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GCSE Physics/ Science

5PH1H/01 (Higher Tier)

Support Materials

Top 10 Tips from the Principal Examiner for P1 and exemplar materials for the six-marker questions from the November 2011 session

Contents

Top 10 Tips from the Principal Examiner for Physics 5PH1H (Higher Tier)

1. Practise **substitution of given numbers into equations.** This can help to score partial marks for a numerical question even if the arithmetical part causes difficulty. This can be assisted if the student is in the habit of copying the equation from page 2 of the question paper into the question space. There is no mark for this copying but it helps to obtain the correct substitution.

2. A task starting with '**Calculate...**' means that there is, at least some (possibly basic), arithmetic to do.

3. When the **identification of a unit** is asked for as part of a calculation, a specific place is given for this after the space for the numerical answer. This is designed to serve as a reminder.

4. Care should be taken with the **context of multi-meaning words**. Radiation can often be ionising and dangerous but sunlight is also radiation and does not contaminate sea water!

5. It is essential to learn items identified in the specification. These will normally begin with a trigger such as '**State...**'. There are some technical terms such as 'converging', 'nebula', 'alternating' and 'colours of the visible spectrum'.

6. Going one stage further than 'State...', '**Describe...**' can refer, for example, to a list of ideas, to a list of actions in sequence or to a change due to a given cause, an example of which would be to relate changes in image and object distances for a lens.

7. '**Explain...**' items often require a statement/ observation followed by a reason. For example, explaining the effect on a lamp of increasing the speed at which a generator turns implies a statement that the bulb will become brighter (or fuse etc.) BECAUSE the current/voltage/ power will be increased.

8. When asked to '**Compare...**', '**Describe how effects are different...**', '**Distinguish between...**', or '**Describe similarities and differences...**', candidates must make it clear which of their statements apply to which of the things being compared. 'Hedging bets' between descriptors of reflecting telescopes and refracting telescopes did not score and there was much ambiguity over the dangers posed by UV and IR radiations.

9. It is important to **read values from the correct place on a graph**. This can be assisted by drawing vertical and/or horizontal lines. This can also help to score partial marks.

10. A **line of best fit** (straight or curved) will only receive full credit:
    - if there is no tram-lining;
    - if it is drawn bearing in mind the majority of plotted points;
    - if (for a continuous variation) the points are not joined by a series of straight lines.

Exemplar Materials for Question 5(b)

Sample A

6 marks

This response briefly describes both pieces of evidence and links them with the theories, concluding with which theory is better supported.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

~~Both~~ The Steady State theory argues that though the universe appears to be expanding (which can be seen with the red shift of light from distant galaxies), new matter is being created in between, maintaining a constant density. The Big Bang theory says that the expansion is because of a singularity, ~~a~~ a point where all mass and energy were created at ~~once~~. Both theories allow for red shift, but ~~only~~ a major piece of evidence for the Big Bang theory is Cosmic Microwave background (CMB) radiation. This low frequency radiation from all directions can only be explained by the Big Bang. Because of this and because the Big Bang theory makes more accurate predictions about the universe, most Scientists prefer the Big Bang theory.

(Total for Question 5 = 12 marks)

Sample B

6 marks

This response explains the evidence which supports both theories, and the evidence which supports only Big Bang, and that Steady State cannot explain CMB.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

The evidence that supports both theories, is known as red shift. This is where light emitted from galaxies has an observed decrease in frequency – shifted towards red end. It is evidence that the universe is expanding. The big bang and steady state both account for the theory of red shift, as both of the theories support that the universe is expanding. The other evidence is cosmic microwave background radiation, or CMB. This is a background radiation which is present everywhere in the universe. It therefore must mean the universe must have started somewhere, and in the same place. It is said to have been left over from the big bang, an explosion which got everything moving and expanding. Steady state can't explain CMB, as they believe that the universe has always been here, had no end or beginning.

(Total for Question 5 = 12 marks)

Sample C

6 marks

Good explanation of red shift, supporting both theories and CMB which supports only Big Bang.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

Both theriors are supported by the evidence that Red-shift occures when looking at distant stars. This is when the wavelength of a light coming from an object moving away stretches becoming increased, and therefore its frequency is decreased. This move the light towards the red end of the spectrum, appearing redder than it should.* Cosmic Background Radiation supports only the Big Bang theory, in the form of microwaves it seemes to appear from all directions in space. The Big Bang proves this by saying it is the cooling down of the intense heat given off by a large explosion that has cooled so much it is in the microwave section of the electromagnetic spectrum. Scientists prefer the Big Bang theroy because it explains the Cosmic Background Radiation, whilst the Steady State theroy doesn't

(Total for Question 5 = 12 marks)

* This shows that stars are moving away from us and that the universe must be expanding, proved by both theories

Sample D

6 marks

This response describes red shift well and explains why it supports both theories. It then goes on to explain why CMB supports the idea of a singularity.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

Both theories state that the Universe is expanding. ~~Therefore~~ Therefore, redshift shown in distant galaxies supports both theories because as a galaxy moves ~~away~~ away, the apparent wavelength becomes stretched, making the galaxy appear red. Further away galaxies show greater redshift, ~~so~~ implying that the Universe is expanding. However, only the Big Bang theory states that the Universe had a beginning and expanded from a singularity, a theory which is supported by Cosmic Microwave Background Radiation, which fills the Universe and is believed to be leftover radiation from the 'Big Bang' that started the Universe. Therefore the Big Bang theory is preferred by most scientists.

