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Examiners' Report
Principal Examiner Feedback

January 2018

Pearson Edexcel International GCSE
In Chemistry (4PH0) Paper 1P

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January 2018
Publications Code 4PH0_1P_1801_ER

Report to centres 4PH0 1P January '18

General Comments

On the whole, students demonstrated that they could recall facts, equations and definitions (with a few notable exceptions) but were less proficient at applying these in new situations. There was evidence that students who had experience of laboratory work gained good marks on questions targeted at AO3 (experimental methods, data processing, variables etc.). Generally, students made few numerical mistakes in their calculations. There was evidence of an increasing trend of writing the equation in units rather than word or correct symbols. A 'units equation' will not gain credit. Students should be reminded of the need for precision in their responses; 'the wavelength is different' will not gain a mark when 'the wavelength is longer' is needed. Students would also be well advised to practice writing logical explanations when required rather than giving descriptions.

Question 1
Solar cells

It was expected that this question would be a suitably straightforward start to the paper. However, over 25% of students failed to gain a mark in part (a). Common errors included mislabelling light energy as 'solar', 'thermal' or 'chemical' and mislabelling electrical energy as 'heat'. Nearly 90% of candidates gaining the next three marks for the equation and calculation. The final part (c) also proved to be more difficult than anticipated with under 50% of students gaining the mark.

Question 2
'The Bee'

The force diagram in part (a) was answered with varying amounts of success: some students failed to realise that acceleration upwards implied that the downwards arrow should be smaller; other students mislabelled the force as 'gravity' instead of 'weight.

Part (b) was in generally much better answered: the marks for the objective questions were gained by approximately 90% of students. As mentioned in the introduction, some students failed to gain the equation mark because they wrote only in units, but these mostly went on to gain the marks for the calculation.

In part (ci), only 50% of students were able to name a use for ultraviolet radiation. A common error was to say 'security marker' when a correct response would have been to say 'to check for a security mark/invisible ink'. There were in addition some surprising incorrect uses: 'heating food', 'communications' etc which suggested that students had confused infrared and ultraviolet. The difference between ultraviolet and visible also caused some difficulties, in this case because of lack of precision: a statement such as 'the frequency is different' is insufficient. Over 25% of students failed to gain a mark in part (cii).

Question 3
Stopping distance
It was pleasing to note that 60% of students were able to gain full marks for this question. Those students who failed to gain full marks usually did so because they gave two or more examples of the same factor e.g. the driver was tired, the driver was distracted, the driver had consumed drugs. A very small minority of students failed to gain any marks.

Question 4
Determination of mass without a balance
This was a variation on determination of the volume of an irregularly shaped solid. This question was primarily targeted at practical skills and nearly parts proved to be accessible for most students. Over three quarters of students gained at least one mark for realising that they had to find the volume of the bolt in order to determine the mass. Many accounts showed a good appreciation of the method needed with over 40% of students gaining 4 or more marks. It was pleasing to note that a number of students had used the space for a labelled diagram and thus gained credit. The most common oversight was not quoting the equation in the form 'mass = density x volume'.

Question 5
Energy transfer in a house
In part (a) nearly 50% of students were able to calculate the energy lost through the walls in one week. A further 30% gained two of the three marks. Just over half of the students could state a sensible method to reduce the energy lost through the windows.
Part (c) caused difficulties for many students with just over 40% of students failing to gain any of the available marks. The responses showed a great confusion and inappropriate technical language e.g. 'heat is trapped inside wool'. Part (d) also caused problems for many students. The most common errors included incorrect proportions, using 75% as the input, lacking labels and, surprisingly, more than one input.

Question 6
Centre of gravity and Pressure
Part (a) was designed to be a relatively straightforward introduction into this question. However, just 50% of the students were able to correctly position the centre of gravity. The most common error was to not place the centre of gravity in the same straight line as the force arrow.
In part (bi), the equation was well known but many students made simple errors in part (bii). The most common of these errors was to omit the factor of four (for the four legs of the chair). Students also struggled with the area of 5.2 cm^2 by either attempting to convert cm^2 to m^2 incorrectly or by

misguiding squaring 5.2 cm^2. There were also the usual problems with rearrangement of the equation. Just 50% of students gained 4 or more marks in part (b).
It was noticeable that some students do not see the 'flow' of entire question as over one third failed to gain a mark in part (c) because they responded in terms of dragging the chair and reduction of friction instead of attempting a pressure answer. Other students correctly mentioned increased area and thus reduced pressure but omitted to mention that the force remains constant. Just under 15% of students gained all three marks in this part.

Question 7
Moment of a spanner
Many students found this question relatively straightforward. Less than 10% failed to gain a mark in part (a) and 50% gained four of more marks.
As expected, the equation was well known in part (ai). Many students chose the wrong distance in part (aii) and so lost a mark, and there were the inevitable mistakes in processing the calculation.
Only 11% of students gained both marks in part (b) for realising that either the force had to be doubled or the length had to be doubled. Almost two thirds of students did respond with an increase in either length or force and so gained one of the marks.

Question 8
Image formation in a plane mirror
Students found this question problematic even though it is a standard task. There was a wide range of answers seen with just under 20% gaining full marks. Often the responses were poor with for example: lines drawn without a ruler, none of the reflections shown obeying the law of reflection and the virtual lines non-contiguous with the reflected rays. One quarter of the students gained a mark for 'virtual' in part (b).

