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Examiners' Report
June 2019

IGCSE Physics 4PH1 2P

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June 2019
Publications Code 4PH1_2P_1906_ER

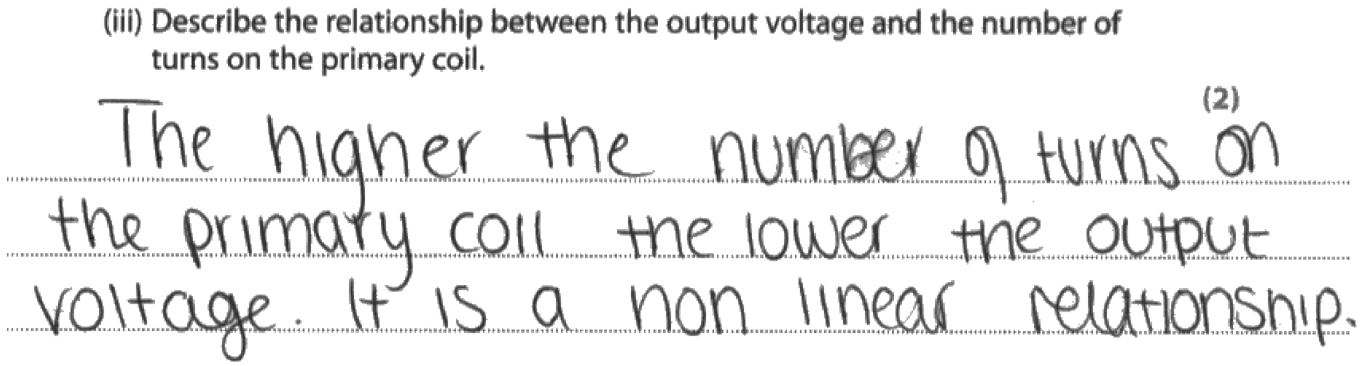
Introduction

As in examinations for the previous specification, most candidates were able to recall the equations and usually they handled the related calculations well. Candidates who gave the best practical descriptions usually appeared to be writing from first-hand experience. Responses to the longer questions showed that some candidates tend to struggle when assembling a logical description or when asked to offer more than one idea.

There was a wide range of responses and it was good to see that many candidates could give full and accurate answers.

Question 2 (a) (iii)

Some candidates only referred to the change in direction, only scoring one mark. Better responses included an idea about the rate of change or that the relationship was non-linear.



(iii) Describe the relationship between the output voltage and the number of turns on the primary coil.

(2)

The higher the number of turns on the primary coil the lower the output voltage. It is a non linear relationship.

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Examiner Comments

This candidate has extended their answer by referring to a non-linear relationship. Alternatively, candidates could have described the output voltage decreasing at a decreasing rate, with an increase in the number of primary terms.

2 marks scored.

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Examiner Tip

Look at the number of marks for this question. There are two marks, so a simple statement such as the first sentence here will only score one mark.

Question 2 (a) (i) - (ii)

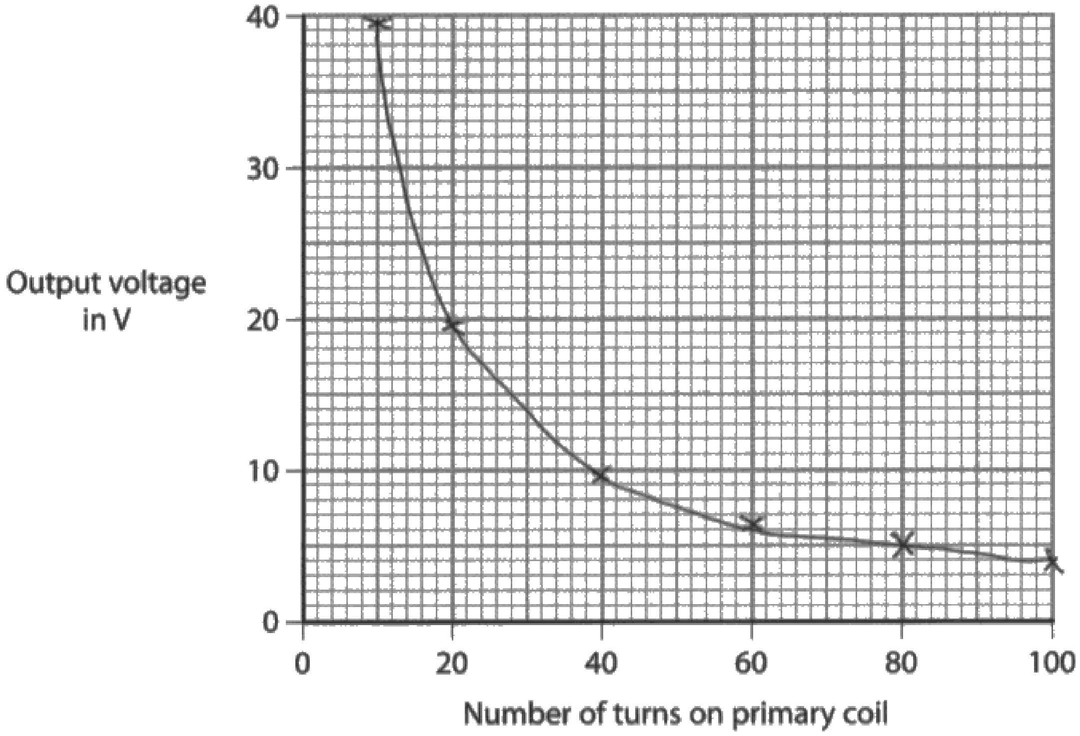
The majority of candidates showed excellent graph plotting and curve drawing skills.

(a) (i) Plot a graph of the student's results on the grid.

(1)

(ii) Draw a curve of best fit.

(1)



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Examiner Comments

The data on this graph has been plotted carefully, with neat, small (yet visible) crosses. The curve is just about acceptable, since all of the crosses are within half a small square of the curve and the curve is smooth.

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Examiner Tip

Practise drawing smooth curves in one action. You might find it easier to turn the paper so that your hand starts close to you, and then sweeps away from you as you draw.

Question 2 (b)

Just over half of all candidates successfully remembered the formula and showed excellent mathematical skills to calculate the number of turns on the secondary coil. A small minority of candidates recalled the formula yet could go no further, generally because they substituted incorrectly.

(b) (i) State the formula linking input and output voltages and the turns ratio for the transformer.

(1)

$$\frac{\text{input voltage}}{\text{output voltage}} = \frac{\text{number of } \cancel{\text{pr}} \text{ turns on primary coil}}{\text{number of turns on secondary coil.}}$$

(ii) The input voltage of the transformer is 6.8 V.

Calculate the number of turns on the secondary coil.

(2)

$$\frac{6 \cdot 8}{4} = \frac{100}{\text{second}} = \underline{58} \cdot 8$$

$\underline{58} \cdot 235$

$\underline{57} \cdot 94$

$\underline{58} \cdot 2$

$$\frac{6 \cdot 8}{39 \cdot 6} = \frac{10}{\text{secondary turns.}}$$

$$\frac{6 \cdot 8}{5} = \frac{80}{\text{second}}$$

$$\frac{80 \times 5}{6 \cdot 8} = \underline{58} \cdot 8$$

$$\frac{10 \times 39 \cdot 6}{6 \cdot 8} = \text{secondary turns}$$

$$= \underline{58} \cdot 2$$

number of turns = 58

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Examiner Comments

This candidate has written the formula clearly in verbal format. A set of three numbers has been correctly substituted and each stage of the working from that point is very clear. The data in the table has offered a chance to check the calculation independently. With the repeated attempts matching, the candidate has given a final answer for the number of turns.

All 3 marks awarded.

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Examiner Tip

Consider writing formulae using words instead of symbols. This might make your intentions clearer and help later on when it comes to substituting the correct number into the correct place in the formula.

Question 3 (a)

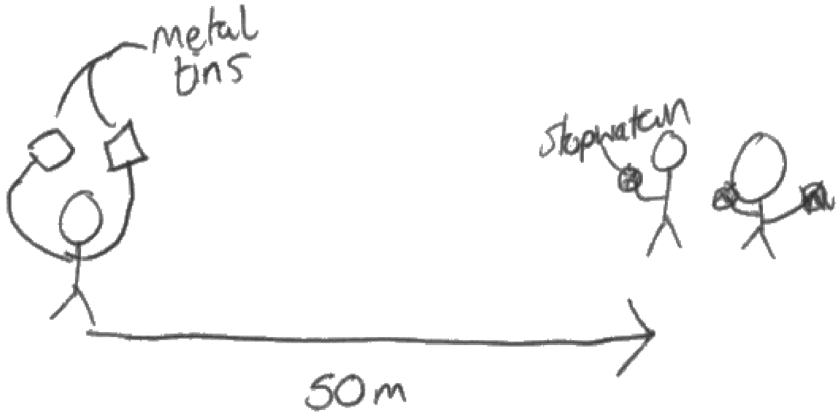
Candidates provided a range of sensible methods for measuring the speed of sound. Just under three-quarters of all candidates scored at least three marks, showing that this core practical had been learnt well.

3 This question is about sound waves.

(a) Describe an experiment to measure the speed of sound in air.

You may draw a diagram to help your answer.

(5)



- Place someone with two metal tins in one place
- Use a trudle wheel to go ~~80~~ 50 metres directly ahead of them
- Place 2 people with stopwatches at the ~~80~~ 50m mark
- Get the 1st person to bang the tins together
- When the others see this they should start their stopwatches and stop when they hear the sound. Take the average time
- used a $speed = \frac{distance}{time}$ to find speed of sound

ResultsPlus
Examiner Comments

This is a good example of a 'direct' method of measuring the speed of sound. The intention is to measure the time taken for a sound to travel a set distance.

The distance of 50 m quoted is too short for the time to be measured practically by hand and so was not creditworthy.

There is scientific detail in that the stopwatch will be started and stopped at the appropriate times.

The candidate has used the correct equation and stated that the experiment should be repeated and an average time calculated.

5 marks scored.

