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Examiners' Report
June 2019

GCSE Combined Science 1SC0 1PH

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Introduction

This was the second examination of paper 1SC0 1P at Higher Level for the new specification.

Questions were set to test students' knowledge, application and understanding from these seven 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. It included questions designed at targeting students' knowledge and understanding of practical work. 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. The assessment of students' mathematical skills involved recall of some equations and became more demanding as the paper progressed. There was also an extended open response question, worth six marks.

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 being able to recall and rearrange equations and use numbers in standard form
- 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 knowledge of the topics of this paper
- had gaps in their procedural knowledge, relating to their practical work
- failed to set out calculations in a logical way that could be easily followed by the examiner
- did not focus sufficiently on what the question was asking

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 that highlight successes and misconceptions, with the aim of aiding future teaching of these topics. It will be useful to have the question paper and published mark scheme to hand in order to place the comments that follow into context.

Question 1 (b)

Most candidates were able to score at least one mark; usually by stating the infrared would be blocked by the armchair. Better candidates gave a reason; usually that the wavelengths of infrared and radio waves are different. A few candidates included the idea of radio waves diffracting around the armchair in their response.

There was a common misconception that radio waves are 'stronger' than IR.

(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 waves would be blocked by the armchair and be absorbed or reflected back. Radio waves would be able to pass through the arm chair because they ca travell long distances.

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Examiner Comments

This response correctly suggests that infrared would be blocked but then goes on to essentially repeat this by stating that radio waves would pass through. It scored 1 out of 2 possible marks.

For 2 marks, the answer needs to suggest a reason why they behave differently; such as radio and infrared have different wavelengths.

Question 1 (c) (i)

Most candidates correctly identified the x axis for wavelength with many correctly answering 12cm. The majority of marks lost were for not understanding what constitutes one whole wave.

Question 1 (c) (ii)

Candidates were usually able to describe the motion of the cork as being either up and down or perpendicular to the direction of the wave. However, there was a wide-spread misconception that the cork would also be carried along with the wave.

(ii) Describe the motion of the cork.

You should include how the cork moves relative to the direction of travel of the wave.

(2)

This is a transverse wave which means that the cork will bob up and down, travelling perpendicular to the direction of the wave.

ResultsPlus
Examiner Comments

A concise response that scored both marks.

(ii) Describe the motion of the cork.

You should include how the cork moves relative to the direction of travel of the wave.

(2)

Starting at the top of the wave, the cork will ~~move~~ work down to the bottom of the wave height and then back to the top. It will also move to the right, the same direction as the wave but just not as fast.

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Examiner Comments

There is a mark for describing the up and down motion of the cork but the cork does not move along with the direction of the wave.

1 mark only.

Question 1 (d)

This was a straightforward calculation for many candidates. The majority of mistakes came from incorrect evaluation resulting in answers that were 10 times too large.

Question 2 (b) (i)

Most candidates could recall that a Geiger counter was an appropriate detector.

Question 2 (b) (ii)

Candidates were very familiar with the idea of background radiation and this was a well answered question with a broad spread of correct answers given. Incorrect answers stated were mainly forms of electromagnetic radiation

Question 2 (c)

Previous papers have used a decay graph to introduce half-life. This question gave the required information as two statements. Many candidates found it difficult to extract and process the required values from these statements. Some candidates identified 3 half-lives but then made errors. Many candidates attempted halving more than once to score the first mark point but did not then multiply the number of half-lives by the time for 1 half-life or counted 4 half-lives instead of 3. A common mistake was to subtract 5700 from 125,000 or to divide 1 000 000 by 125 000

(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)

$$\frac{1\,000\,000}{125\,000} = 8 = 2^3$$

$$3 \times 5700 = 17100$$

age of wood = 17100 years

ResultsPlus
Examiner Comments

This illustrates a very good way of approaching this sort of calculation. However, it does require very good skills in mathematics. Examiners did not see many responses using this approach.

(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)

1000 000
↓
500,000
↓
250,000
↓
125,000
= 3 half lives

5 700 x 3 = 17,100 yrs

age of wood = 17 100 years

ResultsPlus
Examiner Comments

This was a more common approach. The candidate has found the number of half-lives that have elapsed by dividing the number of atoms by two until 125 000 remain. It needed to be divided 3 times.

The age is then 3 half-life periods, or 17 100 years.

Full marks

(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)

1000000 ÷ 2 = 500000
500000 ÷ 2 = 250,000
250,000 ÷ 2 = 125,000
} Half lifed 3 times

57000 × 3 = 171000

age of wood = 171000 years

ResultsPlus
Examiner Comments

Here the candidate has used a similar method to find 3 half-lives.

Unfortunately an extra 0 appeared when calculating the age which gave an answer that is 10 times too large.

However, the examiner could clearly follow the working and could confidently award 1 mark of of a possible 2

ResultsPlus
Examiner Tip

Always show your working. You may still get some marks even if your final answer is wrong; provided that the examiner can see that you are following the correct method.

