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Examiners' Report
June 2018

GCSE Physics 1PH0 2H

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Introduction

This was the first examination of paper 2, at higher level, for the new specification. Questions were set to test students' knowledge, application and understanding from these nine topics in the specification:

- Topic 1 – Key concepts of physics
- 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

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 were also two extended open response questions, worth six marks each.

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 (b) (ii)

Candidates were required to select and rearrange the equation relating pressure and volume for a fixed mass of gas at a constant temperature. The most common errors were in the rearrangement.

Examiners awarded partial marks if the answer clearly showed the given values substituted into the correct equation.

(ii) It takes 4.8 litres of air from the atmosphere to inflate the empty tube to a pressure of 400 000 Pa.

Atmospheric pressure is 100 000 Pa.

Calculate the volume of air inside the tube.

Assume the temperature of the air inside the tube is the same as the temperature of the air outside the tube.

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

(3)

$P_1 \times V_1 = P_2 \times V_2$

$100000 \times 4.8 = 400000 \times V_2$

$= 480000 - 400000 = 80000$

volume = 80000 litres

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Examiner Comments

The candidate has written the correct equation and put the given values into the correct place. Even though the rearrangement and evaluation is incorrect, this answer still scored one mark.

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Examiner Tip

Always start calculations by writing down the equation and then substituting the letters by the values which you have been given.

Question 1 (b) (iii)

Candidates were required to explain that work done in compressing the air in the tube results in an increase in the (average) kinetic energy of the air particles or an increase in the thermal energy of the system. Weaker candidates often attributed this to "more collisions" of air particles.

(iii) When a bicycle pump is used to inflate the tube, the air in the bicycle pump gets warm.

You should ignore any effects of friction in the pump.

Explain why the air in the bicycle pump gets warm.

(2)

work done is done when the person pushes the pump, this means that the energy is transfered to the KE of the particles raising their internal energy and therefore temperature.

(Total for Question 1 = 7 marks)

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Examiner Comments

A straightforward response that scored both marks.

Question 2 (a) (i)

This question was based on a Core Practical: the determination of the specific heat capacity of water. Candidates were given a drawing of apparatus that could be used and were required to state, for one mark each, the three quantities that needed to be measured. An additional mark was given for clear detail of how at least one of those measurements could be made. Weaker candidates often simply stated the quantities taken from the equation list at the end of the paper.

2 (a) A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

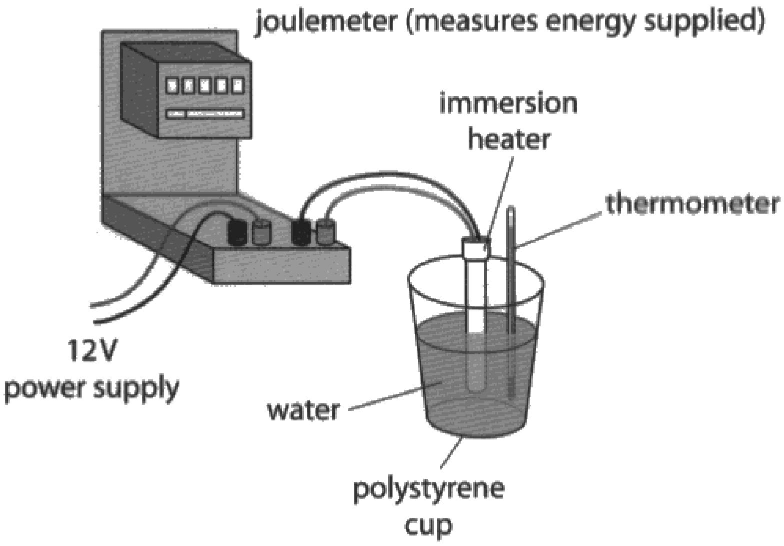

Figure 3

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

(4)

amount of water
temperature of water before experiment
temperature of water after experiment
the difference between temperatures
amount of supplied power.

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Examiner Comments

Although “the amount of water” is not clear enough for a mark, there is one mark for stating that the temperature rise needed to be measured and a second mark for explaining how this is done. The amount of energy supplied is not the same as the power.

2 marks in total

2 (a) A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

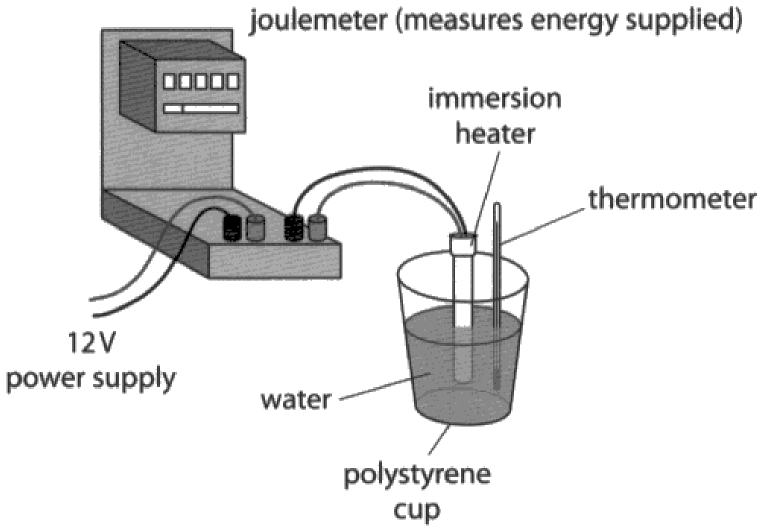

Figure 3

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

(4)

You need the energy transferd which can be read of the joulemeter, ~~You'll~~ ~~a~~ You will need the start temperat-ure and end temperature so you can work out the temperature change and you will need the mass of the water.

Change in energy = mass x temp change x specific heat capacity

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Examiner Comments

All three measurements are clearly stated and there is detail about how one of them (the temperature rise) can be made. 4 marks

Question 2 (a) (ii)

The apparatus in the drawing had a number of shortcomings and candidates were asked to state two adaptations which recognised these shortcoming and suggested an improvement.

(ii) State **two** ways that the apparatus could be adapted to improve the procedure.

(2)

1 insulate the polystyrene cup

2 Stir the water regularly

ResultsPlus Examiner Comments

Two good suggestions for 2 marks.

(ii) State **two** ways that the apparatus could be adapted to improve the procedure.

(2)

1 Put a lid on the polystyrene cup to ensure no energy is lost to the surroundings

2 Use a different material of cup.

ResultsPlus Examiner Comments

The first suggestion scores a mark but the second suggestion is too vague.

Question 2 (b)

Candidates were required to recognise that continued supply of energy to water would raise its temperature up to the boiling point of water, but thereafter, any further supply of energy would not cause any further temperature rise. Most candidates extrapolated the graph to arrive at an unrealistic temperature.

