AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.3.1

Stopping distance

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**16**
Available paper years	**2005–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.5.6.3.1 Stopping distance

Answer 01 · Mark scheme June 2005 | 3451 | Original Q14 | Legacy

The full source mark scheme begins on page 28. Follow original question 14 in that document.

Answer 02 · Mark scheme June 2005 | 3462 | Original Q12 | Legacy

The full source mark scheme begins on page 46. Follow original question 12 in that document.

Answer 03 · Mark scheme June 2006 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 60. Follow original question 15 in that document.

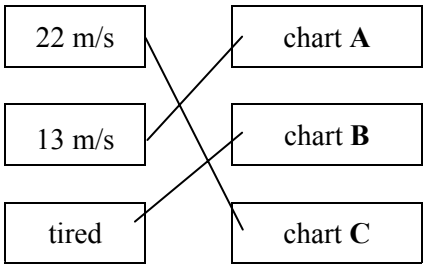
Answer 04 · Mark scheme June 2006 | 3462 | Original Q13 | Legacy

The full source mark scheme begins on page 80. Follow original question 13 in that document.

4.5.6.3.1 Stopping distance

Answer 05 · Mark scheme January 2008 | PHY2F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)(i)	constant		1
(ii)	heat		1
(b)(i)	3 links correct  	allow **1** mark for 1 correct link if more than one line is drawn from a condition mark all lines from that condition incorrect	2
(ii)	increased		1
total			5

4.5.6.3.1 Stopping distance

Answer 05 · Mark scheme

January 2008 | PHY2F | Original Q3 | Legacy

PHY2F

4.5.6.3.1 Stopping distance

Answer 06 · Mark scheme June 2008 | PHY2F | Original Q1 | Legacy

Question 1

	answers	extra information	mark
(a)	53 (m)		1
(b)(i)	Similar shape curve drawn above existing line going through (0,0)	allow **1** mark for any upward smooth curve or straight upward line above existing line going through (0,0)	2
(ii)	rain on road car brakes in bad condition		1 1
(c)(i)	all three lines correctly labelled top line – C middle line – B bottom line – A	allow **1** mark for one correctly labelled accept 1.2 accept 0.9 accept 0.7	2
(ii)	any **two** from: • (table has) both variables are together • both (variables) could/ would affect the reaction time • cannot tell original contribution • need to measure one (variable) on its own • need to control one of the variables	 accept tired and music as named variables accept cannot tell which variable is affecting the drive (the most) accept need to test each separately	2
total			9

4.5.6.3.1 Stopping distance

Answer 06 · Mark scheme

June 2008 | PHY2F | Original Q1 | Legacy

PHY2F

June 08

4.5.6.3.1 Stopping distance

Answer 07 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	**R** has the greatest speed / velocity	reason cannot score if **R** is not chosen accept it is going at 28 m/s answer should be comparative	1 1
3(b)(i)	3250	allow **1** mark for correct substitution of 130 and 25 ie 130 × 25 accept 2600 or 3640 for **1** mark	2
3(b)(ii)	kg m/s	accept answer given in (b)(i) if no answer given here	1
3(c)(i)	increase it	accept make it slower accept slow it down accept make it longer accept (reactions) would be slower do **not** accept if the answer clearly refers to distance comparative answers expected	1
3(c)(ii)	increase it	accept make it longer do **not** accept if the answer clearly refers to time comparative answers expected	1
Total			**7**

4.5.6.3.1 Stopping distance

Answer 07 · Mark scheme

January 2010 | PHY2F | Original Q3 | Legacy

PHY2F

4.5.6.3.1 Stopping distance

Answer 08 · Mark scheme

June 2010 | PHY2F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	distance travelled under the braking force	accept braking (distance)	1
3(b)	(directly) proportional **or** increase in the same ratio	accept a correct description using figures eg if speed doubles then thinking distance doubles accept for **1** mark positive correlation accept for **1** mark as speed increases so does thinking distance accept as one increases the other increases accept as thinking distance increases speed increases	2
3(c)(i)	control variable		1
3(c)(ii)	experiment done, student listens to music / ipod (etc) experiment (repeated), student not listening to music	 for both marks to be awarded there must be a comparison	1 1
3(d)	increase it	accept an answer which implies reactions are slower do **not** accept answers in terms of thinking distance only	1
3(e)	**Y**		1
Total			**8**

4.5.6.3.1 Stopping distance

Answer 08 · Mark scheme June 2010 | PHY2F | Original Q3 | Legacy

PHY2F

4.5.6.3.1 Stopping distance

Answer 09 · Mark scheme

January 2013 | PH2FP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	gravitational / gravity / weight	do **not** accept gravitational potential	1
8(b)	accelerating	accept speed / velocity increases	1
	the distance between the drops increases		1
	but the time between the drops is the same	accept the time between drops is (always) 5 seconds accept the drops fall at the same rate	1
8(c)(i)	any **one** from: • speed / velocity • (condition of) brakes / road surface / tyres • weather (conditions)	accept specific examples, eg wet / icy roads accept mass / weight of car friction is insufficient reference to any factor affecting thinking distance negates this answer	1

Question 8 continues on the next page . . .

