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Examiners' Report
June 2025

GCSE Physics 1PH0 1F

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June 2025

Publications Code 1PH0_1F_2506_ER

Introduction

This examination of single science Physics paper 1, at foundation level, is one of a continuing sequence since 2018. Questions were set to test candidates' knowledge, application and understanding from the 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.
- Topic 7 – Astronomy.

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. Candidates' knowledge and understanding of practical work also featured. This included assessing their fundamental knowledge of practicals specified in the specification, together with further application, especially where they were asked to reflect upon procedures. One assessment of this skill featured in the six-mark question Q09(c), concerning a radioactivity practical. The two six-mark questions were used additionally to test candidates' quality of using evidence in their written communication skills. The novel question Q07(c), about habitable planets, including exo-planets, featured an up-to-date diagram contrasting the Solar system planets with distant exo-planets. Candidates were required to interpret and extract evidence from a simplified diagram, taken from research.

Candidates coped well with most questions and often did particularly well in the questions asking for calculations using equations. Candidates' knowledge of practical work, in contrast, continues to be not so secure.

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)

A majority of candidates could draw a reasonable reflected ray, with clear symmetry about the vertical.

Fewer candidates could label angles of incidence and reflection correctly.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in one of the four boxes ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Figure 1 shows a ray of light incident on a mirror.

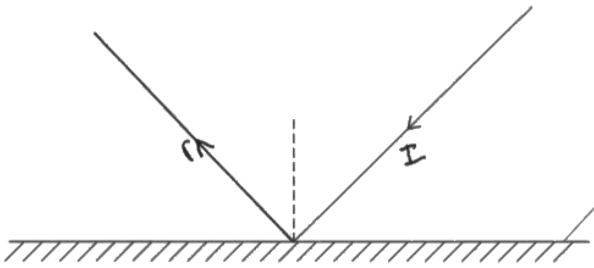

Figure 1

(i) Draw the reflected ray on Figure 1.

(1)

(ii) On Figure 1, label the angle of incidence with the letter **i** and the angle of reflection with the letter **r**.

(2)

ResultsPlus
Examiner Comments

The candidate gains a mark for drawing a good symmetrical ray. They fail to label correct angles of incidence and reflection.

ResultsPlus
Examiner Tip

Recognising that the angles are between the normal and the rays is the key thing.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in one of the four boxes ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

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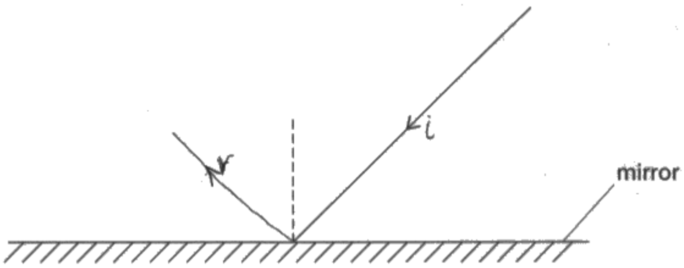

Figure 1

(i) Draw the reflected ray on Figure 1.

(1)

(ii) On Figure 1, label the angle of incidence with the letter **i** and the angle of reflection with the letter **r**.

(2)

2

P 7 8 7 2 7 R A 0 2 3 6

ResultsPlus
Examiner Comments

This candidate gains a mark for (i). 'r' is between the reflected ray and the normal, so gets a mark. 'i' does not comply in that way.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in one of the four boxes ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

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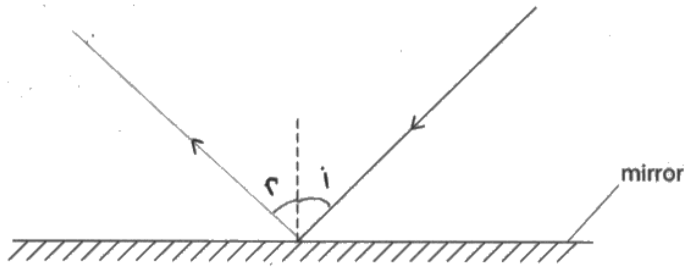

Figure 1

(i) Draw the reflected ray on Figure 1.

(1)

(ii) On Figure 1, label the angle of incidence with the letter **i** and the angle of reflection with the letter **r**.

(2)

2

P 7 8 7 2 7 R A 0 2 3 6

ResultsPlus
Examiner Comments

This candidate achieves all the marks available for (i) and (ii). The labelling is now exactly what is expected.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in one of the four boxes ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

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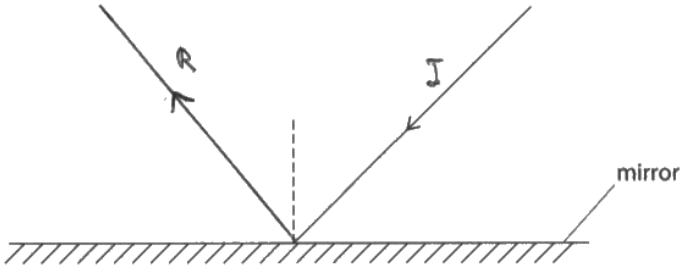


Figure 1

(i) Draw the reflected ray on Figure 1.

(1)

(ii) On Figure 1, label the angle of incidence with the letter **i** and the angle of reflection with the letter **r**.

(2)

P 7 8 7 2 7 R A 0 2 3 6

ResultsPlus
Examiner Comments

This candidate does not score the mark for (i). 'i' is not equal to 'r'; this is judged by eye and is clear in this case. They do get two marks for (ii); the labels are drawn between the rays and the normal.

ResultsPlus
Examiner Tip

Look for symmetry when drawing reflected rays, (this will then be pleasing to the eye).

Question 1(b)

This was successfully done by most candidates who attained all 3 marks. En route they had to convert 17cm to 0.17 m for use in the given equation. Some candidates fell down with this but still manged to get compensatory marks for handling substitution into the given equation.

(b) A lens has a focal length of 17 cm.

Calculate the power of the lens in dioptres.

Use the equation

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

(3)

17cm = 0.17m

$$\frac{1}{0.17} = 5.88$$

power = 5.88 dioptres

ResultsPlus
Examiner Comments

This shows an admirably well communicated answer achieving full marks. The conversion from cm to m is very clear.

ResultsPlus
Examiner Tip

Units matter a lot in physics and candidates need to be prepared to convert those involving milli- centi- kilo- and mega- etc. A full list is given on page 11 of the specification.

(b) A lens has a focal length of 17 cm.

Calculate the power of the lens in dioptres.

Use the equation

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

(3)

$P = \frac{1}{17} = 0.1$

power = 0.1 dioptres

ResultsPlus
Examiner Comments

This candidate does not convert cm to m. They gain one mark (mark point 1) for the direct substitution element of their response.

ResultsPlus
Examiner Tip

Look keenly for opportunities to convert units, where needed.

(b) A lens has a focal length of 17 cm.

Calculate the power of the lens in dioptres.

Use the equation

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

(3)

$17 \div 100 = 0.17\,m$

$d = \frac{1}{0.17}$

5.98

$5.98 \times 0.17 = 1$

power = 5.98 dioptres

ResultsPlus
Examiner Comments

This candidate substitutes and converts units. Unfortunately, there is then a calculation error in their final answer, meaning they score 2 out of 3 marks.

ResultsPlus
Examiner Tip

Be careful with calculator work, transcribing accurately between the question, calculator and your answer.

(b) A lens has a focal length of 17 cm.

Calculate the power of the lens in dioptres.

Use the equation

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

(3)

$$\frac{1}{17}$$

power = 0.0588235 dioptres

ResultsPlus

Examiner Comments

A bare bones answer given the substitution mark. They fail to convert from the question's focal length of 17 cm to the equation's focal length (in metres). This means they only get 1 mark out of 3.

Question 2(a)

This question required candidates to link the type of radiation to a description about that radiation.

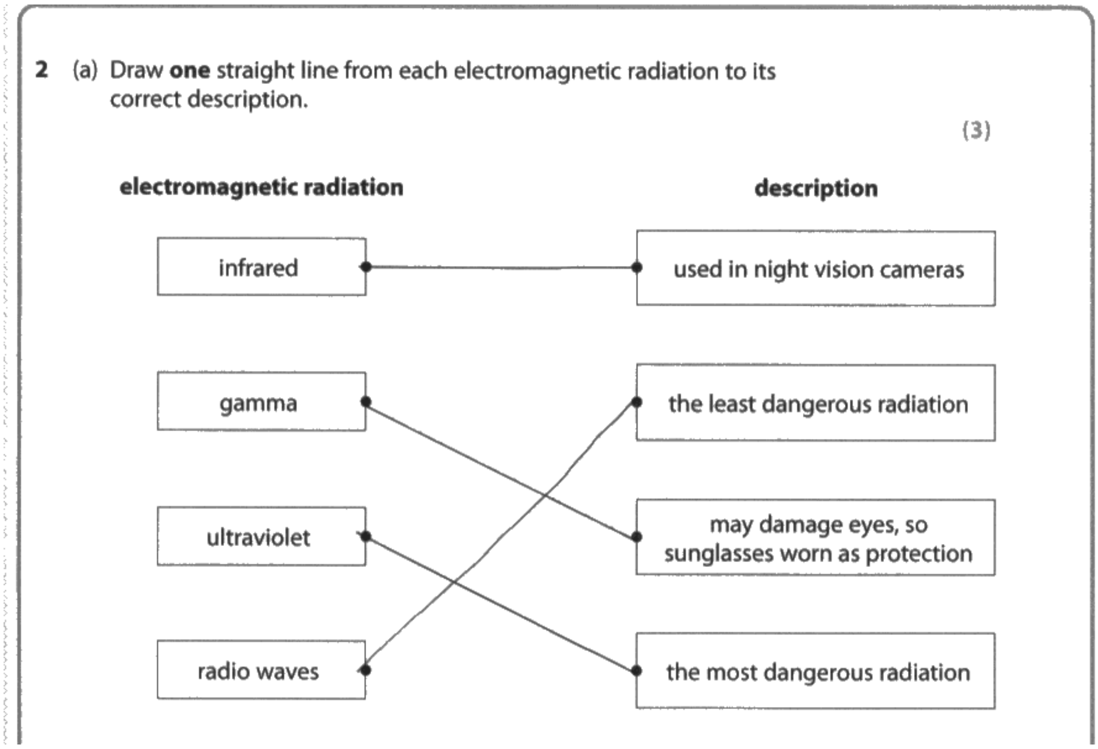
There were 3 marks available, awarded with the following strictures in place:

1 mark for one line correct.

2 marks for two or three lines correct.

3 marks for four lines correct.

'If more than one line is drawn from or to a box, do not credit any of those lines'.



2 (a) Draw **one** straight line from each electromagnetic radiation to its correct description.

(3)

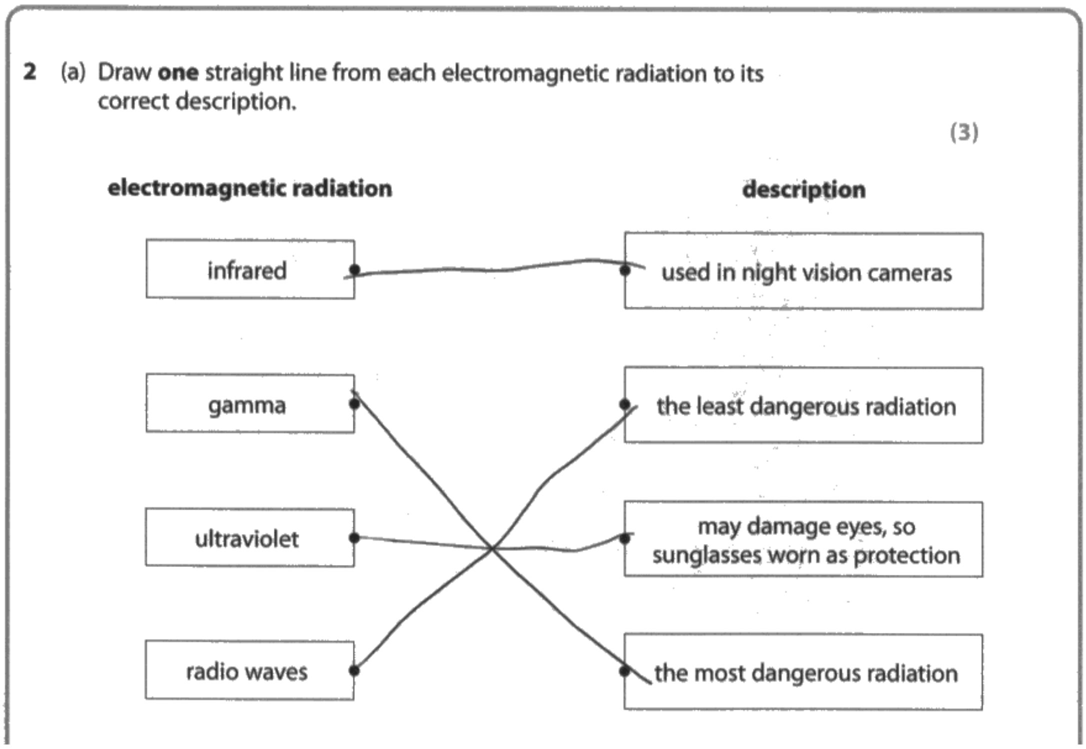
electromagnetic radiation	description
infrared	used in night vision cameras
gamma	the least dangerous radiation
ultraviolet	may damage eyes, so sunglasses worn as protection
radio waves	the most dangerous radiation

ResultsPlus Examiner Comments

Correct links for infrared and radio waves gave 2 marks.

ResultsPlus Examiner Tip

Electromagnetic spectrum questions often feature in paper 1. You should know each of the types from radio to gamma, with their associated behaviours and uses.


2 (a) Draw **one** straight line from each electromagnetic radiation to its correct description.

(3)

electromagnetic radiation	**description**
infrared	used in night vision cameras
gamma	the least dangerous radiation
ultraviolet	may damage eyes, so sunglasses worn as protection
radio waves	the most dangerous radiation

ResultsPlus
Examiner Comments

Correct associations seen, so full marks given.

ResultsPlus
Examiner Tip

Please do not think the lines have to perform any particular pattern. Just study and interpret the content.

Question 2(c)i-ii

Graph plotting, together with drawing best fit curves, are well honed skills demonstrated by the vast majority of candidates.

Figure 4 shows a graph of these results.

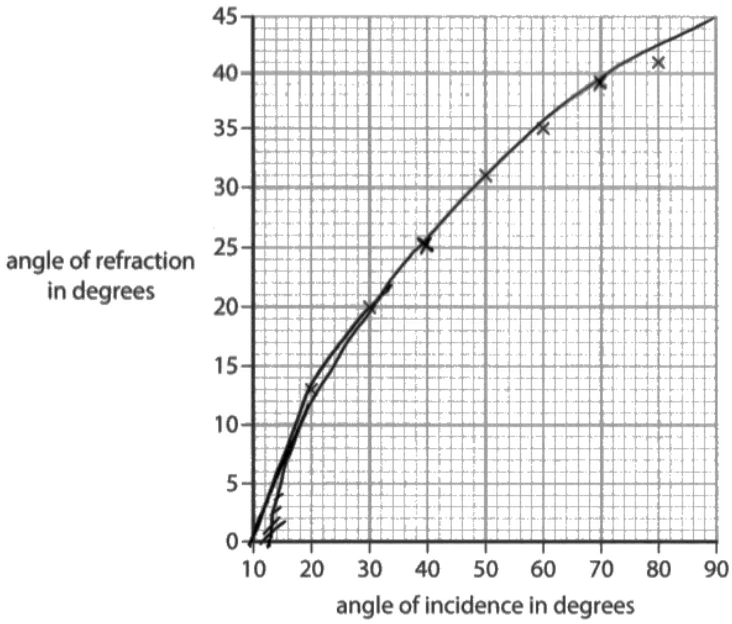


Figure 4

(i) The two shaded rows in Figure 3 are not plotted on the graph in Figure 4.

Plot these missing results on the graph in Figure 4.

(2)

(ii) Draw a curve of best fit through the points on the graph in Figure 4.

(1)

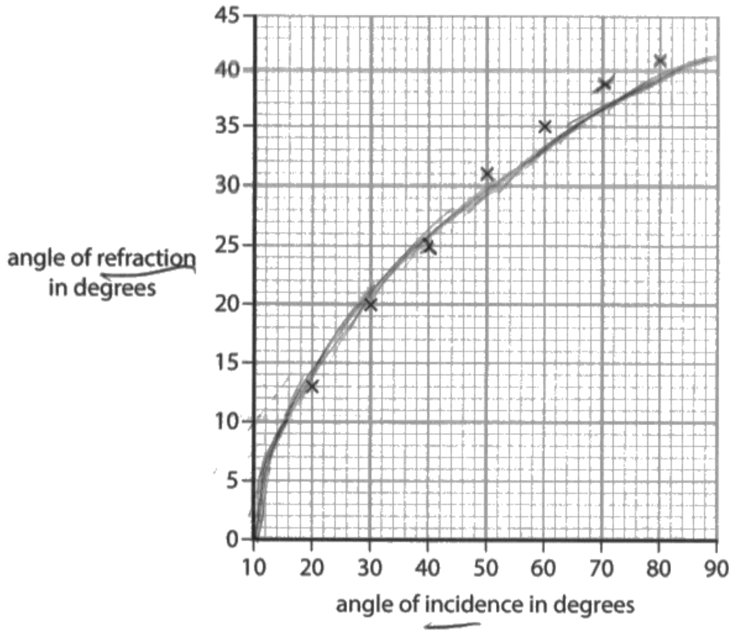
ResultsPlus
Examiner Comments

This gained full marks. 2 marks for plotting the two points, and 1 mark for curve drawing. The mark scheme says 'do not accept tramlining (multiple curves)'. In this case the lower part of the graph, where there are multiple lines drawn, was not considered bad enough to prohibit that mark.

ResultsPlus
Examiner Tip

Plot points carefully, paying attention to what each small square on the graph represents. With your pencil try to draw best fit curves with one sweep of your pencil, sweeping away from your body. Please avoid multiple lines. A rubber eraser may be useful.

Figure 4 shows a graph of these results.



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Plot these missing results on the graph in Figure 4.

(2)

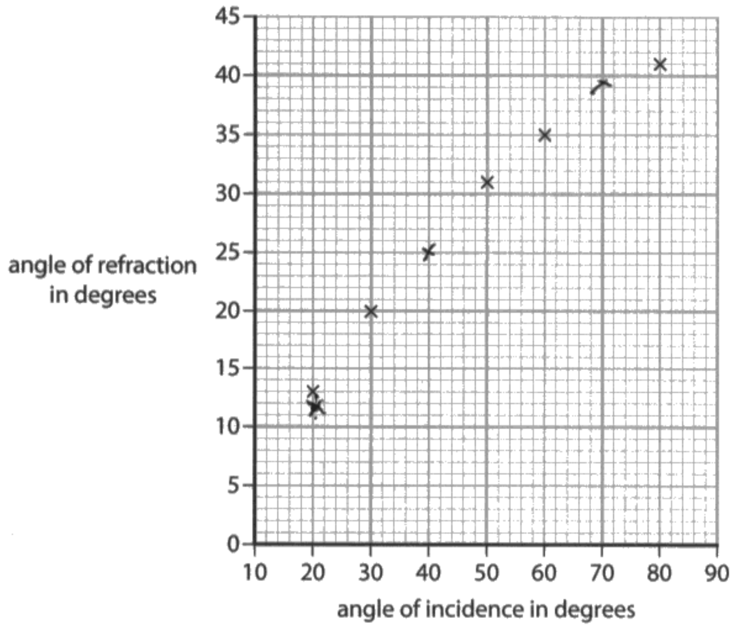
(ii) Draw a curve of best fit through the points on the graph in Figure 4.