Question 2 (d)

Most candidates knew that there was a change in the number or neutrons and/ or protons but many misidentified which ones increased, which ones decreased and the consequence. For example, it was common to read: “mass changes, but proton number stays the same”. There was some confusion over what happens to the electron and many answers incorrectly referred to (or implied) ionisation. There was also a surprising amount of confusion over beta plus and beta minus decay.

(d) Carbon-14 decays into nitrogen-14.

The symbol for nitrogen-14 is $^{14}_{7}N$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

$^{14}_{6}C \rightarrow ^{14}_{7}N$ Beta^{-} decay because its atomic number has increased by 1, so it gains 1 proton but the mass number stays the same.

ResultsPlus
Examiner Comments

1 mark for beta minus decay.

I mark for stating that the atomic number increases but the mass number stays the same.

(d) Carbon-14 decays into nitrogen-14.

The symbol for nitrogen-14 is $^{14}_{7}N$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

The carbon-14 nucleus undergoes beta decay and it gains electrons, and neutrons, It is ionised and then loses electrons.

ResultsPlus
Examiner Comments

1 mark for identifying beta decay. The remainder of the answer is not correct.

Answers like this were quite common.

Question 3 (a)

Candidates were better this year at describing practical investigations and are taking more care to identify what is being measured and how the measurements are to be made. Many responses identified mass as a key variable and went on to correctly describe repeating with different masses.

There was less clarity about the measurement of height. Typical incorrect responses would refer to the height of track, or to how far the trolley went up the track.

Few candidates mentioned that it would be necessary to mark the highest point reached by the trolley in order to then make the necessary measurement of h.

Better candidates suggested repeated readings in order to get more reliable results.

3 Figure 2 shows a way of projecting a small trolley up a sloping track.

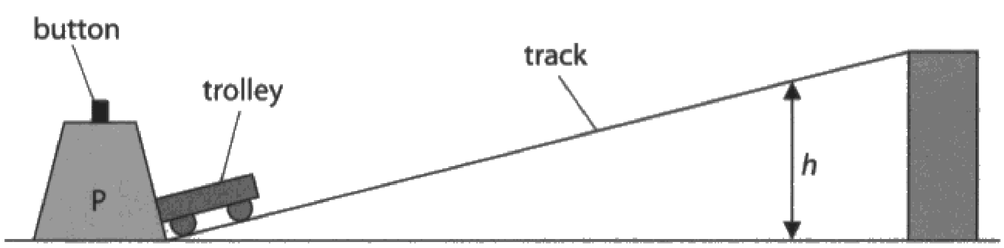


Figure 2

When the button is pressed, a spring is released in P that projects the trolley up the track.

The trolley travels up the track, stops and then rolls back down.

The spring in P always exerts the same force when projecting the trolley.

(a) A student investigates how the mass of the trolley affects the maximum vertical height, *h*, reached by the trolley.

State the measurements the student should make to complete the investigation.

You should make use of the equipment shown in Figure 2 and any other equipment that is needed.

(4)

Firstly, the student will need to use a scale to measure the mass of multiple trolleys, as this is the independent variable of the experiment. Then using a ruler ~~the~~ or metre stick, the student will need to measure the maximum height that the trolley reaches on the track. This is the dependent variable. They will need to repeat these steps with trolleys of different masses to see how mass affects how ~~[illegible]~~ much force is needed to move an object.

ResultsPlus
Examiner Comments

This answer describes exactly what should be measured and how the measurements should be made.

It scored full marks.

Examiners saw many responses like this.

- Take/ record the initial mass of the trolley using scales.

*

- launch the trolley and measure the distance travelled using a ruler
- Add more weight to the trolley and record its new weight using the same set of scales
- launch it again measuring the distance travelled using a ruler then work out the difference.

* measure the force exerted by the spring

ResultsPlus
Examiner Comments

There is a mark for describing how to measure the mass of the trolley and another mark for describing how the mass can be changed.

However, it not clear what is meant by "distance travelled". No further marks were awarded.

2 marks out of 4

Question 3 (b)

There was some uncertainty about the instruction to “use data from any two points on the graph”. Candidates would often simply quote values without attempting to process the data.

Nevertheless, many candidates attempted at least one calculation and most of those found two appropriate points on the graph to use in their calculations.

The most common error was to simply multiply the height by the mass rather than calculate gravitational potential energy from m x g x h. They could, however, score 1 of the three marks for this.

A few candidates misunderstood the question and attempted to find the gradient of the graph and /or simply described the shape of the graph.

(b) Figure 3 is a graph of the student's results.

