AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.1.2

Mass number, atomic number and isotopes

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**52**
Available paper years	**2003–2025**

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.

4.4.1.2 Mass number, atomic number and isotopes

Answer 01 · Mark scheme June 2003 | 3451H | Original Q14 | Legacy

The full source mark scheme begins on page 57. Follow original question 14 in that document.

Answer 02 · Mark scheme June 2003 | 3462H3 | Original Q12 | Legacy

The full source mark scheme begins on page 79. Follow original question 12 in that document.

Answer 03 · Mark scheme June 2005 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 96. Follow original question 15 in that document.

Answer 04 · Mark scheme June 2005 | 3462 | Original Q11 | Legacy

The full source mark scheme begins on page 114. Follow original question 11 in that document.

Answer 05 · Mark scheme November 2006 | PHY1B | Original Q5 | Legacy

Five	**A**	a distant galaxy	**3**
	B	a satellite	**1**
	C	the Earth	**2**
	D	the Universe	**4**

4.4.1.2 Mass number, atomic number and isotopes

Answer 06 · Mark scheme

January 2007 | PHY1H | Original Q4 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 07 · Mark scheme

March 2007 | PHY1B | Original Q6 | Legacy

Six	**A**	conclusion	**3**
	B	confidentiality	**4**
	C	control	**1**
	D	evidence	**2**

	A	**B**	**C**	**D**

Answer 08 · Mark scheme

June 2007 | PHY1B | Original Q8 | Legacy

Eight	**3**	**4**	**4**	**4**

4.4.1.2 Mass number, atomic number and isotopes

Question 1 continued

	answers	extra information	mark
(c)(i)	idea of testing food on humans / animals		1
	no (measured) ill effects **or** monitor their health	accept monitor people that have eaten the food accept a measurement / comparison for **1** mark eg measure the amount of radiation in treated food comparison plus a reason for the comparison would get **2** marks eg idea of measuring level of radiation in treated food **with** no measurable increase in level = **2** marks **or** comparing it to untreated food = **2** marks	1
(ii)	so can make own decision about eating or not eating treated food	accept may be against their religious / moral views accept some people prefer food that hasn't been tampered with ignore in case they don't like the idea of eating treated food accept don't want to eat treated food ignore might be allergic to the food eg think it will give them cancer = **0** marks think it will give you cancer so I need to know so that I can choose = **1** mark	1
total			8

4.4.1.2 Mass number, atomic number and isotopes

PHY1H Question 2

	answers	extra information	mark
(a)	the outside colour of the cans		1
(b)(i)	18 (°C) **or** 88 to 70	ignore negative sign	1
(ii)	8 (°C) **or** 70 to 62	ignore negative sign	1
(c)	greater temperature difference between water and surroundings (at start)	must mention temperature difference ignore just water hotter accept energy used to heat cans initially	1
(d)	black temperature falls the fastest (in L) black is a good / the best / better emitter (of heat / radiation)	 accept (can L) loses more heat / cools quicker accept heat for temperature accept converse ignore black is best absorber	1 1 1
total			7

4.4.1.2 Mass number, atomic number and isotopes

PHY1H Question 3

	answers	extra information	mark
(a)(i)	national grid		1
(ii)	increases voltage / potential difference	accept decrease current accept step-up / boosts the voltage do **not** accept increases energy / power / current ignore reference to voltage going through	1
(iii)	any **two** from: • reduce current • reduces energy loss / power loss (from cables) • increases efficiency (of distribution)	 ignore increased voltage / pd accept reduces heat loss do **not** accept stops energy loss	2
(b)	any **one** from: • produces pollutant gases • produces solid waste / ash / smoke	 accept produces carbon dioxide / sulfur dioxide / nitrogen oxides accept global warming / greenhouse effect / carbon emissions / air pollution / acid rain ignore ozone layer do **not** accept carbon monoxide accept global dimming ignore produces pollution	1

Continued on next page

4.4.1.2 Mass number, atomic number and isotopes

Answer 10 · Mark scheme November 2007 | PHY1B | Original Q5 | Legacy

Five	**4**	**2**	**1**	**1**

Answer 11 · Mark scheme November 2007 | PHY1B | Original Q6 | Legacy

Six	**4**	**4**	**1**	**4**

Answer 12 · Mark scheme November 2007 | PHY1B | Original Q8 | Legacy

Eight	**1**	**4**	**3**	**2**

4.4.1.2 Mass number, atomic number and isotopes

Question 4

question	answers	extra information	mark
(a)(i)	beta and gamma	both answers required accept correct symbols	1
(ii)	alpha and beta	both answers required accept correct symbols	1
(iii)	gamma	accept correct symbol	1
(b)	nothing *(*you do to a radioactive substance / source*)* changes the count rate / activity / rate of decay / radiation (emitted) **or** *(*reducing*)* the temperature does not change the activity / count rate / rate of decay / radiation (emitted)	accept it = radiation emitted	1
(c)(i)	has <u>one</u> more neutron	correct answer only	1
(ii)	14 days	no tolerance allow **1** mark for showing a correct method on the graph	2

Question 4 continues on the next page

PHY1H

Question 4 continued

question	answers	extra information	mark
(iii)	any **two** from: • beta particles / radiation can be detected externally • beta particles / radiation can pass out of / through the plant • long half-life gives time for phosphorus to move through the plant / be detected / get results • phosphorus-32 is chemically identical to phosphorus-31 • phosphorus-32 is used in the same way by a plant as phosphorus-31		2
total			9