Question 9
Pressure and temperature
Part (ai) proved to be a suitably straightforward start to the question for most students, with over 54% of candidates gaining both marks. The most common error was to give a positive temperature. In (aii), over 89% of students knew that increasing the temperature of a gas increased the average speed of its particles.
In part (bi), approximately 60% of students gained a mark for naming one suitable control variable with a further 25% gaining both marks. A common error was to name pressure. In part (bii), although approximately a third of students gained full marks, it was surprising how few students took the opportunity to draw a suitable sketch graph. Instead there were diagrams of particles in unlabelled boxes, and gas syringes. In addition, some students explained how particles cause a pressure rather than answering the question asked. Nearly 45% of students failed to gain a mark in this part.

Question 10
Forces and astronomy
Some of the difficulty that students found with part (a) was due to mis-reading the question and describing the structure of comets and moons (which is not on the specification). The marks for this part were evenly spread: approximately a third gaining each of 2 marks, 1 mark and no marks.
The calculation in part (b) proved accessible for most students with almost 60% gaining full marks. However, only 55% of students realised that the work done in lifting the hammer equalled the GPE lost when it fell. The final part of (b) was found to be challenging, with just 4 % gaining full marks. A logical explanation was required not a vague description.
The calculation in part (c) also proved accessible for most students with almost 60% gaining three or more marks. Common errors included inverting the last stage of the calculation and omitting the factor of 2π.

Question 11
Magnetic fields
Many students were able to gain full marks for a labelled diagram showing multiple aligned plotting compasses and field lines around a magnet. However, some students ignored this opportunity and made less progress. It is useful to note that here detail was critical: mention of iron filings alone could not gain full marks as direction can't be inferred by iron filings.
Many students found part (b) challenging, with two thirds failing to gain any marks. Students made more progress in part (c) especially in (cii) with nearly 50% gaining full marks. In part (ci), some students mistakenly thought that the wire was connected to a cell and this misapprehension carried into (cii).

Question 12
Brownian motion
Many students found this question challenging. The largest cause for concern was the lack of precision in the responses: students stated that 'they moved randomly' instead of 'pollen grains can be seen to move randomly' or even 'water particles move randomly'; also, 'water particles collided with each other' which would not cause the movement seen. Approximately a third of students gained full marks, with another third failing to gain any marks.

Question 12
Radioactivity

This question was designed to be targeted at AO1, which is understanding and recall, not application. However, as a whole, students struggled with the question, possibly because this topic had been left until the last when taught. Over a quarter could not identify even one piece of equipment needed in part (a).

In part (bi), many students only gave three ticks when four marks were available. Less than 10% gained all four marks. Commonly, students thought that source one was alpha, source two was beta and source three was gamma and so gained only the mark for source two. Two thirds of students were unable to name background radiation in (bii).

The definition of half-life was as poorly attempted as in previous series: the majority of students gained only the 'time' mark. It was noted that those students who mentioned activity were more likely to get full marks. The consequent half-life calculation also caused problems as half of the students failed to gain a mark. However, 30% did gain full marks. A common error was to miscount the number of half-lives and thus obtain 24 days instead of 18 days.

Question 12
Thermistor

This question was primarily targeted at practical skills and most parts proved to be accessible for most students.

Over 80% of students were able to identify the thermistor symbol in part (a). In part (bi) naming the independent and dependent variables was found quite difficult with just under 60 % success rate. As expected the graph plotting was much better attempted by the majority of students: nearly 75% gained four or more marks with over a third gaining all six marks. Common errors included: using an inappropriate scale (e.g. 0 ,150, 300, 450 etc.) or a nonlinear scale, omitting units on the axes and joining the points with straight line sections. The improvements were not well answered with over 45% of students failing to gain credit. It seemed that students had not seen or taken note of the evidence that they were given, the diagram and the results table, in order to suggest improvements. The limited range of temperature readings, the obvious 'gap' in the data and the placement of the thermometer and thermistor were ignored. A few students did gain a mark for 'repeat and average' but less than 5% gained full marks.

The calculation in part (c) proved accessible for more students with over 50% gaining full marks. Here, there was evidence of poor calculator skills as some students lost marks for power of ten errors or for truncation. The final explanation in (ciii) proved to be quite challenging as less than 10% gained full marks. In part this could be due to lack of examination skills: for a three-mark explanation question, students must expect to mention three factors or stages.

Recommendations for improvement

1. Wherever possible, centres should ensure that students do the suggested practicals. If this is not possible for whatever reason, students should be encouraged to use good simulations, some of which are available with minimal cost online.
2. Some equations are not well known, e.g. the equation for kinetic energy is often misquoted. It is strongly suggested that students be tested regularly on recall of equation. Students can't gain marks for calculations if they don't know the equation or how to transform it.
3. While many students are very proficient at substation into equations, they are less so with transforming the equation. In a similar manner, many students make mistakes when converting power of tens in units. There is no requirement that students work in standard form, but students should know what the standard prefixes mean. It is strongly recommended that this be an area of focus during revision.
4. Students should practice different types of data analysis e.g. from graphical data and from text or tables. There has been at least one of these on all recent examination papers in this subject as it is forms part of the required AO3 skills.
5. Students should also practice recognising areas where poor technical vocabulary loses otherwise easy marks. This can be done by for example giving students (photo) copied but otherwise unidentified sections from internal examinations where they can try to spot errors. Teachers can discuss why confusing say power and energy loses marks. Teachers can also see such areas by reading the notes section on the mark schemes.

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