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Examiner Tip

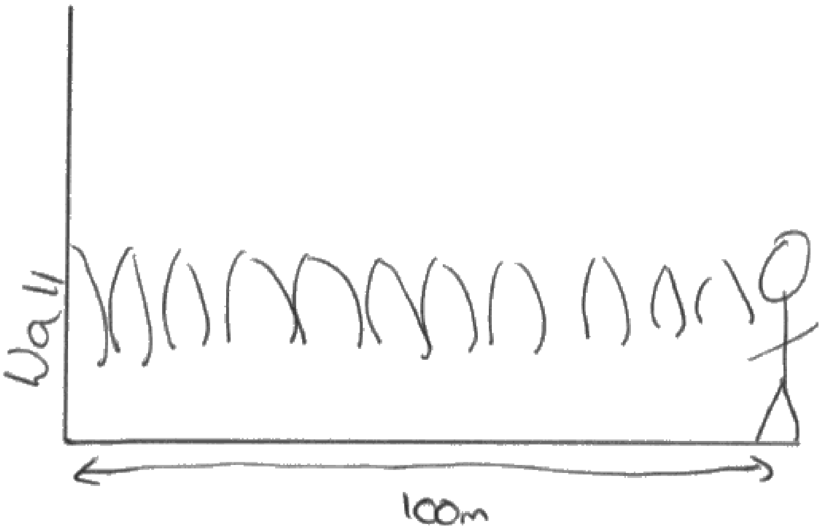
Quite often, the simplest of solutions is the best. Consider writing experimental methods using bullet points or some other highly structured way.

3 This question is about sound waves.

(a) Describe an experiment to measure the speed of sound in air.

You may draw a diagram to help your answer.

(5)



- Stand 100m from a solid wall.
- Set off a clicker whilst simultaneously starting a stopwatch.
- When you hear the sound return stop the stopwatch.
- ~~use the~~ repeat several times to find an average.
- use data in Speed = $\frac{\text{Distance}}{\text{Time}}$ formula

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Examiner Comments

A second traditional method is given in this example. Again the intention is to measure a time elapsed for a chosen distance.

The distance this time is acceptably long. There is also good scientific detail in sending the sound at the same time as starting a stopwatch, a named scientific instrument. The candidate has been clear to include the idea of repeating the experiment and finding an average time.

At this point, 5 marks have been scored.

The equation by itself here is not enough. It is not clear that the correct distance for the time recorded is 200 m or that the time for 100 m is half of that recorded.

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Examiner Tip

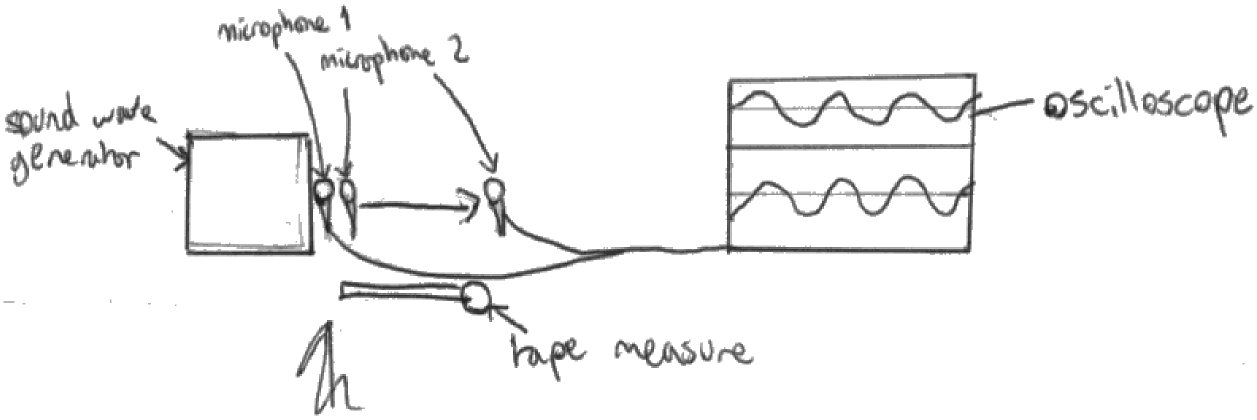
Normally it is good practice to be clear about which values you will be substituting into a formula.

3 This question is about sound waves.

(a) Describe an experiment to measure the speed of sound in air.

You may draw a diagram to help your answer.

(5)



Using a sound wave generator to emit a sound of frequency that you set. Place two microphones next to the sound wave generator, having connected the microphones to an oscilloscope. Then move one of the microphones further away from the other until ~~they~~ the oscilloscope reads that ~~the~~ microphone one picked up the sound wave one wavelength before. At this point measure the distance between the two microphones with a tape measure. Finally using the formula of wave speed = frequency x wavelength, multiply the distance between the two microphones in metres by the set frequency in hertz to find wave speed.

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Examiner Comments

This approach is more novel. The intention is to measure the wavelength of the sound waves directly for a given frequency produced by a signal generator.

This example does not have practical distance that can be measured by this technique. Ideally a distance of at least a metre would be acceptable, by using a suitably low frequency. The method is good and gives excellent agreement without relying on human reaction times.

The method does not refer to repeating the measurement of the wavelength nor to find an average.

The wave equation is employed to calculate the speed of sound.

4 marks in total.

ResultsPlus
Examiner Tip

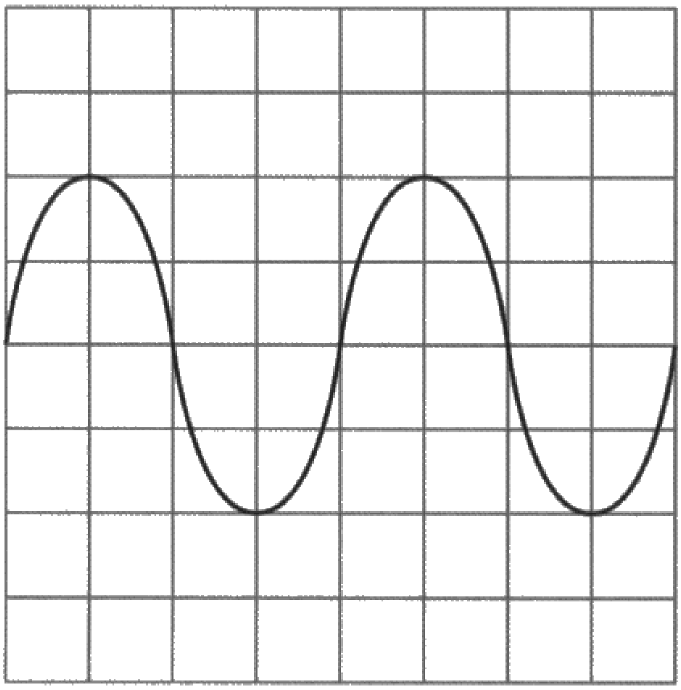
Be confident in your use of electronic methods, provided that the fundamental practical ideas are fulfilled. This would include examples of suitable values as well as the relevant formula, repeats and an average.

Question 3 (b)

It was clear that most candidates had had some experience with the use, and interpretation, of oscilloscopes. Most candidates received over half marks on this question, remembering how to successfully convert a number of squares on a screen to a time period. Some candidates believed that the screen showed either 1 or 4 complete oscillations, when in fact there are two. Others did not convert milliseconds into seconds as required (and stated by the answer line).

(b) An oscilloscope can be used to determine the frequency of a sound wave.

The diagram shows an oscilloscope trace of a sound wave.



Oscilloscope settings

y direction: 1 square = 1 V

x direction: 1 square = 0.25 ms

(i) Calculate the period of this sound wave.

(3)

period: 4×0.25

0

= 1 ms

= 0.01

period = 0.01 s

(ii) Calculate the frequency of this sound wave.

(2)

$\text{frequency} = \frac{1}{\text{period}}$

$= \frac{1}{0.01}$

$= 100$

frequency = 100 Hz

ResultsPlus
Examiner Comments

In this example, the candidate has correctly identified that one complete oscillation, or the period, is represented by 4 squares in the x-direction.

They have used the scale factor of 1 sqaure = 0.25 milliseconds correctly. Unfortunately, there is an error in the conversion from milliseconds to seconds. 2 marks for Q03(b)(i).

Despite this error, the candidate has correctly selected the formula from the formula relating time period and frequency. Using their value of the period, the frequency is correct, so 2 marks have been awarded with error carried forward.

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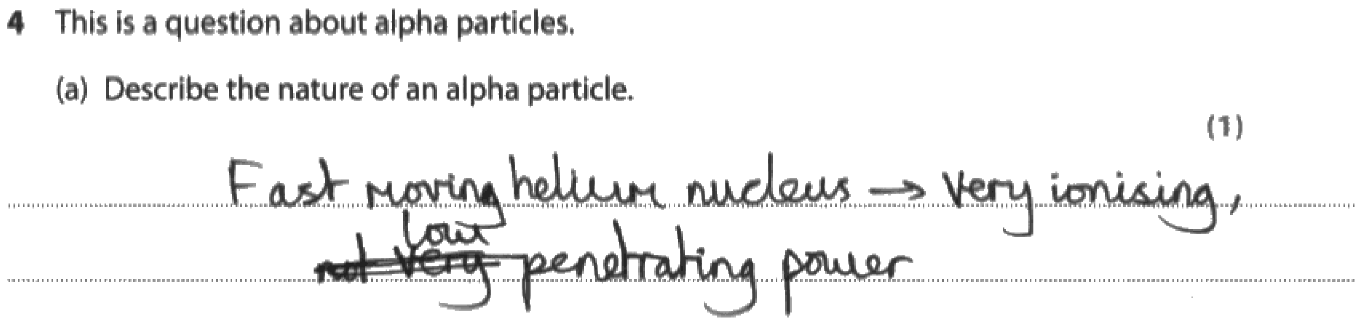
Examiner Tip

Take care to look at the unit on the answer line as well as any prefix in front of units for quantities given in the question.

Commit the common ones to memory and how to convert them. It is probably easier to remember these in standard form, eg 1 ms = 10^{-3} s.

Question 4 (a)

About two-thirds of candidates did not correctly identify the nature of the alpha particle, either because they described what an alpha particle can do, or because they referred to a helium atom rather than a helium nucleus. The A-Z notation was not accepted, as the question asks for a description.



