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Examiners' Report
June 2018

GCSE Science 1SC0 1PH

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Introduction

This was the first examination of paper 1P, at Higher Level, for the new specification. Questions were set to test students' knowledge, application and understanding from these seven topics in the specification:

- Topic 1 – Key concepts of physics
- Topic 2 – Motion and forces
- Topic 3 – Conservation of energy
- Topic 4 – Waves
- Topic 5 – Light and the electromagnetic spectrum
- Topic 6 – Radioactivity

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three or four marks each. There was a new emphasis, too, in the inclusion of questions designed at targeting students' knowledge and understanding of practical work. This included assessing their fundamental knowledge of practicals specified in the specification, together with further application, especially where they were asked to propose improvements to a procedure. The assessment of students' mathematical skills involved recall of some equations and became more demanding as the paper progressed. There was also an extended open response question, worth six marks.

Successful candidates:

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

Less successful candidates:

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

- found difficulty in applying their knowledge to new situations

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

Question 1 (a) (iii)

To answer this question fully, candidates had to appreciate that there was a range of angles for which there was no data and suggest a procedure for this particular context.

Most candidates knew that measurements should be repeated.

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

To test this, the student must repeat the investigation to ensure their values for each as accurate as possible. This will allow for them to then create a conclusion.

ResultsPlus
Examiner Comments

Although this has the idea of repeating measurements, it does not recognise that more angles should be used in order to give a wider range of values to verify the conclusion.

1 mark out of 3.

Examiners saw many very good answers.

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

Investigate using more degrees. For example place the light at 30°, 40° and 50°, if ~~the light~~ the graph is still a ~~straig~~ straight line the student has tested this conclusion in more detail

ResultsPlus
Examiner Comments

A much clearer answer that scored all three marks.

Question 1 (b)

Calculations involving electromagnetic radiation will usually contain numbers in standard form. This was tested here; the rearranged equation having been given in the question.

(b) The speed of light is 3.0×10^8 m/s.

The wavelength of yellow light is 5.8×10^{-7} m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

$$\text{frequency} = \frac{\text{speed}}{\text{wavelength}}$$

(3)

$$\frac{3.0 \times 10^8}{5.8 \times 10^{-7}} = 5.172413793$$

frequency = 5.17 unit Hz

ResultsPlus
Examiner Comments

Many candidates seemed uncertain about numbers in standard form and simply ignored the powers of ten in their evaluation.

Question 2 (a)

Candidates here are required to apply their knowledge and understanding of measuring radioactivity to devise a method for comparing the count-rates from two different rocks. Credit is given for knowing how a GM tube is used and what steps should be taken to make a fair comparison.

Some candidates had a clear recollection of seeing a GM tube and counter in use.

2 Figure 3 shows a Geiger-Müller (GM) tube used for measuring radioactivity.

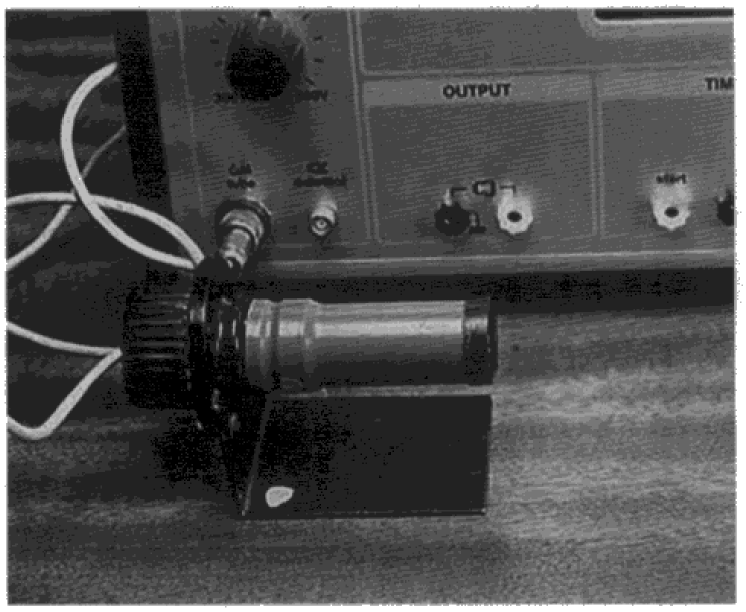

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Figure 3

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

Fistly the teacher Should measure background radiation for a minutte 3 times for an average then take this away from the final results of the rock He Should use the Geiger-Müller again to measure Rock 1 for a minutte then repeat 3 times for an average, do the same for rock 2 and take away the background radiation for exact results.

