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Examiners' Report
June 2015

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.

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 and tabular 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 and tabular form
- did not consider powers of ten in their 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. It will not demonstrate all of the acceptable answers to each question. These can be found in the published mark scheme.

Question 1 (a)

Most candidates were able to identify gamma as an electromagnetic wave. The most frequent error was to confuse alpha and beta radiation.

Question 1 (b)

Candidates were generally secure in their understanding of the role of control rods in a fission reactor. The most common error was to confuse control rods with the moderator and to write about neutrons being slowed down.

(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

When the rods are pushed down they absorb more neutrons whereas when they are not pushed down they do not absorb as many neutrons.

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Examiner Comments

The candidate has explained what the controls do but not how they affect the rate of nuclear fission. 1 mark.

Pushing control rods between the fuel rods will decrease the rate of nuclear fission.

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Examiner Comments

The candidate has described the change in rate of fission but not explained how the control rods do this. 1 mark

(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

The control rods being pushed between the fuel rods reduces the rate of nuclear fission because it absorbs ~~a~~ neutrons produced by a fission reaction; and prevents some of them from causing ~~collisio~~ a fission reaction with other nuclei.

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Examiner Comments

This answer explains how the rate of fission is affected by the control rods. 2 marks

ResultsPlus
Examiner Tip

When you answer a question that asks you to "explain" make sure that you write **what** happens and **why** it happens.

Question 1 (c) (ii)

Candidates generally knew that fusion involved nuclei joining together but often lost a mark through inaccurate use of terms (e.g. "atoms" rather than "nuclei") or only "colliding" rather than actually joining.

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

Two light nuclei (hydrogen) can collide and fuse together to become a helium nuclei. This gives off thermal energy. This also produces more energy than nuclear fission.

ResultsPlus
Examiner Comments

A clear answer which makes both mark points. The question did not ask about energy, but there was no penalty for including this (correct) statement.

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

The nuclei fuse together creating a new atom, out of the two lighter nuclei.

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Examiner Comments

This answer has the idea of nuclei fusing for 1 mark, but then missed a possible second mark by writing about atoms rather than nuclei.

ResultsPlus
Examiner Tip

Make sure that you use terms like atoms and nuclei correctly.

Question 2 (b)

Examiners were looking for a clear statement that the plates had the opposite charge to the particles and that this caused the particles to be attracted.

A large number of candidates described charging by induction and wrote about negative charge being repelled from the surface of the plates. In fact, induction is not the process taking place in this case. Here it is a simple attraction caused by the metal plate having an overall positive charge.

Question 2 (c) (i-ii)

Candidates generally knew that the dust particles would lose their charge to the plates. Although the question asked what happens to the charge, examiners accepted answers that referred to the particles; e.g. the particles become neutral. In part (ii) examiners were looking for an explanation which described the movement of charge through a conductor. Better candidates were able to provide clear answers but very many either stated that the metal was a conductor or that the metal was earthed without going on to mention the movement of charge.

(c) (i) State what happens to the charge on the dust particles when they settle on the metal plates.

(1)

They become ~~[illegible]~~ neutral

(ii) Explain why the charge does not build up on the metal plates.

(2)

The metal plates are earthed. This allows the electrons to flow through them down to the ground neutralising the charge.

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Examiner Comments

This was an acceptable answer for part (i) although it actually describes what happens to the particles rather than what happens to the charge.

Part (ii) scored full marks.

The metal plate is earthed so the charge does not build up on the metal plates.

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Examiner Comments

1 mark for realising that the earth connection will remove the charge, but the rest of the answer simply repeats the stem.

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Examiner Tip

Check that you are not just repeating what you have been told in the question.

Question 2 (d)

Most candidates knew that the current must be multiplied by the time but a very large number did not take account of the fact that current was in milliamps rather than amps. Some candidates attempted to convert the value but multiplied by 1000 rather than divided.

Coulombs were not well known. It was common to see the symbol Q as unit of charge. Many candidates attempted to use a compound unit of mA and s but almost invariably gave it mA/s.

(d) There is a current of 1.2 mA in the circuit.

Calculate the charge transferred by this current in 40 s.

State the unit.

(3)

Q = I x t

Q = 1.2mA x 40s

= 48mC

(m Coulombs)

1.2 x 1,000,000 = 1,2,00000 A

charge transferred = 48 unit: mC

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Examiner Comments

This candidate seems to have attempted to convert powers of ten but then simply, and quite wisely, used milli all the way through to score full marks.