4 This is a question about alpha particles.

(a) Describe the nature of an alpha particle.

(1)

Fast moving helium nucleus → very ionising, ~~not very~~ low penetrating power

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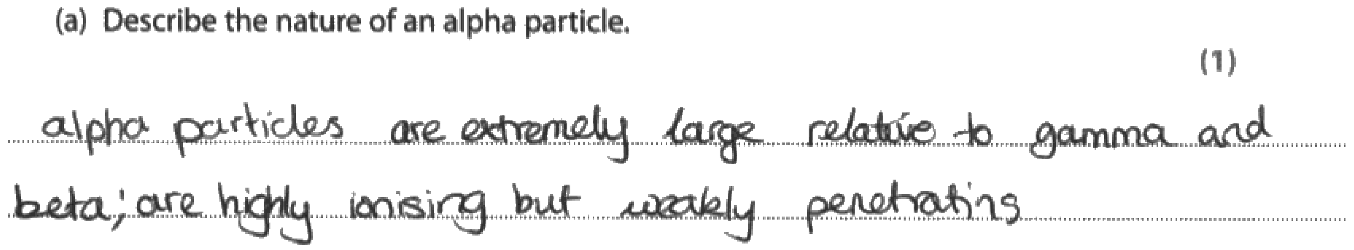
Examiner Comments

This candidate has scored the mark because they have referred to the helium nucleus. The rest of the response is true but not relevant.



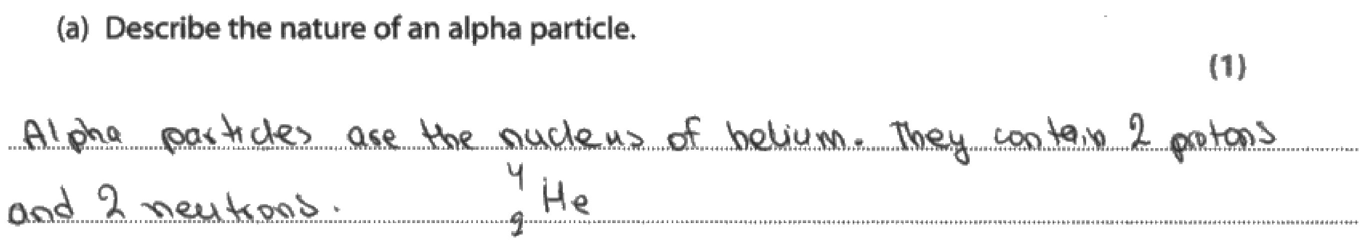
(a) Describe the nature of an alpha particle.

(1)

alpha particles are extremely large relative to gamma and beta; are highly ionising but weakly penetrating

ResultsPlus
Examiner Comments

Contrast this response with the previous response. There is a lot of true information which does not describe the fundamental nature of the alpha particle.


(a) Describe the nature of an alpha particle.

(1)

Alpha particles are the nucleus of helium. They contain 2 protons and 2 neutrons. $^{4}_{2}He$

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Examiner Comments

This candidate has included two acceptable descriptions of the nature of the alpha particle, ie equivalent to a helium nucleus and that an alpha particle 'contains' 2 protons and 2 neutrons. The 4-2 He symbol did not score, however, either of the other two descriptions would have scored the mark.

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Examiner Tip

The nature of a particle refers to its physical representation. The beta particle is an electron and a gamma is an electromagnetic wave.

Question 4 (b) (iii)

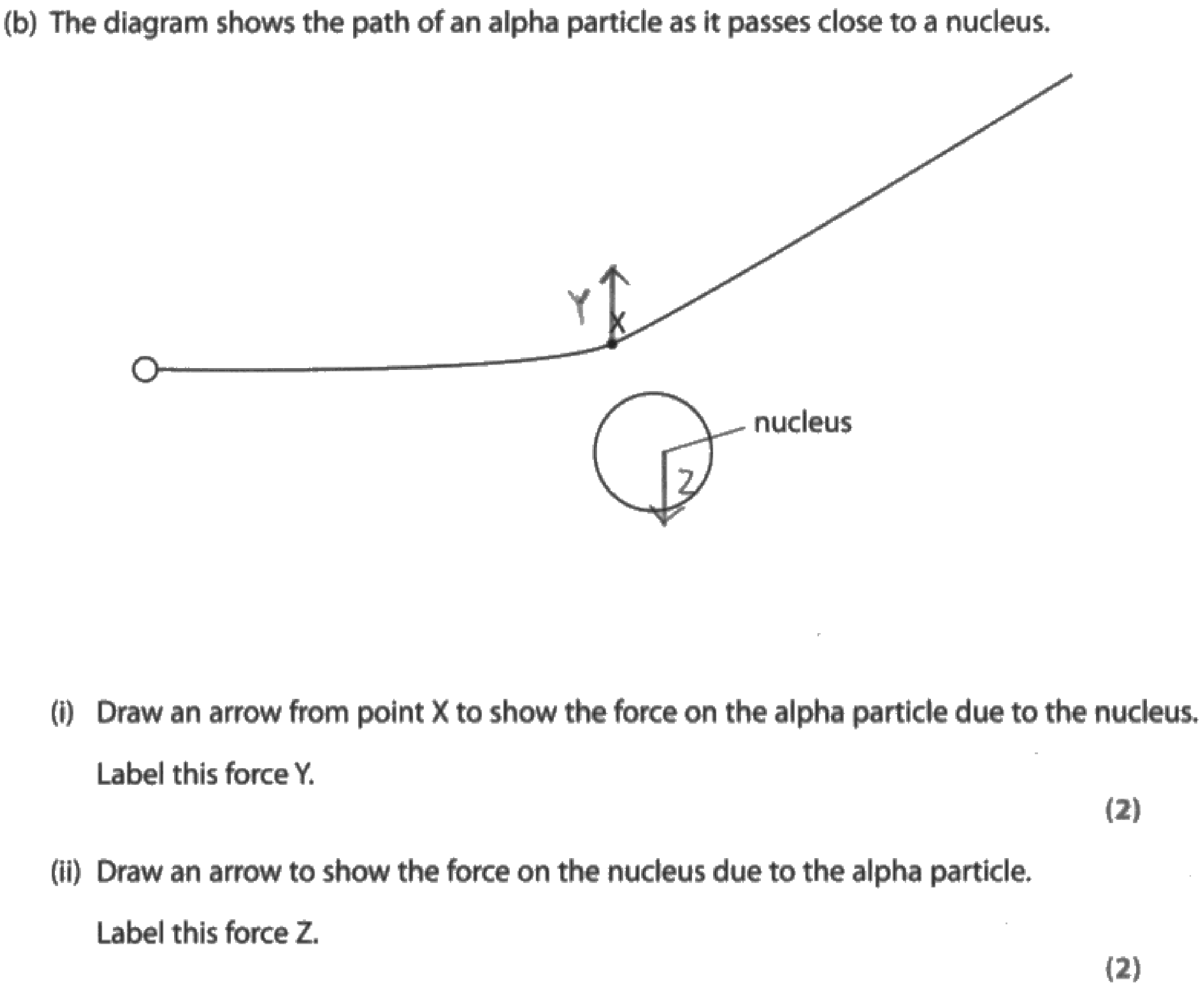
About a third of all candidates scored full marks here. A sizeable minority did not score any marks, mostly because they listed all three possibilities of the nuclear charge without making it clear which one linked to the evidence in the diagram of Q04(b).

Question 4 (b) (i) - (ii)

This question clearly distinguished between candidates. It tested knowledge of electrostatics, the nature of the alpha particle and the nucleus, as well as Newton's Third Law.

The majority of candidates understood that the alpha and the nucleus are both positive and so the alpha should experience a force of repulsion. Significantly fewer realised that force must be directed away from the centre of the nucleus.

In Q04b(ii), many candidates understood that the force on the nucleus must be in the exact opposite direction to that on the alpha particle. Most candidates did not recall that these forces must also be equal in magnitude. Error carried forward was applied from Q04b(i).



(b) The diagram shows the path of an alpha particle as it passes close to a nucleus.

(i) Draw an arrow from point X to show the force on the alpha particle due to the nucleus.

Label this force Y.

(2)

(ii) Draw an arrow to show the force on the nucleus due to the alpha particle.

Label this force Z.

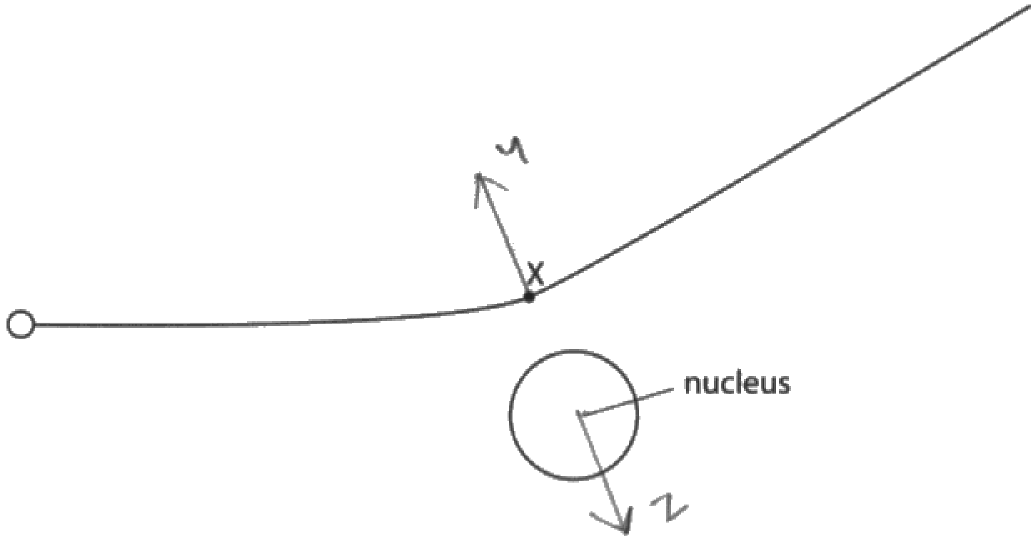
(2)

ResultsPlus
Examiner Comments

This candidate has clearly labelled both forces. The force on the alpha particle is definitely away from the nucleus so the first mark has been awarded; there was a large tolerance on this. The second mark for Q04b(i) has not been awarded as the force does not appear to be in line with the centre of the nucleus. There was a rather smaller tolerance here.