Question 2 (c)

Candidates were required to select and use the correct equation linking the change in thermal energy required to melt ice, mass of ice and the specific latent heat of fusion of ice. Partial credit was given for answers that clearly showed selection and use of the correct equation but with an incorrect final evaluation resulting from an error in either converting g to kg and/or an error in handling values in standard form.

Question 3 (a)

Candidates were required to use the equation supplied to calculate kinetic energy given the velocity and mass. Partial credit was given for answers that clearly showed a correct substitution in the equation but that had an incorrect final evaluation.

Question 3 (b)

Examiners were looking for a description of energy transfers that linked a decrease in the kinetic energy of the cyclist and/or bicycle with an increase in thermal energy. Although generally well answered, examiners frequently saw references to gravitational potential energy, chemical energy and sound.

Question 3 (c)

Candidates were required to recall and use the equation linking work done with force and distance.

Partial credit was given to answers that clearly showed substitution of correct values into a correctly recalled equation but did not rearrange the resulting expression correctly.

Question 3 (d)

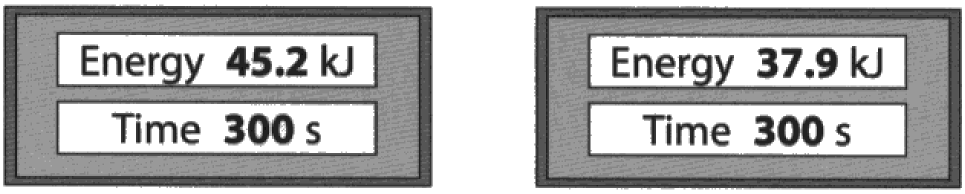
Candidates were required to extract information given in two displays of energy transferred and time taken to draw the conclusion that the (average) power developed in session 1 was greater than that in session 2 because more energy was transferred in the same amount of time.

Full credit was given to candidates who calculated the power in each case to support their conclusion as well as to candidates who correctly explained their reasoning in words.

(d) An athlete uses a training machine in a gym.

The display on the machine shows the time spent on the machine and the amount of energy transferred during a training session.

Figure 5 shows the displays for two different sessions by the same athlete.



session 1 session 2

Figure 5

Explain what the displays show about the average power of the athlete in each of these two sessions.

(2)

The athelete had more power in the first session than the second. This is probably because he used up as lot of power in the first session and didn't have as much left to use for the second session.

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Examiner Comments

Examiners saw many answers like this. The candidate has tried to explain why the power of the athlete has changed rather than how the power has changed.

It scored one mark only.

Question 4 (a) (i)

Examiners were looking for recognition that this an example of charging by friction (1 mark) . Credit was given for correct identification of the nature of the charge transferred; i.e. negative electrons (1 mark) and the direction of transfer (1 mark) . Candidates who failed to make one of the previous three mark points could still gain full credit by explaining why the comb was left with an overall positive charge.

Question 4 (a) (ii)

Examiners were looking for a clear explanation of charging by induction.

(ii) Explain how the positively-charged plastic comb picks up the small pieces of paper.
(3)

the small pieces of paper have electrons which are negatively charged. through induction, the electrons are attracted to the positively charged comb. (~~px~~ opposite charges attract) and they move to the surface of the small pieces of paper so they attach to the comb.

ResultsPlus
Examiner Comments

A typical answer that scored all 3 marks.

(ii) Explain how the positively-charged plastic comb picks up the small pieces of paper.
(3)

~~As~~ The comb charges the paper by induction as the comb gets near the pieces of paper, it's positive charge attracts electrons in the paper (like charges repel, opposites attract) so the paper is picked up by the comb.

ResultsPlus
Examiner Comments

Many answers, like this one, did not describe how the charge is distributed in the paper. 2 marks only.

Question 4 (c) (i)

Candidates were required to recognise that the electrostatic forces acting on two charged objects can be explained by the interaction of their electric fields.

(c) Figure 7 shows two metal spheres.

Metal sphere A is fixed to a table.
Metal sphere B can be moved.

Metal sphere B is placed at a short distance from metal sphere A.

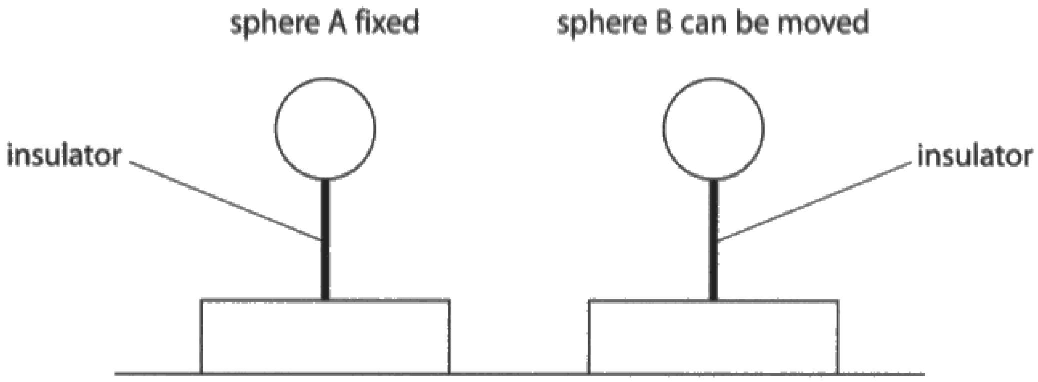

Figure 7

Both spheres are insulated from the table and given a negative charge.

The force between the charged spheres is measured.

(i) Explain, in terms of electric fields, why a force is exerted on sphere B.

(2)

Sphere B lies in the electric field of sphere A~~, and vice versa~~. This means that they both experience a repelling force as they are ~~opposite~~ similarly charged and ~~each other~~ B is in the electric field of A.

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Examiner Comments

A clear explanation that scored 2 marks.

Question 4 (c) (ii)

Candidates were required to interpret the graph to describe the non-linear relationship between the electrostatic force and the separation distance between the charged objects.

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

Figure 8 is a graph of force on sphere B against distance between the centres of the spheres.

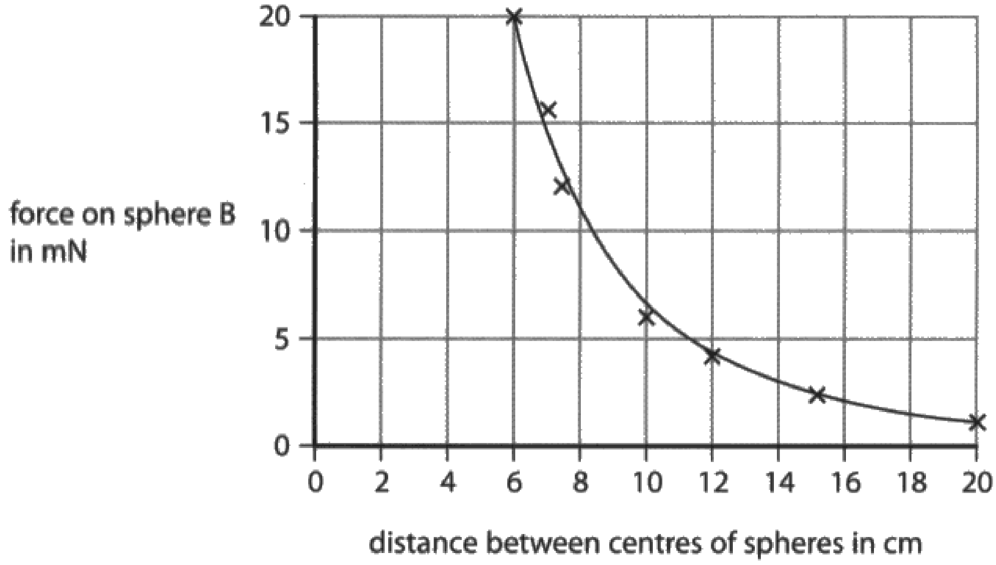

Figure 8

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

(2)

The furthe the distance between spher A and B, the lower the force on sphae B.

