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Examiners' Report
June 2018

GCSE Physics 1PH0 2F

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Introduction

This was the first examination of the new specification for Physics Paper 2 Foundation Tier. The questions were set to test, knowledge, application and the students' ability to analyse information and ideas having been taught the eight topics which make up the specification.

The topics covered by the specification are:-

- Topic 8 - Energy-forces doing work
- Topic 9 – Forces and their effects
- Topic 10 –Electricity and circuits
- Topic 11 –Static electricity
- Topic 12 -Magnetism and the motor effect
- Topic 13 – Electromagnetic induction
- Topic 14 – Particle model
- Topic 15 – Forces and matter

The assessment is through multiple choice questions, short answers, extended writing, calculations and analysis. New to this specification is the testing of the skills acquired by students when completing practical work. The specification includes core practicals which should be included in the scheme of work and a number of suggested practicals which exemplify points in the specification to help students' understanding.

The work produced for the examination showed that most students were able to deal with calculations when given the equation. Most students showed the substitution so that even with an incorrect evaluation a mark could be obtained. Students also coped well with questions on forces and energy and showed some knowledge of transformers but found the questions on pressure much more difficult.

Students were less successful when describing how measurements had to be made to determine a quantity in a practical situation, suggesting more emphasis needs to be placed on practising these skills throughout the course.

Static electricity was also a difficult topic for students to deal with especially as a knowledge of electric fields is now required.

Question 1 (a) (i)

The majority of candidates knew that electrical power was generated at a power station.

Question 1 (a) (ii)

The majority of candidates recognised that electricity is transmitted by the national grid.

Question 1 (a) (iii)

Most candidates realised that electricity is transmitted at high voltages so that heat loss is reduced.

Question 1 (c)

The majority of candidates scored two marks for the calculation. Most showed their working and substituted correctly in the equation. However some students confused primary and secondary voltages by not being aware of the significance of the subscripts.

Correct calculation showing correct substitution.

(c) In a small transformer

- the primary voltage is 230 V
- the primary current is 0.020 A
- the secondary voltage is 5.0 V

Calculate the secondary current.

Use the equation

$$I_s = \frac{V_p \times I_p}{V_s}$$

$$\frac{230 \times 0.020}{5.0}$$

(2)

secondary current = 0.92 A

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Examiner Comments

The correct voltages and current have been assigned according to the subscripts.

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Examiner Tip

Make sure you note the subscripts and relate p to primary and s to secondary when completing calculations on transformers.

Question 2 (a) (i)

Candidates were not able to score highly on this question being unable to describe how pressure is exerted by a gas in terms of the particles that are moving within the gas. No marks were awarded if there was no reference to particles.

A well written response which did not fully explain why the gas exerts a pressure.

2 (a) Figure 1 shows a fixed mass of gas inside a cylinder with a movable piston.

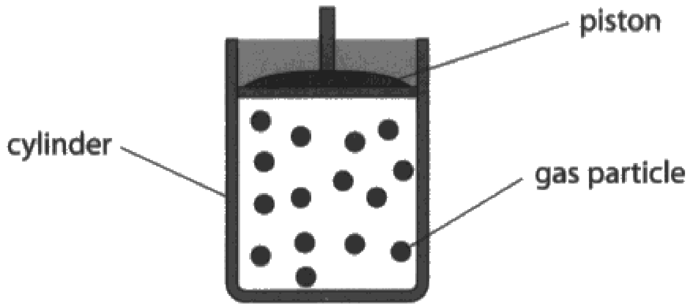

Figure 1

(i) Describe, in terms of **gas particles**, how the gas exerts a pressure on the cylinder.

(3)

The gas particles exert pressure on the cylinder as they have more energy to move around more, therefore they would be moving more and colliding with each other more if more are condensed in a smaller space.

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Examiner Comments

The candidate has made two relevant points:
the particles are moving
the particles collide

For the third mark, collision with the walls of the container must be included.

As the question requires a description of how the gas exerts a pressure on the cylinder there is no mark for restating this in the answer.

ResultsPlus
Examiner Tip

Remember particles have to collide with a sufrace in order to exert a pressure on it.

A well-written answer which shows an understanding of the behaviour of particles in a gas.

2 (a) Figure 1 shows a fixed mass of gas inside a cylinder with a movable piston.

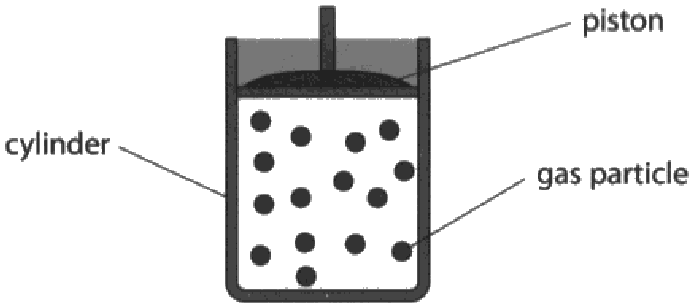

Figure 1

(i) Describe, in terms of **gas particles**, how the gas exerts a pressure on the cylinder.

(3)

The gas particles are moving around freely as they are not in fixed positions therefore they are bumping into each other and the sides. This creates ~~wave~~ a thermal energy which produces a pressure on the cylinder.

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Examiner Comments

The answer follows logically from particles moving, to collisions between particles and then to collisions with the sides. Another way to gain a mark would be to give that when particles hit the sides of a container they exert a force and it is this force which causes the pressure over the surface

ResultsPlus
Examiner Tip

Remember to consider gas particles and not the gas as a whole.

Question 2 (a) (ii)

A surprising large number of candidates did not appreciate that as the volume of a gas is reduced then the pressure exerted by the gas increases.

Question 2 (a) (iii)

More than half of the candidates were unable to state what happened to the particles in the gas when the volume of gas was reduced. Many are under the misconception that the particles themselves are compressed rather than the particles get closer together or collide more frequently.

Question 2 (b)

More than half the candidates were able to complete this calculation successfully. Errors occurred due to the inability of candidates to relate the information in the question to the subscripts used in the equation.

This response shows that candidates do not relate the correct volumes to the subscripts given in equation. This means that no marks are awarded as the substitution is incorrect.

(b) Figure 3 shows an oxygen cylinder.

Figure 3

The volume of the gas in the cylinder is 2100 cm^3.

When the gas is released into the atmosphere the volume of the gas is 8600 cm^3.

The pressure of the atmosphere is 98 kPa.

Calculate the pressure of the gas when it is in the cylinder.