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Examiner Comments

This is a very clear answer that describes in detail the correct procedure. Full marks.

Many candidates seemed to think that the samples should be placed inside the GM tube.

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

Place one radioactive rock into the GM tube and record the count rate. Then remove the rock and place ~~ta~~ it back into its ~~radioactive~~ led case to prevent it from affecting the next reading. Then place the next radioactive rock into the GM tube and record the count rate. Then look at the difference.

ResultsPlus
Examiner Comments

There is only one mark here for the idea that each rock should be tested independently.

Some candidates spent time in writing about how the apparatus works rather than how it should be used.

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

The teacher may use a rock emmitting alpha radiation, the (GM) tube will count the amount of alpha radiation by making a clicking sound. The teacher may then use a rock emmitting Beta ~~part~~ radiation, the teacher may then place lead infront of the rock to see how strong the radiation is. Also the (GM) tube, the faster the clicks, the higher the radiation, so the more dangerous it is.

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Examiner Comments

This answer was typical of many that seemed to confuse different experiments involving radioactivity. The examiner could only award one mark (for the idea of testing each rock independently).

Question 2 (b)

Candidates were asked to analyse some information about half-life to complete a graph. Full credit could be gain by either plotting three points from the information or two points and an appropriate curve.

Question 3 (a)

Here, examiners were looking for reference oscillations in the air and the direction of the oscillations in relation to the direction of travel of the sound wave.

Many candidates made no reference to the air.

3 (a) Figure 5 shows a tuning fork.

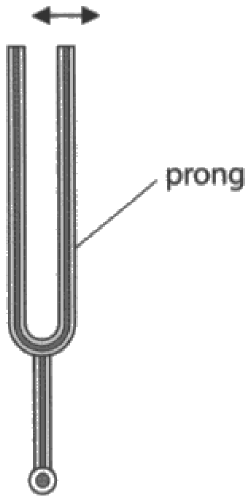

Figure 5

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 5.

Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

The vibrations of the tuning fork are parallel to the direction of the wave. ~~Sound waves are~~ This is longitudinal which compres waves making them have high pressure.

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Examiner Comments

Although there is a mark for identifying that sound waves are longitudinal, there is no description of the movement of air particles.

1 mark out of 2.

3 (a) Figure 5 shows a tuning fork.

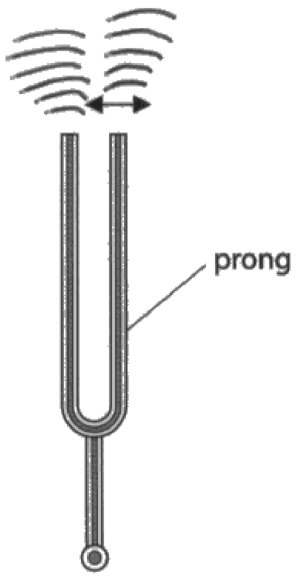

Figure 5

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 5.

Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

This is because the vibrations travel through the air as longitudinal waves. The vibrations cause the air to vibrate which causes the sound.

ResultsPlus
Examiner Comments

A much clearer answer that correctly describes the vibrations of the air particles.

Question 3 (c)

Candidates were required to apply their knowledge and understanding of the relationship between refraction, speed and wavelength to explain the dispersion of light at an air-glass boundary.

(c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain, in terms of speed, why the light behaves like this.

(3)

light moves very fast, so fast that you are unable to see the colours it is made up of. When it goes from air to glass, glass is denser than air which slows the light down. This means ~~to~~ it breaks up the ~~ele~~ colours and we are able to see the ~~electromag~~ colours of the spectrum.

ResultsPlus
Examiner Comments

Examiners saw many answers like this one. It implies that colours only become visible when light slows down.

(c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain, in terms of speed, why the light behaves like this.

(3)

Light travels at different speeds in different mediums. When light hits the boundary of the glass at an angle, the light wave is refracted. Lightwaves travel faster in air than in glass. When the lightwaves hit the glass, the ~~speed of the~~ lightwaves slowdown and bend towards the normal. The different colours have different wavelengths so their speed ~~d~~ varies in the glass.