4.5.6.3.1 Stopping distance

PH2FP

Question 8 continued . . .

question	answers	extra information	mark
8(c)(ii)	75 000	allow **1** mark for correct substitution, ie 3000 × 25 provided no subsequent step shown **or** allow **1** mark for an answer 75 **or** allow **2** marks for 75 k(+ incorrect unit), eg 75 kN	2
	joules / J	do **not** accept j an answer 75 kJ gains **3** marks for full marks the unit and numerical answer must be consistent	1
Total			**8**

4.5.6.3.1 Stopping distance

Answer 09 · Mark scheme

January 2013 | PH2FP | Original Q8 | Legacy

PH2FP

4.5.6.3.1 Stopping distance

Answer 10 · Mark scheme

June 2013 | PH2FP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	time force	correct order only	1 1
6(b)	The car tyres being badly worn		1
6(c)(i)	braking distance increases with speed relevant further details, eg • but not in direct proportion • and increases more rapidly after 15 m/s • double the speed, braking distance increases × 4	accept positive correlation do **not** accept stopping distance for braking distance accept any speed between 10 and 20 accept numerical example	1 1
6(c)(ii)	line drawn above existing line starting at the origin	as speed increases braking distance must increase each speed must have a single braking distance	1
6(d)(i)	reaction time / reaction (of driver) does not depend on speed (of car)		1

Question 6 continues on the next page . . .

4.5.6.3.1 Stopping distance

PH2FP

Question 6 continued . . .

question	answers	extra information	mark
6(d)(ii)	(on the reduced speed limit roads) over the same period of time monitor number of accidents before and after (speed limit reduced)	accept a specific time, eg 1 year allow **1** mark only for record number of vehicles / cars using the (20 mph) roads **or** collect data on accidents on the (20 mph) roads to score both marks the answer must refer to the roads with the reduced speed limit	1 1
Total			**9**

4.5.6.3.1 Stopping distance

Answer 10 · Mark scheme

June 2013 | PH2FP | Original Q6 | Legacy

PH2FP

Answer 11 · Mark scheme

June 2014 | PH2FP | Original Q8 | Legacy

8(a)(i)	friction		1	AO1 2.1.3a

8(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

8(a)(iii)	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 5, and apply a 'best-fit' approach to the marking.		**Mark** **6**	**AO spec ref**
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO2 AO3 2.1.4c
No relevant content.	There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points **or** a description of how the velocity changes between any two points.	There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z **or** a complete description of how the velocity changes from X to Z. **or** an explanation and description of velocity change for either X to Y or Y to Z	There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z **and** a description of the change in velocity between X and Z.	

4.5.6.3.1 Stopping distance

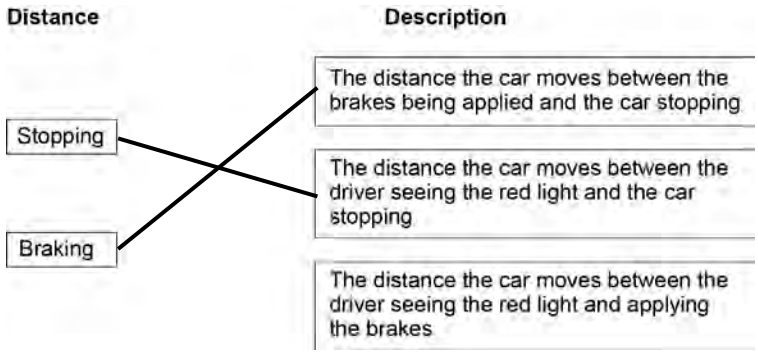
Answer 11 · Mark scheme

examples of the points made in the response	extra information
X to Y • at X force A is greater than force B • cyclist accelerates • and velocity increases • as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity) • resultant force decreases • cyclist continues to accelerate but at a smaller value • so velocity continues to increase but at a lower rate **Y to Z** • from Y to Z force B (air resistance) increases • acceleration decreases • force B becomes equal to force A • resultant force is now zero • acceleration becomes zero • velocity increases until… • cyclist travels at constant / terminal velocity	accept speed for velocity throughout

Question	Answers	Extra information	Mark	AO spec ref
8(b)(i)	3360	allow **1** mark for correct substitution, ie 140 × 24 provided no subsequent step accept 3400 for **2** marks if correct substitution is shown	2	AO1 AO2 2.2.1b
	joule / J	do **not** accept j do **not** accept Nm	1	
8(b)(ii)	decreases	accept an alternative word / description for decrease do not accept slows down	1	AO1 2.1.3e
	temperature	accept thermal energy accept heat	1	
Total			**13**	

4.5.6.3.1 Stopping distance

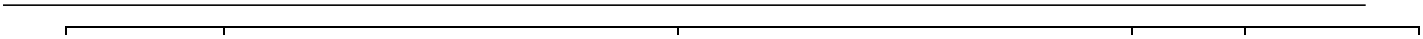
Answer 12 · Mark scheme June 2017 | PH2FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	 If more than one line goes from a 'distance' box, all those lines are incorrect		2	AO1 2.1.3c
2(b)(i)	0.8s		1	AO2 2.1.3c
2(b)(ii)	increases thinking distance so increases (overall) stopping distance	 takes longer to stop more likely to have an accident is insufficient	1 1	AO1 2.1.3c, d
2(b)(iii)	$\frac{1}{2} \times 750 \times 8^2$		1	AO2 2.2.1g
2(b)(iv)	decrease(s) increase(s)	correct order only	1 1	AO1 2.1.3e
Total			**8**	