Use the equation

$$P_1 = \frac{P_2 \times V_2}{V_1}$$

(2)

$$P = \frac{98 \times 2100}{8600} = 23.930232558\ldots$$

$$= 23.9$$

pressure of the gas in the cylinder = 23.9 kPa

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Examiner Comments

Most candidates correctly assigned the the pressure of the atmosphere to P_2 but did not realise that P_2 and V_2 both refer to the gas when it is released into the atmosphere and used the volume of gas in the cylinder as V_2

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Examiner Tip

Recognise that the subscripts refer to the gas in a particular situation, i.e. if P_2 is the pressure in the atmosphere then V_2 must be the related volume in the atmosphere.

This response gives a correct substitution and evaluation.

$$P_1 = \frac{98 \times 8600}{2100}$$ **(2)**

$$P_1 = 401.3$$

pressure of the gas in the cylinder = 401.$\dot{3}$ kPa

ResultsPlus
Examiner Comments

The candidate realises that provided the units of volume are the same then no conversion of units is required. Similarly for the pressure the answer line gives the pressure in kPa and this unit is also used in the question.

ResultsPlus
Examiner Tip

Remember that provided P_1 and P_2 have the same unit there is no need to apply a conversion. Similarly for V_1 and V_2.

Question 3 (c)

Attainment was low on this question. The idea of **induced** magnetism was not well understood. Students attempted explanations in terms of strange magnetic currents or through proposing adding more paperclips. This is a 'how to' experimental question requiring an understanding of the practical work undertaken.

Many candidates had carried out practical work adding paperclips to a magnet but did not understand that the paperclips became induced magnets when they were attached to the magnet.

(c) Figure 5 shows a magnet holding some paper clips.

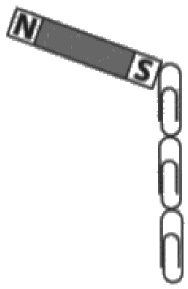

Figure 5

Describe how a student could show that the paper clips are induced magnets.

(2)

Attempt to join the paper clips without the magnet. And show after the magnet touches the paper clips. A current is run through.

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Examiner Comments

This response shows that the candidate understands that the paperclips do not behave in the same way when not attached to the magnet but does not understand why the paperclips are attracted to the magnet.

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Examiner Tip

Remember that magnetism involves forces of attraction and repulsion and that here are no currents flowing.

Gives a method of showing that the paper clips are induced magnets.

(c) Figure 5 shows a magnet holding some paper clips.

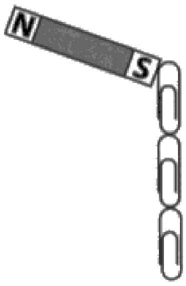

Figure 5

Describe how a student could show that the paper clips are induced magnets.

(2)

Place three ~~magnet~~ paper clips attached ^to the magnet as shown in the diagram, remove the magnet from the chain of paper clips, and see if the chain of magnets fail to join together. (fall apart)

ResultsPlus
Examiner Comments

The candidate has used the information shown in the diagram and clearly describes how to show that the paperclips are induced magnets, i.e. if the magnet is removed the paperclips will no longer join together.

ResultsPlus
Examiner Tip

Make notes when doing practical work to explain the effects that have been observed.

Question 3 (d)

Many candidates were unable to grasp the relatively simple way that you can show that the earth has a magnetic field, i.e. use a compass; it will always point north. A lot of students deliberated upon gravitational fields, or looking at the Earth from space. Once again many students did not focus on the 'how to' experimental description that was required.

The candidate described using the correct instrument but did not describe how it was to be used to show the Earth has a magnetic field.

(d) Describe how you could show that the Earth has a magnetic field.

(2)

By use a compass, a compass uses the earths magnetic field to track direction.

ResultsPlus
Examiner Comments

Only a partial answer, giving that a compass could be used but not describing how this would indicate a magnetic field.

ResultsPlus
Examiner Tip

Remember to describe how you know that there is a magnetic field when a compass is used.

The response gives a complete answer to the question.

(d) Describe how you could show that the Earth has a magnetic field.

(2)

by using a compass as the red bit on the arrow always points north.

ResultsPlus
Examiner Comments

The candidate describes that a compass could be used and how you know from looking at the compass that there is a magnetic field.

ResultsPlus
Examiner Tip

Remember if you are asked to show an effect you must say how the device you have chosen will do that.

Question 3 (e) (i)

The majority of candidates succeeded in identifying the north pole. Some placed their 'N' symbol too far away from the end of the bar so that it could not be credited. Also some put the 'N' at the end of the arrow representing the compass needle, this was inappropriate for the question, as it required the candidates to 'mark the north pole of the bar magnet ' and was therefore not credited

Question 3 (e) (ii)

About half of the candidates achieved some marks on this question. Some candidates gained one mark with a correct reference to the use of iron filings. Full achievement was seen in students who described moving a compass and tracing where the compass's N pole was pointing or using additional compasses. These marks could also be achieved by adding to the diagram. A common incorrect response was 'use another magnet'.

This example shows a complete correct answer for 3(e)(ii) although the pole of the magnet has been labelled incorrectly.

(e) A student uses a compass to investigate the magnetic field near a bar magnet.

The student places the compass near the bar magnet as shown in Figure 6.

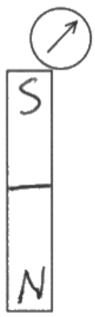

Figure 6

(i) Mark the north pole of the bar magnet with an 'N' in Figure 6.

(1)

(ii) State two ways in which the investigation could be developed to show the shape of the magnetic field around the bar magnet.

You may add to Figure 6 to help with your answer.

(2)

1 Using multiple compass's around the magnet.

2 use iron filings to show the magnetic field lines.

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Examiner Comments

Adding compasses around the magnet will indicate the shape of the magnetic field just as the use of iron filling will.

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Examiner Tip

The question requires two ways to develop the investigation and this example gives compasses and iron filings.

This response gives an extension to adding more compasses and is credited with both marks.

(e) A student uses a compass to investigate the magnetic field near a bar magnet.

The student places the compass near the bar magnet as shown in Figure 6.

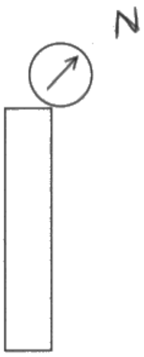

Figure 6

(i) Mark the north pole of the bar magnet with an 'N' in Figure 6.

(1)

(ii) State two ways in which the investigation could be developed to show the shape of the magnetic field around the bar magnet.

You may add to Figure 6 to help with your answer.

(2)

1 By moving the compass around the magnet by the same amount each time

2 Record where the arrow points and record the shape of the magnetic field.

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Examiner Comments

Moving the compass around the magnet will show there is a magnetic field around the magnet and the shape of the field can then be shown by plotting points.

