AS LEVEL
PHYSICS

7407/1
Report on the Examination

7407
June 2018

Version: 1.0

General Comments

This was Paper 1 of the third series of the AS examination. The paper consisted of seven questions from across the AS specification. It made use of a range of question styles: short answer, single- and multi-step calculations and extended writing. Some of the questions required an application of basic physics principles in some unfamiliar contexts. These proved to be quite challenging, with a significant number of students giving contradictory statements in their answers. Calculations proved to be more accessible although weaker students struggled with multi-step solutions.

Question 1

This question was about particle physics and gave students the opportunity to demonstrate their knowledge of the fundamental interactions and basic quark structure.

01.1 This required a description of the strong interaction and it was well answered, with just under half of students gaining all three marks. Most students appreciated the type of interaction involved and were able to provide correct properties. The range of repulsion and attraction of the interaction seemed to be well understood.

01.2 This question proved to be more challenging; only 11.3% of students gained maximum marks here. This was mainly due to poor structuring of answers so it was not clear how baryon number was being conserved in these decays. Many students concentrated on the baryon number of the alpha particle without referring to the baryon numbers of the nuclei involved. With beta decay it was common to see responses that showed how the baryon number had not changed as a neutron changed to a proton. It was, however, less common to see a discussion of the other particles involved and why, because they were leptons, they did not affect baryon number.

01.3 There was reasonably good discrimination in this question. Over half of the students were able to provide a correct quark structure for one of the particles involved but only the best students were able to deduce the correct quark structure of the lambda particle.

01.4 This question was well answered with many students (53.7%) appreciating that strangeness was not conserved.

01.5 Over half of the students managed to come up with a reason for many teams being beneficial. However, only a few students (5.1%) were able to come up with more than one reason.

Question 2

This question required an understanding of the vector nature of acceleration and momentum and also how using energy considerations can lead to a simpler analysis due to it being a scalar quantity.

02.1 This was a straightforward calculation but a lot of students were caught out because they used $v^2 = u^2 + 2as$ instead of energy considerations. This meant that they did not get credit for their answer unless they allowed for the different directions of *v*, *a* and *s*.

02.2 Some good responses were seen to this question although it was not uncommon for contradictory statements to be made. Most students were able to state that acceleration was constant in figure 1 but analysis of figure 2 proved more of a challenge. It was quite common to see answers that referred to speed rather than acceleration decreasing as the truck moved down the ramp. Also, a significant proportion of students thought that the truck decelerated between C and D. A quarter of students managed to gain all three marks.

02.3 Only more able students could give a satisfactory explanation for the speeds being the same (19.8% correct).

02.4 This was a challenging question that required a good understanding of momentum conservation in closed systems and also the importance of direction in momentum considerations. Very few students managed to give complete discussions. The commonest answer was that as mass went up momentum increased, with students failing to appreciate that with no external horizontal forces acting, this could not be the case. Better students did appreciate that the total horizontal momentum remains constant and so as mass increases speed must decrease. It was very rare for there to be a discussion of how the momentum of the rain water changes from vertical to horizontal. Nearly three-quarters of students failed to score on this question.

Question 3

This question assessed the understanding of excitation and ionisation and also the photoelectric effect.

03.1 This objective question was correctly answered by the majority of students (66%).

03.2 This question produced very good discrimination. Many students were able to explain satisfactorily that an exact amount of energy was needed to excite an electron to a higher energy level. Linking this to why the photon needed an exact amount of energy, whereas the free electron only needed a minimum, was more challenging. The idea that all the photon's energy was absorbed was better understood than the reason why the incident electron only needed a minimum energy. It was common to see answers that made correct statements but then went on to include a discussion of the photoelectric effect. Nearly 40% of students gained no credit.

03.3 This question was well done with nearly half the students scoring full marks.

03.4 Performance in this multi-step calculation was disappointing, with over half the students failing to score any marks. The photoelectric equation did seem well known but substitution was a real issue for many. Students had to extract data from different sources and this clearly caused them problems. A common error was a failure to convert the photon energy to joule.