4.4.1.2 Mass number, atomic number and isotopes

Answer 13 · Mark scheme

January 2008 | PHY1H | Original Q4 | Legacy

PHY1H

4.4.1.2 Mass number, atomic number and isotopes

Answer 14 · Mark scheme January 2008 | PHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)(i)	(nuclear) fission	accept fision providing clearly **not** fusion	1
(ii)	(released) neutrons are absorbed by further (uranium) nuclei more neutrons are released (when new nuclei split)	accept hit nuclei for absorbed / hit do **not** accept atom for nuclei accept for **both** marks a correctly drawn diagram	1 1
(iii)	increases by 1 **or** goes up to 236		1
(b)	any **two** from: • (more) neutrons are absorbed • (chain) reaction slows down / stops • less energy released	 accept there are fewer neutrons accept keeping the (chain) reaction controlled accept heat for energy accept gases (from reactor) are not as hot	2
total			6

4.4.1.2 Mass number, atomic number and isotopes

Answer 14 · Mark scheme January 2008 | PHY2H | Original Q4 | Legacy

PHY2H

Answer 15 · Mark scheme March 2008 | PHY1BP | Original Q8 | Legacy

Eight	**2**	**2**	**3**	**2**

Answer 16 · Mark scheme June 2008 | PHY1BP | Original Q4 | Legacy

Four	**4**	**3**	**4**	**3**

4.4.1.2 Mass number, atomic number and isotopes

Answer 17 · Mark scheme June 2008 | PHY2H | Original Q2 | Legacy

Question 2

	answers	extra information	mark
(a)(i)	protons neutrons	answers may be in either order	1 1
(ii)	86		1
(iii)	two **fewer** protons and two **fewer** neutrons **or** 84 protons 134 neutrons	do **not** accept two fewer protons and neutrons do **not** accept 218 protons and neutrons	1
(b)(i)	0.4	accept $\frac{2}{5}$ / accept 40 % for 2 marks allow **1** mark for correct totalling = 1.8 allow **1** mark for a clearly correct method with a clearly incorrect total	2
(ii)	any **one** from: • nuclear weapon testing • nuclear power (stations) • nuclear accidents • medical	do **not** accept nuclear accept nuclear/ radioactive waste accept X-rays	1
(c)(i)	2	accept 2:1 accept twice as big ignore units	1

Question 2 continues on the next page

4.4.1.2 Mass number, atomic number and isotopes

PHY2H

Question 2 continued

	answers	extra information	mark
(ii)	No with a reasonable reason explained only going for two weeks so **or** even staying for a year		1
	total exposure well under lowest limit for causing cancer **or**	**1** mark is for a time frame **1** mark is for correctly relating to a dose	1
	Yes with a reasonable reason explained all levels of radiation are (potentially) hazardous (1) harm caused by lower doses may not have been recorded (1) **or** evidence may not be complete **or** insufficient research into effect of small doses	accept low doses could still cause cancer accept all levels affect you do **not** accept radiation dose is high(er) do **not** accept level of background radiation is higher in Germany	
total			10

4.4.1.2 Mass number, atomic number and isotopes

Answer 17 · Mark scheme June 2008 | PHY2H | Original Q2 | Legacy

PHY2H

Answer 18 · Mark scheme November 2008 | PHY1BP | Original Q2 | Legacy

Two	**A** 4.5	**2**	
	B 8	**3**	
	C 24	**4**	
	D 400	**1**	

	A	**B**	**C**	**D**

Answer 19 · Mark scheme November 2008 | PHY1BP | Original Q7 | Legacy

Seven	**1**	**3**	**3**	**1**

4.4.1.2 Mass number, atomic number and isotopes

Answer 20 · Mark scheme January 2009 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	(atoms / elements with) the same number of protons but different numbers of neutrons	accept (atoms / elements with) different mass number but same atomic number	1
4(a)(ii)	substances that give out radiation	accept alpha, beta or gamma for radiation accept an unstable nucleus that decays radioactive decay takes place is insufficient	1
4(b)	85 years	± 2 years allow **1** mark for showing correct method on the graph	2
4(c)(i)	a helium nucleus	accept 2 neutrons and 2 protons accept $_2{}^4He$ do **not** accept helium atom	1
4(c)(ii)	the rate of decay (of plutonium) decreases less heat produced	accept fewer (plutonium) nuclei (to decay) accept radioactivity decreases do **not** accept energy for heat	1 1

Question 4 continues on the next page

PHY1H

Question 4 continued

question	answers	extra information	mark
4(d)(i)	(outside the body) alpha (particles) cannot penetrate into the body (inside the body) (heat produced from decay) damages / kills cells / tissues	 accept causes cancer for damages / kills cells / tissues accept **highly** toxic	 1 1
4(d)(ii)	any **one** from: • worried same could happen again • an accident may cause radiation to be spread around the Earth / atmosphere • idea of soil contamination resulting from accident / release of radioactive material • idea of negative effect on health resulting from accident / release of radioactive material	 accept any sensible suggestion	1
Total			**10**

4.4.1.2 Mass number, atomic number and isotopes

Answer 20 · Mark scheme

January 2009 | PHY1H | Original Q4 | Legacy

PHY1H

4.4.1.2 Mass number, atomic number and isotopes

Answer 21 · Mark scheme

January 2009 | PHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	146		1
6(b)	atomic number		1
6(c)(i)	alpha		1
6(c)(ii)	number of protons changes	accept atomic number changes accept loses or gains protons do **not** accept protons with any other particle e.g. number of protons and neutrons changes incorrect do **not** accept any reference to mass number	1
Total			**4**

4.4.1.2 Mass number, atomic number and isotopes

Answer 21 · Mark scheme January 2009 | PHY2H | Original Q6 | Legacy

PHY2H

Answer 22 · Mark scheme March 2009 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	3	**4**
	B	10	**1**
	C	12	**2**
	D	60	**3**

