AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.2.4

Radioactive contamination

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**10**
Available paper years	**2007–2025**

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.

4.4.2.4 Radioactive contamination

Answer 01 · Mark scheme

November 2007 | PHY1B | Original Q8 | Legacy

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

4.4.2.4 Radioactive contamination

Answer 02 · Mark scheme

June 2008 | PHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
(a)(i)	3 fewer neutrons	accept fewer neutrons accept different number of neutrons do **not** accept different number of electrons	1
(a)(ii)	electron from the nucleus	both points needed	1
(a)(iii)	32 (days)	allow **1** mark for clearly obtaining 4 half-lives	2
(a)(iv)	has a **<u>much</u>** longer half-life little decay happened / still in the atmosphere	accept converse answers in terms of iodine-131 accept it has not reached one half-life yet accept it is still decaying	1 1
(b)	any **two** from: • some children developed TC before 1986 • some children (after 1986) that developed TC did not live in highly contaminated areas • the (large) increase can (only) be explained by (a large increase in) radiation as caused by Chernobyl • all areas would be contaminated (and raise the risk of TC) • no evidence (of effect) of other variables	marks are for reasons	2
(c)	People not exposed (to the radiation but who were otherwise similar)	accept people not affected (by the radiation)	1

Question 6 continues on the next page

4.4.2.4 Radioactive contamination

PHY1H

Question 6 continued

question	answers	extra information	mark
(d)	any **two** from: • produce no pollutant / harmful gases • produces a lot of energy for a small mass (of fuel) **or** is a concentrated energy source • it is reliable **or** it can generate all of the time • produces only a small volume of (solid) waste	answers should be in terms of nuclear power and **not** why we should not use other fuels accept named gas or greenhouse gases do **not** accept no pollution accept amount for mass accept high energy density accept amount for volume	2
total			11

4.4.2.4 Radioactive contamination

Answer 03 · Mark scheme

March 2009 | PHY1BP | Original Q3 | Legacy

Three	**1**	**3**	**2**	**1**

4.4.2.4 Radioactive contamination

Answer 04 · 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**

4.4.2.4 Radioactive contamination

Answer 04 · Mark scheme June 2011 | PHY1H | Original Q2 | Legacy

PHY1H

4.4.2.4 Radioactive contamination

Answer 05 · 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**

4.4.2.4 Radioactive contamination

Answer 05 · Mark scheme

June 2013 | PH2HP | Original Q5 | Legacy

PH2HP

4.4.2.4 Radioactive contamination

Answer 06 · Mark scheme

June 2019 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	$^{206}_{82}Pb$		1 1	4.4.2.2 AO1
5.2	alpha radiation is highly ionising causing an increased risk of cancer **or** organ failure **or** radiation sickness / poisoning **or** mutation of genes / DNA **or** damage to cells / tissues / organs until the radioactive material is removed / excreted **or** activity of radioactive material reaches / approaches background radiation levels	 allow kill cells allow all the alpha radiation is absorbed by the body ignore references to half-life	1 1 1	4.4.2.4 AO1
5.3	$\frac{414}{138} = 3$ (half-lives) $1.45 \times 10^{-4} \times 2 \times 2 \times 2$ $= 1.16 \times 10^{-3}$ (g) **or** = 0.00116 (g)	an answer of 1.16×10^{-3} (g) scores **3** marks	1 1 1	4.4.2.3 AO2
Total			**8**	

4.4.2.4 Radioactive contamination

Answer 07 · Mark scheme

June 2022 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	two protons and two neutrons	allow helium nucleus ignore symbols	1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	85 37	this order only	1 1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	alpha radiation has a low penetrating ability		1	AO1 4.4.2.4
	(so externally) alpha radiation is stopped by skin (so is low risk)	allow absorbed for stopped ignore reference to range of alpha particles through other materials	1	
	internally, alpha radiation is absorbed by living tissue / organs	allow (internal) contamination will increase the radiation dose	1	
	(as) alpha radiation is highly ionising		1	
	(internal) contamination will cause greater (risk of) harm to cells / tissues / organs / DNA / genes	allow contamination causes greater chance of developing cancer allow greater chance of mutations	1	