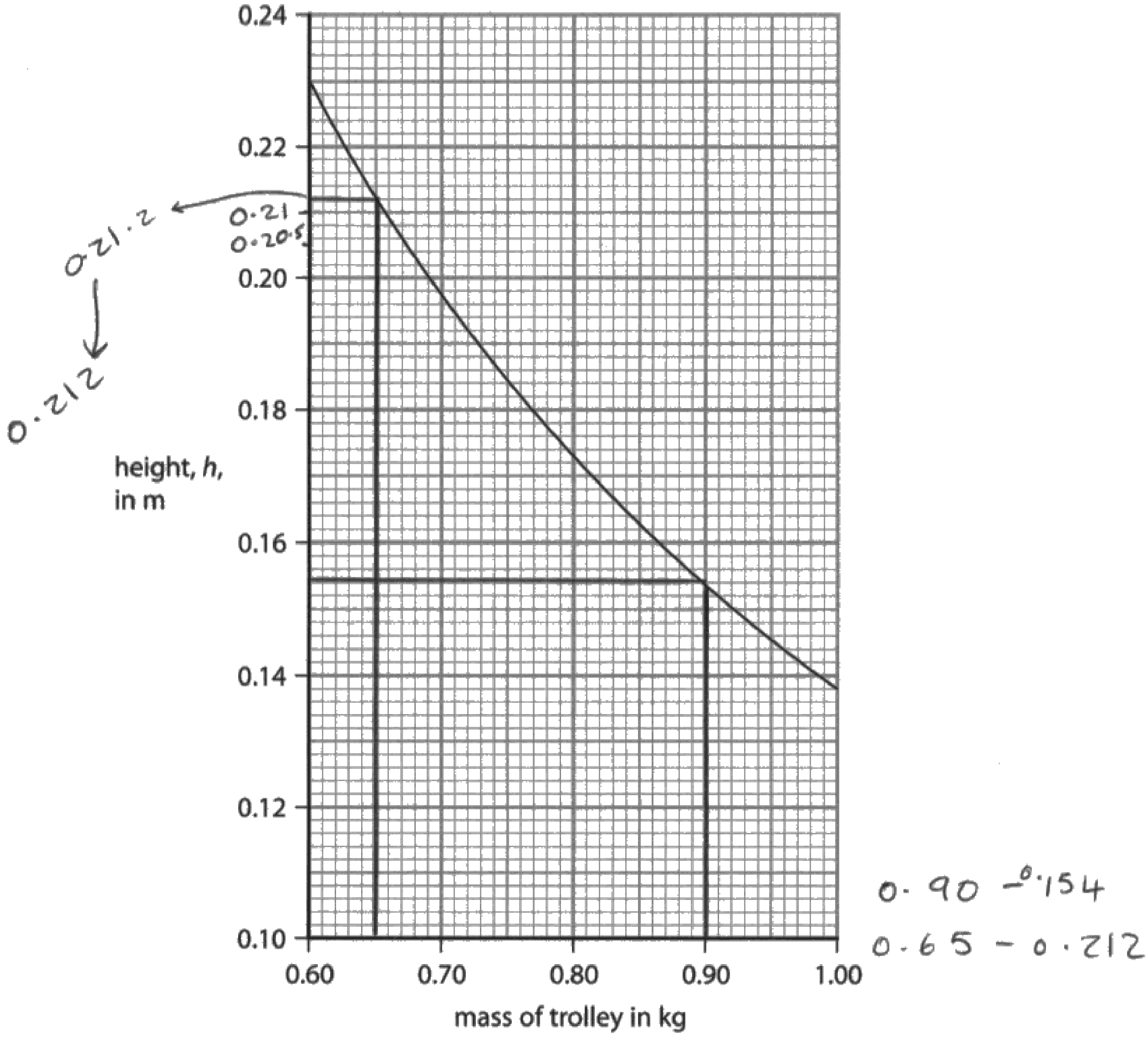


Figure 3

The student states that the energy transferred by the spring is the same each time it is used.

Use data from any two points on the graph in Figure 3 to support this statement.

(3)

At 0.65kg the height was 0.212m.
At 0.90kg the height was 0.154m.
This shows that the height is always relative to the mass.

ResultsPlus
Examiner Comments

This answer simply quotes values from the graph. It does not **use** those values.

No marks

ResultsPlus
Examiner Tip

If you are asked to use numbers or values then you are expected to process them in some way; in other words do a calculation using those numbers.

0.2 x 0.69 = 0.138
0.154 x 0.9 = 0.1386 } → the two are very similar / the same so the difference in
(of course also multiply by 10) 0.0006 is most likely due to human error
energy transferred = gravitational feild strength x mass x height

ResultsPlus
Examiner Comments

The candidate has given the equation for energy transferred for 1 mark.

Two points from the graph have been selected and a calculation carried out for both points. However, the calculations omitted to include the value for g.

Examiners allowed 1 mark only for those calculations.

2 marks out of 3

Question 4 (a)

Better candidates gave some excellent answers about how to improve this practical investigation. Most candidates recognised that the measurement of the short time interval was unreliable. Surprisingly few responses suggested increasing the distance in order to increase the time interval. Most responses focussed on more accurate technology such as using computers, microphones, recording (often with a mobile phone) or oscilloscopes. It was clear that they could recall such methods being used to but were much less clear about exactly how they could be employed in this situation. It was commonly appreciated that human reaction times were limiting the reliability of the results, but this was often only implied in vague references to “human error”. The proposed (incorrect) solution was often to have another person doing the timing or to repeat the experiment to take an average.

4 (a) The diagram in Figure 4 shows two students, P and Q, trying to measure the speed of sound in air.