For Q04b(ii), both marks have been awarded since the force on the nucleus is exactly opposite to the force on the alpha and is within tolerance in terms of being the same magnitude.

(b) The diagram shows the path of an alpha particle as it passes close to a nucleus.



(i) Draw an arrow from point X to show the force on the alpha particle due to the nucleus.

Label this force Y.

(2)

(ii) Draw an arrow to show the force on the nucleus due to the alpha particle.

Label this force Z.

(2)

ResultsPlus
Examiner Comments

This candidate has made it obvious that they understand the force on the alpha particle appears to be in line with the centre of the nucleus. The force on the nucleus is within tolerance in terms of its magnitude and direction.

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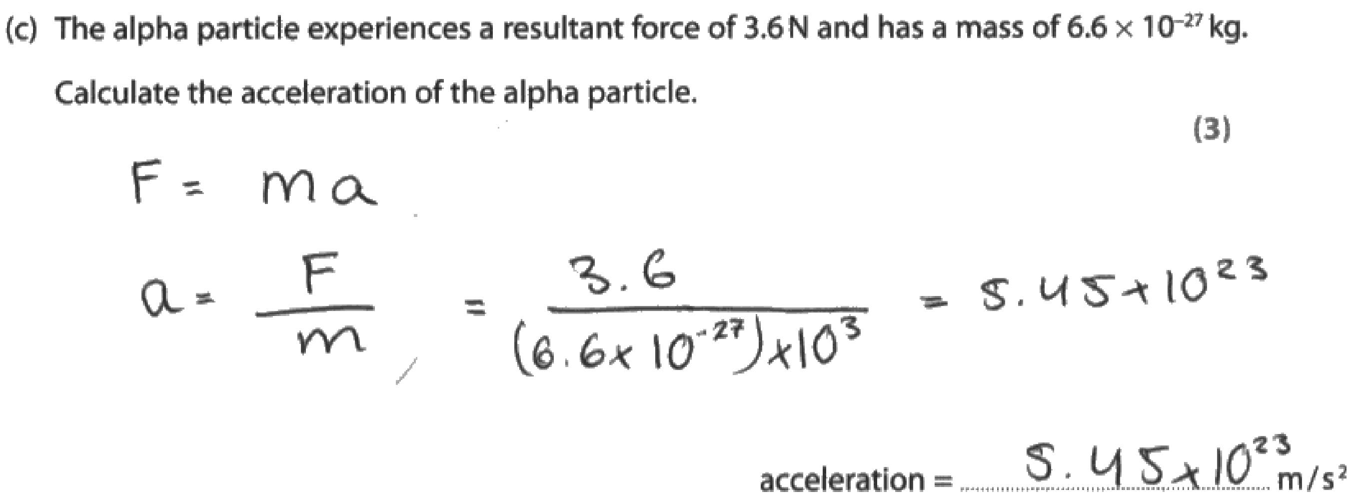
Examiner Tip

Ideas about forces on pairs of charged particles are well understood. Link this idea with Newton's Third Law and think through other pairs of forces.

Question 4 (c)

The majority of candidates either gained full marks or dropped one mark because they incorrectly converted the mass into grams.



(c) The alpha particle experiences a resultant force of 3.6 N and has a mass of 6.6×10^{-27} kg.

Calculate the acceleration of the alpha particle.

(3)

$$F = ma$$

$$a = \frac{F}{m} = \frac{3.6}{(6.6 \times 10^{-27}) \times 10^{3}} = 5.45 \times 10^{23}$$

acceleration = 5.45×10^{23} m/s²

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Examiner Comments

This candidate has presented their calculation clearly, from stating the formula at the start, then rearranging and substituting until the correct evaluation for their subsitution is given.

The only error is converting the mass of the alpha particle into grams.

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Examiner Tip

Virtually all of the formula in Physics use the kilogram as the unit of mass, and the metre as the unit of length.

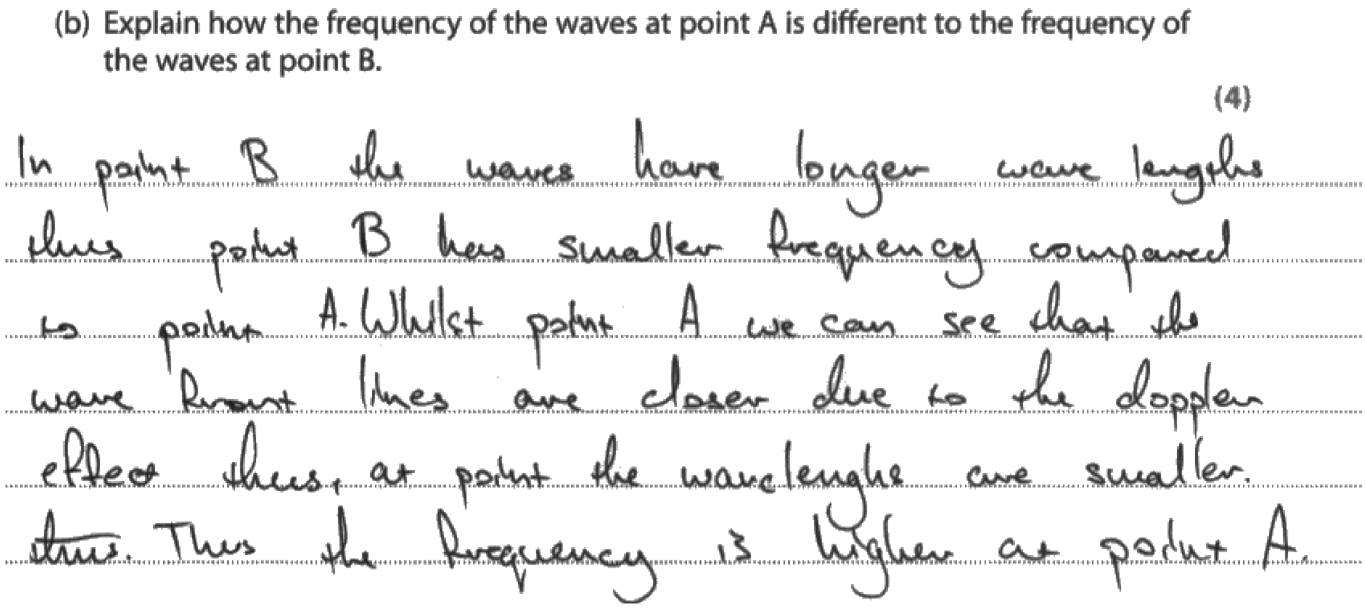
Question 5 (a)

The vast majority of candidates appreciated that the toy was moving from left to right in diagram 2. A large tolerance on the precise direction was given this series.

Question 5 (b)

The idea of the Doppler effect and explaining how it arises is new to the specification. It was encouraging to see that most candidates could explain this to some degree with the prompt from the two diagrams.

The evidence from the diagrams shows that the wavefronts are closer together at point A. This shows that the wavelength here is decreased. Although the wave equation was not required, it, along with the idea that the speed of the waves has remained constant, implies that the frequency has increased. Many otherwise successful explanations did not include reference to a constant speed.



(b) Explain how the frequency of the waves at point A is different to the frequency of the waves at point B.

(4)

In point B the waves have longer wave lengths thus point B has smaller frequency compared to point A. Whilst point A we can see that the wave front lines are closer due to the doppler effect thus, at point the wavelenghs are smaller. ~~thus.~~ Thus the frequency is higher at point A.

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Examiner Comments

This candidate has made clear reference to the evidence that the wavefronts are closer together at A and indeed further apart at B. They have also made the link between the distance between wavefronts and the wavelength at A, which is smaller, 2 marks so far.

At both points A and B, they have inferred that the frequency has changed in the correct way, gaining them a third mark.

The only idea that is missing is that of a constant wavespeed.

