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Examiners' Report
June 2019

GCSE Physics 1PH0 1F

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Introduction

This was the second examination of paper 1, at Foundation Level, for the new specification. Questions were set to test candidates' knowledge, application and understanding from these topics in the specification:

Topic 1 – Key concepts of physics

Topic 2 – Motion and forces

Topic 3 – Conservation of energy

Topic 4 – Waves

Topic 5 – Light and the electromagnetic spectrum

Topic 6 – Radioactivity

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three or four marks each. The inclusion of questions designed at targeting candidates' knowledge and understanding of practical work continued. This included assessing their fundamental knowledge of practicals specified in the specification, together with further application, especially where they were asked to propose improvements to a procedure. One assessment of practical skills featured in the six-mark question Q07b. The other six-mark question, Q09d, tested their ability to apply their knowledge of the structure of atoms to interpreting some given data.

Candidates coped well with most questions and did particularly well in the questions asking for calculations using equations. Students' knowledge of practical work shows improvement, particularly in Q07b.

Successful candidates were:

- well-acquainted with the content of the specification
- had been engaged with practical work during their course
- were competent in quantitative work, especially in using equations
- were willing to apply physics' principles to the novel situations presented to them
- recognised key command words such as "describe" and "explain" and constructed their responses accordingly
- were willing to apply physics' principles to the novel situations presented to them.

Less successful candidates:

- had gaps in their conceptual knowledge of the topics of this paper
- had gaps in their procedural knowledge, relating to their practical work

- misread and/or misunderstood the symbols used in equations
- failed to set out calculations in a logical way that could be easily followed
- did not focus sufficiently on what the question was asking
- found difficulty in applying their knowledge to new situations

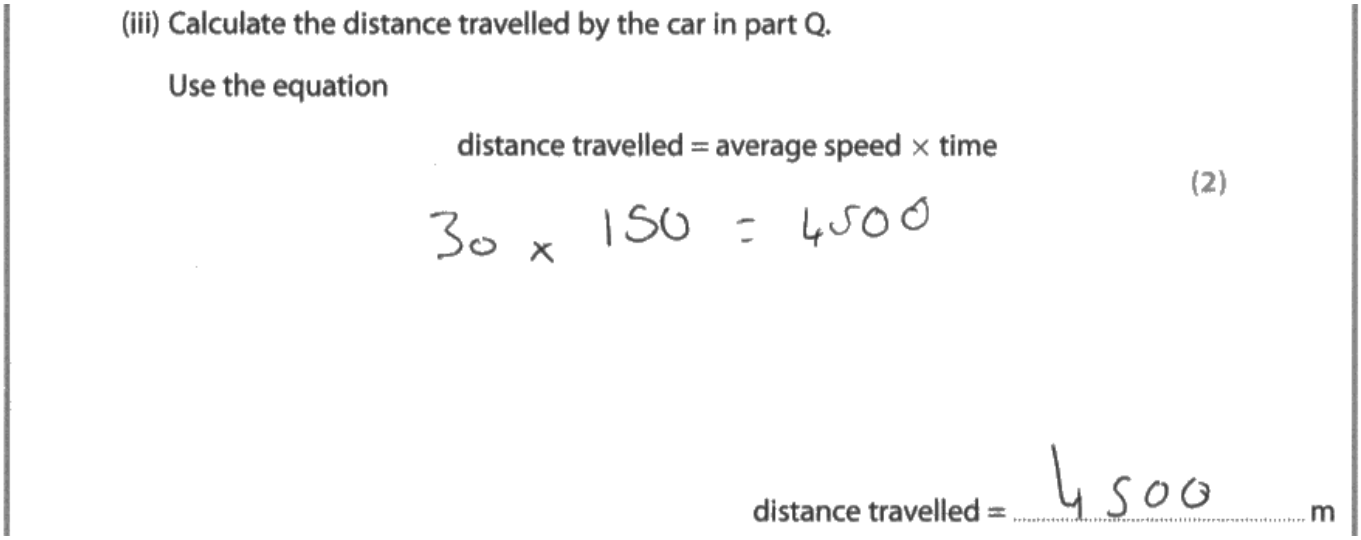
This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come from responses which highlight successes and misconceptions, with the aim of aiding future teaching of these topics.

Question 1 (a) (i)

In Q01ai and Q01aii, it was pleasing to see that the vast majority of candidates were able to score at least 3 of the 4 marks available for interpreting the velocity/time graph.

Question 1 (a) (iii)

Candidates had to select data from the graph to substitute into the given equation.



(iii) Calculate the distance travelled by the car in part Q.

Use the equation

distance travelled = average speed × time

(2)

30 x 150 = 4500

distance travelled = 4500 m

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Examiner Comments

This response uses the time from the start of the graph rather than the time from the start of section Q.

This scores only 1 of the 2 marks.

Question 1 (b)

