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GCSE

Physics A

Twenty First Century Science Suite

General Certificate of Secondary Education **J245**

OCR Report to Centres

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

OCR will not enter into any discussion or correspondence in connection with this report.

CONTENTS

General Certificate of Secondary Education

Physics A (Twenty First Century Science) (J245)

OCR REPORT TO CENTRES

Content	Page
Overview	1
A181/01 Modules P1, P2, P3 (Foundation Tier)	2
A181/02 Modules P1, P2, P3 (Higher Tier)	4
A182/01 Modules P4, P5, P6 (Foundation Tier)	7
A182/02 Modules P4, P5, P6 (Higher Tier)	10

Overview

This is the second session of examinations for the new Physics A specification. The papers illustrate two key changes from the old specification; the introduction of six mark free response questions and the raising of demand, with the inclusion of more challenging questions and a greater proportion of questions requiring mathematical skills.

Candidates had clearly been well prepared for the six mark free response questions, with nearly all candidates attempting the questions and taking the opportunity to demonstrate their understanding. The quality of communication was generally adequate and often better than the quality of the science being presented.

The more difficult questions often involve novel contexts and the evaluation of data or explanations. This aspect proved challenging for even some of the better candidates. To gain high marks on the Level of Response questions, candidates often have to draw together two or more distinct threads in their answers.

In addition to a greater mathematical content in the papers, candidates are often expected to use the solution to calculations to reach a conclusion. At present many candidates are simply giving a numerical solution or just stating a conclusion; they also need to explain how the calculated value gives rise to the conclusion. Unfortunately the problem of candidates not having calculators in the examination persists, seriously disadvantaging many. Questions are written based on the assumption that candidates will have access to a calculator.

A181/01 Modules P1, P2, P3 (Foundation Tier)

General Comments

This was one of the new specification papers. The range of marks suggests that there was plenty of challenge for the more able candidates whilst still including more accessible questions for the lower ability. The inclusion of the longer, six mark questions was a challenge to the foundation candidates although there were a significant number of very good answers to these questions. Centres should be praised for preparing candidates well for these questions. However there is evidence that candidates need to focus more carefully on the wording of each question, especially the "command words" to ensure that they fully understand what is required. See specific questions below.

Misunderstanding the instructions of the questions is causing some candidates to lose marks. Candidates are reminded they should follow the instruction of the question e.g. if the question required one line to be drawn between options, then they will lose marks for drawing more than one line.

Candidates performed well on the objective, old style questions.

There is still some evidence of candidates not having a calculator available. It is worth reminding Centres that candidates are disadvantaged when they do not have the correct equipment for the examination.

There was no evidence of candidates running out of time on this paper.

Comments on Individual Questions

1(a) Many candidates felt they had to multiply numbers together here although many did get the unit mark for light years. Part (ii) was well answered with most candidates recalling the two methods. In part (iii), it was the diameter of the Sun that caused most candidates trouble, with the other distances clearly in the correct order.

1(b) Centres are to be commended on candidates understanding of peer review – this question was very well answered.

1(c) This was the first of the six mark Level of Response questions on this paper. Many candidates responded well to this question. The use of their own knowledge was clear and together with the information in the question candidates performed pleasingly. Candidates were let down if they drew our own Solar System or if their scientific communication was not clear. A clearly labelled diagram showing the orbits of the objects including planets and others such as asteroids, comets and moons was required.

2(a) This question was well answered and candidates seem to understand this process.

2(b) These two questions allowed candidates to show a deeper understanding of seafloor spreading and use it to try to support Wegener's ideas. This was accessible as weaker candidates could link continents and tectonic plates whilst more able candidates could explain the link and describe the mechanism. Some candidates were distracted by talking about other evidence for Wegener's ideas such as the jigsaw fit of continents.

2(c) Most candidates performed well on this question.

3 Most candidates performed well overall on this question with (a)(iii) being the most challenging part.

4 This was another six mark Level of Response question. Candidates struggled to use the model given (and included in the course) to the context of the situation given. Some candidates just repeated the stem of the question and didn't attempt to identify any parts of the model in the context. Common misconceptions were that the sign was the detector or that the radiation involved was dangerous. Centres should be aware that the Level of Response questions may require candidates at all levels to apply models and scientific understanding to novel situations and contexts. Candidates who were able to justify their conclusions performed well in this question.

5 This was a familiar context to candidates and they performed very well on this question. Centres should be commended for the candidates' knowledge and application of the greenhouse effect and global warming.

6(a) Candidates who picked up on the stem of the question regarding the convenience of electricity, performed very well on this question. Many highlighted the versatility of electricity and the important role it plays in our lives. However many candidates think all electricity is free, renewable, and has no pollution associated with it.