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Examiner Tip

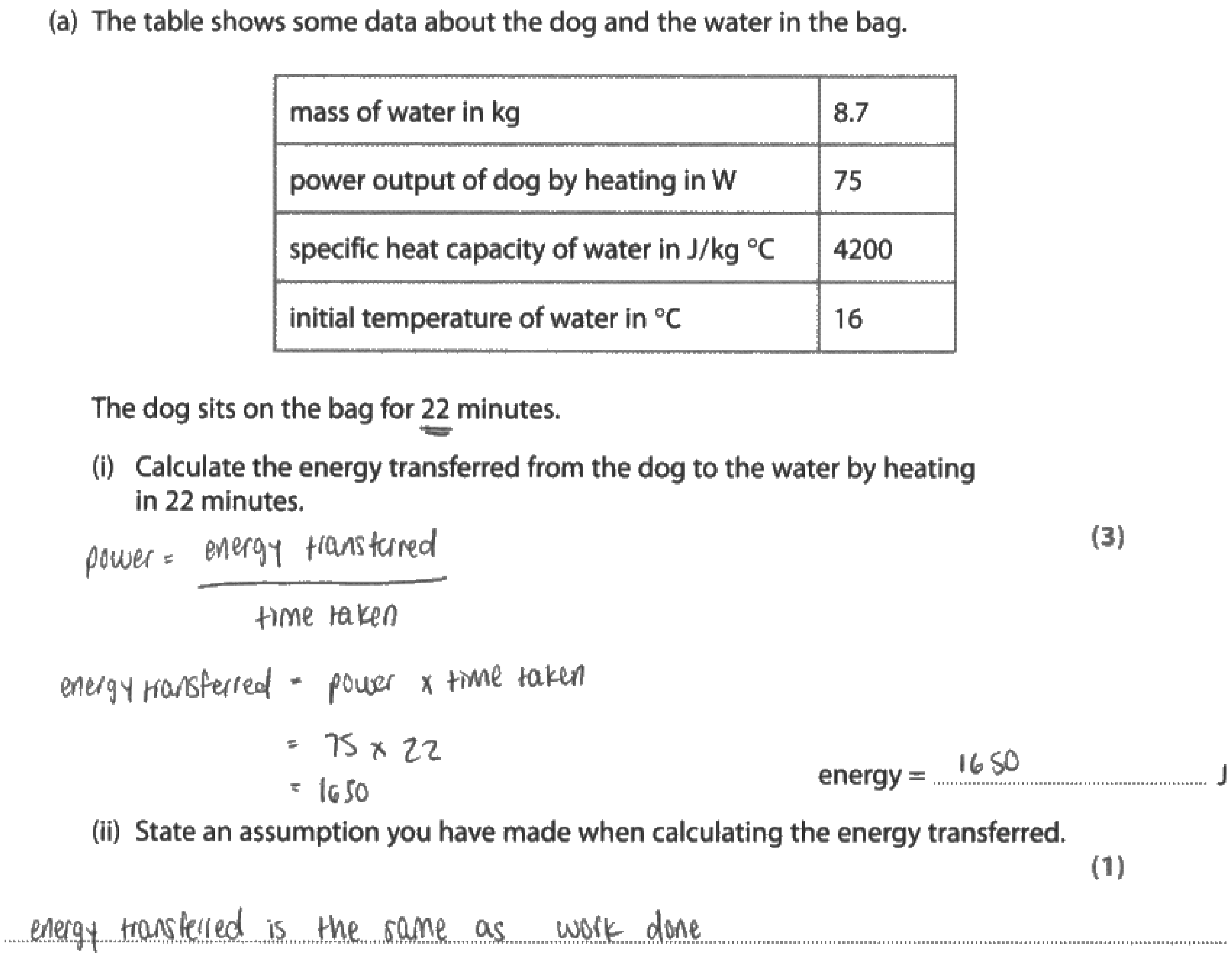
Bullet points can greatly enhance your chances of spotting whether you have made all of the relevant points required for the long response question. This candidate would have spotted that they had only made three relevant statements had they used such a method.

Question 6 (a)

Just under half of all candidates scored either full marks or seven marks for this item. The formula for Q06a(i) is included on the formula page, although many candidates chose the wrong formula, opting for the formula relating to specific heat capacity.

In Q06a(ii), generic answers such as 'It's 100% efficient' were not accepted. There needed to be some context-specific information.

Q06a(iii) tested the specific heat capacity relationship for the first time, as this too is new to the specification. An error in part Q06a(i) was carried forward, even if that resulted in a temperature increase that would have boiled the water.



(a) The table shows some data about the dog and the water in the bag.

mass of water in kg	8.7
power output of dog by heating in W	75
specific heat capacity of water in J/kg °C	4200
initial temperature of water in °C	16

The dog sits on the bag for 22 minutes.

(i) Calculate the energy transferred from the dog to the water by heating in 22 minutes.

(3)

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$$

energy transferred = power x time taken

= 75 x 22

= 1650

energy = 1650 J

(ii) State an assumption you have made when calculating the energy transferred.

(1)

energy transferred is the same as work done

(iii) Calculate the temperature of the water after 22 minutes.

(4)

$\Delta Q = m \times c \times \Delta T$

$1650 = 8.7 \times 4200 \times \Delta T$

$1650 = 36540 \times \Delta T$

$\Delta T = \frac{1650}{36540}$

$\Delta T = \text{Ans} \uparrow$

$16 + \text{Ans} = 16.0452$

temperature = 16.0452 °C

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Examiner Comments

Q06a(i) - This candidate has used the correct given formula and substituted correctly for the power and time, apart from not converting the time from minutes into seconds. 2 marks.

Q06a(ii) - While this statement is often true it isn't in this case, as the dog is heating the bag, rather than doing work. 0 marks.

Q06a(iii) - Although the energy transferred is incorrect by a factor of 60, the candidate has selected and written down the correct given formula. They have substituted in the values clearly and rearranged the equation correctly to give a change in temperature which is appropriate to the value of energy transferred. Some candidates tried unsuccessfully to write the temperature change as (16 - final temperature). This is only correct if the bag were cooling down.

Many candidates stopped at this point. The question asks for the temperature of the water, not just the temperature change. Here, the candidate has correctly added the initial temperature to get a final temperature. 4 marks awarded, given error carried forward.

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Examiner Tip

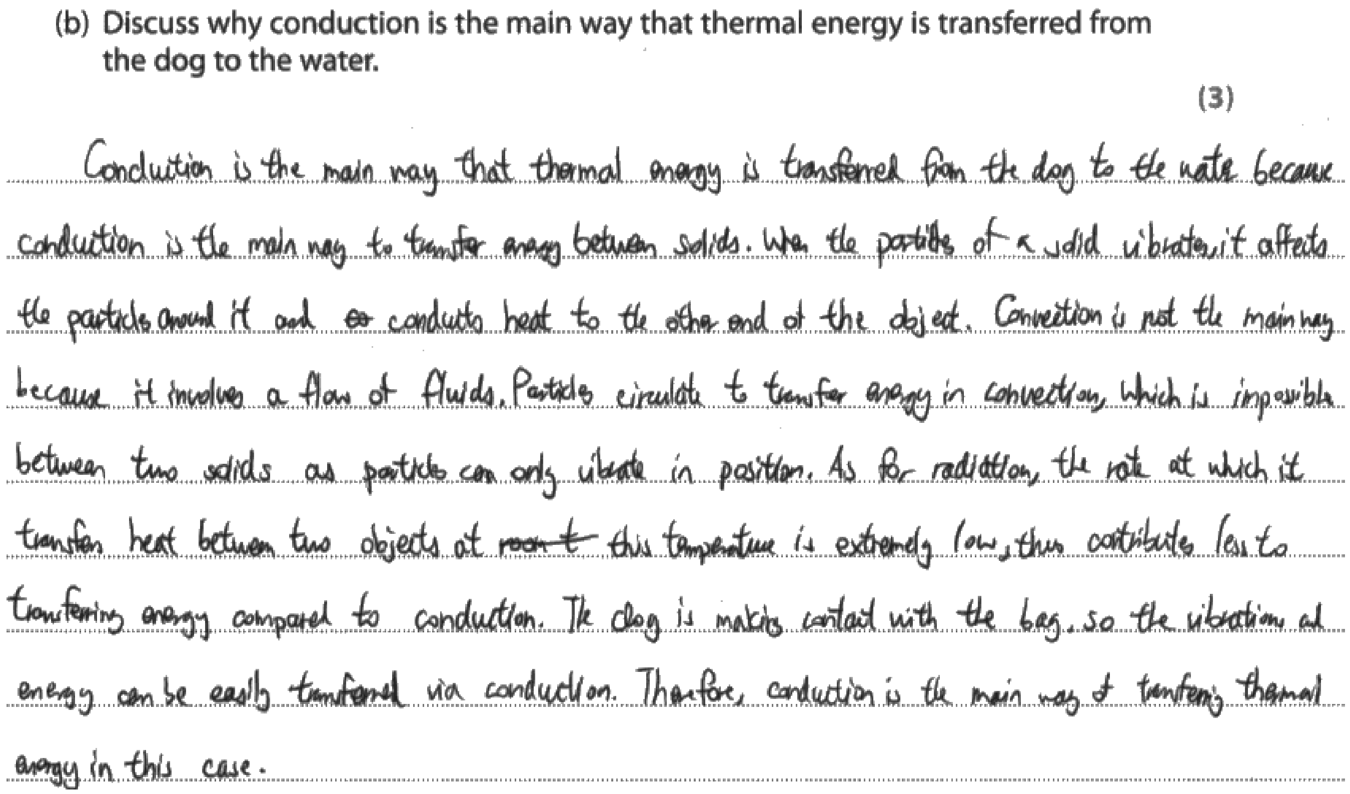
Remember that it is highly likely that the formulae you use will require the time to be given in minutes.

For multiple step calculations, make each step as simple as possible and don't try to do multiple steps at once.

Question 6 (b)

Heat transfer remains generally misunderstood, with over half of all candidates scoring zero. About a third of candidates mentioned that as the two objects are in contact with each other, then conduction is highly likely. A second mark could have been scored by many by stating that the dog has a higher temperature than the water, which is what causes the thermal transfer in the first place.

Convection can be ruled out, since both objects are solid and any gap between the dog and the bag is likely to be very small or not there at all.



(b) Discuss why conduction is the main way that thermal energy is transferred from the dog to the water.

(3)

Conduction is the main way that thermal energy is transferred from the dog to the water because
conduction is the main way to transfer energy between solids. When the particles of a solid vibrate, it affects
the particles around it and ~~so~~ conducts heat to the other end of the object. Convection is not the main way
because it involves a flow of fluids. Particles circulate to transfer energy in convection, which is impossible
between two solids as particles can only vibrate in position. As for radiation, the rate at which it
transfers heat between two objects at ~~room t~~ this temperature is extremely low, thus contributes less to
transferring energy compared to conduction. The dog is making contact with the bag, so the vibrations and
energy can be easily transferred via conduction. Therefore, conduction is the main way of transferring thermal
energy in this case.

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Examiner Comments

This candidate has described conduction at length yet has only scored the mark on lines 7-8.

The statement about convection from the end of line 3 to the middle of line 5 is correct and scores a mark.

The statement about radiation from the middle of line 5 into line 7 is correct also - the two objects are at roughly the same temperature and so radiative transfer will be small.