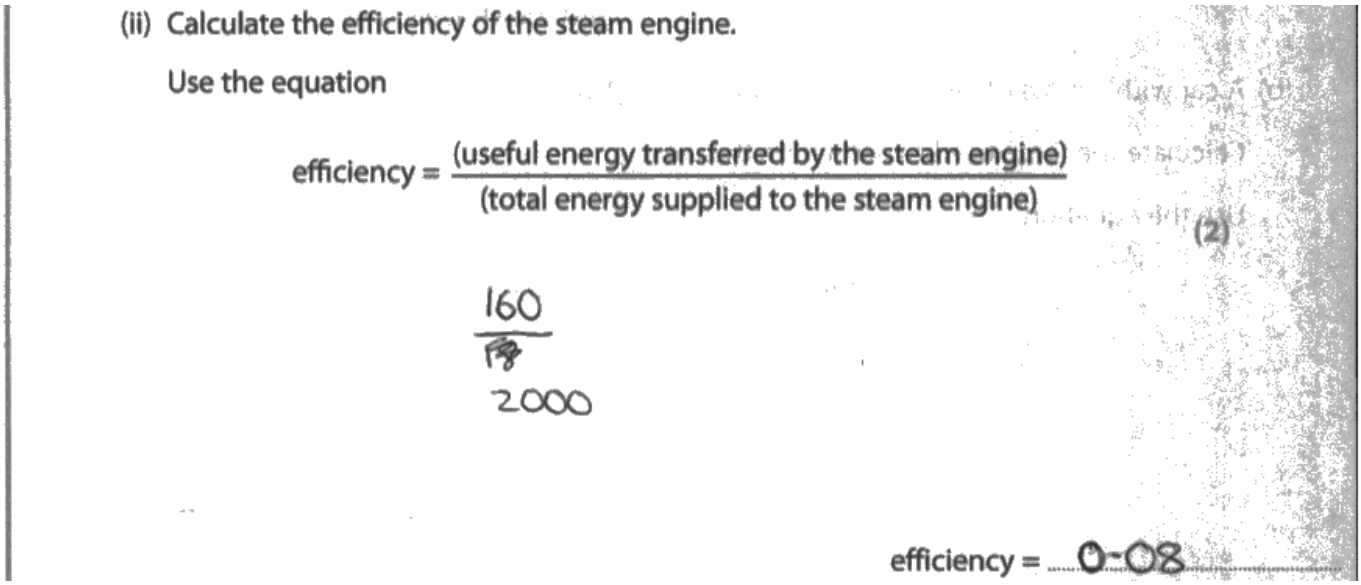
A direct substitution into F = ma for which most candidates scored both marks.

Question 2 (a) (i)

The majority of candidates could interpret the energy transfer diagram and calculate the wasted energy.

Question 2 (a) (ii)

Interpreting the energy transfer diagram to calculate efficiency from the given equation proved to be more challenging but most candidates succeeded.



(ii) Calculate the efficiency of the steam engine.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

160 / 2000

efficiency = 0.08

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Examiner Comments

This response shows the value of showing your working.

The candidate was about to use the wasted energy (previously calculated) then checked and used the correct value for energy input.

2 marks.

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Examiner Tip

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

(ii) Calculate the efficiency of the steam engine.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

$$\frac{160}{2000} = 0.08$$

efficiency = 0.08

ResultsPlus
Examiner Comments

A clear progression to the correct answer and full marks.

Question 2 (a) (iii)

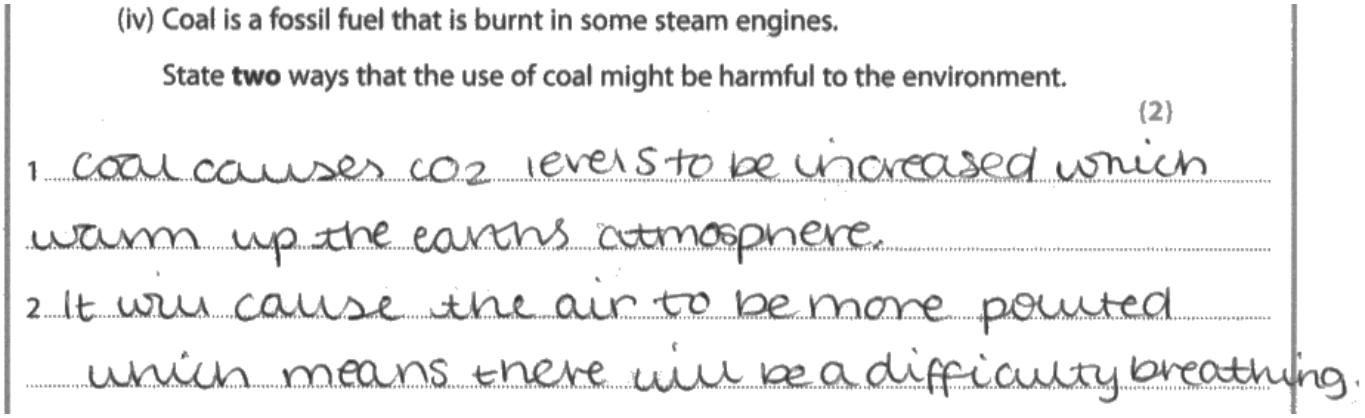
Examiners were looking for the idea of dissipation.

Most candidates were able to express this idea in a suitable form.

Question 2 (a) (iv)

Many candidates were able to give one way in which the use of coal might be harmful to the environment.

Not quite as many were able to give two.



(iv) Coal is a fossil fuel that is burnt in some steam engines.

State **two** ways that the use of coal might be harmful to the environment.

(2)

1 coal causes CO_2 levels to be increased which warm up the earths atmosphere.

