



**General Certificate of Secondary
Education**

Science A 4406

SCA2HP Unit 6

Mark Scheme

2012 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

- 2.1** In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following lines is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

Quality of Written Communication and levels marking

In Question 8 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.


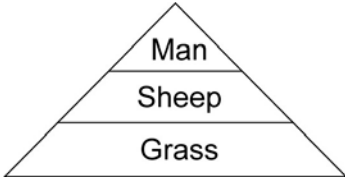
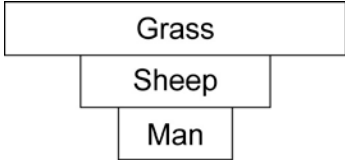
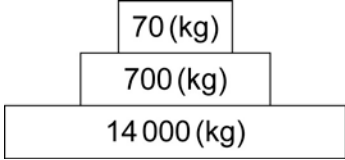
SCA2HP

Question 1

question	answers	extra information	mark
1(a)	camouflaged in <u>summer and winter / all year</u>	allow matches background for (camouflage) all year	1
	(so) fewer eaten (by predators) or light coloured coat emits less energy / heat (than darker coat) (1) (so helps) hare stays warmer in winter (1)	allow to avoid / hide from predators accept converse argument but answer must be comparative do not accept darker coat absorbs more energy / heat (in summer)	1
1(b)	small(er) surface area	allow small(er) surface area : volume ratio do not accept small volume : SA or large SA : volume ignore references to being less visible	1
	(so) lose less energy / heat	allow retains / conserves <u>more</u> energy / heat ignore prevents / stops heat loss ignore keeps heat in ignore absolutes	1
Total			4

SCA2HP

Question 2

question	answers	extra information	mark
2(a)		<p>allow:</p>  <p>allow 1 mark for:</p>  <p>allow 1 mark for:</p>  <p>these are the only acceptable answers</p>	2
2(b)	<p>materials (lost in) wastes / faeces / urine / urea / carbon dioxide</p> <p>not all of the organism is eaten / digested</p>	<p>allow excretion</p> <p>ignore energy loss / heat / movement / growth</p> <p>only accept respiration if related to loss of carbon dioxide</p> <p>accept example eg bones / wool</p> <p>ignore references to size / numbers of organisms</p>	1 1
Total			4

SCA2HP

Question 3

question	answers	extra information	mark
3			6
<p>Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.</p>			
0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a basic description of either differences or explanations only.	There is a clear description of at least one difference with a correctly linked attempt at an explanation.	There is a clear and detailed description of at least two differences explained and correctly linked. Competition explained.
<p>examples of the points made in the response</p> <p>description of tree on its own:</p> <ul style="list-style-type: none"> • is wider / bushier • has more leaves • is shorter • has leaves all over tree <p>explanation linked:</p> <ul style="list-style-type: none"> • more space • more light • more nutrients <p>competition mentioned:</p> <ul style="list-style-type: none"> • for light • for nutrients • for space 	<p>extra information</p> <p>allow converse statements for trees in forest</p> <p>allow (leaves / branches) spread out</p> <p>ignore trunks</p> <p>ignore size of leaves</p> <p>allow photosynthesis more</p> <p>ignore reference to being eaten</p> <p>is shorter cannot be linked with more nutrients</p> <p>ignore tree roots unless clearly linked to obtaining nutrients</p> <p>ignore fight</p> <p>ignore water and carbon dioxide</p> <p>ignore evolution / natural selection / adapting</p>		
Total			6

SCA2HP

Question 4

question	answers	extra information	mark
4(a)	ethene + water → ethanol	<p>ethene and water can be in either order</p> <p>accept steam instead of water</p> <p>accept C₂H₄ for ethene accept H₂O for water accept C₂H₅OH / C₂H₆O for ethanol</p> <p>if formula used letters must be uppercase and numbers must be subscript</p> <p>if name and formula given mark the name and ignore formula</p> <p>ignore balancing of formula</p> <p>do not accept ethane or ethanal</p>	1
4(b)	<p>plentiful supply of sugar (cane) or sugar (cane) grows there or Brazil has limited crude oil resources or so Brazil doesn't need to import crude oil</p>	<p>accept sugar (cane) is renewable accept fermentation is sustainable</p> <p>allow no for limited</p> <p>ignore all reference to cost ignore environmental reasons ignore doesn't use oil</p>	1

Question 4 continues on the next page

SCA2HP

Question 4 continued

question	answers	extra information	mark
4(c)	any two from: (fermentation) <ul style="list-style-type: none"> • <u>s</u>low(er) process • a mixture of ethanol and water is formed <p>or</p> distillation is needed to obtain pure ethanol <ul style="list-style-type: none"> • batch process 	ignore takes a few days allow ethanol produced is not pure allow ethanol needs to be separated ignore (dilute) solution allow fermentation is not a continuous process ignore cost ignore pollution ignore reference to land use accept for 2 marks slower batch process	2
Total			4

