Examiners' Report
March 2013

GCSE Physics 5PH2H 01

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Introduction

This unit is divided into six topics and all six topics are tested in the examination.

The topics are:

- controlling and using electric current
- static and current electricity
- motion and forces
- momentum, energy, work and power
- nuclear fission and nuclear fusion
- advantages and disadvantages of using radioactive materials.

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. To achieve this, each question increased in difficulty as the question progressed. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth 1 or 2 marks each and longer questions worth 3 or 4 marks each. The two 6-mark questions were used to test quality of written communication.

Successful candidates were:

- well grounded in the fundamental knowledge required
- willing to think, use their knowledge to solve new problems and apply their knowledge to unfamiliar situations
- able to analyse and interpret data in graphical form
- able to tackle calculations methodically and show the stages in their working
- able to construct their explanations in a logical order, using the marks at the side of the questions as a guide.

Less successful candidates:

- had gaps in their knowledge
- found difficulty in applying their knowledge to new situations
- found difficulty in analysing and interpreting data in graphical form
- did not show their working in calculations
- did not think through their answers before writing.

The quality of written communication was generally appropriate to the level of response.

When it was not, the mark within that level was reduced, if possible.

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates.

Charge and current

Question 1(b)

This question provided a straightforward start to the paper, requiring the use of the equation relating charge, current and time. The vast majority of candidates scored both marks. Of those who did not, working was rarely shown. This removed the opportunity of scoring 1 mark.

(b) The current in a wire is 3.7 A.

Calculate the charge that flows into the wire in 13 s.

(2)

Charge = current × time

3.7 × 13 = 48.1c

charge = 48.1 C

ResultsPlus
examiner comment

This response gives the correct answer with the working clearly shown. Both marks were awarded.

ResultsPlus
examiner tip

Always show your working, even in the simplest of calculations.

Question 1(c)

In this question examiners were looking for statements about electrons being transferred from the cloth to the rod, leaving the cloth with an **equal** but opposite charge to the rod.

Most candidates scored 3 marks, mainly missing out on the 'equal' mark. Very few scored all 4 marks.

(i) Explain how the plastic is charged by the rubbing.

(2)

When the cloth and plastic rub together, friction is created which causes a transfer of charge/electrons. The cloth gives ~~an~~ electron(s) to the plastic which causes it to become ~~negatively~~ positively charged and the plastic is negatively charged as it recieved an electron.

(ii) The cloth is also charged when it rubs against the plastic.

Describe the charge on the cloth.

(2)

The cloth is also charged when the plastic and cloth rub due to the friction and transfer of electrons, as the cloth gives electron(s) to the plastic it obtains a positive charge. Both object obtain an equal but opposite charge.

(Total for Question 1 = 8 marks)

ResultsPlus
examiner comment

This is a well-structured response which scored all 4 marks.

Going downhill

Question 2(a)

In this energy transfer question examiners were looking for three ideas:

- a transfer between GPE and kinetic as Andrew descends
- a transfer between KE and thermal during the decent
- what happens to the energy when he has stopped.

Most candidates failed to score. About a third of candidates scored 1 mark or better with only a very few scoring full marks.

Describe the energy changes that happen between starting and stopping.

(3)

When he starts skiing, the potential energy that he had at the top of the hill would be released as kinetic energy as he moved. As his skiis rub against the ground, this will cause friction and may release some heat energy, but most of the energy is kinetic. However, when the skier stops, his kinetic energy will then be transferred into heat energy of his skiis rubbing against the ground. Also,

ResultsPlus
examiner comment

Even though the word 'transfer' is not used, this answer was sufficient to score all 3 marks.

Question 2(b)(i)–(ii)

These were straightforward questions involving the use of equations. The vast majority of candidates scored full marks.

Question 2(b)(iii)

This question tested the idea that force is proportional to rate of change of momentum. It proved to be a good discriminator. The idea did not have to be formally stated. The following examples show some ways in which full marks could be scored.