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Examiner Tip

This answer could also be shown by adding to the diagram.

Question 4 (b)

A good majority of students drew a vector arrow pointing downwards, gaining 1 mark. A third of the students went on to match the length of the force up arrow, giving the second mark.

The question was to test that candidates recognised that pairs of forces can be represented by vectors and as the box is stationary the forces are equal and opposite and the vectors should be the same size in opposite directions.

(b) Figure 7 shows a box at rest on a floor.

The force that the floor exerts on the box is shown by the vector in Figure 7.

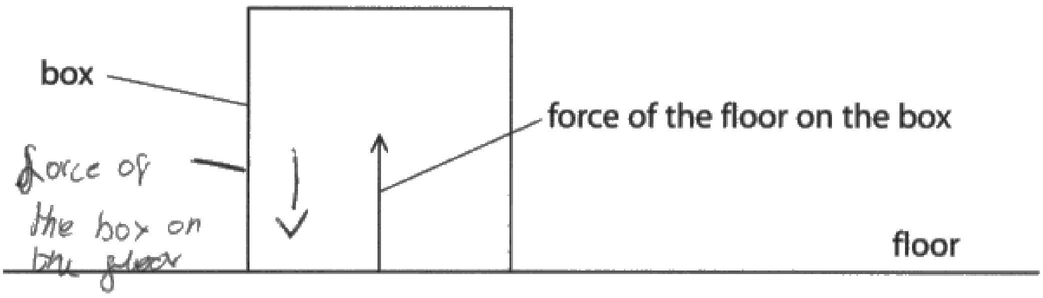

Figure 7

Add another vector to the diagram in Figure 7 to show the weight of the box.

(2)

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Examiner Comments

The candidate realises that the vector representing weight has to act downwards but does not consider that the magnitude of the two forces must be the same and therefore the vectors must be of equal length.

ResultsPlus
Examiner Tip

Remember that vectors represent size by their length and an arrow gives the direction.

This response is completely correct.

(b) Figure 7 shows a box at rest on a floor.

The force that the floor exerts on the box is shown by the vector in Figure 7.

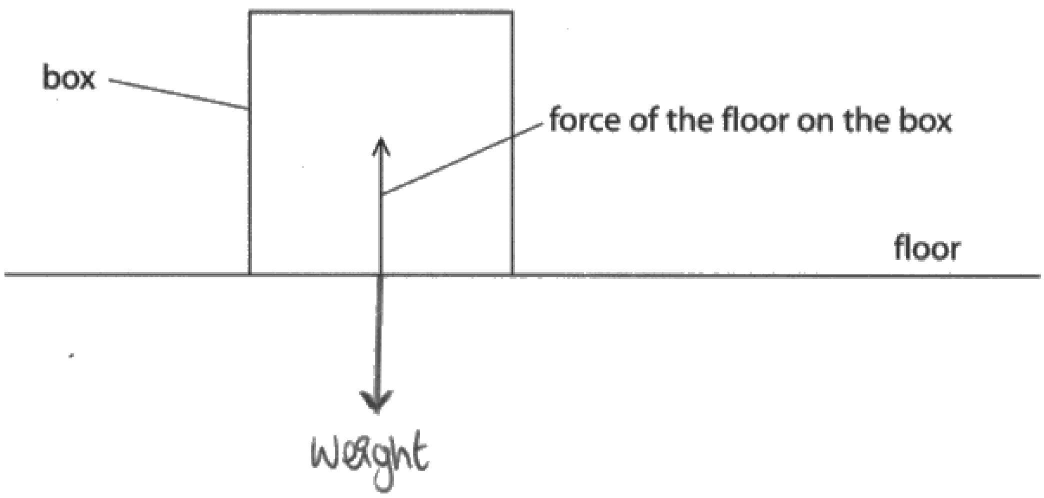

Figure 7

Add another vector to the diagram in Figure 7 to show the weight of the box.

(2)

ResultsPlus
Examiner Comments

The diagram shows the two forces acting through the same point. The vectors are the same size and the arrows show the opposite direction of the forces.

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Examiner Tip

Remember to bring a ruler to the examination as this often helps in adding accurately to diagrams.

Question 4 (c) (i)

A good proportion of the students saw that friction was the cause of the warming but only a quarter of students went on to say that (heat) energy was transferred as a result.

Partially correct answer. No marks can be awarded for a repeat of the stem of the question.

(c) Figure 8 shows part of a cart.

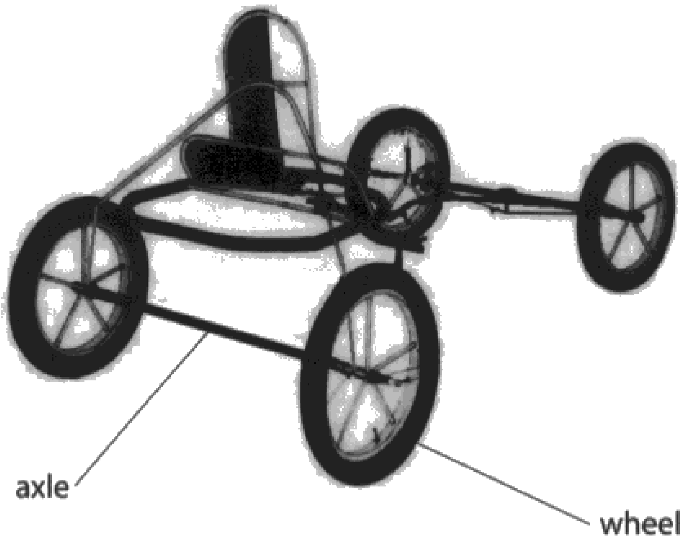

Figure 8

When the wheels turn the axles become warm.

(i) Explain why the axles become warm when the wheels turn.

(2)

Because it is movement and after a while the ~~Frection~~ friction ~~be~~ from the movement creates it to become warm.

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Examiner Comments

The candidate realises that there will be friction but then repeats the stem of the question 'it becomes warm'. The candidate needs to state that it is thermal or heat energy generated due to the friction that makes the axle warm.

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Examiner Tip

Take care not to repeat the stem of the question in the answer you give.

Question 4 (c) (ii)

Less than half of candidates gave a correct answer. Oil or lubrication were the most common correct answers. Quite a lot of students described inappropriate cooling systems, or even proposed insulating the axles in some way.

Any method of reducing the heating of the axle when the wheels turn was acceptable.

(ii) Give **one** way of reducing the heating of the axles when the wheels turn.

(1)

use barings so the the axle don't move the it won't get hot

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Examiner Comments

The 'use of barings' (bearings) will reduce the amount of heat produced.

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Examiner Tip

Relate the question to any moving parts that rub together to give a common sense answer.