Answer 23 · Mark scheme March 2009 | PHY1BP | Original Q6 | Legacy

Six	**3**	**4**	**4**	**3**

Answer 24 · Mark scheme June 2009 | PHY1BP | Original Q5 | Legacy

Five	**2**	**3**	**4**	**3**

4.4.1.2 Mass number, atomic number and isotopes

Answer 25 · Mark scheme June 2009 | PHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	gamma hardly ionises the air	accept does not ionise accept gamma radiation is not charged do **not** accept answers in terms of danger of gamma or other properties	1
6(a)(ii)	half-life (too) short	accept need frequent replacement 'it' refers to curium-242	1
6(a)(iii)	(two) fewer neutrons	accept different numbers of neutrons if a number is specified it must be correct do **not** accept more neutrons unless curium-244 is specified	1
6(b)(i)	gamma	accept correct symbol	1
6(b)(ii)	both absorbed by the metal / steel / weld	only scores if (b)(i) is correct accept cannot pass through the metal / steel / weld	1
6(c)(i)	put source into water at **one** point on bank see if radiation is detected in polluted area	accept the idea of testing different parts of the river bank at different times accept idea of tracing	1 1
6(c)(ii)	2.7 (days)	allow **1** mark for showing correct use of the graph	2
Total			**9**

4.4.1.2 Mass number, atomic number and isotopes

Answer 26 · Mark scheme June 2009 | PHY2H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	Particle / Relative Mass / Relative charge Proton / 1 / Neutron / / 0	accept one, accept +1 do **not** accept -1 accept zero do **not** accept no charge/ nothing/ neutral unless given with 0	1 1
1(b)	equal numbers/amounts of protons and electrons protons and electrons have equal but opposite charge	accept protons charge +1 and electron charge -1 accept (charge on) proton cancels/balances (charge on) electron accept positive (charges) cancel out the negative(charges) neutrons have no charge is neutral do **not** accept total charge of protons, electrons (and neutrons) is 0 unless qualified	1 1

Question 1 continues on the next page . . .

4.4.1.2 Mass number, atomic number and isotopes

PHY2H

Question 1 continued . . .

question	answers	extra information	mark
1(c)(i)	(3) fewer neutrons . . .	accept lower/ smaller mass number do **not** accept different numbers of neutrons any mention of fewer/more protons or electrons negates mark accept answers in terms of U-238 providing U-238 is specifically stated i.e. U-238 has (3) more neutrons	1
1(c)(ii)	neutron		1
1(c)(iii)	(nuclear) fission	accept fision do **not** accept any spelling that may be taken as fusion	1
Total			**7**

4.4.1.2 Mass number, atomic number and isotopes

Answer 26 · Mark scheme June 2009 | PHY2H | Original Q1 | Legacy

PHY2H

Answer 27 · Mark scheme November 2009 | PHY1BP | Original Q4 | Legacy

Four	**2**	**1**	**2**	**3**

4.4.1.2 Mass number, atomic number and isotopes

Answer 28 · Mark scheme January 2010 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	alpha (particle)		1
4(a)(ii)	(unstable) nucleus	accept (unstable) nuclei do **not** accept middle do **not** accept helium nucleus	1
4(a)(iii)	same number of protons	accept same number of electrons accept same atomic / proton number accept they both have 92 protons same number of neutrons negates answer	1
4(b)(i)	4500 million years	do **not** accept 4500 years	1
4(b)(ii)	curve starting at 100 000 with a correct general shape passing through (4500, 50 000) and (9000, 25 000)	 allow **1** mark for points plotted **or** line passing through (4500, 50 000) and (9000, 25 000)	1 1
Total			**6**

4.4.1.2 Mass number, atomic number and isotopes

Answer 28 · Mark scheme

January 2010 | PHY1H | Original Q4 | Legacy

PHY1H

4.4.1.2 Mass number, atomic number and isotopes

Answer 29 · Mark scheme January 2010 | PHY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	**K** and **L**	both answers required either order	1
3(a)(ii)	(1) same number of protons (2) different numbers of neutrons	accept same number of electrons accept same atomic number	1 1
3(b)(i)	90		1
3(b)(ii)	140		1
3(c)	alpha (particle) mass number goes down by 4 **or** number of protons and neutrons goes down by 4 **or** number of neutrons goes down by 2 atomic / proton number goes down by 2 **or** number of protons goes down by 2	reason may score even if beta or gamma is chosen candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit accept an alpha particle consists of 2 neutrons and 2 protons for **1** mark accept alpha equals $^{4}_{2}He$ or $^{4}_{2}\alpha$ for **1** mark an alpha particle is a helium nucleus is insufficient for this mark	1 1 1
Total			**8**

4.4.1.2 Mass number, atomic number and isotopes

Answer 29 · Mark scheme

January 2010 | PHY2H | Original Q3 | Legacy

PHY2H

Answer 30 · Mark scheme

June 2010 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	three	**3**
	B	four	**1**
	C	five	**2**
	D	eight	**4**

Answer 31 · Mark scheme

June 2010 | PHY1BP | Original Q4 | Legacy

Four	4	2	2	2

Answer 32 · Mark scheme

June 2010 | PHY1BP | Original Q5 | Legacy

Five	1	3	4	2

4.4.1.2 Mass number, atomic number and isotopes

Answer 33 · Mark scheme

June 2010 | PHY1H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	gamma will pass through the body **or** alpha will not pass through the body	it refers to gamma answers must relate to the body accept skin for body	1
	gamma is only slightly ionising **or** alpha is heavily ionising	accept gamma causes less damage to cells / tissue do **not** accept gamma causes no damage to cells less harmful is insufficient	1
2(b)(i)	(both graphs show an initial) increase in count-rate	accept both show an increase	1
2(b)(ii)	only the right kidney is working correctly		1
	any **two** from: • count-rate / level / line for right kidney decreases (rapidly) • count-rate / level / line for <u>left</u> kidney does not change • radiation is being passed out / into urine - if referring to right kidney • radiation is not being passed out - if referring to the left kidney	if incorrect box chosen maximum of **1** mark can be awarded reference to named kidney can be inferred from the tick box it decreases is insufficient it does not change is insufficient	2

Question 2 continues on the next page . . .

