AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.3.2.1

Internal energy

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**2**
Available paper years	**2019–2023**

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.

6.3.2.1 Internal energy

Answer 01 · Mark scheme June 2019 | 8464/P/1F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.1	pressure decreased		1	AO2.1	E
	because molecules have less (kinetic) energy	allow less speed/velocity	1	6.3.3.1	
	so fewer collisions (with the wall/container each second)	allow collide with less force allow less force on the walls	1		
07.2		an answer of 0.0021(212121…) scores **3** marks		AO2.1 6.3.2.2	E
	$0.70 = m \times 330$ **or** $700 = m \times 330\,000$		1	6.1.1.3	
	$m = \frac{0.70}{330}$ **or** $m = \frac{700}{330\,000}$	allow correct rearrangement using converted value(s) of E to J and/or L to J/kg	1		
	$m = 0.0021$ (kg)	allow 0.0021(212121…) allow correct calculation using converted value(s) of E and/or L **3** marks can only be awarded for m = 0.0021(212121…) (kg)	1		
07.3			2	AO3/2b 6.3.1.1	E

Substance	Solid	Liquid	Gas
Oxygen		✓	
Nitrogen			✓
Carbon dioxide	✓		

2 correct answers scores **1** mark.
if more than one tick in a row, neither can score a mark

6.3.2.1 Internal energy

Answer 01 · Mark scheme

June 2019 | 8464/P/1F | Original Q7

07.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4		
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2		
	No relevant content	0		
	Indicative content cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

6.3.2.1 Internal energy

Answer 02 · Mark scheme

June 2023 | 8464/P/1F | Original Q3

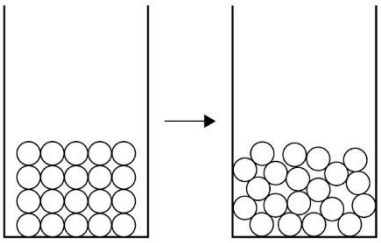
Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$\Delta E = 4.0 \times 420 \times 50$ $\Delta E = 84\,000$ (J)		1 1	AO2 6.1.1.3 6.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	the total kinetic energy and potential energy of the steel particles		1	AO1 6.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the particles are in fixed positions		1	AO1 6.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	stays the same		1	AO1 6.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5			1	AO1 6.3.1.1

6.3.2.1 Internal energy

Answer 02 · Mark scheme

June 2023 | 8464/P/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(the space between the particles) increases	allow the particles move further apart	1	AO1 6.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	physical		1	AO1 6.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	mass per kg = $\frac{18}{4.0}$		1	AO3 6.3.1.1
	mass per kg = 4.5 g		1	
	medium carbon	dependent on MP2	1	
	OR			
	mass in 4.0 kg of medium carbon steel = 4.5 × 4.0 (1)	allow mass in 4.0 kg of low carbon steel = 8 (g) allow mass in 4.0 kg of high carbon steel = 28 (g)		
	mass in 4.0 kg of medium carbon steel = 18 g (1)	dependent on MP1		
	medium carbon (1)	dependent on MP2		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	280 000 = 4.0 × L		1	AO2 6.3.2.3
	$L = \frac{280\,000}{4.0}$		1	
	L = 70 000 (J/kg)		1	

Total Question 3	14

6.3.2.1 Internal energy

Answer 01 · Examiner comments June 2019 | 8464/P/1F | Original Q7

Question 7

07.1 This question tested students' understanding of the links between temperature and pressure via the motion of the particles in a gas. Over 30% of students scored at least one mark but fewer than 5% scored all three marks. Roughly 20% made no attempt. Many

6.3.2.1 Internal energy

Answer 01 · Examiner comments June 2019 | 8464/P/1F | Original Q7

students wrote about successful collisions, which was condoned here. However, writing about particles moving less was not seen as equivalent to writing about particles moving more slowly. The most common reason for gaining 2 marks rather than three was the omission of any mention of collisions. One common misconception is that, as the particles cool down, the number of particles increases. There were also a number of students who did not mention pressure in their answer, instead discussing how the movement of particles changed as they cooled and how this linked with temperature.

07.2 Just over 25% of students scored at least one mark while around 1 in 5 students scored all three marks; approximately 10% made no attempt at all. Some students did not show an equation and just divided one number by the other – sometimes achieving the correct result. Others multiplied the two numbers and therefore did not score. Some chose the wrong equation, while others multiplied or divided by zero, because it was in the question. Those students who scored 2 marks had usually made an erroneous conversion of either kJ to J or kg to g. Many students tried to answer the question using the equation $E = mc\Delta\theta$, with 20 °C as their change in temperature, gaining 0 marks.

07.3 Slightly over a quarter of students scored on this question, and half of those scored both marks. Many students drew a temperature line, which then enabled them to come to the correct conclusions and gain both marking points. A small number of students chose to fill the boxes with numbers representing temperatures, rather than ticking one box for each row of the table.

07.4 Many students who gained 0 marks on this question failed to talk about particles, instead naming and describing changes of state. Many students were able to get into Level 1 (1 or 2 marks) because they knew something about the arrangement and movement of particles in one state. A common misconception was that particles cease to move at all in the solid state. A large number of students gave a basic description of the change of arrangement such as the particles getting closer together as the change of states occurs or the movement of the particles slowing down, but then gave very little additional detail. Fewer students managed to link the changes to energy changes or forces between particles. Very few students achieved Level 3. Some students referred to the energy decreasing at each change of state and some talked about ‘bonding’ occurring. However, often the relevant points regarding the changes to arrangement or movement were not effective and prevented them from acquiring Level 3. Around 15% made no attempt at the question, about 20% scored 0 marks, around 30% scored in Level 1, approximately 30% in Level 2, with the remainder reaching Level 3.

6.3.2.1 Internal energy

Answer 01 · Examiner comments

June 2019 | 8464/P/1F | Original Q7

Use of statistics

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

Mark Ranges and Award of Grades

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

6.3.2.1 Internal energy

Answer 02 · Examiner comments June 2023 | 8464/P/1F | Original Q3

Question 03 (Low demand and standard demand)

03.1 Nearly 90% of students gained both marks for this calculation. A fairly common incorrect method was to subtract 50°C from 420 J/Kg°C, and give a value for the temperature change of 370°C, which gained no credit.

03.2 Slightly less than 40% of students selected the correct meaning for internal energy. It was (very) slightly more common for students to think that internal energy is the energy added to the steel particles as they are heated than to select the correct answer.

03.3 About 70% of students chose the correct statement describing the particles in a solid.

03.4 Approximately 45% of students knew the mass of steel stays the same.

Answer 02 · Examiner comments June 2023 | 8464/P/1F | Original Q3

03.5 The correct diagram to show the change in arrangement of the particles was chosen by over 95% of students.

03.6 Roughly two fifths of students answered this correctly. Many students wrote about the motion of particles, which was ignored, rather than the arrangement of particles. Students who stated that the particles spread out but remained in contact with each other scored this mark.

03.7 Just over three quarters of students recognised that melting is a physical change.

03.8 Over half of the students gained full marks on this question. Almost no students gained 1 or 2 marks, but about 10% did not attempt it at all. Evidence of a relevant calculation had to be shown before any credit could be awarded. So, for example, students who calculated the average of 2, 4.5 and 7 and came up with an answer of 4.5 g, and then selected medium carbon did not score any marks.

03.9 Nearly 60% of students gained full marks on this standard demand calculation. A small proportion of students attempted to convert 4.0 kg to g, which limited them to a maximum mark of 2.