4.5.6.3.1 Stopping distance

Answer 12 · Mark scheme

June 2017 | PH2FP | Original Q2 | Legacy



4.5.6.3.1 Stopping distance

Answer 13 · Mark scheme

June 2019 | 8463/2F | Original Q10

Question 10

Question	Answers	Mark	AO/ Spec. Ref
10.1	**Level 3**: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1/1 AO2/1 4.5.6.3.2 4.5.6.3.3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • reaction time explained in terms of longer reaction times increase thinking distance (from a given speed) • taking drugs • drinking alcohol • tiredness • age • distractions explained in terms of effect on driver's reaction time • speed explained in terms of the faster the vehicle the greater the distance travelled in the driver's reaction time (or converse) **OR** explained in terms of increased speed increases KE so increases work done to stop the vehicle • condition of the tyres • condition of road surface • wet/icy roads explained in terms of condition of tyres and road surface (including weather considerations) affecting <u>friction</u> (between tyres and road) • condition of brakes explained in terms of effect on braking force (applied to the wheels) or reduced <u>friction</u>		

4.5.6.3.1 Stopping distance

Answer 13 · Mark scheme

June 2019 | 8463/2F | Original Q10

	• mass / weight of vehicle explained in terms of deceleration force or kinetic energy or change in momentum answers do not need to reference thinking / braking distance a Level 1 answer would list factors only **or** one factor with one linked explanation a Level 2 answer lists at least three factors with one linked explanation **or** two factors with two linked but different explanations a Level 3 answer lists at least three factors with at least two linked but different explanations			
10.2	work (done) = force × distance	allow W = F s	1	AO1/1 4.5.2
10.3	900 000 = 60 000 × distance distance = $\frac{900\,000}{60\,000}$ distance = 15 (m)	an answer 15 (m) scores **3** marks	1 1 1	AO2/1 4.5.2
10.4	brakes overheating **or** brakes locking (causing) loss of control **or** (causing) a skid	allow brake fade allow wheels locking allow increasing the stopping / braking distance **ONLY** if the first marking point scored ignore any effects on passengers or possible accidents	1 1	AO1/1 4.5.6.3.4
Total			**12**	

4.5.6.3.1 Stopping distance

Answer 14 · Mark scheme

November 2021 | 8463/2F | Original Q8

Question 8

Question	Answers	Mark	AO/ Spec. Ref
08.1	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO1 4.5.6.3.3 4.5.6.3.4 4.1.1.2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content Factors • poor condition of tyres • poor road surface • wet or icy road • poor/worn brakes Explanation • because of decreased friction Factors • increased mass of car/passengers Explanation • increases kinetic energy of car • more work needs to be done to stop car • increases momentum of the car Factor • road slopes downhill Explanation • (a component of) gravity opposes the braking force • resultant (braking) force is reduced allow answers in terms of reducing braking distance throughout A single factor with no related explanation is insufficient to score a mark		

4.5.6.3.1 Stopping distance

Answer 14 · Mark scheme

08.2	resultant force = mass × acceleration		1	AO1 4.5.6.2.2
08.3	7200 = 1600 × *a* $a = \frac{7200}{1600}$ *a* = 4.5 (m/s^2)	ignore negatives throughout	1 1 1	AO2 4.5.6.2.2
08.4	15 (m) 38 (m) = 53 (m)	two correct values identified allow the correct addition of a misread braking distance and /or a misread thinking distance taken from the graph	1 1	AO3 4.5.6.3.1
08.5	$p = \frac{F}{A}$		1	AO1 4.5.5.1.1
08.6	120 000 = $\frac{60}{A}$ $A = \frac{60}{120\,000}$ *A* = 0.0005 *A* = 5 (.0) × 10^{-4} m^2	 allow an answer given to 2 sig figs from an incorrect calculation using the given data	1 1 1 1 1	AO2 AO2 AO2 AO2 AO1 4.5.5.1.1
Total			**16**	

4.5.6.3.1 Stopping distance

Answer 15 · Mark scheme

June 2023 | 8463/2F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	kinetic thermal	this order only	1 1	AO1 4.5.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(minimum braking) distance increases with increasing speed	allow positive correlation	1	AO2 4.5.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	increases		1	AO1 4.5.6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	12.5 – 5.0 = 7.5 (m/s) $t = \frac{7.5}{0.25}$ t = 30 (s)	 this mark may be awarded if the change in velocity is incorrectly calculated allow a correctly calculated answer using a change in velocity incorrectly calculated	1 1 1	AO2 4.5.6.1.5

4.5.6.3.1 Stopping distance

Answer 15 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	*F* = 1600 × 0.25 *F* = 400 (N)		1 1	AO2 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	initial height of the ruler above the person's hand		1	AO3 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	there will be more variation in distances	allow reaction times for distances allow the three students tested are not typical	1	AO3 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	carry out the experiment listening to music then not listening to music (and compare the results)	 allow compare with original results	1 1	AO3 4.5.6.3.2

Total Question 2	13

4.5.6.3.1 Stopping distance

Answer 16 · Mark scheme

June 2025 | 8463/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	car **X** has a smaller maximum acceleration		1	AO3 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$F = 900 \times 2.5$ 2250 (N)	 allow 2300 (N)	1 1	AO2 4.5.6.2.2

Question	Answers	Mark	AO / Spec. Ref.
04.3	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO3
	No relevant content	0	4.5.1.4 4.5.6.1.5 4.5.6.2.1 4.5.6.2.2
	Indicative content • driving force increases • driving force has a maximum value • driving force is greater than air resistance • there is a resultant forward force • air resistance increases (as speed increases) • resultant force decreases • air resistance becomes equal to the driving force (at maximum speed) • resultant force is zero For **Level 2** answers must include how both driving force and air resistance change.		