(1)

ResultsPlus
Examiner Comments

This scores 2 marks for the plotting of points but none for the best fit curve. The mark scheme says 'best fit curve touching at least four of the points'. That ought not to be so difficult with these data points.

Figure 4 shows a graph of these results.



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(2)

(ii) Draw a curve of best fit through the points on the graph in Figure 4.

(1)

ResultsPlus
Examiner Comments

(ii) instructs the candidate to draw a best fit curve. Not following instructions always costs marks in exams.

Figure 4 shows a graph of these results.

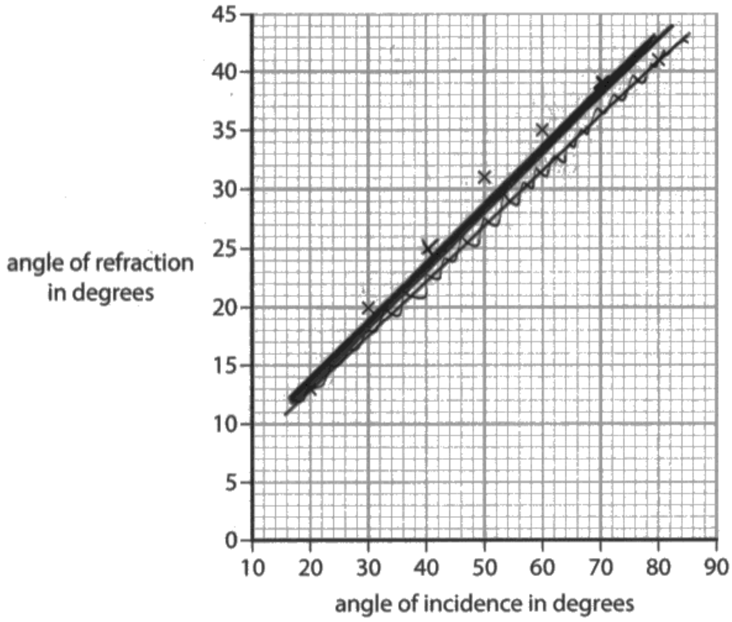

Figure 4

(i) The two shaded rows in Figure 3 are not plotted on the graph in Figure 4.

Plot these missing results on the graph in Figure 4.

(2)

(ii) Draw a curve of best fit through the points on the graph in Figure 4.

(1)

ResultsPlus
Examiner Comments

For (ii) if the question instructs draw a curve the candidate must comply to get the mark.

ResultsPlus
Examiner Tip

Best practice is to have a sharpened pencil and not draw thick (uncertain) lines. You need experience with a variety of graphs so you know when straight lines or curves are most appropriate. Exam questions normally advise you which to draw, but you should not take that for granted.

Question 2(c)iii

Questions about the relationship between variables, as seen in graphs, are often seen.

Two marks are often involved, one for a basic description, and the second for elaborative detail. Here that amounted to seeing the relationship as non-linear and stating as much. That second mark often eluded candidates.

(iii) Using Figure 4, describe the relationship between the angle of refraction and the angle of incidence.

(2)

The relationship is positive as it goes up and after to each 10 it goes up.

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

This is too vague and no credit was given.

ResultsPlus
Examiner Tip

Communication within an answer is vital. Don't expect examiners to fill in things you do not make clear or miss out on saying.

(iii) Using Figure 4, describe the relationship between the angle of refraction and the angle of incidence.

(2)

~~w The angle of incidence increases as the angle of refraction~~ Both angles increase but the angle of refraction bends towards the light.

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

No credit awarded. What does 'both angles increase' convey? We need to see 'As i increases, so does r' for the first mark. Then that the relationship is non-linear for the second. Alternatives to 'non-linear' accepted in this question were: not proportional / not directly proportional, curve gets less steep (as angle of incidence increases).

ResultsPlus
Examiner Tip

2 marks seen in questions like this – try and nail down that second mark if you can.

(iii) Using Figure 4, describe the relationship between the angle of refraction and the angle of incidence.

(2)

The angle of refraction increase with an increase in angle of incidence. The graph is non-linear.

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

This was the desired answer, well communicated.

(iii) Using Figure 4, describe the relationship between the angle of refraction and the angle of incidence.

(2)

As the angle of incidence increases the angle of refraction increases

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

This is a one-mark answer, with the basic relationship described, and nothing further.

ResultsPlus
Examiner Tip

Actively consider 'How may I get that second mark?'

Question 3(a)i

A great majority of candidates scored full marks on this item, being able to adequately describe velocity changes in all three stages.

3 Figure 5 shows a velocity / time graph for a car moving on a test track.

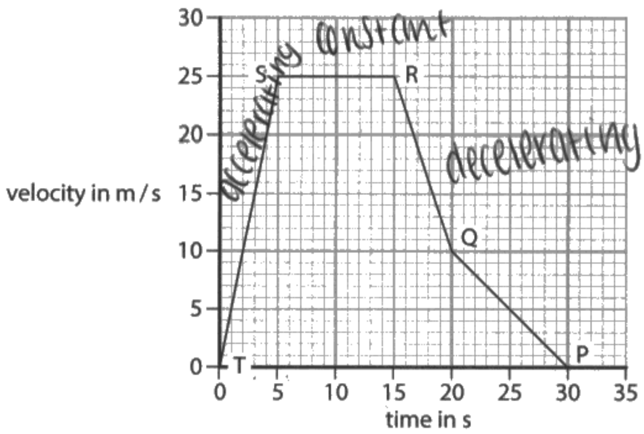

Figure 5

(a) (i) Use this graph to describe the velocity of the car in stages TS, SR and RQ.

(3)

TS The velocity of the car is accelerating

SR The ~~car~~ velocity ~~velocity~~ is staying at a constant speed

RQ The velocity of the car is decelerating

ResultsPlus
Examiner Comments

Full three marks awarded. All three stages described accurately. Alternatives such as velocity increases or accelerating were equally acceptable.

ResultsPlus
Examiner Tip

You should know the basic descriptions for velocity-time graphs. It is a key aspect of Topic 2, Motion and Forces.

3 Figure 5 shows a velocity/time graph for a car moving on a test track.

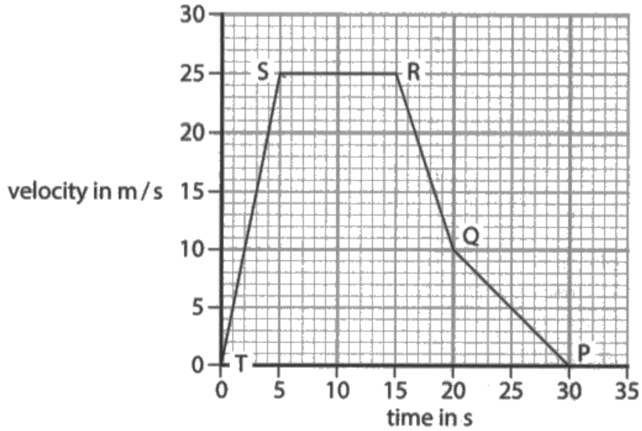

Figure 5

(a) (i) Use this graph to describe the velocity of the car in stages TS, SR and RQ.

(3)

TS

the velocity rapidly increases, going from 0 to 25 m/s in just 5 seconds.

SR

the velocity remains at 25m/s for a further 10 seconds.

RQ

It then quickly decreases 15m/s in 5 seconds, leaving it now at 10m/s.

ResultsPlus
Examiner Comments

The question asks the candidate to describe the velocity in each stage. This is what the candidate has done, very clearly.

3 Figure 5 shows a velocity/time graph for a car moving on a test track.

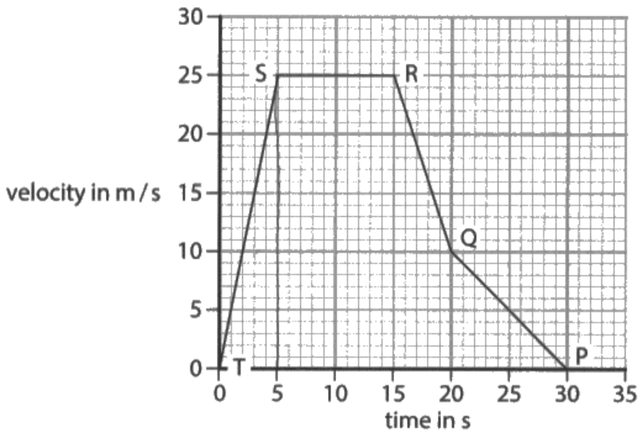

Figure 5

(a) (i) Use this graph to describe the velocity of the car in stages TS, SR and RQ.

(3)

TS

Constant Speed

SR

Stationary

RQ

Slower Constant Speed

ResultsPlus
Examiner Comments

The candidate's answer would be true if it were a distance-time graph, but it isn't. 0 marks awarded.

ResultsPlus
Examiner Tip

Studying examples of distance-time and velocity-time graphs will help you.

3 Figure 5 shows a velocity / time graph for a car moving on a test track.

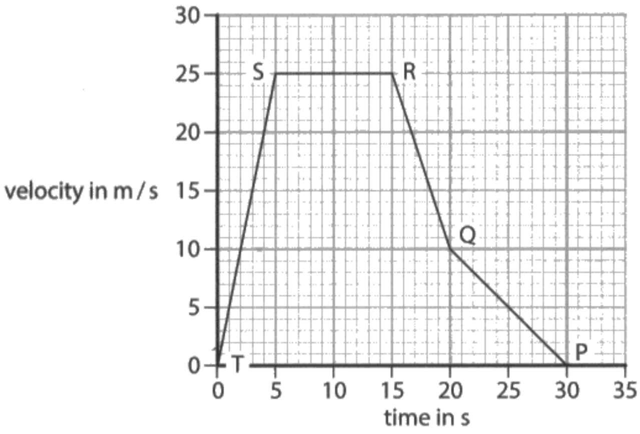

Figure 5

(a) (i) Use this graph to describe the velocity of the car in stages TS, SR and RQ.

(3)

TS

The car is rapidly accelerating

SR

The car is stationary

RQ

The car is rapidly acceterating

ResultsPlus
Examiner Comments

One mark is given for the description in stage TS. The candidate makes the most common mistake in interpreting SR. It would be stationary if it were a distance-time graph. 'Deceleration' idea needed for stage RQ.

Question 3(a)ii

Just under a half of candidates got the one mark for stating the difference between stages RQ and QP.

RQ is where it decelerates / slows down faster (than QP) was an answer given by many who achieved the mark.

A comparison needed to be evident to get the mark.

(ii) State how the motion of the car is different in RQ compared with QP.

(1)

in RQ it is decelating at a faster rate

ResultsPlus
Examiner Comments

This is a correct response with the comparative 'decelerating at a faster rate'.

ResultsPlus
Examiner Tip

Comparisons need to be clear. Fast for RQ would not be enough.

(ii) State how the motion of the car is different in RQ compared with QP.

(1)

RQ the cars velocity decreases more rapidly
QP the cars velocity decreases at a slower rate

ResultsPlus
Examiner Comments

Good, clear comparison made. 1 mark awarded.

ResultsPlus
Examiner Tip

This candidate communicates with care and precision. This should be all candidates' aim.

(ii) State how the motion of the car is different in RQ compared with QP.

(1)

QP has more force going down.

ResultsPlus
Examiner Comments

The candidate is not answering the question 'State how the motion of the car is different'. More force involved in the second stage cannot be true anyway.

ResultsPlus
Examiner Tip

Study the words in the question. Make sure you are not going off on a tangent.

(ii) State how the motion of the car is different in RQ compared with QP.

(1)

R Q is at a steady motion whereas Q P is at a greater motion.

ResultsPlus
Examiner Comments

Unhelpful comparison, if anything the wrong way around.

ResultsPlus
Examiner Tip

Steeper slopes of velocity-time graphs are associated with greater accelerations, with greater rates of change.

Question 3(b)i

This was a very straightforward calculation for the vast majority of candidates, looking at the TS triangular section to use change of velocity over time.

(b) (i) Calculate the acceleration of the car in Figure 5 in the first 5 s.

Use the equation

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

(2)

$$\frac{0 - 25}{5} = \frac{25}{5} = 5$$

acceleration = 5 m/s²

ResultsPlus
Examiner Comments

We expect to see final - initial velocity in the numerator. The candidate's minor rearrangement does not overrule the mark though. The mark scheme rule with calculations is most often 'Award full marks for correct answer without working', so when a correct final answer is seen that always overrides in these cases.

(b) (i) Calculate the acceleration of the car in Figure 5 in the first 5 s.

Use the equation

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

(2)

$$= \frac{25 - 0}{5}$$

$$= \frac{25}{5} = 5 \text{ m/s}^2$$

acceleration = 5 m/s²

ResultsPlus
Examiner Comments

This is an excellent example of a well-executed answer.

0 marks awarded.

There is no basis for this calculation.

(b) (i) Calculate the acceleration of the car in Figure 5 in the first 5 s.

Use the equation

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

(2)

5+5+3

acceleration = 13 m/s²

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Examiner Comments

Random guesses, using any numbers you see, will get you nowhere.

Question 3(b)ii

The answer to this question involved a less well-known principle than the first part, when an acceleration was asked for.

The specification says candidates should be able to 'determine the distance travelled using the area between the graph line and the time axis' (with a v-t graph).

Here it was a simple rectangle.

(ii) Calculate the distance travelled by the car in Figure 5 from 5 s to 15 s.

(2)

25 x 10

distance = 250 m m

(Total for Question 3 = 8 marks)

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Examiner Comments

25 x 10 gives that distance, being the area of the rectangle. It’s the same as average speed x time.

ResultsPlus
Examiner Tip

This is worth spending time on to gain understanding. It is a frequent place where candidates fall down.

(ii) Calculate the distance travelled by the car in Figure 5 from 5 s to 15 s.

(2)

triangle – 62.5 m

rectangle – 250 m

62.5+250 = 312.5

distance = 312.5 m

(Total for Question 3 = 8 marks)

ResultsPlus
Examiner Comments

This is a pity. The candidate shows good understanding in some ways. Unfortunately, they have tagged on another area to the asked for one, from 5 s to 15 s.

ResultsPlus
Examiner Tip

There's no substitute for reading questions carefully. Misinterpretations often result from hurried / skim reading of the question.

Question 4(a)

The majority of candidates achieved full marks with this question, showing a good understanding of the constituents of an atom.

4 (a) Figure 6 shows a diagram of a helium atom.

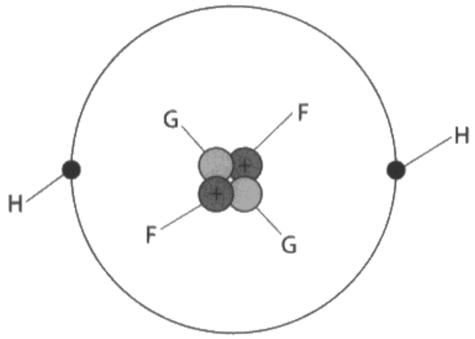


Figure 6

Complete the table for particles G and H, as shown in Figure 6.

(4)

particle	name of particle	charge
F	proton	positive
G	neutron	0 ~~negative~~
H	electron	negative ~~0~~

ResultsPlus
Examiner Comments

A good example of the perfect answer.

ResultsPlus
Examiner Tip

Notice how the candidate self corrects, as shown by their two crossings out. Your answers are always worth self-reflecting upon.

4 (a) Figure 6 shows a diagram of a helium atom.

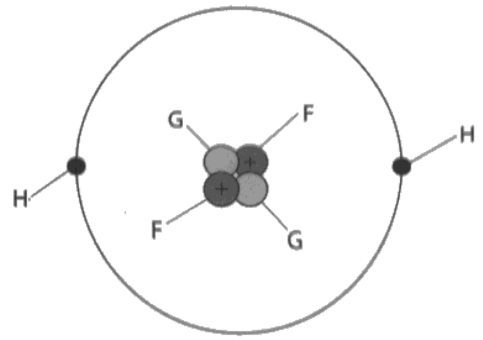


Figure 6

Complete the table for particles G and H, as shown in Figure 6.

(4)

particle	name of particle	charge
F	proton	positive
G	Neutron	negative
H	Electron	neutral

ResultsPlus
Examiner Comments

This candidate gets the names of the particles correct but then muddles up their charges. 2 marks awarded.

4 (a) Figure 6 shows a diagram of a helium atom.

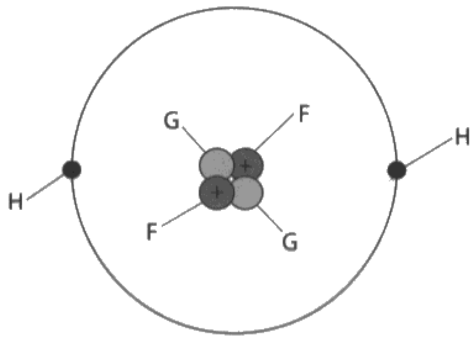


Figure 6

Complete the table for particles G and H, as shown in Figure 6.

(4)

particle	name of particle	charge
F	proton	positive
G	electrons	negative
H	neutrons	none

ResultsPlus Examiner Comments

This candidate also scores two marks. The contents of each box is wrong but the mark scheme obliges with the principle: if name of particle for G or H is incorrect: 1 mark for neutron and zero / 0 / neutral charge on same row. 1 mark for electron and -1 / negative charge on same row. Otherwise, some correct associations would not have been credited.

ResultsPlus Examiner Tip

Identifying particles with their charge state is required in our specification. Some basic memorisation is required.

4 (a) Figure 6 shows a diagram of a helium atom.

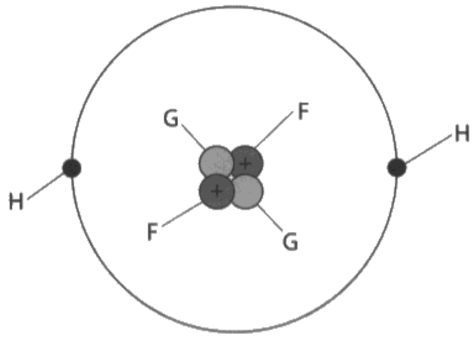


Figure 6

Complete the table for particles G and H, as shown in Figure 6.

(4)

particle	name of particle	charge
F	proton	positive
G	neutron	positive
H	electron	negative

ResultsPlus Examiner Comments

3 marks awarded. Wrong identification of neutrons as being positively charged.