ResultsPlus
Examiner Comments

This is a better answer that makes two mark points on the last two lines. However, it does not fully explain why the colours split up at the air/glass boundary.

2 out 3 marks.

Examiners saw many good answers.

(c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain, in terms of speed, why the light behaves like this.

(3)

The different colours slow down at different rates which means they refract in different angles and split. Also, velocity = frequency x wavelength and each colour has a different wavelength meaning if frequency is the same, they must move at different speeds

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

A clear answer that scored full marks.

Question 4 (c)

All three readings in (b)(ii) and the calculated reading in (b)(i) were significantly below the accepted value for *g*. This, and the method described in (b)(i), meant that examiners were looking for improvements to the procedure in part (b) that would eliminate or reduce the effect of human reaction time.

(c) Explain **one** way the students could improve their procedure to obtain a more accurate value for *g*.

(2)

Repeat the experiment to get more values. ~~Bs~~ Therefore a more accurate mean can be calculated.

ResultsPlus
Examiner Comments

Examiners saw very many answers like this one. The candidate has not appreciated possible sources of error.

There were no marks scored here.

ResultsPlus
Examiner Tip

Repeating measurements is important but it will not remove the reasons for errors in those measurements.

(c) Explain **one** way the students could improve their procedure to obtain a more accurate value for *g*.

(2)

They could use electronic sensors instead of them using a stop watch as it eliminates room for human error.

ResultsPlus
Examiner Comments

Electronic sensors were allowed as a suitable improvement for one mark. However, it is not clear from this response what human error would be removed.

1 mark out of 2.

(c) Explain **one** way the students could improve their procedure to obtain a more accurate value for *g*.

(2)

~~Do the experemen~~ use light gates so that human error is not involved such as human reaction time to stop a stop watch.

ResultsPlus
Examiner Comments

Here it is clear that human reaction time is a source of error and that a system using light gates would remove that error.

Full marks.

Question 4 (d)

Candidates were asked to use an equation selected from the list of equations at the end of the paper. They then had to rearrange the equation to find deceleration.

Partial credit can be awarded for clearly applying the correct equation; even if the final evaluation is incorrect.

(d) A car travelling at 15 m/s comes to rest in a distance of 14 m when the brakes are applied.

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

(3)

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

speed =
distance = 14m

$(0^2) - (15^2) = 2 \times \underline{\underline{a}} \times 14m$

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

$a = 2 \times 14m - (0^2 - 15^2)$

$= 253$

deceleration = 253 m/s²

ResultsPlus
Examiner Comments

The candidate has selected the correct equation and correctly substituted the given values. This scores 1 mark; even though the subsequent rearrangement is incorrect.

(d) A car travelling at 15 m/s comes to rest in a distance of 14 m when the brakes are applied.

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

(3)

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

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

$$a = \frac{0 - 15}{2 \times 14} = -0.5\dot{3}571428\dot{}$$

deceleration = -0.5 m/s²

ResultsPlus
Examiner Comments

Here the candidate has selected the correct equation and chosen to rearrange it first of all. The rearrangement is correct for 1 mark. However, the substitution omitted squaring the velocity and did not score any further marks.

1 mark out of 2.

ResultsPlus
Examiner Tip

Always show your working. You may score marks even if your final answer is wrong.

Question 5 (c) (i)

The question stated that the water gained kinetic energy by falling from the top of a dam. Candidates, therefore, had to recall and use the equation for change in gravitational potential energy, involving a rearrangement, to calculate the minimum height the water must fall.

Many candidates attempted to use the wrong equation.

(c) Electricity can be generated using a water turbine.

(i) Water gains kinetic energy by falling from the top of a dam.

Calculate the minimum height that 7.0 kg of water must fall to gain 1300 J of kinetic energy.

(3)

Kinetic energy = ½ mass × ~~velocity~~ speed^2

1300 J = ½ × 7.0 × speed^2

$\frac{1300}{\frac{1}{2} \times 7.0}$ = speed^2

= 371.428571

= $\sqrt{Ans}$

= 19.27248223

= 19.27

minimum height = 19.27 m

ResultsPlus
Examiner Comments

The candidate has not appreciated that quantities given in the question cannot be used in the kinetic energy equation.

(c) Electricity can be generated using a water turbine.