Total Question 7		**8**

4.4.2.4 Radioactive contamination

Answer 08 · 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

4.4.2.4 Radioactive contamination

Answer 08 · 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

4.4.2.4 Radioactive contamination

Answer 08 · 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

4.4.2.4 Radioactive contamination

Answer 09 · Mark scheme

June 2024 | 8463/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	radiation (from source **A**) travels (approximately) 3 cm (in air)		1	AO1 4.4.2.1 4.4.3.1
	(after which) count rate decreases to background radiation		1	
	(because) alpha radiation has a short range (in air)	allow alpha radiation has (very) low penetrating ability allow beta and gamma radiation have a (much) longer range in air	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	use an aluminium sheet	allow other materials that beta would be stopped by e.g. brick, sheets of iron / lead, etc. ignore sheet(s) of metal foil unless thickness is given	1	AO1 4.4.2.1
	(which) beta radiation will not penetrate but gamma will **or** (which) only gamma will penetrate	MP2 dependent on scoring MP1	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	any **one** from: • increase distance between source and teacher • limit exposure time • use tongs / forceps • wear a lead apron • keep source in box unless in use • stand behind safety screen • point source away from teacher	allow any reasonable precaution that increases distance between the source and the teacher, or limits exposure time ignore wear PPE unqualified ignore examples of additional clothing	1	AO1 4.4.2.4

4.4.2.4 Radioactive contamination

Answer 09 · Mark scheme

June 2024 | 8463/1H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	wear gloves / apron **or** wear a lab coat **or** handle source with tongs / forceps	allow no eating / drinking (while radioactive source is in the lab) allow do not touch the source (with bare hands) ignore wear a mask ignore wear safety glasses ignore protective clothing unqualified ignore wear a hazmat suit ignore wear PPE unqualified	1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	tangent drawn on line at 300 s	do not allow a line drawn that crosses the graph line	1	AO2
	attempt to calculate gradient of the tangent	allow missing power for Δy	1	AO2
	activity = 7.1×10^{20}	allow a value between 6.5 and 7.6×10^{20}	1	AO1
	becquerel / Bq	ignore decays/second	1	4.4.2.1

Total Question 9	**11**

4.4.2.4 Radioactive contamination

Answer 10 · Mark scheme

June 2025 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	new evidence is discovered that existing models cannot explain		1	AO1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	irradiation is the exposure to radiation (radioactive) contamination is the (unwanted) presence of radioactive material on / inside a person	 allow an object for a person	1 1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(Po) 84 (Pb) 206		1 1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	number of half-lives = 4 time = 4 × 138 time = 552 (days)		1 1 1	AO2 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	polonium-209 has a lower <u>activity</u> than polonium-210 (because polonium-209) has a longer half-life	ignore description of rate of decay MP2 dependent on MP1	1 1	AO3 4.4.2.1

Total Question 7	**10**

4.4.2.4 Radioactive contamination

Answer 08 · 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.

4.4.2.4 Radioactive contamination

Answer 09 · Examiner comments June 2024 | 8463/1H | Original Q9

Question 9 (High Demand)

09.1 Students needed to refer to the graph, and factual recall about alpha radiation, to score the 1st and 3rd mark points.,. The 2nd mark point was much more unlikely to score, as students often stated the graph went to zero, rather than being just above zero. A number of students confused the graph with a half-life graph, believing the *x*-axis showed time, not distance. 8% of students scored 3 marks, while 45% scored 2 marks and 35% scored 1 mark.

09.2 A lot of students thought it was enough to say 'an absorbing material' without specifying what the absorbing material should be made from. Any suitable absorbing material was creditworthy, a block of wood for example. However, reference to any metal foil was not creditworthy unless students referred to a certain thickness eg 5 mm thick aluminium foil. A 'foil' was taken to be the same thickness as kitchen foil, whereas a 'metal sheet' was taken to be thick enough to absorb

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Answer 09 · Examiner comments June 2024 | 8463/1H | Original Q9

beta radiation, provided students did not contradict their earlier statements. Paper and cardboard were not creditworthy as suitable absorbing materials. 51% of students scored 2 marks, while 7% of students scored 1 mark.