ResultsPlus Examiner Tip

Particle F has already been identified as positive. Pause to ask yourself, 'Can we have two different lots of positively charged particles in the nucleus?' PROTON = POSITIVE. NEUTRON = Neutral or NO CHARGE.

Question 4(b)i

(b) An atom of beryllium has the symbol

Total of protons and ~~electrons~~ neutrons

$^{9}_{4}\text{Be}$

Total of protons.

The beryllium atom has 4 protons.

(i) Determine the number of neutrons in this atom.

(1)

number of neutrons ..... 5 .....

ResultsPlus
Examiner Comments

Correct so 1 mark awarded.

ResultsPlus
Examiner Tip

Top number with atomic symbols - bottom number to give number of neutrons.

Question 4(b)ii

(ii) Determine the number of electrons in this atom.

(1)

number of electrons ......4......

ResultsPlus
Examiner Comments

Correct answer.

ResultsPlus
Examiner Tip

The bottom number with the atomic symbols represents number of protons OR number of electrons (in a neutral atom). Electron number was asked for here.

Question 4(c)ii

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

10mins = 60
20 = 30
30 = 0

mass remaining = 0 g

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

This got one mark for 'evidence of halving 120g'.

ResultsPlus
Examiner Tip

They halved again for 20 minutes, but then mistakenly jumped to 0 g for 30 minutes, wrongly seeing an arithmetical progression that way.

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

mass	time
120	0
80	10
30	20
15	30

mass remaining = 15 g

(Total for Question 4 = 9 marks)

ResultsPlus Examiner Comments

Full marks for the correct answer.

ResultsPlus
Examiner Tip

Making that small table for progressive halving really worked.

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

Time	activity
0	120
~~5~~	~~60~~
10	130
20	140
30	150

mass remaining = 150 g

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

No marks awarded. The activity may not increase like that.

ResultsPlus
Examiner Tip

Good practice making a table, but ineffective due to misconception involving an increasing activity.

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

~~120 halfs = 60 halfs again~~

mass remaining = 40 g

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

40 g gets one mark, with some evidence of taking three half-lives, albeit in an arithmetical

sequence that is wrong. Crossed out working, by the way, may gain credit if there is no other working. That has been a common marking practice for many years.

Question 5(b)

A large majority of candidates obtained two marks, giving two reasonable factors.

These were:

- mass / weight of the van (1).
- speed / velocity of van (1).
- state of (the van's) brakes (1).
- state of the road (1).
- friction (between the tyre and the road surface) (1).
- (idea of driver's) reaction time (1).
- tiredness (1).
- alcohol / drugs / energy drink (1).

(b) There are several factors that affect the overall stopping distance of a van.

State **two** factors that may affect the overall stopping distance of a van.

(2)

1 the brakes depending on how old or new they are.

2 ~~how heavy the~~ the overall mass of the van

ResultsPlus
Examiner Comments

Mark points 3 and 1 represented here.

(b) There are several factors that affect the overall stopping distance of a van.

State **two** factors that may affect the overall stopping distance of a van.

(2)

1 tiredness of human driving.

2 If the driver has consumed alcohol.

ResultsPlus
Examiner Comments

Mark points 7 and 8 seen here.

(b) There are several factors that affect the overall stopping distance of a van.

State **two** factors that may affect the overall stopping distance of a van.

(2)

1 ~~Is~~ wet road

2 Weight

ResultsPlus
Examiner Comments

Mark points 4 and 1 credited here. Some benefit of doubt that weight must be referring to the van in the way that figures in the question stem. (Also, what other weight could it be?)

(b) There are several factors that affect the overall stopping distance of a van.

State **two** factors that may affect the overall stopping distance of a van.

(2)

1 Thinking time

2 ~~Breaking~~ Breaking distance

ResultsPlus
Examiner Comments

These are not factors. They are the two components that make up the overall stopping distance. No marks given.

Question 5(c)i

This had two marks.

One for a straight horizontal section at 15 m/s up to 0.5s.

Second mark for a parallel line to the braking line above.

(c) Figure 7 is a velocity / time graph for a van braking from an initial velocity of 25 m / s.

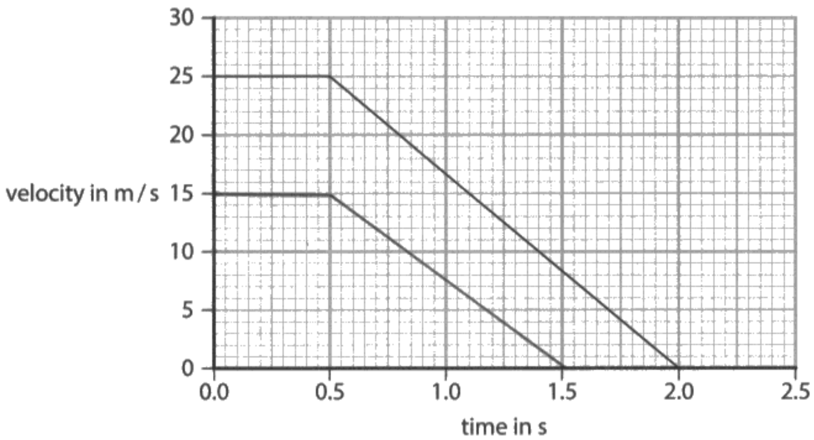


Figure 7

(i) On Figure 7 draw a similar graph for the same van braking from an initial velocity of 15 m / s.

Assume the thinking time and the braking force remain the same.

(2)

ResultsPlus Examiner Comments

This is a good example where both mark points are satisfied. A tolerance is applied to the braking line. It should intersect the x axis at about 1.42 s. This was judged to be in tolerance; the mark scheme says 'judge by eye' – ie regarding the parallelness.

(c) Figure 7 is a velocity/time graph for a van braking from an initial velocity of 25 m/s.

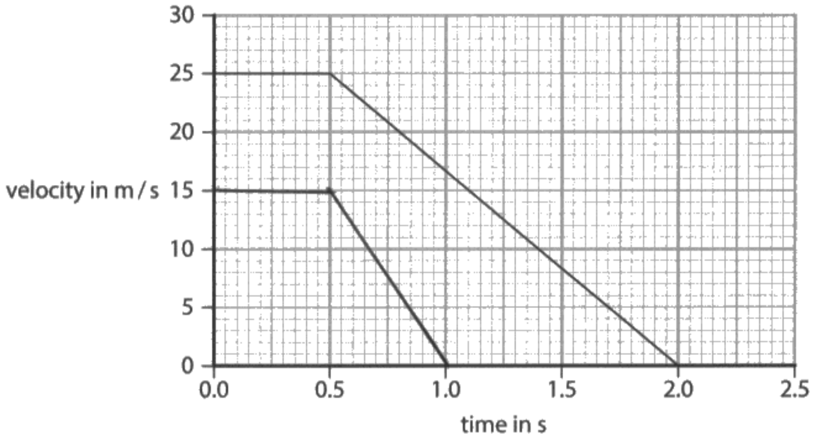


Figure 7

(i) On Figure 7 draw a similar graph for the same van braking from an initial velocity of 15 m/s.

Assume the thinking time and the braking force remain the same.

(2)

ResultsPlus Examiner Comments

This gets the first mark for the horizontal line up to 0.5s. The gradient of the line is clearly not the same as the above one.

ResultsPlus Examiner Tip

Same braking force gives the same deceleration and hence the gradient should be the same.

(c) Figure 7 is a velocity / time graph for a van braking from an initial velocity of 25 m / s.

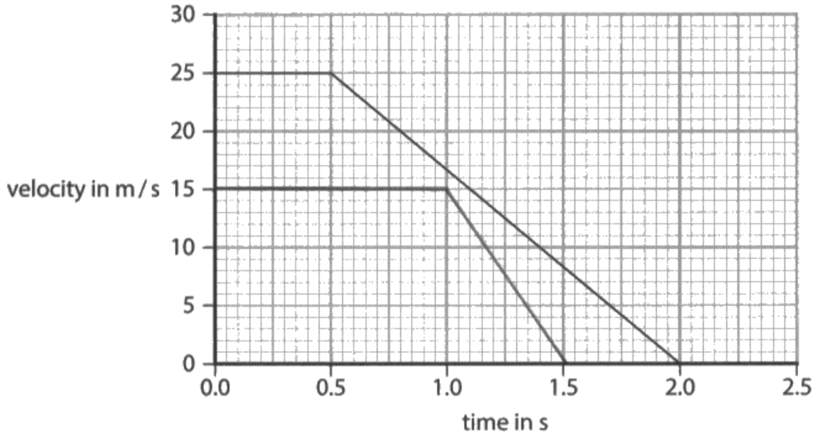


Figure 7

(i) On Figure 7 draw a similar graph for the same van braking from an initial velocity of 15 m / s.

Assume the thinking time and the braking force remain the same.

(2)

ResultsPlus Examiner Comments

Horizontal section extends too far and gradients of lines clearly different.

Question 5(c)ii

Only a few candidates scored the full 3 marks.

A large majority of candidates scored two marks. They just failed to convert kJ (kilojoules) into joules.

Question 6(a)i

A good number scored the 1 mark for this, but a majority of candidates didn't.

It involved interpreting a diagram representing three dimensions. To measure the height accurately that the object fell through, you had to have an upper arrow up to at least the bottom of the object. That's where many candidates fell down, unfortunately.

Acceptable limits, for labelling the height, are shown on the mark scheme.

6 (a) Figure 8 shows apparatus set up to investigate the speed of a falling object.

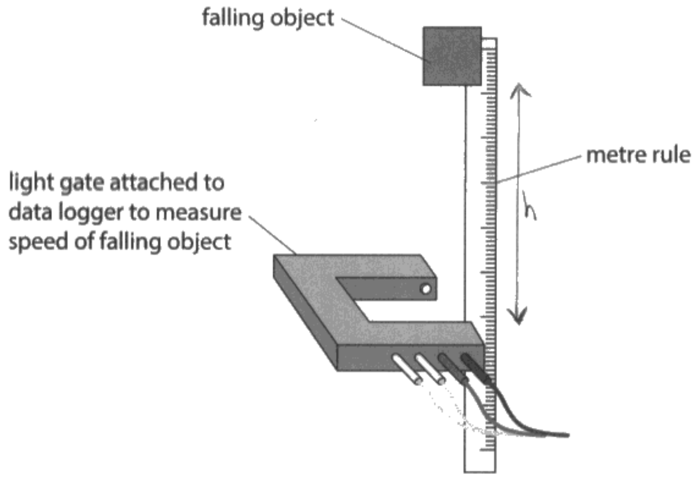


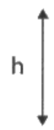
Figure 8

The object is dropped from rest at the position shown.
The object falls through the light gate.

(i) The speed of the object, after it has fallen through a height, h, is measured by the light gate.

Label Figure 8 to show the height, h.
Your label should look like this

(1)



ResultsPlus
Examiner Comments

This is a good answer, labelling the height fallen from the bottom of the object to a reasonable place for the beam of the light gate to be interrupted.

ResultsPlus
Examiner Tip

Study the diagram carefully. Remember what we are trying to measure – the height the object falls through. Don't fall short.

6 (a) Figure 8 shows apparatus set up to investigate the speed of a falling object.

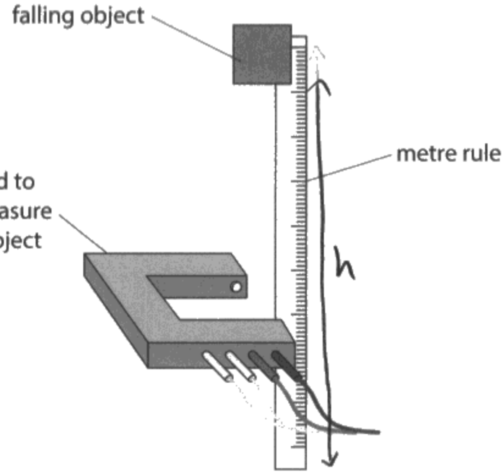


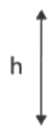
Figure 8

The object is dropped from rest at the position shown.
The object falls through the light gate.

(i) The speed of the object, after it has fallen through a height, h, is measured by the light gate.

Label Figure 8 to show the height, h.
Your label should look like this

(1)



14

P 7 8 7 2 7 R A 0 1 4 3 6

ResultsPlus
Examiner Comments

The length delineated by the line with arrow heads is too large and unrepresentative. It extends well below the light gate and is unacceptable.

6 (a) Figure 8 shows apparatus set up to investigate the speed of a falling object.

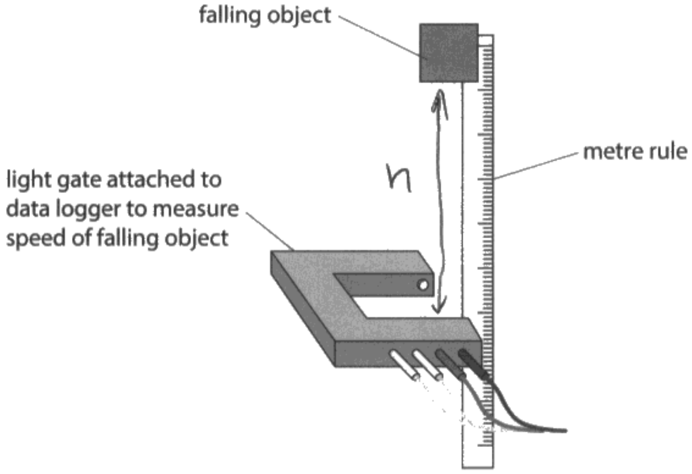


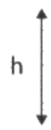
Figure 8

The object is dropped from rest at the position shown.
The object falls through the light gate.

(i) The speed of the object, after it has fallen through a height, h, is measured by the light gate.

Label Figure 8 to show the height, h.
Your label should look like this

(1)



ResultsPlus
Examiner Comments

Now the upper limit of height shown in significantly below the object. It would yield a measurement that is too small and would be hard to measure ending at a vague point below the object like that.

Question 6(a)ii

Ideally, we were looking for 'to check for anomalies'. However other answers were acceptable, including to calculate an average or mean value.

A common oft quoted answer was to improve accuracy, which the mark scheme expressly says to ignore. It is a ubiquitously quoted answer which doesn't address the question here.

(ii) The speed is measured at least four times for each drop height.

Give **one** reason for repeating the measurements.

(1)

To make sure it is accurate

ResultsPlus
Examiner Comments

A common answer given. This is not a reason for repeating measurements. The issue of reliability is the correct one here.

ResultsPlus
Examiner Tip

Don't just quote 'improve accuracy' as a universal answer to all questions involving improving experimental procedure. It is not always appropriate.

(ii) The speed is measured at least four times for each drop height.

Give **one** reason for repeating the measurements.

(1)

So that you can find the avrage as each drop will have a slightly diffrent speed

ResultsPlus
Examiner Comments

A good answer incorporating the idea of varying results from such observations; therefore, an average is taken.

ResultsPlus
Examiner Tip

Imagine doing the investigation. Have you had experience of experiments which have variation in outcome, for which an average is needed?

(ii) The speed is measured at least four times for each drop height.

Give **one** reason for repeating the measurements.

(1)

To get rid of human error to get a more accurate number.

ResultsPlus
Examiner Comments

'Getting rid of human error' is another answer which candidates write down as a universal panacea, alongside 'improve accuracy'. No marks awarded.

(ii) The speed is measured at least four times for each drop height.

Give **one** reason for repeating the measurements.

(1)

In case there are any anomolys.

ResultsPlus
Examiner Comments

The classic expected answer for an investigation such as this.

ResultsPlus
Examiner Tip

Hopefully the idea of watching out for anomalous results has figured in some of your school laboratory investigations. If so, you will have realised the importance of counteracting such an issue via repetition of measurements.

Question 6(a)iii

To enable the measurement of h to be as accurate as possible precautions such as using a set square, ensuring eye is level or using clamps was expected.

The vast majority of candidates didn't know about this and so repeat readings or remove human error were inappropriately seen. Testing knowledge of practical work means candidates need to think about their lab work.

(iii) The metre rule shown in Figure 8 is used to measure the height, h.

Suggest **two** ways to make the measurement of h as accurate as possible.

(2)

1 Measure the height in mm, so you can get more specific results.

2 Use a clamp stand to hold the ruler, so it cannot be moved.

ResultsPlus
Examiner Comments

This gets two marks for: improving the resolution of measurement, use of a clamp stand.

ResultsPlus
Examiner Tip

These kinds of things are experienced by candidates in their school laboratory work. You should think back, 'what kinds of things did I do to get to the true value of what I was trying to measure?'

(iii) The metre rule shown in Figure 8 is used to measure the height, h.

Suggest **two** ways to make the measurement of h as accurate as possible.

(2)

1 to see the millimetre (or the smallest number) for more accuracy

2 ~~use a t~~ use different measuring items e.g. measuring tape

ResultsPlus
Examiner Comments

The candidate's first answer gets the credit, for mark point 5 on the mark scheme. Their second suggestion doesn't add anything.

ResultsPlus
Examiner Tip

You must always be addressing the question 'How?' when asked about ways to do something. How would a measuring tape help?

(iii) The metre rule shown in Figure 8 is used to measure the height, h.

Suggest **two** ways to make the measurement of h as accurate as possible.

(2)

1 Start the falling object from the exact sam height from the ruler each time.

2 place the light gate on a clampstand so it does not move which may cause inaccurate results.

ResultsPlus
Examiner Comments

This gets the mark for the clamp stand suggestion. Their first suggestion, about starting from the same height, doesn't earn the mark. How would that be achieved?

(iii) The metre rule shown in Figure 8 is used to measure the height, h.

Suggest **two** ways to make the measurement of h as accurate as possible.

(2)

1 ~~A stop watch start when falling objet~~ Record a Video

2 Repeat the measurements more than one time, then write down the Modal heights he get.

ResultsPlus
Examiner Comments

These seem hopeful suggestions that don't hit the mark. How could a video help? Otherwise, it's too general.

Question 6(b)

This question differentiated well.

Many candidates have a good knowledge of energy transformations.

The most common non-scoring answers were to write generically – input, useful and wasted as answers.

The question asked for application to an object falling.

(b) As the object in Figure 8 falls, energy is transferred.

These energy transfers are represented in Figure 9.

Complete the labels of the energy stores involved.

(3)

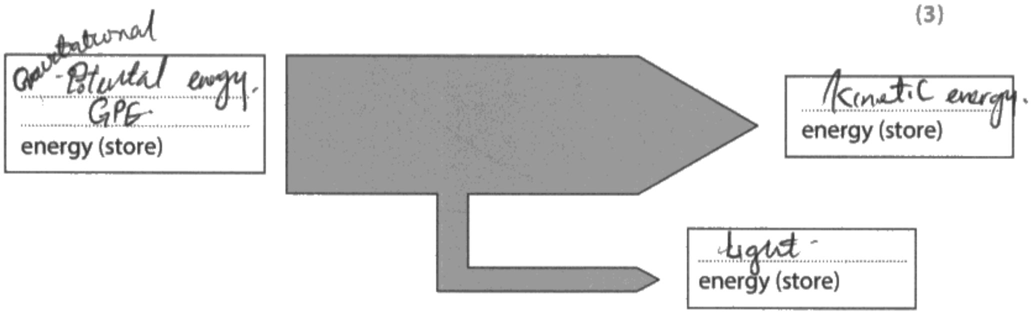


Figure 9

ResultsPlus
Examiner Comments

Gravitational potential and kinetic scored the marks. Light didn't.