SCA2HP

Question 5

question	answers	extra information	mark
5(a)	any three from: <ul style="list-style-type: none"> • (adding) compost increases water holding capacity • (adding) hydrogel increases water holding capacity • hydrogel is more effective than compost (at holding water) or smaller mass of hydrogel needed for same effect as compost <ul style="list-style-type: none"> • combination of compost and hydrogel gives the highest water holding capacity 	allow for 1 mark adding compost and / or hydrogel increases water holding capacity ignore incorrect figures	3
5(b)	any two from: <ul style="list-style-type: none"> • double bond changes (to single bond) • <u>many</u> monomers / <u>many</u> small molecules • (monomers / molecules) bond / join together • to form long-chain / (very) large molecules 	idea of many or long-chain or very large needed for 2 marks maximum 1 mark if cracking mentioned allow double bond opens / breaks allow combine accept for 2 marks displayed formulae written in equation to represent reaction $n \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{C} = & \text{C} \\ & \\ \text{H} & \text{H} \end{array} \longrightarrow \left(\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n$	2
Total			5

SCA2HP

Question 6

question	answers	extra information	mark
6(a)	any three from: <ul style="list-style-type: none"> • ammonia • methane • hydrogen • water <u>vapour</u> • carbon dioxide • carbon monoxide 	if <u>only</u> formula given it must be correct accept NH ₃ accept CH ₄ allow ethane / butane / propane accept H ₂ accept H ₂ O <u>vapour</u> / steam accept CO ₂ accept CO allow oxygen / O ₂ allow nitrogen / N ₂ ignore nitrogen oxide ignore carbon	3
6(b)	(in atmosphere today) (much) less carbon dioxide / CO ₂ more nitrogen / N ₂ <u>more</u> oxygen / O ₂ no ammonia / NH ₃ or less methane / CH ₄ or more argon / Ar or more noble gases	ignore references to water vapour allow converse allow carbon dioxide was the <u>main</u> gas (in Earth's early atmosphere) allow nitrogen is now the <u>main</u> gas (in the atmosphere today) or nitrogen is now 78–80% allow less ammonia / NH ₃	 1 1 1 1

Question 6 continues on the next page

SCA2HP**Question 6 continued**

question	answers	extra information	mark
6(c)	(fractional) distillation		1
	gases have different boiling points	allow gases condense at different temperatures ignore condensing points / levels ignore evaporating points / levels	1
Total			9

SCA2HP

Question 7

question	answers	extra information	mark
7(a)	<p>any two similarities and any two differences</p> <p>similarities</p> <ul style="list-style-type: none"> • (both can be) reflected • (both can be) refracted • (both can be) diffracted • (both) interfere • (both) <u>transfer</u> energy • (both exhibit) Doppler effect 	<p>read whole answer to ensure that there are no contradictory statements which negates that mark</p> <p>ignore reference to senses in similarities and differences</p> <p>allow both travel through any correctly named solid / gas / liquid</p> <p>ignore both are types of energy / waves / oscillations</p> <p>do not accept statements like both are transverse as a similarity</p>	4

Question 7 continues on the next page

SCA2HP

Question 7 continued

question	answers	extra information	mark
7(a)	<p>differences</p> <ul style="list-style-type: none"> • light can travel through a vacuum or sound cannot travel through a vacuum • (different) speed / velocity • one is longitudinal <u>and</u> one is transverse <ul style="list-style-type: none"> • sound is a mechanical wave / caused by vibrations <u>and</u> light is an electromagnetic wave 	<p>allow sound requires a medium / particles to travel through</p> <p>accept light is faster than sound</p> <p>do not accept sound is transverse and light is longitudinal</p> <p>allow correct description: (longitudinal) the oscillations / vibrations are parallel to / same direction as (the direction of energy transfer) and (transverse) the oscillations / vibrations are 90° to / perpendicular to (the direction of energy transfer)</p> <p>accept sound waves have a longer wavelength / lower frequency</p> <p>if no other marks gained allow 1 mark for any correct difference(s) where the waves are not specified eg one is transverse eg have different wavelengths / frequencies</p>	

Question 7 continues on the next page

SCA2HP

Question 7 continued

question	answers	extra information	mark
7(b)(i)	4800 × 0.25	working must be shown for 3 marks	1
	1200(m/s)		1
	(liquid) C	ignore water / named liquid	1
7(b)(ii)	(yes / no)	ignore yes / no, marks are for the explanation	1
	speed increases as density increases	allow positive correlation allow the more dense the liquid the less time (for sound to travel through)	
	but, mercury should have a (much) greater speed given the higher density	ignore they both increase ignore there was no pattern allow mercury does not fit the pattern / is an anomaly	1
Total			9