Reducing speed is another acceptable answer.

(ii) Give **one** way of reducing the heating of the axles when the wheels turn.

(1)

Don't go as fast.

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Examiner Comments

There will be less rotations of the wheels and therefore less friction and less heat generated.

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Examiner Tip

The question refers to the wheels turning and the less they turn the smaller the amount of heat generated.

Question 4 (d)

There were some good answers seen, about a third of the candidates gaining all four marks. However, many showed confusion over the terms ‘useful’, ‘total’ and ‘wasted’. Nevertheless a mark was often obtained through a correct subtraction for part (ii) and a correct substitution into an incorrect equation given in part(i) also yielded some marks.

This response gains four marks.

(d) (i) Complete the equation that relates efficiency, useful energy transferred by a device and total energy supplied to the device.

(1)

efficiency = useful energy from the device / total energy transferred to the device

(ii) In one second an engine has a total energy input of 7500 J.

In one second 3200 J is transferred to the surroundings as wasted energy.

Calculate the useful energy transferred by the engine.

(1)

7500 - 3200 = 4300

useful energy transferred = 4300 J

(iii) Calculate the efficiency of this engine.

(2)

$$\frac{4300}{7500} = 0.57\dot{3}$$

efficiency of the engine = $0.57\dot{3}$

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Examiner Comments

A completely correct answer showing a complete equation in part (i), correct calculation of useful energy in part (ii) and a substitution and correct evaluation for part (iii).

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Examiner Tip

Keep working through a question. You may not be able to recall the correct equation to start off with but marks can often be picked up as you go through the question.

This response starts off poorly but marks are gained as each part is worked through.

(d) (i) Complete the equation that relates efficiency, useful energy transferred by a device and total energy supplied to the device.

(1)

efficiency = total energy input / energy lost to the surroundings

(ii) In one second an engine has a total energy input of 7500 J.

In one second 3200 J is transferred to the surroundings as wasted energy.

Calculate the useful energy transferred by the engine.

(1)

~~7500 3200~~

7500 - 3200 =

useful energy transferred = 4300 J

(iii) Calculate the efficiency of this engine.

(2)

7500 / 3200

efficiency of the engine = 2.35

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Examiner Comments

The initial equation is incorrect but a mark is gained for correctly completing part (ii). The equation given in part (i) then has the correct values substituted for this incorrect equation. The substitution gives the candidate a mark.

ResultsPlus
Examiner Tip

Work through the whole question and attempt each part.

Question 5 (b) (i)

The majority of candidates were able to score two marks for the calculation, having been given the equation. However the third mark, for the unit of moment of a force, was only gained by about half the candidates.

Evaluation and unit correct.

(b) Figure 11 shows a lever used to lift a heavy load.

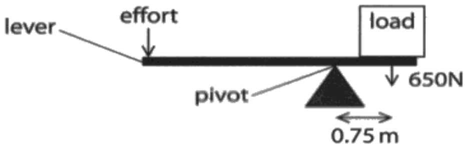

Figure 11

(i) The weight of the load is 650 N.
The centre of the load is 0.75 m from the pivot.

Calculate the moment of the load about the pivot.
State the unit.

Use the equation

moment = force × distance from the pivot

Moment = 650N × 0.75m = 487.5 **(3)**

moment = 487.5 unit Nm

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Examiner Comments

The candidate has shown the substitution and evaluated correctly. The correct unit Nm has also been included.

ResultsPlus
Examiner Tip

Each quantity has a unit and as the quantities are multiplied so are the units Nxm written as Nm.

Question 5 (b) (ii)

Very few candidates were able to attempt to state the principle of moments. Candidates do not appear to be familiar with the principal that when a system is in equilibrium the sum of the clockwise moments about a point is equal to the sum of the anticlockwise moments about that point.

Question 5 (b) (iii)

A few candidates were able to gain three marks on this question not because they were able to apply the principal of moments but because they used the equation:

moment of a force = force x distance from pivot

This worked because the moment calculated in part (i) was clockwise and the effort was providing an anticlockwise moment as effort x distance from pivot. Candidates then had to rearrange the equation to get a value for the distance of the effort from the pivot.

Correct evaluation of the distance of the effort from the pivot

(iii) An effort of 160 N is applied to the end of the lever to balance the load in Figure 11.

Calculate the distance between the effort and the pivot.

(3)

M
f p

$$\text{distance} = \frac{487.5}{160} = 3.046875$$

distance = 3.04 m

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Examiner Comments

The candidate has rearranged the equation to give the value for distance and as the mark scheme gives full marks for any answer which rounds to 3 then the incorrect rounding of 3.045875 to 3.04 is ignored.

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Examiner Tip

Learn how to round values correctly. This example shows a truncated answer to 2 decimal places.

The response shows that rounding incorrectly mean the loss of marks.

(iii) An effort of 160 N is applied to the end of the lever to balance the load in Figure 11.

Calculate the distance between the effort and the pivot.

(3)

$\frac{m}{F \mid D}$ distance = $\frac{\text{moment}}{\text{force}}$ $\frac{487.5}{166}$ = 2.9367

moment = 487.5

force = 160 N

distance = 2 m

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Examiner Comments

The calculation has a substitution which the candidate has read as 166 because it is badly written. Using 166 the answer is 2.9367. However this has been given as 2 in the answer line having been truncated not rounded correctly and only two marks are awarded.

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Examiner Tip

Take care to write figures that you can read correctly.

Question 6 (b) (i)

This was performed well, with many students gaining both marks. All the candidates had to do was multiply the two numbers using the given equation. There was only the occasional error in mutiplying two decimal values and giving the wrong power of ten.

Question 6 (b) (ii)

This was wholly successful for three quarters of candidates. Candidates were able to select the correct equation and usually were able to substitute correctly although the main error came at this point when 35s was substituted as 0.35s. This gave a power of ten error for which candidates lost a mark.

Question 6 (b) (iii)

This was wholly successful for three quarters of candidates. Once again when candidates took the time as 0.35s they lost a mark because of that power of 10 error.

Question 6 (c)

6(c) – This question required candidates to comment on a conclusion that was made about a set of results obtained from measuring the current through a lamp as the potential difference across the lamp was increased. This was done quite well with more than half the candidates gaining two or three marks.

The question is an exercise in taking numerical information and recognising the relationships between the variables.

(c) A student measures the current in the lamp for several values of potential difference across the lamp.

Figure 13 shows the student's results.

potential difference across the lamp in volts (V)	current through the lamp in amps (A)
0.06	0.05
0.12	0.08
0.18	0.10
0.24	0.12
0.30	0.13
0.36	0.13

Figure 13

The student uses the results in Figure 13 to write this conclusion.