6(b) This question was answered well by most candidates.

6(c) A large number of candidates did not know the mains supply voltage in the UK.

7(a) Many candidates thought that renewable energy can be used again rather than that it can be easily replaced in a reasonable time or that it comes from a source that will not run out.

7(b) Most candidates calculated the correct 8m/s but then failed to use this to say the generator would work because 8m/s was less than the limit of 10m/s. The command phrase "use the data…" is the key here.

7(c) The Sankey diagram was generally well done and many candidates went on to calculate the correct efficiency. Some candidates did gain credit from the error carried forward here and candidates should be encouraged to follow all calculations through until the end and to show all working out, to ensure they have the best chance of gaining marks.

7(d) This question was answered well in kWh, although some candidates used time in seconds and power in watts to give an answer in joules and therefore lost marks. Some candidates lost marks by incorrectly converting the earning from the generator into £ at the end of the calculation.

8 This was the final Level of Response question on this paper. Many candidates answered this question in a very general and non specific way without referring to the situation or context. This limited most candidates to Level 1 marks. The question is clearly about the plan for the island and as such suggestions and recommendations should be based on the information that is given in the question. Generic answers referring to the general advantages and disadvantages of a method of power production were credited but not as highly as suggestions in context.

A181/02 Modules P1, P2, P3 (Higher Tier)

General Comments

The candidates represented a wide range of abilities. There was a good spread of marks. The majority of candidates made a good attempt at the paper, with nearly all candidates attempting all questions. There was no evidence of candidates running out of time.

There was clear evidence that candidates were responding to the longer prose style questions with reasonable success, with most filling the available space with writing. Unfortunately this was often vague and sometimes consisted of little more than rephrasing the question, rather than demonstrating their knowledge and understanding. The quality of writing was sometimes poor; deciphering candidates' answers was often difficult. Candidates would benefit from taking more care in reading the question when answering the longer six mark questions. A failure to address the question asked can limit candidates to Level 0 or Level 1 marks rather than allowing them to score the marks at Levels 2 and 3.

The mathematical content was not dealt with well by many candidates. The mathematical content of the exams will continue to be present in future exam series**.** It is worth pointing out the mathematical requirements in Appendix C of the specification.

Comments on Individual Questions

1(a) Most candidates selected the correct answer of 10cm/year. The most common error was 10mm/year.

1(b) In part (i) the idea of opposite poles was not secure. Many responses indicate misconceptions about magnetism, for example the idea that one stripe points north or is north while the other stripe points south or is south. Another common misconception is that the stripes have different strengths. Many responses in part (ii) were unable to make four distinct observations but credit was most often given for magma rising and becoming magnetised in some way. Again the idea of pole reversal, hence poles becoming opposite is not well understood, with many candidates simply referring to change. For part (iii) good responses were often succinct and to the point. However many responses wrote about plate movement but, as they did not address the question by relating this conclusion to the evidence, did not gain credit. The weakest responses simply mentioned seafloor spreading without linking this either to the magnetic patterns or continents moving apart.

2(a) Most candidates showed a good understanding of the features of digital signals. In part (ii) some candidates lost marks by changing their minds and overwriting the number. It is very difficult to decipher this (different colours do not help, as the scripts are scanned in black and white before marking). In general changes should always involve crossing out the wrong answer and writing the replacement alongside.

2(b) Part (b) was answered less well, with A and C being popular errors.

3(a) Most candidates made a reasonable attempt at calculating the time interval. However many had the idea of subtracting the 185 from 2012 but then failed to consider the 8200.

3(b) Most selected the correct responses, with the universe expanding as the most commonly correct response. There was no clear pattern to incorrect answers.

3(c) This proved very challenging with very few candidates correctly selecting the correct hydrogen and helium. By far the most common answers were the incorrect gold and iron.

3(d) Candidates were not expected to be familiar with this context. The quantitative treatment of the data provided good differentiation in this question. However only the best candidates took this approach as most limited their answers to describing the risk from gamma and vague suggestions for the government to 'do something'. The realisation that a 1 in 250 million chance is small was sadly absent from most candidates considerations. Although many realised there would be a delay between the light and shockwave, few attempted to quantify the delay. Weak answers contained suggestions that were impractical with many candidates failing to appreciate that gamma travelled at the same speed as light so satellites in orbit would not give an earlier warning.