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Examiner Tip

If the current is in milliamps, then you can calculate the charge in millicoulombs without changing the decimal places.

(d) There is a current of 1.2 mA in the circuit.

Calculate the charge transferred by this current in 40 s.

State the unit.

(3)

1·2 x 1000

= 1200

1200 x 40

= 48000

charge transferred = 48000 unit: coulombs

ResultsPlus
Examiner Comments

Many candidates realised that there was a factor of a thousand to take into account, but often got this the wrong way round.

2 marks.

ResultsPlus
Examiner Tip

Check that you know the difference between the abbreviations m (milli) and k (kilo).

Question 3 (a) (ii)

Transfer of gravitational potential energy to kinetic energy as the ball fell was generally well known although many candidates went on to describe energy transfers when it hit the ground; which were not asked for in this part of the question.

Weaker candidates often used terms such as force, air resistance, acceleration and gravity instead of energy.

(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

The energy ~~gy~~ transfers from gravitational potential energy to kinetic energy and ~~a~~ some energy may be transfered to heat energy.

ResultsPlus
Examiner Comments

A simple and fully correct answer. 2 marks.

(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

It's speed and velocity increase to a ~~z~~ certain point where it becomes constant. This point is when it reaches terminal velocity.

ResultsPlus
Examiner Comments

Terminal velocity was often mentioned in answers to at least three different questions in this paper.

ResultsPlus
Examiner Tip

Falling objects do not always reach terminal velocity! 0 marks.

(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

The energy ~~gy~~ transfers from gravitational potential energy to kinetic energy and ~~m~~ some energy may be transfered to heat energy.

ResultsPlus

Examiner Comments

It was quite common to see important terms being used out of context.

Here the idea of force is being incorrectly used. 0 marks

(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

The energy changes because acceleration increases so it uses up more of its energy.

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Examiner Comments

Here the term acceleration is being incorrectly used. 0 marks.

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Examiner Tip

Make sure that you know how to use important terms like force, acceleration and energy.

Question 3 (b)

Although many candidates quoted the formula "work done = force x distance moved" very few could put this into a context such as this is where the sand has clearly been moved. Those candidates that did mention the movement of sand would often not mention any forces involved.

Many answers tended to dwell on energy being transformed (often into heat and sound) without attempting to relate this to work.

The energy is transferred to the sand which causes the sand to move, as it applies force to the sand, and pushes it outwards over a distance.

ResultsPlus
Examiner Comments

This answer shows a clear link between energy transfer and a force acting over a distance. It easily scored both marks however, responses such as this were quite rare.

The balls have caused the sand to shift and move.

ResultsPlus
Examiner Comments

The candidate has the idea of movement over a distance being involved and scored one mark.

Question 3 (c) (i-ii)

The first part of this question was correctly answered by most candidates. It was pleasing to see the working clearly written out and there were few answers without some calculation shown. It was also noted that candidates are getting much better at quoting answers to the correct number of significant figures and there were fewer values read straight from the calculator display then in previous years.

In part (ii) many candidates attempted to use the force = mass x acceleration formula but then struggled to find a suitable value for acceleration and simply selected the value given for momentum. A few did correctly calculate acceleration from change in velocity and time.

Those who did identify the correct equation to use generally scored both marks.

(c) When one ball hits the sand, it has a velocity of 6.2 m/s.

It has a momentum of 0.46 kg m/s.

(i) Calculate the mass of the ball.

(3)

$P = m \times v$

$m = \frac{P}{v}$

$= \frac{0.46}{6.2}$

$= 0.074$

mass of ball = 0.074 kg

(ii) The ball takes 0.17 s to come to rest after it hits the sand.

Calculate the average impact force.

(2)

$F = \frac{(mv - mu)}{t}$

$= \frac{0.46}{0.17}$

$= 2.7$

average impact force = 2.7 N

ResultsPlus

Examiner Comments

A nicely laid-out and fully correct answer with the correct number of significant figures.

Question 4 (a) (iii)

Candidates could achieve marks a number of ways in this question. The most common observation was that the isotope was unstable and/or radioactive, followed by recognition that it had a long half-life. Some of the more able candidates wrote that the decay must be random because only some nuclei had decayed in that time.

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

This means it has a long half-life and it takes a long time for it to decay. It also shows that after it has decayed, it will become Argon-40.