ResultsPlus
Examiner Tip

Imagine the object falling. There's no reason to suggest it's emitting light, is there?

(b) As the object in Figure 8 falls, energy is transferred.

These energy transfers are represented in Figure 9.

Complete the labels of the energy stores involved.

(3)

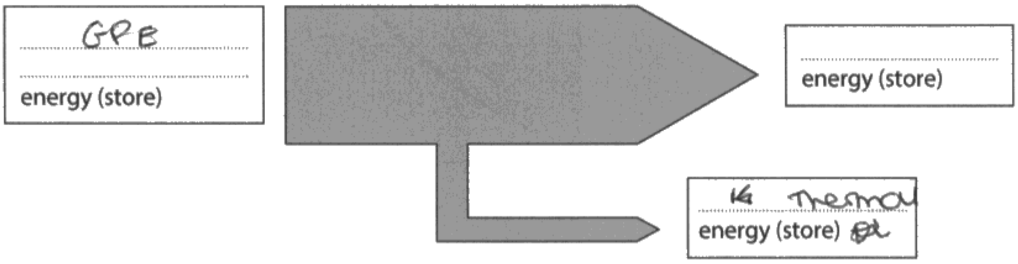


Figure 9

ResultsPlus
Examiner Comments

Two marks, for GPE and thermal.

(b) As the object in Figure 8 falls, energy is transferred.

These energy transfers are represented in Figure 9.

Complete the labels of the energy stores involved.

(3)

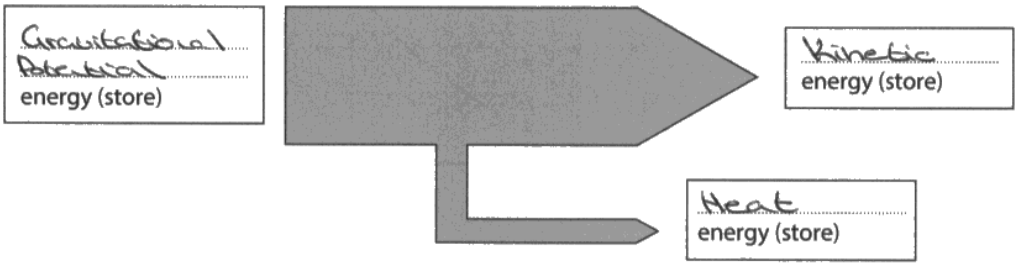


Figure 9

ResultsPlus
Examiner Comments

'Heat' is accepted for 'thermal'. This gains all three marks.

(b) As the object in Figure 8 falls, energy is transferred.

These energy transfers are represented in Figure 9.

Complete the labels of the energy stores involved.

(3)

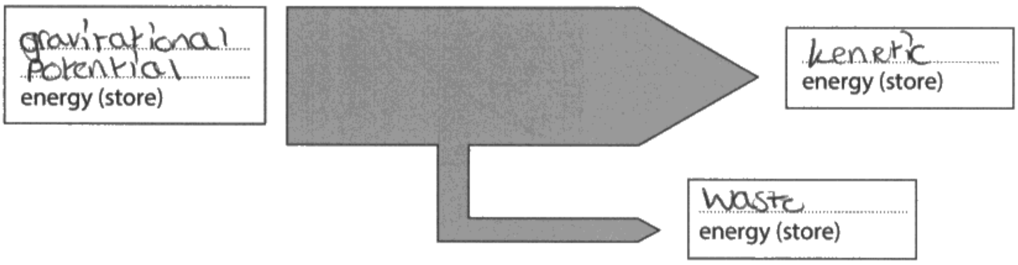


Figure 9

ResultsPlus
Examiner Comments

Two marks for Gravitational Potential and kinetic. 'Waste' energy is a generic answer. The answer should be specific to the scenario, naming an actual energy store.

Question 6(c)

This item tested candidates' knowledge and understanding of percentage change calculations, with graphical interpretation being required as well.

(c) Figure 10 shows wind power generation from the year 2000 onwards.

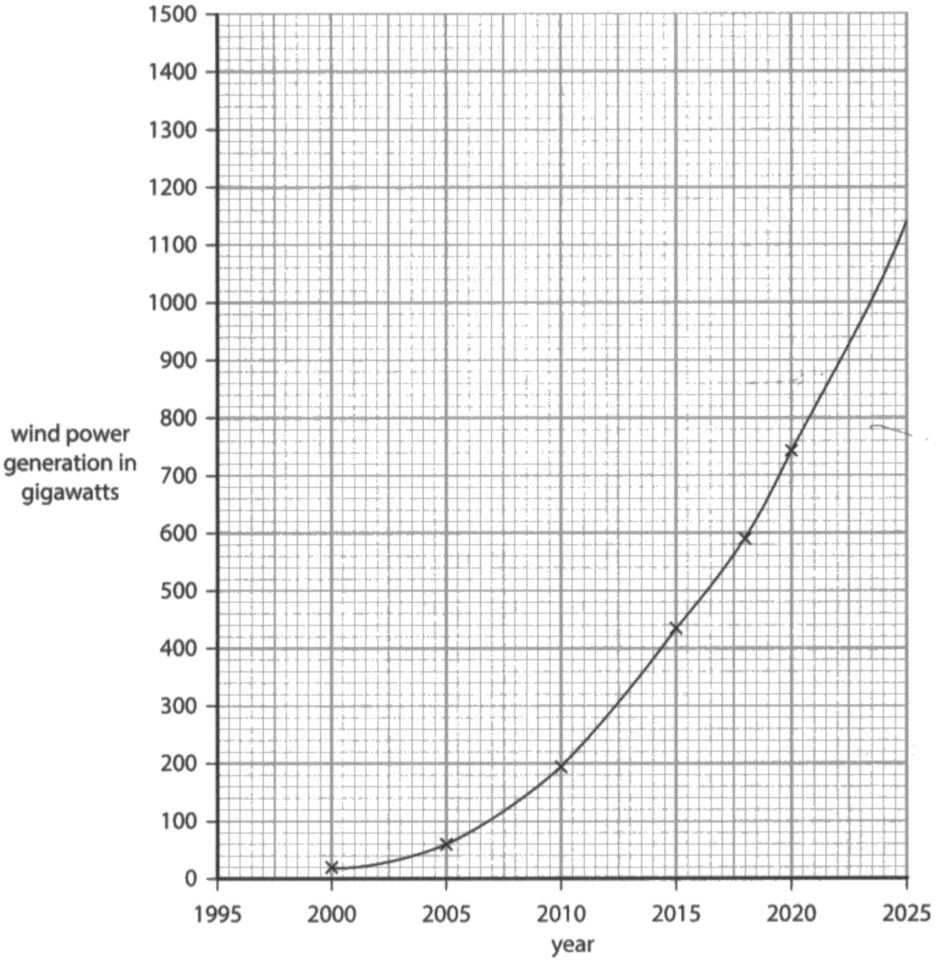


Figure 10

Estimate the percentage change in wind power generation from 2005 to 2020.

(3)

~~2000~~ ~~60~~ $\frac{740-60}{60} \times 100 = 1133.3$

percentage change = 1133 %

(Total for Question 6 = 10 marks)

16

P78727RA01636

ResultsPlus
Examiner Comments

This candidate obtained full marks. This was rare. Perfect reading from the graph, substitution and evaluation is shown, well communicated.

ResultsPlus
Examiner Tip

Avoid speculating what a % change might be. Here, starting from a small value, and going to a large value, results in a very large percentage change. You should always divide by the starting / initial value to get a % change.

(c) Figure 10 shows wind power generation from the year 2000 onwards.

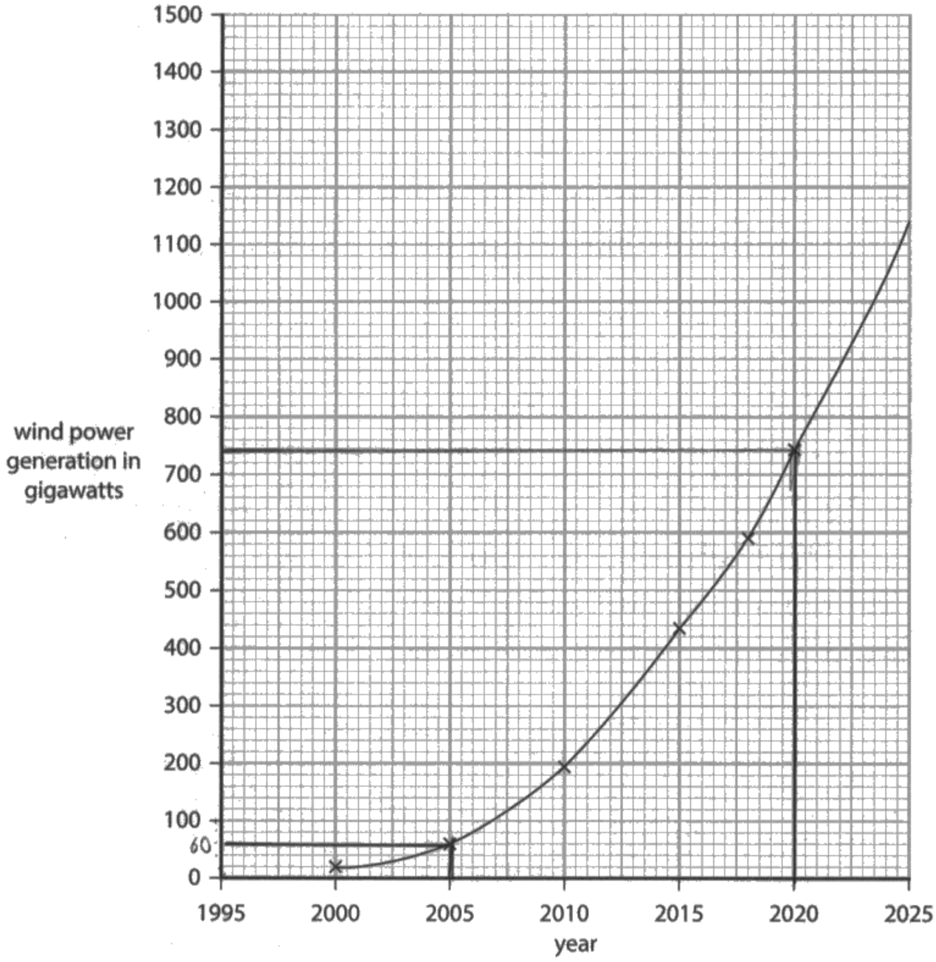


Figure 10

Estimate the percentage change in wind power generation from 2005 to 2020.

(3)

2005 - 60
2020 - 740

740 - 60 = 680

~~100% → 60 → 10% → 6~~
~~1230% → 740~~

100% - 740
100 - 8 = 92   10% - 74
1% - 7.4
8% - 60

percentage change = 92 %

(Total for Question 6 = 10 marks)

16

ResultsPlus
Examiner Comments

This got two marks for, as a result of effectively taking the wrong denominator, as spelled out in the additional guidance section of the mark scheme. Their working shows them taking a starting reference point of 740. Since the question says 'from 2005' they should have taken that as the starting / reference point ie from 60 Gw.

(c) Figure 10 shows wind power generation from the year 2000 onwards.

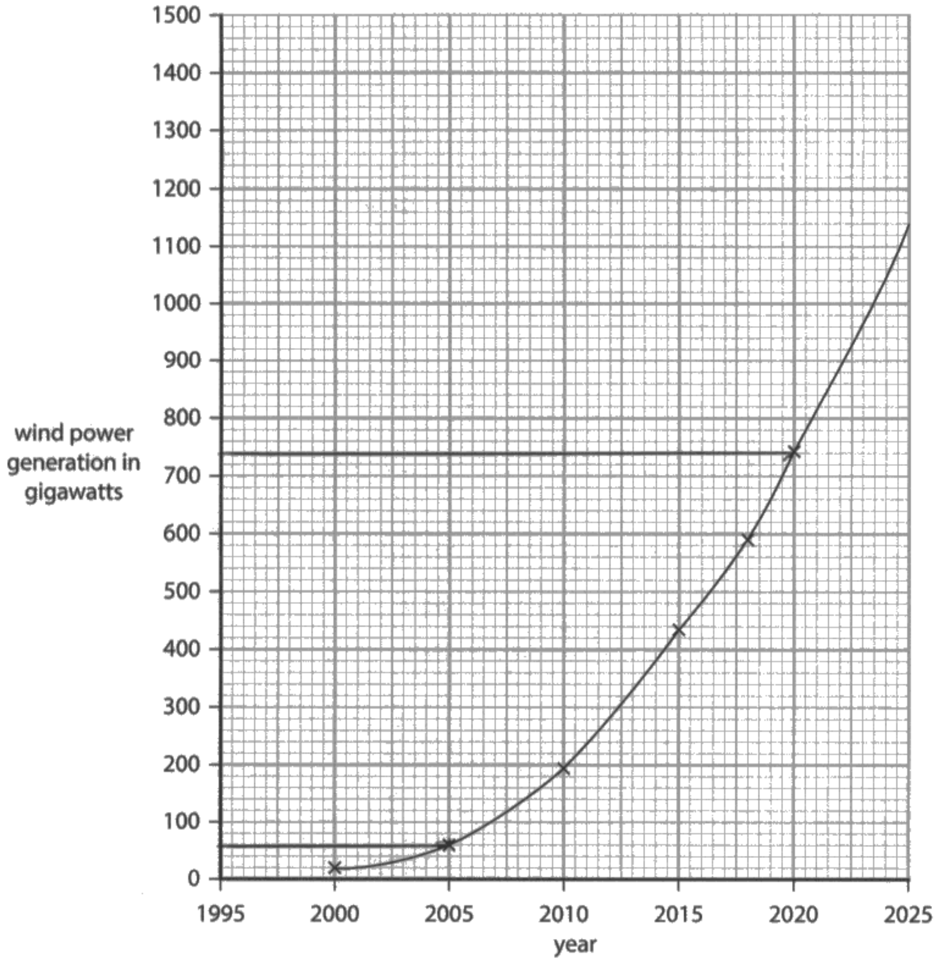


Figure 10

Estimate the percentage change in wind power generation from 2005 to 2020.

(3)

60 ≃ 100
740 ≃ 700

$\frac{100}{700} \times 100 = 14.29$

percentage change = 14.29 %

(Total for Question 6 = 10 marks)

16

ResultsPlus
Examiner Comments

This candidate scores 1 mark for reading those values – 40 and 740 – from the graph. Both values needed to be within specified bounds to achieve this mark.

Question 7(a)i-ii

(i) looked for a calculation of the ratio of the value of 'g' on Earth to that on Mars.

A large majority of candidates had no problem with this.

(ii) was more demanding involving the person’s weight on earth x ratio of gMoon to gEarth.

It was expected that some reflection might expect weights on the Moon to be considerably less than the same masses on the Earth.

However, a significant number of candidates allowed very implausible answers through.

7 (a) Figure 11 gives the values of gravitational field strength, *g*, on the surfaces of Earth, the Moon and Mars.

	value of *g* in N/kg
Earth	10
The Moon	1.6
Mars	3.7

Figure 11

(i) Calculate the ratio

$$\frac{\text{value of } g \text{ on Earth}}{\text{value of } g \text{ on Mars}}$$

(2)

$\frac{10}{3.7} = 2.\dot{7}0\dot{2}$

ratio = 2.702

(ii) A person has a weight of 730 N on Earth.

Calculate the person's weight on the Moon, using information from Figure 11.

(2)

$\frac{730}{10} = 73$

weight on the Moon = 116.8 N

$73 \times 1.6 = 116.8$

ResultsPlus
Examiner Comments

Full marks obtained for both parts.

ResultsPlus
Examiner Tip

Set out your work clearly and logically like this, and you will do well.

7 (a) Figure 11 gives the values of gravitational field strength, g, on the surfaces of Earth, the Moon and Mars.

	value of g in N/kg
Earth	10
The Moon	1.6
Mars	3.7

Figure 11

(i) Calculate the ratio

$$\frac{\text{value of } g \text{ on Earth}}{\text{value of } g \text{ on Mars}}$$

(2)

$\frac{10}{3.7}$ $\frac{100}{37}$

ratio = 100 : 37

(ii) A person has a weight of 730 N on Earth.

Calculate the person's weight on the Moon, using information from Figure 11.

(2)

73 × 1.6

weight on the Moon = 116.8 N

18

P 7 8 7 2 7 R A 0 1 8 3 6

ResultsPlus
Examiner Comments

(i) has the correct ratio for the first mark. Unfortunately, they didn't proceed to evaluate the number for the second mark. The working and evaluation for (ii) is clear and accurate, gaining two marks.

ResultsPlus
Examiner Tip

Evaluating a number for a ratio is a physics requirement. This is indicated in the answer line being the way it is. We do not leave quantities like this in fractional form, or as two numbers separated by a colon.

7 (a) Figure 11 gives the values of gravitational field strength, g, on the surfaces of Earth, the Moon and Mars.

	value of g in N/kg
Earth	10
The Moon	1.6
Mars	3.7

Figure 11

(i) Calculate the ratio

$$\frac{\text{value of } g \text{ on Earth}}{\text{value of } g \text{ on Mars}}$$

10 : 3.7) ÷3.7

2.7 : 1

(2)

ratio = 2.7 : 1

(ii) A person has a weight of 730 N on Earth.

Calculate the person's weight on the Moon, using information from Figure 11.

(2)

W = M × g   730 × 1.6

weight on the Moon = 1168 N

P 7 8 7 2 7 R A 0 1 8 3 6

ResultsPlus
Examiner Comments

(i) – correct calculation, with an evaluated 2.7. This part scores 2 marks. (ii) – in taking 730 for the mass of the person, the candidate ends up with an exaggerated weight on the Moon. This part scores no marks.

ResultsPlus
Examiner Tip

The weight on the moon can't be that much. You don't weigh more on the Moon. With that thinking, the candidate could and should have reevaluated their response.

7 (a) Figure 11 gives the values of gravitational field strength, g, on the surfaces of Earth, the Moon and Mars.

	value of g in N/kg
Earth	10
The Moon	1.6
Mars	3.7

Figure 11

(i) Calculate the ratio

$$\frac{\text{value of } g \text{ on Earth}}{\text{value of } g \text{ on Mars}}$$

$\div 10$ 10 : 3.7 $\div 10$
1 : 0.37

$\frac{10}{3.7} = 2.702$

(2)

$\div 3.7$ 10 : 3.7 $\div 3.7$
2.7 : 1

ratio = 2.7 : 1

(ii) A person has a weight of 730 N on Earth.

Calculate the person's weight on the Moon, using information from Figure 11.

