TEST2-AQA-8464P2H-QP-JUN25 - Student Feedback

Student: Test User

Overall Score: 44/70 (62.9%)
Grade: Grade 8-8
Grade boundaries: Grade boundaries 2024-26 · AQA · Higher
Assessment Tier: Higher
Questions Marked: 27/27

WWW (What Went Well) You demonstrated strong understanding in the Forces topic, scoring an impressive 24/32 marks (75.0%) overall. You also showed excellent calculation and problem-solving skills, highlighted by achieving full marks on the challenging 6-mark question in Q6.2. **EBI (Even Better If)** You would benefit from consolidating your understanding of Magnetism and Electromagnetism, where you scored 6/12 marks (50.0%) and dropped marks on extended questions such as Q4.3. Practice explaining magnetic fields and wave properties using targeted 4- to 6-mark practice questions alongside step-by-step mark schemes to refine your technical explanations. Working through these focused questions will build your confidence and help you secure higher-tariff marks in future assessments.

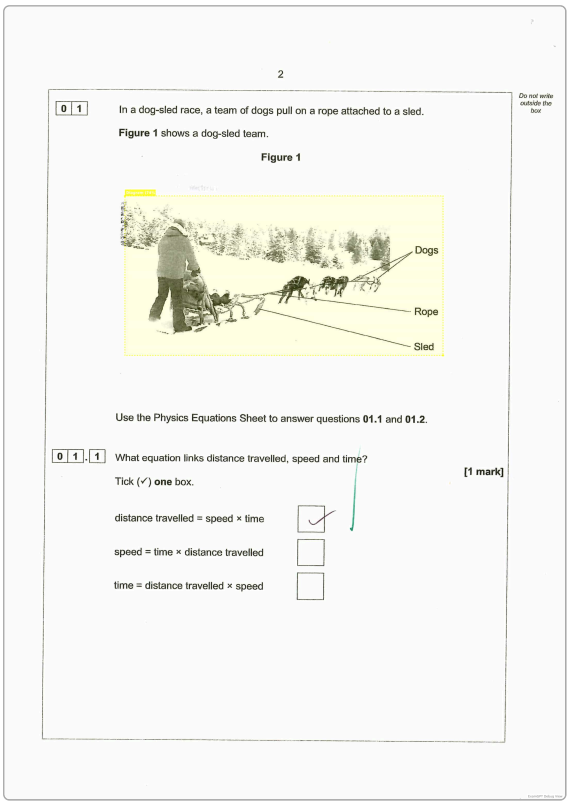
Question	Topic	Subtopic path	Spec	SPARX	Page	Marks Achieved	Max Marks	Marked
1.1	Forces	Forces and motion > Speed	6.5.6.1.2	–	2	1	1	✓
1.2	Forces	Forces and motion > Speed	6.5.6.1.2	–	3	3	3	✓
1.3	Forces	Forces and elasticity > Resultant forces	6.5.1.4	–	3	2	2	✓
1.4	Forces	Forces and motion > The distance-time relationship	6.5.6.1.4	–	4	0	1	✓
1.5	Forces	Forces and motion > Newton's First Law	6.5.6.2.1	–	5	1	1	✓
1.6	Forces	Forces and motion > Newton's Third Law	6.5.6.2.3	–	5	0	1	✓
2.1	Forces	Forces and motion > Acceleration	6.5.6.1.5	–	6	3	3	✓
2.2	Forces	Forces and motion > Stopping distance	6.5.6.3.1, 6.5.6.3.3, 6.5.6.3.2	–	7	4	6	✓
2.3	Forces	Forces and motion > Factors affecting braking distance 2	6.5.6.3.4	–	8	2	3	✓
3.1	Waves	Waves in air, fluids and solids > Transverse and longitudinal waves	6.6.1.1	–	9	0	2	✓
3.2	Waves	Electromagnetic waves > Properties of electromagnetic waves 2	6.6.2.3	–	9	1	1	✓
3.3	Waves	Electromagnetic waves > Types of electromagnetic waves	6.6.2.1	–	9	1	1	✓
3.4	Waves	Waves in air, fluids and solids > Properties of waves	6.6.1.2	–	10	3	4	✓
3.5	Waves	Electromagnetic waves > Properties of electromagnetic waves 1	6.6.2.2	–	11	0	2	✓
3.6	Waves	Electromagnetic waves > Properties of electromagnetic waves 1	6.6.2.2	–	12	0	2	✓
4.1	Magnetism and electromagnetism	The motor effect > Electromagnetism	6.7.2.1	–	14	2	2	✓
4.2	Magnetism and electromagnetism	The motor effect > Fleming's left-hand rule (HT only)	6.7.2.2	–	15	3	5	✓
4.3	Magnetism and electromagnetism	The motor effect > Electric motors (HT only)	6.7.2.3	–	16,17	1	5	✓
5.1	Waves	Black body radiation (physics only) > Emission and absorption of infrared radiation	6.6.3.1	–	19	0	1	✓
5.2	Waves	Black body radiation (physics only) > Emission	6.6.3.1	–	19	1	2	✓

Question	Topic	Subtopic path	Spec	SPARX	Page	Marks Achieved	Max Marks	Marked
		and absorption of infrared radiation						
5.3	Waves	Black body radiation (physics only) > Emission and absorption of infrared radiation	6.6.3.1	–	21	3	4	✓
5.4	Waves	Black body radiation (physics only) > Emission and absorption of infrared radiation	6.6.3.1	–	22	3	3	✓
5.5	Waves	Black body radiation (physics only) > Emission and absorption of infrared radiation	6.6.3.1	–	23	2	4	✓
6.1	Forces	Forces and motion > Speed	6.5.6.1.2	–	24	1	1	✓
6.2	Forces	Forces and motion > Acceleration	6.5.6.1.5, 6.1.1.2	–	25	6	6	✓
6.3	Forces	Forces and motion > Velocity	6.5.6.1.3	–	26	0	2	✓
6.4	Forces	Forces and motion > Acceleration	6.5.6.1.5	–	27	1	2	✓
TOTAL	-	-	-	-	-	**44**	**70**	-

Individual Question Results

Question 1.1 Forces > Forces and motion > Speed 6.5.6.1.2

Q: In a dog-sled race, a team of dogs pull on a rope attached to a sled (Figure 1 shows a dog-sled team). Use the Physics Equations Sheet. What equation links distance travelled, speed and time? Tick one box. Options: distance travelled = speed × time; speed = time × distance travelled; time = distance travelled × speed



2

0 1 In a dog-sled race, a team of dogs pull on a rope attached to a sled.

Figure 1 shows a dog-sled team.

Figure 1

Use the Physics Equations Sheet to answer questions 01.1 and 01.2.

0 1 . 1 What equation links distance travelled, speed and time? [1 mark]

Tick (✓) one box.

distance travelled = speed × time ✓

speed = time × distance travelled

time = distance travelled × speed

Student Response (OCR):

```
The student has ticked the box for: distance travelled =
speed × time
```

Marking Analysis:

AO1: Awarded — Correctly selected the equation distance travelled = speed × time.

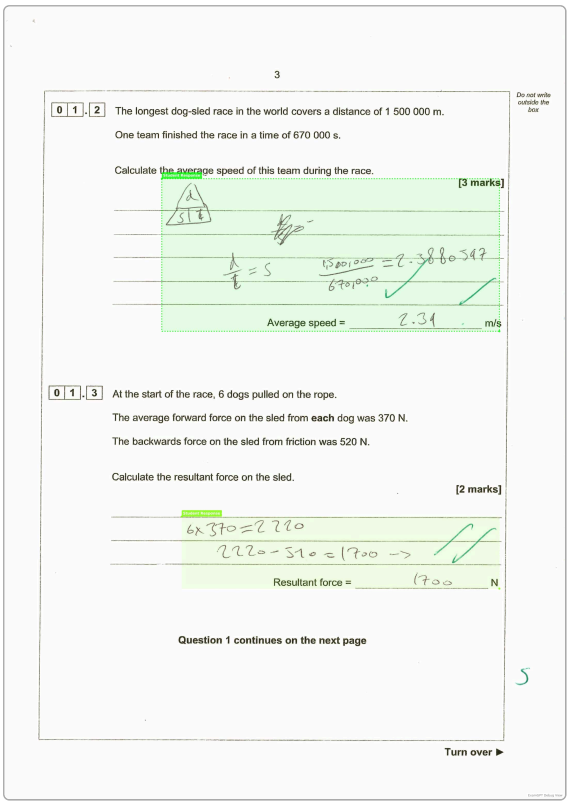
Total Marks: 1/1

Question 1.2

Forces > Forces and motion > Speed

6.5.6.1.2

Q: The longest dog-sled race in the world covers a distance of 1 500 000 m. One team finished the race in a time of 670 000 s. Calculate the average speed of this team during the race. Use the Physics Equations Sheet.



3

0 1 . 2 The longest dog-sled race in the world covers a distance of 1 500 000 m.

One team finished the race in a time of 670 000 s.

Calculate the average speed of this team during the race.

[3 marks]

Average speed = 2.31 m/s

0 1 . 3 At the start of the race, 6 dogs pulled on the rope.

The average forward force on the sled from **each** dog was 370 N.

The backwards force on the sled from friction was 520 N.

Calculate the resultant force on the sled.

[2 marks]

6 x 370 = 2220

2220 - 520 = 1700

Resultant force = 1700 N

Question 1 continues on the next page

5

Turn over ▶

Student Response (OCR):

A formula triangle is drawn with 'd' in the top section, 's' in the bottom left, and 't' in the bottom right.
[scribbled out text]
$\frac{d}{t} = s$
$\frac{1,500,000}{670,000} = 2.23880597$
Average speed = 2.24 m/s

Marking Analysis:

AO2.1: Awarded — You correctly identified and substituted the values for distance and time into the speed equation.

AO2.2: Awarded — You correctly rearranged the equation to show that speed equals distance divided by time ($v = \frac{1\,500\,000}{670\,000}$).

AO2.3: Awarded — You calculated the correct value of $2.24\ \text{m/s}$, which accurately rounds the unrounded answer of $2.2388...$.

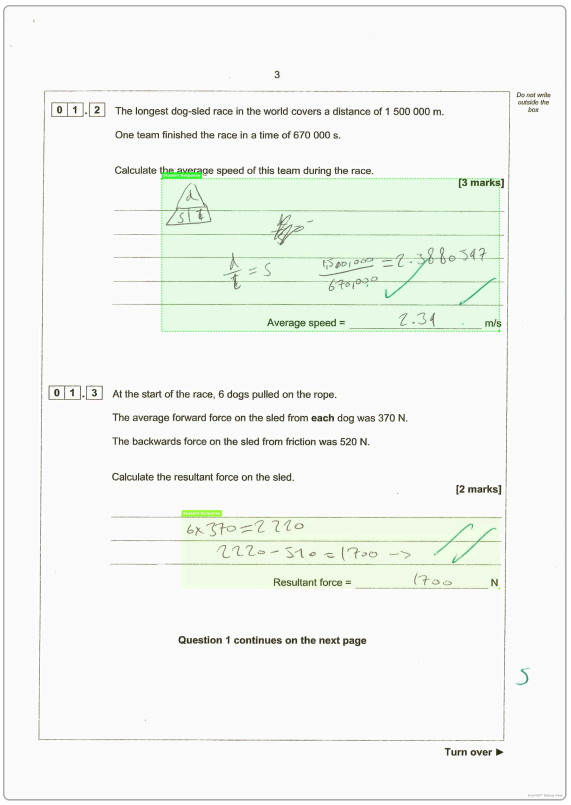
Total Marks: 3/3

Question 1.3

Forces > Forces and elasticity > Resultant forces

6.5.1.4

Q: At the start of the race, 6 dogs pulled on the rope. The average forward force on the sled from each dog was 370 N. The backwards force on the sled from friction was 520 N. Calculate the resultant force on the sled.