SCA2HP

Question 8

question	answers	extra information	mark
8(a)	<u>carbon dioxide</u> (released from burning fossil fuels) is captured and stored	ignore carbon emissions / carbon ignore containers	1
	in (old) gas / oil fields / underground / under the sea (bed) / rocks	allow traps carbon dioxide	1

Question 8 continues on the next page

SCA2HP

Question 8 continued

question	answers	extra information	mark
8(b)	<p>advantages any two from:</p> <ul style="list-style-type: none"> • renewable • can meet electricity demand quickly • pumped storage to store energy for later use • no air pollution / named gas eg sulfur dioxide / nitrogen oxides • no acid rain • no fuel needed / no fuel cost • does not cause global warming <p>disadvantages any two from:</p> <ul style="list-style-type: none"> • relies on rainfall / not as reliable (as coal) • destruction of wildlife habitats (during construction) • <u>higher</u> set-up cost 	<p>unless answers state otherwise advantages and disadvantages relate to hydroelectric</p> <p>ignore answers that relate to the disadvantages of coal</p> <p>allow idea of pumped storage to meet demand quickly allow short start-up time</p> <p>allow harmful gases</p> <p>ignore no carbon dioxide / greenhouse gases as an advantage</p> <p>ignore reference to running cost ignore can be used as a leisure area</p> <p>accept displacement of people</p> <p>ignore unsightly ignore large area needed</p>	4
Total			6

SCA2HP**Question 9**

question	answers	extra information	mark
9	quicker cheaper get plants identical to parent plant or have same genes as parent plant	first two points must be comparative ignore quick ignore cheap allow plants have known / desired characteristics ignore genetically similar to parent ignore produces clones unless qualified do not accept get the same plant	1 1 1
Total			3

SCA2HP**Question 10**

question	answers	extra information	mark
10	reduces landfill scheme self-financing or produces compost / fertiliser which can be sold produces nutrients / fertiliser / minerals (ions) for plants	accept reduces pollution from burning wastes ignore less waste unqualified allow returns / recycles nutrients into soil ignore helps plants grow	1 1 1
Total			3

SCA2HP

Question 11

question	answers	extra information	mark
11	(plants) photosynthesise	read 'the gas' or 'it' as carbon dioxide	1
	(plants) absorb carbon dioxide / CO ₂ (from the air)	allow take in / use carbon dioxide / CO ₂ (from the air)	1
	(overall) more carbon dioxide / CO ₂ is being released into the air than is being removed	allow 470 (billion tonnes) released but / and 450 (billion tonnes) taken in	1
	(by) respiration (by all organisms / any named organism)	ignore breathing ignore carbon	1
	(and) combustion / burning	ignore carbon	1
	(so) amount of carbon dioxide / CO ₂ in air is increasing	allow 20 (billion tonnes) of carbon dioxide / CO ₂ added to air each year	1
Total			6

SCA2HP

Question 12

question	answers	extra information	mark
12(a)	the birds now arrive earlier (in the UK)	must imply both species of birds	1
	the Sand martin (now) arrives before the Barn swallow or the Barn swallow (now) arrives later than the Sand martin or arrival time of the two birds has reversed		1
12(b)	any two from: <ul style="list-style-type: none"> • warmer in UK <u>earlier</u> (in year) or • colder abroad <u>earlier</u> (in year) or • insects / food appears <u>earlier</u> (in year in UK) or • shortage of insects / food abroad <u>earlier</u> (in year) or • new genes / mutation 	allow too hot / cold abroad <u>earlier</u> (in year) ignore global warming accept feasible reference to competition for food allow evolution / natural selection ignore adapted ignore pollution	2
Total			4

SCA2HP

Question 13

question	answers	extra information	mark
13(a)(i)	(bromine water) is decolourised / changes (from orange) to colourless	allow brown / red-brown / orange-brown → colourless ignore clear / liquid ignore oil changes colour	1
13(a)(ii)	sunflower (oil) contains the <u>most</u> unsaturated fat	independent marking points allow more for most	1 1
13(a)(iii)	(yes / no) pattern identified as the percentage of saturated fat increases the smoke point decreases or as the percentage of unsaturated fat decreases the smoke point decreases anomaly identified soybean does not fit the pattern	yes / no does not gain mark pattern must be based on more than one substance allow smoking for smoke ignore references to boiling point allow sunflower oil does not fit pattern	1 1
13(a)(iv)	sunflower (oil) as contains the most unsaturated fat / least saturated fat or soybean as has the highest smoke point	ignore more healthy option unless qualified allow more for most allow less for least allow can heat to the highest temperature allow higher for highest ignore boiling point	1