ResultsPlus
Examiner Comments

One mark for describing that the force decreases as the distance increases.

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

Figure 8 is a graph of force on sphere B against distance between the centres of the spheres.

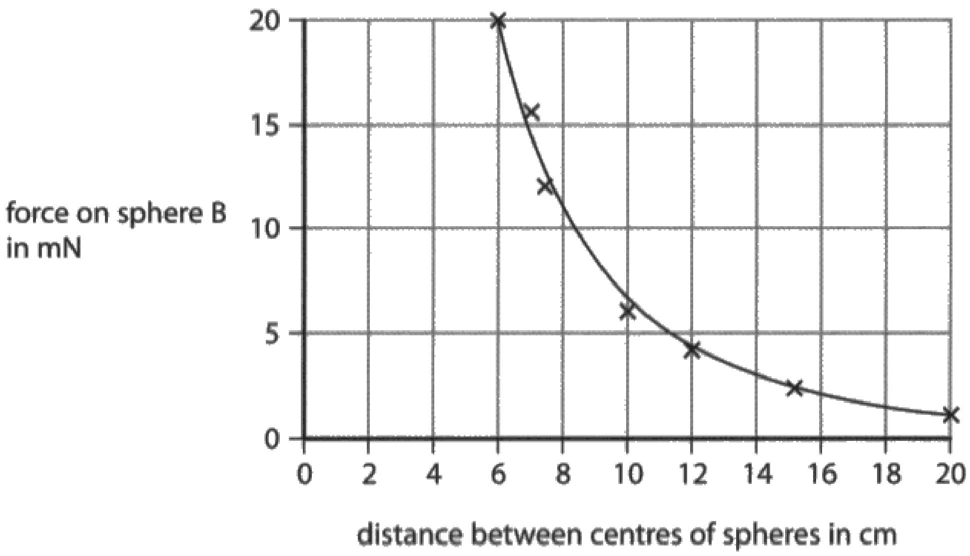

Figure 8

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

(2)

As the distance between the spheres increases, the force on sphere B decreases. It's a non linear relationship.

ResultsPlus
Examiner Comments

As well as describing how the force changes, this answer also goes on to identify that the relationship is not linear. 2 Marks

Question 5 (a)

Examiners were looking for a clear description of how to demonstrate that a magnetic material such as iron can become an induced magnet, but that the effect is only temporary.

5 (a) A student has a bar magnet, a piece of iron the same size as the magnet, and some paper clips.

Describe how the student could use these items to demonstrate temporary induced magnetism.

(3)

show that Iron is not magnetic on its own - won't pick up the paper clips. Then, place the bar magnet on the iron, and place the iron near the paper clips which it will then pick up because of induced magnetism

ResultsPlus
Examiner Comments

This response gives a clear description of how to show that a piece of iron can become an induced magnet, but it does not fully answer the question. 2 out of 3 marks were awarded.

5 (a) A student has a bar magnet, a piece of iron the same size as the magnet, and some paper clips.

Describe how the student could use these items to demonstrate temporary induced magnetism.

(3)

The iron should be brought into the magnetic feild of the bar magnet, this will temperaly induce the magnet, then the iron should be held near the paper clips. The iron will attract the paper clips. Then take the iron out of the magnets faild and watch the paper clips fall.

ResultsPlus
Examiner Comments

The response not only describes how to show that a piece of iron can become an induced magnet, but it also goes on to describe how to show that the effect is only temporary.

Question 5 (b) (i)

Candidates were given a drawing of some familiar apparatus being used in what was probably an unfamiliar way. They were required to devise an experimental procedure that involved two different topics: electromagnetism and elasticity.

Examiners were looking for clear descriptions of the measurements that could be made in this investigation including a clear description of how the extension of the spring from its natural length can be measured. Candidates were not required to make any predictions, nor to explain how a particular hypothesis could be tested. However, credit was given to those answers that recognised that the extension of the spring could be used to determine the force of attraction.

Many candidates had the idea that the extension of the spring needed to be recorded for different currents but did not give any detail about how these measurements could be made.

(b) A student sets up the apparatus shown in Figure 9.

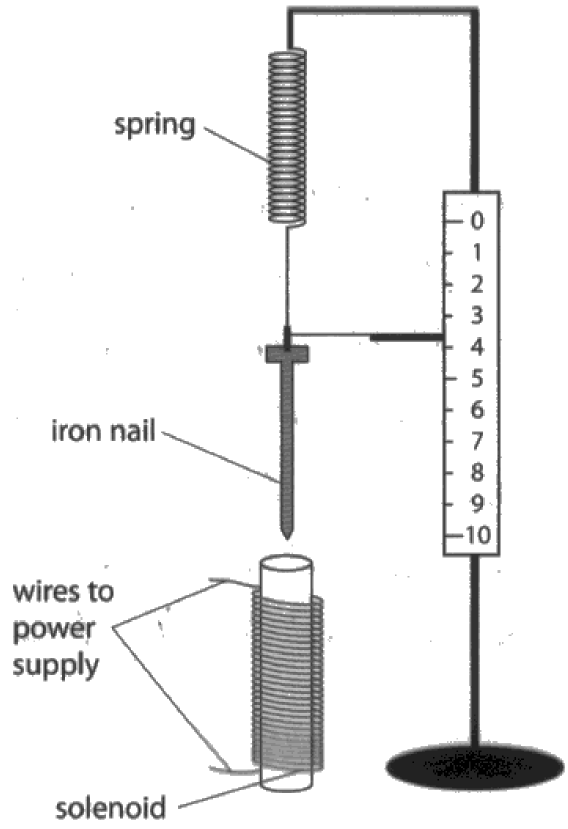

Figure 9

(i) When the current in the solenoid is switched on, the solenoid attracts the iron nail.

Describe how the student could use this apparatus to investigate how the size of the current in the solenoid affects the force of attraction between the solenoid and the iron nail.