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

The force was not great enough to injure him due to the time it took him to reduce his momentum. Increasing the time it takes to reduce his momentum will decrease the force impacted on him

(Total for Question 2 = 9 marks)

ResultsPlus
examiner comment

This is a perfectly acceptable way of relating force to the time it takes to reduce the momentum. It scored full marks.

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

It took a long time for him to stop. The rate of change of momentum was not that high so the force on him was not that much.

(Total for Question 2 = 9 marks)

ResultsPlus
examiner comment

This is closer to the formal statement of Newton's second law. It also scored full marks.

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

rate of change momentum
The greater the ~~force~~ is the greater the force is. His momentum changes slowly because he slides across the snow rather than stopping suddenly this reduces the amount of force acting upon him so he is not injured.

(Total for Question 2 = 9 marks)

ResultsPlus
examiner comment

This is a very good, well expressed response, which scored full marks.

ResultsPlus
examiner tip

In a situation like this, write down the relevant equation:

force = change in momentum ÷ time

then use it to construct your written answer.

Motion and forces

Question 3(b)(i)

This question involved judging halfway between 2 and 4 on the *x*-axis then estimating the corresponding value for velocity on the *y*-axis. A generous range of answers between 11 and 14 were accepted.

Question 3(b)(ii)

Candidates needed to take data from the graph to substitute into the equation for acceleration. Most were able to do this successfully.

(ii) Calculate the acceleration of the car when it is speeding up.

(2)

Acceleration = Change in Vel / Time

Accel = 20 / 5 = 4

acceleration = 4 m/s²

ResultsPlus
examiner comment

This is a good example of working which is clearly shown. It was awarded 2 marks.

Question 3(b)(iii)

This question tested knowledge of units related to an equation and the ability of the candidates to express their ideas clearly.

(iii) Explain why the units of acceleration are m/s^2.

(2)

Because acceleration is change in velocity divided by time. Velocity ~~divided~~ is measured in m/s and time is measured in seconds $\frac{m/s}{s} = m/s^2$

ResultsPlus
examiner comment

This response shows clear thinking and a logical progression to the answer and was awarded both marks.

(iii) Explain why the units of acceleration are m/s^2.

(2)

The unit for speed is m/s (metres per second) as this is divided by ~~speed~~ time for acceleration. We ~~can~~ divide ~~Multiply~~ the unit ~~for time~~ by the time to obtain the m/s/s which can be simplified as m/s^2.

ResultsPlus
examiner comment

This is a correct response which got there eventually. It was awarded both marks.

ResultsPlus
examiner tip

Always read your answer through after you have written it. This is a clear example of that practice being effective.

Question 3(b)(iv)

Where candidates realised that the second distance travelled was not at constant velocity, they usually went on to score all 3 marks by using the area under the graph or the idea of average velocity. Unfortunately, this was rare with most candidates scoring either 1 mark for the distance at constant velocity or zero marks.

(iv) Show that the car travels further at a constant velocity than it does when it is slowing down.

(3)

Constant velocity = 20 × 3 = 60 ~~m/s~~

~~½ (8 × 2~~

Decelerating = ½ (20 × 2) = 20

60m is further than 20.

ResultsPlus
examiner comment

Ideally, this candidate should have written 'Distance travelled at constant velocity =…' and 'Distance travelled when decelerating = …'. However, what was given was clear enough to be awarded all 3 marks.