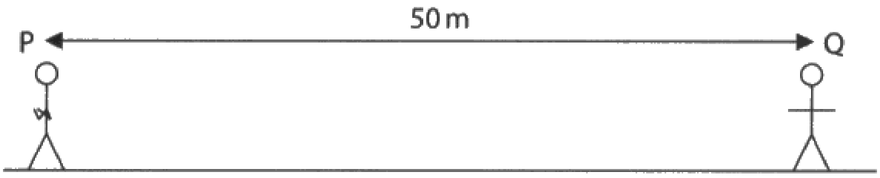


Figure 4

P will clap his hands together.

When Q sees P clap his hands, she will start a timer.

When Q hears the clap, she will stop the timer.

Explain **one** way the students could improve their method.

(2)

increase the distance between them to reduce the effect of human error on the stopwatch

ResultsPlus
Examiner Comments

There is a mark for stating that the distance should be increased.

However, the statement about human error is too vague to score a further mark.

Explain **one** way the students could improve their method.

(2)

The students could improve their method by increasing the distance each time and doing it multiple times. This will create a better average for the speed of sound.

ResultsPlus
Examiner Comments

There is a mark for increasing the distance.

However, simply repeating the measurements will not help to overcome the problem that the time interval is too short to measure reliably.

Question 4 (b)

Candidates had a good understanding that sound waves are caused by vibrations. However, they often did not specifically state that particles were vibrating but simply mentioned the metal rod. Candidates were less secure in describing how the vibrations were propagated with many candidates writing that the sound wave passed along the rod rather than the vibrations being passed on from one particle to the next. There was also occasional confusion between longitudinal and transverse waves.

(b) Figure 5 shows a long metal rod and a hammer.
The rod is hit at one end by the hammer.
This causes a sound wave to travel along the inside of the metal rod.

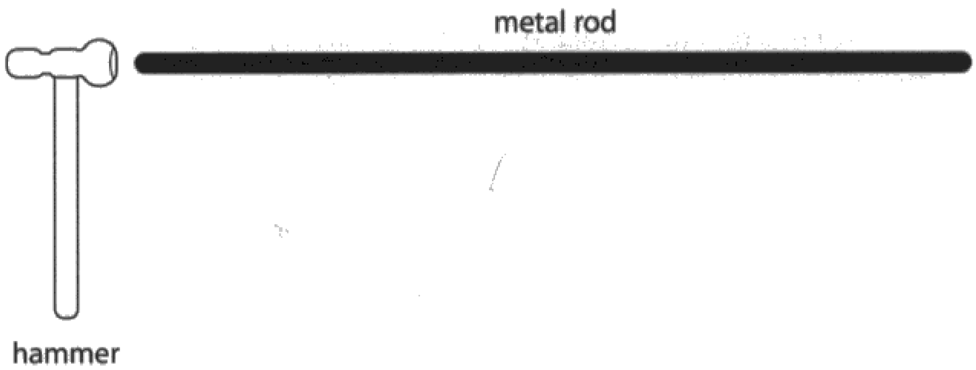


Figure 5

Describe how hitting the rod causes a sound wave to travel along the inside of the rod.

(2)

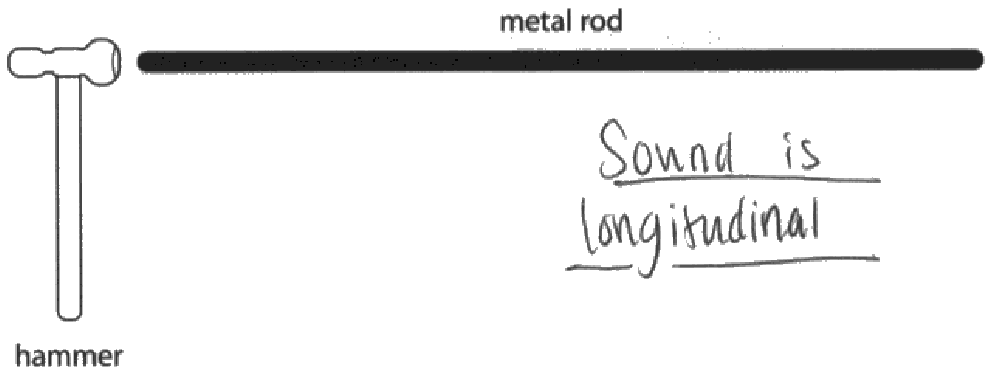
As all the particles in the rod vibrate when hit and passes it on down the rod until it gets to the end.

ResultsPlus
Examiner Comments

This answer describes the particles in the rod vibrating and has the idea that those vibrations are transmitted through the rod.

Full marks

(b) Figure 5 shows a long metal rod and a hammer.
The rod is hit at one end by the hammer.
This causes a sound wave to travel along the inside of the metal rod.



Sound is longitudinal

Figure 5

Describe how hitting the rod causes a sound wave to travel along the inside of the rod.

(2)

As the hammer hits the rod, it causes a vibrations to travel along the rod. As sound is a longitudinal wave, the vibrations from the hammer to the metal rod will cause sound.

ResultsPlus Examiner Comments

There is a mark for describing vibrations but it is not clear exactly what is vibrating.