'As the potential difference across the lamp increases, the current in the lamp increases and the relationship is directly proportional.'

Comment on the student's conclusion.

(3)

As the potential difference increases, so does the current however they aren't proportional as the current begins to equilise between 0.30 and 0.36 volts which shows they aren't directly proportional as the amps stay the same.

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Examiner Comments

This response shows that the candidate recognises that as one value increases so does the other up to a point and uses numerical values to support the fact that the variables are not directly proportional.

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Examiner Tip

Remember to look at the whole of the conclusion and support your comments with data from the table.

Question 7 (a) (i)

This question introduced the idea of electric fields which is a new topic to be studied. Very few of the candidates were aware that because the spheres were charged they were at the centre of an electric field and that the reason for the force being exerted on the second sphere was because it was within the field of the first sphere.

Question 7 (a) (ii)

The majority of candidates were able to read from the graph the pressure at 6000m, although this was not at an intersection of grid lines.

Question 7 (a) (iii)

Only about a quarter of candidates were able to suggest a a reason for atmospheric pressure decreasing with height above sea level. Answers such as the air gets less dense, there are fewer molecules or even there is less air were few and far between and it was noted that the concept of sea level being ground level was not understood by a significant number of candidates.

Question 7 (b)

Almost half the candidates were able to gain both marks for this question, although the correct scientific answer that 'pressure in a liquid inceases with depth' was not seen. However many candidates identified that the greater the height of water in the container the more force there would be to push the water out of the tap at the bottom.

This response gives a complete explanation.

(b) Figure 15 shows different water levels in two similar water containers with taps.

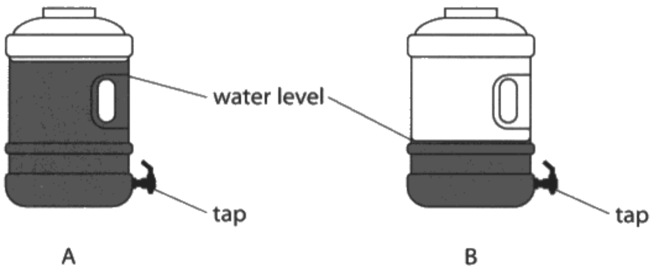

Figure 15

Explain why the water runs out of the tap of container A faster than out of the tap of container B.

(2)

The more water in the container means more pressure on the container and therefore more water is coming out meaning it'll be quicker.

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Examiner Comments

The amount of water in the containers is compared and this is linked to providing the pressure to make the water leave the tap faster.

ResultsPlus
Examiner Tip

Use the diagrams to help with your answer.

The question requires an explanation which is only partially given by this response.

(b) Figure 15 shows different water levels in two similar water containers with taps.

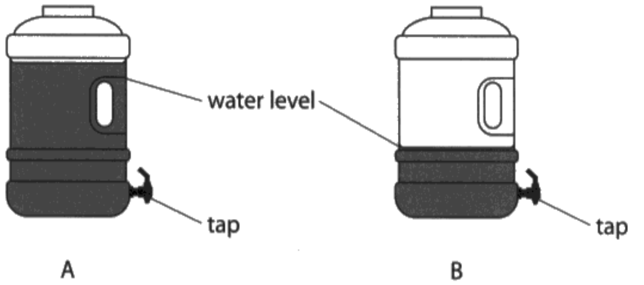


Figure 15

Explain why the water runs out of the tap of container A faster than out of the tap of container B.

(2)

The pressure in A is much higher than B so as the tap opens, the pressure is released quickly.

ResultsPlus
Examiner Comments

The candidate states that the pressure in A is much higher than in B but does not explain why this is the case.

ResultsPlus
Examiner Tip

The question has two marks and is an 'explain' so remember to give a reason.

Question 7 (c)

About half of the candidates were able to get one mark for doing the first part of the calculation and dividing 50 by 10 giving that the pressure was 5 times greater than atmosperic at a depth of 50m.

Very few candidates then went on to gain the second mark by adding the one atmosphere for the pressure of the atmosphere. This makes the pressure on the submarine at a depth of 50m six times greater than atmospheric pressure.

Question 7 (d)

Surprisingly although the question asked for ideas of pressure, force and area to be used very rarely was the equation P=F/A seen. If candidates had used the equation as a basis for their answer a greater level of attainment may have been the result. The majority of candidates only achieved Level 1 as they only considered the difference in area between the point of the drawing pin and the flat top. The answers showed that there is great confusion between force and pressure but if an attempt was made to link these to the area then a Level 2 could be achieved. If candidates knew that the force was the same throughout the drawing pin and could then relate this force to different pressures because of the different cross sectional areas this type of answer gave Level 3.

This example is Level 1 because it shows elements of physics understanding and gives an explanation with same structure and coherence.

*(d) Figure 16 illustrates an effect that can be explained using the ideas of pressure, force and area.

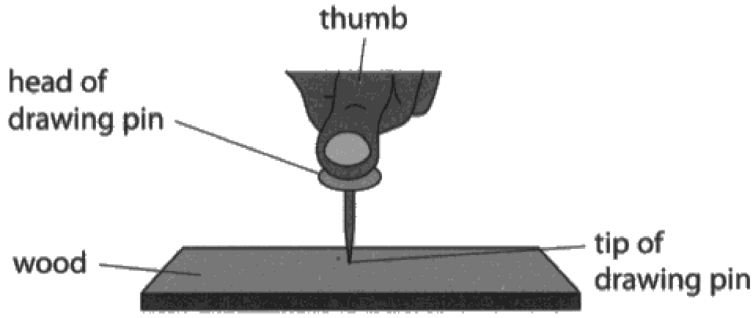


Figure 16

Explain why the tip of the drawing pin goes into the wood but the head of the drawing pin does not go into the thumb.

(6)

As the head of the drawing pin has a flat large surface are meaning the man can exert force on the pin without piercing his skin. However the tip of the pin has a very small surface area and is pointed and the wood is flat with a large surface area. This means when he uses his strength to force the pin down it is able to pierce the wood. As all the energy he is using from his thumb is transferred to the bottom of the pointy needle.

ResultsPlus
Examiner Comments

The candidate has only considered the different area at the top and bottom of the drawing pin. The word 'force ' has been used but not as a physical quantity.

ResultsPlus
Examiner Tip

Read the stem of the question carefully to gain all the information possible to help with answering the question.

This answer demonstarates physics understanding which is mostly relevant but may include some inaccuracies and it has a logical, clear structure. This response is Level 2.

Because there is a lower surface area on the tip of the drawing pin which is exerting more pressure on to the wood than the larger surface area of the pin which exerts less pressure onto the thumb and so the pin can only go through the wood.