(i) Water gains kinetic energy by falling from the top of a dam.

Calculate the minimum height that 7.0 kg of water must fall to gain 1300 J of kinetic energy.

(3)

GPE = Mass x GMF x hΔ
10 N/kg

~~KE = 1/2 x mass x (speed)^2~~

~~1/2 x 7.0~~

$$\Delta h = \frac{GPE}{Mass \times GMF}$$

$$\Delta h = \frac{1300}{7.0 \times 10} = 18.5714385 7$$

~~speed = d/t~~

minimum height = 18.571 m

ResultsPlus
Examiner Comments

Correct equation and method leading to a correct answer for full marks.

Question 5 (c) (ii)

This required recall and use of the equation for kinetic energy, involving rearrangement and taking a square root.

A mark was awarded for recall of the equation for kinetic energy; even if the substitution and rearrangement was wrong.

(ii) As water enters the turbine at the bottom of the dam, the kinetic energy of 8.0 kg of moving water is 1100 J.

Calculate the speed of the moving water as it enters the turbine.

(3)

$1100 \div \frac{1}{2} \times 8000 = \sqrt{17600000} = 4195.23$

speed = 4195.24 m/s

ResultsPlus
Examiner Comments

Although there would be a mark for recalling the equation for kinetic energy, this is not the case here. Examiners will not credit "triangles" in place of equations.

ResultsPlus
Examiner Tip

Triangles may be a helpful way of remembering some equations but they will not score any marks. Always write the equation out in words or symbols.

(ii) As water enters the turbine at the bottom of the dam, the kinetic energy of 8.0 kg of moving water is 1100 J.

Calculate the speed of the moving water as it enters the turbine.

(3)

$Ke = \frac{1}{2} \times mass \times speed^2$

$\frac{1100}{\frac{1}{2} \times 8^2} = 725$

speed = 34.375 m/s

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Examiner Comments

This answer does get a mark for recall of the equation even though the substitution and rearrangement was incorrect.

1 mark out 3.

Question 5 (d)

This was quite a complex calculation that required recall and use of the efficiency equation, involving interpretation of an unfamiliar graph.

(d) Moving air can be used to generate electricity using a wind turbine.

Figure 6 is a graph of kinetic energy against wind speed for a mass of moving air.

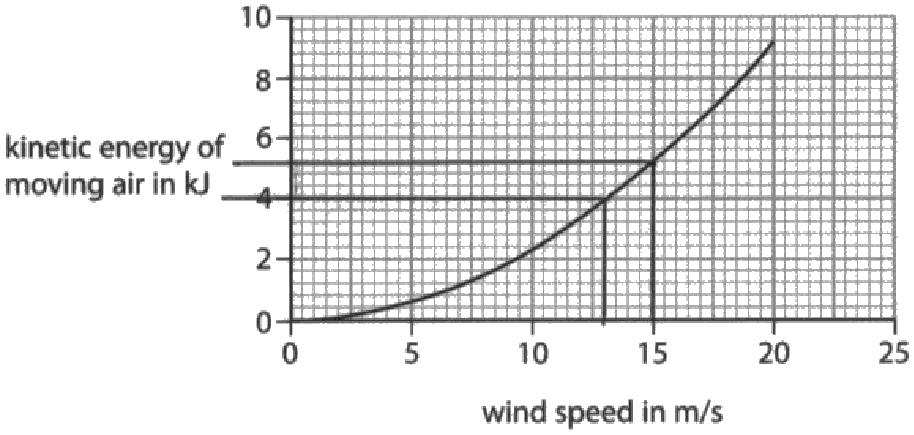

Figure 6

Just before the air reaches a wind turbine it has a wind speed of 15 m/s.

When the air has gone through the turbine it has a wind speed of 13 m/s.

As the air moves through the turbine some of its kinetic energy is transferred to the turbine.

Use the graph to determine the percentage of the kinetic energy transferred to the turbine from the air.

(3)

15m/s = 5.2 kJ

13m/s = 4kJ.

5.2 − 4 = 1.2

5.2 = 100%

((100 ÷ 5.2) × 1.2) = 23.

percentage of kinetic energy transferred from the air = 23 %

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Examiner Comments

A well-reasoned response that produced an acceptable answer.

Full marks.

(d) Moving air can be used to generate electricity using a wind turbine.