(4)

By ~~testing~~ seeing the extension of the spring when different currents go through the ~~sol~~ solenoid. First they should record the ~~exten~~ extension of the spring when the current is low and gradually make the current higher. The greater the spring extension the greater the attraction is between the nail and solenoid.

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Examiner Comments

This answer scored 2 marks. One mark for stating that the extension of the spring should be recorded and another mark for stating that the current should be varied.

ResultsPlus
Examiner Tip

If you are describing an experiment, make sure you describe exactly how the measurements should be made.

Question 5 (b) (ii)

Candidates were required to select and apply the equation relating energy transferred in stretching a spring to the extension of the spring and the spring constant.

Partial credit was given to answers that clearly showed correct substitution into the correct equation but contained an error in the final evaluation; usually resulting from incorrect conversion from cm to m.

(ii) The spring constant of a different spring is 24 N/m.

The spring is extended from its unstretched length by 12 cm.

Calculate the energy transferred in extending the spring by 12 cm.

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

(2)

$E = 1/2 \times k \times x^2$

$E = 1/2 \times 24 \times 12^2$

$E = 1728$

energy transferred = 1728 J

ResultsPlus
Examiner Comments

A well laid out answer that would have scored both marks if the candidate had converted cm into m.

Even so, the examiner was able to award 1 mark out of 2 for clear evidence of selection and application of the equation.

(ii) The spring constant of a different spring is 24 N/m.

The spring is extended from its unstretched length by 12 cm.

Calculate the energy transferred in extending the spring by 12 cm.

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

(2)

$E = \frac{1}{2} \times k \times x^2$ 12 cm ÷ 100 = 0.12 m

$\frac{1}{2} \times 24 \times 0.12^2 = 0.1728$

energy transferred = 0.1728 J

ResultsPlus
Examiner Comments

Another well laid answer; this time scoring both marks.

Question 6 (a) (ii)

Candidates were required to extract information from the diagram to calculate the distance moved by a geared rack.

The simplest way to approach this question is to recognise that the distance moved can be calculated by multiplying the pitch between each gear tooth by the number of teeth on the rack that have been moved by the large gear wheel.

(ii) Figure 11 shows the same arrangement with gear R replaced by a rack.

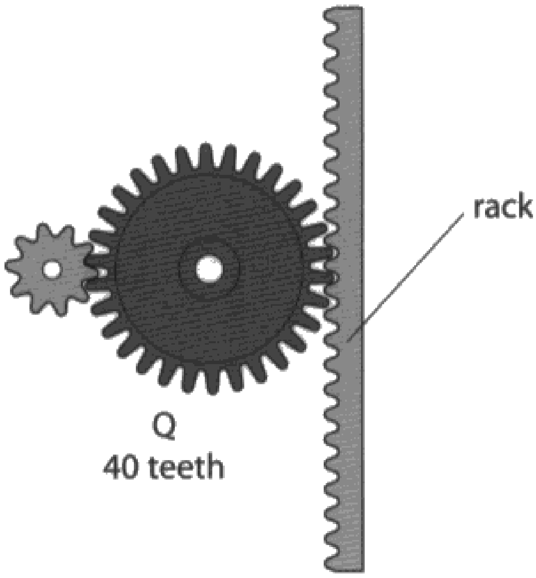

Figure 11

The rack can move up or down when the gears turn.

The teeth on the rack are 2 mm apart.

Calculate how far the rack moves when P turns through to one complete revolution.

(2)

P - moves Q by 10 teeth

2mm × 10 = 20

distance = 20 mm

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Examiner Comments

Examiners frequently saw fully correct responses such as this.

Question 6 (b)

This question required candidates to recall and apply the principle of moments. Candidates who scored well tended to present answers that clearly showed each of the several necessary stages in their working.

(b) Figure 12 shows three toy animals hanging from a rod.

The rod hangs from the ceiling by a string tied to the centre of the rod.

The system is in equilibrium.

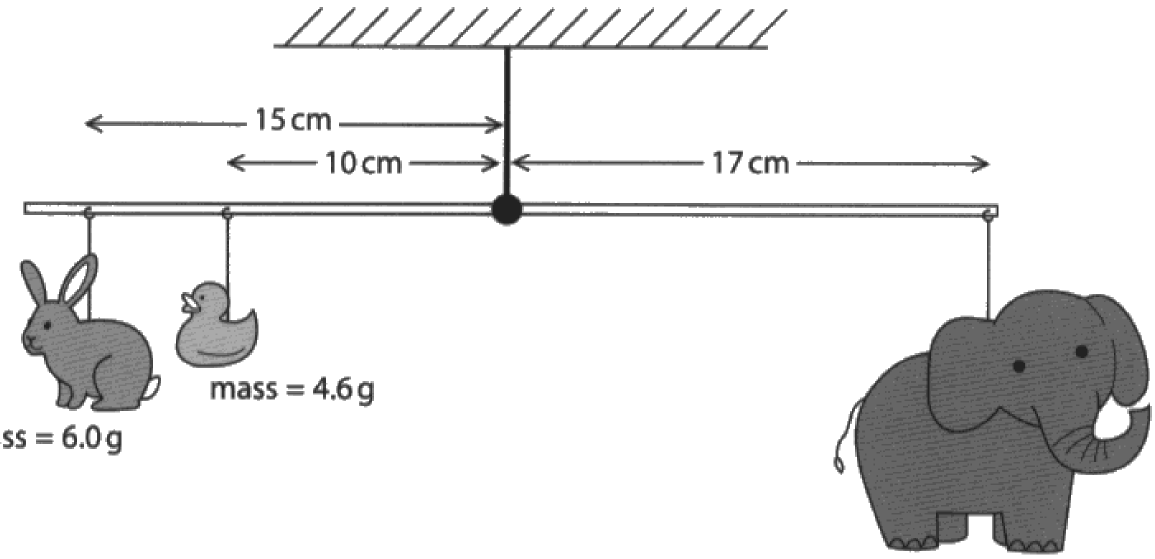

Figure 12

Use the principle of moments to calculate the mass of the toy elephant.

(4)

Sum of clockwise moments = sum of anticlockwise moments.

~~10 cm~~
15 cm = 6 + 4.6
15 cm = 10.6g

15 cm = 10.6 g (÷15)
1 cm = 0.706 (×17)
17 cm = 12.013
= 12g

mass = 12 g

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Examiner Comments

The candidate has highlighted important words in the question. This has helped to make a start to the answer by stating the principle of moments to score one mark even though the calculation did not go any further.

(b) Figure 12 shows three toy animals hanging from a rod.

The rod hangs from the ceiling by a string tied to the centre of the rod.

The system is in equilibrium.