ResultsPlus
Examiner Comments

The difference in cross-sectional area is related to the pressure but the explanation is incomplete as the constant force is not considered.

ResultsPlus
Examiner Tip

Keep work in a logical order and use all the information given in the stem of the question.

This is a Level 3 response, it demonstrates accurate physics, thorough understanding of scientific ideas and the explanation is presented in a way that is clear coherent and logical.

The tip of the drawing pin goes into the wood but the head of the drawing pin does not go into the thumb because there is a larger area on the head of the drawing pin than the tip. The increased area on the head of the pin means that when a force is applied it spreads out across the larger area, decreasing the pressure and allowing it to not go into the thumb. However, the tip of the pin has a much smaller area due to the pointed end, this smaller area means that although the same force is being applied to the head and tip of the pin, the pressure is increased due to the smaller area for it to spread across. This increase in pressure compared to the head of the pin, causes the tip of the pin to go into the wood but not the ~~head~~ head of the drawing pin go into the thumb.

ResultsPlus
Examiner Comments

The response uses the ides of force, pressure and area as given in the stem of the question and explains clearly the different effect at the head and point of the drawing pin.

ResultsPlus
Examiner Tip

Practice extended writing questions to learn to use all the information in the stem of the question and the diagram and to organise your ideas in a clear, logical sequence.

Question 8 (a) (i)

This question had a good spread of marks with most candidates gaining 2 or 3 marks for this 4 mark question. Some candidates found the equation for measuring specific heat in the list of equations at the end of the paper and used this as the basis for their answer. Most marks were gained for measuring the mass or volume of water and the temperature at the start and end of the experiment. The term change in thermal energy instead of energy supplied was not given a mark as it was taken from the wording of the equation. It appeared that most candidates recognised the experiment and knew or could work out the measurements that had to be taken.

This concise answer gives all the measurements that need to be made.

8 (a) A student uses the apparatus in Figure 17 to determine the specific heat capacity of water.

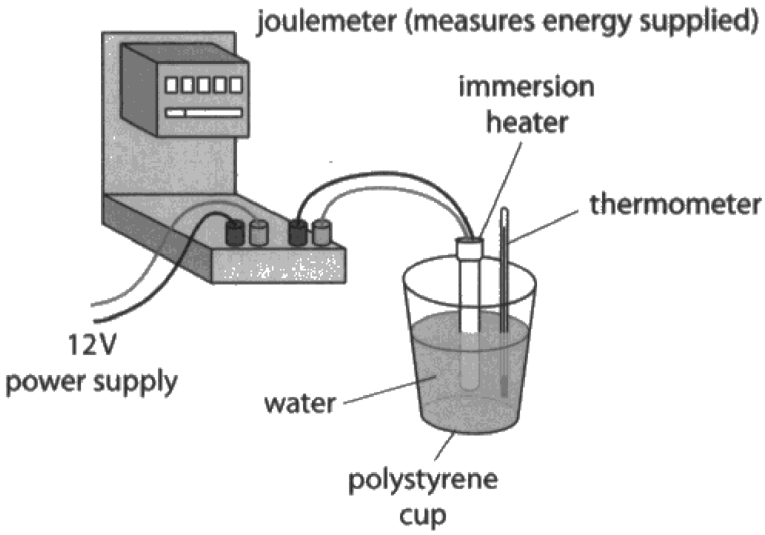


Figure 17

(i) State the measurements needed to calculate the specific heat capacity of water.

(4)

The ~~amount~~ volume of water and the water temperature ~~beaker~~ before, need to be measured and then the ~~water~~ temperature after and also the amount of enefgy supplied needs to be measured.

ResultsPlus
Examiner Comments

Volume of water is allowed as well as mass because water is often measured in a measuring cylinder and the volume converted to mass. Measuring the amount of water did not get a mark as this is not a quantitative value. The temperature before and after is included as is the energy supplied.

ResultsPlus
Examiner Tip

Use the diagram or the equation to help with your answer.

Question 8 (a) (ii)

This question was about improving a procedure. It was poorly answered by the vast majority of candidates. There were very many insubstantial unhelpful comments seen such as ‘use a plastic cup’ or ‘use more water’ although if these had been extended to 'use a plastic cup and put the polystyrene cup inside' or 'use more water to fully submerge the heater' then a mark could have been awarded. Perhaps more student evaluations of their experiments might improve this aspect of students’ procedural understanding. Adding a lid was the most popular correct answer, whilst some scored a mark with a suggestion of ‘use a digital thermometer’.

Question 8 (b)

Some candidates did give the answer of 100°C since that is the temperature that they expect water to boil. However, those that tried to extrapolate the graph tended to get a value well about 100°C as they did not account for the increased heat loss as the water gets hotter and therefore the temperature does not increase by equal amounts each minute.

Question 8 (c)

A majority of candidates scored one mark out of two on this question. In these cases student had the correct idea of multiplying the two numbers together but failed to convert 380g to kg to get the correct answer in joules.

An example of the most common error in completing this question.

(c) Another student decides to melt some ice.

The student melts 380 g of ice at 0 °C.

The specific latent heat of fusion of ice is 3.34×10^5 J/kg.

Calculate the thermal energy needed to melt the ice.

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

(2)

thermal energy ~~change~~ for change of state = mass x specific latent heat.

$380 \times (3.34 \times 10^5) = 126920000$

1.2692×10^8

thermal energy needed = 1.2692×10^8 J

ResultsPlus
Examiner Comments

The correct equation has been selected but the mass of ice has not been converted from g to kg and the anwer is too large by 1000, (10^3).

ResultsPlus
Examiner Tip

The value for specific latent heat is given in J/kg.

Read the question and note the units that are used this will often tell you if a conversion of units is required.

Question 8 (d)

Three quarters of candidates were unable to recall the density equation correctly. They either took volume ÷ mass or volume x mass. Students acquire a good feel for the notion of density by handling various objects – blocks of wood, aluminium, e.g. and then measuring densities via their core practical work. So they shouldn't fail at this question to the extent to which they did; a quarter of candidates succeeded in recall and substitution.

An example where the incorrect equation has been recalled.

(d) The volume of 380 g of ice is 410 cm³.

Calculate the density of the ice in g/cm³.

(2)

density = ~~volme,~~ volume / mass = 1.0789

density = 1.1 g/cm³

ResultsPlus
Examiner Comments

The density equation has been recalled wrongly; it should be:

Density =mass/volume

However because the equation is given then it can be seen that the appropriate values of volume and mass have been used to get the answer and 1 mark is given for correct substitution into an incorrect equation.