ResultsPlus
Examiner Comments

This answer correctly identifies a long half-life and gains 1 mark.

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

It gives the information that the isotope potassium-40 is unstable and needs to emit gamma radiation to become stable. This shows that its ~~[illegible]~~ Radioactive.

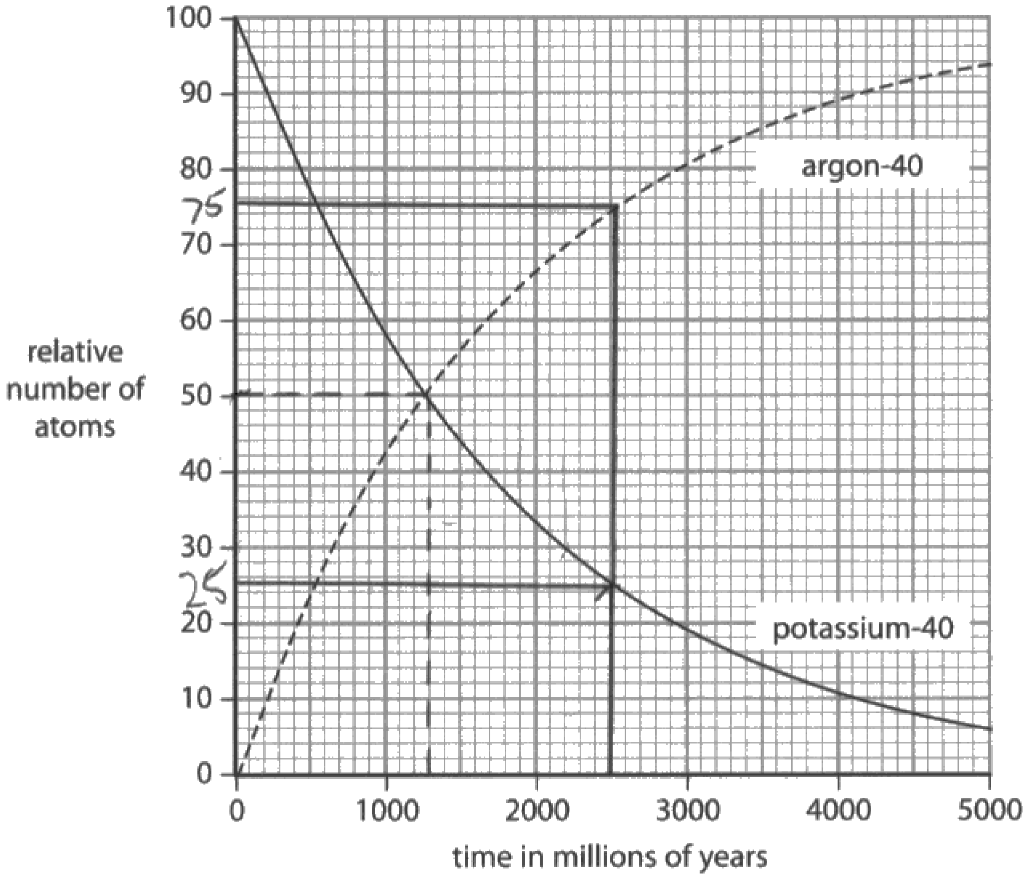
ResultsPlus
Examiner Comments

This response was awarded 1 mark for recognising that it must be unstable and a second mark for the fact that this means it is radioactive.

Question 4 (b) (i-ii)

Most candidates could find the half-life from the graph and many went on to double this value to correctly answer the second part.

In part (ii) a large number of candidates clearly used the graph to identify the point where the amount of argon was three times the amount of potassium (i.e. at 75/25) to arrive at the correct answer but an equally large number simply multiplied the half-life by 3 and so failed to score any marks.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = 1300 million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = 2500 million years

ResultsPlus
Examiner Comments

This candidate clearly knew how to interpret the graph and arrived at the right answer for the full 2 marks.

ResultsPlus
Examiner Tip

If you are reading values from a graph it is always a good idea to draw lines with a ruler: like this candidate did.

Examiners award at least 1 mark for showing the correct method even if the final answer is incorrect.

Question 4 (c)

Answers tended to focus on the risks from radiation rather than explaining why the radon coming out of the rocks would increase this risk.

Candidates were also unclear about where the background radiation comes from and frequently wrote about alpha radiation from the rocks (which, of course, has a very limited range).

Because radon gas is radioactive so if we breathe it in it could change are cells in our body causin mutations.