PHY1H

Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	time taken for number of nuclei to halve **or** time taken for the count-rate to halve		1
2(c)(ii)	short half-life - the level of radiation (in the body) decreases rapidly to a safe / very small level **or** a long half-life - the radiation remains in the body / for a long time level of radiation remains high	it refers to short life isotope answers in terms of damage eg cancer are insufficient	1 1
Total			**9**

4.4.1.2 Mass number, atomic number and isotopes

Answer 33 · Mark scheme June 2010 | PHY1H | Original Q2 | Legacy

PHY1H

4.4.1.2 Mass number, atomic number and isotopes

Answer 34 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	isotopes		1
4(b)	$^{231}_{90}$Th	correct order only	1 1
4(c)(i)	(nuclear) fission	accept fision do **not** accept any spelling that may be confused with fusion	1
4(c)(ii)	neutron / neutrons		1
4(d)	plutonium (239)	accept MOX (mixed oxide) accept Pu do **not** accept uranium 238 / hydrogen	1
Total			**6**

4.4.1.2 Mass number, atomic number and isotopes

Answer 34 · Mark scheme June 2010 | PHY2H | Original Q4 | Legacy

PHY2H

Answer 35 · Mark scheme November 2010 | PHY1BP | Original Q3 | Legacy

Three	1	3	3	1

Answer 36 · Mark scheme November 2010 | PHY1BP | Original Q4 | Legacy

Four	2	1	3	3

Answer 37 · Mark scheme November 2010 | PHY1BP | Original Q8 | Legacy

Eight	2	2	4	2

Answer 38 · Mark scheme March 2011 | PHY1BP | Original Q2 | Legacy

Two	**A**	infra red	3
	B	microwaves	2
	C	visible light	1
	D	X-rays	4

Answer 39 · Mark scheme March 2011 | PHY1BP | Original Q8 | Legacy

Eight	1	3	2	1

Answer 40 · Mark scheme June 2011 | PHY1BP | Original Q2 | Legacy

Two	**A**	16	3
	B	25	2
	C	150	4
	D	600	1

	A	**B**	**C**	**D**

Answer 41 · Mark scheme June 2011 | PHY1BP | Original Q3 | Legacy

Three	3	1	2	4

Answer 42 · Mark scheme June 2011 | PHY1BP | Original Q7 | Legacy

Seven	2	2	1	3

4.4.1.2 Mass number, atomic number and isotopes

Answer 43 · Mark scheme

June 2011 | PHY1H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	decommissioning		1
2(a)(ii)	level of radiation **or** radiation dose (to workers) decreased	accept the isotope / cobalt(-60) has decayed (a lot) accept the isotope / cobalt(-60) has decayed in 2 half lives accept exposed to less radiation do **not** accept no radiation left	1
	less hazardous / dangerous (to workers health)	accept safer do **not** accept there is no hazard accept allows reactor to cool (down) an answer of radiation levels decrease by 75 % or drops to 25 % gains **2** marks	1
2(b)(i)	more in favour **or** fewer against	quoting figures alone is insufficient do **not** accept it increases ignore any reasons given	1

Question 2 continues on the next page

PHY1H

Question 2 continued

question	answers	extra information	mark
2(b)(ii)	any **one** from: • sample too small • do not know how many (people) were asked • different people asked (in different years) • sample not representative (of population) • people did not understand the questions • do not know who carried out the surveys • do not know if surveys asked same questions	do **not** accept they are biased unless acceptable reason for bias given	1

Question 2 continues on the next page

PHY1H

Question 2 continued

question	answers	extra information	mark
2(b)(iii)	any **one** from: • no / less pollutant gases produced • reliable source (of energy / electricity) • running out of fossil fuels • conserve fossil fuels • meet increasing demand • less reliance on imported fossil fuels / electricity • concentrated energy source(s) • lower transportation costs for fuel • to replace old <u>nuclear</u> power stations	accept a named gas accept does not contribute to global warming accept a named fossil fuel accept fossil fuels won't have to be used accept named fossil fuel ignore references to efficiency / job creation / local economy / selling electricity	1
2(c)	economic issues		1
Total			**7**

4.4.1.2 Mass number, atomic number and isotopes

Answer 43 · Mark scheme June 2011 | PHY1H | Original Q2 | Legacy

PHY1H

4.4.1.2 Mass number, atomic number and isotopes

Answer 44 · Mark scheme

June 2011 | PHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	number of protons are the same number of neutrons are different	accept atomic number / number of electrons for number of protons accept mass numbers are different – only if the first mark is awarded	1 1
6(a)(ii)	an electron from the nucleus	both parts needed	1
6(b)	decays at the same rate as it is made	accept decays as fast as it is made accept absorbed / used by plants (in CO_2) at same rate as it is being made	1
6(c)(i)	3500	no tolerance	1
6(c)(ii)	adjusted age correctly obtained from the graph adjusted age +50	accept values between 3700–3800 inclusive accept their **(c)(i)** used correctly to obtain an adjusted age from the graph second mark can only be scored if first mark awarded if no working shown an answer between 3750–3850 inclusive scores both marks note: any line or mark made on the graph counts as working out	1 1
Total			**7**

4.4.1.2 Mass number, atomic number and isotopes

Answer 45 · Mark scheme

June 2011 | PHY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	**L** **J** **K**	all 3 in correct order allow **1** mark for 1 correct	2
3(b)	number of electrons = number of protons	accept amount for number	1
3(c)	neutrons	this answer only	1
3(d)	loses / gains electron(s)		1
Total			**5**

4.4.1.2 Mass number, atomic number and isotopes

Answer 45 · Mark scheme June 2011 | PHY2H | Original Q3 | Legacy

PHY2H

4.4.1.2 Mass number, atomic number and isotopes

Answer 46 · Mark scheme

January 2013 | PH2HP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	any **one** from: • nuclear power (stations) • nuclear weapons (testing) • nuclear accidents	accept nuclear waste accept coal power stations accept nuclear bombs / fallout accept named accident, eg Chernobyl or Fukushima accept named medical procedure which involves a radioactive source accept radiotherapy accept X-rays accept specific industrial examples that involve a radioactive source nuclear activity / radiation is insufficient smoke detectors is insufficient	1
2(a)(ii)	(radioactive decay) is a random process	accept an answer in terms of background / radiation varies (from one point in time to another)	1
2(b)	any **one** from: • (maybe) other factors involved • evidence may not be valid • may not have (a complete) understanding of the process (involved)	accept a named 'sensible' factor, eg smoking accept not enough data	1

Question 2 continues on the next page . . .