Carbon dating

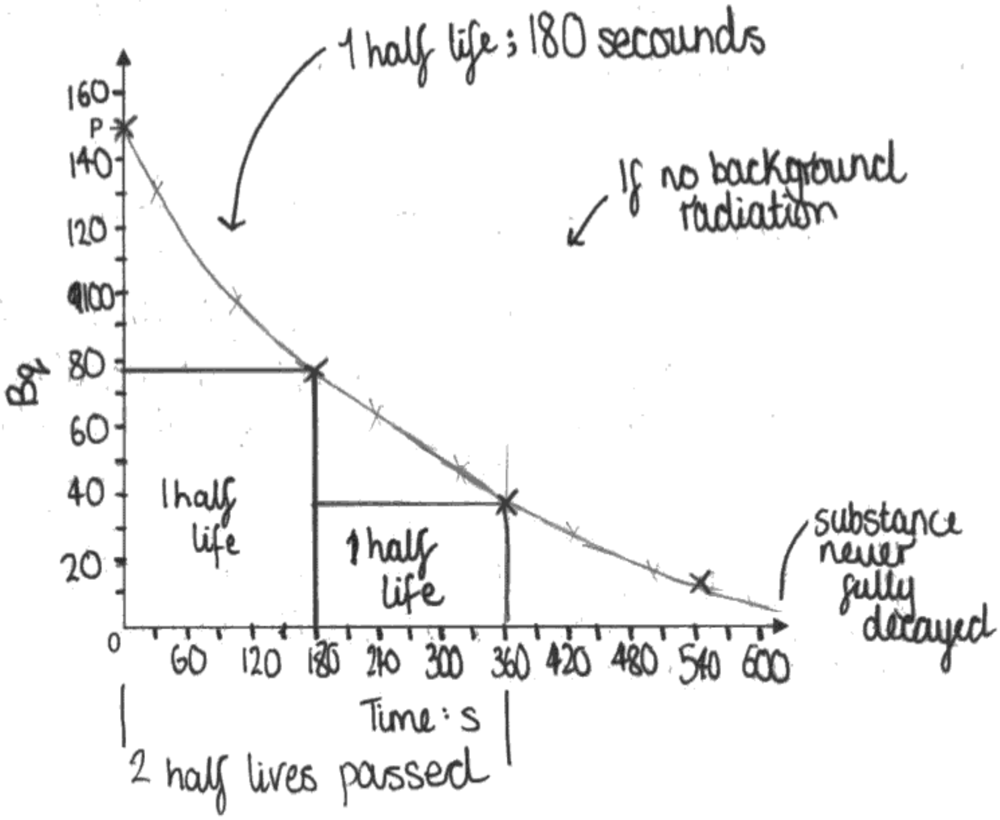
Question 4(b)

To gain full credit for this sketch of a decay curve, the axes needed to be labelled. The label or the unit was acceptable. The decay curve had to be the correct shape and not touch the time axis.

(b) Sketch a graph to show how the activity of a radioactive isotope changes with time.

Use the axes below. Start your line from point P.

(3)



ResultsPlus
examiner comment

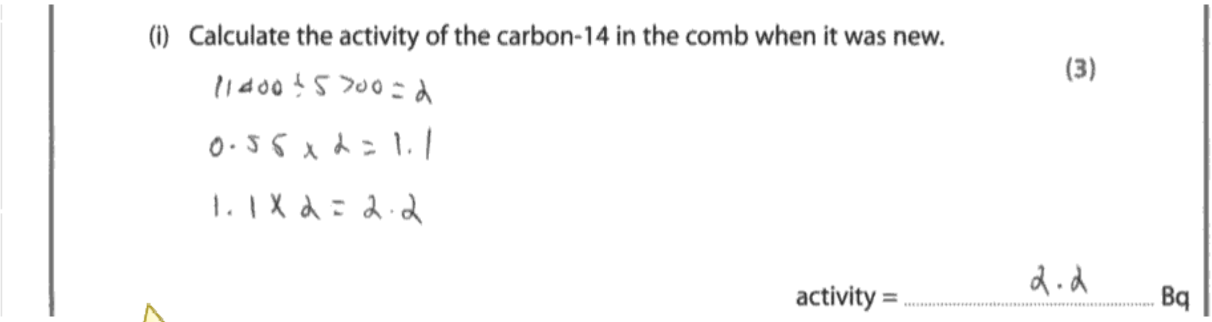
The *y*-axis shows the correct unit and the time axis shows the label and the unit. The curve is the correct shape and is just smooth enough to be acceptable. It does not reach the time axis. The other information, to do with half-life was good but irrelevant here.

This response scored all 3 marks.

Question 4(c)(i)

This question tested the understanding of the term ‘half-life’. Candidates were expected to realise that 11 400 years was two half-lives of carbon-14 and then to use this to calculate the activity in the comb when it was new.