Figure 6 is a graph of kinetic energy against wind speed for a mass of moving air.

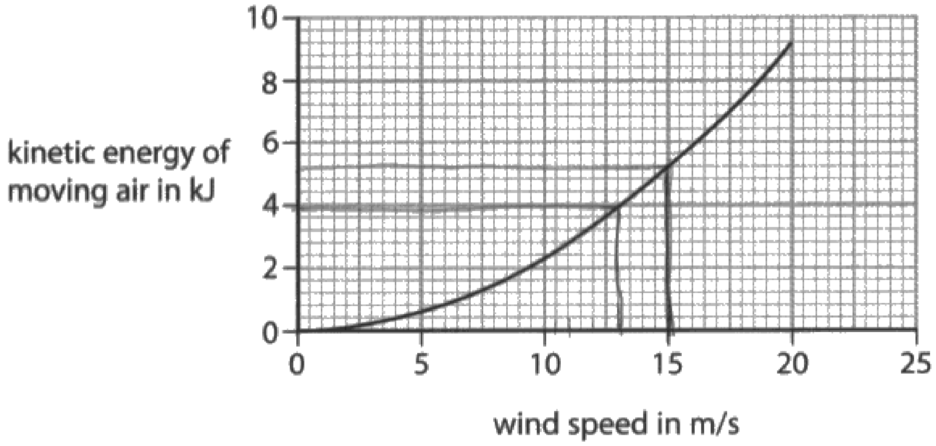

Figure 6

Just before the air reaches a wind turbine it has a wind speed of 15 m/s.

When the air has gone through the turbine it has a wind speed of 13 m/s.

As the air moves through the turbine some of its kinetic energy is transferred to the turbine.

Use the graph to determine the percentage of the kinetic energy transferred to the turbine from the air.

(3)

15 m/s is equivilent to 5.2 kJ

13 m/s is equivilent to 4 kJ

Percentage = $\frac{4}{5.2} \times 100 = 76.9$

percentage of kinetic energy transferred from the air = 76.9 %

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Examiner Comments

The candidate has interpreted the graph correctly and has read some values and so can score 1 mark.

Question 6 (a) (i)

This was about the procedures and techniques involved in a core practical.

Two different ways of increasing the accelerating force are possible.

6 (a) A student investigates the relationship between force and acceleration for a trolley on a runway.

Figure 7 shows some of the apparatus the student uses.

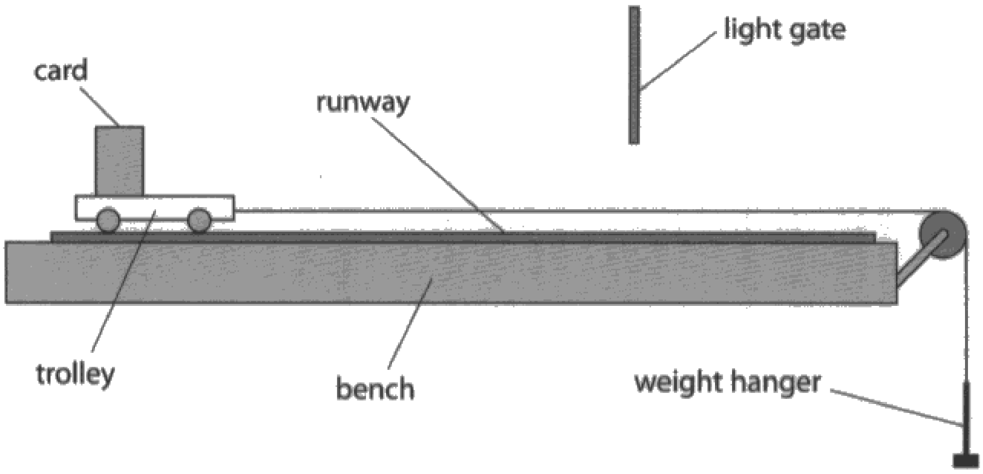

Figure 7

(i) Describe how the student could increase the accelerating force applied to the trolley.
(2)

Adding ~~to~~ more weight onto the weight hanger would increase the force on the trolly making it accelerate. The higher the mass the faster it accelerates.

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Examiner Comments

The most common acceptable method was to increase the number of weights on the weight hanger.

2 marks.

6 (a) A student investigates the relationship between force and acceleration for a trolley on a runway.