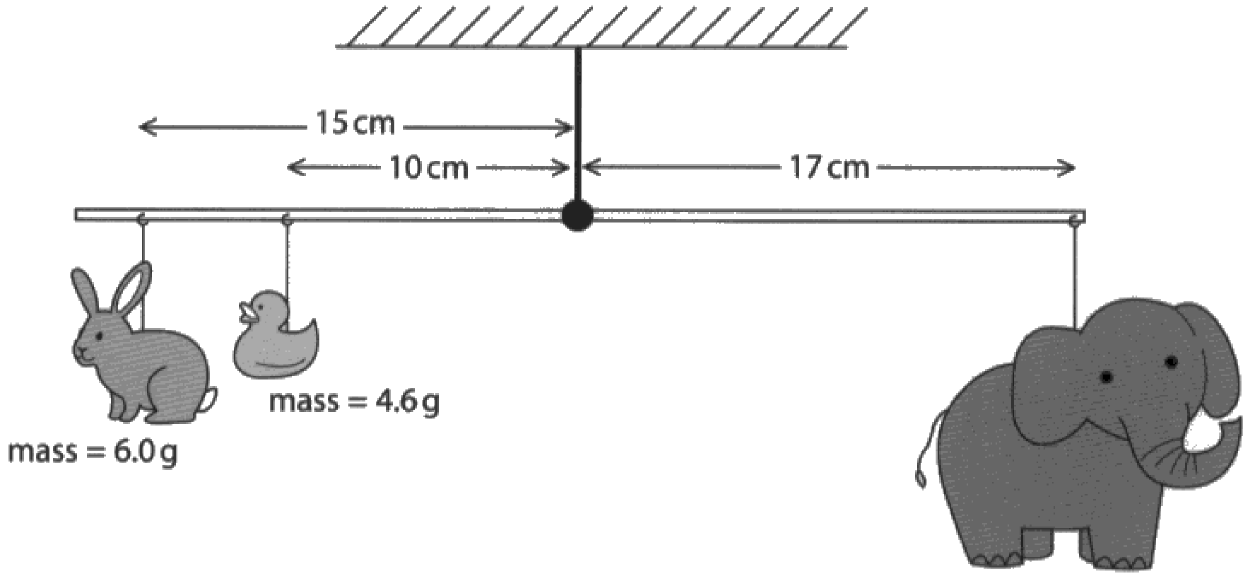

Figure 12

Use the principle of moments to calculate the mass of the toy elephant.

(4)

Moment = force x distance

mass = ... g

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Examiner Comments

This demonstrated recall of the equation linking moment, force and distance and earned the candidate one mark.

Question 6 (c)

Candidates were required to interpret the information given in the diagram to explain that the pressure from a force acting over a given area in a liquid will result in a larger force acting over a larger area of the same liquid.

Many candidates seemed to confuse the concepts of pressure and force.

(c) Figure 13 shows a diagram of a device for lifting heavy loads.

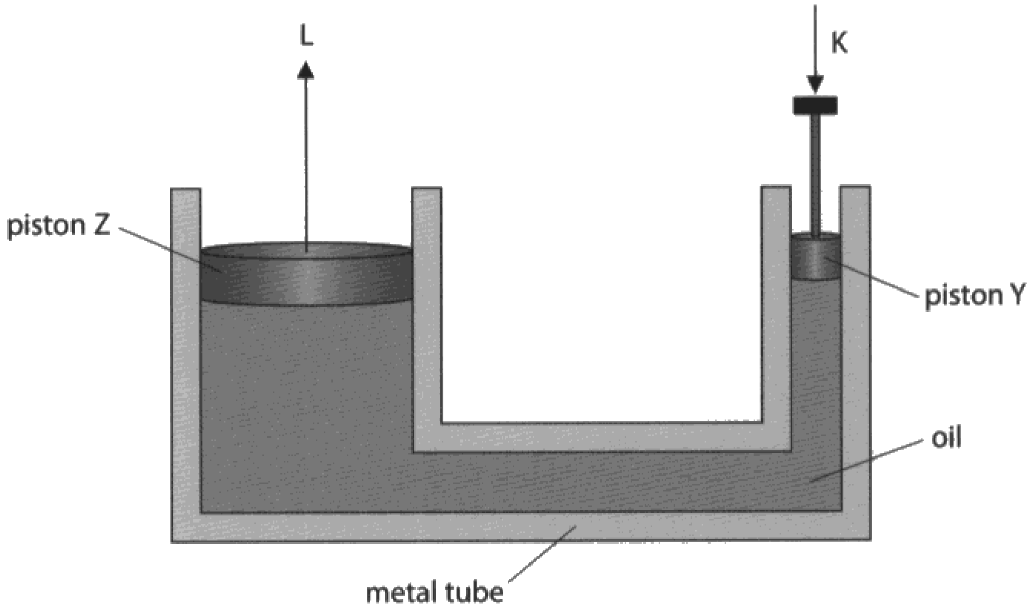

Figure 13

The metal tube is filled with oil.

The piston Y is pushed down with a force K.

This produces a force L on piston Z.

The pressure exerted on the oil by piston Y is the same as the pressure exerted by the oil on piston Z.

Explain the difference between the size of force K and the size of force L.

(3)

Force K is larger than force L because there is a more concentrated direction of force and a smaller surface area for piston Y to exert a force on to the oil. Piston Y is also smaller so will require more force to exert pressure on to the oil.

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Examiner Comments

Although the answer scores 1 mark for identifying that the area under piston Y is smaller than that under piston Z, the candidate has incorrectly argued that this will "concentrate" the force on that piston to make K larger than L.

1 mark only

(c) Figure 13 shows a diagram of a device for lifting heavy loads.

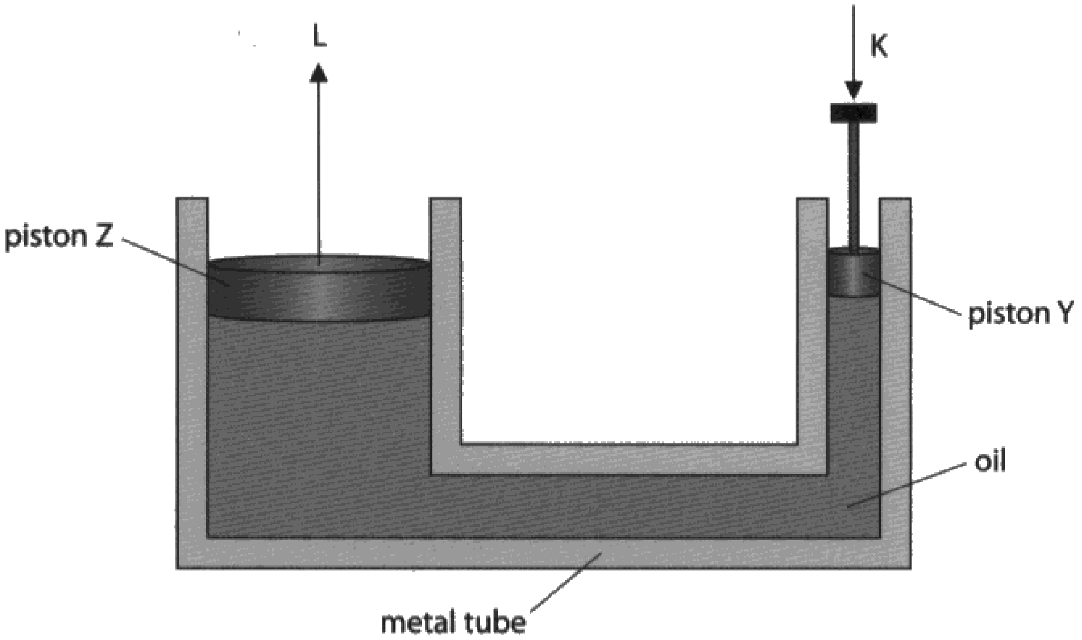

Figure 13

The metal tube is filled with oil.