4 Perhaps because of the design of the question most of the best responses seen gave full explanations using the photon model. The idea that each photon carries the same energy was not seen however which is important as it underpins the significance of photon intensity. There was a misconception in some responses that photons lost energy. The very best answers integrated the general model and photon model as an explanation. It was common for candidates to attempt an explanation with one model and only make a passing reference to the other. Many weaker answers did refer to the ‘spreading out’ of photons but a lot of candidates failed to attempt an explanation of ‘why’ Rachel’s hand felt warmer nearer the radiator. The lack of contextualisation was a common feature of the weakest responses.

5(a) Many candidates correctly identified ‘Carbon dioxide absorbs some radiation in the Earth’s atmosphere.’ and ‘Radiation absorbed by the atmosphere may be radiated towards the Earth.’, but few identified ‘The Earth emits radiation at a lower principal frequency than it absorbs.’

5(b) This was generally well answered but the link between increased CO_2 and deforestation by combustion was ignored in many responses despite this being cued in the stem of the question. Weaker responses were often very vague about the causes of changes in CO_2 in the air or referred to 'breathing' or 'respiration' of trees instead of photosynthesis.

6(a) This question was usually correct although a number of candidates put water vapour for the first answer and velocity or speed as the final answer.

6(b) A surprising number failed to identify nuclear fuel as the correct answer. Almost every possible energy source appeared.

7 Parts (a)-(c) of question 7 were common with the foundation paper.
Most candidates performed well in these parts.

7(a) In part (a) weaker candidates felt that renewable resources could be used again, or simply listed renewable resources. Some candidates felt that the definition was based on being “environmentally friendly” or non-polluting.

7(b) In part (b) candidates were sometimes not clear in justifying the conclusion, assuming the calculation was sufficient.

7(c) For part (c) a few candidates tried to write the types of energy instead of the amounts, and few included units. The rounding of a recurring decimal confused some. A few candidates put the wrong numbers into the equation or forgot to multiply by 100.

7(d) In part (i) the 24x60x60 in this calculation was commonly the problem, with candidates slipping up on one of the steps. In part (ii) candidates confused which numbers referred to the cable's carrying abilities and which referred to the generated electricity. Candidates were generally able to choose a relevant equation, but were then unable to explain what the relevance of the number they had calculated was.

8 (This question was common with the foundation paper).
The best answers clearly placed the consideration of energy sources in the island context, relating all suggestions and proposals to the island situation. In weaker answers many justifications given were generic and not clearly in 'island' context and this limited marks available. Less able candidates seemed content to just list possible energy sources with little or no justification. It was rare to see 'waves' and 'tides' being viewed as separate/discrete sources of energy. Many candidates did not appear to have a clear idea of what is meant by 'hydroelectricity'.

A182/01 Modules P4, P5, P6 (Foundation Tier)

General Comments

This paper is designed for candidates operating in C – G grade range.

A considerable number of the marks on this paper were awarded to objective type questions and candidates should be encouraged to make sure that a response to all these questions is made. Candidates will not be penalised for incorrect answers unless more answers are given than were asked for. Failure to read the question as to how many ticks are required did cause problems for some candidates. In general candidates performed well on these objective type questions.

Questions 2, 6 and 8, which were marked on the quality of written communication as well as the physics content of the answer proved rather difficult with candidates often contradicting themselves or using poor English. More detail to specific good practice is given below.

There was no evidence of candidates having time difficulties with the vast majority completing all questions in the time allowed. It was also clear that the vast majority of candidates were entered for the correct level paper.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously. Any marks that are ambiguous – possibly made with the intention that the examiner could give credit to either of two possible responses, where only one is correct will not gain credit.

Comments on Individual Questions

1(a) Both parts were answered reasonably well with weight being the most common distracter in part (i).

1(b) Parts (i) and (ii) were well answered. Part (iii) caused some problems with candidates often starting with the 'why' part of the question and missing the easier 'how' part at the start. Many candidates ambiguously said that the gymnast came down faster than she went up or that her speed changed without giving any indication that it actually increases. There was also a considerable amount of confusion between energy and forces by stating that the gravitational potential energy pulled the gymnast down and very few actually wrote that the gravitational potential energy decreased whilst the kinetic energy increased.

1(c) With the cyclist increasing his speed along a horizontal road there was a lot of confusion about what happens to the vertical forces with many candidates incorrectly stating that his weight increased. The majority did correctly state that the driving force increased and a smaller number also stated that the drag force would also increase.

