AS

Physics

7407/1

Report on the examination

Version: 1.0
June 2025

Overview

The overall demand of the June 2025 paper was comparable to the June 2024 paper. Students responded positively to the less contextual nature of several questions, which allowed broader accessibility, particularly for mid- to lower-attaining students. The paper included a good balance of straightforward calculations and questions that required synthesis and deeper conceptual understanding, enabling differentiation across the ability range.

Straightforward numerical questions enabled grade E students to demonstrate foundational knowledge, while higher-order questions allowed A-grade students to display their ability to link concepts across the specification.

Question 1

01.1

Most students performed well in this straightforward calculation, with over 65% achieving full marks and a further 20% securing one mark.
Common misconceptions included:

- reversing the required ratio by dividing mass by charge, despite the unit (C kg^{-1}) provided on the answer line.
- incorrectly using the relative mass and charge values of 1 for a proton rather than the actual values.
- misjudging the magnitude; some students incorrectly rewrote 3.2×10^7 as 3.2×10^{-7}, believing the initial result was implausibly large.

01.2

Over 80% of students gained at least one mark, though only about 40% were able to produce an answer that gained both marks.
Common deficiencies in answers included:

- discussing differences in mass between isotopes without noting that the charge remains constant.
- identifying that isotopes have different numbers of neutrons but neglecting to deduce, either from previous knowledge or the information in the question, that hydrogen-3 has more neutrons.
- not recognising hydrogen-1 as an isotope limiting their comparisons to hydrogen-3 and hydrogen-2 (although these students were able to gain both marks where appropriate working that mentioned charge and mass was seen).

01.3

Approximately 40% of students correctly deduced and justified the quark structure of this neutral kaon ($s\bar{d}$).
A further 20% gained two marks, typically by:

- stating the correct structure but neglecting to provide the supporting reasoning.
- correctly identifying the presence of a strange quark but omitting the understanding that a kaon is a meson.

01.4

Higher performing students (approximately 40%) were able to answer this question by realising that conservation of lepton number occurs within each generation and that particle **A** must be an antilepton due to it carrying a positive charge.

The compensatory mark was quite easy to achieve and typically student scored this for:

- stating that charge must be conserved.
- a general statement that lepton number is conserved without realising that this is true within each lepton generation.

Common incorrect responses for **A** and **B** included:

- an incorrect lepton-antilepton combination such as electron and electron antineutrino, through not applying conservation of charge.
- quoting **A** as a positron but then quoting **B** as an electron antineutrino, through not realising that both are antiparticles.

Question 2

02.1

Approximately 60% of students were able to recall that frequency of light is unchanged when it travels from air into glass.
The most common incorrect answer (approximately 30% of students) selected that frequency decreases. These students seemed to know that the speed of light decreases and thought this meant that frequency decreases too.

02.2

This was a straight-forward calculation with approximately 70% of students gaining both marks.
The most common incorrect answer seen was a refractive index of 1.53 for the cladding. This occurred because these students mixed up n_1 and n_2 in their attempt to use either

$\sin\theta_C = \frac{n_2}{n_1}$ or $n_1 \sin\theta_1 = n_2 \sin\theta_2$. This error demonstrated the student's lack of awareness that n_2 must be less than n_1 for total internal reflection to occur.

02.3

This was another straight-forward calculation with approximately 70% of students gaining both marks.
Some students misinterpreted the question and treated θ_B as a critical angle.
Others used the incorrect value for the refractive index of the core using 1.49 rather than 1.53. These students could have improved their exam performance by realising that the refractive index of the core being given as a mini stem above **02.2** indicated that this piece of information was relevant to more than **02.2**.

02.4

This question discriminated well between lower and higher attaining students.
Just over 20% of students gained 3 marks with another 28% gaining 2 marks and 18% gaining 1 mark.
Certainly, any student gaining all 3 marks demonstrated a high-level of understanding and was able to perform the multi-step calculation in a clear and coherent way.
Any student who didn't recognise that the speed of light was no longer 3×10^8 ms^{-1} typically didn't score more than one mark.