Question 13 continues on the next page

SCA2HP**Question 13 continued**

question	answers	extra information	mark
13(b)(i)	can be used as spreads / in cakes / in pastries	allow for margarine / in baking ignore shelf-life / forms a solid do not accept to make butter	1
13(b)(ii)	(react with) hydrogen	accept reference to hydrogenation	1
	heat to 60°C	allow values from 50–120°C	1
	nickel catalyst		1

Question 13 continues on the next page

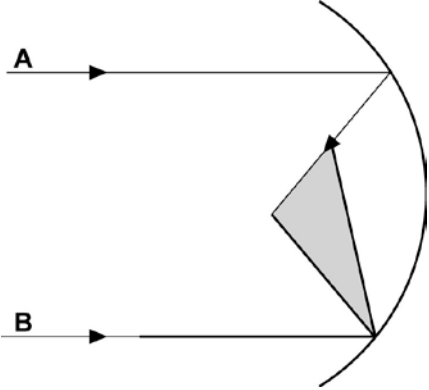
SCA2HP

Question 13 continued

question	answers	extra information	mark
13(b)(iii)	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	<p>no marks if number of carbon atoms is not 4 uppercase C and H</p> <p>ignore brackets</p> <p>allow 1 mark for any of the following:</p> $ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & & & \text{H} \end{array} $ $ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & =\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ $ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ $ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H}- & \text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ <p>do not accept:</p> $ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H}- & \text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	2
Total			12

SCA2HP

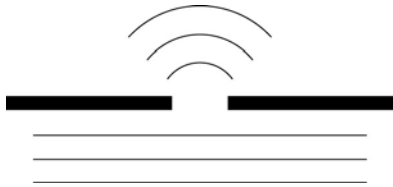
Question 14

question	answers	extra information	mark
14(a)	microwaves can travel through the atmosphere / ionosphere or radio waves cannot (escape from the atmosphere)	accept 'they' as referring to microwaves accept not reflected by ionosphere allow cannot penetrate / travel through ignore frequency / wavelength ignore reference to speed of waves	1
14(b)(i)	straight continuous lines drawn to show microwave B reflected by satellite dish	reflected ray should be within limits of grey area 	1
14(b)(ii)	receiver drawn using rectangle symbol where microwaves A and B meet / cross over	allow ecf from (b)(i) if (b)(i) not attempted no marks can be awarded for (b)(ii) if lines do not meet / cross over allow receiver where extended lines would meet allow any clear indication where receiver should be	1

Question 14 continues on the next page

SCA2HP

Question 14 continued

question	answers	extra information	mark
14(c)	<p>description <u>spreading</u> of waves</p> <p>as they pass through a gap / past an obstacle</p> <p>explanation the <u>wavelength</u> is (much) bigger than the holes in the mesh</p> <p>(significant) diffraction occurs when the holes are the same size as the wavelength</p>	<p>allow curving with reference to after gap</p> <p>ignore bending / change direction</p> <p>allow for 2 marks:</p>  <p>ignore too big to fit through gap</p> <p>ignore can't pass through gap</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>
Total			7

SCA2HP**Question 15**

question	answers	extra information	mark
15(a)	Doppler (effect / shift)	do not allow red shift do not allow blue shift	1
15(b)(i)	shorter / decreased	allow smaller allow radar gun wavelength is longer ignore reference to speed / frequency ignore closer together	1
15(b)(ii)	the same / 300 000 000 (m/s)	accept 3×10^8 (m/s) accept <u>300 000 km/s</u>	1

Question 15 continues on the next page

SCA2HP

Question 15 continued

question	answers	extra information	mark
15(c)(i)	<p>(speed =) 80 (km/hour) so speeding or 10 (km/hour) above speed limit</p> <p>or change in frequency 3.5 kHz at 70 km/hour (1)</p> <p>(observed change in frequency =) 4 (kHz) so speeding / 80 km/hour (1)</p>	<p>if answer 'not speeding' = 0 marks</p> <p>implication that the car is speeding needed to gain 2 marks</p> <p>if no reference to speeding allow 1 mark for 80 (km/hour)</p> <p>if say speeding and 4(kHz) and 80 (km/hour) shown on graph = 2 marks</p> <p>if no reference to speeding 4(kHz) and 80 (km/hour) shown on graph = 1 mark</p>	2
15(c)(ii)	<p>40 (km/hour)</p> <p>away from (police officer / radar gun) or in opposite direction to other car</p>	<p>accept (observed change in frequency =) (-)2 (kHz) for 1 mark</p> <p>allow reversing</p>	2 1
Total			8

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