ResultsPlus
Examiner Comments

This is a very clear answer which explains why radon gas is significant (a radioactive gas which can be breathed in) and then why it is a hazard (causes mutations in our cells). 3 marks.

The background radiation can cause cancer or mutations in the DNA.

ResultsPlus
Examiner Comments

This response describes a risk arising from background radiation but does not explain how living near radon-producing rocks might increase this risk. 1 mark.

ResultsPlus
Examiner Tip

Remember to check how many marks a question is worth. Examiners would usually expect to see three correct statements in order to award three marks.

Question 5 (a) (i)

A large majority correctly identified force as a vector quantity.

Question 5 (a) (iii)

Most candidates drew an upward-pointing arrow to correctly represent the thrust for 1 mark.

The second mark was frequently missed by either incorrectly calculating the size (answers of 1.3 were often seen) or by mistaking the thrust for the resultant force of 0.5N.

Question 5 (b) (i)

Most candidates had no difficulty in identifying the correct equation and substituting the given values. A large majority, however, failed to convert the mass from g into kg and so their evaluation (of 297) was 1000 times too large.

It was noted that very few candidates rounded their answer to the correct number of significant figures (0.30).

Force = mass x acceleration

f = 90 x 3.3 = 297

resultant force = 297 N

ResultsPlus
Examiner Comments

This response was typical of very many. 1 mark.

ResultsPlus
Examiner Tip

Remember that the SI unit of mass is Kg and not g.

mass = 90g

acceleration = 3.3 m/s²

F = m x a

~~3.3²~~ =

90 x 3.3² = 980

resultant force = 980 N

ResultsPlus
Examiner Comments

Some candidates seem confused by the units of acceleration. 0 marks.

ResultsPlus
Examiner Tip

Make sure that you understand that the units of acceleration are "meters per second squared". You do not have to square the value in calculations.

(2)

force = mass x acceleration

1kg = 1000

90g = 0.09 kg

force = 0.09 x 3.3

force = 0.297

resultant force = 0.297 N

ResultsPlus
Examiner Comments

This demonstrates a fully correct answer. The examiner can easily follow the steps.

Question 5 (b) (ii)

This question required candidates to demonstrate that they could interpret a velocity-time graph, even though it may have been different to those normally seen. This proved to be a challenging question for a large number of candidates. It was clear that they interpreted the graph as showing the path of the rocket instead of a velocity-time graph. In particular the end of stage 1 was seen as being when the rocket reached maximum height. They then struggled to account for the fact that the velocity was positive during stage 2 and eventually saw stage 4 as the rocket bouncing.

Nevertheless a large number could describe an initial (positive) acceleration followed by deceleration. Better candidates were able to write that in stage 3 the rocket was increasing speed in a downwards direction. Most candidates, however, failed to give a coherent explanation of how the forces involved produced these changes in velocity. It was very common to read about terminal velocity; usually linked to air resistance. Although gravity was sometimes mentioned, it very often appeared to "switch on" at the start of stage 2. It was rare to see the term "resultant force" correctly used in context.

Examiners also saw a large number of responses which confused speed and acceleration: statements such as "increasing velocity at a constant speed" were very common.

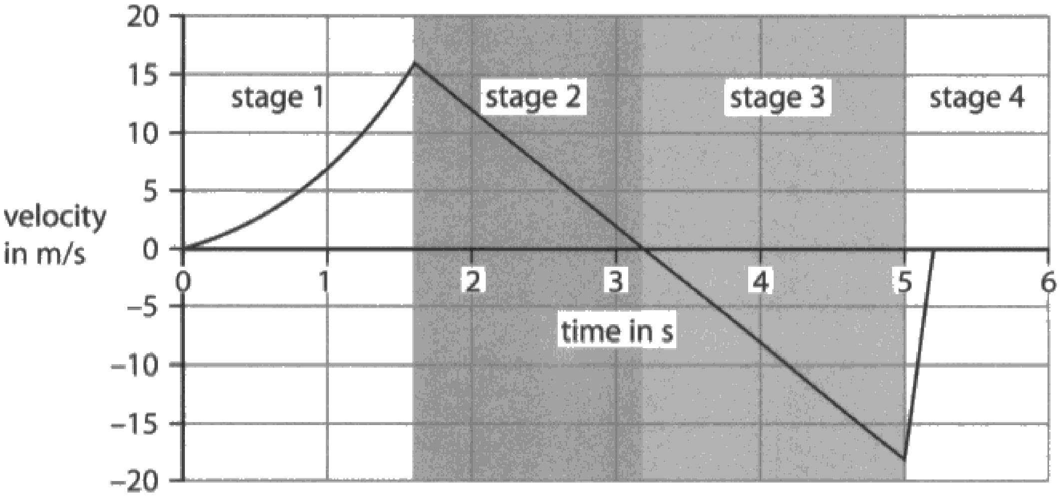
The most able candidates could relate forces to changes in velocity to reach level 3.