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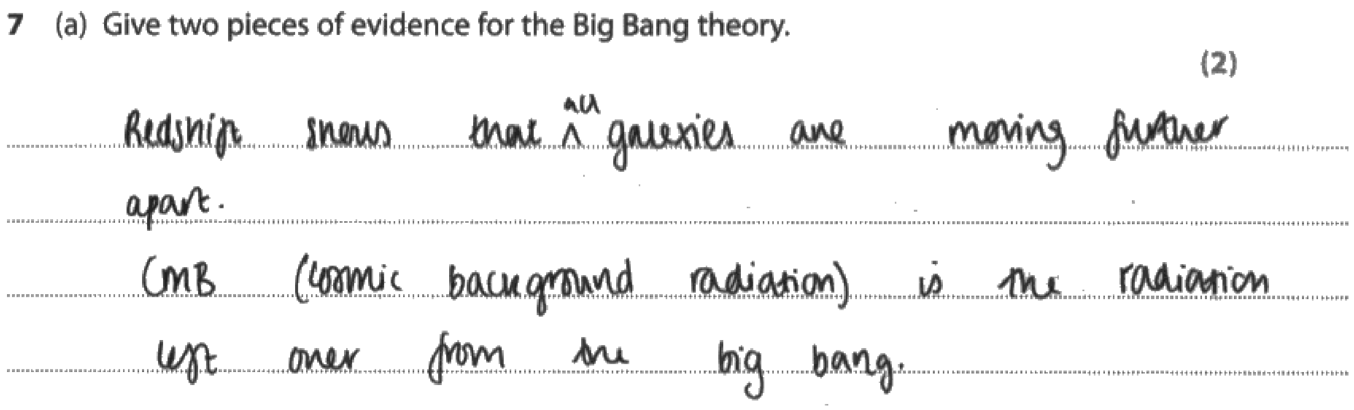
Examiner Tip

In any heat transfer question, think about the direction of transfer, first of all by identifying which of the two objects involved has the higher temperature and then stating this.

Consider then the nature of the two objects and check whether they are compatitble with each transfer method in turn.

Question 7 (a)

A significant number of candidates lost either a mark for not relating the red shift to that of galaxies or merely referring to background radiation, or both.



7 (a) Give two pieces of evidence for the Big Bang theory.

(2)

Redshift shows that all galaxies are moving further apart.

CMB (cosmic background radiation) is the radiation left over from the big bang.

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Examiner Comments

The comment about red shift is related to that of galaxies.

The comment about CMB is also acceptable, as the reference to background radiation is linked to coming from a cosmic source.

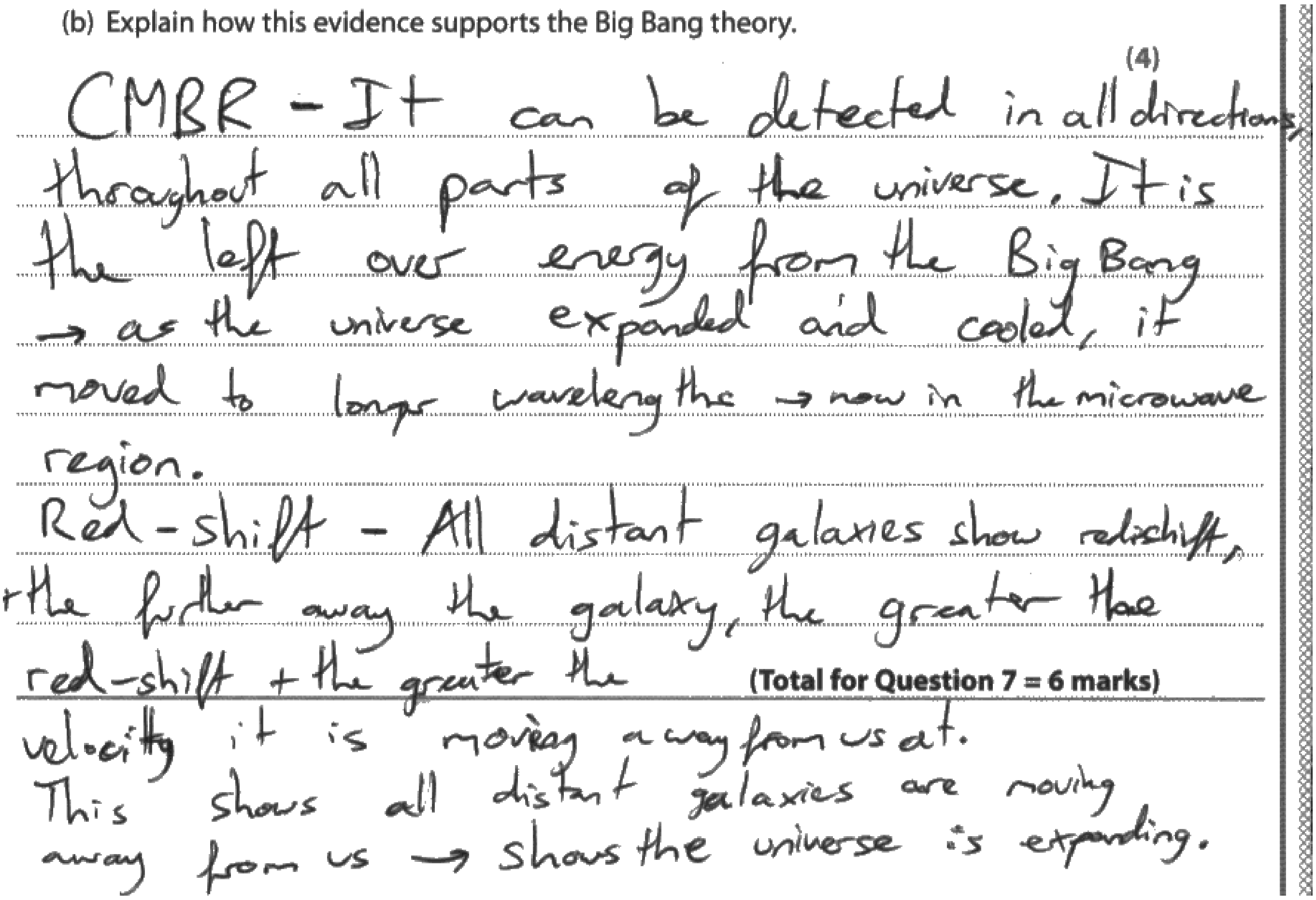
2 marks.

ResultsPlus
Examiner Tip

Make sure that your answers are specific to the question and not generic in nature.

Question 7 (b)

The evidence for the Big Bang theory was also new to the specification. Most candidates were very keen to describe what cosmic microwave background radiation and red-shift of galaxies were. The question asks for something more complex, ie how those two pieces of evidence are interpreted and how they imply that there was a Big Bang.



(b) Explain how this evidence supports the Big Bang theory.

(4)

CMBR - It can be detected in all directions, throughout all parts of the universe. It is the left over energy from the Big Bang → as the universe expanded and cooled, it moved to longer wavelengths → now in the microwave region.

Red-shift - All distant galaxies show redshift, + the further away the galaxy, the greater the red-shift + the greater the velocity it is moving away from us at.

This shows all distant galaxies are moving away from us → shows the universe is expanding.

(Total for Question 7 = 6 marks)

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Examiner Comments

The candidate has been careful to separate points from the two pieces of evidence. In both cases, a statement of the relevant evidence is useful and creditworthy.

In the first line, the fact that the CMBR is detected in all directions is mentioned. Futher to that, in lines 4-5, the expansion of the universe is linked to the increase in wavelength of the CBR. 2 marks scored.

For the red-shift of galaxies, in the second and third lines of this portion of the response, the relevant evidence is that the further away the galaxy, the greater the red-shift. This point was expanded upon - the greater the red-shift, the greater the recessional velocity. 2 marks scored.

ResultsPlus
Examiner Tip

Explain questions which have 4 or more marks will often require discussion of evidence and the interpretation of that evidence.

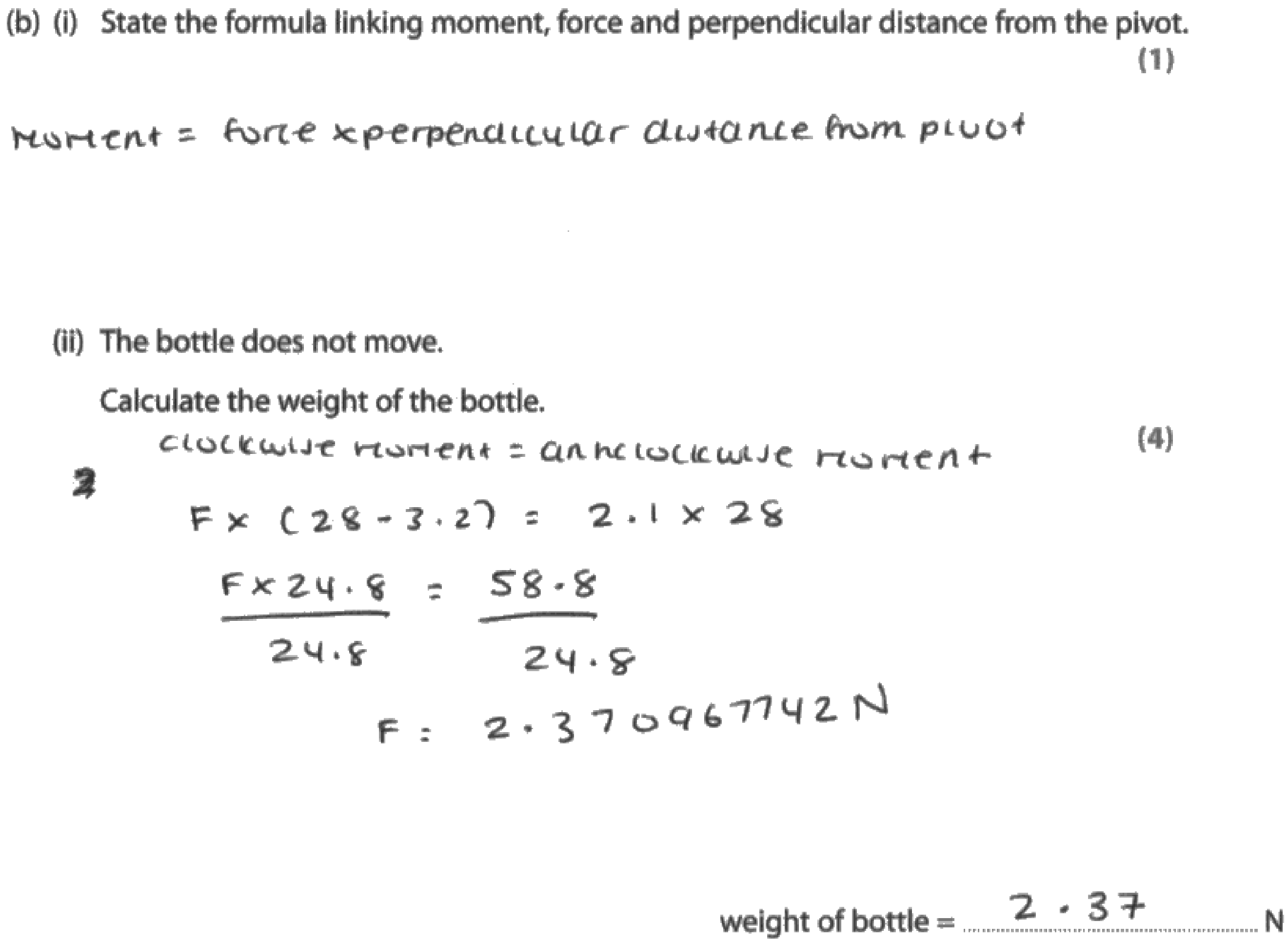
Question 8 (a)

Just under a quarter of all candidates correctly identified point Z as either the centre of gravity or the equally acceptable centre of mass.