2 It will cause the air to be more pouted which means there will be a difficulty breathing.

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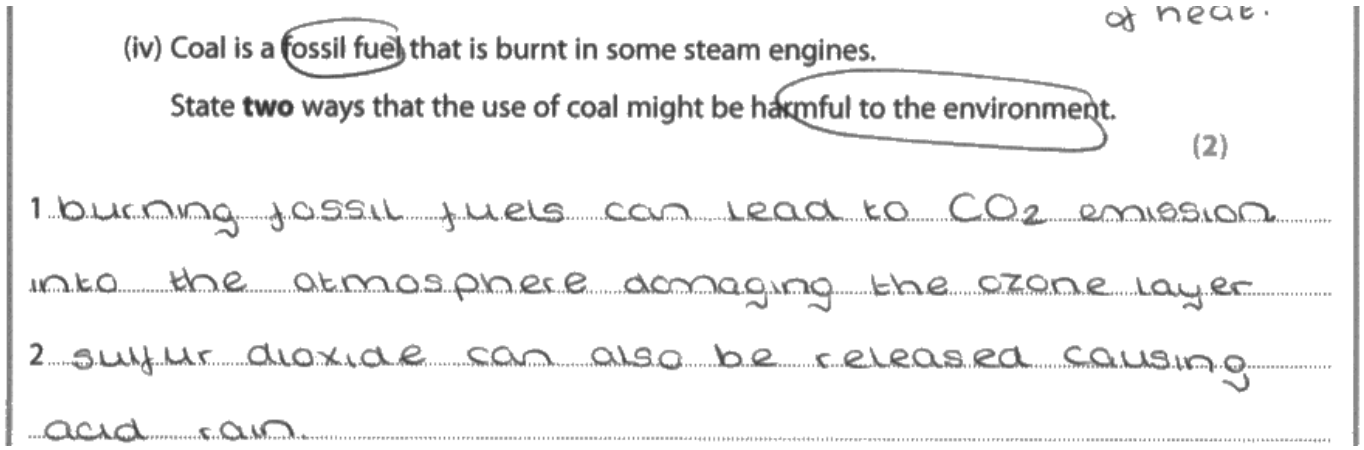
Examiner Comments

Two suitable examples.



(iv) Coal is a fossil fuel that is burnt in some steam engines.

State **two** ways that the use of coal might be harmful to the environment.

(2)

1 burning fossil fuels can lead to CO_2 emission into the atmosphere damaging the ozone layer

2 sulfur dioxide can also be released causing acid rain.

of heat.

ResultsPlus
Examiner Comments

Two more suitable examples.

Here the candidate shows good practice by circling key parts of the question.

Question 2 (b)

Calculation of kinetic energy from the given equation can cause problems for some candidates when it comes to squaring but here a pleasing number scored both marks.

(b) A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.

Calculate the kinetic energy of the model train.

Use the equation

kinetic energy = ½ × mass × (speed)²

(3)

$\frac{1}{2} \times 8.0 \times (1.5)^2 = 9$

kinetic energy = 9 J

ResultsPlus
Examiner Comments

Clear working, correct answer, full marks.

(b) A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.

Calculate the kinetic energy of the model train.

Use the equation

kinetic energy = ½ × mass × (speed)²

(3)

$9 = ½ \times 8 \times (1.5)^2$

$9000 = ½ \times 8000 \times (1.5)^2$

kinetic energy = 9000 J

ResultsPlus
Examiner Comments

This response scores the substitution mark and the mark for correct squaring but then goes on to convert kilograms to grams so loses the evaluation mark.

Question 3 (c)

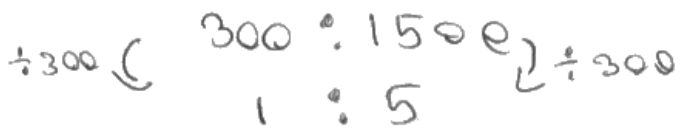
A potentially challenging ratio question for which most candidates scored both marks, expressing their answers in the lowest form and the correct way around.

(c) The speed of sound in air is 300 m/s.

The speed of sound in water is 1500 m/s.

Calculate the ratio of the speed of sound in air to the speed of sound in water.

(2)



ratio of speed of sound in air to the speed of sound in water = 1 : 5

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Examiner Comments

A typical example of a correct response.

Question 4 (b) (i)

There was a range of acceptable answers for this straightforward but important question.

Examples

- (radiation from them)
- can cause tumours
- can damage cells
- can cause radiation sickness
- can cause birth defects

Question 4 (b) (ii)

Examiners were looking for a mention of a neutron in the nucleus becoming a proton.

Answers that referred to an increase in atomic number by one while the mass number remained the same were accepted.

Answers in terms of quarks were, of course, acceptable - but not required by the specification.

There were very few correct responses to this question.

(ii) Lead-214 emits β^- particles.

Describe what happens to the nucleus of a lead-214 atom when it emits a β^- particle.

(2)

when it emits a β^- particle the nucleus will gain an proton as the isotope changes in atomic number but stays the ~~same~~ same mass number

ResultsPlus
Examiner Comments

A correct response in terms of atomic number and mass number scores both marks.

Question 4 (d)

This was a question to do with the relative masses of protons and neutrons which involved using numbers in standard form and an answer expressed to 2 significant figures.

It was targeted at grades 4 and 5 and in that context, a pleasing number of candidates were able to score at least 2 of the 3 marks available.

(d) The mass of a proton is 1.6726×10^{-27} kg.
The mass of an electron is 9.1094×10^{-31} kg.

Calculate how many times the mass of a proton is greater than the mass of an electron.

Give your answer to two significant figures.

(3)

$$\frac{1.6726 \times 10^{-27}}{9.1094 \times 10^{-31}} = 1836.125321$$

$= 1800$

1800 times

ResultsPlus
Examiner Comments

Clear working leading to the correct answer, expressed to 2 significant figures.

(d) The mass of a proton is 1.6726×10^{-27} kg.
The mass of an electron is 9.1094×10^{-31} kg.

Calculate how many times the mass of a proton is greater than the mass of an electron.

Give your answer to two significant figures.

(3)

$1.6726 \times 10^{-27} = 1.6726 \times 10^{-27}$
$9.1094 \times 10^{-31} = 9.1094 \times 10^{-31} = 1836.12532$

1836.12 times

ResultsPlus
Examiner Comments

This correctly evaluated answer is expressed to 2 decimal places, rather than 2 significant figures so scores only 2 of the 3 marks.

Question 5 (a) (i)

Most candidates were able to score at least 1 of the 2 marks available for describing one use of PET scanners in hospitals with many score both marks.

Question 5 (a) (ii)

A list of acceptable precautions with examples is given in the mark scheme.

Again, most candidates scored at least 1 mark with many scoring 2.

(ii) State **two** precautions that hospital staff should take when working with radioactivity.