3

0 1 . 2 The longest dog-sled race in the world covers a distance of 1 500 000 m.

One team finished the race in a time of 670 000 s.

Calculate the average speed of this team during the race.

[3 marks]

Average speed = 2.31 m/s

0 1 . 3 At the start of the race, 6 dogs pulled on the rope.

The average forward force on the sled from **each** dog was 370 N.

The backwards force on the sled from friction was 520 N.

Calculate the resultant force on the sled.

[2 marks]

6x370=2220

2220-520=1700 →

Resultant force = 1700 N

Question 1 continues on the next page

5

Turn over ►

Student Response (OCR):

$6 \times 370 = 2220$
$2220 - 520 = 1700 \rightarrow$
Resultant force = 1700 N

Marking Analysis:

AO2.1: Awarded — Correct method shown by multiplying the force of each dog by 6 and subtracting the frictional force: $(6 \times 370) - 520$.

AO2.2: Awarded — Correct resultant force calculated as $1700\ \text{N}$.

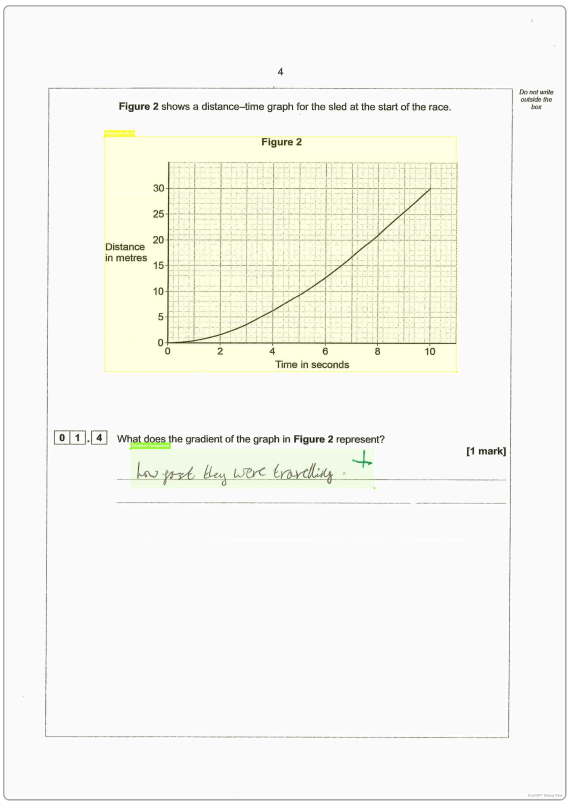
Total Marks: 2/2

Question 1.4

Forces > Forces and motion > The distance-time relationship

6.5.6.1.4

Q: Figure 2 shows a distance-time graph for the sled at the start of the race (a curve of increasing gradient, distance rising from 0 to 30 m over 10 s). What does the gradient of the graph in Figure 2 represent?



4

Figure 2 shows a distance–time graph for the sled at the start of the race.

Do not write outside the box

Figure 2

0 1 . 4 What does the gradient of the graph in **Figure 2** represent?

how fast they were travelling +

[1 mark]

Student Response (OCR):

how fast they were travelling

Marking Analysis:

AO1: Not Awarded — The mark required naming the physical quantity **speed** (or velocity). The response described the motion informally as 'how fast they were travelling' rather than giving the specific quantity. For a distance-time graph, state **speed**.

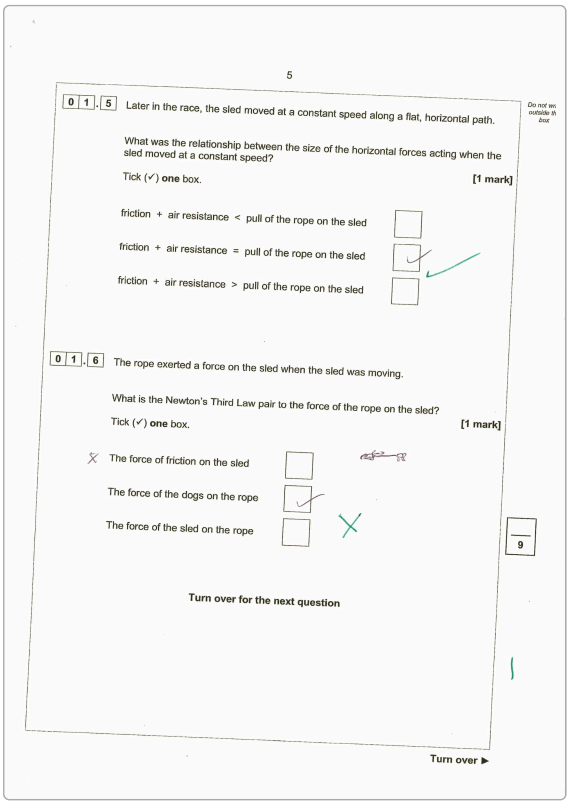
Total Marks: 0/1

Question 1.5

Forces > Forces and motion > Newton's First Law

6.5.6.2.1

Q: Later in the race, the sled moved at a constant speed along a flat, horizontal path. What was the relationship between the size of the horizontal forces acting when the sled moved at a constant speed? Tick one box. Options: friction + air resistance < pull of the rope on the sled; friction + air resistance = pull of the rope on the sled; friction + air resistance > pull of the rope on the sled



5

0 1 . 5 Later in the race, the sled moved at a constant speed along a flat, horizontal path.

Do not write outside the box

What was the relationship between the size of the horizontal forces acting when the sled moved at a constant speed?

Tick (✓) **one** box. **[1 mark]**

friction + air resistance < pull of the rope on the sled ☐

friction + air resistance = pull of the rope on the sled ☑

friction + air resistance > pull of the rope on the sled ☐

0 1 . 6 The rope exerted a force on the sled when the sled was moving.

What is the Newton's Third Law pair to the force of the rope on the sled?

Tick (✓) **one** box. **[1 mark]**

✗ The force of friction on the sled ☐

The force of the dogs on the rope ☑

The force of the sled on the rope ☐ ✗

9

Turn over for the next question

Turn over ▶

Student Response (OCR):

```
The student has ticked the second box, selecting the option:
friction + air resistance = pull of the rope on the sled
```

Marking Analysis:

AO1: Awarded — Correctly identified that 'friction + air resistance = pull of the rope on the sled', showing that resistive forces balance the forward force when an object moves at a constant speed.

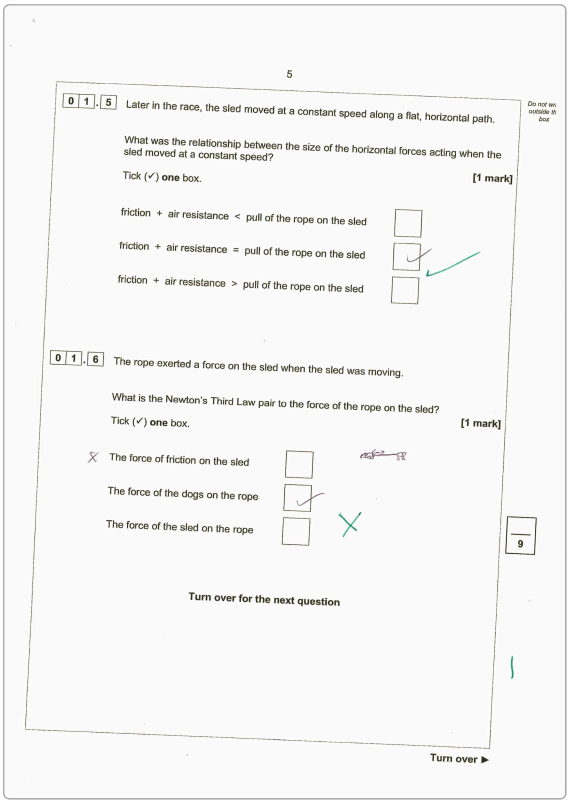
Total Marks: 1/1

Question 1.6

Forces > Forces and motion > Newton's Third Law

6.5.6.2.3

Q: The rope exerted a force on the sled when the sled was moving. What is the Newton's Third Law pair to the force of the rope on the sled? Tick one box. Options: The force of friction on the sled; The force of the dogs on the rope; The force of the sled on the rope



5

0 1 . 5 Later in the race, the sled moved at a constant speed along a flat, horizontal path.

Do not write outside the box

What was the relationship between the size of the horizontal forces acting when the sled moved at a constant speed?

Tick (✓) **one** box. **[1 mark]**

friction + air resistance < pull of the rope on the sled ☐

friction + air resistance = pull of the rope on the sled ☑

friction + air resistance > pull of the rope on the sled ☐

0 1 . 6 The rope exerted a force on the sled when the sled was moving.

What is the Newton's Third Law pair to the force of the rope on the sled?

Tick (✓) **one** box. **[1 mark]**

☒ The force of friction on the sled ☐

The force of the dogs on the rope ☑

The force of the sled on the rope ☐

9

Turn over for the next question

Turn over ▶

Student Response (OCR):

```
Selected answer: The force of the dogs on the rope (The
student has ticked the second box).
[Note: There is also a faint 'X' marked to the left of the
first option and a small scribble to the right of the first
option's text.]
```

Marking Analysis:

AO1: Not Awarded — The mark required identifying 'the force of the sled on the rope'. You selected 'The force of the dogs on the rope'. Newton's third law states that whenever two objects interact, they exert equal and opposite forces on each other, so the pair to the force of the rope on the sled must be the force of the sled on the rope.

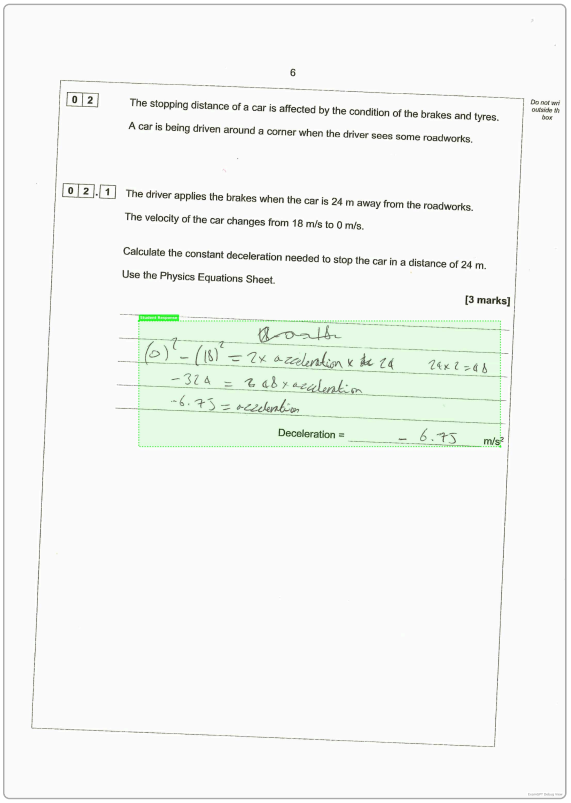
Total Marks: 0/1

Question 2.1

Forces > Forces and motion > Acceleration

6.5.6.1.5

Q: The stopping distance of a car is affected by the condition of the brakes and tyres. A car is being driven around a corner when the driver sees some roadworks. The driver applies the brakes when the car is 24 m away from the roadworks. The velocity of the car changes from 18 m/s to 0 m/s. Calculate the constant deceleration needed to stop the car in a distance of 24 m. Use the Physics Equations Sheet.



