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Examiners' Report
June 2024

GCSE Combined Science 1SC0 1PF

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Introduction

This was the seventh examination of paper 3 of combined science, at Foundation Level, for this 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 practical procedures specified in the specification, together with further application.

The 6-mark question tested candidates' ability to describe practical procedures in measuring speed. A pleasing improvement on previous years was noted.

Candidates coped well with most questions and did particularly well in the questions asking for calculations using equations. Rearranging equations is an improving skill.

Successful candidates:

- were well-acquainted with the content of the specification
- had been engaged with practical work at some stage 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

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)

This was a straightforward question about waves in the electromagnetic spectrum.

Candidates had to complete three sentences, selecting words from a given list.

The vast majority of candidates scored at least 1 mark with many going on to score 2 or 3.

Use words from the box to complete the sentences.

(3)

amplitude	**frequency**	**longitudinal**	**speed**	**transverse**	**wavelength**

X-rays and microwaves are both ....transverse.... waves.

In a vacuum, x-rays and microwaves always have the same ....Speed.....

X-rays always have a higher ....frequency.... than microwaves.

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Examiner Comments

This response scores all 3 marks.

Use words from the box to complete the sentences.

(3)

~~amplitude~~	~~frequency~~	longitudinal	speed	~~transverse~~	wavelength

X-rays and microwaves are both ....transverse.... waves.

In a vacuum, x-rays and microwaves always have the same ....amplitude.....

X-rays always have a higher ....frequency.... than microwaves.

ResultsPlus
Examiner Comments

This response includes a common error, not realising that all em waves have the same speed in a vacuum.

2 marks scored.

Question 1 (b)

Here candidates had to link different types of em radiation with information about the waves. The names of the different types of em radiation were given in the question.

Most candidates scored at least 3 of the 4 marks available with many going on to score all 4 marks,

State the name of each type of radiation next to its information.

(4)

Information	Type of electromagnetic radiation
emitted by bright objects **and** can be detected by the human eye	visible light
emitted by radioactive nuclei **and** can be used to treat cancer	gamma rays
produced in an aerial **and** can be used for communication	Radio waves
can cause skin cancer in humans **and** can be used to detect forged banknotes	ultra violet

Figure 2

ResultsPlus
Examiner Comments

4 marks scored.

State the name of each type of radiation next to its information.

(4)

Information	Type of electromagnetic radiation
emitted by bright objects **and** can be detected by the human eye	visible light
emitted by radioactive nuclei **and** can be used to treat cancer	radio waves.
produced in an aerial **and** can be used for communication	infrared
can cause skin cancer in humans **and** can be used to detect forged banknotes	ultraviolet

Figure 2

ResultsPlus
Examiner Comments

2 marks scored here. The second wave type should be gamma rays and the third should be radio waves or microwaves.

Question 2 (a)(ii)

Candidates were asked to state one factor that might increase a driver's reaction time.

Although many candidates scored the mark, the majority of candidates did not.

(ii) State **one** factor that might increase a driver's reaction time.

Drugs or Medication

ResultsPlus
Examiner Comments

An acceptable answer.

1 mark scored.

(ii) State **one** factor that might increase a driver's reaction time.

appling brakes faster.

ResultsPlus
Examiner Comments

This response misses the point of the question, a common error.

0 marks scored.

Question 2 (a)(iii)

This was a difficult calculation, involving finding the distance travelled from a velocity/time graph.

The equation ''distance travelled = area under the sloping line of the graph'' was given in the question.

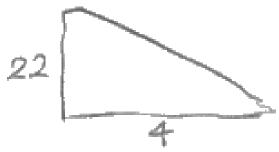
Many candidates were able to score at least 1 of the 3 marks available but few went on to score all 3 marks.

(iii) Calculate the distance travelled between when the driver applies the brakes and when the car comes to rest in Figure 3.

Use the equation

distance = area under the sloping line of the graph in Figure 3

(3)



22×4

$22 \times 4 = 88 \times \frac{1}{2} = 44$

distance = ...44........ m

ResultsPlus
Examiner Comments

This response calculates the area under a sloping part of the graph, using the correct formula for the area of a triangle.

Unfortunately, the time value used was incorrect. It should be 3s, not 4s.

2 marks scored.