4.4.1.2 Mass number, atomic number and isotopes

PH2HP

Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	2 2		1 1
2(c)(ii)	218 84	correct order only	1 1
2(d)	3.8 (days)	allow **1** mark for showing correct method using the graph provided no subsequent steps correct answers obtained using numbers other than 800 and 400 gain **2** marks provided the method is shown	2
Total			**9**

4.4.1.2 Mass number, atomic number and isotopes

Answer 46 · Mark scheme

January 2013 | PH2HP | Original Q2 | Legacy

PH2HP

4.4.1.2 Mass number, atomic number and isotopes

Answer 47 · Mark scheme

June 2013 | PH2HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	78		1
5(b)	atomic		1
5(c)(i)	131 54	correct order only	1 1
5(c)(ii)	32 (days)	allow **1** mark for showing 4 half-lives provided no subsequent step	2
5(c)(iii)	limits amount of iodine-131 / radioactive iodine that can be absorbed so reducing risk of cancer (of the thyroid)	accept increases level of non-radioactive iodine in thyroid do **not** accept cancels out iodine-131 accept stops risk of cancer (of the thyroid)	1 1
Total			**8**

4.4.1.2 Mass number, atomic number and isotopes

Answer 47 · Mark scheme

June 2013 | PH2HP | Original Q5 | Legacy

PH2HP

4.4.1.2 Mass number, atomic number and isotopes

Answer 48 · Mark scheme

June 2014 | PH2HP | Original Q6 | Legacy

6(a)	(same) number of protons	same atomic number is insufficient	1	AO1 2.5.1e
6(b)(i)	nuclei split	do **not** accept atom for nuclei / nucleus	1	AO1 2.6.1b
6(b)(ii)	(nuclear) reactor		1	AO1 2.6.1a
6(c)	beta any **one** from: • atomic / proton number increases (by 1) • number of neutrons decreases / changes by 1 • mass number does not change • a neutron becomes a proton	 accept atomic / proton number changes by 1 (total) number of protons and neutrons does not change	1 1	AO2 2.5.2d
6(d)	(average) time taken for number of nuclei to halve **or** (average) time taken for count-rate / activity to halve		1	AO1 2.5.2h

Question 6 continues on the next page . . .

4.4.1.2 Mass number, atomic number and isotopes

Question 6 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
6(e)(i)	6.2 (days)	Accept 6.2 to 6.3 inclusive allow **1** mark for correctly calculating number remaining as 20 000 **or** allow **1** mark for number of 80 000 plus correct use of the graph (gives an answer of 0.8 days)	2	AO2 2.5.2h
6(e)(ii)	radiation causes ionisation that may then harm / kill healthy cells	allow radiation can be ionising accept specific examples of harm, eg alter DNA / cause cancer	1 1	AO3 2.5.2g
6(e)(iii)	benefit (of diagnosis / treatment) greater than risk (of radiation)	accept may be the only procedure available	1	AO3 2.5.2g
Total			**11**	

4.4.1.2 Mass number, atomic number and isotopes

Answer 48 · Mark scheme

June 2014 | PH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

4.4.1.2 Mass number, atomic number and isotopes

Answer 49 · Mark scheme June 2015 | PH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
3(a)(i)	splitting of a(n atomic) nucleus	do not accept splitting an atom	1	AO1 2.6.1b	**E**
3(a)(ii)	Neutron		1	AO1 2.6.1c	**E**
3(b)(i)	nuclei have the same charge **or** nuclei are positive	accept protons have the same charge	1	AO1 2.3.1d	**E**
3(b)(ii)	(main sequence) star	accept Sun or any correctly named star accept red (super) giant	1	AO1 2.6.2b	**E**
3(c)(i)	any **two** from: • easy to obtain / extract • available in (very) large amounts • releases more energy (per kg) • produces little/no radioactive waste	do **not** accept figures *only* naturally occurring is insufficient seawater is renewable is insufficient less cost is insufficient	2	AO2/3 2.6	**E**
3(c)(ii)	any **one** from: • makes another source of energy available • increases supply of electricity • able to meet global demand • less environmental damage • reduces amount of other fuels used	accept any sensible suggestion accept a specific example accept a specific example	1	AO3 2.6	**E**
3(d)	12	allow **1** mark for obtaining 3 half-lives	2	AO2 2.5.2h	**E**

4.4.1.2 Mass number, atomic number and isotopes

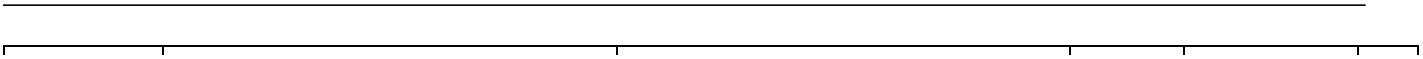
Answer 49 · Mark scheme

Total			**9**

4.4.1.2 Mass number, atomic number and isotopes

Answer 49 · Mark scheme

June 2015 | PH2HP | Original Q3 | Legacy



4.4.1.2 Mass number, atomic number and isotopes

Answer 50 · Mark scheme

November 2021 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	148		1	AO1 4.4.1.2
06.2	D and E		1	AO1 4.4.1.2
06.3	line between B and 86 protons same line between B and 222 mass number		1 1	AO2 4.4.2.2
06.4	can't predict which nucleus will decay next **or** can't predict when a (particular) nucleus will decay		1	AO1 4.4.2.3
06.5	one alpha decay would decrease proton number by 2 two beta decays would increase proton number by 2 so the proton / atomic number of the final nucleus is the same as the proton / atomic number of the original nucleus	 this mark is dependent on scoring the first two marks	1 1 1	AO1 4.4.2.2
Total			**8**	