2 This was the first Level of Response question in the paper. To gain Level 3 (5 or 6 marks) candidates either had to make a correct link between any two factors that were shown in the stem of the question (for example to recognise that a smaller force was due to a longer time of collision or a smaller force would lead to less injury/loss of life) or they had to put forward the two counter arguments about how the crumple zone would save lives versus the extra cost or they had to identify the factors which made it a fair test. Few candidates actually made this link and wrote about the smaller force or the longer time or less injury but did not link any of them; fewer used the two argument route and very few listed the factors which made this a fair test. Answers often contained contradictions such as the 0.2 seconds in the non-crumple zone car was longer than the 1 second in the car with the

crumple zone. Many of these responses were due to difficulties in candidates being able to communicate well.

3(a) A common incorrect answer was 600m/s where candidates did not convert minutes into seconds to calculate time, one mark was given for this incorrect answer.

3(b) Part (i) was well answered with the majority either plotting the points or drawing a correct straight line. Part (ii) was not so well answered with many non-creditworthy answers such as 'the highest' or 'the one that went the furthest' without mentioning 'in the same time'. Few mentioned the steepest slope/gradient.

4(a) In part (i) a surprising number chose flat screen televisions or electric irons as having a motor and a number only put one tick even though the question specifically asks for two ticks. Part (ii) required candidates to explain that a motor causes spin or movement and the vast majority of candidates succeeded in doing so.

4(b) Although this was fairly well answered and many candidates did know that a current carrying conductor experienced a force when in a magnetic field the other alternatives still proved to be fairly popular choices with power and voltage being chosen quite often.

4(c) This was a very poorly answered question with only the 'circuit A being a series circuit' or 'circuit B being a parallel circuit' mark being given and that was not often. Ideas about current and voltage were confused and many candidates answered in terms of energy or power without any understanding of these quantities. Some common misconceptions were 'in A the motor runs slower because they are next to each other', 'current is used up' or 'in A the current is shared'.

5(a) The LDR symbol was not well known. Quite a few did not know the filament lamp either.

5(b) The majority got this calculation correct.

5(c) This was well answered with the majority stating that a small animal could switch the lamp on through the night and therefore cause an irritation to the householder.

6 This Level of Response question was common between this paper and the higher paper and therefore an increased level of response was required to gain full marks as well as clear written English. To gain Level 3 (5 or 6 marks) candidates were required to mention charging, discharging and risk and to give an explanation of at least one of these. There were many significant errors in the science. A lot of responses just wrote about shocks and friction and the responses were not sufficient to gain high marks. Some of the better answers did involve movement of some form of charge during charging or discharging, often stating electrons carried negative charge. Some candidates wrongly identified the risk as being high and potentially dangerous.

7(a) The majority of candidates gained one of the two marks here but those that did not get the electron mark in the first answer often incorrectly included it as part of the nucleus.

7(b) This was not well known by candidates and all distracters were equally chosen.

7(c) In part (i) the majority of candidates knew that radioactive materials gave out ionising radiation. In part (ii) many stated that both statements were incorrect but failed to justify their answer. A few candidates misread the question and believed that they had to identify which ONE was correct.

8 To gain Level 3 marks in this Level of Response question candidates had to recognise that there was no increased level of risk and either to use the statistics to show this or to describe the possible harmful effects of radiation. A large number of Level 2 mark answers identified the low risk but there was then a considerable amount of misreading of the data, with the expected rates for the whole of the UK being used with regards to children of nuclear workers. Some candidates concluded that there was a 50-50 chance or worse of the child developing cancer. Some responses simply stated that the risks were very high and the father should not work in the nuclear power industry.

9(a) Very few candidates mentioned the random nature of radioactive decay.

9(b) Similarly background radiation was rarely named and many candidates thought that some of the original salt was left in the container.

9(c) Most gained a mark for stating that there may have been more salt in Billy's container. Virtually no candidates tried to show that the means were very different and there was no overlap in the two sets of data.

9(d) It was pleasing to note that the majority chose beta radiation as being stopped by aluminium and lead.

9(e) This proved a rather difficult question with only a minority gaining both marks, many candidates were correct in the first row of the table identifying that Amy's results fitted the fact that the activity stayed the same but then went wrong in the next two rows with all distracters being equally chosen.

A182/02 Modules P4, P5, P6 (Higher Tier)

General Comments

This is the first session for this paper.

The paper was generally well attempted and produced a good spread of marks across the paper.

It is hoped that with increased familiarity with the requirements of this specification, more candidates will be able to access the top range of marks in future sessions.

This paper saw the introduction of six mark questions in this unit, one for each of P4, P5 and P6. These are marked using a Level of Response mark scheme, with each question targeted at a particular grade range (indicated in the guidance column of the mark scheme). It is important to refer to the exemplar answers at each level to better understand the requirements of the mark scheme when interpreting responses to these questions. The vast majority of candidates made a good attempt to tackle these questions and the outcomes produced showed a good level of differentiation.