*(ii) The rocket contains 50 g of fuel when it takes off.
The fuel burns and the rocket rises vertically.
After a while, there is no fuel left.
Eventually the empty rocket falls back to the ground.

still
constant
acceleration
changing acceleration

The graph is a velocity–time graph for the rocket.

Four stages are labelled on the graph.



Explain why the velocity of the rocket changes as shown in the graph.

(6)

At stage one the rocket is accelerating and the rate of acceleration is changing. This because the rocket is getting lighter as it burns more fuel ~~Because force = mass x acceleration~~ Acceleration = ~~mass~~ force ÷ mass, so with a smaller mass, the rocket can accelerate faster, which is why the gradient steepens. At stage two the ~~fuel~~ rocket decelerates because there is no fuel left and so the ~~downwards force of gravity begins to become balan~~ upwards force begins to become less, slowing the rocket down. Eventually the downward force becomes the ~~stronger~~ resultant force and so the rocket accelerates to the ground, which is seen as stage ~~four~~ three. Finally, at stage four, the rocket lies stationary on the ground.

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Examiner Comments

This answer has clear descriptions of the changes in velocity at different places in the graph and correctly identifies where fuel ran out. There are some errors: for example the upward force does not begin to become less when the fuel runs out. There is actually no upward force at all at this point. There is enough good physics in the explanation of why the initial acceleration is not constant to gain the full 6 marks.

ResultsPlus
Examiner Tip

The candidate has drawn some sketches at the top as a quick reminder. This is a very good idea.

Level two responses correctly described some features of the graph in terms of changes in velocity and some mention of the forces involved.

At first the velocity - time graph goes up with a curve because as the rocket burns more fuel it gains speed during stage 1 so the velocity increases quicker.
Then when it gets to stage 2 the rocket runs out of fuel so it starts to slow down until the velocity reaches 0. When the velocity reaches 0 the rocket has stopped moving and is at constant velocity for a very short amount of time - less than 1 second.
Stage 3 shows the velocity going into negative numbers as the rocket falls. This means that the rocket is traveling faster, downwards, in the opposite direction to when it took off. Then in stage 4 the rocket hits the ground and so the velocity travels very quickly up the

graph to 0, where it stays at constant velocity because the rocket is not moving.

ResultsPlus
Examiner Comments

This is a good description of how the velocity changed and is a level 2 answer. It does not go on to explain why the velocity changed in the way described and so did not reach level 3.

(6)

Stage 1 represents the gradual accelaration of the rocket. Stage 2 shows the rocket is decelarating which could be due to air resistance. Decelaration is continued in stage 3. and stage 4 is accelaration because there is no air in space. The gradient shows the acceleration towards a certain direction.

ResultsPlus
Examiner Comments

A level 1 response such as this gives a description of how the velocity changes but does not give any correct explanation.

Question 6 (a) (ii)

Candidates were expected to substitute the given values of current and resistance into the V= I x R equation and then evaluate to show that this resulted in value for voltage which was (approximately) the same value as the one given. These two steps, correctly carried out, would score both marks.

Many candidates, however, chose to transpose the equation and substitute values for V and R. In this case full marks would be scored without having to carry out a third step of evaluation.

(ii) When the LDR is in bright sunlight, its resistance is 185 Ω.
The voltage across the LDR is then 7.2 V.

Show that the current in the LDR is about 0.039 A.

(2)

V = I×R

I = V/R

= 7.2/185

= 0.0389 ... → = 0.039 (3dp)

ResultsPlus
Examiner Comments

This answer gains full credit for the transposition and substitution.

ResultsPlus
Examiner Tip

A triangle is often a helpful way of remembering how to re-arrange an equation but always write the equation out in words as well. Examiners will not give any credit for the triangle on its own.

p.d = current × resistance

7.215 ~~[illegible]~~ = ~~current~~ 0.039 × 185

∴ the current is about 0.039 as the voltage is 7.2 (1dp).