A large number of candidates failed to score in this question and of those who were awarded any marks; the majority scored only 1.



(i) Calculate the activity of the carbon-14 in the comb when it was new. (3)

11400 ÷ 5700 = 2

0.55 x 2 = 1.1

1.1 X 2 = 2.2

activity = 2.2 Bq

ResultsPlus
examiner comment

This is a well-structured answer which scored all 3 marks.

Question 4(c)(ii)

Candidates were expected to know how background count is dealt with in practical circumstances. Responses that recognised the effect of background radiation on readings and that the background reading has to be subtracted from the original reading scored well.

The majority of candidates scored at least 1 mark, whilst almost a third scored both marks.

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

Because background radiation adds to the reading from the comb, so to make the investigation more accurate, they take away the background radiation from the total.

ResultsPlus
examiner comment

This is a good example of a response, which was awarded a clear 2 marks.

Question 4(c)(iii)

Answers relating to the difficulties of measuring small amounts of radiation were awarded the mark.

Electric circuits

Question 5(a)(i)

This question involved the straightforward use of the equation $V = IR$ for which the vast majority of candidates scored 2 marks. The most common error for those who did not was to use 0.06 A as the current in *R*.

(i) R has a resistance of 11 ohms.

Calculate the potential difference across R.

(2)

Potential difference = Current × Resistance.

So 0.40 × 11 = 4.4 v

potential difference = 4.4 V

ResultsPlus
examiner comment

The correct current is used and the working is clearly shown. 2 marks were awarded.

Question 5(a)(ii)

This question tested the idea that at a junction in a circuit, current is conserved and most candidates answered it correctly.

Question 5(b)

Responses in terms of collisions between electrons and ions in the lattice or even atoms in the metal gained full credit.

(b) Explain why the temperature of a resistor increases when a current passes through it.

(2)

Because the electrons collide with atoms in the ~~[crossed out]~~ lattice structure when passing through, causing the atoms to vibrate more, and therefore increase temperature as they are gaining more energy

ResultsPlus

examiner comment

In this answer 'atom' was accepted instead of 'ion'. This response scored both marks.

Question 5(c)

Candidates were asked to explain how LDRs and thermistors can be used to control the current in a circuit. A Level 1 response would typically say that the light falling on an LDR and the temperature of a thermistor would affect the resistance or current. A Level 2 response typically gave the correct relationship between light intensity and resistance for an LDR and temperature and resistance for a thermistor. A Level 3 response correctly linked light intensity, resistance and current for an LDR and temperature, resistance and current for a thermistor.

Most candidates knew that the resistances of these components depended on light and temperature and an encouraging number knew the correct relationship. Fewer candidates went on to say how this affected the current. Errors occurred where candidates did not express their answer as a logical series of linked statements.

*(c) A resistor is a circuit component.

Two other circuit components are a light dependent resistor (LDR) and a thermistor.

Explain how LDRs and thermistors can be used to control the current in a circuit.

(6)

LDRs in a circuit can control the current in darkness mostly. As the resistance of the light-dependent resistor is at its highest in the dark, so less current will flow or more voltage will be needed to keep the same current flowing. However, in lighter conditions the resistance of an LDR falls which means the current increases and so does the voltage.

A thermistor is very similar to an LDR except it depends on temperature rather than light. If the temperature of the circuit gets to hot then the resistance falls and the current increases but as the circuit gets colder the resistance is now at its highest and so therefore less current will flow.

(Total for Question 5 = 12 marks)

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This response is presented in a logical, well-ordered way. It deals first with an LDR and then with a thermistor. It is a Level 3 answer, which scored 6 marks. The scientific terminology is used correctly and there are only a few spelling, punctuation and grammatical errors.

ResultsPlus
examiner tip

In a question such as this, plan your answer so that it is in logical steps. This will also help you to exclude information that is not necessary for the answer.

*(c) A resistor is a circuit component.

Two other circuit components are a light dependent resistor (LDR) and a thermistor.

Explain how LDRs and thermistors can be used to control the current in a circuit.