(2)

1 use protective clothing ~~external~~ that contain lead

2 limit the time ~~to excessive sorry~~ exposed to radioactive source

ResultsPlus
Examiner Comments

Two acceptable precautions, the first to do with shielding and the second to do with exposure time.

(ii) State **two** precautions that hospital staff should take when working with radioactivity.

(2)

1 Monitor the time they are exposed to radiation through their badge.

2 Behind the lead stay behind a window that has lead around it.

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Examiner Comments

This response has better detail than the previous one. Both responses score 2 marks.

Question 5 (b) (i)

Common errors were:

- reading the x-axis scale incorrectly (e.g a few candidates answered with 6.8cm which is outside the accepted range)
- halving the thickness of the bone e.g. picking 5cm and finding the % intensity associated with 5cm.

(b) (i) X-rays can be used in diagnosis and treatment from outside the body. Some x-rays are absorbed by bone as they travel through the body.

Figure 4 shows how the intensity of the x-ray beam gets less as the x-rays travel further through the bone.

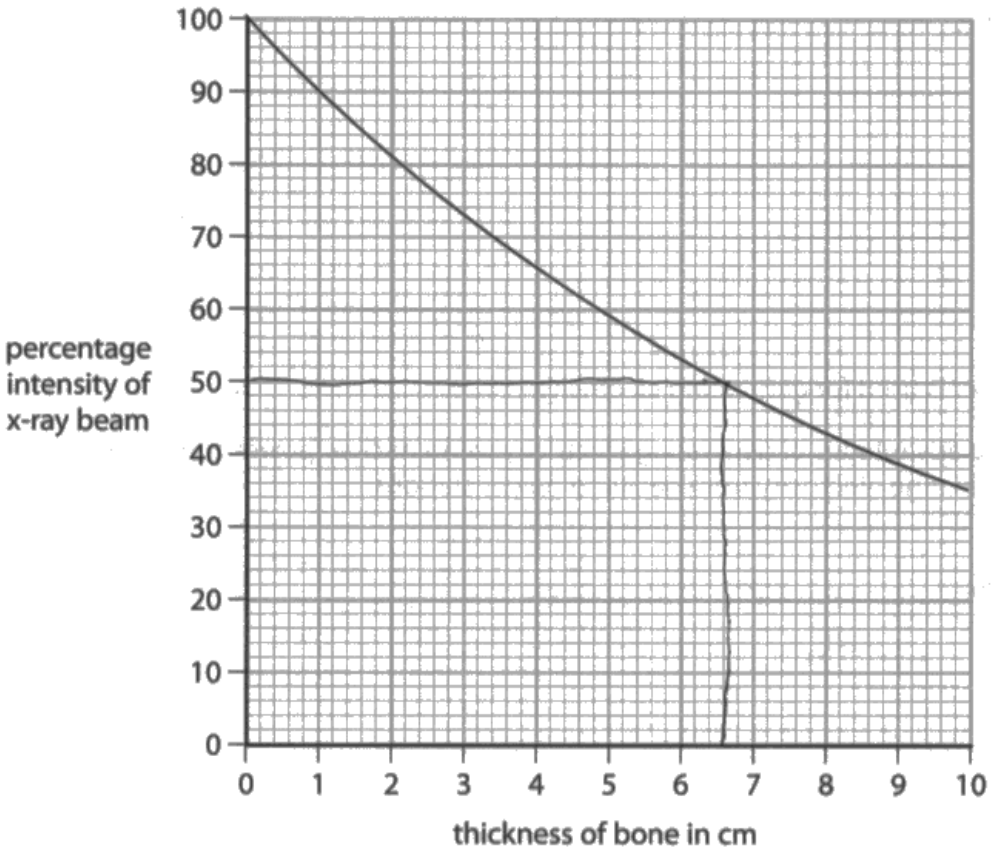

Figure 4

Use the graph to determine the thickness of bone that will reduce the percentage intensity of the x-ray beam by half.

(2)

thickness = 6·6 cm

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Examiner Comments

Correct working shown on the graph and an answer in the middle of the allowed range.

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Examiner Tip

When reading data from a graph like this, always show your working. This can allow the examiner to award intermediate marks if you read the scale incorrectly.

Question 5 (c) (i)

Many candidates failed to score on this question because their answers were too vague or not true.

There were many unsupported references to pollution, cost and efficiency.

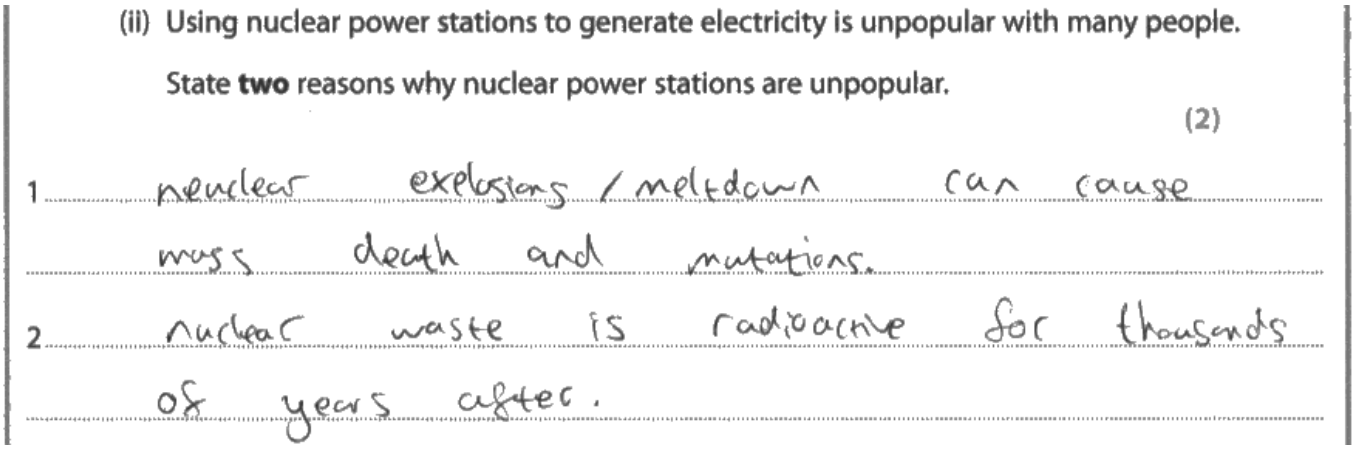
Examples of acceptable responses are given in the mark scheme.