Question 8 (b)

Nearly all candidates could recall the formula relating moment, force and perpendicular distance for Q08(b)(i).

Just over a third could complete the calculation. The majority of those that did not, correctly calculated the moment of the horizontal force or deduced that the moment of the weight force was 0.032 times the weight, but could go no further.



(b) (i) State the formula linking moment, force and perpendicular distance from the pivot.
(1)

moment = force x perpendicular distance from pivot

(ii) The bottle does not move.

Calculate the weight of the bottle.
(4)

clockwise moment = anticlockwise moment

2

$F \times (28 - 3.2) = 2.1 \times 28$

$\frac{F \times 24.8}{24.8} = \frac{58.8}{24.8}$

$F = 2.370967742$ N

weight of bottle = 2.37 N

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The formula in part Q08b(i) is correct here, so 1 mark.

The candidate has appreciated that they need to use the principle of moments, so have guaranteed 1 mark if they set up the equation. The anti-clockwise moment is correct, but the distance for the moment of the weight is incorrect.

This therefore scores 2 marks.

ResultsPlus Examiner Tip

It is a good idea to use words to explain what physics calculation you intend to use. By sign-posting your work, it makes it easier for you and the examiner to follow.

(b) (i) State the formula linking moment, force and perpendicular distance from the pivot.

(1)

moment = force x perpendicular distance from pivot.

(ii) The bottle does not move.

Calculate the weight of the bottle.

(4)

weight = mass x 10

$2.1 \times 28 = 3.2 \times x$

$\frac{58.8}{3.2} = x$

$x = 18.375$

$18.375 \times 10 = 183.75$

weight of bottle = 183.75 N

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Examiner Comments

Again, this candidate has correctly quoted the formula linking moment, force and perpendicular distance in Q08(b)(i). 1 mark here.

In Q08(b)(ii), the equation has been correctly set up, with 'x' as the weight of the bottle. The candidate has rearranged the formula correctly and found x correctly. Unfortunately, incorrect conversion from a mass to a weight has cost 1 mark. 3 marks here.

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Examiner Tip

In moments calculations, the two quantities are forces and distances. A shortcut involving masses instead is possible in some cases, however, it is ill-advised in examinations.

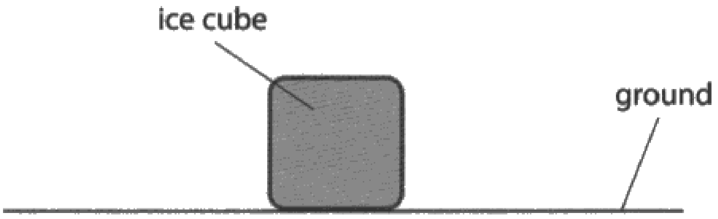
Question 9 (a) (i)

Roughly equal proportions of candidates scored 0 or full marks for Q09(a)(i). The formula relating pressure, force and area was generally well remembered. The question, however, gives the mass of the ice cube, so the candidate must convert the mass into kilograms, then to a weight in newtons.

Many candidates forgot to do either the mass conversion to kg or the weight in newtons. Failing to convert a mass to a weight meant that no further marks could be scored.

9 This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is $2.6 \times 10^{-4}\,\text{m}^2$.

Calculate the pressure the ice cube exerts on the ground.

(4)

$\text{pressure} = \frac{\text{force}}{\text{area}}$ ~~Pressure =~~

$\text{Pressure} = \frac{0.0037}{2.6 \times 10^{-4}} = 14.2\ \text{Pa}$

$3.7 \rightarrow \text{kg} = 0.0037$

pressure = 14.2 Pa

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Examiner Comments

This candidate has quoted the correct formula and successfully converted the mass from grams into kilograms.

The mass of the ice cube has not been converted to a weight, so no further marks can be scored.

2 marks.

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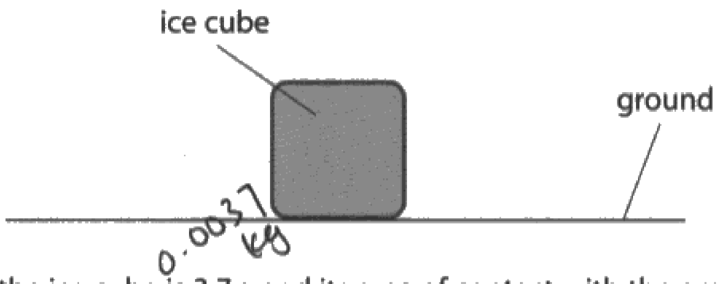
Examiner Tip

Be clear about the distinction between mass and weight.

9 This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is 2.6×10^{-4} m².

Calculate the pressure the ice cube exerts on the ground.

(4)

$3.7\,g - 3.7 \times 10^{-3}$ kg

$\text{pressure} = \frac{\text{Force}}{\text{area}}$

$3.7 \times 10^{-3} \times 10 = 0.037$

$\frac{0.037}{2.6 \times 10^{-4}} = 140$ (2sf)

pressure = 140 Pa

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Examiner Comments

The candidate has sensibly converted the mass to kilograms straight away.

After quoting the formula, the mass has then been converted to a weight before substitution into the formula.

The calculation has been evaluated correctly.

4 marks.

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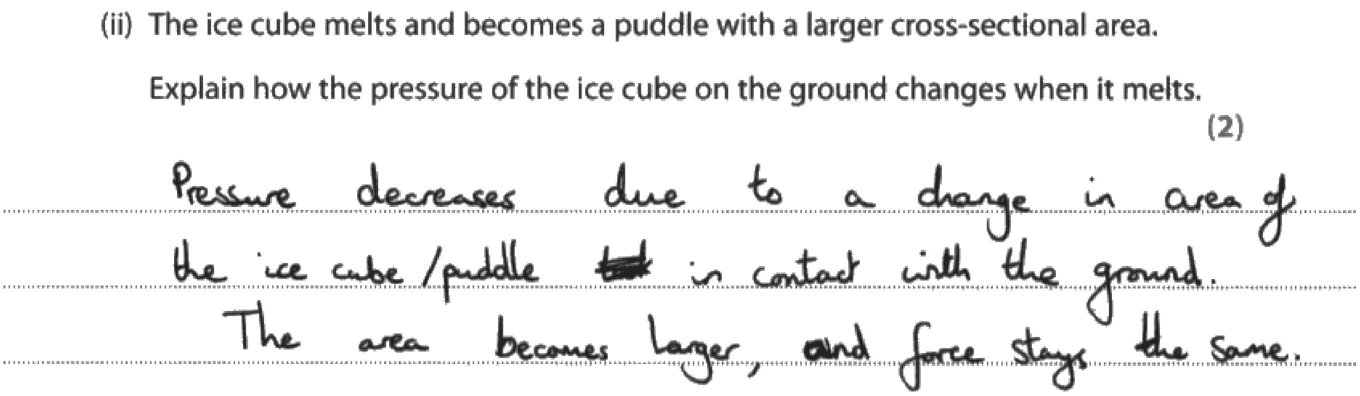
Examiner Tip

Take time to think and plan your response to a multi-stage calculation.

Question 9 (a) (ii)

Two thirds of the candidates scored zero for this item. For a complete answer, not only is the correct change of pressure required, a full justification is required. This includes reference to the formula and indication that the force or weight is unchanged.



(ii) The ice cube melts and becomes a puddle with a larger cross-sectional area.

Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

Pressure decreases due to a change in area of the ice cube /puddle ~~[illegible]~~ in contact with the ground. The area becomes larger, and force stays the same.

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Examiner Comments

This candidate has scored a mark for stating that the force is constant. The correct change in pressure has been deduced however, the formula has not been quoted to support the answer.

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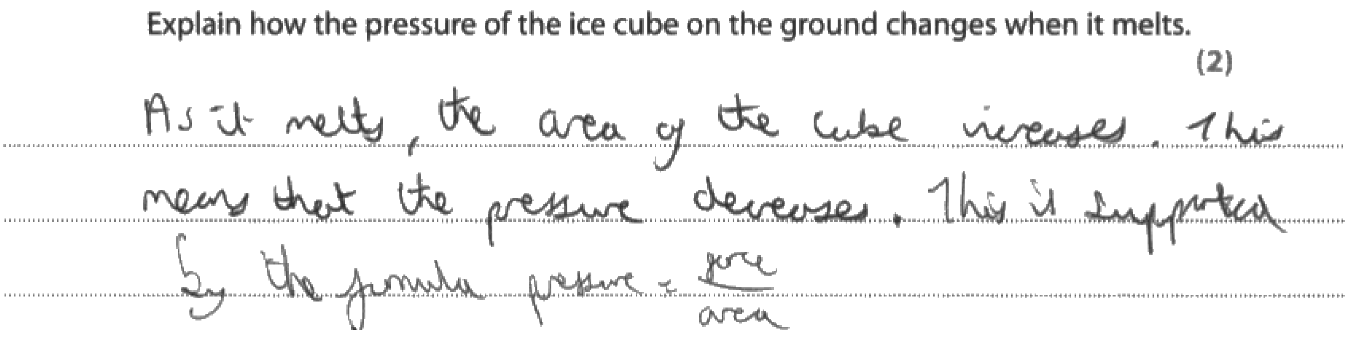
Examiner Tip

Quote the relevant formula to support your answer.



Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

As it melts, the area of the cube increases. This means that the pressure decreases. This is supported by the formula pressure = $\frac{\text{force}}{\text{area}}$

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Examiner Comments

This candidate has quoted the formula and got the correct decrease in pressure. All that is missing is reference to a constant force or weight.

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Examiner Tip

Remember to quote which quantity or quantities are constant. There can be no marks for merely repeating the question, in this case the statement about the area increasing.

Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

As the ice cube melts, the surface area increases, although the overall force stays the same. $P = \frac{F}{A}$, so the pressure decreases as the area increases.

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Examiner Comments

This candidate has produced a complete solution, mentioning all of the relevant detail.

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Examiner Tip

Questions of this type usually require:

- A statement of what stays the same.
- What quantity changes.
- The correct formula.
- How the change in one quantity affects the other quantity.

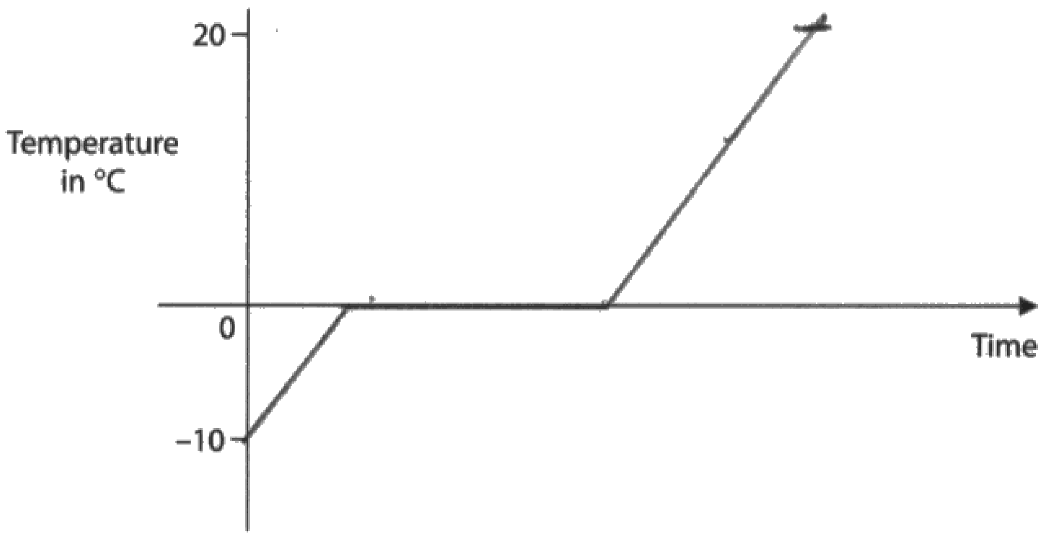
Question 9 (b)

The majority of candidates did not realise that there would be a short period of time where the temperature did not change, at zero degrees. Some candidates produced a correct response, apart from the temperature not reaching 20 degrees.

(b) Ice melts at a temperature of 0 °C.

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of −10 °C to a temperature of 20 °C.

(3)



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Examiner Comments

This is an excellent response. The period of time where the ice is melting is clearly marked. The candidate has been careful to make a horizontal mark to show where 20 degrees is and then made sure that the last stage of the graph has met that mark. 3 marks.

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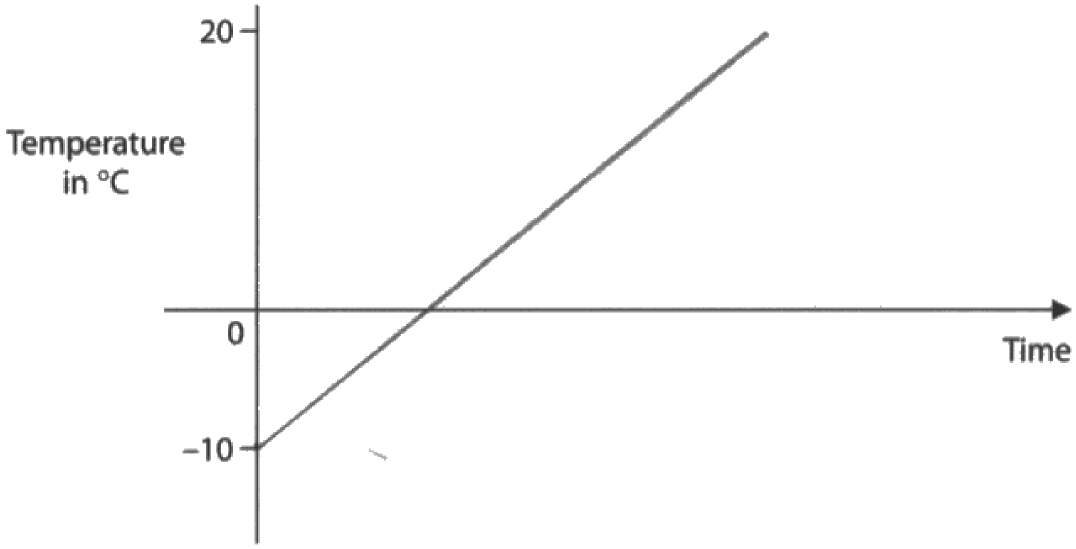
Examiner Tip

Use the information in the question to plan out your answer. By counting the number of marks, it might indicate how many stages the temperature-time graph takes.

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of –10 °C to a temperature of 20 °C.

(3)



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Examiner Comments

This candidate has not included any period of time where the ice has stayed at zero degrees so this can only score a maximum of one mark.

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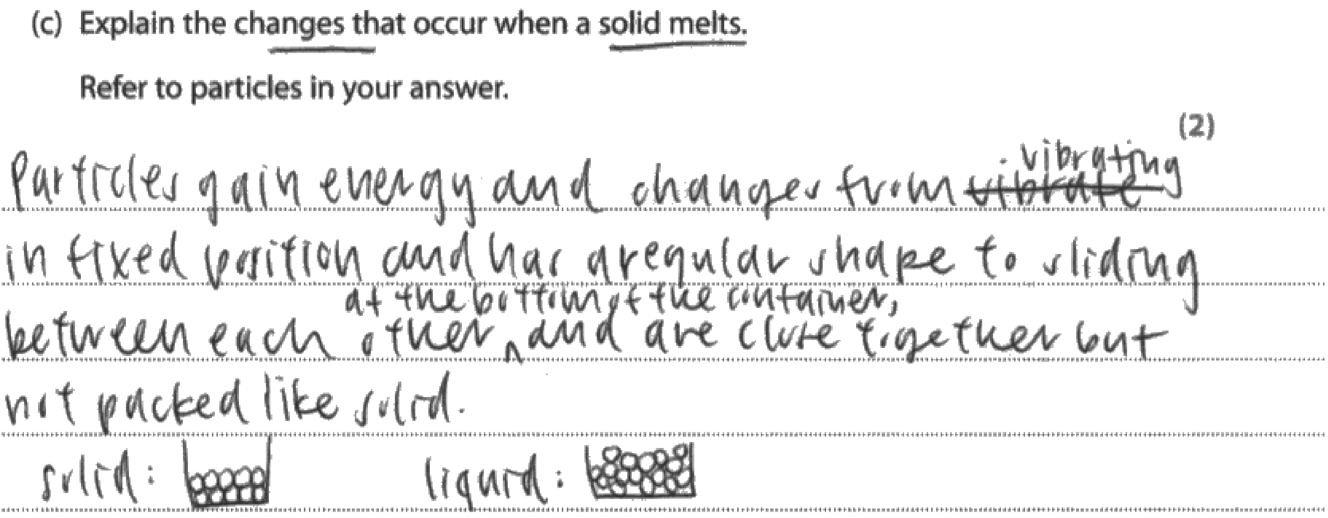
Examiner Tip

A single straight line is unlikely to score all three marks at this stage in the paper.

Question 9 (c)

This question asks for the changes that occur when a solid melts into a liquid. Many candidates did not refer to changes but limited themselves to talking about what the particles are doing in one state or the other.

The most common marking point awarded here was for mention of breaking bonds.



(c) Explain the changes that occur when a solid melts.

Refer to particles in your answer.

(2)

Particles gain energy and changes from ~~vibrate~~ vibrating in fixed position and has a regular shape to sliding between each other at the bottom of the container, and are close together but not packed like solid.

solid: liquid:

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Examiner Comments

This candidate scored two marks, because they had mentioned features of the solid state and the liquid state.

The motion is referred to in line 2 ('fixed position') and in lines 2-3 ('sliding between each other').

The structure is referred to in line 2 ('regular shape') and in lines 3-4 ('close together but not packed like a solid'). This would not have been enough to score the second mark, however, there is a diagram to help their answer.

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Examiner Tip

If the question asks for changes, make sure you compare **before** with **after**.

You can always draw a diagram to help your answer.

Paper Summary

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

- Take care when drawing diagrams. Remember to add labels and draw accurately.
- Either build or simulate circuits in which the number of components changes; noting the effect on the currents and voltages in or across those components.
- Ensure that you have either seen or performed the practicals named in the specification where possible.
- Take note of the number of marks given for each question and use this as a guide for the amount of detail expected in the answer.
- Take note of the command word used in each question to determine how the examiner expects the question to be answered, for instance, whether to give a description or an explanation.
- Be familiar with the equations listed in the specification and be able to use them confidently.
- Recall the units given in the specification and use them appropriately, eg frequency.
- Be familiar with the names of standard apparatus used in different branches of physics.
- Practise structuring and sequencing longer extended writing questions.
- Show all working. It is possible to gain marks where individual items are correct, if this is evident within the working candidates provide.
- Be ready to comment on data and suggest improvements to experimental methods.
- Take care to follow the instructions in the question, eg when requested to use itemicular ideas in the answer.
- Take advantage of opportunities to draw labelled diagrams as well as, or instead of, written answers.
- Allow time at the end of the examination to check answers carefully and correct basic slips in wording or calculation.

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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