4.5.6.3.1 Stopping distance

Answer 16 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	time		1	AO1 4.5.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	force		1	AO1 4.5.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(thinking distance =) 20 **and** (braking distance =) 60	subsequent marks may be awarded if incorrect reading(s) are taken from the graph	1	AO2 4.5.6.3.1
	stopping distance = 20 + 60		1	
	80 (m)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	the driver becoming tired		1	AO1 4.5.6.3.2 4.5.6.3.3
	driving on a wet road		1	

Total Question 4	**14**

4.5.6.3.1 Stopping distance

Version 1.0: *27092005*

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2005 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 candidates' 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 candidates' 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 candidates' 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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4.5.6.3.1 Stopping distance

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3451/F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.5.6.3.1 Stopping distance

3451/F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	X-rays do not go through lead	references to gamma rays are incorrect accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect	1
	Quality of written communication	award for a sensible sequence of **two** points	1
total			8

4.5.6.3.1 Stopping distance

3451/F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

3451/F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.5.6.3.1 Stopping distance

3451/F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.5.6.3.1 Stopping distance

3451/F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest half-life	accept the others have longer half-lives	1
total			7

4.5.6.3.1 Stopping distance

3451/F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.5.6.3.1 Stopping distance

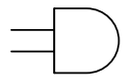
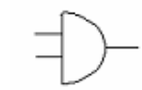
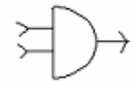
3451/F Q9

question	answers	extra information	mark
(a)	capacitor	accept condenser	1
	LDR	**or** light dependent resistor accept 'ldr', 'Ldr' etc.	1
	relay (normally open)	do **not** accept 'relay normally closed'	1
(b)(i)	battery	accept '(battery of) cells' do **not** accept 'battery / cell'	1
(ii)	LED	**or** light emitting diode accept 'led' or 'Led' do **not** accept just 'diode'	1
(iii)	B will light (but C will not)	accept '(only) B will work' accept 'one is on the other is off' do **not** accept 'C is on and B is off'	1
(iv)	any **one** from: B is connected the right way round (and C is not) a (light emitting) diode only allows (a significant) current to flow in one direction B's anode is connected to the positive side of the supply B's cathode is connected to the negative terminal	N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction if (iv) is completely consistent with (iii) which is wrong, allow **1** mark	1
(c)(i)	first input / second input / output 0 / 0 / **0** 1 / 0 / **0** 0 / 1 / **0** 1 / 1 / **1**	**all** correct allow: OFF NO OFF NO OFF NO ON YES	1
(ii)	truth (table)		1

cont…

4.5.6.3.1 Stopping distance

3451/F Q9 cont…

(iii)		a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction allow  	1
(d)	light sensor	**or** light dependent resistor **or** LDR accept 'ldr', Ldr' etc allow solar cell, photo cell	1
	NOT gate	accept 'Not gate' **or** 'not gate' if both correct but in the wrong order credit with **1** mark	1
total			12

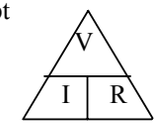
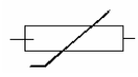
4.5.6.3.1 Stopping distance

3451/F Q10

question	answers	extra information	mark
(a)(i)	rays continued to meet on the right hand side of the lens and beyond	must be straight lines from the right hand side of the lens ignore details through the lens allow if no arrows	1
	meet exactly on the axis	negate mark if contradictory arrow(s) added do not need to go beyond the focus for this mark	1
(ii)	(principal) focus	**or** focal (point)	1
(iii)	converging	**or** convex	1
(b)(i)	**A**		1
(ii)	rays seem to come from this point	**or** words to this effect **or** shows this on the diagram	1
(iii)	diverging	**or** concave	1
(c)	film	accept any unambiguous method of showing the correct response	1
	smaller than		1
	further away from		1
(d)	any **three** from: • real image can be put on a screen • virtual image cannot be put on a screen / film • virtual image is imaginary • real image is formed where (real) rays cross / converge • virtual image is where virtual / imaginary rays (seem to) come from • virtual image formed where virtual rays intersect / cross	allow film allow real image has light travelling through it **or** virtual image is where rays seem to come from	3
total			13

4.5.6.3.1 Stopping distance

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.5.6.3.1 Stopping distance

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q12

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.5.6.3.1 Stopping distance

3451/F Q13

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.5.6.3.1 Stopping distance

3451/F Q14

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.5.6.3.1 Stopping distance

3451/F Q14 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.5.6.3.1 Stopping distance

3451/F Q15

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do **not** accept just 'centripetal'	1
total			10