(2)

730 × 1.6 = 1168

$\frac{730}{1.6}$ = 456.25

weight on the Moon = 456.25 N

P 7 8 7 2 7 R A 0 1 8 3 6

ResultsPlus
Examiner Comments

First part well done, with the expected '2.7'. 2 marks awarded. For (ii), two speculative calculations are provided, with the second one alighted on for the final answer. Both speculations are off the mark.

Question 7(a)iii

The question asked why the values of 'g' are different for different solar system objects.

The expected answer, for two marks was:

1. it depends on the mass of the object.
2. it depends on the diameter of the object, accepting size and radius as valid alternatives here.

(iii) The gravitational field strength, g, is different on the surfaces of Earth, the Moon and Mars.

Explain why this is the case.

(2)

because they have different sizes and different masses.

ResultsPlus
Examiner Comments

Succinctly identifies the two major factors. 2 marks awarded.

(iii) The gravitational field strength, g, is different on the surfaces of Earth, the Moon and Mars.

Explain why this is the case.

(2)

Because of its mass

ResultsPlus
Examiner Comments

One factor identified. 1 mark awarded.

(iii) The gravitational field strength, g, is different on the surfaces of Earth, the Moon and Mars.

Explain why this is the case.

(2)

because there is less gravity ~~es~~ because Earth is bigger and Mars and the Moon are smeller

ResultsPlus
Examiner Comments

Size factor identified. 1 mark awarded.

Question 7(c)

This question seemed to engage candidates well, with its context of thinking about the possibility of life on distant planets.

The best Level 3 answers required:

- identifying the solar system planets P, Q and R (Venus, Earth and Mars).
- using the chart and other evidence in the text to discuss the possibility of life on planets. This required focusing of the chart's graphic where the 'habitable zone' was identified as a region on the chart.

*(c) Scientists have been searching beyond the Solar System to find planets where life could exist.

One requirement for life to exist on a planet is that there is water on the surface of the planet.

The planets where surface water could exist are in a region called the habitable zone.

Figure 12 is a diagram showing our Sun, with its five closest planets, and a more distant star with three of its planets labelled A, B and C.
The habitable zone is shaded.

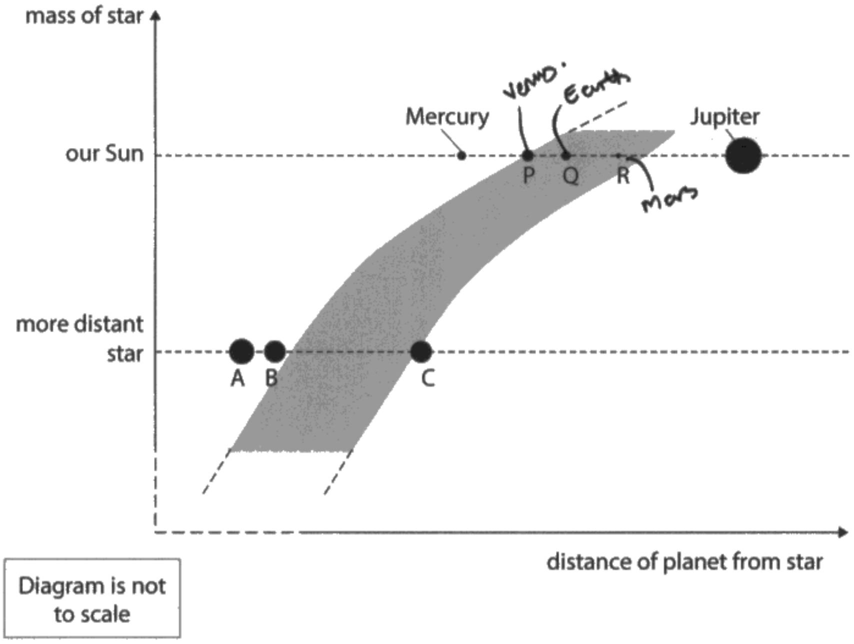


Figure 12

(Source adapted from: https://www.researchgate.net/publication/23993674_Darwin_-A_Mission_to_Detect_and_Search_for_Life_on_Extrasolar_Planets/figures?lo=1)

Discuss the chance of life existing on the planets shown in Figure 12.

Your answer should refer to

- the five planets shown from our Solar System, giving the names of P, Q and R.
- the three planets, A, B and C, orbiting the more distant star.

(6)

The chances of life existing on other planets in our solar system are quite ~~stim~~ slim. This is because, although there are a few planets that are in the habitable zone, these planets cannot have existing life on them. Although Mars is technically ~~in~~ well inside the habitable zone there are some other factors which means that it is unlikely that other life exists. Mars doesn't have any sources of water from what we currently know, so as a result of this it means that in order for life to exist on a planet, not only does the planet have to be inside the habitable zone, the planet must also contain some form of water on the ~~of~~ surface, which Mars doesn't have. Furthermore, Venus is right on the edge of the habitable zone which means that even if there may was some form of water on the planets surface, it would be quite hard for life to exist on the venus because of it being right on the edge of the habitable zone. Also, we do have some other planets which orbit a more distant star. However, all of these planets are not inside of the habitable zone and so there would be very little chance of life exisiting on these planets. Inside our orbit there is also Mercury and Jupiter, however, in order to for there to be life existing on these planets they have to be inside the habitable zone. So anyways even if there was water on the surface of these planets, there would be no chance of life existing anyway.

(Total for Question 7 = 13 marks)

21

Turn over ▶

P 7 8 7 2 7 R A 0 2 1 3 6

ResultsPlus Examiner Comments

The candidate identifies P, Q and R accurately on the chart. In a wide-ranging discussion they draw upon their own knowledge of life on Solar System planets, relating it to water existing on the surface of the planet concerned. They discuss positions of planets in the habitable zone depicted in the chart, for the distant planets as well as Earth, Venus and Mars. A clear Level 3 answer worth 6 marks.

ResultsPlus Examiner Tip

Try and organise your thinking, marshalling evidence, like this candidate does.

*(c) Scientists have been searching beyond the Solar System to find planets where life could exist.

One requirement for life to exist on a planet is that there is water on the surface of the planet.

The planets where surface water could exist are in a region called the habitable zone.

Figure 12 is a diagram showing our Sun, with its five closest planets, and a more distant star with three of its planets labelled A, B and C.
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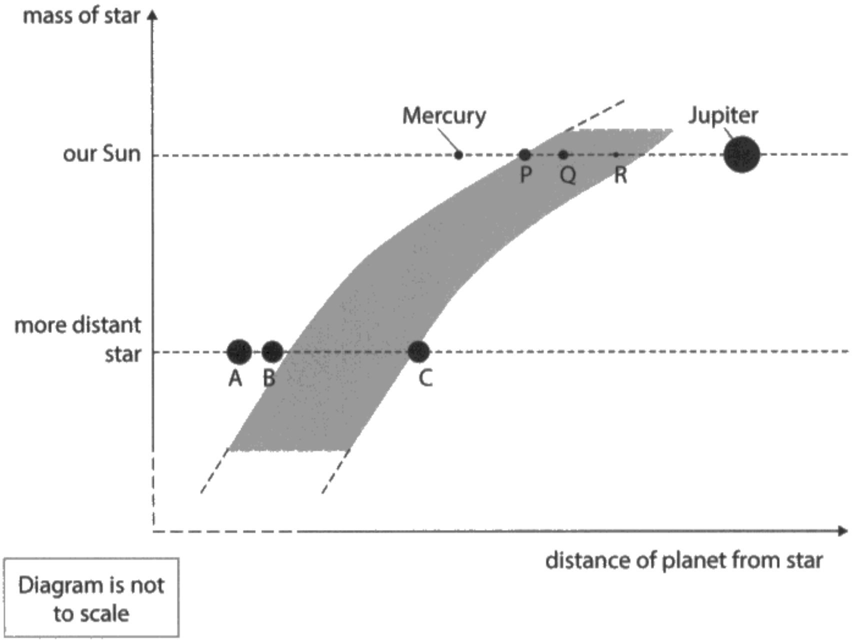

Figure 12

(Source adapted from: https://www.researchgate.net/publication/23993674_Darwin_-A_Mission_to_Detect_and_Search_for_Life_on_Extrasolar_Planets/figures?lo=1)

Discuss the chance of life existing on the planets shown in Figure 12.

Your answer should refer to

- the five planets shown from our Solar System, giving the names of P, Q and R.
- the three planets, A, B and C, orbiting the more distant star.

(6)

20

P 7 8 7 2 7 R A 0 2 0 3 6

The five closest planets too the Sun are shown ~~as~~ but only three of them being shown in the habitable zone. AS off right now we only know life exists on one planet, earth. This shows just because its in or near the habitable zone doesn't mean there is life on the ~~stars~~ more distant stars. We know however its impossible for life to be on mercury due to the excess heat caused from being so close to the Sun. This can tell us there is nearly 0 percent chance of life on ~~stars~~ planets labbeled A and B as they are close to the more distant star and not in the habitable zone. Planet C however is just inside the habitable zone and a good distance away from the star showing a decent chance of life.

P = mars

Q = earth

R = neptune

(Total for Question 7 = 13 marks)

21

Turn over ▶

P 7 8 7 2 7 R A 0 2 1 3 6

ResultsPlus
Examiner Comments

This candidate draws on their own knowledge of the Solar System. Some identification of Solar System planets P, Q and R occurs. They do draw on evidence from the charts for the two planetary systems, ie related to the habitable zone. Their discussion of positions within the habitable zone is very good, for both systems. This response is deemed Level 3. In extended open response questions we don't look for perfection regarding Level 3 attainment. 6 marks awarded.

*(c) Scientists have been searching beyond the Solar System to find planets where life could exist.

One requirement for life to exist on a planet is that there is water on the surface of the planet.

The planets where surface water could exist are in a region called the habitable zone.

Figure 12 is a diagram showing our Sun, with its five closest planets, and a more distant star with three of its planets labelled A, B and C.
The habitable zone is shaded.

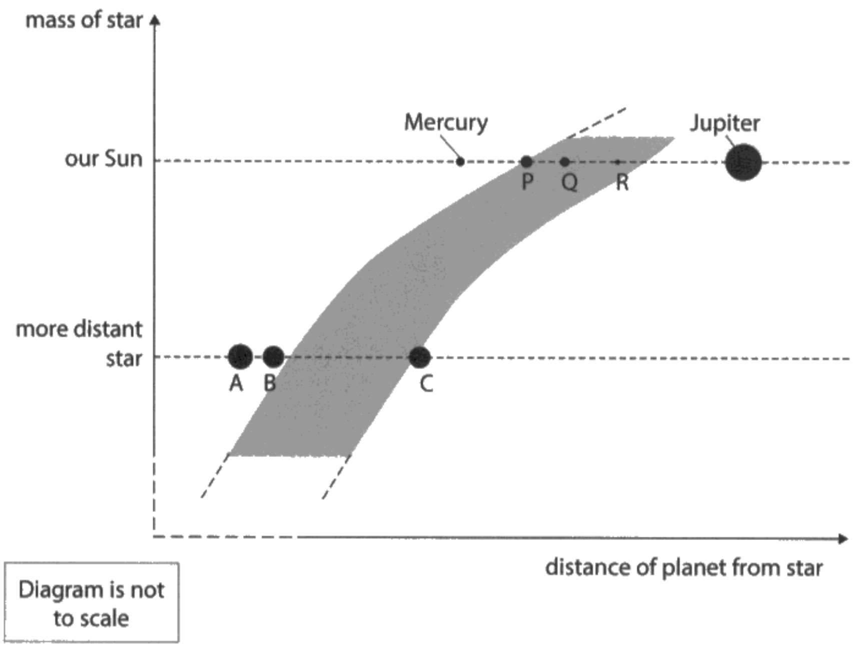

Figure 12

(Source adapted from: https://www.researchgate.net/publication/23993674_Darwin_-A_Mission_to_Detect_and_Search_for_Life_on_Extrasolar_Planets/figures?lo=1)

Discuss the chance of life existing on the planets shown in Figure 12.

Your answer should refer to

- the five planets shown from our Solar System, giving the names of P, Q and R.
- the three planets, A, B and C, orbiting the more distant star.

(6)

P 7 8 7 2 7 R A 0 2 0 3 6

In Figure 12 the ~~plant~~ planets P, Q and R which are venus, earth and mars are orbiting the sun. Q which is earth has life on it ~~whi~~ and its in the habitable zone which means it could have ~~a~~ possible of human life.

The planet A, B, and C are more distance from the other planets. It is also not orbiting the sun and is not in the habitable zone. This means the chance of life is very slim.

(Total for Question 7 = 13 marks)

21

P 7 8 7 2 7 R A 0 2 1 3 6

Turn over ▶

ResultsPlus
Examiner Comments

The candidate identifies P, Q and R well. They discuss their positions relative to the habitable zone. There is a very basic discussion about A, B and C in this regard. This is a good example of an intermediate Level 2 response, judged holistically. 4 marks are due.

*(c) Scientists have been searching beyond the Solar System to find planets where life could exist.

One requirement for life to exist on a planet is that there is water on the surface of the planet.

The planets where surface water could exist are in a region called the habitable zone.

Figure 12 is a diagram showing our Sun, with its five closest planets, and a more distant star with three of its planets labelled A, B and C.
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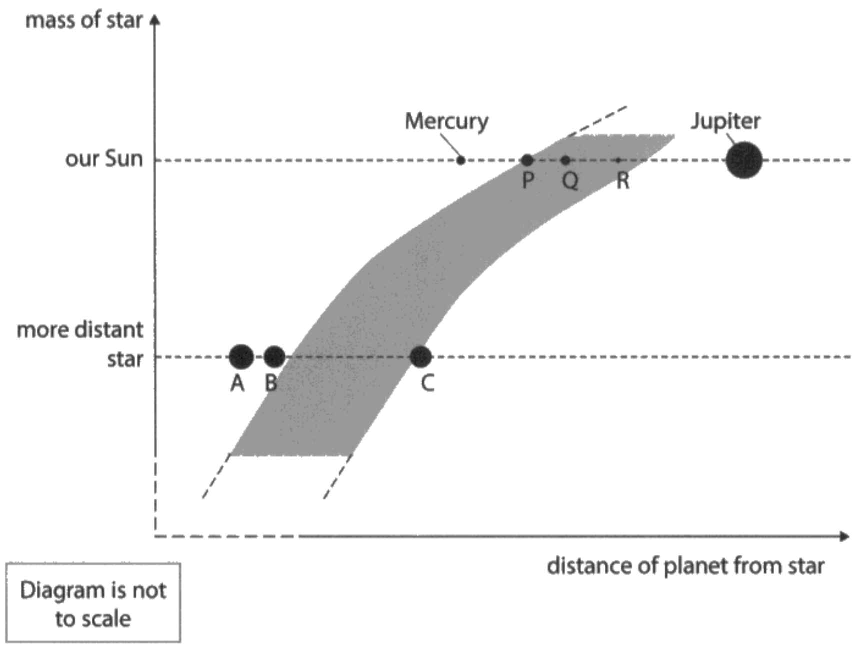

Figure 12

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Your answer should refer to

- the five planets shown from our Solar System, giving the names of P, Q and R.
- the three planets, A, B and C, orbiting the more distant star.

(6)

20

P 7 8 7 2 7 R A 0 2 0 3 6

Planets P, Q and R are very likely to have life on the surface due to them being in the habitable zone. As a result, these planets could ~~both~~ have water on the surface.

~~How~~

However, planets A, B and C are not likely to have life on the surface due to them not being in the habitable zone. This means that these planets are highly unlikely to have water on the surface

(Total for Question 7 = 13 marks)

ResultsPlus
Examiner Comments

A basic discussion is seen, drawing evidence from the chart. No Solar System planets are identified. This immediately limits attainment to Level 1. See the summary table in the mark scheme. 2 marks awarded.

ResultsPlus
Examiner Tip

6-mark questions often have a list of things your answer should refer to, as here. You must try to address all points in any such list if you want high attainment.

*(c) Scientists have been searching beyond the Solar System to find planets where life could exist.

One requirement for life to exist on a planet is that there is water on the surface of the planet.

The planets where surface water could exist are in a region called the habitable zone.

Figure 12 is a diagram showing our Sun, with its five closest planets, and a more distant star with three of its planets labelled A, B and C.
The habitable zone is shaded.

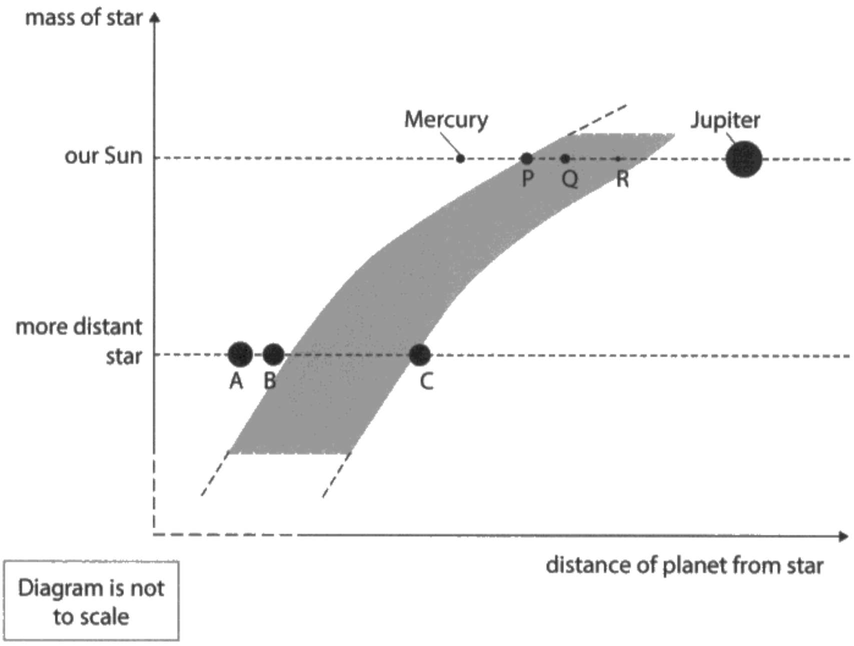

Figure 12

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Discuss the chance of life existing on the planets shown in Figure 12.

Your answer should refer to

- the five planets shown from our Solar System, giving the names of P, Q and R.
- the three planets, A, B and C, orbiting the more distant star.

(6)

P 7 8 7 2 7 R A 0 2 0 3 6

There is a high possibility that there is life existing on other planets because the five planets in our solar system (Mercury, P, Q, R, and Mars) can't be the only ones in the whole of space.
The planets A B and C could potentially have life on them, they also orbit around the more distant star meaning there could be more planets then just them three.

(Total for Question 7 = 13 marks)

21

Turn over ▶

P 7 8 7 2 7 R A 0 2 1 3 6

ResultsPlus
Examiner Comments

This is a rather speculative answer with very little content. They do engage with the ideas in a very limited way. The mark scheme says an answer must be worthless to be given 0 marks. This is a low Level 1 answer. 1 mark given.

Question 8(a)ii

This question asked for a piece of equipment that can be used to measure mass.