(iii) Calculate the distance travelled between when the driver applies the brakes and when the car comes to rest in Figure 3.

Use the equation

distance = area under the sloping line of the graph in Figure 3

(3)

22

3

$$\frac{22 \times 3}{2} = 33$$

distance = 33 m

ResultsPlus
Examiner Comments

In this response, it is clear that the correct data points have been used and the correct distance calculated.

3 marks scored.

Question 2 (b)

Here, examiners were looking for an explanation linking reaction time (comparing the human to the computer) with 'thinking' distance (comparing the human to the computer).

Most candidates scored 1 mark. Only a few went on to score both marks.

(b) The stopping distance of a car is the thinking distance plus the braking distance.

A car has a device that can detect an obstacle in the road ahead.

The device is linked to a computer that can apply the brakes.

It is claimed that, in an emergency, the computer-controlled car will have a shorter stopping distance than if the car is controlled by a human driver.

Explain why this claim could be true.

(2)

Because a human has a longer thinking distance, and reaction time making them brake slower than the computer-controlled car.

ResultsPlus
Examiner Comments

This response makes the link successfully.

2 marks scored.

(b) The stopping distance of a car is the thinking distance plus the braking distance.

A car has a device that can detect an obstacle in the road ahead.

The device is linked to a computer that can apply the brakes.

It is claimed that, in an emergency, the computer-controlled car will have a shorter stopping distance than if the car is controlled by a human driver.

Explain why this claim could be true.

(2)

Humans have a reaction time and Coputer - Controlled Car is automatic not having a reaction time. It takes time to signal the brain ~~tha~~ when in an emergency.

ResultsPlus
Examiner Comments

This compares 'reaction' times successfully but does not make the link with thinking distance.

1 mark scored.

Question 2 (c)(i-ii)

This question is about a computer being able to change the speed of a car in wet weather.

Candidates were asked to state the change of speed required and give a reason.

Most candidates scored both marks here.

(c) A different car has a device that can detect rain.

This device is linked to a computer that can change the speed of the car.

In wet weather, the computer changes the speed of the car.

(i) State the change in speed that the computer should make when the road is wet.

(1)

decrease the speed to slow.

(ii) Give a reason why this change in speed is necessary when the road is wet.

(1)

To avoid road accidents from slippery surfaces on the road.

ResultsPlus
Examiner Comments

A decrease in speed because of slippery surface.

2 marks scored

(c) A different car has a device that can detect rain.

This device is linked to a computer that can change the speed of the car.

In wet weather, the computer changes the speed of the car.

(i) State the change in speed that the computer should make when the road is wet.

(1)

the computer should slow the speed down

(ii) Give a reason why this change in speed is necessary when the road is wet.

(1)

there is less traction in the rain so breaks wont be as effective

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

A more detailed reason than the previous response.

2 marks scored.

Question 3 (c)

This was a calculation of the frequency of a sound wave from a given equation.

The calculation involved a rearrangement of the equation.

The majority of candidates scored at least 1 mark for this question.

(c) The speed of a sound wave in air is 330 m/s.

The wavelength of this wave is 0.75 m.

Calculate the frequency of this wave.

Use the equation

$$v = f \times \lambda$$

S = 330

Wl = 0.75

(3)

wavespeed = frequency X wavelength

330m/s = ? x 0.75

330 ÷ 0.75 = 440

frequency = 440 Hz

ResultsPlus
Examiner Comments

This shows a good way of working through a question such as this.

First the equation in words followed by the substitution, the rearrangement and the final answer.

3 marks scored

Question 3 (e)(i)

Here candidates had to describe a method to determine the wave speed of ripples on a pond, a slightly unusual situation.

Examiners were looking for:

use of the equation speed = distance/time

measurement of a relevant time

measurement of a specified distance.

Most scored at least 1 of the 3 marks available but the 'distance' mark was scored by only a few.

(e) Ripples travel out from the centre of a small circular pond to its edge.

(i) Describe how a student could determine the wave speed of the ripples.

(3)

A student could determine the wave speed by measuring the distance from t edge of the pond to the centre and time with a stopwatch how fast it takes the ripples to reach the edge finaly divide the distance by the time to get the wave speed

ResultsPlus Examiner Comments

This is a clear, well-structured description that scores all 3 marks.