ResultsPlus
Examiner Tip

Note the units of density are given in the answer line and these are g/cm^3 g is mass and it is divided by cm^3 which is volume therefore the equation for density must be mass divided by volume.

Use the information in the question.

Question 9 (a)

The majority of candidates were able to get the correct answer by remembering to square the velocity. Allowance was made for those that converted the kg to g for some unknown reason and if the substitution was correct for a mass of 68000g then one mark was awarded.

Question 9 (b)

Only about half of the candidates were able to gain marks on this question, although all that was required was kinetic energy is transferred to thermal energy. Candidates needed to appreciate that when the cyclist is moving the energy store is kinetic which deceases when the brakes are applied and the thermal energy store increases.

Question 9 (c)

About half the candidates were able to gain full marks on this question despite having to recall an equation substitute values, rearrange the equation and then evaluate. As only occasionally was the equation seen the high percentage of full mark answers may have been due to just two quantities being given and the logic that multiplying the two numbers together would make the force too large, therefore they must be divided.

The response shown is a typical answer which gains three marks.

(c) The cyclist starts to cycle again.

The cyclist does 1600 J of useful work to travel 28 m.

Calculate the average force the cyclist exerts.

(3)

$\frac{1600}{28} = 57.142857$

average force = 57.142857 N

ResultsPlus
Examiner Comments

No equation is shown and the rearrangement is correct. The calculation is given to a large number of decimal places.

ResultsPlus
Examiner Tip

The candidate is not penalised for the excess of decimal places, but it is good practice to limit the number of significant figures in the answer to the number of significant figures given in the question.

Question 9 (d)

Coherent plans were few and far between. The responses to this question showed, first and foremost, a lack of understanding of the term '**power**'. Secondly there was a lack of familiarity with the suggested practical work. Many took 'steps' as being horizontal with little idea of the concept of 'work done' being involved. Many students embarked on comparing the two methods in vague and insubstantial ways. Quite a number equated power with the ability to hold increasing masses up for periods of time. They seemed to be equating power with strength. Very few students employed useful diagrams. Some described inappropriate experiments, notably the core practical of stretching a spring, which was not relevant to this question. Some even proposed measuring heart-rates and body mass indices as part of their investigations.

This plan is Level 3. It is supported throughout by linkage and application of knowledge and an understanding of scientific procedures, analyses scientific information and provides logical connections.

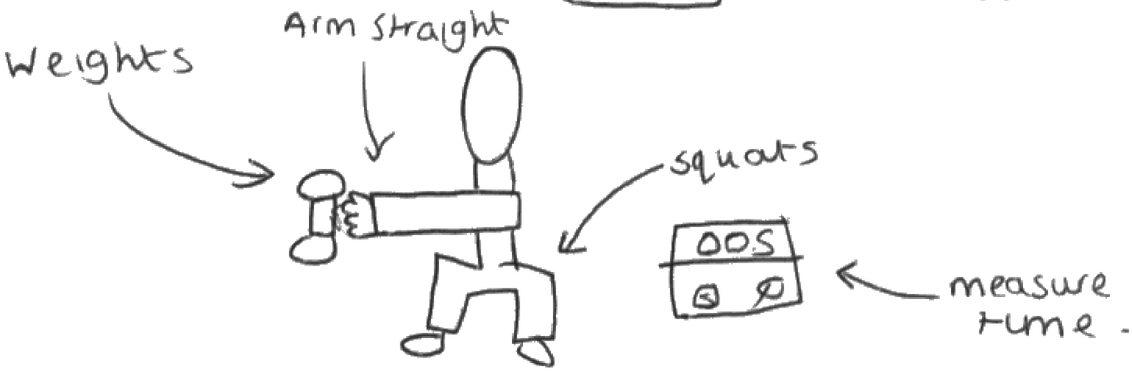
*(d) A class of students investigate the power output of each student in the class.

The class must decide whether they use a method using steps or a method using weights. The whole class must use the same method.

Plan what measurements the students should take and how these can be used to calculate and compare the power output of each student.

You may draw a diagram to help with your plan. $P = \frac{E}{T}$ ~~$P = I \times V$~~ ~~$P = I^2 R$~~

(6)



- Get a set of Kg weight (all must weigh the same) and give the set to every student.
- The student must put the arm strait (with weights in hand) and do a certain number of squats at a time. (ie. 10, 20, 30)
- Another student must measure how long it took for the student to do these amount of squats.
- You must then find the work done with the equation:

$E = F \times d$ ← Arm length. (F ← Weight of masses)

- To then find out power you must use equation:

~~To t~~ $P = \frac{E}{T}$ (E ← Work done; T ← Time Taken.)

ResultsPlus
Examiner Comments

The plan shows that the candidate knows what has to be measured in order to calculate power and gives the required equations. The error is in measuring the length of the arm instead of the height through which the weight is moved but apart from that the plan will work and the experiment could be used to compare the power output of students.

ResultsPlus
Examiner Tip

As power is not measurable directly then it is useful to note the equations which are used to calculate it to find out what has to be measured.

This plan is Level 2. The plan is mostly supported by linkage and application of knowledge. There is scientific information given and some logical connections in a partially completed plan.

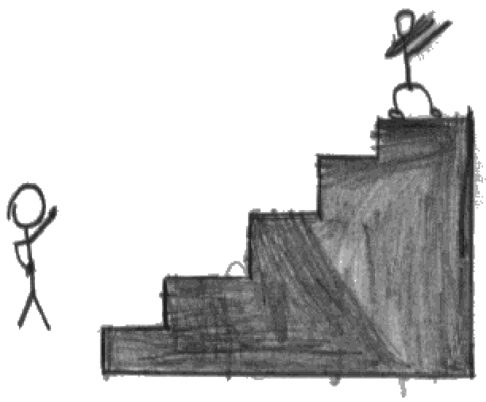
*(d) A class of students investigate the power output of each student in the class.

The class must decide whether they use a method using steps or a method using weights. The whole class must use the same method.

Plan what measurements the students should take and how these can be used to calculate and compare the power output of each student.

You may draw a diagram to help with your plan.

(6)



The students when using either method will need to know what the work done is. For the steps method the students will need to time how long it takes the students to run up the steps and then they can use power = work done ÷ time to work out the power output of each student.

ResultsPlus
Examiner Comments

The diagram shows the steps and the text explains that the time to go up the steps needs to be found; power can be calculated, using power = work done /time taken.

The candidate does not explain how the work done is to be found but there is part of a plan which would a comparison of power of the students in a class.

ResultsPlus
Examiner Tip

To plan an experiment to determine a quantity, like power, you need to work out the quantities to be measured and then explain how you intend to measure them.

This example is Level 1. There is an attempt to link and apply knowledge and an understanding of scientific enquiry, and the plan is incomplete.