Student Response (OCR):

```
[scribbled out (illegible)]
(0)^2 − (18)^2 = 2 × acceleration× [scribbled out (illegible)] 24
24 \times 2 = 48$
−324 = [scribbled out (illegible)] 48 × acceleration
−6.75 = acceleration
Deceleration = - 6.75 m/s$^2
```

Marking Analysis:

AO2.1: Awarded — Correct substitution into $v^2 - u^2 = 2as$ as $(0)^2 - (18)^2 = 2 \times a \times 24$.

AO2.2: Awarded — Correct rearrangement of the values to solve for acceleration, shown via $-324 = 48 \times a$.

AO2.3: Awarded — Correct calculation giving $-6.75\ \text{m/s}^2$.

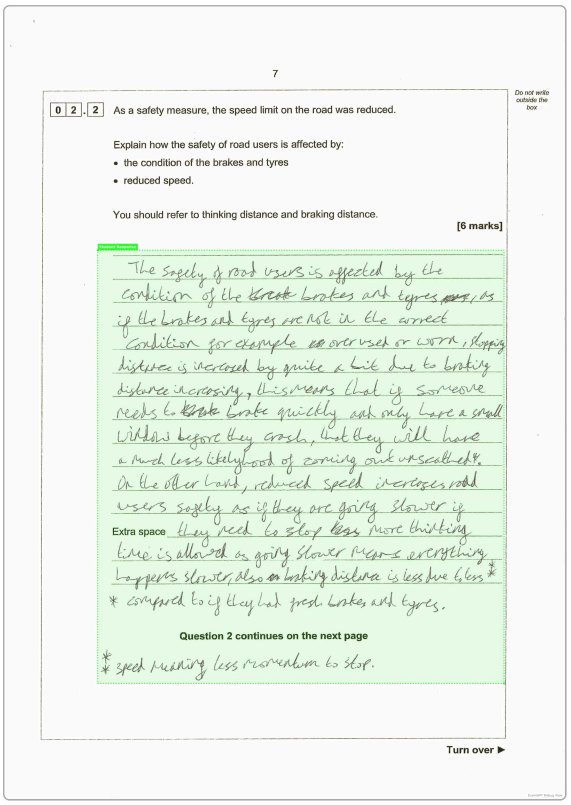
Total Marks: 3/3

Question 2.2

Forces > Forces and motion > Stopping distance

6.5.6.3.1, 6.5.6.3.3, 6.5.6.3.2

Q: As a safety measure, the speed limit on the road was reduced. Explain how the safety of road users is affected by: the condition of the brakes and tyres; reduced speed. You should refer to thinking distance and braking distance.



7

0 2 . 2 As a safety measure, the speed limit on the road was reduced.

Do not write outside the box

Explain how the safety of road users is affected by:

- the condition of the brakes and tyres
- reduced speed.

You should refer to thinking distance and braking distance.

[6 marks]

Student Response

The safety of road users is affected by the condition of the ~~break~~ brakes and tyres ~~are~~, as if the brakes and tyres are not in the correct condition for example ~~are~~ overused or worn, stopping distance is increased by quite a bit due to braking distance increasing, this means that if someone needs to ~~break~~ brake quickly and only have a small window before they crash, that they will have a much less likelyhood of coming out unscathed*.
On the other hand, reduced speed increases road users safety as if they are going slower if they need to stop Extra space [scribbled out less] more thinking time is allowed as going slower means everything happens slower, also ~~as~~ braking distance is less due to less**

* compared to if they had fresh brakes and tyres.

Question 2 continues on the next page

** speed meaning less momentum to stop.

Turn over ▶

Student Response (OCR):

```
The safety of road users is affected by the condition of the
[scribbled out break] brakes and tyres [scribbled out are,],
as if the brakes and tyres are not in the correct condition
for example [scribbled out are] overused or worn, stopping
distance is increased by quite a bit due to braking distance
increasing, this means that if someone needs to [scribbled
out brake] brake quickly and only have a small window before
they crash, that they will have a much less likelyhood of
coming out unscathed*.
On the other hand, reduced speed increases road users safety
as if they are going slower if they need to stop [scribbled
out less] more thinking time is allowed as going slower
means everything happens slower, also [scribbled out as]
braking distance is less due to less**
• compared to if they had fresh brakes and tyres.
** speed meaning less momentum to stop.
```

Marking Analysis:

AO1: Awarded — Level 2 (4 marks): relevant points identified with attempts at logical linking, but the account is not fully clear and contains a misconception regarding reaction time.

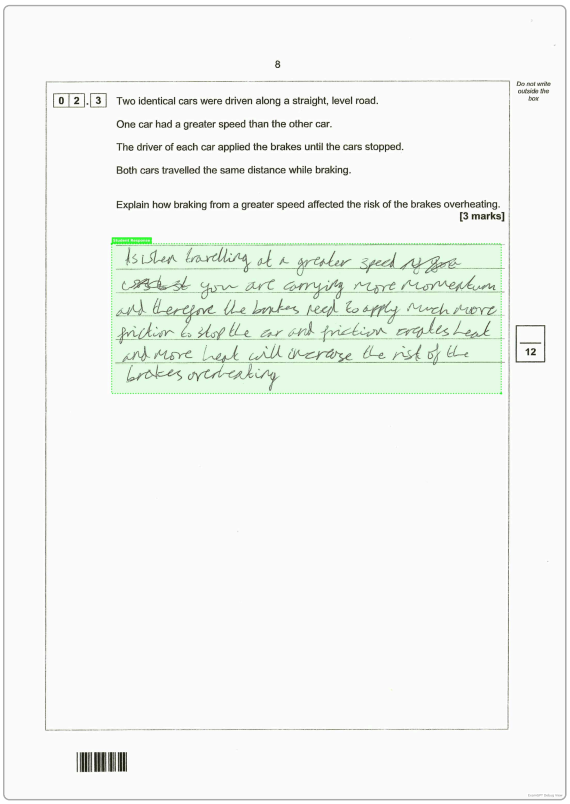
- Correctly linked worn tyres and brakes to an increased braking distance and overall stopping distance, increasing collision risk.
- Correctly linked lower vehicle speed to a reduced braking distance.
- Clarify that lower speed decreases thinking distance because less distance is covered during the driver's reaction time, rather than giving "more thinking time".
- State that driver reaction time itself is not changed by the speed of the car.
- Mention that tyre condition affects the friction between the tyres and the road surface.

Total Marks: 4/6

Question 2.3

Forces > Forces and motion > Factors affecting braking distance 2 | 6.5.6.3.4

Q: Two identical cars were driven along a straight, level road. One car had a greater speed than the other car. The driver of each car applied the brakes until the cars stopped. Both cars travelled the same distance while braking. Explain how braking from a greater speed affected the risk of the brakes overheating.



8

0 2 . 3 Two identical cars were driven along a straight, level road.

One car had a greater speed than the other car.

The driver of each car applied the brakes until the cars stopped.

Both cars travelled the same distance while braking.

Explain how braking from a greater speed affected the risk of the brakes overheating. **[3 marks]**

Do not write outside the box

Student Response

As when travelling at a greater speed ~~(if you)~~ ~~(cars st)~~ you are carrying more momentum and therefore the brakes need to apply much more friction to stop the car and friction creates heat and more heat will increase the risk of the brakes overheating

12

Student Response (OCR):

```
As when travelling at a greater speed [scribbled out (if
you)]
[scribbled out (cars st)] you are carrying more momentum
and therefore the brakes need to apply much more
friction to stop the car and friction creates heat
and more heat will increase the risk of the
brakes overheating
```

Marking Analysis:

AO1: Awarded — You correctly identified that the frictional force needed is greater, stating that 'the brakes need to apply much more friction to stop the car'.

AO3.1: Not Awarded — The mark required stating that more work is done by the brakes (or that more energy is transferred). You wrote that 'friction creates heat', but describing heat rather than scientific work done or energy transfer is insufficient.

AO3.2: Awarded — You clearly concluded that this will 'increase the risk of the brakes overheating', which satisfies this dependent mark.

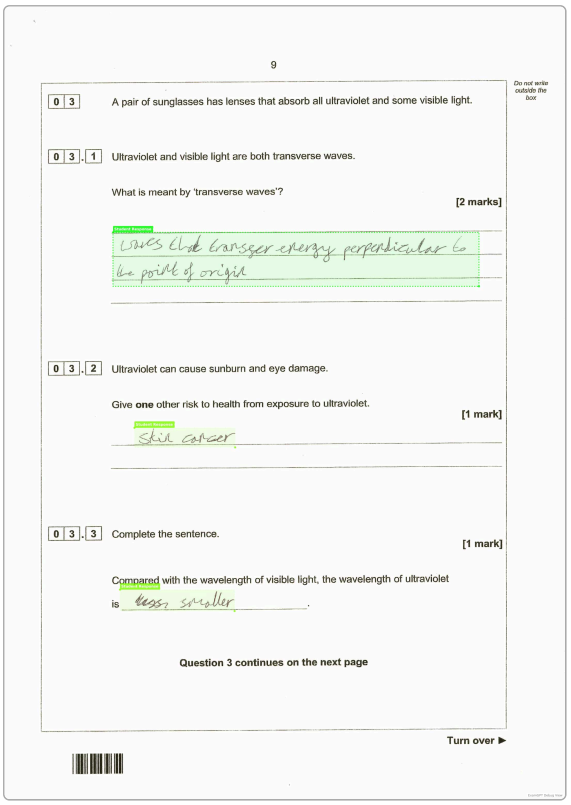
Total Marks: 2/3

Question 3.1

Waves > Waves in air, fluids and solids > Transverse and longitudinal waves

6.6.1.1

Q: A pair of sunglasses has lenses that absorb all ultraviolet and some visible light. Ultraviolet and visible light are both transverse waves. What is meant by 'transverse waves'?



9

Do not write outside the box

0 3 A pair of sunglasses has lenses that absorb all ultraviolet and some visible light.

0 3 . 1 Ultraviolet and visible light are both transverse waves.

What is meant by 'transverse waves'?

[2 marks]

Student Response

waves that transfer energy perpendicular to the point of origin

0 3 . 2 Ultraviolet can cause sunburn and eye damage.

Give **one** other risk to health from exposure to ultraviolet.

[1 mark]

Student Response

skin cancer

0 3 . 3 Complete the sentence.

[1 mark]

Compared with the wavelength of visible light, the wavelength of ultraviolet is less, smaller.