The piston Y is pushed down with a force K.

This produces a force L on piston Z.

The pressure exerted on the oil by piston Y is the same as the pressure exerted by the oil on piston Z.

Explain the difference between the size of force K and the size of force L.

(3)

Force K is smaller than force L as as piston Z has a much larger surface area than piston Y.

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Examiner Comments

This answer correctly links the larger area under piston Z with a larger force L and scored 2 out of the 3 available marks.

Answers needed to explain the link between pressure, force and area in order to score full marks. This was most clearly done by stating the equation.

(c) Figure 13 shows a diagram of a device for lifting heavy loads.

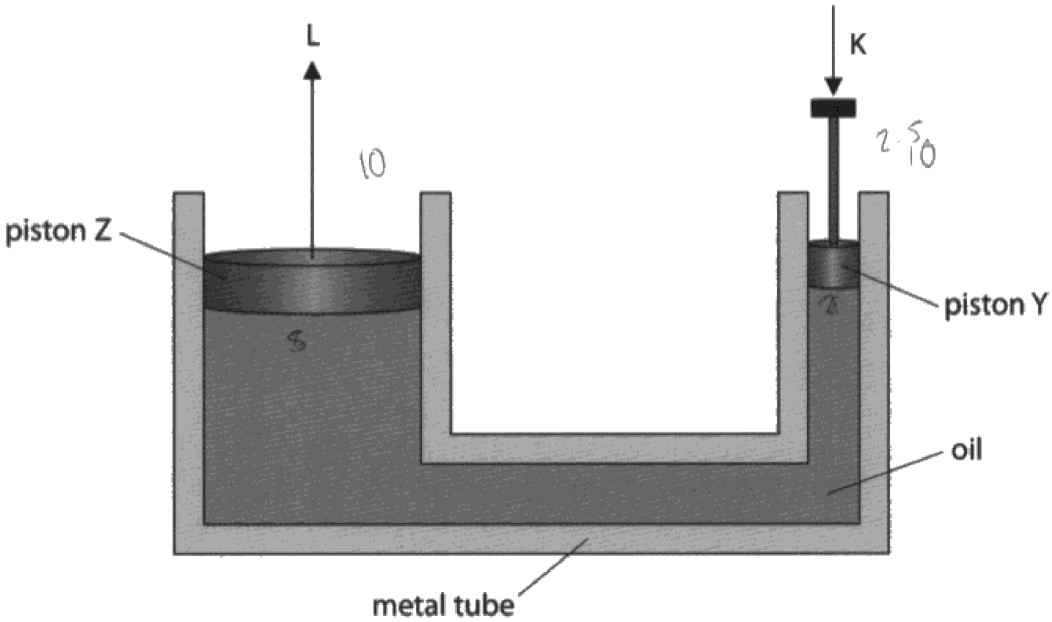

Figure 13

The metal tube is filled with oil.

The piston Y is pushed down with a force K.

This produces a force L on piston Z.

The pressure exerted on the oil by piston Y is the same as the pressure exerted by the oil on piston Z.

Explain the difference between the size of force K and the size of force L.

(3)

pressure = force ÷ area. The area of K is less than the area of L, therefore if the pressure remains the same then the force ~~of~~ on K must be smaller in order to keep the same pressure. From K to L the force on the piston increases.

(Total for Question 6 = 10 marks)

10 × 5 = 50   50 ÷ 5

10 × 2 = 20   20 ÷ 2

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Examiner Comments

A well-reasoned answer. The examiner had no hesitation in awarding 3 marks out of 3.

Question 7 (a) (i)

This question assessed the ability of candidates to resolve two collinear forces into a single force of 0.9 kN upwards.

Question 7 (a) (ii)

This question required candidates to demonstrate how to find, graphically, the resultant of two mutually perpendicular forces.

Although many candidates correctly calculated the magnitude of the resultant as 500N, this was not necessary for the mark.

(ii) The aeroplane is descending.

Figure 15 shows a diagram of the resultant vertical and horizontal forces on the aeroplane as it is descending.

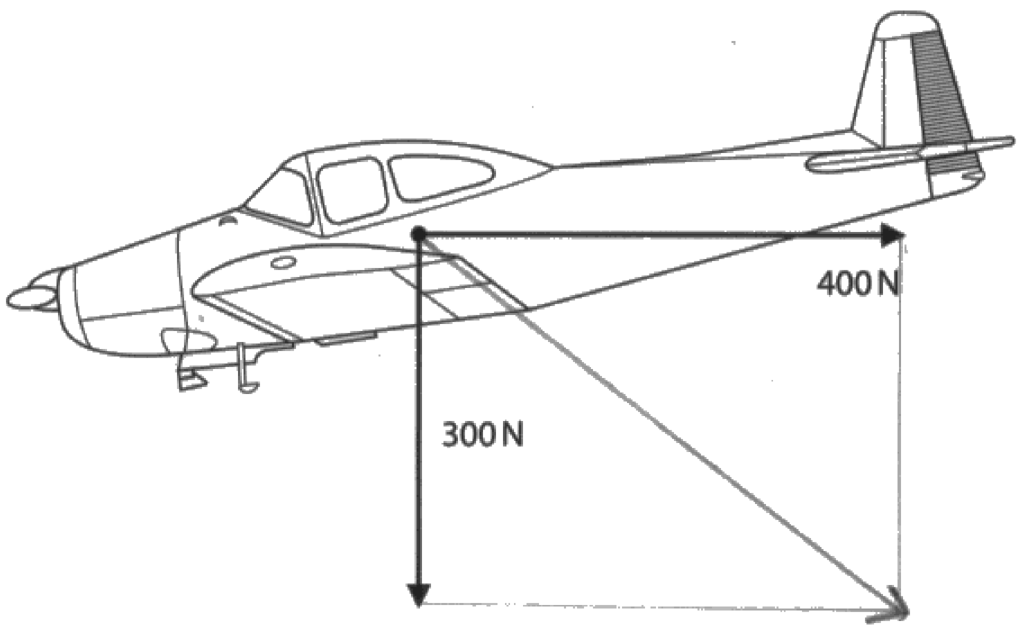

Figure 15

Complete the diagram to show the resultant of these two forces.

