AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.3.2

Perfect black bodies and radiation

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**15**
Available paper years	**2006–2023**

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.

4.6.3.2 Perfect black bodies and radiation

Answer 01 · Mark scheme November 2006 | PHY1B | Original Q2 | Legacy

Two	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet waves	**2**

Answer 02 · Mark scheme June 2007 | PHY1A | Original Q3 | Legacy

Three	**4**	**3**	**1**	**2**

Answer 03 · Mark scheme June 2007 | PHY1B | Original Q6 | Legacy

Six	**4**	**1**	**3**	**1**

Answer 04 · Mark scheme November 2008 | PHY1BP | Original Q8 | Legacy

Eight	**1**	**3**	**3**	**3**

Answer 05 · Mark scheme June 2009 | PHY1BP | Original Q7 | Legacy

Seven	**4**	**1**	**3**	**4**

Answer 06 · Mark scheme November 2009 | PHY1BP | Original Q5 | Legacy

Five	**3**	**2**	**3**	**1**

Answer 07 · Mark scheme November 2010 | PHY1AP | Original Q8 | Legacy

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

Answer 08 · Mark scheme November 2010 | PHY1BP | Original Q9 | Legacy

Nine	**3**	**3**	**4**	**4**

4.6.3.2 Perfect black bodies and radiation

Answer 09 · Mark scheme March 2011 | PHY1AP | Original Q2 | Legacy

Two	**A**	conduction	**1**
	B	convection	**2**
	C	insulation	**4**
	D	radiation	**3**

Answer 10 · Mark scheme March 2011 | PHY1BP | Original Q4 | Legacy

Four	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet rays	**2**

Answer 11 · Mark scheme March 2011 | PHY1BP | Original Q7 | Legacy

Seven	**1**	**4**	**1**	**2**

Answer 12 · Mark scheme March 2011 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**1**	**2**	**2**

4.6.3.2 Perfect black bodies and radiation

Answer 12 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2011

Higher Tier

Question	Key		
One	**A**	a belief that science cannot disprove	**1**
	B	a conclusion based on observations of red-shift	**3**
	C	a theory supported by scientific evidence but not direct observations	**4**
	D	a theory that science has disproved	**2**
Two	**A**	Isotope **A**	**4**
	B	Isotope **B**	**1**
	C	Isotope **C**	**3**
	D	Isotope **D**	**2**

	A	**B**	**C**	**D**
Three	**1**	**3**	**2**	**1**
Four	**4**	**1**	**2**	**2**
Five	**4**	**3**	**4**	**3**
Six	**2**	**3**	**2**	**4**
Seven	**1**	**2**	**3**	**4**
Eight	**3**	**2**	**4**	**2**
Nine	**2**	**3**	**4**	**3**

4.6.3.2 Perfect black bodies and radiation

Answer 13 · Mark scheme

June 2011 | PHY1BP | Original Q4 | Legacy

Four	**2**	**3**	**4**	**1**

4.6.3.2 Perfect black bodies and radiation

Answer 14 · Mark scheme

June 2019 | 8463/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	The frequency increases and the wave speed in air stays the same		1	AO1/1 4.6.2.1 iso
7.2	pass through soft tissue (but) absorbed by bone	allow penetrate for pass through allow skin/muscle/etc… for soft tissue pass through tissue is insufficient allow do not pass through bone do not accept reflected by bone	1 1	AO1/1 4.6.2.4
7.3	accept a sensible practical suggestion eg • complete the investigation standing up • use (slightly) cooler water • do not touch the hot cube	do not accept use cold water pour water in carefully is insufficient ignore wear safety goggles or gloves	1	AO2/2 4.6.2.2 WS2.4
7.4	distance between each side (of the cube) and the (infrared) detector	allow distance between cube and detector	1	AO1/2 4.6.2.2 WS2.2
7.5	measurements (for each surface) have not been repeated (to show that they cluster closely)	do not accept any answer for measurement should be repeated for any reason other than to show they cluster eg to show accuracy / average / anomalies would be wrong	1	AO3/3b 4.6.2.2 WS3.7
7.6	(the student) could not conclude that black surfaces always emit more (infrared) than a white surface (as) the reading for the matt white and shiny black would both be 66 (°C)	a (matt) white surface (appears to) emit(s) the same amount (of infrared) as a (shiny) black surface the conclusion is wrong is insufficient allow (as) the reading for the matt white and shiny black would be the same	1 1	AO3/1a/2b 4.6.2.2 WS2.2
7.7	0.0	allow 0 allow zero	1	AO1/1 4.6.3.1

4.6.3.2 Perfect black bodies and radiation

Answer 14 · Mark scheme

June 2019 | 8463/2H | Original Q7

7.8	at night, more radiation is emitted from the Earth than absorbed from space cloud reflects radiation (towards the Earth) at A, (there is no cloud cover so) a larger proportion of radiation will be emitted into space	 allow solar radiation for radiation 	1 1 1	AO1/1 4.6.3.2
Total			**12**	

4.6.3.2 Perfect black bodies and radiation

Answer 15 · Mark scheme

June 2023 | 8463/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	perpendicular		1	AO1 4.6.1.1