Question 5 (c) (ii)

As in Q05ci, many candidates failed to score because their answers were too vague or not true.

For example, stating 'it's dangerous' (not explicitly stating the risks), too expensive, an eyesore, takes up a lot of space.

The mark scheme shows some acceptable responses.



(ii) Using nuclear power stations to generate electricity is unpopular with many people.

State **two** reasons why nuclear power stations are unpopular.

(2)

1 neuclear explosions / meltdown can cause mass death and mutations.

2 nuclear waste is radioactive for thousands of years after.

ResultsPlus
Examiner Comments

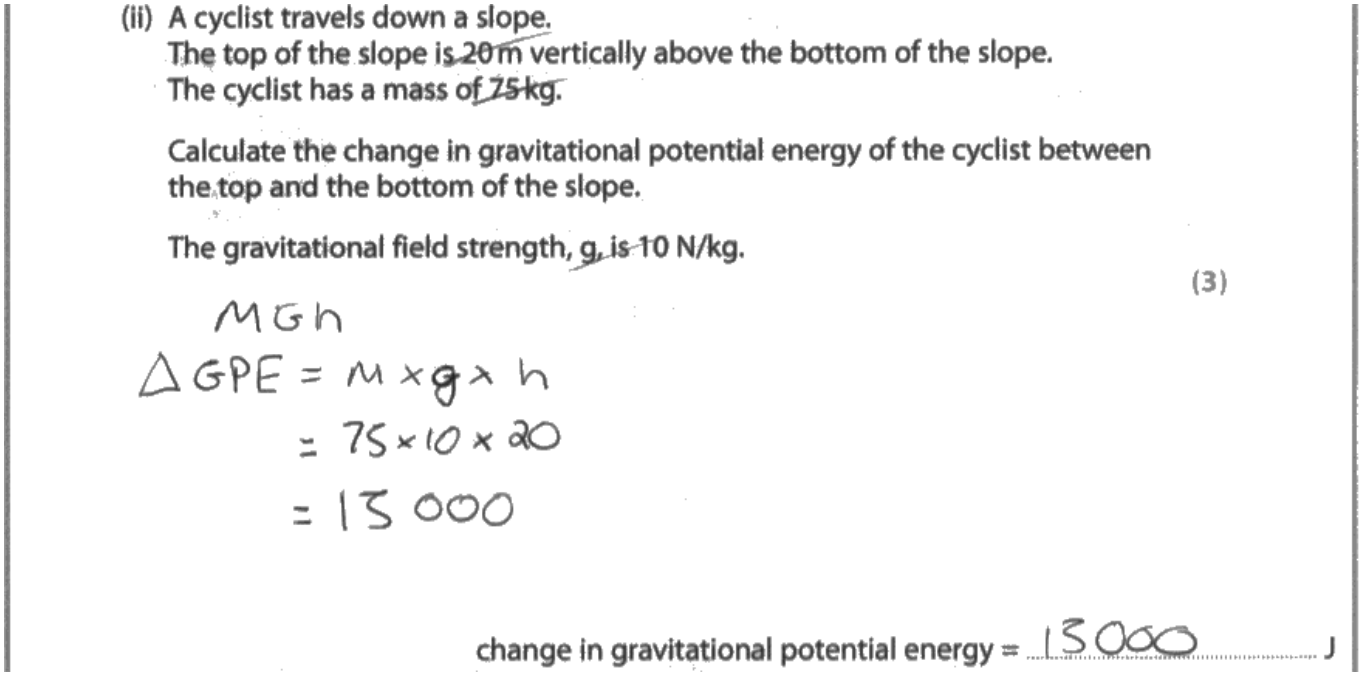
Two good reasons with sufficient detail.

2 marks.

Question 6 (a) (ii)

Candidates had to recall and use the equation for change in GPE. The value of g, gravitational field strength, was given in the question.

Many scored all 3 marks but a significant number failed to recall the equation.



(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.

Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.

The gravitational field strength, g, is 10 N/kg.

(3)

MGh
ΔGPE = M × g × h
= 75 × 10 × 20
= 15 000

change in gravitational potential energy = 15000 J

ResultsPlus
Examiner Comments

Working shown step by step, finishing with the correct answer.

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Examiner Tip

When you need to recall an equation, write it in symbols or words before you substitute values into it.

This makes the process clearer for you and also possible for the examiner to award intermediate marks if you make an error from then on.

Question 6 (b)

Here candidates are given a rearranged version of an equation from the list at the end of the paper.

The main problem here is squaring the velocities.

(b) An aircraft waits at the start of a runway.
The aircraft accelerates from a speed of 0 m/s to a speed of 80 m/s.
The acceleration of the aircraft is 4 m/s^2.

Calculate the distance, x, travelled by the aircraft while it is accelerating.

Use the equation

$$x = \frac{v^2 - u^2}{2a}$$

$$\frac{80^2 - 0^2}{2 \times 4} = 800$$

(2)

$x =$ 800 m

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Examiner Comments

Clear working and the correct answer. Full marks

Question 6 (c) (i)

In this practical question, a device for measuring distance such as a metre rule was required.

Most candidates were able to score this mark.

Question 6 (c) (ii)

In a continuation of the practical question, candidates were asked to describe how to make the trolley accelerate.

An image of the set up was provided in the question.