Question 3 continues on the next page

Turn over ▶

Student Response (OCR):

```
waves that transfer energy perpendicular to the point of
origin
```

Marking Analysis:

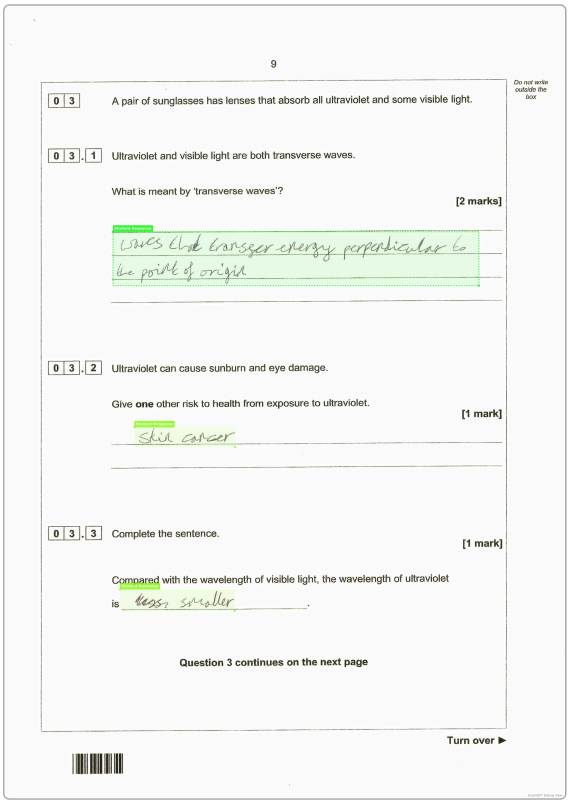
AO1: Not Awarded — A transverse wave is defined as having oscillations or vibrations that are perpendicular to the direction of energy transfer (or wave travel). You mentioned energy transfer being 'perpendicular to the point of origin', missing both the mention of 'oscillations' or 'vibrations' and the correct reference to the direction of energy transfer.

Total Marks: 0/2

Question 3.2

Waves > Electromagnetic waves > Properties of electromagnetic waves 2 | 6.6.2.3

Q: Ultraviolet can cause sunburn and eye damage. Give one other risk to health from exposure to ultraviolet.



9

Do not write outside the box

0 3 A pair of sunglasses has lenses that absorb all ultraviolet and some visible light.

0 3 . 1 Ultraviolet and visible light are both transverse waves.

What is meant by 'transverse waves'?

[2 marks]

Student Response

waves that transfer energy perpendicular to the point of origin

0 3 . 2 Ultraviolet can cause sunburn and eye damage.

Give **one** other risk to health from exposure to ultraviolet.

[1 mark]

Student Response

skin cancer

0 3 . 3 Complete the sentence.

[1 mark]

Compared with the wavelength of visible light, the wavelength of ultraviolet is less, smaller.

Question 3 continues on the next page

Turn over ▶

Student Response (OCR):

skin cancer

Marking Analysis:

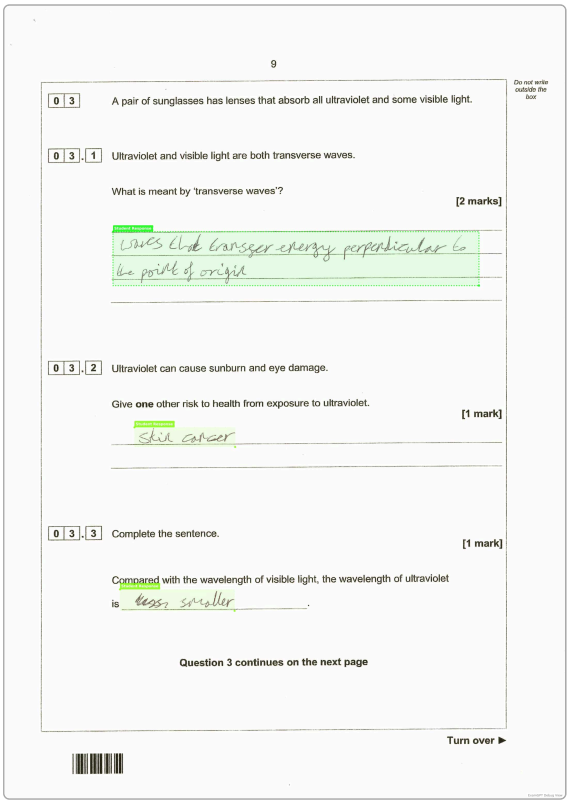
AO1: Awarded — You correctly identified 'skin cancer' as a health risk from exposure to ultraviolet radiation.

Total Marks: 1/1

Question 3.3

Waves > Electromagnetic waves > Types of electromagnetic waves | 6.6.2.1

Q: Complete the sentence. Compared with the wavelength of visible light, the wavelength of ultraviolet is _____.



9

Do not write outside the box

0 3 A pair of sunglasses has lenses that absorb all ultraviolet and some visible light.

0 3 . 1 Ultraviolet and visible light are both transverse waves.

What is meant by 'transverse waves'?

[2 marks]

Student Response

waves that transfer energy perpendicular to the point of origin

0 3 . 2 Ultraviolet can cause sunburn and eye damage.

Give **one** other risk to health from exposure to ultraviolet.

[1 mark]

Student Response

skin cancer

0 3 . 3 Complete the sentence.

[1 mark]

Compared with the wavelength of visible light, the wavelength of ultraviolet

Student Response

is ~~less~~ smaller.

Question 3 continues on the next page

Turn over ▶

Student Response (OCR):

```
is [scribbled out (less)] smaller
```

Marking Analysis:

AO1: Awarded — The mark scheme requires 'shorter', and 'smaller' is accepted as an equivalent description of a decreased wavelength.

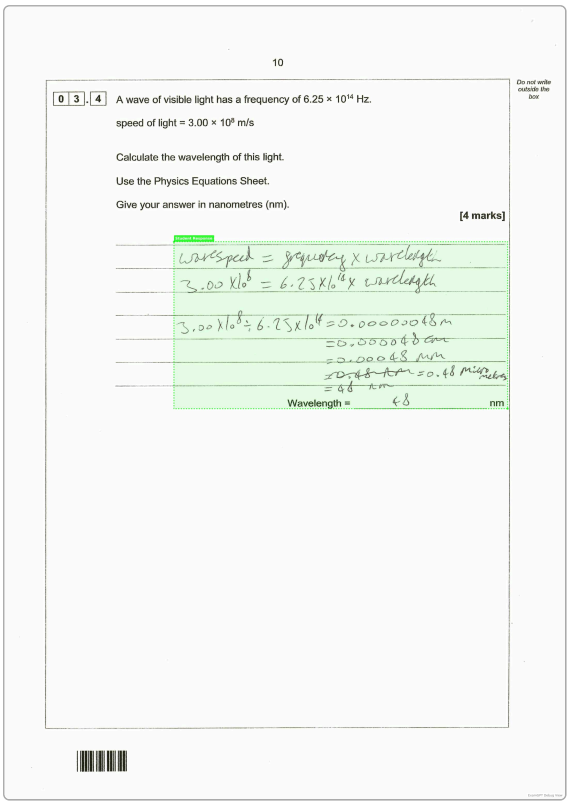
Total Marks: 1/1

Question 3.4

Waves > Waves in air, fluids and solids > Properties of waves

6.6.1.2

Q: A wave of visible light has a frequency of 6.25 × 10^{14} Hz. speed of light = 3.00 × 10^{8} m/s. Calculate the wavelength of this light. Use the Physics Equations Sheet. Give your answer in nanometres (nm).



Student Response (OCR):

$wavespeed = frequency \times wavelength$
$3.00 \times 10^{8} = 6.25 \times 10^{14} \times wavelength$
$3.00 \times 10^{8} \div 6.25 \times 10^{14} = 0.00000048m$
$= 0.000048cm$
$= 0.00048mm$
$= 0.48$ [scribbled out nm] $= 0.48micrometres$
$= 48$ [scribbled out nm]
Wavelength = 48 nm

Marking Analysis:

AO2.1: Awarded — Correct substitution of values into the wave equation: $3.00 \times 10^{8} = 6.25 \times 10^{14} \times \text{wavelength}$.

AO2.2: Awarded — Correct rearrangement to make wavelength the subject: $3.00 \times 10^{8} \div 6.25 \times 10^{14}$.

AO2.3: Awarded — Correctly calculated the wavelength in metres as 0.00000048 m (4.80×10^{-7} m).

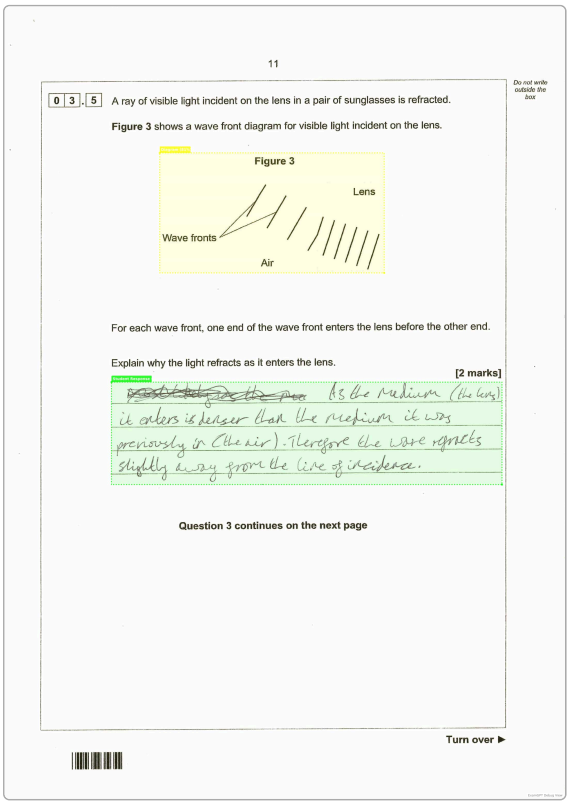
AO2.4: Not Awarded — The final answer required 480 nm, but the response gave '48 nm'. To convert from metres to nanometres, multiply by 10^{9} ($0.00000048 \times 10^{9} = 480$ nm) or multiply micrometres by 1000 ($0.48 \times 1000 = 480$ nm).

Total Marks: 3/4

Question 3.5

Waves > Electromagnetic waves > Properties of electromagnetic waves 1 | 6.6.2.2

Q: A ray of visible light incident on the lens in a pair of sunglasses is refracted. Figure 3 shows a wave front diagram for visible light travelling through air (wave fronts at an angle) incident on the lens. For each wave front, one end of the wave front enters the lens before the other end. Explain why the light refracts as it enters the lens.



11

0 3 . 5 A ray of visible light incident on the lens in a pair of sunglasses is refracted.

Do not write outside the box

Figure 3 shows a wave front diagram for visible light incident on the lens.

Figure 3

For each wave front, one end of the wave front enters the lens before the other end.

Explain why the light refracts as it enters the lens.

[2 marks]

~~As the medium (the lens)~~ As the medium (the lens) it enters is denser than the medium it was previously in (the air). Therefore the wave refracts slightly away from the line of incidence.

Question 3 continues on the next page

Turn over ▶

Student Response (OCR):

```
[scribbled out (illegible)] As the medium (the lens)
it enters is denser than the medium it was
previously in (the air). Therefore the wave refracts
slightly away from the line of incidence.
```

Marking Analysis:

AO1.1: Not Awarded — This mark requires stating that the speed of light decreases as it enters the lens. Stating that the lens is 'denser than the medium it was previously in' is insufficient, as density changes must be linked to the light wave slowing down.