4.4.1.2 Mass number, atomic number and isotopes

Answer 51 · Mark scheme

June 2023 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	Similarities: • same number of protons **or** same atomic number • same number of electrons Difference: • different number of neutrons **or** different mass number	 allow both atoms / nuclei contain 6 protons allow carbon-12 has 6 neutrons **and** carbon-14 has 8 neutrons	 1 1 1	AO1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the time it takes for the number of nuclei (in a radioactive sample) to halve (is 5700 years) **or** the time it takes for the activity (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the radiation emitted (by a radioactive sample) to halve (is 5700 years) **or** the time it takes for the count rate (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the mass of carbon-14 (in a sample) to halve (is 5700 years)	allow atoms for nuclei ignore radioactivity	1	AO1 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	2 half-lives 128.74 (s)	 allow 129 (s)	1 1	AO2 4.4.2.3

4.4.1.2 Mass number, atomic number and isotopes

Answer 51 · Mark scheme

June 2023 | 8463/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	nitrogen-18 greatest activity (so) greatest dose of radiation absorbed (per second)	 MP2 and MP3 dependent on scoring MP1 allow emits most radiation per second allow emits most radiation in a given time period ignore shortest half-life	1 1 1	AO3 4.4.2.1 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	irradiation is the exposure of an object / person to radiation (while) contamination is the (unwanted) presence of radioactive material / atoms on an object / person	allow 'absorption of radiation' for 'exposure' allow specific examples of ionising radiation allow 'inside a person' for 'on an object / person'	1 1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **one** from: • cancer / tumours • DNA / genetic mutation • damages / kills cells • radiation poisoning / sickness / burns	 ignore mutates cells ignore death	1	AO3 4.4.3.3

4.4.1.2 Mass number, atomic number and isotopes

Answer 51 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	some radioactive materials emit alpha radiation which has a (very) short range (in air)	 MP2 dependent on scoring MP1 allow weakly penetrating for short range (in air)	1 1	AO3 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	pilot's dose in 24 hours = 0.072 (mSv) number of days = $\frac{0.072}{0.00050}$ number of days = 144 OR nuclear power worker hourly dose = 0.0000208… (mSv) (1) number of days = $\frac{0.0030}{0.0000208}$ (1) number of days = 144 (1) OR $\frac{\text{hourly dose}}{\text{daily dose}} = \frac{0.0030}{0.00050} = 6$ (1) number of days = 6 × 24 (1) number of days = 144 (1)		1 1 1	AO2 4.4.3.1

Total Question 5	17

4.4.1.2 Mass number, atomic number and isotopes

Answer 52 · Mark scheme

June 2025 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(atoms of an element with) the same number of protons but a different number of neutrons	ignore number of electrons allow same atomic number allow different mass number	1 1	AO1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	light(er) nuclei fuse to form heavier nuclei / elements some of the mass (of the nuclei) is converted into energy (of radiation)	allow hydrogen nuclei fuse ignore bonding / colliding allow to form helium nuclei	1 1 1	AO1 4.4.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(a large amount of energy transferred) causes a small temperature increase of the walls / material (therefore) the walls of the reactor should not reach melting point	 allow (therefore) the walls of the reactor should not melt	1 1	AO3 4.1.1.3 4.3.2.2 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **one** from: • a nuclear explosion • a (nuclear) meltdown • a nuclear bomb	allow atomic for nuclear allow Chernobyl / Fukushima (disaster)	1	AO1 4.4.4.1

Total Question 5	8

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

Foundation

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Kathleen Tattersall: *Director General*

4.4.1.2 Mass number, atomic number and isotopes

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

4.4.1.2 Mass number, atomic number and isotopes

3.2 Marking of lists

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

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

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

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

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

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

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

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

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

3.8 Phonetic spelling

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

3.9 Brackets

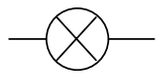
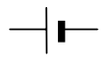
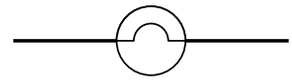
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct   circuit symbol for a cell correct	accept  accept any standard of drawing providing circuit would work	1 1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

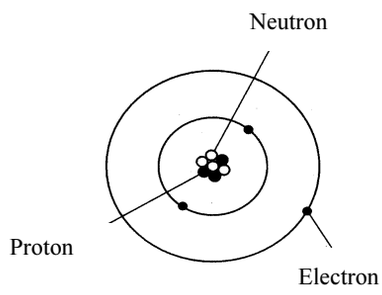
4.4.1.2 Mass number, atomic number and isotopes

3451/F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds		1
	line drawn steeper than LM starting before L	ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1
total			6

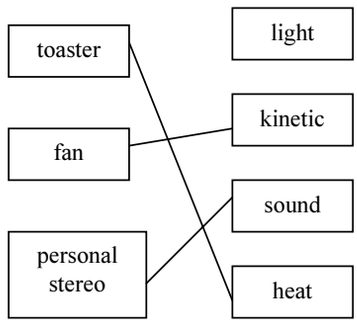
4.4.1.2 Mass number, atomic number and isotopes

3451/F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

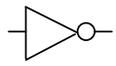
4.4.1.2 Mass number, atomic number and isotopes