ResultsPlus
Examiner Comments

It is possible to gain full marks by substitution and evaluation without transposition.

ResultsPlus
Examiner Tip

In a "show that" question it is easiest to start by writing the equation in words. Then substitute the numbers which you have been given. Then do the arithmetic to show that both sides of the equation had (approximately) the same value.

Question 6 (a) (iv)

For this question candidates first had to extract information from the table and then provide an explanation.

Well prepared candidates clearly knew about light dependent resistors and could write that the resistance increased as the light conditions became darker. There were many examples, however, of confusion with thermistors or with solar cells.

Candidates who wrote about the resistance changing but had the resistance decreasing as it became darker, could still gain one mark.

Because the light conditions are different.
More sun there is, the higher the current.
The less sun there is, the lower the current.

ResultsPlus
Examiner Comments

Answers such as this were quite common. It does not give any more information than was given in the table, and was therefore awarded 0 marks.

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Examiner Tip

Check that your answer does not simply repeat the question.

LDR increases resistance in the dark or "cloudy skies" so current drops
LDR decreases resistance in light or "bright sunlight" so current increases.

ResultsPlus
Examiner Comments

A short, clear and fully correct answer.

Question 6 (b)

Examiners noted that most answers to this question included descriptions of the current being greater in the day time compared with the night. If this was correctly linked to either the changing resistance of the LDR or the amount of energy being transferred then this would reach level 2. There were, however, very many examples of confusion in the terms used in electric circuits. Voltage / current / power and energy were used as though they all meant the same thing. Current was often described as "flowing faster / slower". Many paraphrased the stem with conclusions such as "so the battery lasts longer".

In order to reach level 3, examiners were looking for responses which demonstrated a secure understanding of energy transfer in this context.

Many candidates seemed unsure about what a light dependent resistor is.

The LDR takes in more light energy when ~~the~~ during the day because it is brighter, this means that ~~more~~ it has more energy to light the lamps, this means that energy ~~is only~~ it is ~~is~~ given more energy from the light when it needs to shine the lamps ~~to~~ brighter. The LDR can be used at all times of the day so can be used as a backer up for the battery. It can recharge the battery.

ResultsPlus
Examiner Comments

The answer seems to be describing solar power. It did not score any marks.

To reach level 3, the answer needed to include some detail about how energy transferred depends on the current in the circuit.

A light dependent resistor is a component that means when there is more light, there is less resistance and therefore more current. During the day, when it is lighter, more current flows and during the night, when it is darker, less current flows. A higher current means more energy is transferred as E = I x V x t. Therefore during the day, more energy is transferred ~~and~~ than during the night. ~~At~~ A fixed current would need to be high enough for the light to be seen during the day but this means energy is wasted at night because the light doesn't need to be so bright. ~~A~~ This component changes current depending on light so less energy is transferred at night. This means there is more energy stored in the battery and it will last longer.

ResultsPlus
Examiner Comments

This response has essentially reached level 2 in the first two lines. It goes on to correctly explain how a lower current will result in less energy transferred over a period of time.

The use of the equation to support the answer meant that this was awarded full marks at level 3.

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Examiner Tip

Use equations to support your explanations. It helps demonstrate that you understand the true meaning of the equation in context.

battery last longer.

(6)

(LDRs)

Light dependent resistors change their resistance according to the light conditions. When there is a lot of light ~~&~~ intensity the resistance of the LDR drops therefore ~~the~~ more current can flow. When there is low light intensity there is more resistence so less current flows. By using an LDR on the sign the battery would last longer because it would be using less current during the night ~~tib~~ time because there would be more resistance at night. The sign would still be effective ~~at~~ as well because during the day there is low resistance meaning more current will flow making the lights brighter and more visible.

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Examiner Comments

This answer has enough good descriptions of how the LDR can be used to control the current in the circuit to make it a level 2 response. There are some incorrect use of terms such as "using less current". Higher marks would have been achieved if the candidate had written more about energy.

Paper Summary

Based on their performance on this paper, candidates should:

- make sure that they have a sound knowledge of the fundamental ideas in all six topics
- get used to the idea of applying their knowledge to new situations by attempting questions in support materials or previous examination papers
- make sure that they recognise SI prefixes such as m and K and how to handle these in calculations.
- use the marks at the side of a question as a guide to the form and content of their answer.

Grade Boundaries

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