Figure 7 shows some of the apparatus the student uses.

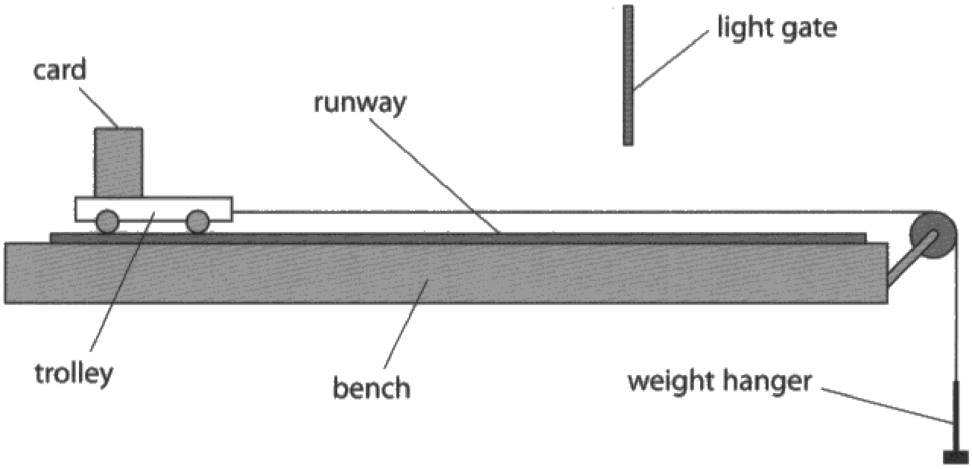

Figure 7

(i) Describe how the student could increase the accelerating force applied to the trolley.

(2)

If you pushed the bench down slightly, gravity would act as an extra force to make it roll down the bench faster and this would increase the acceleration.

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Examiner Comments

An alternative method was to incline the bench so that there was an additional force from gravity on the trolley.

Although this particular answer was somewhat poorly expressed, the meaning was clear enough for the examiner to award 2 out 2 marks.

6 (a) A student investigates the relationship between force and acceleration for a trolley on a runway.

Figure 7 shows some of the apparatus the student uses.

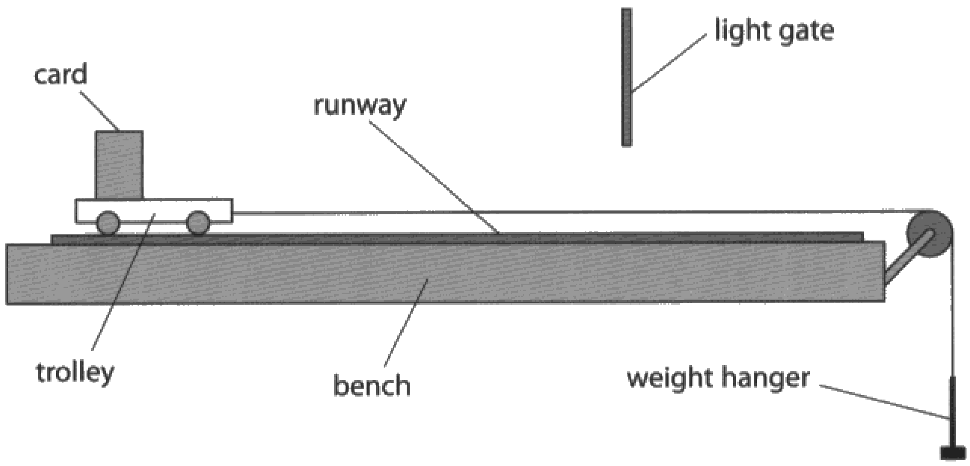

Figure 7

(i) Describe how the student could increase the accelerating force applied to the trolley.

(2)

He / she could make the ramp steeper so the trolley can move faster. They can do this by placing a block under the starting end of the runway.

ResultsPlus
Examiner Comments

However, this answer seems to confuse the speed of the trolley with the accelerating force. It scored just one mark for the idea of inclining the ramp.

Question 6 (a) (ii)

This part of the question appeared to present the greatest challenge.

(ii) Describe how the mass of the moving system can be kept constant.

(2)

It can be kept constant by not adding weight on to it, otherwise the mass will change and it would change the acceleration of the moving system.

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Examiner Comments

Examiners saw a very large number of answers like this one.

