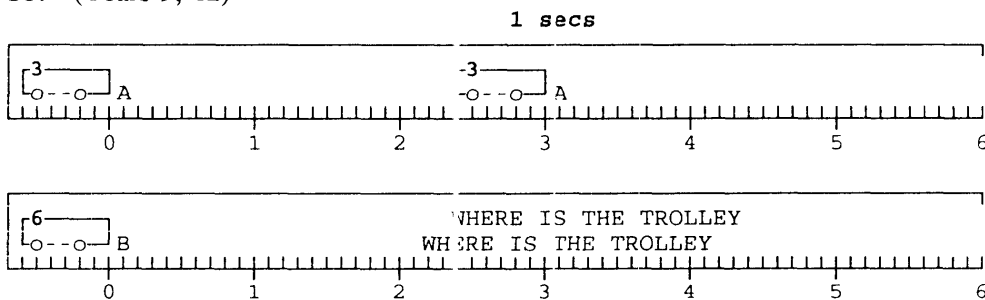
The speed is doubled. Find the time?

C7. (Years 6, 9, 12)



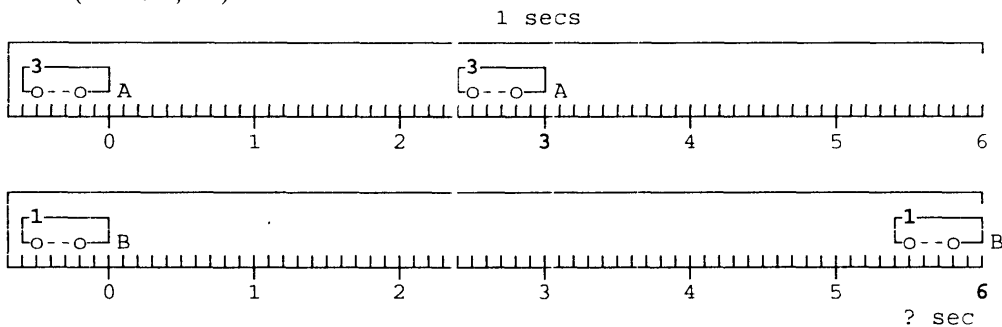
Time is increased by 3 times and the distance doubled. Find the speed?

C8. (Years 9, 12)



Speed is doubled and time increased by 3 times. Find the distance?

C9. (Years 9, 12)



Speed decreased by $\frac{1}{3}$, distance doubled. Find the time?