Question	Answers	Mark	AO / Spec. Ref.
01.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	AO1
	No relevant content	0	
	Indicative content **Method:** • heat the water / kettle • add an equal volume of (hot) water to each flask • insert a thermometer into each flask • record the initial temperature from both flasks OR • place an IR detector near each flask • the distance between the IR detector and the flask should be the same each time • record initial reading from IR detectors • (and) start a stop clock • record the temperatures / readings after 10 minutes from both flasks • calculate the change in temperatures / readings during the 10 minutes • compare the results to test the hypothesis to access level 3 the method must allow the correct consideration of a temperature decrease for both flasks or the correct comparison of IR detected from both flasks		4.6.2.2

4.6.3.2 Perfect black bodies and radiation

Answer 15 · Mark scheme

June 2023 | 8463/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	during the 1st minute there is the greatest temperature difference (between the hot water and the surroundings)	 allow highest temperature or hottest MP 2 dependent on scoring MP 1	1 1	AO2 AO1 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the temperature (increase / change after 10 minutes)	allow the final temperature do not allow temperature decrease	1	AO1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	black surfaces absorb more (infrared than white surfaces) matt surfaces absorb more (infrared) than shiny surfaces of the same colour	allow black surfaces have a greater temperature increase (than white surfaces) allow matt surfaces have a greater temperature increase than shiny surfaces of the same colour if no other marks scored, allow 1 mark for matt black surface is the best absorber and shiny white surface is the worst absorber if no other marks scored, allow 1 mark for matt black has the greatest temperature increase and shiny white has the smallest temperature increase	1 1	AO3 4.6.2.2 4.6.3.1

4.6.3.2 Perfect black bodies and radiation

Answer 15 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	pressure = $\frac{\text{force}}{\text{area}}$		1	AO1 4.5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	area of base = 0.0144 (m^2)	do not allow this or subsequent marks unless base area is used	1	AO2 4.5.5.1.1
	$1500 = \frac{F}{0.0144}$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 1500 \times 0.0144$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 21.6$ (N)	this mark may be awarded if base area is incorrectly calculated allow 22 (N)	1	

Total Question 1	**17**

4.6.3.2 Perfect black bodies and radiation

Answer 14 · Examiner comments

June 2019 | 8463/2H | Original Q7

Question 7 (Standard and standard/high and high demand)

07.1 Around 42% of the students scored this mark. Many students seem to think that the wave speed changes.

07.2 About 35% of the students scored both marks. Some students did not specify 'soft' tissue or a named soft tissue, which was required as bone is a tissue. Many students incorrectly described bones as reflecting X-rays rather than absorbing them. Some students appeared to confuse X-rays with gamma rays or even alpha particles.

07.3 A large number of the students failed to appreciate that the hot cube was the main hazard rather than the kettle. The majority gave an answer in terms of 'wear safety goggles and/or

Answer 14 · Examiner comments

June 2019 | 8463/2H | Original Q7

gloves. Less than a quarter of the students gave a correct answer, these appeared to be evenly distributed across the alternatives given in the mark scheme.

07.4 Only a quarter of the students scored this mark, with most incorrect answers giving the temperature or volume of the water as the control variable.

07.5 There appeared to be some confusion of the term precise with either accuracy or resolution. The lack of repeat readings was sometimes given but then incorrectly linked to the idea of calculating a mean or identifying anomalies. About 10% of the students scored this mark.

07.6 About 64% of the students realised that two of the surfaces would give the same temperature reading and therefore undermine the conclusion. However most of these students then simply wrote that the conclusion would not be valid without then going on to explain why.

07.7 Just over 70% of the students gave the correct answer.

07.8 Only a small number of the students scored any marks on this question. Those that did usually scored the mark for 'clouds reflect radiation'. Virtually no students related their answer to night time. Marking points 1 and 3 were rarely awarded. Many of the students wrote about insulation with a few mentioning the cloud as a 'blanket' keeping the ground warm. These answers did not score any marks.

4.6.3.2 Perfect black bodies and radiation

Answer 15 · Examiner comments June 2023 | 8463/2H | Original Q1

01.1

72% scored a mark on this question. The most frequent incorrect response was ‘parallel’.

01.2

Most responses were levels 1 and 2. Many failed to gain marks because they did not think it was necessary to explain the need for additional equipment. Very few students explained the need to calculate the temperature change or to compare the readings on infrared detectors, which was a requirement to get into level 3. A number of students suggested using cold water, or even described a different practical. Students were not penalised for using tiny volumes of water, but it is clear that students have no concept of how much 50 ml is, for example. There was a lot of confusion relating to use of infra red detectors and what they measured.
Many students stated they would take readings every minute, and lots suggested repeating to get averages, or producing graphs. This was not required by the question.
There were some pleasing summaries referring to the evidence and the hypothesis.

01.3

80 % of students scored the first mark, but only 47% scored both marks. Some students simply reworded the stem. There was a small amount of confusion with radioactivity, because of the use of the word radiation, and a number who seemed to think a chemical reaction was taking place.

01.4

A majority of students gained this mark, but there seemed to be some confusion as to what is meant by the dependent variable.

01.5

The most common response related to the matt black surface and the shiny white surface. This was awarded 1 mark. Some did mention that black was the best absorber but failed to adequately describe the relative absorbance of matt versus shiny surfaces, as they did not explain this only applied for the same colour surface. In addition, some gave their response in terms of emission or reflection of IR radiation, both of which scored zero. Only 3% of students successfully gave both conclusions.

01.6

99% of students identified the equation for calculating pressure.

Answer 15 · Examiner comments June 2023 | 8463/2H | Original Q1

01.7

78% of students scored all 4 marks for this calculation. Some scored zero, as they calculated the total surface area, the volume or used the length of the cube.