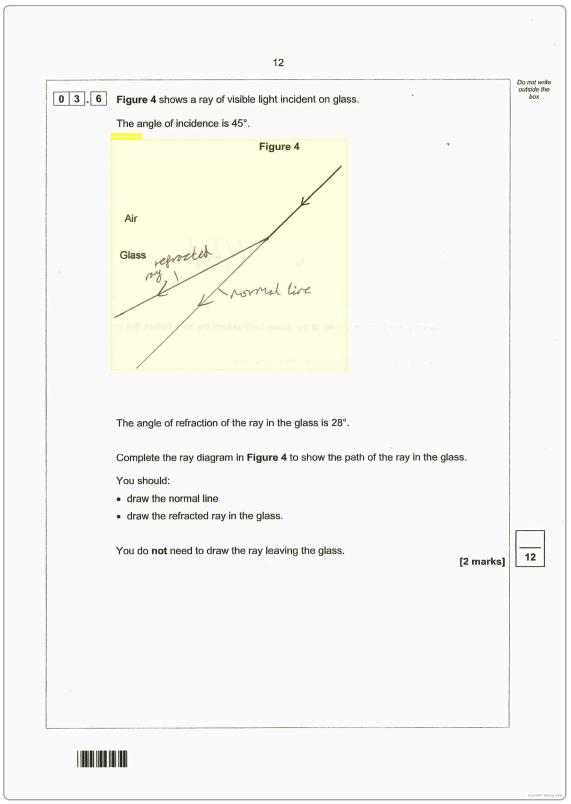
AO1.2: Not Awarded — This mark requires explaining that one end of the wavefront slows down before the other end. The response did not mention wavefronts or the effect of one part of the wave changing speed before the rest.

Total Marks: 0/2

Question 3.6

Waves > Electromagnetic waves > Properties of electromagnetic waves 1 | 6.6.2.2

Q: Figure 4 shows a ray of visible light incident on glass, travelling from air, with the angle of incidence 45°. The angle of refraction of the ray in the glass is 28°. Complete the ray diagram in Figure 4 to show the path of the ray in the glass. You should: draw the normal line; draw the refracted ray in the glass. You do not need to draw the ray leaving the glass.



Student Response (OCR) ⚡:

Based on the image provided, here is the description of the student's handwritten response for Question 3.6:
The student has drawn two solid lines on the diagram, both originating from the end of the printed incident ray (the point of incidence):

- **Line 1:** A line extending downwards and to the left into the "Glass" area, with a directional arrowhead drawn on it pointing away from the point of incidence. The student has written "**refracted ray**" and drawn an arrow pointing from the text to this line.
- **Line 2:** A second line extending downwards and to the left from the point of incidence, drawn at a steeper, more vertical angle than the first line. The student has written "**normal line**" and drawn an arrow pointing from the text to this second line.

Marking Analysis ⚡: Gemini 3.1 Pro

AO2.1: Not Awarded — The mark requires a "normal line drawn" perpendicular to the boundary between the two media. The line labelled "normal line" is drawn at a diagonal angle rather than 90° to the implied horizontal boundary, and incorrectly includes a directional arrow. To earn this mark, draw a straight, vertical line perpendicular to the boundary at the exact point where the incident ray ends.

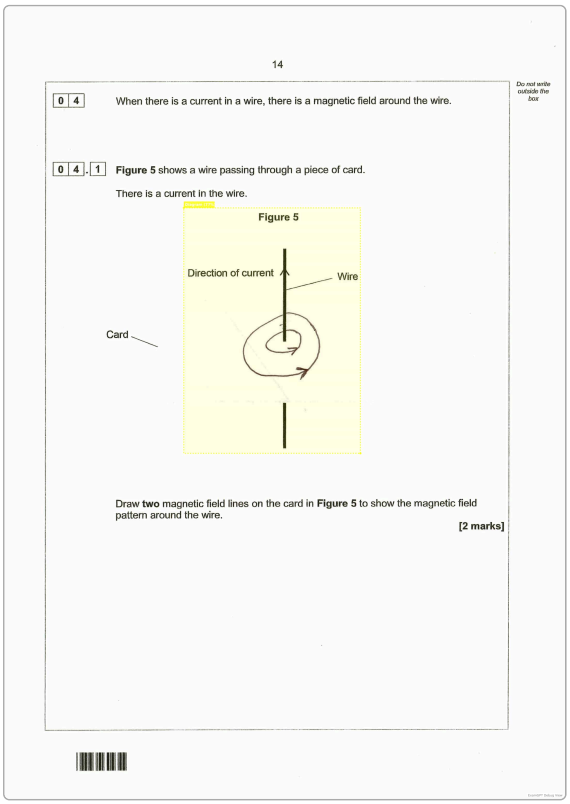
AO2.2: Not Awarded — This mark requires a "ray drawn with an angle of refraction of 28°". The line labelled "refracted ray" bends away from the vertical normal, resulting in an angle much larger than 28°. To earn this mark, use a protractor to measure 28° from the normal line and draw the refracted ray inside the glass.

Total Marks: 0/2

Question 4.1

Magnetism and electromagnetism > The motor effect > Electromagnetism | 6.7.2.1

Q: When there is a current in a wire, there is a magnetic field around the wire. Figure 5 shows a wire passing through a piece of card, with a current in the wire in the direction shown (upwards). Draw two magnetic field lines on the card in Figure 5 to show the magnetic field pattern around the wire.



14

0 4 When there is a current in a wire, there is a magnetic field around the wire.

Do not write outside the box

0 4 . 1 **Figure 5** shows a wire passing through a piece of card.

There is a current in the wire.

Figure 5

Draw **two** magnetic field lines on the card in **Figure 5** to show the magnetic field pattern around the wire.

[2 marks]

Student Response (OCR) ⚡:

Based on the provided image, here is a description of the student's handwritten response for Question 4.1:

The student has drawn two roughly concentric, closed oval loops around the central wire on the area representing the 'Card'.

- The inner loop has an arrowhead on its bottom section pointing to the right.
- The outer loop has an arrowhead on its lower-right section pointing to the right.

Both arrows indicate a counter-clockwise direction for the magnetic field.

Marking Analysis ⚡: Gemini 3.1 Pro

AO1.1: Awarded — The mark requires at least 2 concentric rings around the point where the wire passes through the card. This response successfully provides two concentric loops around the central wire on the card.

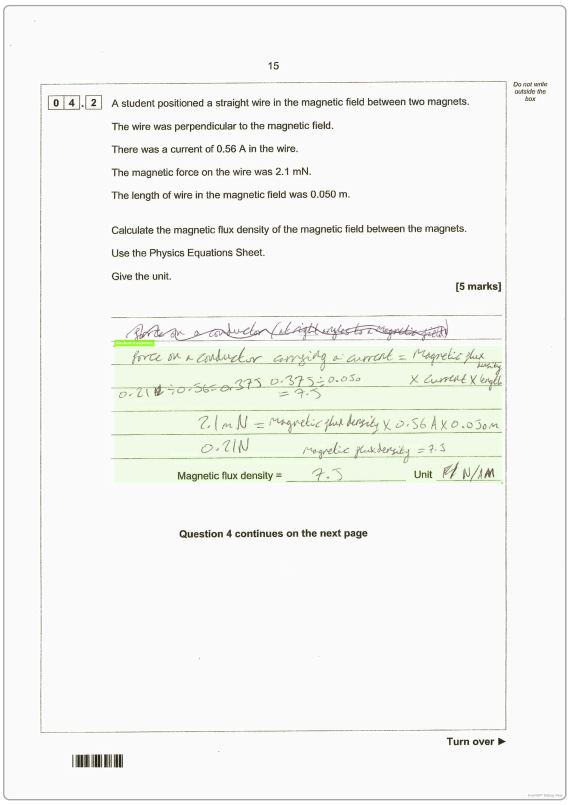
AO1.2: Awarded — The mark requires arrow(s) drawn in an anticlockwise direction around the wire. This response correctly includes arrows on the lower section of the loops pointing to the right, which indicates a counter-clockwise direction.

Total Marks: 2/2

Question 4.2

Magnetism and electromagnetism > The motor effect > Fleming's left-hand rule (HT only) | 6.7.2.2

Q: A student positioned a straight wire in the magnetic field between two magnets. The wire was perpendicular to the magnetic field. There was a current of 0.56 A in the wire. The magnetic force on the wire was 2.1 mN. The length of wire in the magnetic field was 0.050 m. Calculate the magnetic flux density of the magnetic field between the magnets. Use the Physics Equations Sheet. Give the unit.



15

0 4 . 2 A student positioned a straight wire in the magnetic field between two magnets.

The wire was perpendicular to the magnetic field.

There was a current of 0.56 A in the wire.

The magnetic force on the wire was 2.1 mN.

The length of wire in the magnetic field was 0.050 m.

Calculate the magnetic flux density of the magnetic field between the magnets.

Use the Physics Equations Sheet.

Give the unit.

[5 marks]

Do not write outside the box

~~Force on a conductor (at right angles to a magnetic field)~~

force on a conductor carrying a current = Magnetic flux density X current X length

0.21 ÷ 0.56 = 0.375 0.375 ÷ 0.050 = 7.5

2.1mN = magnetic flux density X 0.56A X 0.050m

0.21N magnetic flux density = 7.5

Magnetic flux density = 7.5 Unit ~~T~~ N/AM

Question 4 continues on the next page

Turn over ▶

Student Response (OCR):

```
[scribbled out: force on a conductor (at right angles to a
magnetic field)]
force on a conductor carrying a current = Magnetic flux
density X Current X length
0.21 [scribbled out: N] ÷0.56 = 0.3750.375 \div 0.050 = 7.5$
2.1mN = magnetic flux density × 0.56A × 0.050m
0.21N\text{magnetic flux density} = 7.5$
Magnetic flux density = 7.5 Unit [scribbled out: T] N/AM
```

Marking Analysis:

AO2.1: Not Awarded — To convert millinewtons to newtons, divide by 1000 to get $0.0021\ \text{N}$; writing '0.21 N' divides by 10 instead of 1000.

AO2.2: Awarded — Correct substitution of current and length into $F = B \times I \times L$ using your converted force value.

AO2.3: Awarded — Correct rearrangement showing magnetic flux density calculated by dividing force by (0.56×0.050).

AO2.4: Awarded — Correct numerical evaluation of 7.5 awarded with error carried forward from using $0.21\ \text{N}$.