(6)

Light-dependat resistors depend on light to decide how much resistance they have and therefore, how much current passes through. When it's dark, the resistance is high but when it is light, the resistance is low. This controls the current depending on the light on the LDR

A thermistor depends on temperature. When it is hot, the resistance is low but when it's cool, the resistance is high. This means that the temperature controls the amount of current in the circuit.

(Total for Question 5 = 12 marks)

ResultsPlus
examiner comment

This candidate has the correct relationship for resistance in both cases but does not go on to say how this affects the current. This makes it a Level 2 answer, which scored 4 marks.

Ionising radiation

Question 6(a)

As expected here, the vast majority of candidates were able to state two ways in which gamma radiation is different from alpha radiation.

> **6** Alpha, beta and gamma are types of ionising radiation.
>
> (a) State **two** ways in which gamma radiation is different from alpha radiation. **(2)**
>
> Gamma radiation is different from alpha radiation because gamma is weakly ionising and penetrates far into a material before interacting with an atom.

ResultsPlus
examiner comment

Two clear differences are given here, penetrating power and ionising ability. This answer scored 2 marks.

> **6** Alpha, beta and gamma are types of ionising radiation.
>
> (a) State **two** ways in which gamma radiation is different from alpha radiation. **(2)**
>
> Gamma radiation is disserent Srom alpha radiation because Gamma rays can Penetrate almost anything and Gammar rays travelle Suther than alpha radiation.

ResultsPlus
examiner comment

This response gives only one difference, to do with penetrating power so scored only 1 mark.

Question 6(c)

In explaining how atoms can become ionised by radiation, candidates were expected to know that the radiation causes the atom to lose or gain electrons. The majority of candidates scored at least 1 mark here with a large number going on to score both marks.

(c) Explain how an atom becomes ionised by radiation.

(2)

The high energy particle or wave collides with the atom knocking off electrons and turning the atom into an ion. The ~~elect~~ atom becomes charged.

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examiner comment

This clearly expresses the idea that the radiation causes the atom to lose an electron. It was awarded 2 marks.

Question 6(d)

In this question, candidates were asked to apply their knowledge about alpha, beta and gamma radiation to an unfamiliar situation. Examiners were looking for an explanation of the difference between at least two of the sets of readings in terms of the abilities of the three radiations to penetrate materials.

The majority of candidates achieved at least Level 2 marks with a pleasing number scoring full marks.

Explain why the readings in the three directions are different.

(6)

There is less radiation coming from the front because the radiation has to go through the glass. Gamma radiation can go through it fine whilst beta radiation doesn't travel as far and might be stopped. Alpha particles are stopped by the glass. from the side beta and Alpha particles cannot go through the aluminium. This means only gamma particles go through the Aluminium to be detected.

from the back, Gamma and Beta radiation can travel to be detected whilst the Alpha particles are stopped by the thin layer of magnesium fluoride in all 3 directions.

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This response correctly explains the differences between all three sets of readings so is a Level 3 response which scored all 6 marks.

The reference to gamma as particles was not enough to lose a quality of written communication mark in the context of the question.

Explain why the readings in the three directions are different.

(6)

There is more radiation coming from the back as there is a radioactive piece of glass there and only 110Bq is coming from the front as the glass must be stopping any alpha radiation through. There is less radiation coming from the side as there is thick aluminium which must be blocking the beta radiation from coming through. There is a lot more radiation coming from the back because that is where the main source of radiation is coming from.

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This answer makes some unrelated points but does not explain why the readings are different in terms of the type of radiation detected. It is a Level 1 response and scored 2 marks.

Summary

Based on their performance in this paper, candidates should:

- make sure that they have a sound knowledge of the fundamental ideas in all six topics
- make sure that they understand the meaning of terms like force, momentum, acceleration and velocity and that they use these words accurately
- get used to the idea of applying their knowledge to new situations by attempting questions in support materials or previous examination papers
- show their working at each stage of a calculation and know how to tackle calculations involving changing the subject of an equation
- use the marks at the side of a question as a guide to the form and content of their answer.

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