The majority of candidates showed evidence of using their time well with no evidence of time being an issue with regard to completion of the paper.

Many candidates seemed unprepared for the calculations on this paper, with evidence that a significant number failed to either refer to the formulae at the front of the paper or make use of a calculator in their attempt to answer the question.

Comments on Individual Questions

1 Question 1 considered aspects of the P4 topic, including interaction pairs and energy transfer.

1(a) Part (a) of the question was well answered by the majority of candidates, although some weaker candidates only provided one answer in (i) when two were required for the mark.

1(b) Part (i) was well answered by most candidates. In part (ii) only the most able candidates correctly calculated the height gained with 2m being the most common incorrect response. The description of the energy changes required in (iii) proved too challenging for all but the most able candidates. Weaker candidates often discussed the forces acting or individual energies rather than changes in energy.

2 This was a Level of Response question on crumple zones targeted at grades up to A/A*. This question differentiated well in terms of ability. Weaker candidates tended to present answers unsupported by any calculations, perhaps just selecting raw data from the table in an attempt to justify their answer. Even the most able candidates struggled to differentiate between the change in momentum of the driver as opposed to the car itself. These candidates received some credit for making use of the correct formulae. The majority of candidates were unable to select appropriate units for any quantities they had calculated.

3(a) Most candidates scored well on this question involving distance-time graphs. The calculation in part (a) was tackled well, although a minority of candidates failed to convert the time into seconds and so dropped a mark here.

3(b) Part (b) posed few problems to all but the weakest of candidates.

4(a) Most candidates found this question involving motors and circuits very challenging. Part (a) was a gentle start for most, with almost any sensible suggestion for a device with an electric motor being accepted. Cars were not accepted unless the candidate had specified a starter motor or electric vehicle.

4(b) The majority of candidates struggled with the objective question in part (b) and a wide range of answers were seen with few completely correct.

4(c) Part (c) showed significant weaknesses in candidates understanding of series and parallel circuits, even with more able candidates. Only a minority of candidates could produce a coherent cause and effect style argument in response to (ii).

5(a) Overall, this question produced a good spread of marks. Almost all candidates could match up the circuit symbols to the correct components and their functions in part (a).

5(b) Part (b) proved harder than anticipated, with many candidates incorrectly selecting the switch as their answer.

5(c) Part (c) produced relatively few attempts at power calculations even from more able candidates, despite a strong hint to candidates in the question. Weaker candidates often quoted data directly from the table to justify their answer e.g. “LEDs are used as they use less voltage”.

5(d) The vast majority of candidates scored well on the final part of question 5, offering sensible alternative causes for the correlation in the data.

6 This question was a Level of Response question targeted at grades up to C. Responses were therefore a little below expectations for candidates on a higher tier paper, with a significant number of lower ability candidates failing to achieve Level 2 or better. These candidates often failed to make use of appropriate scientific terminology in their response, instead presenting a “common sense” approach based on their everyday experiences of shocks involving static electricity. Better candidates produced very detailed descriptions of the charging and discharging process and correctly assessed the risks involved. Additional practice of this type of question in class as part of, for example, a peer assessment activity would be strongly recommended to help boost future performance of lower ability candidates. Further exemplar materials can be obtained via your cluster coordinators.

7(a) Part (a) produced answers that differentiated well in terms of ability, with more able candidates finding little difficulty in identifying the parts of two isotopes. Weaker candidates failed to realise that the protons must be the particles which have the same number in each nucleus.

7(b) Few candidates could correctly recall the information required to answer part (b) on alpha particle scattering – a new topic for this specification.

7(c) This part proved inaccessible to all but a minority of the most able candidates with few recognising the existence of a repulsive force caused by the electrostatic force between nuclear protons.

8(a) This question on radioactivity differentiated well. In part (a) few candidates made correct comparisons of the data sets as required. Some credit was given to candidates who considered other possible factors that could account for the apparent difference in readings.

8(b) Weaker candidates struggled with part (b).

8(c) Weaker Candidates struggled with part (c).

8(d) Very few candidates identified beta as the type of radiation emitted from the source. The most common incorrect response was gamma.

9 This question was a Level of Response question targeted at grades up to A/A*. A limited range of responses were seen, with most candidates operating at Level 1. Very few candidates displayed appropriate awareness of ionising radiation and its effects as applied to this specific context. Only a minority of the most able managed to evaluate the data presented in the article critically and use this correctly to form a coherent argument. This style of question is to be expected as part of this examination series and candidates of all abilities would hopefully benefit from the opportunity to reflect on examples from this paper and from exemplar materials to help in their preparation.

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