(e) Ripples travel out from the centre of a small circular pond to its edge.

(i) Describe how a student could determine the wave speed of the ripples.

(3)

the Student Could use a Stop watch to measure the amount of time it take one ripple to go from the centre to the edge of the pond.

ResultsPlus
Examiner Comments

This scores 1 mark for measuring a relevant time but then goes no further.

Question 3 (e)(ii)

Candidates were asked to draw arrows on the diagram to show how the duck moves due to the ripples.

Arrows indicating an up and down movement **only** were required.

Only a minority of candidates scored this mark.

(ii) Figure 5 shows a duck floating on the pond.

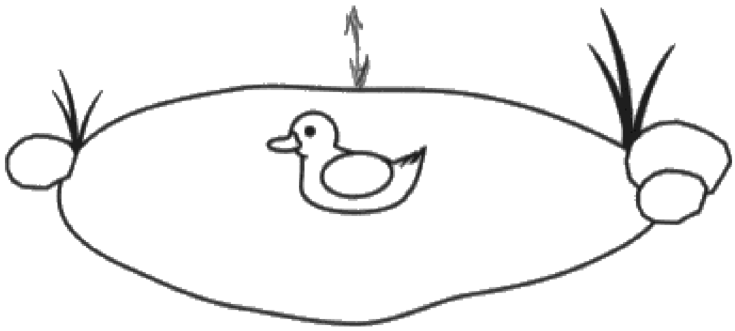


Figure 5

The ripples cause the duck to move.

Draw arrows on Figure 5 to show how the duck moves due to the ripples.

ResultsPlus
Examiner Comments

These arrows are clear enough to show the correct movement.

1 mark scored.

(ii) Figure 5 shows a duck floating on the pond.

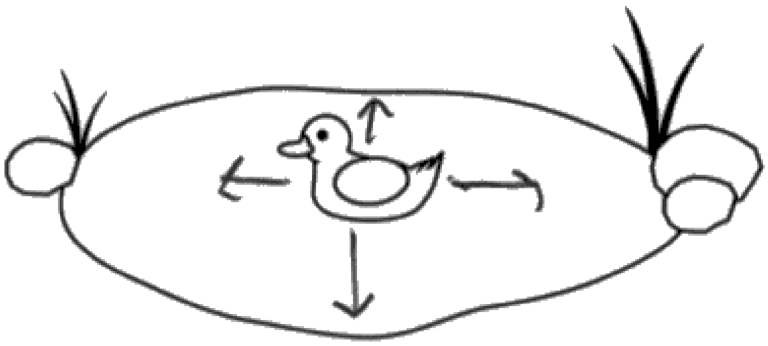


Figure 5

The ripples cause the duck to move.

Draw arrows on Figure 5 to show how the duck moves due to the ripples.

ResultsPlus
Examiner Comments

This response shows side to side as well as up and down movements so does not score the mark.

0 marks scored.

Question 4 (a)

This involved labelling the particles in a diagram representing an atom.

The vast majority of candidates scored all 3 marks here.

Question 4 (c)(i)

Here candidates were asked to state one safety precaution a teacher should take when demonstrating a radioactivity experiment for students.

Examiners would accept a range of statements covering safe distances, exposure time and protective clothing.

Most candidates were able to suggest one suitable precaution.

Question 4 (c)(ii)

Here candidates had to state how the data in a table of results supports the fact that radioactive decay is random.

An encouraging number of candidates were able to score the mark here.

(ii) The teacher uses the detector to measure the activity of the source several times.

Figure 7 shows the results.

	1st measurement	2nd measurement	3rd measurement	4th measurement
activity in Bq	21	23	19	22

Figure 7

The teacher tells the class that radioactive decay is random.

State how the data in Figure 7 supports this statement.

(1)

all the measurements are completely different numbers.

ResultsPlus
Examiner Comments

This is a reasonable and acceptable statement.

1 mark scored.

(ii) The teacher uses the detector to measure the activity of the source several times.

Figure 7 shows the results.

	1st measurement	2nd measurement	3rd measurement	4th measurement
activity in Bq	21	23	19	22

Figure 7

The teacher tells the class that radioactive decay is random.