(ii) Describe how the mass of the moving system can be kept constant.

(2)

The mass of the moving system can be kept constant by not deducting or adding any ~~weight~~ mass to the system, only by transferring the ~~weight~~ mass within the system. E.g) adding more ~~weig mas~~ weight to the hanger by taking it from the trolley. By keeping it a closed system.

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Examiner Comments

This candidate has clearly remembered an important part of this core practical and the answer scored full marks.

Question 6 (b)

This extended open response question was based on specification point 2.23. This requires candidates to recall and apply Newton's third law to a collision and relate it to the conservation of momentum in the collision. Level 3 could be achieved by a detailed statement of how Newton's third law applies to this collision, developed to show how this leads to the idea of conservation of momentum.

Level 1 answers showed recall of at least one of Newton's laws and often had the idea of momentum transfer. However it may not be clearly related to this situation.

*(b) Figure 8 shows two objects, Q and R, before and after they collide.

Figure 8

The arrows show the direction of movement of the objects.
The arrows are not to scale.

Explain how momentum is conserved in the collision.

Use Newton's third law and Newton's second law in your answer.

Newton's second law can be written as

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

(6)

There is an equal and opposite reaction to every action, therefore, object 'R' will begin to move in the same direction as 'Q' after the collision. The object will not move if the forces are balanced, so 'R' would remain stationary until struck by 'Q'. Due to 'R' being a smaller object than 'Q', 'Q' will not be stationary after the collision, it will just transfer momentum to 'R'.

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Examiner Comments

There is recall that "action and reaction are equal and opposite" together with the idea of momentum transfer. However, it is not clear what the action and reactions are.

Level 1 for 2 marks.

Level 2 answers used at least one of Newton's laws in context even if the explanation of the change in velocity and/or momentum after the collision was not complete.

Explain how momentum is conserved in the collision.

Use Newton's third law and Newton's second law in your answer.

Newton's second law can be written as

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

(6)

Newton's second law states that acceleration is directly proportional to the force of an object. This tendency ~~of~~ an object to keep moving is called momentum. Before the collision, object A has momentum as it is moving, when objects A and B collide they exert an equal and opposite force ~~be~~ ~~with~~ on each other (Newton's third law). As a result, when object A collides with object B, the momentum from object A is passed onto ~~the~~ object B consequently the momentum is conserved.

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Examiner Comments

Clear statement of Newton's third law in the context of this situation. It has the idea of momentum being transferred between the objects but not a complete explanation.

Level 2 for 4 marks.

Level 3 answers clearly applied Newton's laws to this situation.

Explain how momentum is conserved in the collision.

Use Newton's third law and Newton's second law in your answer.

Newton's second law can be written as momentum = mass x velocity

f = m x a $\quad$ $\text{force} = \dfrac{\text{change in momentum}}{\text{time}}$

(6)

Newton's third law is that when two objects interact, the force object A applies to object B is equal and opposite to the force object B applies to object A. Before the collision, the total momentum for the system would only be that of Q as R is stationary because no force is acting on it. After the collision, Q has hit R which causes R to accelerate and move. Some of the momentum of Q is lost and is transferred to R as they hit. As R is smaller it will ~~not accelerate as much as~~ more than Q because the larger an object the smaller the acceleration (of a fixed ~~f~~ resultant force). The two different momentums should then add up to the total momentum before the collision.

His second law is force = mass x acceleration ~~so the bigger the mass, the more acceleration~~ force ~~needed to produce the same acceleration.~~

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Examiner Comments

Newton's third law is used in context and it correctly explains the change in velocity of the two objects after the collision.

Level 3 for 6 marks.

Paper Summary

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

- make sure that they have a sound knowledge of the fundamental ideas in all the topics
- get used to the idea of applying their knowledge to new situations by attempting questions in support materials or previous examination papers
- when describing a practical procedure, make sure they are clear about what is to be measured and how the measurements will be taken. (Q2)
- when suggesting improvements or extensions to a practical procedure, make sure they are relevant to the context of the question and not just ‘repeat readings’. (Q1 and Q6)
- where a question involves a calculation, make sure they understand the physics of the situation before recalling or selecting an equation to use calculation. (Q5)
- make sure that they recognise SI prefixes such as m and k and n and how to handle these in calculations.
- use the marks at the side of a question as a guide to the form and content of their answer.

Grade Boundaries

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