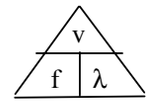
4.5.6.3.1 Stopping distance

3451/F Q16

question	answers	extra information	mark
(a)(i)	**X** at the centre of the lifebelt	measuring from the centre of **X**, allow 2 mm tolerance in any direction	1
(ii)	any **two** from: below the point of suspension at the centre (of the lifebelt) (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only accept '(vertically) below **Y**' accept 'in the middle' **or** (because) the mass / weight is evenly distributed	2
(b)	Nm **or** newton metre(s) 750	accept Newton metre(s) do **not** accept any ambiguity in the symbol ie NM, nM or nm (moment) = force × (perpendicular) distance (between line of action and pivot) **or** (moment) = 500 × 1.5 gains **1** mark	1 2
(c)	**Quality of written communication**: any **three** connected points from: low(er) <u>centre of mass / gravity</u> (more) <u>stable</u> less likely to fall over the <u>turning effect / moment</u> (of the weight of case) is less so the pull on her arm is less	for **2** of the underlined terms used in the correct context **or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground **or** less <u>unstable</u> accept 'less likely to overturn' do **not** accept 'will not fall over' **or** so less effort is needed to hold the case ignore references to pulling the case	1 3
total			10

4.5.6.3.1 Stopping distance

3451/F Q17

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

4.5.6.3.1 Stopping distance

Version 1.0: *27092005*

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B (Co-ordinated)

Mark Scheme

2005 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 candidates' 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 candidates' 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 candidates' 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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4.5.6.3.1 Stopping distance

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3462/ 3F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.5.6.3.1 Stopping distance

3462/3F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	**Quality of written communication**	award for a sensible sequence of **two** points	1
	X-rays do not go through lead	accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect references to gamma rays are incorrect	1
total			8

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

4.5.6.3.1 Stopping distance

3462/3F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.5.6.3.1 Stopping distance

3462/3F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest <u>half-life</u>	accept the others have longer <u>half-lives</u>	1
total			7

4.5.6.3.1 Stopping distance

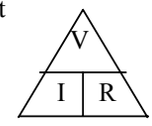
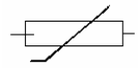
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.5.6.3.1 Stopping distance

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	<u>thermistor</u> or 	accept correct circuit symbol allow phonetic spelling	1
	<u>resistance</u> goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q10

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.5.6.3.1 Stopping distance

3462/3F Q11

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or lowest cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q12

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.5.6.3.1 Stopping distance

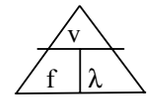
3462/3F Q12 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q13

question	answers	extra information	mark
(a)	**Quality of written communication**	all emboldened terms in candidate's answer used correctly	1
	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark	2
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

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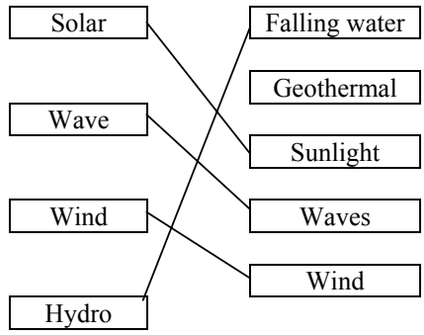
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4.5.6.3.1 Stopping distance

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.5.6.3.1 Stopping distance

3451/F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.5.6.3.1 Stopping distance

3451/F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.5.6.3.1 Stopping distance

3451/F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.5.6.3.1 Stopping distance

3451/F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3451/F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.5.6.3.1 Stopping distance

3451/F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3451/F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.5.6.3.1 Stopping distance

3451/F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.5.6.3.1 Stopping distance

3451/F Q10

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)
LDR(s)
switch(es)
LED(s)
buzzer(s)
motor(s)</td><td>1 mark each
or light dependent resistor(s)
or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge

increases</td><td>accept ‘electrons’
accept ‘energy
or gets bigger/larger</td><td>1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

4.5.6.3.1 Stopping distance

3451/F Q11

question	answers	extra information	mark
(a)(i)	A		1
(ii)	B		1
(iii)	mass is larger	credit if the response is clear by some other means e.g. it is ringed	1
	wire is shorter	credit if the response is clear by some other means e.g. it is ringed	1
(b)	moment		1
	distance		1
(c)(i)	1		1
(ii)	5		1
(iii)	any **two** from • remove slotted mass(es) • slide (slotted) masses / weights nearer pivot • slide forcemeter away from the pivot • slide rod to the left	 **or** ….. to the left **or** ….. to the right **or** …. so that the slotted masses side is shorter **or** …. so that the forcemeter side is longer	2
(d)	centre of the rectangle	accept *2*mm tolerance any direction	1
	centre of the circle	accept *2*mm tolerance any direction	1
	on centre line and 10mm above base	accept *2*mm tolerance any direction	1
total			13

4.5.6.3.1 Stopping distance

3451/F Q12

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.5.6.3.1 Stopping distance

3451/F Q12

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp		1
		accept for **1** mark only the filament lamp does not obey Ohm's law	
total			9

4.5.6.3.1 Stopping distance

3451/F Q13

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

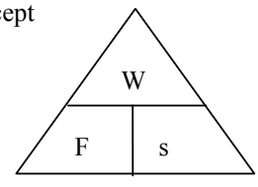
4.5.6.3.1 Stopping distance

3451/F Q14

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.5.6.3.1 Stopping distance

3451/F Q15

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u>	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it <u>increases</u>	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1

Continued

4.5.6.3.1 Stopping distance

3451/F Q15

question	answers	extra information	mark
(ii) **E**	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.5.6.3.1 Stopping distance