09.3 65% of students scored this mark by suggesting a suitable safety precaution. Hazmat suits and PPE were insufficient to score.

09.4 64% of students scored this mark by suggesting a suitable precaution to avoid contamination. Hazmat suits and PPE were insufficient to score.

09.5 Students at GCSE find the idea of rate of change to be a difficult one, hence linking the change in the number of atoms to activity was a difficult question in this exam series. 7% of students scored 4 marks, while 12% of students scored 3 marks. If students failed to draw a tangent, they were very unlikely to score any marks except the unit mark. A common incorrect choice of unit for activity for many students was sieverts, Sv. Examiners were looking for becquerel or Bq. Decays per second or decays/second were insufficient to score.

4.4.2.4 Radioactive contamination

Answer 10 · Examiner comments June 2025 | 8463/1H | Original Q7

07.1

Nearly all of the students chose the correct reason for why scientists change the model used to describe the structure of an atom.

07.2

Many students were confused about the distinction between irradiation and radioactive contamination. Many thought that it had to do with being exposed to radiation inside or outside the body, or one causing harm the other not causing harm. Exposure to a radioactive source was insufficient to score the irradiation mark. Without using the word 'exposed' students often did not express their ideas clearly enough. 'Absorbing radiation from a source' would have been another way of gaining credit for this idea. Students were more secure explaining what radioactive contamination meant and often gave examples like 'radioactive dust' or radioactive atoms' being present on or in people / objects. Almost a quarter of the students scored 2 marks, while just over 40 % of the students scored 1 mark.

07.3

About 90 % of the students scored 2 marks for this nuclear equation, while about 5 % of the students scored 1 mark.

Answer 10 · Examiner comments June 2025 | 8463/1H | Original Q7

07.4

'4 half-lives' needed to be seen to score the first mark, the number '4' was not sufficient by itself for a mark. The most common mistake was to divide 256 000 by 16 000 to give an answer of 16, which scored no marks. Just over 70 % of the students scored 3 marks.

07.5

More / less active was insufficient as was a description of activity in terms of rate of decay.
Just over 20 % of the students scored 2 marks, while a further 12 % of the students scored 1 mark.

4.4.2.4 Radioactive contamination

AQA

GCSE
PHYSICS

8463/1H: Paper 1 (Higher tier)
Report on the Examination

8463
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4.4.2.4 Radioactive contamination

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4.4.2.4 Radioactive contamination

General

Grade 4-5 calculation questions ask for students to recall an equation, before using it in a subsequent calculation. In the 2022 series, students were given an Equations Sheet which had all the equations printed on it. Subsequently, the performance on the more straightforward calculations has improved on previous years.

The multistep calculations targeted at candidates working at grades 8-9, questions **09.1** and **10.1**, were well attempted with many students answering correctly. Of these two questions, students were slightly more successful on question **09.1** with about 55% of students scoring full marks, whereas for question **10.1** approximately 45% of students scored full marks.

Question **02.1** was generally well attempted and students who had carried out the density required practical had an advantage over those who hadn't. For this question, about 35% of students scored 6 marks and approximately 25% of students scored 5 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

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

4.4.2.4 Radioactive contamination

Question 1 (Standard demand)

01.1 About 55% of students scored 2 marks. The unit conversion caused a problem for many students and powers of 10 errors were frequently seen. A correct calculation using an incorrectly or not converted value for power would score 1 mark.

01.2 Students were generally successful at answering this question with approximately 40% scoring 2 marks and about 50% scoring 1 mark. Most students wrote variations of the first and third bullet points in the markscheme. A number of students wrote that the turbines may be broken, which was enough to score a mark for the idea of maintenance.