State how the data in Figure 7 supports this statement.

(1)

theres no pattern ~~in~~ between the 1st, 2nd, 3rd and 4th measurement

ResultsPlus
Examiner Comments

The idea that there is no pattern to the numbers supports the random idea.

1 mark scored.

Question 4 (c)(iii)

Candidates were asked to calculate the mean of the four measurements in the table.

The vast majority were able to do this successfully.

Question 4 (d)(i)

Here was a graph of mean detector reading against distance from the source.

Candidates were asked to explain how the graph shows that the source only emits alpha radiation.

Examiners were looking for an explanation linking the decrease in readings to almost zero within a small increase in distance from the source.

The majority of responses scored zero, but an encouraging number were able to score at least 1 mark.

Explain how the graph in Figure 8 shows that the source only emits alpha radiation.

(2)

It shows that it only emits alpha radiation as it when it gets further away the reading becomes close to zero as Alpha radiation doesn't travel as far as Beta or gamma radiation

ResultsPlus
Examiner Comments

This was a sufficiently good explanation from 2 marks.

Question 4 (d)(ii)

Here candidates were asked to give a reason why the detector reading does not fall to zero.

Examiners were looking for a reference to background radiation.

Question 5 (a)

Here candidates had to calculate the height of a skateboard ramp by rearranging the equation for change in gravitational potential energy.

An encouraging number scored both marks here, but many lost at least 1 mark by trying to rearrange and substitute in one step.

Use the equation

change in gravitational potential energy = $m \times g \times h$

(2)

$980 = 35 \times 10 \times h$

$980 = 350 \times h$

$980 \div 350 = h$

$h = 2.8$

h = 2.8 m

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Examiner Comments

This response shows the correct substitution first then rearranges the equation correctly and finishes with the correct answer.

2 marks scored.

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Examiner Tip

If you are uncertain about rearranging equations, show the substitution first to make sure of at least 1 mark.

Question 5 (b)

Another challenging calculation involving taking square roots.

This time many candidates scored 2 marks for producing a value for v^2.

A minority went on to gain the third mark.

Use the equation

$$v^2 = \frac{2 \times KE}{m}$$

(3)

velocity = 54,29 m/s

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Examiner Comments

This response scores the first 2 marks for calculating v^2.

Use the equation

$$v^2 = \frac{2 \times KE}{m}$$

(3)

$$\frac{2 \times 950}{35} \rightarrow 54.29$$

$$v^2 = 54.29$$

$$\sqrt{54.29} \rightarrow 7.4 \text{ m/s}$$

velocity = 7.4 m/s

ResultsPlus
Examiner Comments

Showing very clear working, this response scores all 3 marks.

Question 5 (c)(i)

Here candidates had to identify part of an energy diagram.

Examiners were looking for the idea that this was energy dissipated.

Many candidates were able to score this mark.

(i) State what is represented by **X**.

(1)

wasted energy for example could be heat.

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Examiner Comments

An acceptable response in this context.

Figure 10

(i) State what is represented by **X**.

Energy not used / ~~[illegible]~~ wasted

ResultsPlus
Examiner Comments

An acceptable response in this context.

Question 5 (c)(iii)

In this efficiency calculation, examiners accepted answers that rounded to 0.97 or to 97%.

Answers that rounded to 97 (without the % sign) scored only 1 mark.

The majority of candidates scored zero for this calculation. Of those who scored, the majority scored both marks.

(iii) Calculate the efficiency of the system represented in Figure 10.

(2)

Essiciency = $\frac{\text{usesul}}{\text{total}}$

$\frac{950}{980} = 0.9\dot{6}9$

efficiency = $0.9\dot{6}9$

ResultsPlus
Examiner Comments

An answer that rounds to 0.97 so scores 2 marks.

(iii) Calculate the efficiency of the system represented in Figure 10.

(2)

$\frac{959}{980}$

$\frac{95}{98}$

efficiency = ...

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Examiner Comments

This response gets the substitution mark only.

1 mark scored.

Question 5 (d)

This item proved to be more challenging than expected.

Examiners were looking for responses that referred to reducing air resistance or lubricating the wheels of the skateboard or the skateboard rider pushing off to give a greater initial velocity.

The majority of responses scored zero.