1 mark out of 2.

Question 4 (d)

This was a challenging question and examiners were pleased to see many good responses or attempts. Candidates generally recognised that the first step was to calculate K but were often uncertain about which values to substitute in each step. Square roots were often forgotten. Weaker candidates divided 331 by 1.19 or 1.16 and struggled to rearrange the equation. Errors in the number of significant figures in the final answer were common. Candidates often confused this with the number of decimal places.

(d) Sound travels slower in cold air than it does in warm air.

The equation relating the speed of sound in air to the density of the air is

$$\text{speed of sound} = \frac{K}{\sqrt{(\text{density})}} \qquad \text{where K is a constant.}$$

The table in Figure 7 gives some data about the speed of sound in air and the density of air.

	speed of sound in m/s	density of air in kg / m^3
in cold air	331	1.29
in warm air		1.16

Figure 7

Use the equation and the data in the table in Figure 7 to calculate the speed of sound in warm air.

Give your answer to an appropriate number of significant figures.

(3)

warm

$\text{Speed} = \frac{k}{\sqrt{1.16}}$

cold

$331 = \frac{k}{\sqrt{1.29}}$

$\frac{375.94}{\sqrt{1.16}} = 349.05$

$k = 331 \times \sqrt{1.29} =$
375.9437325

349

speed of sound in warm air = 349. m/s

ResultsPlus
Examiner Comments

A nicely laid-out, fully correct answer.

(d) Sound travels slower in cold air than it does in warm air.

- density

The equation relating the speed of sound in air to the density of the air is

$$\text{speed of sound} = \frac{K}{\sqrt{(\text{density})}} \qquad \text{where K is a constant.}$$

The table in Figure 7 gives some data about the speed of sound in air and the density of air.

	speed of sound in m/s	density of air in kg / m³
in cold air	331	1.29
in warm air		1.16

Figure 7

Use the equation and the data in the table in Figure 7 to calculate the speed of sound in warm air.

Give your answer to an appropriate number of significant figures.

(3)

$\text{Speed} = \frac{K}{\sqrt{d}}$. cold air $331 = \frac{K}{\sqrt{1.29}}$

$331 \times \sqrt{1.29} = 375.9437325 = K$.

$375.9437325 \times \sqrt{1.16} = 404.90$.

speed of sound in warm air = 404.90 m/s

ResultsPlus
Examiner Comments

The candidate has found the value of K for 1 mark.

However, the next step is not correct.

The final value has been given to 5 significant figures. This is too many.

ResultsPlus
Examiner Tip

Make sure that you understand the difference between **significant figures** and **number of decimal places**.

Question 5 (b) (i)

Better candidates demonstrated clear understanding of centripetal force. Most incorrect answers had arrows showing tangential velocity.

Question 5 (b) (ii)

This was often answered well with many candidates knowing that velocity needed direction as well as magnitude or that velocity is a vector and that moving in a circle meant that the direction was always changing. Some confused responses described velocity as a scalar quantity

(ii) The object in Figure 8 is moving at constant speed.

Explain why it is not moving with constant velocity.

(2)

the object is moving at a constant speed but changing direction constantly which means that it is not moving with constant velocity.

ResultsPlus
Examiner Comments

This answer recognises that the direction is changing but does not fully explain why this means that the velocity is changing.

1 mark out of 2

(ii) The object in Figure 8 is moving at constant speed.

Explain why it is not moving with constant velocity.

(2)

Because velocity is a vector quantity, meaning it includes direction. The ~~direction~~ velocity is not constant because the object is constantly changing direction, so velocity is constantly changing.

ResultsPlus
Examiner Comments

A much better answer that explains why a change in direction means a change in velocity.

Full marks.

Question 5 (c) (i)

Candidates were generally able to substitute the values into the correctly selected equation but many made errors in the rearrangement. Some candidates attempted to rearrange before substituting. Although either approach is valid, it is much easier for an examiner to award the first mark if the response starts with a clear substitution. The most common error in evaluation was in handling the squared values.

(c) Figure 9 shows a skier on a slope.

The skier travels down the slope with a constant acceleration.

The speed of the skier is measured at points P and Q.

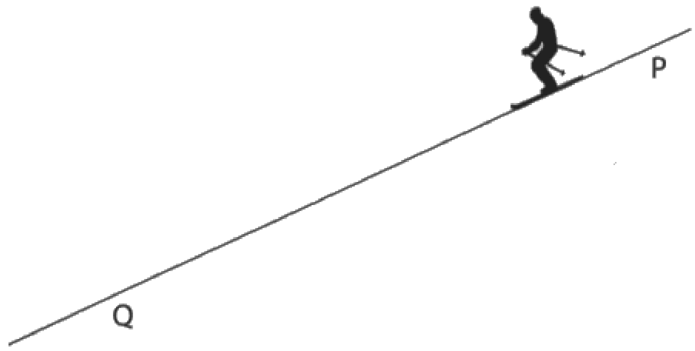


Figure 9

The table in Figure 10 gives some data about the skier making one downhill run.

acceleration	3.0 m/s²
speed at P	7.6 m/s
speed at Q	24 m/s

Figure 10

(i) Calculate the distance from P to Q.