01.3 'Turbine will rotate faster' was insufficient to score a mark. 'Rotate more smoothly' was not enough to score the 'less friction' mark. Students who stated that 'no energy was wasted' did not score the second marking point. Approximately 35% of students scored 3 marks, 35% of students scored 2 marks and 20% of students scored 1 mark.

01.4 About 30% of students scored 2 marks, while approximately 50% of students scored 1 mark. Many students answered in terms of 'saving energy' which was insufficient. Other students answered in terms of absolute statements which did not score, 'energy efficient appliances waste no energy' for example.

Question 2 (Standard demand)

02.1 Generally very well answered with about 35% of students gaining 6 marks and 25% scoring 5 marks. Students were told that this required practical would appear in the 2022 series via the Advance Information. A number of students quoted the density equation incorrectly, although this was given on the Equations Sheet for the 2022 series. There were extremely few students who didn't attempt the question and less than 1% of students who attempted the question scored zero.

02.2 Approximately 85% of students answered this question correctly. Of the incorrect answers seen, a significant proportion gave the maximum and minimum values the wrong way round. Another common mistake was to write maximum: 2.55 and minimum 0.10, which showed a clear misunderstanding of expressing an uncertainty.

02.3 About 95% of students answered this question correctly.

02.4 Approximately 45% of students scored 2 marks and 40% scored 1 mark. 'In case an error / mistake was made the first time' was insufficient. 'To check the repeatability of the data' was ignored, as this wouldn't improve the accuracy of the data. 'Get rid of anomalies' was assumed to mean 'remove anomalies', but 'stops anomalies from occurring' did not score. Likewise 'stops random errors' did not score.

4.4.2.4 Radioactive contamination

Question 3 (Standard demand)

03.1 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.2 Nearly 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the equations sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

03.3 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.4 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the Equations Sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

Question 4 (Standard/High demand)

04.1 A large number of students found it difficult to identify the independent and dependent variables in the investigation that was described. Control variables appeared often in students' answers. 'Temperature change' seemed to be the most common incorrect answer for the dependent variable. About 50% of students scored 2 marks and approximately 35% of students scored 1 mark.

04.2 65% of students answered correctly. The most common incorrect answer was 87.4 °C.

04.3 About 35% of students answered this question correctly. Common incorrect answers referred to the resolution, or just repeated the question and said 'difficult to read' which was insufficient.

04.4 Approximately 75% of students scored 3 marks and about 10% of students scored 2 marks. Power of 10 errors were common and usually resulted in 2 marks being scored for an incorrectly or not converted value of energy.

04.5 Many students found relating the time for the temperature to decrease to thermal conductivity difficult. About 15% of students scored 2 marks, while 40% scored 1 mark. Answers in terms of good / bad insulators were insufficient to score a mark.

4.4.2.4 Radioactive contamination

Question 5 (Standard/High demand)

05.1 Approximately 45% of students scored 1 mark, with about 5% of students scored 3 marks. Around 30% of students scored no marks. The first marking point of this explanation was most likely to score, the third marking point was least likely to score.

05.2 About 30% of students scored all 3 marks for this explanation. 10% of students scored 2 marks and 10% scored 1 mark. A lot of student answers were not creditworthy, with mixed up descriptions of ion transfer, electron transfer, proton transfer, protons weighing more than electrons and transfer of electrons increasing the mass of the rod on the balance. As a result about 50% of students scored zero.

05.3 Approximately 60% of students scored the mark. Some students evidently did not know what a zero error was. Answers like 'it means there is no error' being a good example of this. Some answers were insufficient, 'the actual mass of the rod is not required' being not enough to score the mark. 'Weight' was allowed for 'mass' when used correctly as the reading on the balance does depend on the weight of the object. An answer of 'only the change in weight was needed' would have scored the mark.

05.4 Some very good explanations were seen and about 10% of students scored all 3 marks. The first marking point was least likely to score. The third marking point needed to be linked to the second marking point before it could be scored.

Question 6 (Standard/High demand)

06.1 This question discriminated well between students. About 15% scored 4 marks with 20% gaining 3 marks. The first two marking points were most commonly scored. Students who said that 'no energy was lost' as a consequence of the step-up transformer's effect did not score the third marking point.