A small number scored 1 mark and even fewer scored 2 marks.

(d) The person would like to start from P again but have a greater velocity at Q.

Suggest **two** ways that this can be achieved.

1 push to accelerate.

2 Squat down to reduce drag

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This was one of the few that scored both marks.

Question 6 (a)(i)

In part (a) of this question, candidates had to interpret a distance time graph showing two runners, L and M.

In (a)(i) candidates had to state the distance L had run when M overtakes.

A majority of candidates scored this mark.

Examiners allowed values between 64 and 68 m so this response was right in the middle.

Figure 11

(i) State the **distance** that L has run when M overtakes.

(1)

distance = 66 m

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Examiner Comments

1 mark scored.

Question 6 (a)(ii)

In part (a)(ii), candidates had to use the graph to calculate the velocity of L.

This involved them in finding the gradient of the appropriate line.

Candidates found this more challenging, with most scoring zero. Of those who did score, most scored both marks.

(ii) Calculate the velocity of L when running the 100 m race.

(2)

100m ÷ 15s =

= 6.6 m/s

velocity = 6.6 m/s

ResultsPlus
Examiner Comments

This response selects the correct data from the graph and gets the correct answer.

2 marks scored.

Question 6 (b)(i)

Here candidates had to find the time taken for an acceleration.

The equation was given but the correct change in velocity had to be obtained to gain any marks for the final calculation.

Most of the candidates who scored, scored 2 marks.

Use the equation

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

(2)

$10 - 6.2 = 3.8$ $\frac{3.8}{2.5} = 1.52\,s$

time taken = 1.52 s

ResultsPlus
Examiner Comments

This shows the calculation of the change in velocity, the substitution and the correct final answer.

2 marks scored.

Use the equation

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

(2)

$$time = \frac{3.8}{2.5} = 1.28$$

time taken = 1.28 s

ResultsPlus
Examiner Comments

This response shows the correct change in velocity and the correct substitution into the equation but the evaluation is not correct.

1 mark scored.

Question 6 (b)(ii)

This was a very challenging calculation, involving rearranging an equation containing squared terms.

Very few candidates scored any marks in this question.

Use the equation

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

(2)

~~10 / 4.4~~

$0 - 100 = 2 \times -4.4$

$\frac{-100}{-8.8} = 11.36$

distance = ~~8~~ 11.4 m

ResultsPlus
Examiner Comments

This was one of the few that scored full marks.

2 marks scored.

Use the equation

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

(2)

$0^2 - 10^2 = 2 \times 4.4 \times x$

distance = ... m

ResultsPlus

Examiner Comments

This response scored 1 mark for the substitution but did not take it further.

1 mark scored.

Question 6 (c)

In this 6 mark question candidates were asked to describe the equipment needed and how it was used in taking measurements in an investigation involving the average speed of a trolley on an inclined runway.

To achieve level 3, 6 marks, they had to give detailed descriptions of the measurements of distance and time, including the equipment used, and how the average speed is calculated.

Although a significant number of candidates scored zero, a majority of candidates achieved level 2.

First, the student will need a ruler and a Stopwatch. The student needs to measure the distance between point 'X' and point 'Y'. This will not be changed throughout the experiment. The student needs to measure the height at the end of the ramp and record it in a table. This variable will be changed throughout the experiment. At one height, the student needs to ~~measure~~ record the time taken for the trolley to reach 'Y' from 'X', then record this in a table, including the height of the ramp. The student then needs to change the height of the ramp and record the time the trolley takes to reach 'Y' from 'X'. The student can repeat this at different ramp heights and record the results. To investigate the average speed of the trolley, the student needs to

~~divide do distance between 'x' and 'y' =~~

~~dis~~ do:

distance between 'x' and 'y' ÷ time taken to reach y from x.

using the results the student records, they will be able to find out the average speed of the trolley at different heights.

e.g x and y distance = 5. time taken = 2.

Average speed = 5 ÷ 2 = 2.5.

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Examiner Comments

This response specifies the distance to be considered (from X to Y) and gives good detail of the measurement of the distance between X and Y and the time to travel this distance.

It carries on to say how the average speed is calculated from the measurements.

Level 3, 6 marks.

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

Where a question involves a calculation, make sure they write down the equation they are using 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.

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