*(d) A class of students investigate the power output of each student in the class.

The class must decide whether they use a method using steps or a method using weights. The whole class must use the same method.

Plan what measurements the students should take and how these can be used to calculate and compare the power output of each student.

You may draw a diagram to help with your plan.

(6)

they should measure height, weight, time it takes for the steps. then you can compare the power output because some students will be quicker or slower due to different physical advantages / disadvantages.

ResultsPlus
Examiner Comments

The candidate has given that height, weight and time should be measured and had mentioned steps, but has not been specific about any measurement. There is an idea for comparison because some will be slower than others.

ResultsPlus
Examiner Tip

Give detail of measurements, what you will measure and how you will measure it.

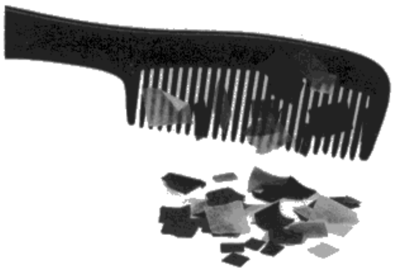
Question 10 (a) (i)

Candidates found this question difficult with more than half not gaining any marks. The explanation of how the comb gains positive charge was poorly done with many candidates under the misconception that electrons could either be negative or positive and that either electrons or protons could be transferred. The most frequently awarded mark was for friction between the cloth and the comb. Transfer of electrons on its own was not given a mark, the direction of transfer from the comb to the cloth needed to be made clear.

This response is worth awarding two marks.

10 (a) A student rubs a plastic comb with a dry cloth to give the comb a positive electric charge.

Figure 19 shows the charged plastic comb picking up small pieces of paper.



(Source © GIPhotoStock/SCIENCE PHOTO LIBRARY)

Figure 19

(i) Explain how rubbing the comb with a dry cloth gives the comb a positive electric charge.

(3)

By rubbing the comb with dry cloth it loses electrons making it positivly charged and the cloth negativly charged.

ResultsPlus
Examiner Comments

The direction of transfer of electrons is from the comb to the cloth giving one mark. The second mark is for leaving the cloth with a negative charge.

ResultsPlus
Examiner Tip

It is often helpful to mark on the diagram which objects become negative and which positive to work out the transfer of electrons.

This is an example of a response which gains three marks.

10 (a) A student rubs a plastic comb with a dry cloth to give the comb a positive electric charge.

Figure 19 shows the charged plastic comb picking up small pieces of paper.

(Source © GIPhotoStock/SCIENCE PHOTO LIBRARY)

Figure 19

(i) Explain how rubbing the comb with a dry cloth gives the comb a positive electric charge.

(3)

The comb and cloth produce friction. The negative electrons move from the ~~cloth to the comb~~ comb to the cloth. Now the comb has lost the electrons. The comb has an overall positive charge.

ResultsPlus
Examiner Comments

The first mark is awarded for the mention of friction, the second mark is for electrons moving from the cloth to the comb. The third mark is for 'the comb has an overall positive charge that is more protons than electrons'.

ResultsPlus
Examiner Tip

Remember it is only electrons that can be transferred and that electrons carry a negative charge.

Question 10 (a) (ii)

More than half of candidates did not gain a mark on this question; the idea of induced charges is not understood. The majority of candidates that did gain a mark assumed that the pieces of paper had a negative charge to begin with and were therefore attracted to the positive charge on the comb. It was not understood that the pieces of paper initially had no charge and obtained the negative charge by induction.

Question 10 (c) (ii)

More than half the candidates were able to gain a mark by describing that as the distance apart of the spheres increased the force between them decreased. The second mark was only gained by a few candidates as most failed to comment on the change in slope or non-linearity of the graph.

This response is worth two marks

(ii) Sphere B is moved and the force between the spheres is measured at several different distances.

Figure 21 is a graph of force on sphere B against distance between the centres of the spheres.

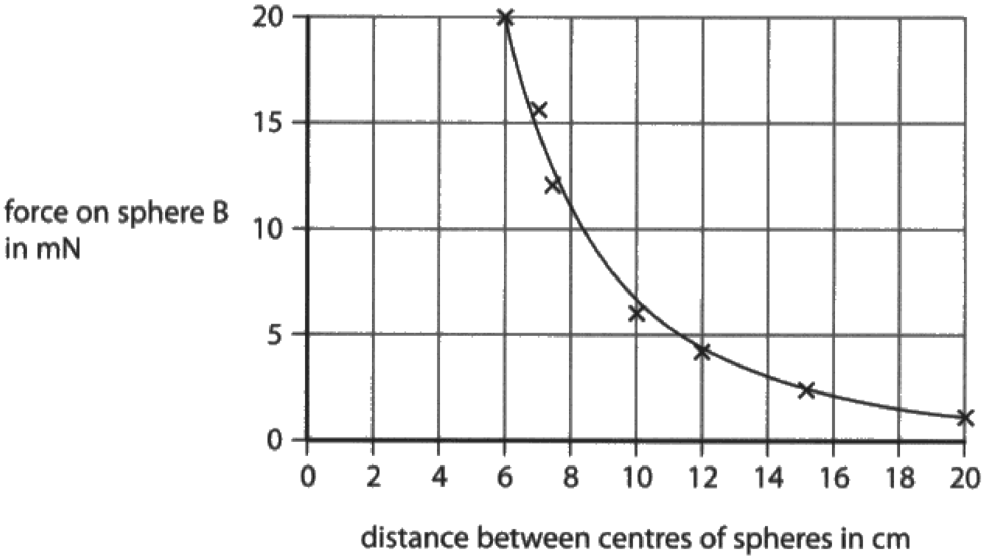


Figure 21

Describe how the force on sphere B varies with the distance between the centres of the spheres.

(2)

As the distance between the sphere centres increases the force on sphere B decreases. But as the distance increases the force on sphere B decreases less and less.

ResultsPlus
Examiner Comments

The candidate has described that the force on the sphere decreases as the distance apart of the centres increases. This is then continued to express the non-linearity of the reationship by stating 'as the distance increases the force on sphere B decreases by less and less'.

ResultsPlus
Examiner Tip

If there are two marks for the answer then look carefully at the graph to give two points about it in your description.

Paper Summary

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

- always show your working for calculations
- if the question has two marks then you need to make two points to get both marks
- understand when and why units need to be changed or can be left unchanged
- use the information provided by diagrams and images to help answer questions
- learn the meanings of scientific terms in physics
- read all questions carefully and take note of the command words
- have a calculator with you in the examination
- understand the importance of 'subscripts' in equations
- make notes on experiments and demonstrations for use when revising

Grade Boundaries

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