The mark scheme worked well and had several routes that positively credited some working towards the answer.

The most common correct method seen was:
- calculates the speed of light in the core.
- determines the total distance travelled by the light inside the core.
- use of speed and total distance to calculate the time.

Question 3

03.1
Again, this multi-step calculation effectively differentiated between student ability levels. Approximately 30% gained all four marks with 20 % gaining three marks, a further 20% gained 2 marks and 15 % one mark.
High achieving students typically obtained all 4marks and presented their working in a clear manner that demonstrated their understanding of the context.
The most common ways in which students obtained partial marks included:
- using 13.1×10^{-19} J as the kinetic energy of the electron yielding a value of 4.3×10^{-10} m for the de Broglie wavelength.
- determining the kinetic energy of the scattered electron but no knowing how to proceed.
- setting their kinetic energy equal to $\frac{hc}{\lambda}$ to determine a wavelength.

03.2
63% of students gained both marks while 25% gained one mark.
Most students could deal with this less onerous calculation. Where a mark was lost, it was very commonly due an incorrect conversion of their wavelength in metres into nanometres or leaving their answer in metres (2.54×10^{-7} m).

03.3
Most students (almost 85%) were able to calculate 82% of the input power.
Those students who lost a mark typically reversed the required ratio and divided the photon energy by their power.

03.4
This question proved very challenging to all but the most able students with approximately 10% gaining 3 marks or more.
Lower performing students typically devoted most of their answer to restating information given in the question or describing the workings of the mercury vapour in the fluorescent tube without ever getting to a consideration of the coating and its role in generating white light.
Students who made progress typically scored the first two marks in the mark scheme without being able to describe why white light was being produced or why there were more photons of visible light emitted than uv photons.

Question 4

04.1

This part of the question was one of the few parts of the paper that was designated as pure recall (AO1).
Most students were only able to produce very limited statements that lacked the appropriate level of technical language expected at AS. This resulted in most students gaining 1 mark for a 'clockwise moments = anticlockwise moments' statement without being able to communicate the conditions under which the principle operates.
Approximately 35% of students gained zero; of these, most attempted to define a moment rather than give a statement of the principle of moments.

04.2

Over 60% of students gained all 3 marks. The most common approach seen was to take moments about the centre of mass.
Lower attaining students had difficulty applying moments and would score one or two marks for determining the distance between W's line of action and the front wheels or for attempting to apply the principle of moments.

04.3 and 04.4

These parts proved to be very inaccessible to the vast majority of students.
Approximately 20% of students scored the mark in **04.3** and this lack of progress had a knock-on effect on performance in **04.4**.
Most students thought that the magnitude of $\mathbf{R_1}$ had increased.
Very few students attempted to apply the principle of moments to this question.

Question 5

05.1

This calculation discriminated well between lower and higher attaining students.
Approximately 20% of the students scored 4 marks with 77% gaining at least two marks.
Those who scored only two marks typically were unable to correctly determine the tension in the cable and usually set the weight of the lift equal to the tension in the cable.

05.2

Over 50% of students gained full marks in this calculation.
A common error seen in this calculation was calculating the distance travelled as 2.55 m by multiplying the velocity of 1.7 ms^{-1} by the time of 1.5 s.
The two successful approaches were determining the area under the velocity-time graph or using appropriate equations of motion to determine the distance travelled.
Some students misinterpreted the question and calculated the kinetic energy of the lift for a velocity of 1.7 ms^{-1}.
Surprisingly, almost 18% of students made no attempt at this question.

05.3

This question proved challenging with less than 20% of students gaining 3 marks.
Almost 50% of students gained at least two marks. Most of these students were unable to carry out the final step of the calculation. Students were unable to apply Newton's 2nd law to this situation where the lift was moving upwards but undergoing a deceleration.

05.4

This question proved challenging with approximately 25% of the students able to correctly assimilate the information and then present working that was both correct and convincing. Many students had errors with signs and didn't seem to appreciate the vector nature of the quantities involved.
A considerable number of students assumed the object hit ground 4 s after it was released from rest.
Others assumed that the initial velocity was 5.5 divided by 4.0 s rather than reading the velocity off the velocity-time graph in **Figure 7**.