'Balance' or 'scales' were the most commonly seen acceptable answers.

Spring balance was also accepted, and in that light newton meter was condoned as well. Strictly speaking it does not measure mass. However, some commercially available devices have calibrations in g and N. They are seen in some schools.

A vast majority of candidates scored the one mark available.

(ii) State the name of a piece of equipment that can be used to measure mass.

(1)

~~[illegible]~~ Scale

ResultsPlus
Examiner Comments

Scale gets the mark.

(ii) State the name of a piece of equipment that can be used to measure mass.

(1)

a balance

ResultsPlus
Examiner Comments

Balance also gets the mark.

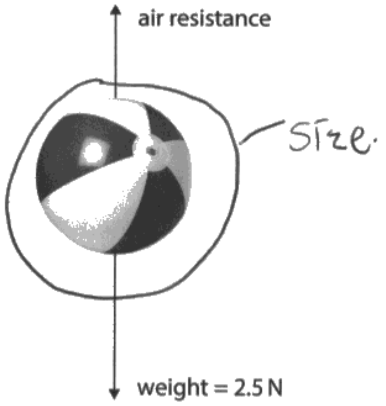
Question 8(b)i

This question tested an application of Newton's second law.

It involved rearrangement of F = m x a with substitution.

Most candidates scored the full 3 marks.

(b) Figure 13 shows the two forces acting on a beach ball as it falls through the air.



(Source: © Stepan Bormotov/Shutterstock)

Figure 13

The resultant of these two forces is 0.92 N downwards.

(i) The mass of the beach ball is 0.25 kg.

Calculate the acceleration of the beach ball as it falls.

Use the equation

$F = m \times a$

0.92 ÷ 2
= 0.46.

Force ÷ Mass

0.46 ÷ 0.25 = 1.84

(3)

acceleration = 1.84 m/s²

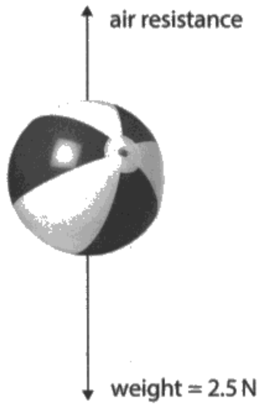
ResultsPlus
Examiner Comments

This scored 2 marks. The mark scheme said allow for 2 marks an evaluation of 1.8(4) (use of incorrect force).

ResultsPlus Examiner Tip

Calculation of the acceleration needed the inclusion of the resultant force on the ball. This was already given. There was no need to make it more complicated.

(b) Figure 13 shows the two forces acting on a beach ball as it falls through the air.



(Source: © Stepan Bormotov/Shutterstock)

Figure 13

The resultant of these two forces is 0.92 N downwards.

(i) The mass of the beach ball is 0.25 kg.

Calculate the acceleration of the beach ball as it falls.

Use the equation

$$F = m \times a$$

(3)

F
M a

$$\frac{0.92}{0.25}$$

acceleration = 3.68 m/s²

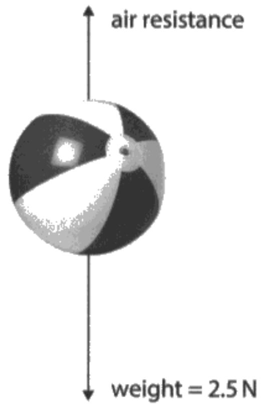
ResultsPlus Examiner Comments

Full marks given. This candidate uses the resultant force (given) and mass. It's that straightforward.

ResultsPlus
Examiner Tip

Newton's second law F = m x a assumes you are using the resultant force. Look for that in such questions.

(b) Figure 13 shows the two forces acting on a beach ball as it falls through the air.



(Source: © Stepan Bormotov/Shutterstock)

Figure 13

The resultant of these two forces is 0.92 N downwards.

(i) The mass of the beach ball is 0.25 kg.

Calculate the acceleration of the beach ball as it falls.

Use the equation

$$F = m \times a$$

(3)

~~Efxa~~

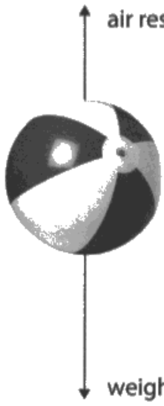
a = f x m

acceleration = 0.23 m/s²

ResultsPlus
Examiner Comments

Wrong rearrangement of equation. No clarity communicated about where 0.23 came from. 0 marks awarded.

(b) Figure 13 shows the two forces acting on a beach ball as it falls through the air.



(Source: © Stepan Bormotov/Shutterstock)

Figure 13

The resultant of these two forces is 0.92 N downwards.

(i) The mass of the beach ball is 0.25 kg.

Calculate the acceleration of the beach ball as it falls.

Use the equation

$F = m \times a$

(3)

$\frac{0.25}{0.92} = A$

acceleration = 0.27 m/s²

ResultsPlus Examiner Comments

Concurs with mark point 1 additional guidance. 0.25 / 0.92 scores one mark.

Question 8(b)ii

This question needed candidates to reckon upon a simple balance between weight - air resistance, yielding the resultant force downwards.

(ii) Calculate the size of the air resistance force on the beach ball.

(1)

~~0.92~~

$2.5 - 0.92 = 1.58\ N$

air resistance = 1.58 N

ResultsPlus
Examiner Comments

A fully correct answer.

Question 8(c)i

This item tested calculator skills, finding the mean of four numbers.

(c) Some students are investigating forces.

They use a newton meter to keep a trolley stationary on a sloping runway, as shown in Figure 14.

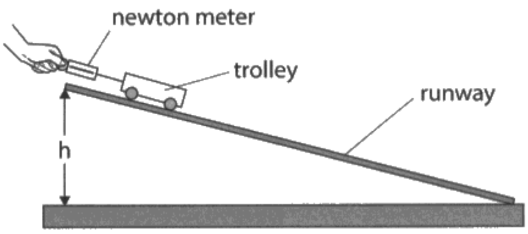


Figure 14

They measure the force needed to keep the trolley stationary on the sloping runway.

(i) They do this at four different places on the runway.

When the height, h, of the runway is 0.60 m, their four readings for force are

2.1 N   2.7 N   2.5 N   2.2 N

Calculate the mean value of these forces.

(1)

mean force = 2.4 N

24

P 7 8 7 2 7 R A 0 2 4 3 6

ResultsPlus
Examiner Comments

Fully correct and rounded to 2 significant figures.

(c) Some students are investigating forces.

They use a newton meter to keep a trolley stationary on a sloping runway, as shown in Figure 14.

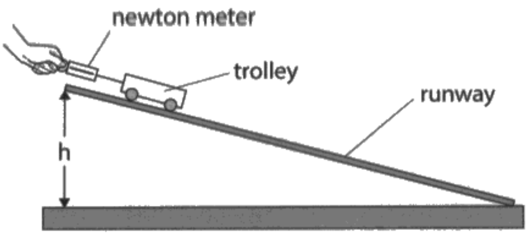


Figure 14

They measure the force needed to keep the trolley stationary on the sloping runway.

(i) They do this at four different places on the runway.

When the height, h, of the runway is 0.60 m, their four readings for force are

2.1 N 2.7 N 2.5 N 2.2 N

Calculate the mean value of these forces.

(1)

mean force = 2.375 N

2.1 + 2.7 + 2.5 + 2.2 = 9.5

9.5 ÷ 4 = 2.375

P 7 8 7 2 7 R A 0 2 4 3 6

ResultsPlus
Examiner Comments

Fully correct. 1 mark awarded.

Question 8(c)ii

This question tested graphical skills, where extrapolating a line and reading off a value was required.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

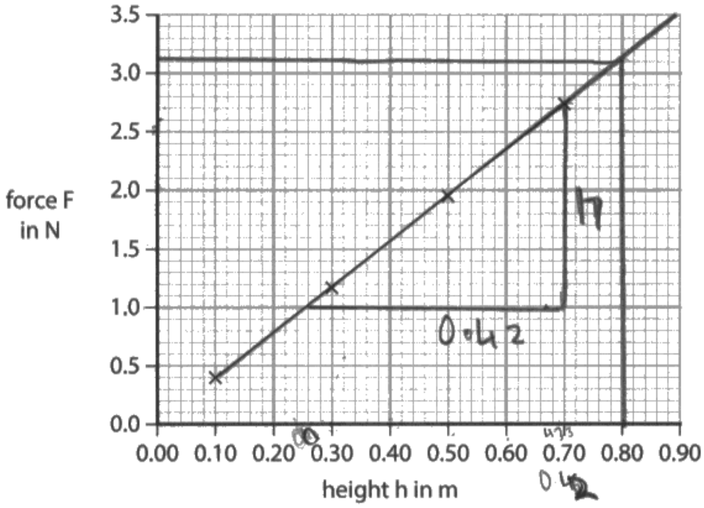


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

F = 3·1 N

ResultsPlus
Examiner Comments

This was the expected answer, read from the graph. The working on the graph is clear.

ResultsPlus
Examiner Tip

Always show working in graphical work like this. There are intermediate marks at stake.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

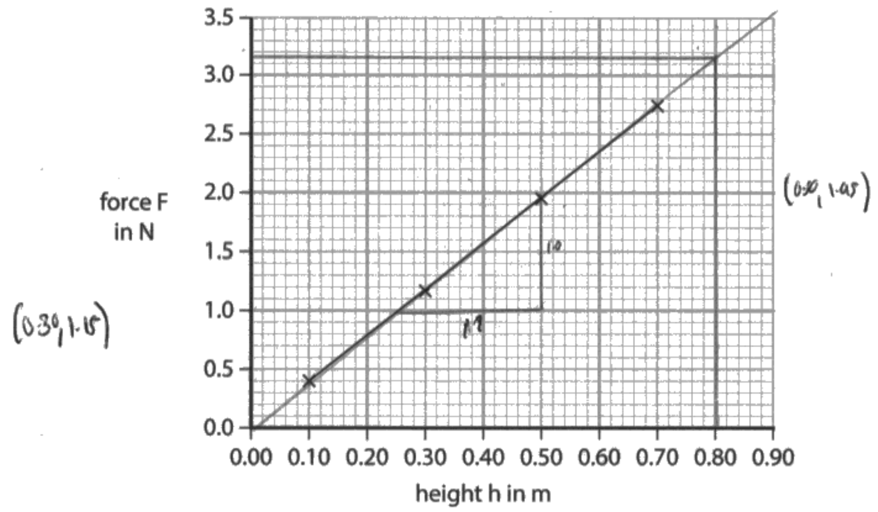


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

F = 3.25 N

ResultsPlus Examiner Comments

The answer given is outside the accurate range expected. This got the intermediate mark for 'straight line extended to meet h = 0.80 m axis (1)'.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

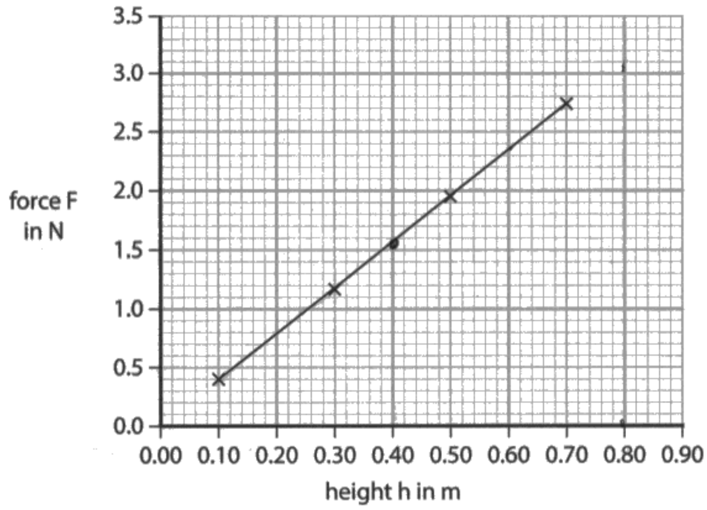


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

h = 0.80

F = 3.0 N

ResultsPlus Examiner Comments

This is outside the acceptable range: 'allow 3.05 to 3.20 inclusive'. No graph work made evident to award any intermediate mark. 0 marks awarded.

Question 8(c)iii

This required finding the gradient of the graph.

Here the intermediate mark was for selecting two points on the line / using a triangle.

The evaluation rewarded 3.90 ± 0.10 (N/m).

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

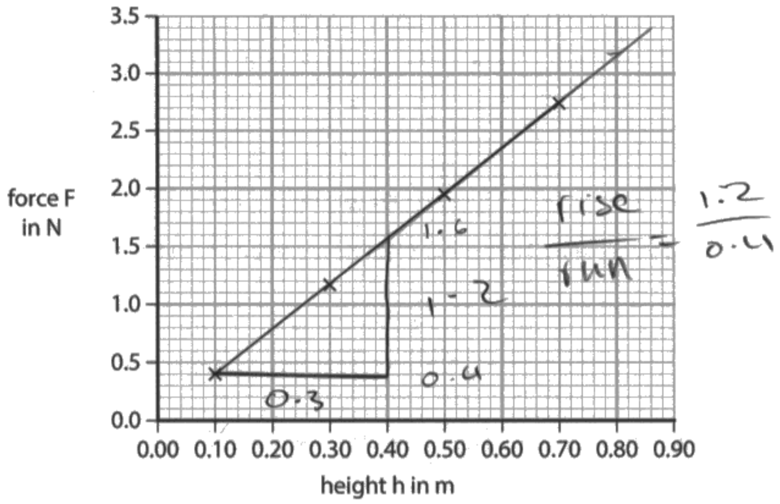


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

F = 3.3 N

(iii) Determine the gradient of the graph in Figure 15.

(2)

gradient = 3 N/m

(Total for Question 8 = 11 marks)

ResultsPlus
Examiner Comments

The answer is outside the expected range. The candidate has slipped up in dividing by 0.4, when 0.3 was indicated. Nevertheless, they get the intermediate mark via their working shown.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

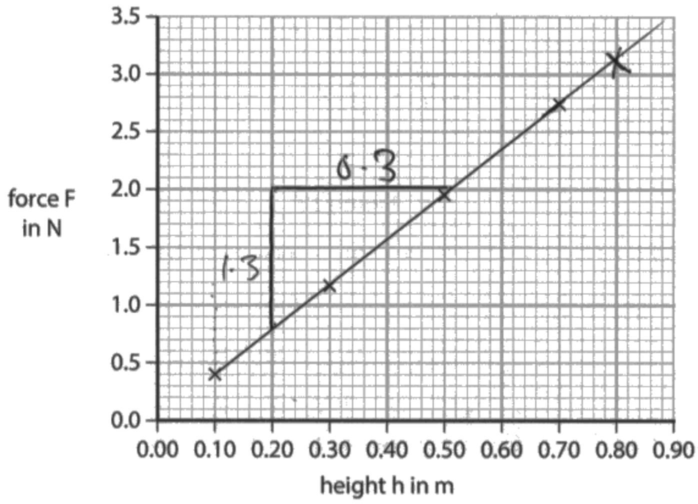


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

F = 3.1 N

(iii) Determine the gradient of the graph in Figure 15.

(2)

$$\frac{1.3}{0.3} = 4.3$$

gradient = 4.3 N/m

(Total for Question 8 = 11 marks)

P 7 8 7 2 7 R A 0 2 5 3 6

ResultsPlus
Examiner Comments

Out of the required range. 1 mark for triangle work shown.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

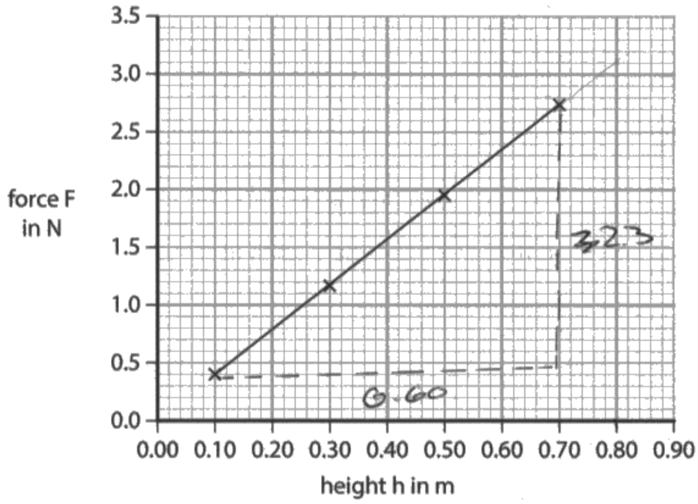


Figure 15

(ii) Use the graph in Figure 15 to determine the value of [redacted] when [redacted]

(2)

F = 3.1 N

(iii) Determine the gradient of the graph in Figure 15.

(2)

2.7 - 0.4 = 2.3

~~y~~ y = mx + c

gradient = $\frac{\text{rise}}{\text{run}}$ = $\frac{2.3}{0.6}$ = 3.833333333

gradient = 3.833333333 N/m

(Total for Question 8 = 11 marks)

ResultsPlus
Examiner Comments

This is in the acceptable accurate range. Full marks awarded.

The students then measure values of the force, F, for several different values of h, the height of the runway.

Figure 15 is a graph of F against h.

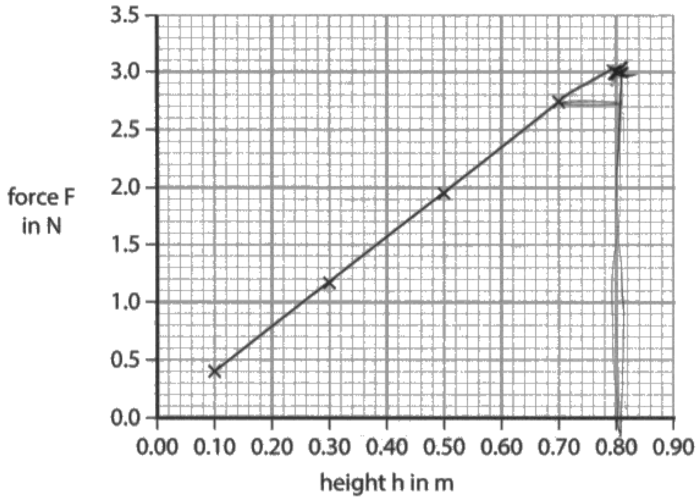


Figure 15

(ii) Use the graph in Figure 15 to determine the value of F when h = 0.80 m.

(2)

F = ~~3.0~~ 3.0 N

(iii) Determine the gradient of the graph in Figure 15.

(2)

$\frac{3.0}{0.80} = 0.375$

gradient = ~~0.38~~ 0.38 N/m

(Total for Question 8 = 11 marks)

ResultsPlus
Examiner Comments

Miscalculation – outside the accepted range. Still gets a mark for showing the triangle.

ResultsPlus
Examiner Tip

Small triangles invariably lead to inaccuracies in finding gradients. Choose a large triangle with an easy horizontal interval (no 3's involved) if you want trouble-free gradient finding.

Question 9(a)i

This question, finding the amplitude of a wave from reading off a graph, proved to be quite difficult for a majority of candidates.