3451/F Q8

question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do **not** accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre line need not be accurately constructed using a ruler	1
(ii)	diverging (lens)	do **not** accept concave	1
(c)	converging film smaller than nearer to	accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake	1 1 1 1
(d)(i)	(image) bigger than object / enlarge	accept just 'made bigger'	1
(ii)	it / real image can be put on a screen **or** real image on the opposite side of the lens to the object	accept 'not an imaginary or virtual image' assume 'it' refers to a real image do **not** credit 'it can be seen'	1
(e)	**either** (the converging lens is) thick in the middle thin(ner) at the edge **or** (both) sides bend outwards (1) in the middle (1) **or** one side bends in the middle (1) more than the other side bends inwards (in the middle) (1)	thickest in the middle gains **2** marks convex gains **2** marks suitable diagrams gains **2** marks	1 1
total			12

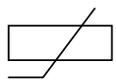
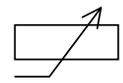
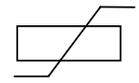
4.4.1.2 Mass number, atomic number and isotopes

3451/F Q9

question	answers	extra information	mark
(a)(i)	off off on	all correct	1
(ii)	AND (gate)	accept and (gate)	1
(iii)	on on on	all correct	1
(iv)	OR (gate)	accept or (gate)	1
(b)(i)	1 0 **or** 0 1 0 1 1 0	do **not** credit on / off responses	1
(ii)		accept mirror image accept  accept with either or both parts shaded accept line through as shading	1
(c)		accept off for 0 and on for 1 throughout	
	0 0	both correct	1
	0 1	both correct	1
	1 1	both correct	1
	1 1	both correct	1

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q9 continued

(d)(i)		accept mirror image **or** inverted do **not** credit  **or**  or similar	1
(ii)	resistance decreases / increases / changes current (through it) increases / decreases / changes **or** temperature changes / increases / decreases (1) resistance changes / decreases / increases (1) (NTC thermistor) both marks independent but must be compatible to score **2** marks	accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series	1 1
total			13

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q10

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q11

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q12

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q13

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

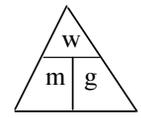
4.4.1.2 Mass number, atomic number and isotopes

3451/F Q14

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q15

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q16

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do **not** award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do **not** credit cell accept (set of) cells accept power supply do **not** accept power pack	1
	(Y is a) LED	**or** light emitting diode	1
(ii)	longer (time)	do **not** accept 'slower time'	1
(iii)	any **two** from: current less (so) rate of flow of charge less **or** less coulombs per second (so) discharge is slower	 do **not** accept current slower accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit	2
(c)	4200	translation correct (= 4000) but percentage addition incorrect gains **1** mark translation incorrect but 5% addition is correct gains **1** mark accept 422.1 **or** 42.2 **or** 6.3 for **1** mark	2
	ohms **or** Ω	4.2 kilohms **or** 4.2 kΩ gains all **3** marks	1
total			10

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q17

question	answers	extra information	mark
(a)	point at which its mass (seems to) act **or** point at which gravity (seems to) act	accept …its weight acts accept correct statements if the intent is clear e.g. … if suspended, the centre of gravity will be directly under the point of suspension e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry) do **not** credit just 'it is a point'	1
(b)	**Quality of written communication** *The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **five** from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	*maximum of **4** marks if ideas not well expressed* **no** marks if method quite unworkable maximum of **3** marks if no 'repeat with other hole'	5
(c)(i)	(turning) effect **or** moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm **or** newton metre(s)	allow 44 × 0.4 **or** 0.4 × 44 for **1** mark do **not** accept N/m **or** N/cm 1760 Ncm gains all **3** marks	2 1
total			10

4.4.1.2 Mass number, atomic number and isotopes

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Science: Double Award Co-ordinated

3462

Paper 3F

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Kathleen Tattersall: *Director General*

4.4.1.2 Mass number, atomic number and isotopes

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

4.4.1.2 Mass number, atomic number and isotopes

3.2 Marking of lists

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

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

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

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

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

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

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

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

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

3.8 Phonetic spelling

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

3.9 Brackets

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

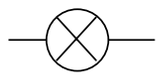
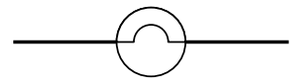
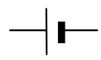
3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.4.1.2 Mass number, atomic number and isotopes

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time wind generator can only produce when the wind is strong enough	accept fuel available all the time accept it's not always windy	1 1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

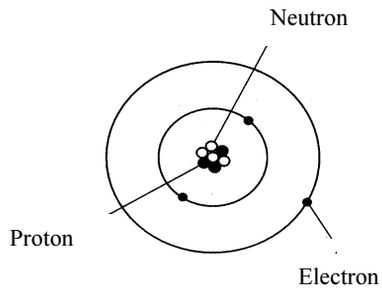
4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

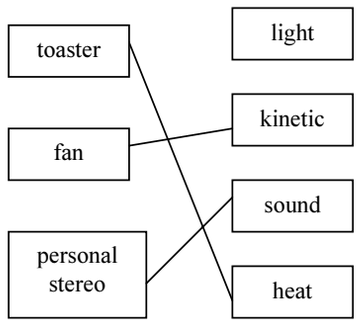
4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q8

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q9

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q10

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q11

question	answers	extra information	mark
(a)	silver is a (good) reflector of heat (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

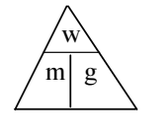
4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q12

question	answers	extra information	mark
(a)(i)	any **one** from:		1
	the ground	do **not** accept mobile phones	
	the air		
	radon (gas)		
	building materials		
	buildings		
	rocks / granite		
	food		
	cosmic rays **or** solar rays	accept from outer space accept sun but **not** sunlight	
	X-rays	accept medical uses	
	nuclear weapons testing		
	nuclear power stations / accidents		
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)		answers must be comparative accept converse answers throughout	
	alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas	accept paper for the card	1
	beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source)	accept aluminium for the metal	1
	gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	accept aluminium for the metal accept lead / aluminium for the metal	1
total			6

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q13

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

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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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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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