3451/F Q16

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

4.5.6.3.1 Stopping distance

3451/F Q17

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do **not** have to be continued beyond F	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(b)	rays seem to come from a focus at G on the left and continued to the right of the lens	this mark is for the current idea of divergence	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(c)	…lens… …image… …object… …image… ...object… …lens…	lens as 1st and 6th words (1) image and object in the correct order 2nd and 3rd words (1) image and object in correct order 4th and 5th words (1)	max 3
(d)(i)	correct statement about real image real rays intersect / cross to form a real image **or** a real image can be formed on a screen **or** real image is (always) on the opposite side (of the lens) **or** real image is (always) upside down (to the object)	may be credited from a correct diagram	1
	correct statement about virtual / imaginary image virtual / imaginary rays intersect / cross to form a virtual image **or** a virtual / imaginary image cannot **or** virtual / imaginary image is (always) on the same side (of the lens) **or** virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

4.5.6.3.1 Stopping distance

3451/F Q17

question	answers	extra information	mark
(ii)	**either** image needs to fall on / affect the film **or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone) **or** image needs to cause a chemical reaction (in / on the film)		1
total			10

4.5.6.3.1 Stopping distance

3451/F Q18

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)

OR (gate)

NOT (gate)

LED or light emitting diode</td><td>accept ‘and’

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’

any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct

allow off or no
off no
on yes
off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch

either
small current from the electronic / control circuit / system (1)

large current through the output / (electric) fire (1)

or

full current through electronic control system (1)

may damage components / lead to overheating / electric shock (1)

QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’

or ‘small current through the coil (of the relay)’

do not accept small current is turned into a large current

annotate Q✓ Q×

if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1

1

1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B

Mark Scheme

2006 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 candidates' 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 candidates' 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.

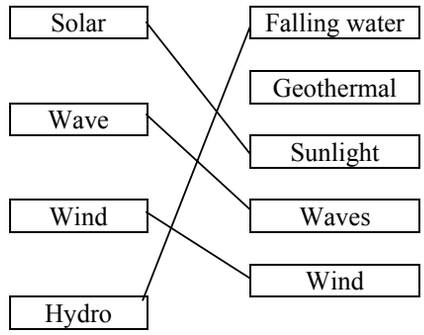
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

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4.5.6.3.1 Stopping distance

Double Award (Co-ordinated)
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.5.6.3.1 Stopping distance

3462/3F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW <u>and</u> time in hours or seconds	2
total			5

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.5.6.3.1 Stopping distance

3462/3F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3462/3F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.5.6.3.1 Stopping distance

3462/3F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3462/3F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.5.6.3.1 Stopping distance

3462/3F Q10

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q10

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp	accept for **1** mark only the filament lamp does not obey Ohm's law	1
total			9

4.5.6.3.1 Stopping distance

3462/3F Q11

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.5.6.3.1 Stopping distance

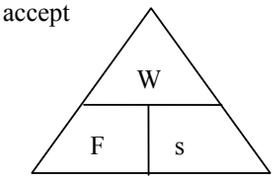
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q12

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.5.6.3.1 Stopping distance

3462/3F Q13

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.5.6.3.1 Stopping distance

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q14

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

4.5.6.3.1 Stopping distance

Answer 13 · Examiner comments

June 2019 | 8463/2F | Original Q10

Question 10 (Standard demand)

10.1 Although there was no need to do this, most students divided their answer into a consideration of thinking distance and a consideration of braking distance. Factors often given were to do with alcohol or drugs but rarely were they related to the effect on reaction time. A common error was to describe reaction time as being reduced and that leading to an increase in the thinking / stopping distance. Condition of the roads / tyres was common as was icy / wet roads. However these factors were rarely linked to a reduction in friction. A description in terms of less grip or traction was not acceptable. Weaker answers tended to describe what is meant by thinking distance and stopping distance without stating what changes either of these two distances.

10.2 This equation was well known, with 70% of students scoring the mark.

10.3 Just over 83% of the students scored all three marks.

10.4 There were few answers in terms of brakes overheating and the driver losing control of the car. Answers which did not score generally referred to the danger to passengers of whiplash, of hitting the windscreen or of cars behind crashing into the back of the car.

4.5.6.3.1 Stopping distance

Answer 13 · Examiner comments

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.6.3.1 Stopping distance

Answer 15 · Examiner comments — June 2023 | 8463/2F | Original Q2

02.1

22 % of students scored 1 mark and 61 % of students scored both marks for identifying the energies

02.2

The majority of the students identified the correct relationship between the speed and the braking distance. Those that didn't described the graph rather than mentioning braking distance or speed, or used incorrect phrases eg 'directly proportional'.

02.3

84% of students knew that braking distance increases when a road becomes icy.

02.4

This 3-mark question required students to calculate the change in velocity then use this correctly to determine the time taken. Many students failed to show how they calculated the change in velocity and could not be awarded any marks.

Answer 15 · Examiner comments — June 2023 | 8463/2F | Original Q2

02.5

86 % scored 2 marks for calculating the resultant force. Common mistakes involved dividing instead of multiplying, or calculating 1600 x 0.25^2, the squared apparently being inferred from the unit of deceleration (m/s^2).

02.6

77% of students were able to identify the control variable for the investigation.