(Total for Question 5 = 12 marks)

Sample E

6 marks

This response explains red shift and CMB very well and how Big Bang is supported by both pieces of evidence, but Steady State cannot explain CMB.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

Generally, the Big Bang theory is more accepted than the Steady State theory. Both theories are backed up by the red shift. This states that any galaxies moving away from us will give off light that shifts towards the red end of the spectrum to our eyes, similar to the dopple effect. The Steady State theory states that the universe expands as new matter is created in the gaps and the Big Bang theory states that the universe started with a huge concentrated explosion and is still expanding from that. However, radiation called Cosmic Microwave Background (CMB) radiation has been discovered. This provides evidence for the Big Bang, as the frequency and the wavelength are changing and this is suggested to be as the universe cools from the Big Bang. The Steady State theory cannot explain this CMB radiation from space

(Total for Question 5 = 12 marks)

Exemplar Materials for Question 6(c)

Sample A

6 marks

This candidate correctly relates heat loss to high current in transmission lines and explains how low currents can be achieved by stepping up voltage with a transformer.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

Transmission lines lose energy in the form of heat. The higher the current, the higher the heat loss, so more energy wasted. Therefore, transformer R steps up the voltage from the power station, in doing so reducing current, for long distance transmission. This minimises heat energy wastage. Transformer S steps the voltage down to levels used in houses. The energy lost by the inefficiency of the two transformers is not as much as would be lost by sending the electricity long distances at higher current, because more heat would be lost from the wires.

Sample B

6 marks

This response explains how a smaller current is achieved in the transmission lines by using a transformer to step up the voltage. Correctly relates low current to low heat loss.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

The energy loss in the transmission lines are reduced as the transformer R steps up the voltage, and because power = voltage x current, the current is stepped down. High current in the transmission lines would lead to high energy losses through wasted heat. Increasing the voltage and decreasing the current reduces the amount of energy lost. Transformer S has to step down the ~~current~~ voltage ~~and~~ and up the current so that it is safe in the home.

Sample C

6 marks

Explains that when the voltage is stepped up by the transformer, the current is stepped down. Relates low current to low heat loss in the transmission lines (when referring to cables). 6 marks awarded, just.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

Transformers are used to step up the voltage so that is in powerlines. This is because a high voltage means there will be a low current and with a low current there is less energy lost as heat to the surrounding. There has to be some lost because there has to be a current. They have to do it like this because the alternative was thick cables and those were too heavy. Transformer S can then step the voltage down to a safe level for more domestic use without losing much voltage energy.

Sample D

6 marks

Correctly relates current to heat loss, explains how to achieve low current in the power cables by stepping up the voltage with a transformer.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

The higher the current, the more heat lost. To reduce the current, you must increase the voltage. Step up transformers increase the voltage to around 400,000 volts to reduce the current and therefore reduce energy lost as heat. Even though transformers are not 100% efficient, more heat energy would be lost as heat if the current was high on the power cables than the transformer lose. The electricity is then run through a step down transformer near where the electricity is needed which reduces the voltage back to around 240 volts for mains usage. Transformers may lose some energy as it transfers to other forms, however not as much as would be lost as heat in power lines without them

Sample E

6 marks

Explains that transformer R steps up the voltage, meaning the current is reduced. Correctly relates low current to low heat loss in the transmission lines.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

Transformer R is a step up transformer which steps up the voltage ~~in the electric At the same time~~ This means the current is reduced. By reducing the current less energy is wasted as heat as the electricity travels along power lines. ~~The energy that is~~ The amount of energy saved by a low current is more than the amount of energy lost by the transforms. Transformer S is there as a step down transformer to lower the voltage because household appliances can't use too high voltages.

Sample F

6 marks

This candidate knows that energy is lost as heat in the transmission wires, that heat loss is related to current and that low current can be achieved by using a transformer to step up the voltage. This puts the response at level three. It scores 5 marks rather than 6 for the incorrect relationship between power and current.

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.

Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

When energy travels through transmission lines, large amounts of it are lost as heat. To decrease the amount of ~~heat~~ energy lost - as heat - the transformers step-up the voltage to very high levels, ~~so~~ so decreasing the current to very small levels. There is much less current running through the wires, and as we know $P = IR$ (power equals current times resistance), much less heat loss. At the other end, the voltage is stepped-down to 230V, the current increases again and much energy loss was prevented, so even though the transformers weren't 100% efficient, it was still beneficial.