Use an equation selected from the list of equations at the end of this paper.

(3)

$v^2 - u^2 = 2 \times a \times x$

$24^2 - 7.6^2 = 2 \times 3.0 \times x$

$518.24 = 2 \times 3.0 \times x$

$-6 \qquad -6$

$512.24 = x$

distance from P to Q = 512.24 m

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Examiner Comments

The candidate has shown the equation and then correctly substituted the values. Even though the rearrangement and evaluation is incorrect, the answer can score 1 mark out of a possible 2.

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Examiner Tip

Always start with the equation and then substitute in the values that you have been given.

Question 5 (c) (ii)

There were two possible approaches to answering this question. Many candidates recalled the equation for acceleration as change in velocity divided by time. They would then often go on to correctly substitute and rearrange to arrive at a correct evaluation. Other candidates attempted to calculate time from distance and speed without recognising that this required first determining the average speed. (15.8 m/s); instead they used the change in speed (16.4 m/s)

(ii) Calculate the time taken for the skier to travel from P to Q.

(3)

→ accelaration = $\frac{\text{change in velocity}}{\text{time}}$

→ time = $\frac{\text{change in velocity}}{\text{accelaration}}$

→ accelaration = 3.0 m/s

→ change in velocity = 24 − 7.6
= 16.4

→ time = $\frac{16.4}{3.0}$ = 5.46

time from P to Q = 5.46 s

ResultsPlus
Examiner Comments

A fully correct answer

(ii) Calculate the time taken for the skier to travel from P to Q.

(3)

speed = $\frac{\text{distance}}{\text{time}}$

24 − 7.6 =
16.4

time = $\frac{\text{distance}}{\text{speed}}$

time = $\frac{86.373}{16.4}$ = 5.26 s

time from P to Q = 5.26 s

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Examiner Comments

It is possible to use speed = distance divided by time provided that the speed used is the average speed and not the change in speed.

Here the candidate has used the change in speed and the answer scores no marks.

(ii) Calculate the time taken for the skier to travel from P to Q.

(3)

D
S T

$T = \frac{D}{S}$

$\frac{24 + 7.6}{2} = 15.8 \quad T = \frac{86.4}{15.8}$

time from P to Q = 5.5 s

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Examiner Comments

Here, the average speed has been calculated and then used to find the time.

Full marks

Question 6 (a)

Responses were divided between those that just commented on colour change, those that made reference to protecting the eyes but without any further detail and those that recognised how the sunglasses might mitigate the dangers of ultraviolet radiation. Examiners were looking for a statement that recognises the dangers of ultraviolet light.

6 (a) Some sunglasses have photochromic lenses.

Photochromic lenses are clear when the lenses are indoors but they darken in bright sunlight to reduce the effects of the sunlight.

Photochromic lenses react to ultraviolet light.

Suggest a benefit of making the lenses go dark with ultraviolet light.

(1)

It protects your eyes instantly as soon as the ~~s~~ bright Sunlight hits the glasses

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Examiner Comments

This answer mentions protection but does not state what the the sunglasses protect against.

0 marks

Question 6 (b)

A large proportion of responses correctly calculated that Jupiter was 5 times more distant than the Earth from the Sun. However, most candidates seemed to arrive at this value by simply dividing 40 by 8. Candidates generally seemed unaware that they had implicitly used the fact that, because radio and light waves travel at the same speed in space, the ratio of the times is also the same as the ratio of the distances. Where a property was stated, it was usually “wavelength”; but many candidates simply left this unanswered.

Question 6 (c)

Most candidates attempted this question that required extraction of information from both table and a diagram. The simplest correct responses drew contrast between the amount of UVA and UVC passing through the atmosphere and sometimes placed UVB “somewhere in the middle”. Fewer mentioned that **some** UVC was reflected and many stated that **all** UVA was transmitted. There was some confusion between the words ‘transmitted’ and ‘absorbed’ with candidates describing how waves were ‘absorbed through’. In spite of the fact that the question asked for how the effects change with wavelength, many wrote entirely about frequency or wrote that high frequency meant large wavelength. There was also a common misconception was that effects depended on “how powerful” the waves are.

(c) Ultraviolet waves cover a range of frequencies.

Scientists divide this range into three types, UVA, UVB and UVC.

The table in Figure 11 shows the frequency range for each type.

type	frequency range in Hz
UVA	7.5×10^{14} to 9.4×10^{14}
UVB	9.4×10^{14} to 10×10^{14}
UVC	10×10^{14} to 30×10^{14}

Figure 11

Figure 12 is a diagram about the effect that the Earth's atmosphere has on three types of ultraviolet radiation.