02.7

Many students correctly stated that there would be a greater number of results, which could lead to a change in the mean. But some simply stated that different people have different reaction times. Credit was also given for those that stated the reaction times of 3 children tested may not be representative of the whole class. However, some only answered by saying 'only 3 children were tested' which was insufficient to get the mark.

02.8

30 % scored 1 mark and only 33 % scored 2 marks. Rather than describing a change to the experiment students would state how they thought music would affect the reaction time, or why music would affect the reaction time.
Many who got 1 mark suggested they did the experiment with music on but did not say to compare with previous results or do it with music off.

4.5.6.3.1 Stopping distance

Questions matter

GCSE

Physics

8463/2F

Report on the examination

Version: 1.0
June 2025

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4.5.6.3.1 Stopping distance

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Report on the examination – GCSE - Physics – 8463/2H – June 2025

General comments

Students should pay attention to the number of options that need to be ticked when doing multiple choice questions. They should make sure they cross out wrong options when they change their minds, as marks cannot be awarded where there are multiple ticks instead of one.

Many students demonstrated good maths skills, although there are always issues with rearrangements. Formula triangles are not always helpful. Students who had correctly written down an equation in a previous question and then tried to use a formula triangle often scored no marks, because they don't understand how to use them. If they had substituted into the equation from the equations sheet they would have scored the 1st mark.

Students had access to the equations sheet for this examination series. A minority of the students however did not use them to find the appropriate equation.

Levels of demand

Questions are set at two levels of demand on this paper:

- Low demand questions are targeted at students working at grades 1–3.
- Standard demand questions are targeted at students working at grades 4–5.

A student's final grade, however, is based on their attainment across the qualification, not just on questions that may have been targeted at the level at which they are working.

01.1

Over 90 % of the students knew that a protractor is used to measure angles. The phonetic spelling of protractor was allowed.

01.2

Almost 70% of the students scored all four marks for completing the graph. Despite a clear instruction a significant number did not label the y-axis. A number of the students did not use a ruler to draw the line of best fit.

01.3

Most of the students correctly identified the relationship between the angle of incidence and the angle of reflection.

01.4

Half of the students knew which measurement was the amplitude of a wave. Most of the others thought the vertical distance between a peak and a trough was the amplitude.

01.5

About 80 % of the students knew which line showed the wavelength of the wave. The most common incorrect answer was the distance showing half the wavelength.

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4.5.6.3.1 Stopping distance

Report on the examination – GCSE - Physics – 8463/2H – June 2025

01.6

Over 90 % of the students correctly calculated the wavelength. Those who did not achieve full marks mainly did so by not choosing the correct unit for wavelength, with Pa being a popular incorrect choice.

01.7

This was well answered, with most of the students scoring both marks. A few inverted the equation and thus calculated the period incorrectly.

02.1

Most of the students correctly calculated the weight of coal.

02.2

Just over 90% of the students were able to use the work done equation correctly. Those that did not get full marks tended to put an additional step into the calculation by dividing the answer 68 000 000 by 4; the number of engines in total.
Occasionally a student would attempt to convert the number calculated into standard form. Whilst not being penalised, this was not required.

02.3

Well answered by most students. As with part 02.2, occasionally a student would attempt to convert the number calculated into standard form.

02.4

Nearly 90% of the students could identify that friction was a contact force.

02.5

Most of the students identified the correct distance-time graph for constant speed.

02.6

This was the 1st calculation that was more challenging for many students. A common error was to use only one of the quoted velocities to calculate the acceleration rather than using the difference between the velocities. However just over 80 % did score full marks, with 10 % scoring zero or not attempting the question.

03.1

Approximately 60% of the students scored both marks. Often students did not know the correct word for a natural satellite. However, many correctly identified ‘star’ for the second word.

03.2

Most of the students knew that we are part of the Milky Way galaxy.

03.3

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4.5.6.3.1 Stopping distance

Only about 40 % of the students knew that the Sun will eventually become a black dwarf. The most popular wrong answer was that it would become a black hole.

03.4

Just fewer than 40 % of the students knew that a very distant galaxy moves faster than a nearer galaxy.

03.5

About 70 % of the students knew that an increase in the wavelength of light from a distant galaxy is called red-shift.

03.6

About 60 % of the students selected the correct word to describe the beginning of the universe.

03.7

Almost 80 % of the students knew that the universe is expanding.

04.1

Just over 70 % of the students were able to make the connection between the mass of a vehicle and how it would affect the maximum acceleration.

04.2

Over 90 % of the students scored full marks for calculating the resultant force using F = ma. However, some of the students thought that the value of acceleration needed to be squared and then multiplied by mass.

04.3

This level of response question proved too challenging for many. Only just over 1 % of the students scored full marks. Most identified that the driving force would increase, but fewer recognised that as this happened the air resistance would also increase, with many stating that the air resistance would decrease as the cars speed increased.

04.4

Most of the students knew that the thinking distance is affected by the driver's reaction time.

04.5

Just fewer than 70 % of the students were aware that the braking distance is the distance travelled under the braking force.

04.6

Only just over 20 % of the students scored full marks for using the graph of distance against speed to find the stopping distance. The correct distances were often identified from the graph. However, these were then either subtracted from each other, divided or multiplied rather than added.

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4.5.6.3.1 Stopping distance

Report on the examination – GCSE - Physics – 8463/2H – June 2025

04.7

Nearly 80 % of the students identified factors that would increase the stopping distance of a car. Despite two being emboldened twice in the question, some students only ticked one box.