An encouraging number of candidates scored both marks.

(ii) Describe how the student can make the trolley accelerate along the bench.

(2)

By placing masses on the end of the string, meaning weight (force x mass) will cause the trolley to accelerate. ~~as the f~~

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Examiner Comments

A clear description of how to make the trolley accelerate.

2 marks.

Question 6 (c) (iii)

The final part of this practical question concerned a development, an additional measurement required to determine the acceleration.

Examiners were looking for:

'another velocity/speed' or 'time between changes in velocity/speed'.

Question 7 (a)

Candidates had to analyse a graph, identify which curve was for the black can and give a reason.

Most could identify the curve but few could combine this with a correct reason.

7 (a) Equal volumes of hot water are added to two cans.
The cans are identical apart from their surfaces.
One can has a black surface and the other can has a silver surface.

The cans are left to cool and their temperatures are monitored.

The graph in Figure 6 shows the results.

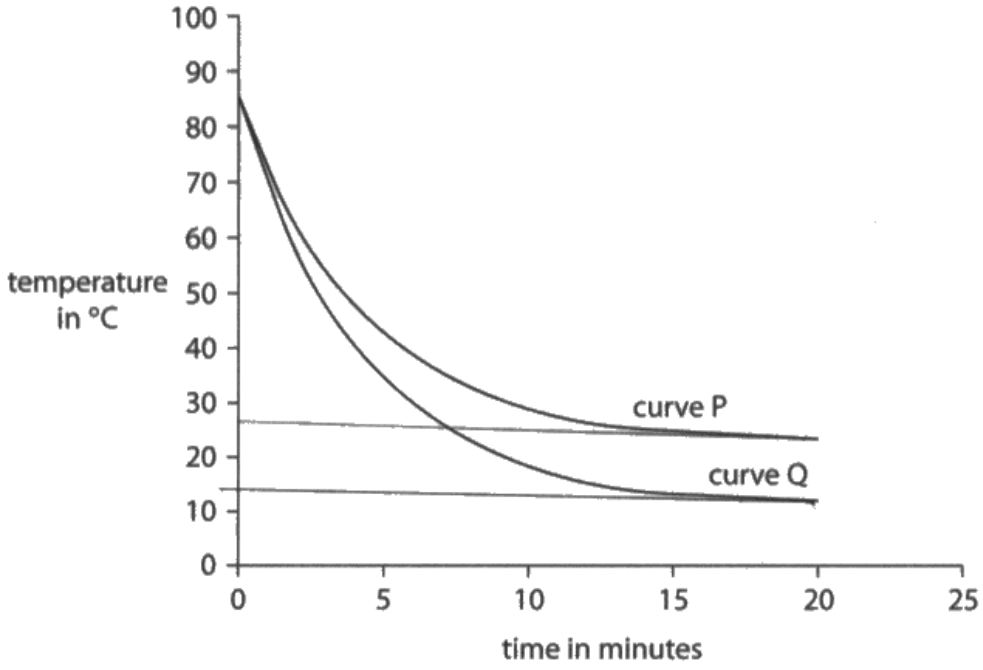

Figure 6

Explain, using evidence from the graph, which curve is for the black can and which curve is for the silver can.

(2)

Curve P is silver because black gives out more heat then Silver and Silver keeps it in more which we can tell from the graph as Curve Q (which is black) is around 14° whereas P is around 26° in the same amount of time (20 minutes).

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Examiner Comments

This candidate makes the correct identification and provides acceptable reasons.

Full marks.

Question 7 (b)

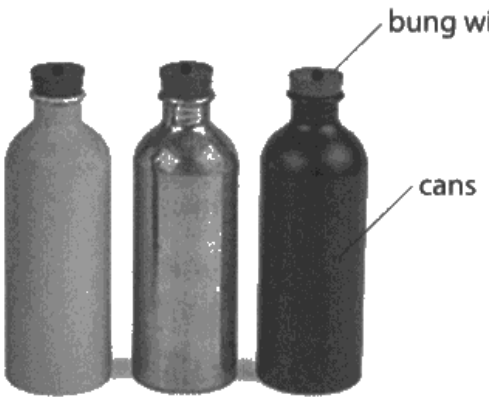
This was a practical question about how the nature of a surface affects the amount of thermal energy absorbed by the surface, a core practical. There was a diagram showing some of the apparatus.

Level 3 could be reached by describing how the cans were heated, how the temperature rise was measured and compared and one other practical detail such as use the same amount of water in each can.

Most candidates achieved level 2 or level 3 with many very good, well-structured answers. This was an encouraging improvement on last year.

*(b) Figure 7 shows some apparatus.

small infrared heating lamp



set of three cans of the same size and material but of different surfaces

Figure 7

Describe an investigation to find out how the nature of a surface affects the amount of thermal energy absorbed by the surface.

You should use the apparatus in Figure 7 and any additional items you choose. Each can in Figure 7 has a bung in the top with a hole in it.

You may use a diagram if it helps your answer.

(6)

Place cans in a line, equidistant from the lamp ~~and turn on the lamp~~. Place a thermometer into each bung hole and then fill each with the same ~~amount~~ volume of water with the same temperature. Switch on the lamp and take the temperature of all three cans every 30 seconds for as long as desired and plot on a table with info about the material on the cans and their temperatures at specific times. The temperatures will tell you the insulating and conducting properties of the material and their efficiency.

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Examiner Comments

This response says how the cans are heated, how the temperature rise is measured and compared with the additional information concerning placing the cans equidistant from the heater.

It loses its way a bit in the final sentence but this does not detract from the fact that this method would work.

Level 3, 6 marks.

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Examiner Tip

In questions requiring a practical method, think about

- what is to be measured
- what it should be measured with
- detail of how the measurement should be made.

Question 7 (c) (i)

In this test of knowledge of the em spectrum, either X-rays or gamma rays was a correct answer.