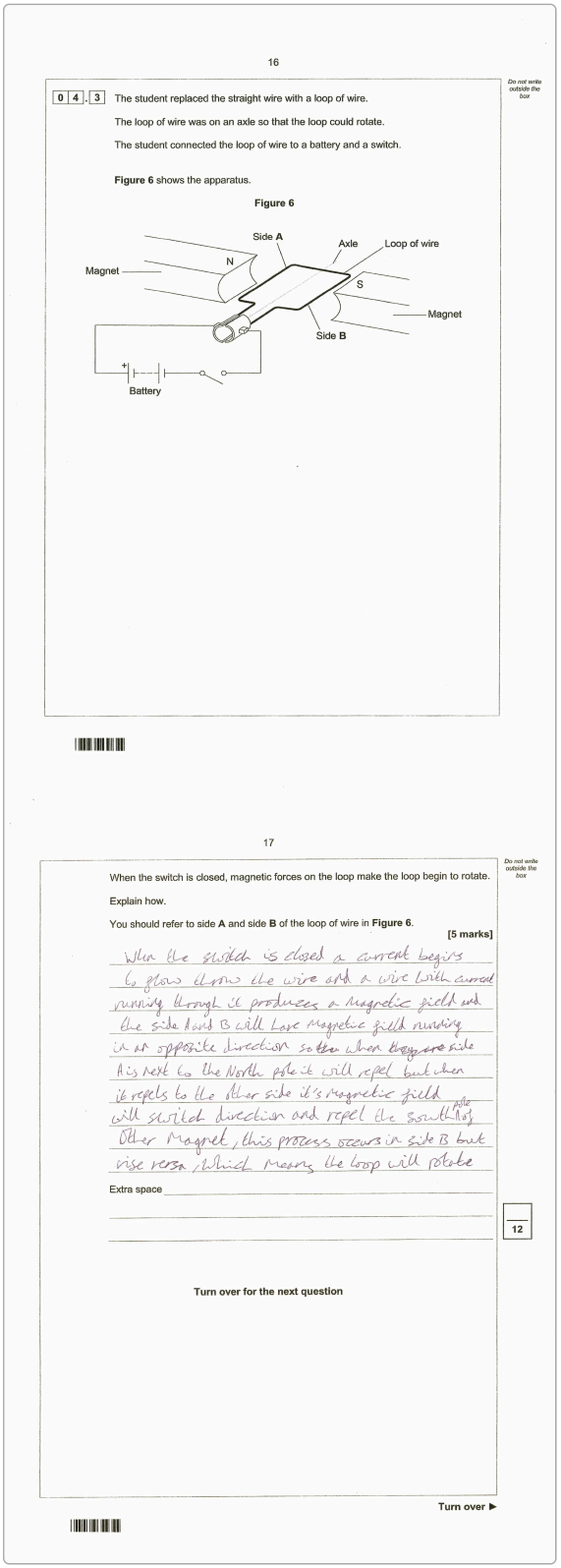
AO1: Not Awarded — The unit required is 'tesla' or 'T'; you crossed out 'T' and gave 'N/AM'.

Total Marks: 3/5

Question 4.3

Magnetism and electromagnetism > The motor effect > Electric motors (HT only) | 6.7.2.3

Q: The student replaced the straight wire with a loop of wire on an axle so the loop could rotate, connected to a battery and a switch. Figure 6 shows the apparatus: a loop of wire between a N pole magnet (left, near side A) and a S pole magnet (right, near side B), on an axle, connected to a battery via a switch. When the switch is closed, magnetic forces on the loop make the loop begin to rotate. Explain how. You should refer to side A and side B of the loop of wire in Figure 6.



16

0 4 . 3 The student replaced the straight wire with a loop of wire.

The loop of wire was on an axle so that the loop could rotate.

The student connected the loop of wire to a battery and a switch.

Figure 6 shows the apparatus.

Figure 6

Do not write outside the box

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When the switch is closed, magnetic forces on the loop make the loop begin to rotate.

Explain how.

You should refer to side **A** and side **B** of the loop of wire in **Figure 6**.

[5 marks]

When the switch is closed a current begins to flow throw the wire and a wire with current running through it produces a magnetic field and the side A and B will have magnetic field running in an opposite direction so [scribbled out when they are] side A is next to the North pole it will repel but when it repels to the other side it's magnetic field will switch direction and repel the south pole of Other Magnet, this process occurs in side B but vise versa, Which means the loop will rotate

Extra space

12

Turn over for the next question

Turn over ▶

Student Response (OCR):

```
When the switch is closed a current begins
to flow throw the wire and a wire with current
running through it produces a magnetic field and
the side A and B will have magnetic field running
in an opposite direction so [scribbled out when they are]
side
A is next to the North pole it will repel but when
it repels to the other side it's magnetic field
will switch direction and repel the south pole of
Other Magnet, this process occurs in side B but
vise versa, Which means the loop will rotate
```

Marking Analysis:

AO1.1: Not Awarded — You did not state that there is a magnetic field between the poles of the permanent magnets. To earn this mark, state that a magnetic field exists between the North and South poles of the magnets.

AO1.2: Awarded — You correctly stated that 'a wire with current running through it produces a magnetic field'.

AO1.3: Not Awarded — You mentioned that 'side A and B will have magnetic field running in an opposite direction', but the mark required stating that the **current** flows in opposite directions in side A and side B.

AO1.4: Not Awarded — You described the sides repelling the poles rather than stating that opposite vertical forces act on side A and side B.

AO1.5: Not Awarded — You concluded only that 'the loop will rotate' without identifying the direction of the forces (force on side A is downwards or force on side B is upwards) or specifying anticlockwise rotation.

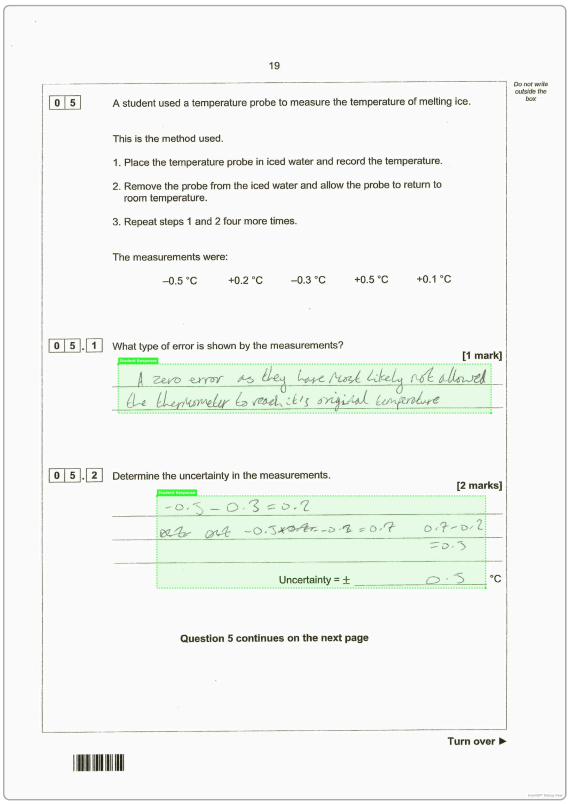
Total Marks: 1/5

Question 5.1

Waves > Black body radiation (physics only) > Emission and absorption of infrared radiation

6.6.3.1

Q: A student used a temperature probe to measure the temperature of melting ice. Method: 1. Place probe in iced water and record temperature. 2. Remove probe and allow to return to room temperature. 3. Repeat steps 1 and 2 four more times. The measurements were: −0.5 °C, +0.2 °C, −0.3 °C, +0.5 °C, +0.1 °C. What type of error is shown by the measurements?



19

0 5 A student used a temperature probe to measure the temperature of melting ice.

Do not write outside the box

This is the method used.

1. Place the temperature probe in iced water and record the temperature.
2. Remove the probe from the iced water and allow the probe to return to room temperature.
3. Repeat steps 1 and 2 four more times.

The measurements were:

−0.5 °C +0.2 °C −0.3 °C +0.5 °C +0.1 °C

0 5 . 1 What type of error is shown by the measurements? [1 mark]

Student Response

A zero error as they have most likely not allowed the thermometer to reach it's original temperature

0 5 . 2 Determine the uncertainty in the measurements. [2 marks]

Student Response

-0.5 − 0.3 = 0.2

or -0.5 - -0.2 = 0.7 0.7 − 0.2 = 0.3

Uncertainty = ± 0.5 °C

Question 5 continues on the next page

Turn over ▶

Student Response (OCR):

```
A zero error as they have most likely not allowed the
thermometer to reach it's original temperature
```

Marking Analysis:

AO3: Not Awarded — The mark requires identifying the error as 'random'. The response gives 'zero error', but because the measurements fluctuate both above and below the true value (0 °C), this represents random error rather than a consistent offset like a zero error.

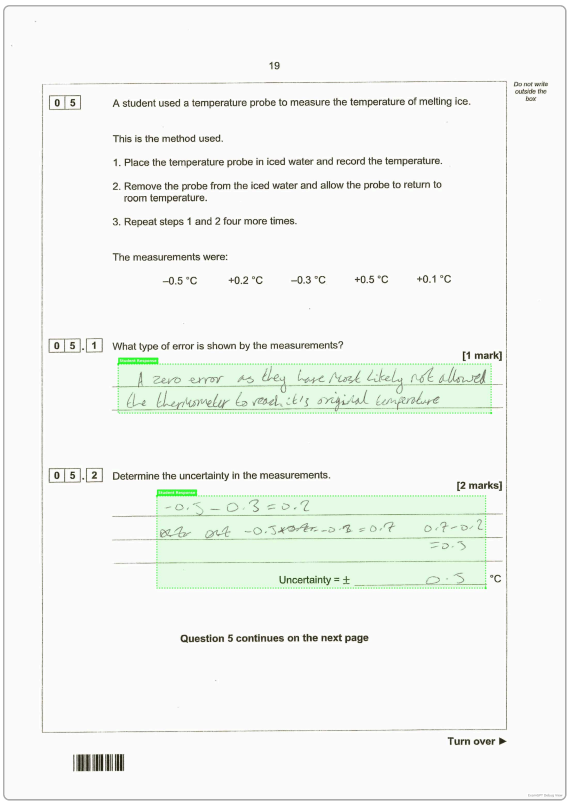
Total Marks: 0/1

Question 5.2

Waves > Black body radiation (physics only) > Emission and absorption of infrared radiation

6.6.3.1

Q: Using the melting ice temperature measurements (−0.5 °C, +0.2 °C, −0.3 °C, +0.5 °C, +0.1 °C), determine the uncertainty in the measurements.



19

Do not write outside the box

0 5 A student used a temperature probe to measure the temperature of melting ice.

This is the method used.

1. Place the temperature probe in iced water and record the temperature.
2. Remove the probe from the iced water and allow the probe to return to room temperature.
3. Repeat steps 1 and 2 four more times.

The measurements were:

−0.5 °C +0.2 °C −0.3 °C +0.5 °C +0.1 °C

0 5 . 1 What type of error is shown by the measurements? [1 mark]

Student Response

A zero error as they have most likely not allowed the thermometer to read it's original temperature

0 5 . 2 Determine the uncertainty in the measurements. [2 marks]

Student Response

-0.5 − 0.3 = 0.2

[scribbled out -0.5 x -0.3 = 0.7 0.7-0.2 =0.5]

Uncertainty = ± 0.5 °C

Question 5 continues on the next page

Turn over ▶

Student Response (OCR):

$-0.5 - 0.3 = 0.2$
[scribbled out (0.7 0.4 -0.5 x 0.2)] $-0.8 = 0.70.7$ - 0.2$ $= 0.5$
Uncertainty = ± 0.5 $^\circC

Marking Analysis:

AO3.1: Not Awarded — Determining uncertainty requires calculating the range as $\text{maximum} - \text{minimum} = 0.5 - (-0.5) = 1.0\ ^\circ\text{C}$ or dividing this range by 2. The working shown does not demonstrate a valid method for finding the range or half-range.