(1)

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Examiner Comments

A perfectly acceptable answer.

Question 7 (a) (iii)

Candidates were required to recall and apply the equation linking change in gravitational potential energy to mass and change in height above the ground.

Question 7 (b) (i)

This was a two-stage calculation requiring recall and application of the equation for efficiency and the equation linking power, energy and time.

Partial credit was given for answers that clearly made progress through the stages even if the final evaluation was incorrect.

(b) The aeroplane is powered by an engine that burns fuel.

The fuel supplies a total of 6500 kJ of energy every minute.

The efficiency of the engine is 0.70 (70%).

(i) Calculate the power output of the engine.

Give your answer in kW.

(4)

$\frac{\text{total energy}}{\text{efficiency}} = \frac{\text{useful energy out}}{\text{total energy in}}$

$\frac{?}{6500} = 0.70$

$6500 \times 0.70 = 4550$ kJ

$6500 - 4550 = 1950$ total energy used up

$P = \frac{E}{t}$ $P = \frac{1950 \text{ kJ}}{60 \text{ secs}}$ per min

$= 32.5$ kW

power = 32.5 kW

ResultsPlus
Examiner Comments

This answer shows the first stage: calculation of the output energy (per minute) from the input energy and efficiency for 2 marks.

The candidate went on the recall the equation linking power, energy and time for a 3rd mark. However, there was some confusion about which values to substitute into that equation and no further marks could be awarded.

(b) The aeroplane is powered by an engine that burns fuel.

The fuel supplies a total of 6500 kJ of energy every minute.

The efficiency of the engine is 0.70 (70%).

(i) Calculate the power output of the engine.

Give your answer in kW.

Efficiency = total / useful × 100

(4)

$70\% = \frac{x}{6500} \times 100$

$\frac{70}{100} = 0.7 = \frac{x}{6500}$

$0.7 \times 6500 = 4550\ kJ = 4550000\ J$

$P = \frac{E}{t} \quad \frac{4550000}{60} = \frac{75833.3\ W}{1000} = 75.83\ kW$

power = 75.83 kW

ResultsPlus
Examiner Comments

A nicely laid out answer scoring full marks.

Question 7 (b) (ii)

Examiners were looking for an understanding that, in an engine, the input energy is greater than the useful output energy because some energy is dissipated in less useful ways.

Question 8 (a) (ii)

Candidates were required to recall and apply the equation linking current, time and charge. Partial credit was given to answers that clearly showed correct substitution into the correctly recalled equation but having an error in either conversion of mA to A and/or seconds into minutes.

Question 8 (a) (iii)

Candidates were required to recall and apply the equation linking energy transferred, charge moved and potential difference.

Question 8 (b)

Examiners were looking for an explanation that linked the collision of electrons with the lattice to an increase in the vibration of the lattice. Examiners would also credit answers that described the kinetic energy of the electrons decreasing as a result of collisions with the lattice.

Many candidates seemed to think that the lattice only starts to vibrate when there is a current in the resistor.

(b) The resistor becomes warm while there is a current in it.

Explain why the resistor becomes warm.

(2)

The electrons from the current are colliding with the ions in the resistor transferring energy. This energy causes the ions to vibrate heating the resistor

ResultsPlus
Examiner Comments

The answer makes the first marking point by describing collisions of electrons with ions in the lattice. However, it is not quite clear enough to score the second mark point.

(b) The resistor becomes warm while there is a current in it.

Explain why the resistor becomes warm.

(2)

Electrons in the current collide with ions in the lattice of the resistor, making them vib-rate with more energy and therefore heating up.

ResultsPlus
Examiner Comments

The addition of a couple of words distinguishes this from the previous answer. Even though the term "energy" is slightly out of context, the examiner could award the second mark for the idea that the lattice vibrates more.

2 out of 2.

Question 8 (c)

Candidates were required to analyse the values of resistance, current and potential difference given in order to deduce that the two resistors must have been connected in parallel. Full marks were given to answers that used calculation to support the conclusion.

There were a number of different successful approaches seen; the most common was to calculate the effective resistance of the combination as being 5 ohms and then to apply understanding that the effective resistance of resistors in parallel is less than the resistance of each one.

(c) Figure 16 shows a cardboard tube with a wire coming out from each end.

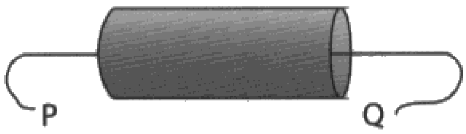


Figure 16

There are two 10 ohm resistors inside the cardboard tube.

A potential difference of 6.0 V is connected between P and Q.

There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

(3)

$6 = 1.2 \times R \Rightarrow R = 5\,\Omega$

Both the resistors must be in parallel, since the total resistance is less than the resistance of each resistor separately.

ResultsPlus
Examiner Comments

A correct conclusion supported by reasoning that included a calculation.

(c) Figure 16 shows a cardboard tube with a wire coming out from each end.

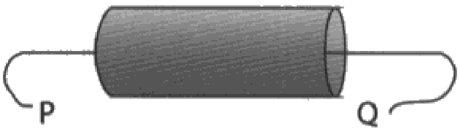


Figure 16

There are two 10 ohm resistors inside the cardboard tube.

A potential difference of 6.0 V is connected between P and Q.

There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

(3)

The resistors have been aranged in a parallel circuit. This is because the voltage/potential difference is the same across both resistors, and the current is 1.2 A throughout the wires. Because of this the resistors must be across separate circuits.

ResultsPlus
Examiner Comments

A correct conclusion for 1 mark. However, there is no calculation or clear reasoning to support this. For example, how do we know that the potential difference across the two resistors is the same?

Question 9 (b) (i)

Candidates had previously been given four different diagrams, each showing a current that changed with time. Candidates were now shown a current that remained constant and were required to reason that such a current in the primary coil of a transformer would not produce the change in magnetic field in the core of a transformer that is necessary to induce a potential difference across the secondary coil.

Many candidates merely stated that the current shown was DC.

(b) (i) Figure 17 shows the output from a battery.

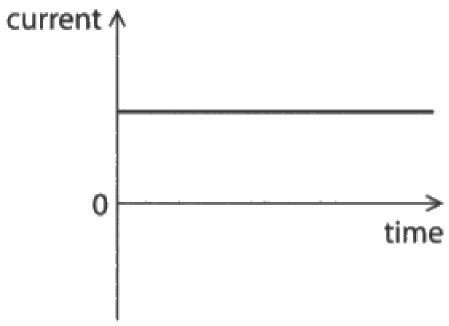


Figure 17

80

Explain why a transformer will not work with the input current as shown in Figure 17.

(2)

The current is ~~not alternation~~ constant which means that the magnetic field around the coil doesn't change and a current can't be induced in the secondary coil.

ResultsPlus Examiner Comments

A good answer for 2 out of 2 marks.

(b) (i) Figure 17 shows the output from a battery.