05.1

The principal focus was correctly identified by just over 60 % of the students.

05.2

About 80 % of the students knew that the change in direction of light as it enters a lens is called refraction.

05.3

Nearly 70 % the students recognised the shape of a convex lens.

05.4

Under a half of the students managed to correctly measure the object height and image height. This may have been due to a lack of skill or a lack of equipment.

05.5

This was much more successfully answered than part 05.4 with nearly 90 % of the students scoring both marks. These students used their values from part 05.4 to calculate magnification.

05.6

Just fewer than 50 % of the students knew that magnification is a ratio, but almost the same number thought it is a power.

05.7

This was a challenging question. Most of the students that did score a mark were awarded only the first mark point. This was for explaining that white light is transmitted through colourless glass. A lot of the students think of white light as an entity in itself rather than the result of the colours of the visible light combined. Few used the word transmitted but rather described it as passing through or goes through.
For the 2nd and 3rd mark points many of the students decided that white light was reflected or refracted, reinforcing the misconception that white light is a single entity rather than being made up of a combination of wavelengths. The idea that filters would absorb different wavelengths of light seemed to be difficult for the students to express, with very few achieving the third mark.

06.1

Only just over 30 % of the students could identify two magnetic materials from the list, with about 60 % being able to identify one. Again, a number of students ticked just one box or more than two boxes.

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4.5.6.3.1 Stopping distance

Report on the examination – GCSE - Physics – 8463/2H – June 2025

06.2

Just over 70 % of the students correctly named the iron nails as induced magnets.

06.3

Just fewer than 40 % of the students knew the direction of the magnetic field.

06.4

Nearly 80 % of the students recognised the shape of the magnetic field around a current carrying wire.

06.5

Very few of the students could give two changes that would increase the magnetic field strength. 'Increasing the current' was a common correct response. Many of the students answered 'increasing the number of coils' as such they were implying the wire was already coiled and not answering the question asked, which was about the straight wire shown in Figure 10.

07.1

Nearly 60 % of the students understood what is meant by the moment of a force. The most common incorrect option was 'The direction of the force.'

07.2

The correct resultant moment was selected by just over 80 % of the students.

07.3

Students generally answered this well, identifying position 7 and on which side of the balance the tag should be placed. Some indicated this on the diagram which was an accepted alternative response, provided what was written did not contradict it.

07.4

Some students wrote the equation for the moment of a force in words and then in symbols. This risks not gaining the mark if either is incorrect. Also, correct use of symbols should be stressed, especially when they are given in the question. It was surprising that some of the students scored zero or did not attempt to write down an equation despite having the equations sheet.

07.5

Almost three quarters of the students were able to rearrange the equation and then calculate the distance between the pivot and the tag on the balance.

08.1

Most of the students found this level of response question difficult to answer. Only just over 1 % gave a level 2 answer. Many of the students scored 2, 1 or 0 marks. Of those that scored a mark the most common response was light travels faster than sound. Many also tried to describe light and sound as transverse and longitudinal waves, with the majority getting this

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confused. Very few identified acceptable similarities. Common answers that did not gain credit included light travels at the speed of light, sound travels at the speed of sound, light can be seen and sound cannot be seen.

08.2

Just fewer than 80 % of the students choose the correct equation for calculating speed.

08.3

This question required students to rearrange the equation. About three quarters of the students scored all three marks.

09.1

About 65 % of the students correctly stated the independent variable in this investigation.

09.2

Just over 40 % of the students scored both marks for identifying a risk of harm and a suitable safety precaution to reduce the risk. Too few students connected a hazard, such as a falling weight, becoming a risk of harm when it hit or hurt the student.

09.3

Students were expected to clearly describe two improvements to the arrangement shown that would improve the accuracy of the results. Many had difficulty describing their ideas clearly and answers were often too vague to gain credit.

09.4

Almost 40 % of the students scored this mark usually by explaining that the spring length was not 0 cm rather than describing the relationship between spring length and force.

09.5

This was not successfully answered, with only about 2 % of the students scoring both marks and a further 13 % scoring one mark. The 1st mark point was for stating or giving a clear description of inelastic deformation. Of those who were awarded marks most of them described how the spring had reached or passed its limit of proportionality.

09.6

Over 90 % of the students selected the correct equation.

09.7

Nearly 80 % of the students scored all three marks. Those that did not often rearranged the equation incorrectly.

10.1

Only about 5% of the students correctly calculated the uncertainty correctly from either the range or the mean.

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4.5.6.3.1 Stopping distance

10.2

Just over 40 % of the students identified that a random error had caused the variation in this investigation. A greater proportion of the students thought there was a systematic error but this would not have accounted for the variation in the results.

10.3

This mark was awarded for a clear description of variation in the way the ball was dropped. For example, through different heights, at different speeds, or a different delay each time. Common answers giving reaction time or human error were too vague, to be awarded marks unless qualified.

10.4

Just fewer than 30 % of the students scored all three marks. Many of the students took only one value from the graph rather than a corresponding pair of values and so scored 0. Those that used a pair of correct values often then used them the wrong way round when calculating the gradient.

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4.5.6.3.1 Stopping distance

Report on the examination – GCSE - Physics – 8463/2H – June 2025

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