Question 4

This question required students to understand the conditions for equilibrium and apply these in a multi-step calculation. They were also required to understand the significance of the centre of mass.

04.1 A pleasing proportion of students (nearly two-thirds) were able to identify one of the conditions for equilibrium; the resultant force being zero being the common answer. Only more able students were able to provide the second condition.

04.2 There was some confusion over how centre of mass is defined. A significant proportion of students stated what is meant by the centre of gravity. This was given credit but it is clear that the distinction between these two is not well understood.

04.3 Very few students (2.9%) managed to score both marks for this question. Nearly a quarter of students appreciated that this was to prevent rotation, but did not then give a complete explanation by referring to no resultant moment about A as the line of action of the forces passes through A when the beam is in equilibrium.

04.4 This is not an unusual calculation at this level but it was clear that a significant proportion of students were unsure how to analyse the forces on the beam. The best students managed complete solutions whilst weaker students did manage to access some of the intermediate marks.

04.5 The calculation in this question proved to be much more accessible and far more students were able to access the marks. Over half managed to score at least two marks. The most common error was failing to calculate the cross-sectional area correctly; the predominant mistake was using the diameter for radius. Weaker students often used surface area of the cable instead of cross-sectional area.

Question 5

This question involved use of the density formula.

05.1 The majority of students (74.4%) had few problems with this calculation. Of those who did, conversion from mass to weight was the common problem.

05.2 As with the previous question, this was well answered. The only common issue was the use of weight rather than mass in the density formula.

05.3 Students found this question very challenging and only a small minority (4.3%) managed to come up with complete solutions. Setting up an expression that enabled the volume of iron to be calculated is clearly a procedure that is unfamiliar to many students. A reasonable proportion did appreciate that a mass needed to be divided by the density of iron and picked up the first mark, but got no further because they did not appreciate that the volume of the ice is less than the volume of the cube because part of the volume is occupied by the piece of iron.

Question 6

This question required students to analyse a parallel circuit and predict the effect of changes in the circuit.

06.1 As is often the case, students struggled to analyse this parallel circuit correctly. The commonest successful approach was to work out the resistance values for the lamps and then use these values to determine the potential difference across each lamp. A minority of students, having found the resistance values of the lamps, calculated the current in each branch and then compared this with the current required for normal operation. Only about a third of students were able to adopt either of these two approaches.

06.2 Only a minority of students appreciated that the potential difference across lamp E would be zero and so there would be no current in the lamp. This meant that there were a considerable number of flawed arguments which assumed there was a current in E. Over 10% of students made no attempt at this question; in addition, 78.9% scored zero.

06.3 The overall performance in this part of the question was also disappointing. The most accessible mark was the calculation of the initial current in the battery – which some students had already done in 06.1. Appreciating that lamp B failing resulted in a parallel and series circuit was not well understood and it was rare to see correct calculations of the new circuit resistance. A significant proportion of students did appreciate that the resistance had increased and this would reduce the current, but were unable to support this with correct calculations. A very high proportion of students (22.7%) failed to attempt this question.

Question 7

This question required students to be familiar with the interference pattern produced by a double slit arrangement. They were also required to explain factors that affect the pattern observed.

07.1 A significant proportion of students appreciated that the fringes would exhibit a range of colours. It was, however, less common for them to identify the central fringe as being white. Some students did try to explain the reason for the formation of the fringes when only a description of the pattern seen was required.

07.2 This question produced good discrimination. Weaker students were able to identify the fact that red and green fringes would be seen, but then frequently thought that the spacing of green fringes would be greater. Only the best students were then able to explain that the red spacing would be 20% greater than the green spacing. It was also quite rare to see responses that explained that the central fringe would be a mixture of red and green.

07.3 This was a ‘levels of response’ question and a high proportion of students did at least get into the middle band because they were able to correctly explain the effect of each change on fringe spacing and give some discussion of the effect these changes have on uncertainties. A disappointing number of students (only 3.5%) reached the top band – this was usually because they did not explain how the change in fringe spacing affected the determination of the wavelength of the light and whether the change reduced the overall uncertainty.

Mark Ranges and Award of Grades

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