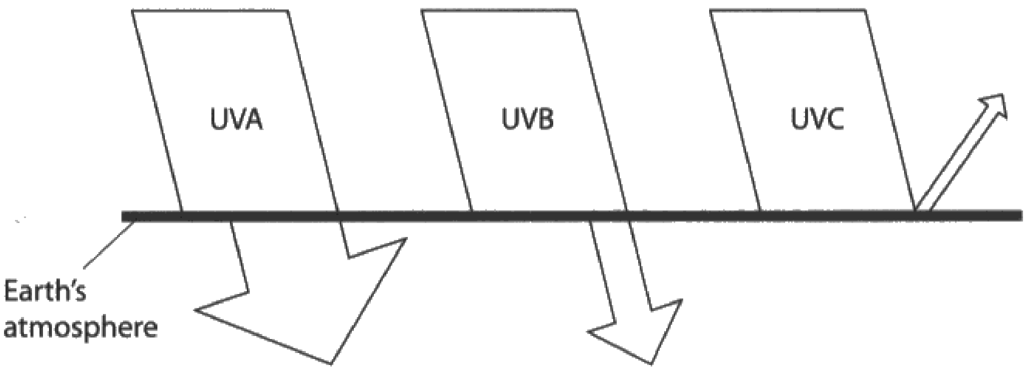

Figure 12

Describe how the effects change with **wavelength**, using information from Figure 11 and Figure 12.

The width of the arrows drawn indicates the amount of radiation that is involved.

Calculations are **not** required.

(4)

the wave length gradually is smaller, for example, no UVC is penetrating earths atmosphere, whereas the UVA is mostly penetrating the Earths atmosphere, the wave lengths get longer as they start to penetrate less

ResultsPlus
Examiner Comments

There is a mark for identifying that no UVC penetrates the atmosphere and a mark for "UVA is mostly penetrating the atmosphere".

There is no mention of UVB nor that some UVC is reflected.

The final statement implies that long wavelength ultraviolet penetrates less than shorter wavelengths; which is incorrect.

2 marks out of 4.

(c) Ultraviolet waves cover a range of frequencies.

Scientists divide this range into three types, UVA, UVB and UVC.

The table in Figure 11 shows the frequency range for each type.

type	frequency range in Hz
UVA	7.5×10^{14} to 9.4×10^{14}
UVB	9.4×10^{14} to 10×10^{14}
UVC	10×10^{14} to 30×10^{14}

Figure 11

Figure 12 is a diagram about the effect that the Earth's atmosphere has on three types of ultraviolet radiation.

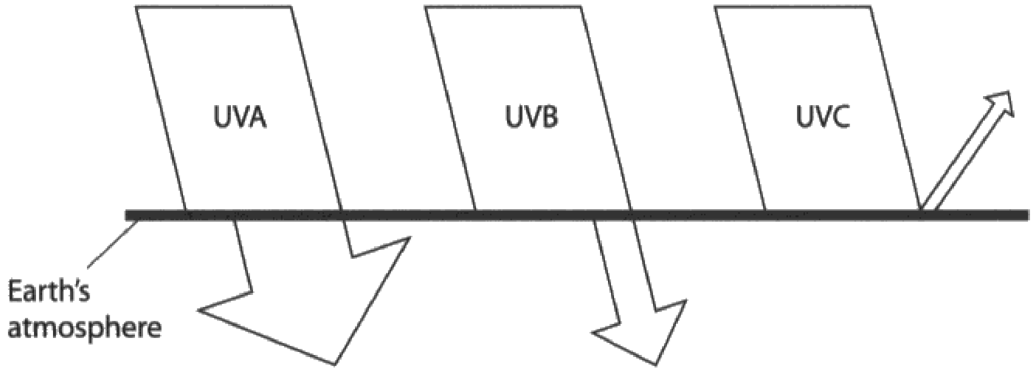

Figure 12

Describe how the effects change with **wavelength**, using information from Figure 11 and Figure 12.

The width of the arrows drawn indicates the amount of radiation that is involved.

Calculations are **not** required.

(4)

With UVA, the atmosphere absorbs some of the waves but lets most of them through. The atmosphere absorbs most of the UVB's waves, and only lets a little amount through, and with UVC the atmosphere absorbs almost all of the waves but bounces a few back away from it

ResultsPlus
Examiner Comments

This answer correctly describes the behaviour of UVA, UVB and UVC and scores 3 marks.

There is no mention of wavelength and so the 4th mark could not be awarded

ResultsPlus
Examiner Tip

It is a good idea to read the question again when you have finished your answer, just to make sure that you have included everything that was asked for.

(c) Ultraviolet waves cover a range of frequencies.

Scientists divide this range into three types, UVA, UVB and UVC.

The table in Figure 11 shows the frequency range for each type.

type	frequency range in Hz
UVA	7.5×10^{14} to 9.4×10^{14}
UVB	9.4×10^{14} to 10×10^{14}
UVC	10×10^{14} to 30×10^{14}