05.5

This question was marked with **05.4** to give potential credit to those who though the object's velocity was zero (or other than 1.7 ms^{-1} upwards) when it was released.
Again, this question proved to be very challenging with only 5% of students gaining two marks.
Many students drew graphs that showed a direct proportionality between the kinetic energy and time.

Question 6

06.1

This question discriminated well between lower and higher attaining students.
Most students were able to describe how to produce a characteristic. However, a significant number described using a water bath to change the temperature of the thermistor rather than using current to change its temperature.
Many students incorrectly stated that the gradient of the voltage-current graph was the resistance. This led to incorrect statements about resistance decreasing to zero around 1.8 mA.
Others thought that the resistance of the thermistor was constant at lower temperatures rather than when the temperature is constant.
Many students didn't appreciate that increasing the current increased the heating effect causing temperature rise in the thermistor.

06.2

Over 50% of students gained full marks in this question.
Common misconceptions included:

- determining the total resistance in the circuit by dividing 10 V by 1mA and presenting this as the answer.
- determining the potential difference across **R** and presenting this as the answer.
- applying the emf and terminal pd equation with an internal resistance of zero and thinking that **R** (the total external resistance) was the answer.

Question 7

07.1

Approximately 60% of students gained two marks in this question.
This was another 'recall of knowledge' question used to introduce the question context.
Frequent deficiencies seen in students' answers included:

- referring to the minimum energy of the radiation without linking this to the minimum frequency.
- expressing the idea of a certain frequency at which the photoelectric effect occurs rather than the minimum frequency.
- restating information given in the question without adding detail about what this process might be.
- describing bond breaking or freeing of electrons without including information about the emission from the surface.

07.2

This question proved very challenging with approximately 50% of students gaining this mark.
14% of students made no attempt at the question.
A very similar question on work done crossing a potential difference was asked on this paper in June 2024 (Q2.1).

07.3

Students enjoyed more success with this question with approximately 60% gaining full marks and a further 24% gaining one mark.
Common deficiencies seen included:

- working out the photon energy and presenting this as the answer. Students should be made aware that an allocation of 3 marks for a calculation is unlikely to be a single-step calculation even where there are prefixes to convert.
- incorrect conversion of THz to Hz. There are two examples of prefix conversions on this paper and these conversions seemed to cause problems for lower attaining students. Students would do well to learn the conversion factors for these prefixes as they will always feature in AS physics exams.
- being unaware of the photoelectric equation and dividing their photon energy by the maximum kinetic energy of the photoelectrons arriving at an answer of 2.1 J.

07.4

This question discriminated well between students of varying ability.
Over 25% of students gained 3 marks with 20% gaining 2 marks and 15% gaining 1 mark.
Almost 13% of students did not make any attempt at this question.
Common misconceptions centred on a greater work function having a more negative y-intercept. Many students interpreted **X** as having a greater work function by having a less negative y-intercept.
Students who scored two marks generally scored these marks for drawing **X** and **Y** lines parallel to the magnesium line and giving the reason that the gradient equals the work function.

Key recommendations

- Reinforce key concepts such as Lepton family conservation, quark composition, moments, and energy transformations.
- Include opportunities to develop skills in calculations that incorporate Multistep Reasoning**.** Guide students through logical sequences in multi-mark questions.
- Practise converting between SI prefixes and using units to check plausibility of the numerical answer.
- Develop students' skills in the interpretation of graphs especially in the context of motion and the photoelectric effect.
- Target misconceptions explicitly by use past-paper examples in classroom discussions and model answers.
- Ensure students use terminology accurately particularly in recall questions where these are used as an easy introduction to set the question's context.

Conclusion

This paper presented a balanced challenge, offering opportunities for students across the attainment spectrum.

While quantitative skills remain a relative strength, conceptual understanding, scientific communication, and response structure continue to be areas for targeted development.

Systematic practice and feedback, particularly using past-paper questions, will be key to supporting future success.

Mark Ranges and Award of Grades

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