06.2 Approximately 55% of students scored 2 marks, while 15% of students scored 1 mark. Students who scored no marks usually confused the quantity that was decreased (pd) with the quantity that increased (current). Some student answers lacked technical accuracy referring to energy, power or charge incorrectly.

06.3 Two thirds of students scored 4 marks for this calculation, whereas about 20% of students scored 3 marks. A common mistake was to try to multiply the answer by the number of seconds in a day, which would probably only score the significant figure mark if correct, as the Physics equations were applied incorrectly.
Common mistakes were to round the answer to 1 400 000 000 C, which would score 3 marks if the full s.f. answer was seen, or round the answer to 141, which would score 3 marks for the supporting calculations if seen. A common error was to miscount the number of zeroes, so would only score 3 marks.

4.4.2.4 Radioactive contamination

Question 7 (Standard/High demand)

07.1 54% of students could state what an alpha particle consists of. The list principle was applied when students wrote '2 protons and 2 neutrons – a helium atom', which did not score.

07.2 65% of students completed the nuclear equation correctly, scoring 2 marks, whereas 24% scored just 1 mark.

07.3 Students generally made good attempts to answer this question and marking points 1, 2 and 4 were seen most often. To score the 5th marking point students need to make a comparative statement, internal versus external damage. The third marking point was least likely to score, as students rarely referred to dose or the living cells / tissues / organs inside the body. Some students incorrectly thought that ionisation was a process that happened to cells, rather than atoms, so often didn't score the fifth marking point for this reason. Very few students scored 5 marks and the question discriminated well between students of differing ability.

Question 8 (Standard/High demand)

08.1 About 90% of students gave the correct measuring instrument. While it wasn't seen often, an answer of a 'volumetric pipette' was also creditworthy. 'Pipette' was insufficient.

08.2 Around 90% of students correctly identified the hazard in the investigation.

08.3 For this calculation, about 45% of students scored 5 marks and 20% of students scored 4 marks. A common mistake was to calculate *L* using one of the masses given in the question, rather than the change in mass. The resulting numerical answer would score zero as the equation was not being used correctly.

08.4 About 15% of students scored 2 marks for this explanation and 10% of students scored 1 mark. Many students reached incorrect conclusions and many students simply reworded the information given in the question.

08.5 7% of students scored 2 marks and 3% of students scored 1 mark. Many students reached incorrect conclusions and many students reworded the information given in the question without adding to it.

4.4.2.4 Radioactive contamination

Question 9 (High demand)

09.1 Approximately 55% of students scored 5 marks, but in the 2022 series students were provided with an Equations Sheet with all the equations. A commonly seen answer was 73 500, which scored 4 marks for not converting the height into metres.

09.2 5% scored 2 marks and about 30% scored 1 mark. Many students failed to score a mark by pointing to the 'inaccuracy of the measured mass / height / gravitational field strength', or referring to the measurements as being 'low resolution'. 'Mass may have been greater than 60 kg' or 'time may have been longer / shorter than 1.40 seconds' were other common incorrect answers.

09.3 About 75% of students identified the correct conclusion.

Question 10 (High demand)

10.1 About 45% of students scored 6 marks for this extended calculation, but in the 2022 series students were provided with an Equations Sheet with all the equations. Therefore, students were supported when it came to attempting this question. With an alternative approach using equations from paper 2, students' answers were marked on whichever approach brought them closest to the correct final answer. An answer of 6 m/s with no supporting working did not score full marks as students could achieve this answer by multiplying the spring constant and the extension together, which would give them the maximum force acting on the toy aeroplane.

10.2 About 65% of students scored the mark. The most common incorrect answers seen were gravitational potential or elastic potential.

10.3 Approximately 20% of students scored a mark. Many students failed to score a mark because they gave a factor without a specific change e.g. 'extension of spring', rather than 'increase the extension of the spring'.

Question 11 (High demand)

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

4.4.2.4 Radioactive contamination

Use of statistics

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

Mark Ranges and Award of Grades

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