Physics B – AQA GCSE Mark Scheme, 2005 June series

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

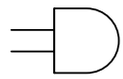
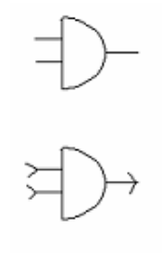
3451/F Q9

question	answers	extra information	mark
(a)	capacitor LDR relay (normally open)	accept condenser **or** light dependent resistor accept 'ldr', 'Ldr' etc. do **not** accept 'relay normally closed'	1 1 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…

4.4.1.2 Mass number, atomic number and isotopes

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

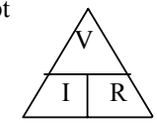
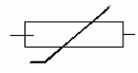
4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 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  <u>resistance</u> goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling 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 1
total			10

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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…

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

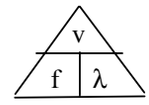
4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

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

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

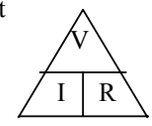
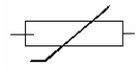
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

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

4.4.1.2 Mass number, atomic number and isotopes

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 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  <u>resistance</u> goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling 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 1
total			10

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

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 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

4.4.1.2 Mass number, atomic number and isotopes

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…

4.4.1.2 Mass number, atomic number and isotopes

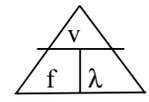
3462/3F Q12 cont…

(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

4.4.1.2 Mass number, atomic number and isotopes

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

4.4.1.2 Mass number, atomic number and isotopes

Answer 50 · Examiner comments November 2021 | 8463/1H | Original Q6

Question 6

Questions **06.1** and **06.2** were well answered, but few students scored any marks on the remainder of the question. In question **06.5** students often failed to give sufficient technical accuracy when describing radioactive decays.

4.4.1.2 Mass number, atomic number and isotopes

Answer 51 · Examiner comments

June 2023 | 8463/1H | Original Q5

Question 5 (Standard/high Demand)

05.1 This question discriminated well with 43 % of students scoring 3 marks, 18 % of students scoring 2 marks and 17 % of students scoring 1 mark. There is evident confusion about the significance of the mass number and the atomic number and what they represent. Lots of students 'shot themselves in the foot' by making statements about incorrect numbers of particles. e.g. 'Number of neutrons in carbon-12 is different from carbon-14, it's 12 in carbon-12 and 14 in carbon-14', would score no marks. Any numbers given as examples had to be correct to score marks.

05.2 'Time for radioactivity to halve' was insufficient to score, which was a commonly seen answer. If a student specified 'the time to halve' they needed to be clear what was halving: mass, number of nuclei, activity, etc. 47% of students scored the mark for this question.

05.3 Students struggled to realise that if ¼ remained two half-lives had passed. Subsequently, any calculation they did scored no marks. 32% of students scored 2 marks. For only 1 mark to score the words '2 half-lives' needed to be seen, it was not sufficient to see the number '2'.

05.4 Most students incorrectly chose Fluorine-18 as causing the biggest risk, believing that its long half-life would cause the most harm. Students who chose nitrogen-18 were often imprecise in their explanation and used 'more radiation emitted' without indicating the time period over which the more radiation was emitted. 'Decays the fastest' was insufficient to score the 2nd marking point. Less than 1% of students scored 3 marks, 7% scored 2 marks and 15% scored 1 mark.

05.5 Students who had learned the definitions as stated in the specification scored well, with 18% of students scoring 2 marks. Many students were unclear of the difference between the two terms and gave vague answers about 'radiation being around you versus in you', which were insufficient to score. It was evident that many students don't appreciate that radioactive materials emit radiation and gave confused answers mixing the terms 'radiation' and 'radioactive'.

05.6 90% of students answered correctly, scoring a mark. The most common correct answer was 'cancer'. 'Death' was ignored as working with nuclear radiation would cause other specific harm before death occurred. 'Damage to tissues / organs' was also creditworthy, as they are made up of cells. As ionisation occurs at an atomic level, this was not sufficient to score a mark. A commonly seen incorrect answer was 'ionises cells'.

05.7 38% of students scored 2 marks on this question, while 3% of students scored 1 mark. Students who didn't mention alpha radiation / particles would not have scored marks. Some students thought that standing close to the radiation detector would help to rule out radiation due to background radiation, which was not creditworthy.

05.8 82% of students scored 3 marks usually for using the first method given in the mark scheme. Some students calculated 144 (days) but thought they had calculated hours so divided by 24 and wrote an answer of 6. They scored 2 marks, as their final answer was treated as a unit error.

4.4.1.2 Mass number, atomic number and isotopes

Answer 52 · Examiner comments June 2025 | 8463/1H | Original Q5

05.1

Just over 80 % of the students scored 2 marks for correctly describing what is meant by an isotope of an element. The number of electrons was ignored as this does not define an isotope.

05.2

Students needed to say light / lighter / small nuclei to demonstrate they understood that it is only lighter nuclei which fuse. The word fuse could have been substituted for other words like 'join', or 'combine' but 'collide' was insufficient. Some students demonstrated an excellent understanding of the fusion process and fusion in stars was accurately described. Fusion on earth where an extra neutron is released was ignored, as the process as stated in the specification was being tested. Just fewer than 20 % of the students scored 3 marks, while nearly 30 % of the students scored 2 marks and approximately 15 % of the students scored 1 mark.

05.3

Most students who scored a mark did so for stating that the reactor walls should not melt. Few students scored the first marking point. Most students were vague and used phrases like the walls need to 'withstand the high temperatures' which did not score a mark. Many students confused specific heat capacity with thermal conductivity and thermal insulation. Containing the fusion energy or products was another common insufficient response. Only

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Answer 52 · Examiner comments June 2025 | 8463/1H | Original Q5

about 4 % of the students scored 2 marks, while approximately 40 % of the students scored 1 mark.

05.4

Just over 30 % of the students scored the mark for the consequence of an uncontrolled chain reaction. 'Explosion' unqualified was insufficient to score the mark.