Figure 11

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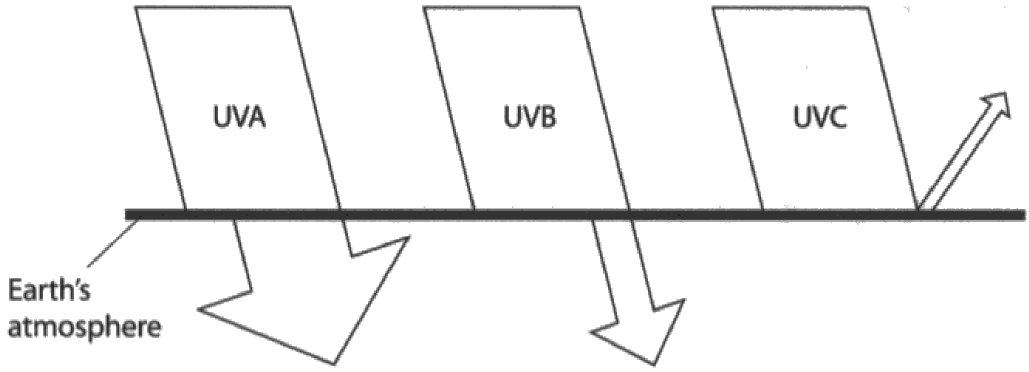

Figure 12

Describe how the effects change with **wavelength**, using information from Figure 11 and Figure 12.

The width of the arrows drawn indicates the amount of radiation that is involved.

Calculations are **not** required.

(4)

Wavelength = $\frac{\text{speed}}{\text{freq}}$ UVA has a wavelength of 4.4×10^{-13} to 3.5×10^{-13} and most of the radiation can pass through Earth's atmosphere. UVB has a wavelength of 3.5×10^{-13} to 3.3×10^{-3} and a lot less radiation passes through Earths atmosphere. UVC has a wavelength of $3 \cdot 3 \times 10^{13}$ to 1.1×10^{-13} and none of this radiation passes through the Earths atmosphere, but instead it reflects. This shows that higher wavelengths can pass more easily through Earth's atmosphere

ResultsPlus
Examiner Comments

This answer includes several calculations even though they were not required.

Nevertheless, the candidate has described how the effects change between UVA, UVB and UVC and goes on to state that "higher wavelengths can pass more easily..." It would have been better to refer "longer" rather than "higher" when describing wavelength, but the meaning was sufficiently clear for the examiner to award full marks.

Question 6 (d)

Candidates clearly had good knowledge of the properties of radio and gamma waves and very many spent most of the answer space expanding on comparisons between these properties rather than addressing the question about how they are produced.

There was general understanding that radio waves can be produced by electrical circuits and that gamma waves can originate from the atomic nucleus and this was usually sufficient for a level 2 answer. Examiners were looking for more detail for a level 3 answer. Where supplied, this was either about electrons in an alternating current in wires (for radio) or about energy changes and / or rearrangement of a nucleus (for gamma).

For many candidates, an understanding that radio waves may be produced by communication devices or satellites was just sufficient for level 1.

*(d) Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

Radio waves are produced by oscillations in electricity. Radiowaves have a longer wavelength as a result and are less harmful, than gamma rays.

Gamma Rays are produced by unstable radioactive nuclei, they have a shorter wavelength and are very dangerous.

Radio waves are created ~~pup~~ purposefully for different uses such as a radio station, whereas Gamma rays ~~can~~ be produced on purpose but also by accident taking a long time to decay as they are ~~very~~ ~~weak~~ not very ionising but highly radioactive.

Radio waves are produced for communication whereas Gamma rays are produced to kill cancer cells and sterilise medical equipment.

(Total for Question 6 = 13 marks)

ResultsPlus
Examiner Comments

This answer gives correct descriptions about how radio waves and gamma rays are produced. It is mostly correct and does show physics understanding, but the ideas are not fully developed. This is a level 2 response.

The candidate has also included information about the properties and uses of radio and gamma waves. This was not asked for and did not gain any credit.

*(d) Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

Radio waves and Gamma waves are at oppisite ends of the spectrum because Radio waves have a low frequency and long wavelength but Gamma waves are the oppisite. Gamma rays come from unstable nuclei and are highly ionising. They can go through pretty much anything and have no particles. Radio waves are created differently.

ResultsPlus
Examiner Comments

Much of this answer compares the properties and uses of radio and gamma waves. There is, however, a correct description of gamma waves coming from unstable nuclei which was just sufficient to bring the response to level 1 for 2 marks.

*(d) Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

Gamma radiation is produced during radioactive decay. When a radioactive isotope wan't's to re-arrange it's nucleus it emmits gamma radiation in order to become more Stable. Radiowaves are produced by oscillations in electrical circuits, The frequency and wavelegnth of the wave produced is ~~depenadant~~ dependant on the current of the circuit. The radio waves can ~~fecus~~ cause ~~ocilli~~ oscillations in large metal rods known as ariels which and absorbe and emit the radiowaves. ~~T~~ when they absorb them the ariel can also produce oscillations in a electrical circuit.

ResultsPlus
Examiner Comments

An excellent, well-structured answer that focuses on the production of the two types of electromagnetic radiation.

This is a level 3 response that scored the full 6 marks.

ResultsPlus
Examiner Tip

The candidate has underlined the key word "produced" in the question. This often helps to make sure that the response answers the question.

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 support materials or previous examination papers
- when describing a practical procedure, make sure they are clear about what is to be measured and how the measurements will be taken.
- when suggesting improvements or extensions to a practical procedure, make sure they are relevant to the context of the question and not just 'repeat readings'.

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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