Question 7 (c) (ii)

Here candidates had to analyse and interpret a diagram to explain why a blue star might be hotter than a red star.

(ii) One star is blue and another star is red.

Explain why an astronomer expects the blue star to be hotter than the red star.

(2)

Because a blue ~~star~~ star has a high frequence and high energy. Therefore increasing tempeachure.

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Examiner Comments

A correct interpretation and conclusion.

2 marks

Question 8 (b)

Most candidates were able to say that the infrared radiation was blocked by the chair while radio waves were not but few went on to apply their knowledge of the em spectrum and suggest that they behaved differently because they had different frequencies/wavelengths.

(b) Some television remote controls use infrared radiation and other remote controls use radio waves.

Explain why an infrared remote control may not switch on the television from behind an armchair but a radio wave remote control always will.

(2)

Infrared cannot travel through objects but radiowaves can because they are more penetrating and stronger. Also radiowaves have a longer wave length meaning its easier to pass through objects whereas infrared has a shorter wavelength so it can't travel through the object.

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Examiner Comments

This response refers to the chair blocking infrared but not radio waves and suggests that this is due to a difference in wavelength.

Question 8 (c) (i)

The correct answer was 12 cm but candidates could score 1 of the 2 marks if it was clear that they had used the horizontal axis only.

Question 8 (c) (ii)

This was testing understanding of a transverse wave motion, in that the motion of the cork was at right angles to the direction of travel of the wave.

Most were able to score the first mark for saying the motion was up and down but then were not able to go on with the description.

Question 8 (d)

It was encouraging to see that most candidates were able to recall and use the equation v = f λ.

(d) A different water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.

Calculate the wave speed.

(2)

Wave speed = frequency x wave length

Wave speed = 1.5 x 0.25 =

wave speed = 0.375 m/s

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Examiner Comments

Clear working and the correct answer.

2 marks.

Question 9 (a)

It was encouraging to see that most candidates could score at least 1 of the 2 marks available in this question about the significance of the numbers in the symbols for nuclei of atoms.

Question 9 (b) (i)

Geiger Műller or GM tube were the expected answers. Approximate spellings were accepted.

Question 9 (b) (ii)

Most candidates were able to give at least one source of background radiation.

Question 9 (c)

Here candidates had to recognise that to going to 1 000 000 from 125 000 involved three half-lives.

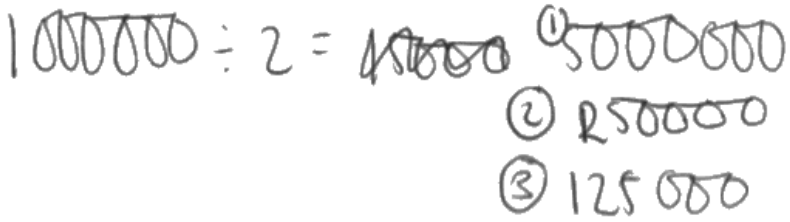
(c) Carbon-14 is radioactive and has a half-life of 5 700 years.

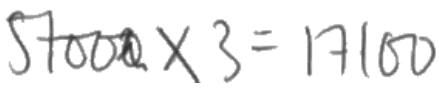
The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

(2)

age of wood = 17100 years





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Examiner Comments

This response shows dividing by 2 three times, going on to successfully calculate 3 x 5700.

Question 9 (d)

This required candidates to know about the Rutherford alpha particle scattering experiment. They had to analyse a diagram and a results table and relate this to their knowledge of the structure of an atom.

A level 3 answer had to do this for at least one aspect of the structure e.g. “an atom is mainly empty space”.

Level 2 could be reached by analysing the diagram to the table without successfully relating this to the structure of an atom or by relating the structure of an atom to either the diagram or the table.

Many candidates produced successful level 3 responses and most were able to reach level 2 or level 1.

Question 10 (a) (ii)

The equation for the power of a lens was given in the question.

Candidates had to rearrange the equation and do a unit conversion.

Many candidates did not complete the rearrangement and substitution successfully and of those that did, the majority did not do the unit conversion.

(ii) The equation that relates the power of a lens to the focal length of the lens is

$$\text{power (in dioptres)} = \frac{1}{\text{focal length (in metres)}}$$

The power of a lens is 5 dioptres.

Use the equation to calculate the focal length of the lens in cm.

(2)

Power – 5 dioptres = $\frac{1}{\text{focal length (m)}}$

$\frac{1}{5} = 0.2$ m

$0.2 \text{ m} \times 100 = 20$ cm

focal length = 20 cm

ResultsPlus
Examiner Comments

The substitution, rearrangement and unit conversion area all clearly shown here and the final answer is correct.

2 marks.

ResultsPlus
Examiner Tip

Always show every step of your working in calculations.

It reduces the chances of you making an error and allows the examiner a chance to award you intermediate marks if you do make an error.

Question 10 (b)

A more complex practical question.

To score full marks, it had to be clear that light was shone in at the curved surface, along a radius and the angle of incidence changed until the angle of refraction was 90°.

Most candidates scored only one mark for shining a ray of light into the block.

(b) Figure 12 shows a semicircular glass block.

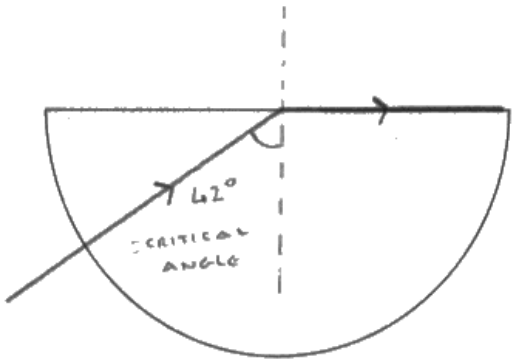

Figure 12

Describe how a student could use the semicircular glass block and other apparatus to determine the critical angle for a glass-air boundary.