They are clearly not acquainted with finding such.

9 (a) Figure 16 is a diagram of part of a water wave.

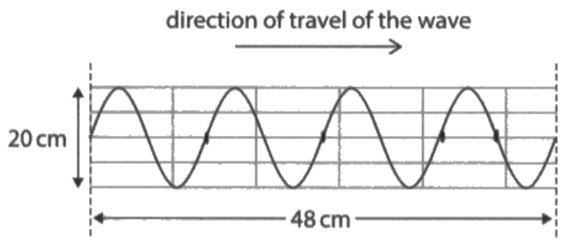


Figure 16

(i) Use data from Figure 16 to determine the amplitude of the wave.

(1)

amplitude = ...10........ cm

ResultsPlus
Examiner Comments

The correct answer.

9 (a) Figure 16 is a diagram of part of a water wave.

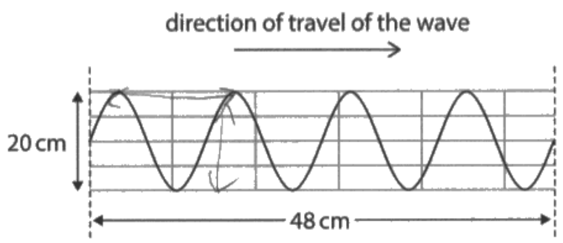


Figure 16

(i) Use data from Figure 16 to determine the amplitude of the wave.

(1)

amplitude = ...20........ cm

ResultsPlus
Examiner Comments

This was wrong. The answer is half that, 10 cm.

ResultsPlus
Examiner Tip

To get the amplitude measure peak to peak and halve it.

Question 9(a)ii

(ii) Use data from Figure 16 to determine the wavelength of the wave.

(1)

$v = f \times \lambda$

wavelength = 48 cm

ResultsPlus
Examiner Comments

48 cm is the total measurement across 4 complete waves.

ResultsPlus
Examiner Tip

Therefore wavelength = 48 / 4 = 12cm.

(ii) Use data from Figure 16 to determine the wavelength of the wave.

(1)

$\frac{48}{4} = 12$

wavelength = 12 cm

ResultsPlus
Examiner Comments

The correct answer, with working shown.

Question 9(a)iii

This is a 'describe how' question involving knowledge of practical ways of doing things.

(iii) The water wave shown in Figure 16 is generated in a large tank.

A student observes the wave.

Describe how the student could determine the wave speed of the wave.

(2)

Count the number of waves ~~passing~~ that hit the end of the tank in 10 seconds, then multiply that by the wavelength (12) and then divide it by 10.

ResultsPlus
Examiner Comments

Expertly handled by the candidate, with a full description and full marks following the mark scheme's 'Alternative Method'.

(iii) The water wave shown in Figure 16 is generated in a large tank.

A student observes the wave.

Describe how the student could determine the wave speed of the wave.

(2)

Calculate how many waves pass a certain point

ResultsPlus Examiner Comments

Mark point 1 in the 'Alternative Method'.

(iii) The water wave shown in Figure 16 is generated in a large tank.

A student observes the wave.

Describe how the student could determine the wave speed of the wave.

(2)

mark a point and record a video for 1 minute. count the number of waves that pass that point + divide by 60.

ResultsPlus Examiner Comments

Gets mark point 1 of the 'Alternative Method'. The divide by 10 is spurious.

(iii) The water wave shown in Figure 16 is generated in a large tank.

A student observes the wave.

Describe how the student could determine the wave speed of the wave.

(2)

Time how long the wave takes to get from one side of the tank to the other, measure the size of the tank. ⟶ $\frac{\text{Distance}}{\text{time}}$

ResultsPlus
Examiner Comments

This scores 2 marks following the mark scheme's first method.

Question 9(b)i

This question asks for another example of a transverse wave (other than an earthquake wave).

There are many to choose from, including all the electromagnetic waves.

(b) When an earthquake happens, waves are transmitted through the Earth.
Figure 17 is a diagram of a part of the Earth's crust.

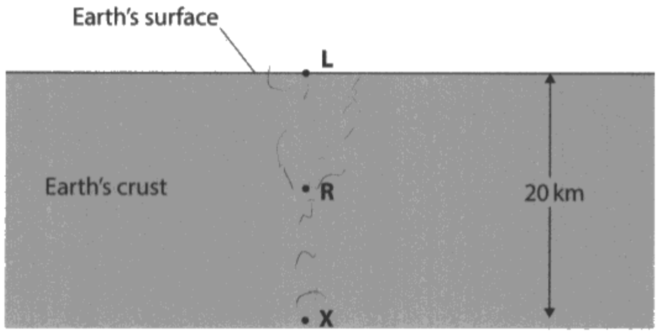


Figure 17

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

(i) State **one** other example of a transverse wave.

(1)

Radio waves

ResultsPlus
Examiner Comments

Radio waves are equally acceptable.

(b) When an earthquake happens, waves are transmitted through the Earth.
Figure 17 is a diagram of a part of the Earth's crust.

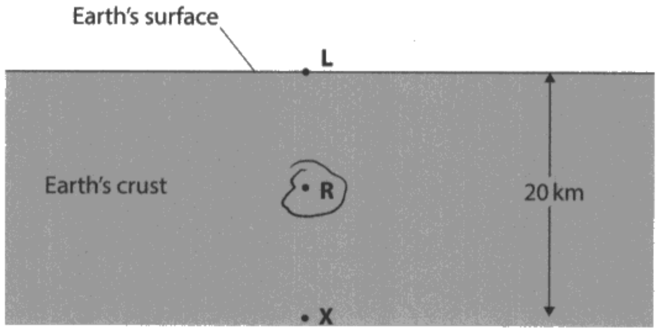


Figure 17

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

(i) State **one** other example of a transverse wave.

(1)

Sound waves

ResultsPlus
Examiner Comments

Quite a few candidates put this. It's not a transverse wave; it's longitudinal.

(b) When an earthquake happens, waves are transmitted through the Earth.
Figure 17 is a diagram of a part of the Earth's crust.

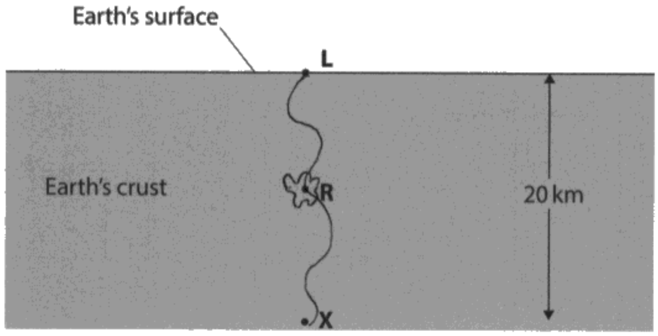


Figure 17

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

(i) State **one** other example of a transverse wave.

(1)

water wave

ResultsPlus
Examiner Comments

Water waves, ripples, even tsunamis were all accepted.

Question 9(b)ii

This question aimed to test candidates' knowledge and understanding of the movement of particles as a transverse wave passes through.

Many candidates did not get this intention though, talking from everyday knowledge about the shattering consequences of earthquakes.

We needed:

1. a simple statement about vibrations / oscillations occurring.
2. that the direction of oscillations is perpendicular to the direction the wave is travelling in.

(b) When an earthquake happens, waves are transmitted through the Earth. Figure 17 is a diagram of a part of the Earth's crust.

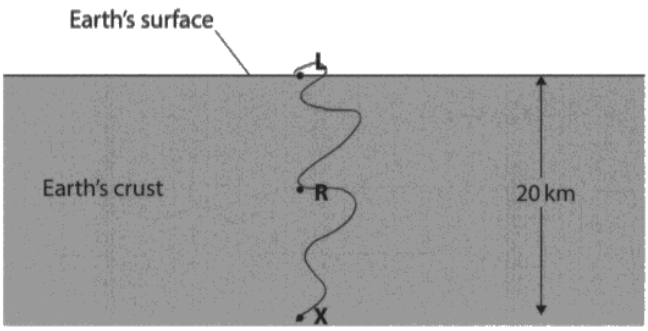


Figure 17

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

(i) State **one** other example of a transverse wave.

(1)

S - waves

(ii) A point in the crust is labelled **R** in Figure 17. There is a rock at point **R**.

Describe the effect that this earthquake wave has on the rock at **R** as the wave passes through the rock.

You may add to Figure 17 to help your answer.

(2)

Transvers - The vibration of waves oscillate pependicular to the direction of energy transfe. More force ~~and~~ with ~~major~~ impact

ResultsPlus
Examiner Comments

The expected response, essentially describing what a transverse wave is in terms of the motion of particles.

ResultsPlus
Examiner Tip

The aim is to test scientific knowledge, so think 'What scientific notions may explain the behaviour described?'

(b) When an earthquake happens, waves are transmitted through the Earth.
Figure 17 is a diagram of a part of the Earth's crust.

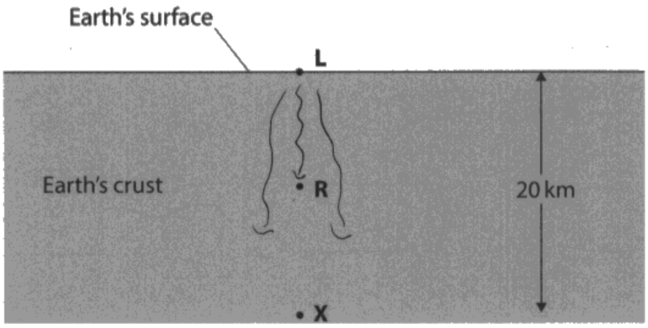


Figure 17

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

(i) State **one** other example of a transverse wave. **(1)**

light

(ii) A point in the crust is labelled **R** in Figure 17.
There is a rock at point **R**.

Describe the effect that this earthquake wave has on the rock at **R** as the wave passes through the rock.

You may add to Figure 17 to help your answer. **(2)**

Would vibrate and
move the ~~to~~ rock
with its energy

27

Turn over ▶

P 7 8 7 2 7 R A 0 2 7 3 6

ResultsPlus
Examiner Comments

This gets the mark for 'vibrate', without going further.

Question 9(c)

Q09(c) asked for analysis of GM tube data, with a particular source and absorbers – especially 4 sheets of paper and 3 cm of lead.

With the level-based mark scheme yielding:

- Level 1 – simple descriptions eg what paper does to alpha particles.
- Level 2 – observations from the provided table were used, linking such to the properties of alpha and / or gamma.
- Level 3 – answers used data from the table linked with scientific insights about the nature of alpha and gamma radiations, often coming to a supported conclusion that both alpha and gamma were present from the source.

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

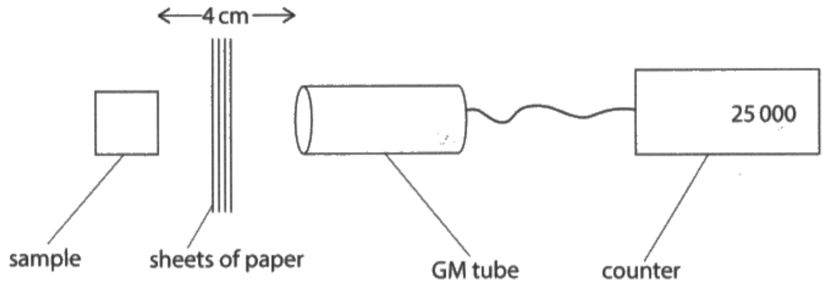


Figure 18

The results are shown in Figure 19.

The count rates are rounded to two significant figures.

The background radiation was 18 counts per minute (cpm).

absorber	count rate / cpm
none	33 000
4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

When the sample emits alpha or gamma radiation it's count rate changes. Sample has a radiation in it and

28

P 7 8 7 2 7 R A 0 2 8 3 6

without any materials between sample and GM tube it has it's strongest radiation 33000 cpm as thicker material is as lower the numbers on the GM tube will be. By using 4 sheets of paper radiation ~~increases~~ decreases to 25000 cpm from 33000 and by using 3 cm of lead radiation ~~increase~~ decreases more, to 4000 cpm from 25000.

(Total for Question 9 = 13 marks)

29

Turn over ▶

P 7 8 7 2 7 R A 0 2 9 3 6

ResultsPlus Examiner Comments

This represents a Level 1 answer, eg simply stating the count rate amounts upon the insertion of paper and then lead.

ResultsPlus Examiner Tip

This question is testing application of knowledge. To gain access to Level 2 marks the candidate would have to invoke more in the way of the scientific knowledge, linking absorptions with alpha and gamma radiation.

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

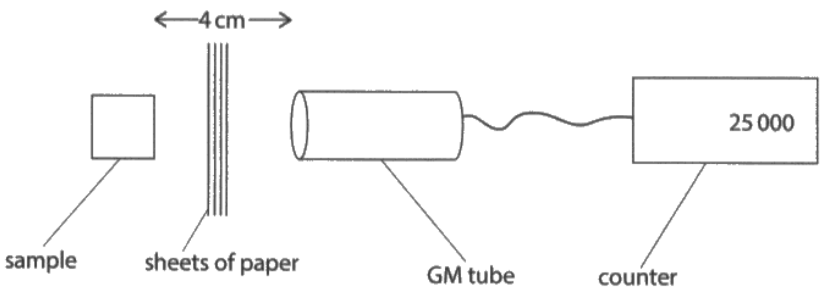


Figure 18

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4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

The Source emitts booth gamma and alpha radiation.
Alpha radiation would be Stopped by 4 Sheets of
paper ~~and lead~~. Because we can see a drop in the
reading after the paper, we can See that Some

P 7 8 7 2 7 R A 0 2 8 3 6

radiation is being stopped, but some even passes through the ~~test~~ lead which only gamma can do.

(Total for Question 9 = 13 marks)

ResultsPlus
Examiner Comments

This candidate actively links observational evidence with scientific knowledge about alpha and gamma radiation. They note, for instance, that the drop in count rate when you insert 4 sheets of paper, may be associated with alpha particle absorption. It is a Level 2 response. 4 marks are due.

ResultsPlus
Examiner Tip

Study the table. To take the mark to the next level more specific scientific arguments are needed. eg: there is a considerable reduction of the count rate when 4 sheets of paper, which corresponds with alpha being absorbed. There is a really big reduction in count rate when the lead is put in the way, which indicates gamma radiation presence. Some gets through the lead even.

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

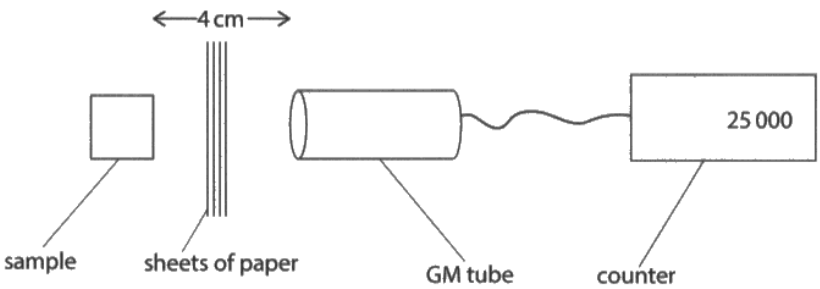

Figure 18

The results are shown in Figure 19.

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The background radiation was 18 counts per minute (cpm).

absorber	count rate / cpm
none	33 000
4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

Gamma radiation can only stop by putting ~~a~~ several cm of lead in front of it. Alpha radiation can pass through paper but not when there is several cm of paper. This proves that the sample emits gamma radiation. This is because it was been able to ~~[illegible]~~ pass through paper without ~~[illegible]~~ losing too much ~~[illegible]~~ radiation energy. And when it starts to pass through lead, there is a massive change in the radiation energy that has been lost. This shows that the sample is struggling to emit radiation through this lead. ~~[illegible]~~ This shows that the sample is ~~[illegible]~~ emitting gamma radiation. We can also tell that there ~~is~~ maybe some emition of alpha radiation. This is because there still was an energy loss when it was absorbed by the paper which shows that some of the radiation was lost. But this sample is mostly giving off, emitting, gamma radiation as the energy loss when it was passed through the ~~paper is much~~ lead is much larger than the energy loss when it was passed through the paper.

(Total for Question 9 = 13 marks)

ResultsPlus
Examiner Comments

This candidate talks about the effects of paper, linking to the alpha radiation, not with accuracy though – at one stage suggesting alpha can get through paper (one sheet). The effects of putting lead in the way are more successfully linked to gamma radiation's properties. Holistic judgement puts this as a solid Level 2, with 4 marks.

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

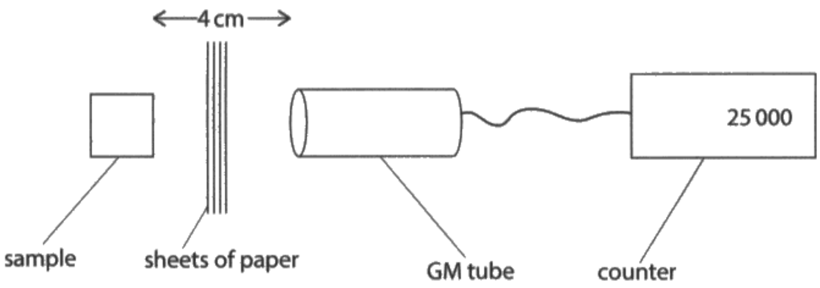


Figure 18

The results are shown in Figure 19.

The count rates are rounded to two significant figures.

The background radiation was 18 counts per minute (cpm).

Gamma stopped by lead
Alpha stopped by paper

absorber	count rate / cpm
none	33 000
4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

- Sample potentially emits both
- Count rate decreases with use of paper, alpha is stopped by paper, however it is not a significant decrease, therefore gamma is likely present.

- Lead stops gamma rays from being emmitted.
- When lead is put infront of the sample, there is a significant decrease in counts via gieger
- However there are still some being detected, however lead also stops alpha from being emitted
- Data shows that the sample contains a lot more gamma than it does alpha because there are still rays being admitted with the presence of paper, and paper stops alpha rays.

(Total for Question 9 = 13 marks)

29

P 7 8 7 2 7 R A 0 2 9 3 6

Turn over ▶

ResultsPlus
Examiner Comments

This is not a perfect answer – it doesn't have to be* to achieve Level 3 status. There are some very good logical links discussed when talking about paper as an absorber of alpha radiation, and gamma being indicated when talking about 'the significant decrease in counts via geiger' (with lead). 6 marks awarded.

(*talking about 'stopping alpha being emitted' is not true but, that may be an English language expression issue, and not necessarily indicative of a lack of understanding, given the wealth of scientific literacy shown in the rest of the argument).

ResultsPlus
Examiner Tip

Interrogate the data. What is it telling you? This candidate grapples with data, with critical thinking evident. Try and do likewise when you are presented with data. Inspect the data and question, 'Why is it showing that change? How big a change is there, and what does that tell me?'.