AO3.2: Awarded — Awarded for stating the correct final uncertainty value of $\pm 0.5\ ^\circ\text{C}$.

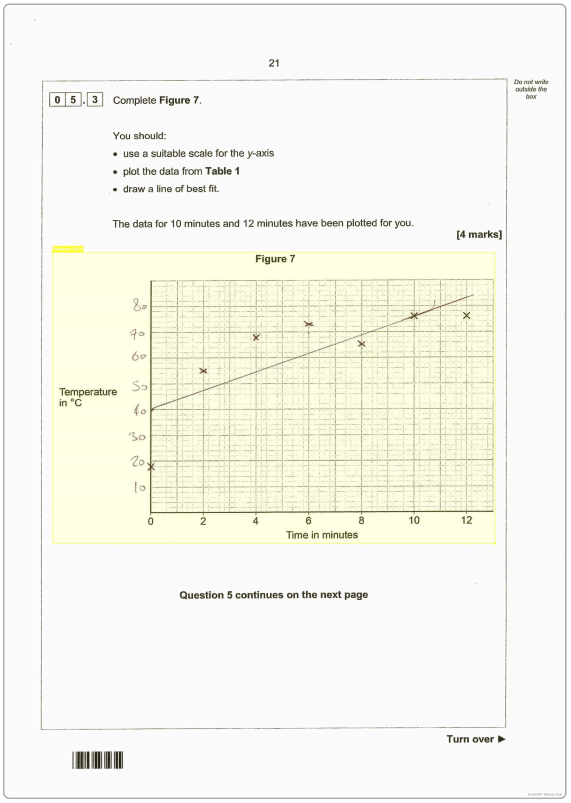
Total Marks: 1/2

Question 5.3

Waves > Black body radiation (physics only) > Emission and absorption of infrared radiation

6.6.3.1

Q: The student investigated how the colour of an object affects the rate of change of temperature. Method: make two identical clay cubes, paint one black and one white, push a temperature probe into the centre of each, place 10 cm from an infrared heater, record temperature every two minutes. Table 1 (white cube): Time (min): 0, 2, 4, 6, 8, 10, 12; Temperature (°C): 18, 55, 68, 73, 65, 76, 76. Complete Figure 7. You should: use a suitable scale for the y-axis; plot the data from Table 1; draw a line of best fit. The data for 10 and 12 minutes have been plotted for you.



21

0 5 . 3 Complete **Figure 7**.

Do not write outside the box

You should:

- use a suitable scale for the *y*-axis
- plot the data from **Table 1**
- draw a line of best fit.

The data for 10 minutes and 12 minutes have been plotted for you.

[4 marks]

Figure 7

Temperature in °C

Time in minutes

Question 5 continues on the next page

Turn over ▶

Student Response (OCR) ⚡:

Based on the image provided, here is the description of the student's graphical response for Question 5.3:

- **Y-axis Scale:** The student has labeled the y-axis starting one major gridline (5 small squares) above the x-axis with **10**, and then incremented by 10 on each subsequent major gridline up to **80** (i.e., **10, 20, 30, 40, 50, 60, 70, 80**). This scale sets 1 small square equal to $2\,^{\circ}\mathrm{C}$.
- **Plotted Points:** The student has plotted points with 'x' marks at the following approximate coordinates (x, y):
- $(0, 18)$
- $(2, 55)$
- $(4, 68)$
- $(6, 73)$
- $(8, 65)$
- **Line of Best Fit:** The student has drawn a straight line of best fit starting at $(0, 40)$, passing through $(10, 75)$, and ending at approximately $(12.3, 83)$.

Marking Analysis ⚡: Gemini 3.1 Pro

AO2.1: Awarded — The mark required a y-axis scale of 10 °C per cm. You correctly used this scale by setting each major gridline (5 small squares) to represent 10 °C.

AO2.2: Awarded — The mark required all points plotted correctly within a tolerance of ± ½ small square. You accurately plotted all five required data points from the table at their correct coordinates.

AO3: Not Awarded — You drew a straight line of best fit that does not follow the initial steep rise in temperature. The mark required a curved line of best fit ignoring the anomalous point at 8 minutes. To earn this mark, draw a smooth curve that follows the clear pattern of the reliable points, leaving the outlier at (8, 65) noticeably off the line.

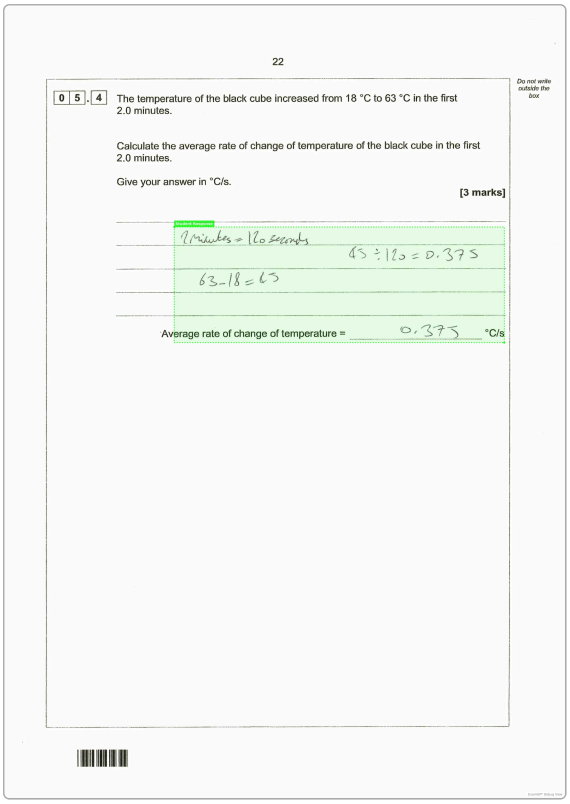
Total Marks: 3/4

Question 5.4

Waves > Black body radiation (physics only) > Emission and absorption of infrared radiation

6.6.3.1

Q: The temperature of the black cube increased from 18 °C to 63 °C in the first 2.0 minutes. Calculate the average rate of change of temperature of the black cube in the first 2.0 minutes. Give your answer in °C/s.



22

0 5 . 4 The temperature of the black cube increased from 18 °C to 63 °C in the first 2.0 minutes.

Do not write outside the box

Calculate the average rate of change of temperature of the black cube in the first 2.0 minutes.

Give your answer in °C/s.

[3 marks]

2 minutes = 120 seconds

63 − 18 = 45

45 ÷ 120 = 0.375

Average rate of change of temperature = 0.375 °C/s

Student Response (OCR):

$2 \text{ minutes} = 120 \text{ seconds}$
$63 - 18 = 45$
$45 \div 120 = 0.375$
Average rate of change of temperature = 0.375 °C/s

Marking Analysis:

AO2.1: Awarded — You correctly converted 2.0 minutes into 120 seconds.

AO2.2: Awarded — You correctly substituted the temperature change and time into the rate equation: $(63 - 18)/120$.

AO2.3: Awarded — You calculated the correct final rate of change of temperature as 0.375 °C/s.

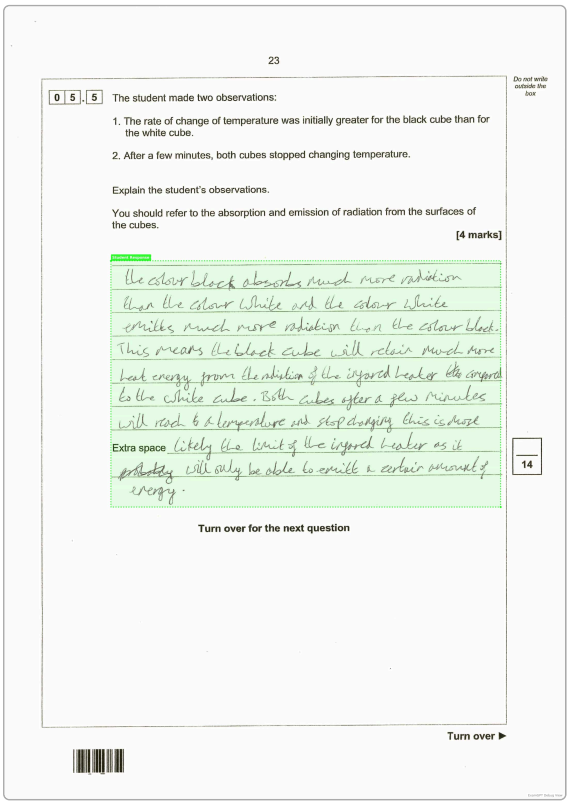
Total Marks: 3/3

Question 5.5

Waves > Black body radiation (physics only) > Emission and absorption of infrared radiation

6.6.3.1

Q: The student made two observations: 1. The rate of change of temperature was initially greater for the black cube than for the white cube. 2. After a few minutes, both cubes stopped changing temperature. Explain the student's observations. You should refer to the absorption and emission of radiation from the surfaces of the cubes.



23

0 5 . 5 The student made two observations:

1. The rate of change of temperature was initially greater for the black cube than for the white cube.

2. After a few minutes, both cubes stopped changing temperature.

Explain the student's observations.

You should refer to the absorption and emission of radiation from the surfaces of the cubes.

[4 marks]

Do not write outside the box

the colour black absorbs much more radiation than the colour White and the colour White emitts much more radiation than the colour black. This means the black cube will retain much more heat energy from the radiation of the infrared heater [scribbled out (the)] compared to the white cube. Both cubes after a few minutes will reach to a temperature and stop changing this is most likely the limit of the infrared heater as it [scribbled out (probably)] will only be able to emitt a certain amount of energy.

Extra space

14

Turn over for the next question

Turn over ▶

Student Response (OCR):

```
the colour black absorbs much more radiation than the colour
White and the colour White emitts much more radiation than
the colour black. This means the black cube will retain much
more heat energy from the radiation of the infrared heater
[scribbled out (the)] compared to the white cube. Both cubes
after a few minutes will reach to a temperature and stop
changing this is most likely the limit of the infrared
heater as it [scribbled out (probably)] will only be able to
emitt a certain amount of energy.
```

Marking Analysis:

AO1.1: Awarded — You correctly identified that black absorbs radiation well by stating 'the colour black absorbs much more radiation'.

AO1.2: Awarded — You correctly stated that 'the colour black absorbs much more radiation than the colour White', recognising that white surfaces are poor absorbers of radiation.

AO1.3: Not Awarded — You did not explain that as the temperature of the cubes increases, they emit radiation at a greater rate. To earn this mark, state that the rate of radiation emission increases as an object gets hotter.

AO1.4: Not Awarded — You suggested the temperature stopped rising due to a 'limit of the infrared heater', but at constant temperature a body emits radiation at the same rate that it absorbs radiation. To earn this mark, state that thermal equilibrium is reached when the rate of emission equals the rate of absorption.