You should add to the diagram in Figure 12 to help with your answer.

(4)

Use a beam of light and shine it into the block at varying angles. When you hit the critical angle no light should be ~~transmitted~~ refracted or reflected but totally internally reflected.

ResultsPlus
Examiner Comments

The description itself is not detailed enough but the clearly labelled diagram lifts this to full marks.

ResultsPlus
Examiner Tip

If the question suggests that you draw or add to a diagram, then do so and make sure you add relevant labels.

Question 10 (c) (i)

This question was about how ideas about the Solar System have changed over time.

An encouraging number of candidates were able to supply an example of this, many referring to the discovery of new planets, such as Pluto, or the reclassification of Pluto as a dwarf planet.

Many of those who did not score mentioned ideas that referred to the whole Universe rather than the Solar System.

Question 10 (c) (ii)

The best way to estimate the distance required was to draw a smooth curve through the points and read the distance corresponding to 4.6 years.

Those who tried to make the estimate without drawing the curve often produced answers outside the accepted range and so did not score.

Some who did draw a curve but misread one of the scales could score 2 of the 3 marks available.

(ii) Figure 13 shows data for some of the planets of the Solar System.

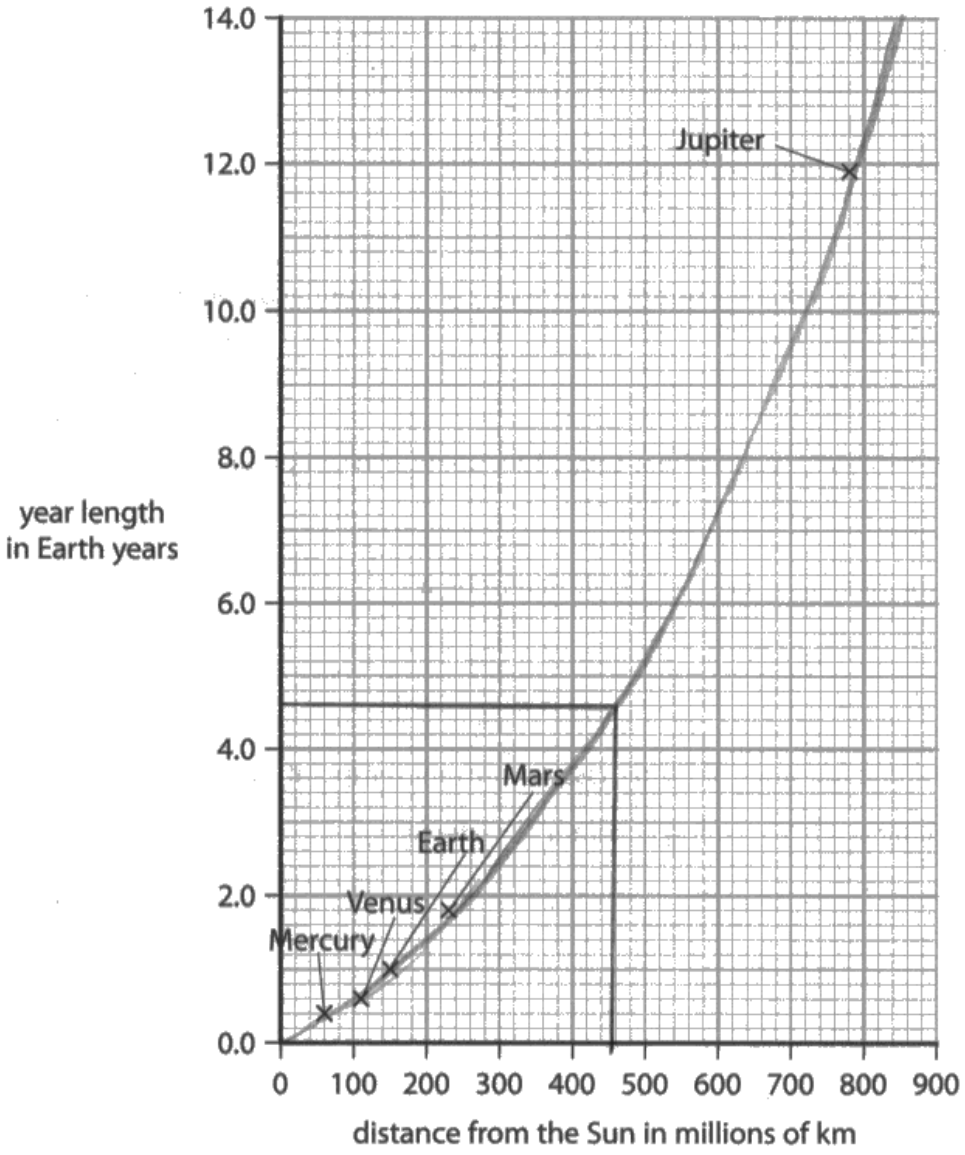

Figure 13

Ceres is an asteroid that orbits the Sun between Mars and Jupiter.
It takes Ceres 4.6 Earth years to make one orbit of the Sun.

Use the graph to estimate the distance of Ceres from the Sun.

Show your working.

(3)

distance of Ceres from the Sun = 460 millions of km

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Examiner Comments

An acceptable curve.

The working is clear on the graph and the answer is within the range 400-460 (million km)

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Make sure that they have a sound knowledge of the fundamental ideas in all the topics
- Get used to the idea of applying their knowledge to new situations by attempting questions in previous examination papers
- When describing a practical procedure, draw a labelled diagram to help their answer. (Q10b)
- When suggesting improvements or extensions to a practical procedure, make sure they are relevant to the context of the question. (Q06c)
- Where a question involves a calculation, make sure they write down the equation they are using (if not given in the question) and show each step in their working.
- Make sure that they recognise SI prefixes such as m and k and n 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

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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