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

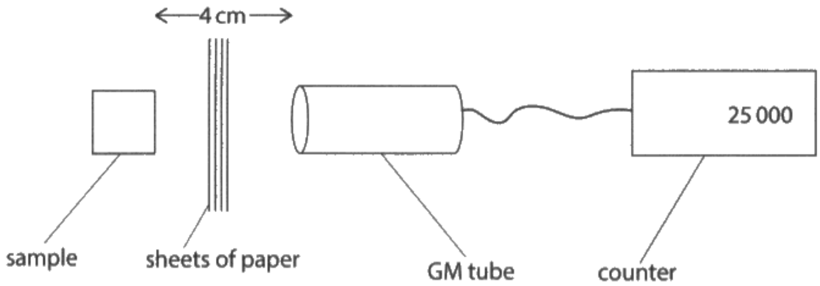


Figure 18

The results are shown in Figure 19.

The count rates are rounded to two significant figures.

The background radiation was 18 counts per minute (cpm).

absorber	count rate / cpm
none	33 000
4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

The sample could emits Alpha radiation as when the Sample was blocked by 4 sheets of paper, the count rate of the radiation by 8000 decreased.

However the sample's radiation ~~didn~~ didn't get completely decreased, only a medium sized amount. ~~It~~

The sample could contain gamma radiation as it wasn't fully blocked by the 4 sheets of paper ~~by~~ but was almost completley blocked by the 3cm of lead as it went from 33,000cpm ~~[illegible]~~ to 4000cpm.

This ~~could~~ means the sample contains both Alpha and gamma radiation as 8000cpm was blocked by the 4 sheets of paper meaning theres a presence of Alpha radiation with 25000cpm of gamma radiation which was blocked by 3cm of lead and decreased the count rate to 4000, meaning there's also a presence of gamma. They are both present in the sample.

(Total for Question 9 = 13 marks)

29

Turn over ▶

P 7 8 7 2 7 R A 0 2 9 3 6

ResultsPlus
Examiner Comments

This is a clear Level 3 answer, showing great skill in analysing the data eg in the use of calculated differences. The science content is excellent, even more secure than the previous example. The answer also exhibits exemplary cautiousness in their conclusion as they talk about 'could emit(s) alpha... could contain gamma, as it wasn't fully blocked...', 6 marks due.

ResultsPlus
Examiner Tip

Admission of uncertainty in conclusions shows high level scientific thinking. That's the way scientific researchers often express their ideas. Being cautious in your conclusions shows a mature scientific approach.

Question 10(b)i

This question involved reading off a graph to calculate a percentage remaining.

The calculation should be:

- reading at 150 minutes x 100
- original reading (50)

Values between 38% and 40% were allowed in the final answer.

(b) The isotope fluorine-18 is used in PET scans, which help to detect cancers.

Figure 20 shows a radioactive decay curve for a sample of fluorine-18.

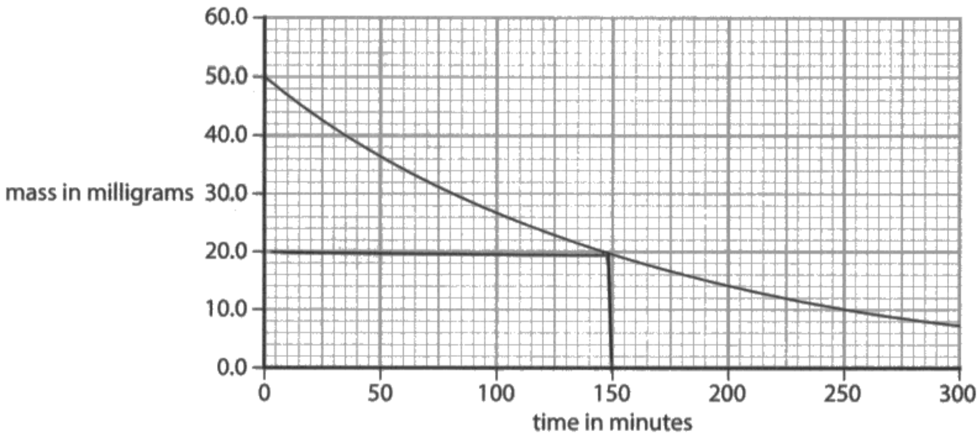


Figure 20

(i) Use the graph to calculate the percentage of fluorine-18 remaining after 150 minutes.

20mg

$$\frac{20}{50} \times 100$$

$$= 40$$

(2)

percentage of fluorine-18 remaining after 150 minutes = 40 %

ResultsPlus
Examiner Comments

This is set out in an excellent manner, achieving full marks. How they got the value (of 20) from the graph and the calculation, are both clearly shown.

ResultsPlus Examiner Tip

Look to communicate what you are doing, in your answers, like this.

(b) The isotope fluorine-18 is used in PET scans, which help to detect cancers.

Figure 20 shows a radioactive decay curve for a sample of fluorine-18.

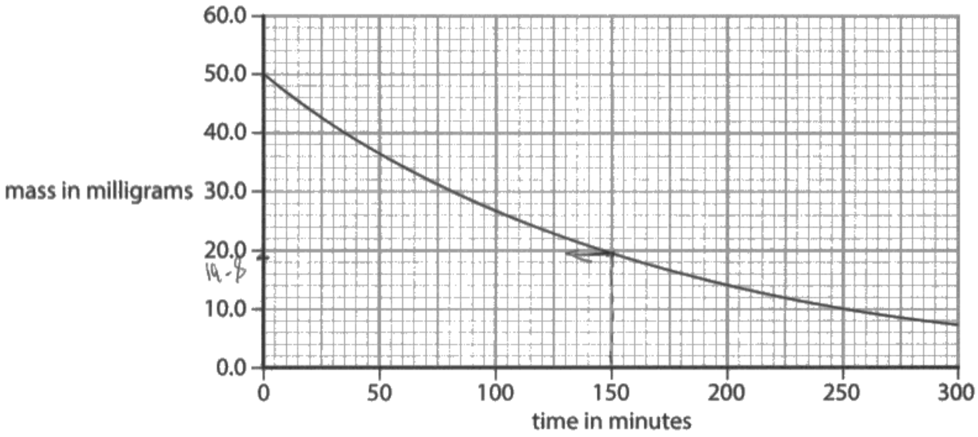


Figure 20

(i) Use the graph to calculate the percentage of fluorine-18 remaining after 150 minutes.

(2)

$\frac{19.8}{50} \times 100 = 39.6\%$

$100 - 39.6\% = 60.4$

percentage of fluorine-18 remaining after 150 minutes = 60.4 %

ResultsPlus Examiner Comments

This gets the first marking point only, for reading off the graph. Their final answer, mistakenly, has involved a subtraction from 100%, which would be the % that has decayed, which was not asked for.

Question 10(b)ii

This question asked what happens when positrons meet electrons.

It was found to be quite demanding.

A significant number of candidates scored one mark, often for mentioning that they would collide.

(ii) Fluorine-18 releases positrons.

Describe what happens when positrons meet electrons.

(2)

They collide with eachother anhilatating themselfs causing 2 rays of gamma to be produced travaling in opposite direcons

ResultsPlus
Examiner Comments

This is a rarely found answer worth 2 marks, gaining those marks for (they) 'collide' and 'annihilating'.

(ii) Fluorine-18 releases positrons.

Describe what happens when positrons meet electrons.

(2)

The 2 nuclei fuse and cancel the charges.

![ResultsPlus Examiner Comments]

ResultsPlus
Examiner Comments

This achieved a mark for talking of 'cancel the charges' – see additional guidance in the mark scheme.

(ii) Fluorine-18 releases positrons.

Describe what happens when positrons meet electrons.

(2)

They ~~annhilate~~ ~~anihil~~ ~~anhi~~ annihilate and are both destroyed.

ResultsPlus
Examiner Comments

One mark for 'annihilate'.

(ii) Fluorine-18 releases positrons.

Describe what happens when positrons meet electrons.

(2)

The collide to form a neutral charge.

positron = +1 charge, electron = -1 charge.

-1+1 = 0 = neutral

ResultsPlus
Examiner Comments

Two marks for 'collide' and 'form a neutral charge' (see additional guidance in the mark scheme).

Question 10(c)

This question asked for an explanation of what happened in the original interaction of **one** neutron with **one** uranium nucleus (the **beginning** of a chain reaction).

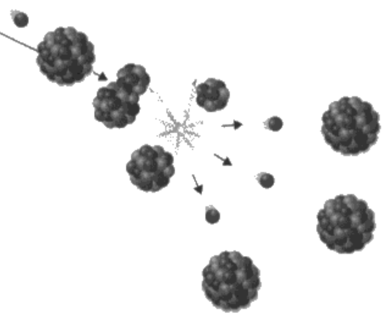
It's always important to read the question carefully, not going further that that original interaction.

Three marks were available from a list of 5 possible:

1. neutron absorbed (into uranium) (1).
2. (causing) nucleus becomes unstable (1).
3. (so nucleus) breaks up / splits (into two nuclei) (1).
4. (then) releasing (more) neutron(s) (1).
5. releases gamma rays / energy (1).

(c) Figure 21 shows what happens during a fission chain reaction.

uranium nucleus



(Source: © Designua/Shutterstock)

Figure 21

Explain what happens when **one** neutron interacts with **one** uranium nucleus.

(3)

The uranium nucleus splits into two lighter nuclei, ~~which then~~ and three neutrons are released, which then go on to ~~the~~ collide with other uranium, heavy nuclei and a chain reaction happens.

32

P 7 8 7 2 7 R A 0 3 2 3 6

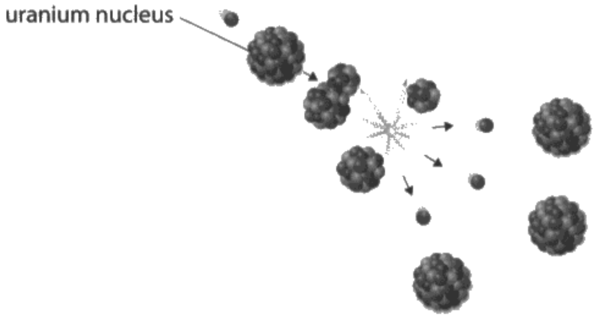
ResultsPlus
Examiner Comments

Mark points 3 and 4 observed. 2 marks awarded.

ResultsPlus
Examiner Tip

This candidate has then gone beyond explaining the first interaction. Since beyond this was not asked for the last two lines were a waste of the candidate's time. The 'collide' there was in the wrong context.

(c) Figure 21 shows what happens during a fission chain reaction.



(Source: © Designua/Shutterstock)

Figure 21

Explain what happens when **one** neutron interacts with **one** uranium nucleus.

(3)

When a neutron interacts with one uranium nucleus, they collide and it causes them to go and break into little pieces.

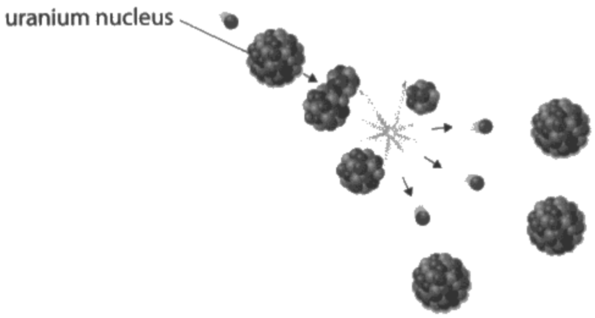
32

P 7 8 7 2 7 R A 0 3 2 3 6

ResultsPlus
Examiner Comments

'Collide' gets the first mark point (additional guidance) and then mark point 3 as well.

(c) Figure 21 shows what happens during a fission chain reaction.



(Source: © Designua/Shutterstock)

Figure 21

Explain what happens when **one** neutron interacts with **one** uranium nucleus.

(3)

The ~~nut~~ nuetron causes the uranium nucleus to ~~st~~ split causing more nuetrons to fire out splitting other uranium nucleus ~~creating~~ releasing energy

32

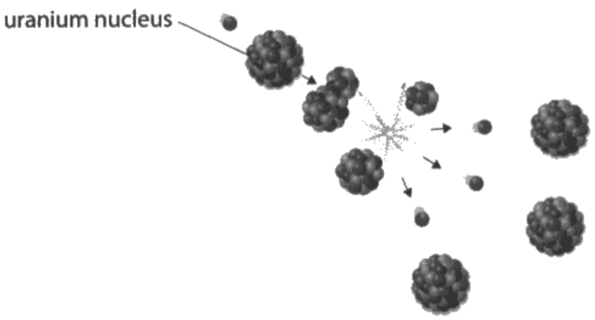
ResultsPlus
Examiner Comments

Mark points 3, 4 and 5 seen.

ResultsPlus
Examiner Tip

The candidate's answer is brief and to the point – very succinct – getting all three marks. Being able to fill in all the lines of the answer space is not necessarily a good thing.

(c) Figure 21 shows what happens during a fission chain reaction.



(Source: © Designua/Shutterstock)

Figure 21

Explain what happens when **one** neutron interacts with **one** uranium nucleus.

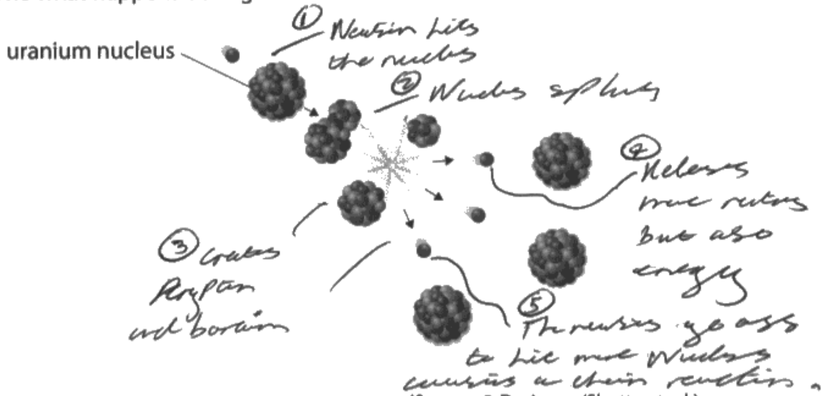
(3)

When a neutron is fired /interacts with one uranium nucleus it splits. This is because the uranium nucleus is already unstable so the neutron interacting with it will make it even more unstable and the uranium nucleus will split into ~~tt~~ two smaller/ daughter nuclei. Lots of energy is given off.

ResultsPlus Examiner Comments

Mark points 2, 3 and 5 seen.

(c) Figure 21 shows what happens during a fission chain reaction.



(Source: © Designua/Shutterstock)

Figure 21

Explain what happens when **one** neutron interacts with **one** uranium nucleus.

(3)

When a neutron hits a nucleus of Uranium, the nucleus splits into two creating krypton and barium. The splitting also creates other neutrons to be fired out but also a lot of energy is released. The neutron's ~~[illegible]~~ released from the splitting go on to hit more uranium nucleus causing a chain reaction.

32

P 7 8 7 2 7 R A 0 3 2 3 6

ResultsPlus
Examiner Comments

Mark points 3, 4 and 5 are seen. These are also echoed in the candidate's annotated diagram.

ResultsPlus
Examiner Tip

It often helps to work things out in a given diagram.

Question 10(d)

This question asked for the calculation of a ratio to 2 significant figures.

To get the second mark required the evaluation **and** the 2 s.f.

(d) In 2023, Finland produced 4.4 GW of power from nuclear power plants.

The UK produced 8.9 GW of power from nuclear power plants.

Calculate the ratio of nuclear power produced in Finland compared with the UK as

$$\frac{\text{power production in Finland}}{\text{power production in the UK}}$$

Give your answer to 2 significant figures (2 s.f.).

(2)

$$\frac{4.4}{8.9} = 0.4943820225$$

$$= 0.49$$

ratio = 0.49

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

33

P 7 8 7 2 7 R A 0 3 3 3 6

ResultsPlus
Examiner Comments

Both marks clearly satisfied.

(d) In 2023, Finland produced 4.4 GW of power from nuclear power plants.

The UK produced 8.9 GW of power from nuclear power plants.

Calculate the ratio of nuclear power produced in Finland compared with the UK as

$$\frac{\text{power production in Finland}}{\text{power production in the UK}}$$

Give your answer to 2 significant figures (2 s.f.).

(2)

$$\frac{4.4}{8.9} \overset{\times 10}{=} \frac{44}{89}$$

ratio = 44 : 89

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

33

P 7 8 7 2 7 R A 0 3 3 3 6

ResultsPlus
Examiner Comments

One mark for the ratio in fractional form. This is the first mark point.

(d) In 2023, Finland produced 4.4 GW of power from nuclear power plants.

The UK produced 8.9 GW of power from nuclear power plants.

Calculate the ratio of nuclear power produced in Finland compared with the UK as

$$\frac{\text{power production in Finland}}{\text{power production in the UK}}$$

Give your answer to 2 significant figures (2 s.f.).

(2)

$$\frac{4.4}{8.9} = 0.\dot{4}9$$

1 : 0.49

ratio = ~~0.49~~

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

33

P 7 8 7 2 7 R A 0 3 3 3 6

ResultsPlus
Examiner Comments

The additional guidance says 'accept 1(.0): 0.49' for the evaluation.

(d) In 2023, Finland produced 4.4 GW of power from nuclear power plants.

The UK produced 8.9 GW of power from nuclear power plants.

Calculate the ratio of nuclear power produced in Finland compared with the UK as

$$\frac{\text{power production in Finland}}{\text{power production in the UK}}$$

Give your answer to 2 significant figures (2 s.f.).

(2)

$$\frac{4.4}{8.9}$$

ratio = 0.5

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

ResultsPlus
Examiner Comments

1 mark for the fraction. The candidate then gives the answer to one significant figure, so can't be credited with the second mark point.

Paper Summary

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

- Candidates did well on questions which provided equations for them, involving straightforward substitutions. They did less well on handling powers of ten and the units involved. These involved converting centimetres to metres in Q01(b) and converting kJ (kilo joules) into joules in Q05(c)(ii).
- Candidates mostly did well when it came to graphical interpretations including the results of a refraction experiment, velocity-time graphs, a graph of wind power generation from 1995 to 2025, and a force-height graph.
- A lack of comprehension concerning command words is still seen, especially with 'Describe how' questions, which require experimental descriptions. For instance, Q02(b) required describing the steps needed to find the density of a metal key and Q04(b)(i) was asking candidates to propose the steps in an investigation of carried weight and deflection for a cantilever system. As ever the question had a novel, but simplified scenario, with a clear diagram. Candidates often delved into conjecture about 'what would happen', as opposed to communicating practical steps. There is a clear need for candidates to imagine their instructions being read by someone else, who was then able to follow the instructions given.

Successful candidates were:

- Well-acquainted with the content of the specification.
- Skilled as a result of having been engaged with practical work during their course.
- Competent in quantitative work, especially in using equations.
- Well-focused in their comprehension of the question-at-hand.
- Willing to apply physics principles to the novel situations presented to them.

Less successful candidates:

- Had gaps in their conceptual knowledge of the topics of this paper.
- Had gaps in their procedural knowledge, relating to their practical work.
- Misread and / or misunderstood the symbols used in equations.
- Did not focus sufficiently on what the question was asking.
- Found difficulty in applying their knowledge to new situations.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link: https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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