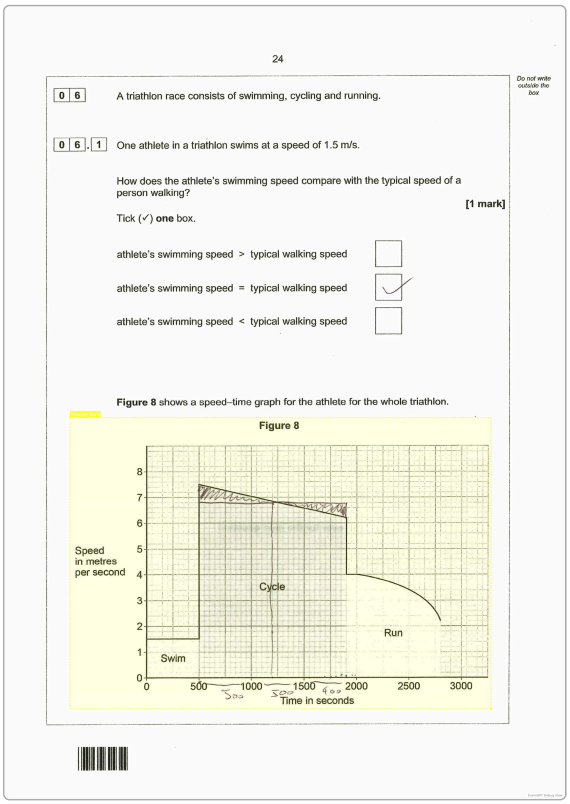
Total Marks: 2/4

Question 6.1

Forces > Forces and motion > Speed

6.5.6.1.2

Q: A triathlon race consists of swimming, cycling and running. One athlete in a triathlon swims at a speed of 1.5 m/s. How does the athlete's swimming speed compare with the typical speed of a person walking? Tick one box. Options: athlete's swimming speed > typical walking speed; athlete's swimming speed = typical walking speed; athlete's swimming speed < typical walking speed



24

Do not write outside the box

0 6 A triathlon race consists of swimming, cycling and running.

0 6 . 1 One athlete in a triathlon swims at a speed of 1.5 m/s.

How does the athlete's swimming speed compare with the typical speed of a person walking?

[1 mark]

Tick (✓) **one** box.

athlete's swimming speed > typical walking speed ☐

athlete's swimming speed = typical walking speed ☑

athlete's swimming speed < typical walking speed ☐

Figure 8 shows a speed–time graph for the athlete for the whole triathlon.

Figure 8

Student Response (OCR):

```
The student has ticked the box for:
athlete's swimming speed = typical walking speed
```

Marking Analysis:

AO1: Awarded — You correctly identified that the athlete's swimming speed (1.5 m/s) is equal to the typical walking speed of a person (approximately 1.5 m/s).

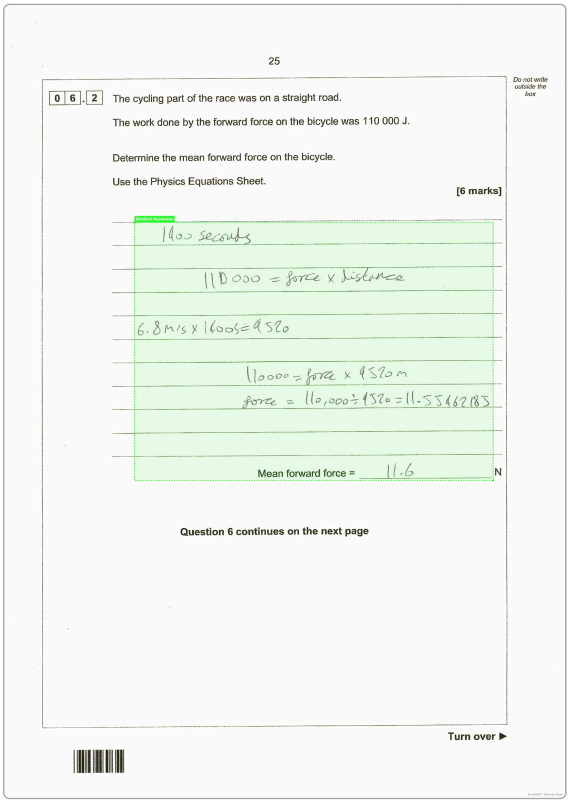
Total Marks: 1/1

Question 6.2

Forces > Forces and motion > Acceleration

6.5.6.1.5, 6.1.1.2

Q: Figure 8 shows a speed–time graph for the athlete for the whole triathlon (Swim: ~1.5 m/s from 0 to 500 s; Cycle: rises to 7.5 m/s at 500 s then falls linearly to 6.2 m/s at ~1900 s; Run: drops to ~4 m/s at ~1900 s then curves down to ~2.2 m/s at ~2800 s). The cycling part of the race was on a straight road. The work done by the forward force on the bicycle was 110 000 J. Determine the mean forward force on the bicycle. Use the Physics Equations Sheet.



Student Response (OCR):

```
1400 seconds
110000 = force × distance
6.8 m/s × 1400s = 9520
110000 = force × 9520m
force = 110,000 ÷ 9520 = 11.55462185
Mean forward force = 11.6 N
```

Marking Analysis:

AO3.1: Awarded — Correct time taken of 1400 s determined from the graph for the cycling stage ($1900 - 500 = 1400$ s).

AO3.2: Awarded — An acceptable mean speed of 6.8 m/s was determined, which is consistent with reading a maximum speed of 7.4 m/s from the graph: $\frac{7.4+6.2}{2} = 6.8$ m/s.

AO3.3: Awarded — Correct calculation of distance using their mean speed and time (6.8 m/s $\times$ 1400 s $= 9520$ m).

AO3.4: Awarded — Correct substitution of the work done and calculated distance into $W = F \times s$ ($110\,000 =$ force $\times$ 9520).

AO3.5: Awarded — Correct rearrangement to find the forward force ($F = 110\,000 \div 9520$).

AO3.6: Awarded — Correct final value of 11.6 N calculated using error carried forward from their distance value.

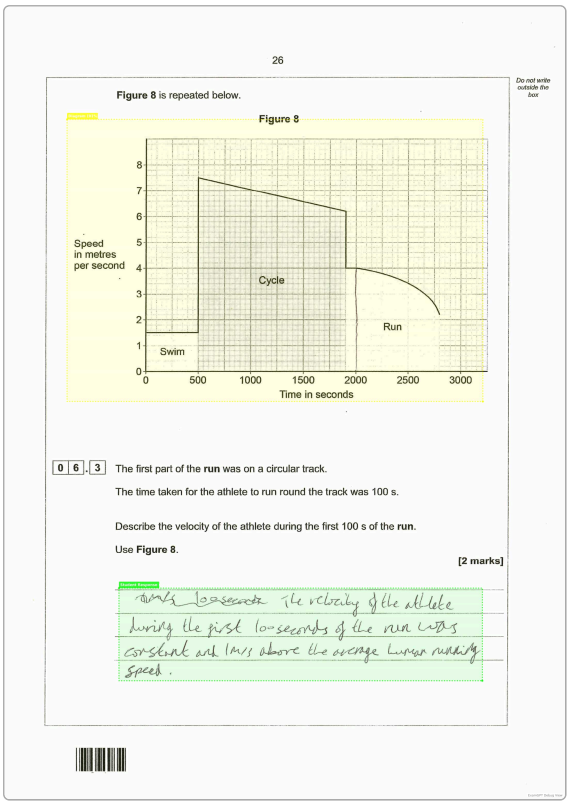
Total Marks: 6/6

Question 6.3

Forces > Forces and motion > Velocity

6.5.6.1.3

Q: Figure 8 (speed–time graph for the whole triathlon) is repeated. The first part of the run was on a circular track. The time taken for the athlete to run round the track was 100 s. Describe the velocity of the athlete during the first 100 s of the run. Use Figure 8.



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Do not write outside the box

Figure 8 is repeated below.

Figure 8

0 6 . 3 The first part of the **run** was on a circular track.

The time taken for the athlete to run round the track was 100 s.

Describe the velocity of the athlete during the first 100 s of the **run**.

Use **Figure 8**.

[2 marks]

Student Response

[scribbled out (first 100 seconds)] The velocity of the athlete during the first 100 seconds of the run was constant and 1m/s above the average human running speed.

Student Response (OCR):

```
[scribbled out (first 100 seconds)] The velocity of the
athlete
during the first 100 seconds of the run was
constant and 1m/s above the average human running
speed.
```

Marking Analysis:

AO2: Not Awarded — The mark requires stating that the magnitude of the velocity (or speed) was constant, but the response states that 'velocity... was constant', which the mark scheme explicitly rejects because velocity includes direction.

AO1: Not Awarded — The mark requires identifying that the direction of velocity was constantly changing because the athlete was moving on a circular track, which was not mentioned.

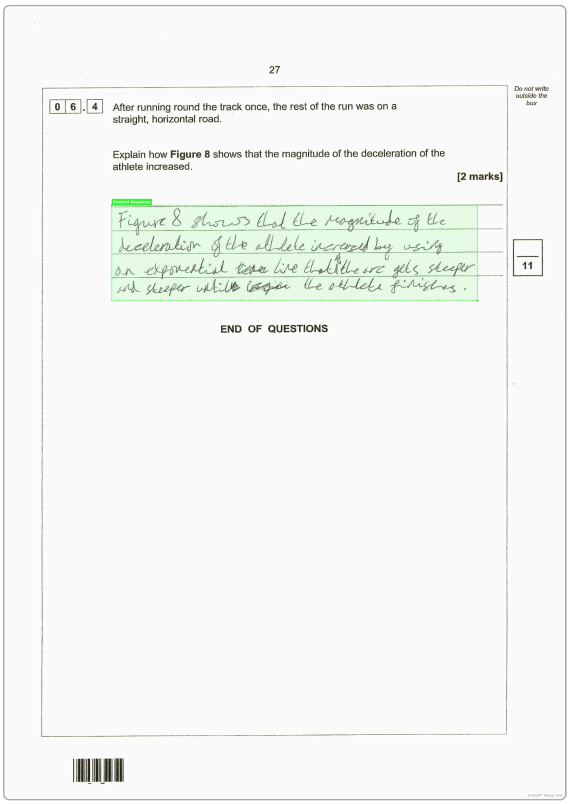
Total Marks: 0/2

Question 6.4

Forces > Forces and motion > Acceleration

6.5.6.1.5

Q: After running round the track once, the rest of the run was on a straight, horizontal road. Using Figure 8 (the Run part of the speed-time graph curves downward from ~4 m/s to ~2.2 m/s with increasing steepness), explain how Figure 8 shows that the magnitude of the deceleration of the athlete increased.



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0 6 . 4 After running round the track once, the rest of the run was on a straight, horizontal road.

Do not write outside the box

Explain how **Figure 8** shows that the magnitude of the deceleration of the athlete increased.

[2 marks]

Figure 8 shows that the magnitude of the deceleration of the athlete increased by using an exponential [scribbled out (curve)] line that [scribbled out (the arc)] gets steeper and steeper until [scribbled out (the origin)] the athlete finishes.

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END OF QUESTIONS

Student Response (OCR):

```
Figure 8 shows that the magnitude of the
deceleration of the athlete increased by using
an exponential [scribbled out (curve)] line that [scribbled
out (the arc)] gets steeper
and steeper until [scribbled out (the origin)] the athlete
finishes.
```

Marking Analysis:

AO3.1: Not Awarded — You did not link deceleration to the gradient of the graph. State clearly that the gradient of a speed-time graph represents acceleration or deceleration to earn this mark.

AO3.2: Awarded — You correctly identified that the line "gets steeper and steeper", which shows that the magnitude of the gradient is increasing.

Total Marks: 1/2