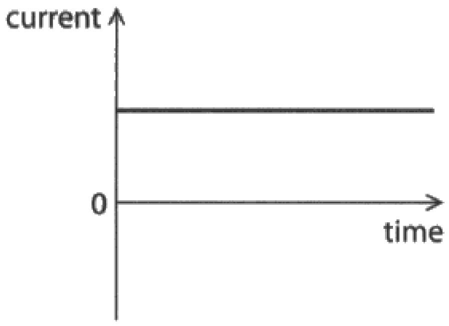


Figure 17

Explain why a transformer will not work with the input current as shown in Figure 17.

(2)

Because the input current does not change as time goes on, it stays at a fixed current. The transformer could not increase of decrease the current.

ResultsPlus
Examiner Comments

This answer shows correct interpretation of the diagram but does not go on to explain why a transformer will not work with an unchanging current.

1 mark out of 2

Question 9 (b) (ii)

This required candidates to apply the equation linking the number of turns of the primary and secondary coils of a transformer with the potential differences across the coils. There was one mark for correctly substituting the values into the correct equation and a second mark for correctly rearranging the expression. The third mark was for correctly evaluating the answer. Weaker candidates often incorrectly selected the equation linking current and potential difference for a transformer.

Candidates could do the substitution and rearrangement in either order and still score at least partial marks if their working was clear.

(ii) A transformer has 30 turns on the primary coil and 150 turns on the secondary coil.

A potential difference of 25 V is applied across the primary coil.

Calculate the potential difference across the secondary coil.

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

(3)

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$V_p = \frac{N_p}{N_s} \times V_s$$

$$V_s = \frac{N_p}{N_s} \times V_p$$

$$V_s = \frac{30}{150} \times 25$$

$$V_s = 5$$

potential difference = 5 V

ResultsPlus
Examiner Comments

The candidate has selected the correct equation and then attempted to rearrange it.

Even though the rearrangement was incorrect, the candidate has substituted the symbols with the correct numerical values and so can score 1 mark for substitution.

1 out of 3 marks.

ResultsPlus
Examiner Tip

Always show your working.

(ii) A transformer has 30 turns on the primary coil and 150 turns on the secondary coil.

A potential difference of 25 V is applied across the primary coil.

Calculate the potential difference across the secondary coil.

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

(3)

$V_p \times I_p = V_s \times I_s$

$25 \times 30 = \square \times 150$

$25 \times 30 = 750$

$750 \div 150 = 5$

potential difference = 5 V

ResultsPlus
Examiner Comments

The candidate has selected the wrong equation.

Even though the final answer is the same as in the previous example, no credit can be given for using the wrong equation.

0 marks

(ii) A transformer has 30 turns on the primary coil and 150 turns on the secondary coil.

A potential difference of 25V is applied across the primary coil.

Calculate the potential difference across the secondary coil.

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

(3)

$N_p = 30$

$N_s = 150$

$V_p = 25V$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\frac{25}{V_s} = \frac{30}{150}$$

$$25 = 0.2(V_s)$$

$$V_s = \frac{25}{0.2} = 125$$

potential difference = 125 V

ResultsPlus
Examiner Comments

A nicely laid out answer for 3 out of 3 marks.

Question 9 (c)

In this extended open response question , examiners were looking for an explanation that linked an high transmission voltage with a lower transmission current in the cables and then went on to reason that this reduced current would mean that less energy would be dissipated due to the resistance of the cables.

To reach Level 3, the answer needed to support the reasoning by applying the two equations given to this scenario.

*(c) High voltage transmission cables and transformers are used in the national grid.

Explain how using high voltage transmission cables and transformers allows the distribution of electrical power around the United Kingdom to be as efficient as possible.

Refer to the following equations in your answer.

$$P = I^2 \times R$$

$$V_p \times I_p = V_s \times I_s$$

(6)

Step up transformers allow the voltage to ~~decrease~~ increase while the current decreases. This is ~~because~~ because the input power should equal the output power and V x I = power so the equation $V_p \times I_p = V_s \times I_s$ shows that the power in primary coil ~~should~~ should be equal to power in secondary coil. So if the voltage ~~is~~ increases from ~~primary~~ primary to secondary coil, the current decreases for power to stay the same. The voltage should travel in high voltages on ~~high~~ high voltage transmission cable because the current is ~~lowered~~ lowered ~~from~~ ~~so~~ meaning the amount of ~~energy transferred power~~ energy transferred as ~~heat~~ heat is reduced ~~1~~ because the equation $P = I^2R$ shows that if current decreases by a factor power decreased by ~~the square of~~ a square of the factor which means less energy is lost every second meaning that ~~more~~ energy is ~~more~~ transferred more efficiently. This also is cost efficient because thinner wires can be used ~~which~~ which cost less.

ResultsPlus
Examiner Comments

The answer starts with a clear description of how transformers are used to change the voltage and current and is supported by use of relevant equations.

It goes on to explain how a low transmission current results in less energy loss. Once again this is supported by use of a relevant equation.

Overall, an explanation that has a well-developed structure which is clear, coherent and logical.

Level 3. 6 marks.

Candidates could reach Level 2 by giving detail about how transformers are used to change both voltage and current together with some discussion about energy dissipation in transmission, even if this was not a complete explanation.

*(c) High voltage transmission cables and transformers are used in the national grid.

Explain how using high voltage transmission cables and transformers allows the distribution of electrical power around the United Kingdom to be as efficient as possible.

Refer to the following equations in your answer.

$$P = I^2 \times R$$

$$V_p \times I_p = V_s \times I_s$$

(6)

Step up transformers ~~use~~ use induced coils to increase the potential difference of the energy being supplied. As shown in the equation $V_p \times I_p = V_s \times I_s$, a higher voltage requires a lower current to achieve ~~a~~ the same power, shown in P = I×V. A lower current decreases the flow of charge and so there are fewer collisions and so ~~fewer~~ less resistance. This means more energy is transferred usefully to homes. When closer to domestic use, step down transformers ~~increase~~ decrease voltage, meaning that current goes up. This means there is lower resistance to achieve given power, shown in the equation ~~P=I²~~ $P = I^2 \times R$, and so minimal energy is lost as heat.

ResultsPlus
Examiner Comments

The answer starts with a good explanation of how transformers are used to change the voltage and current. It goes on to link a lower current with more useful energy transfer. However, there is some confusion about resistance and the answer implies that resistance can be changed by changing the current and/or voltage.

This response is mostly relevant but includes some inaccuracies.

Level 2 for 4 Marks.

Question 10 (a) (i)

Candidates were required to apply their understanding of series circuits to calculate the potential difference across one of the lamps in the circuit.

Question 10 (a) (ii)

This was a complex calculation that could be carried out by recall and application of the equation linking current, power and potential difference and then the equation linking current, potential difference and resistance. Successful candidates tended to be those who showed each stage in their calculation.

10 (a) Figure 18 shows identical filament lamps connected together to a 12V power supply.

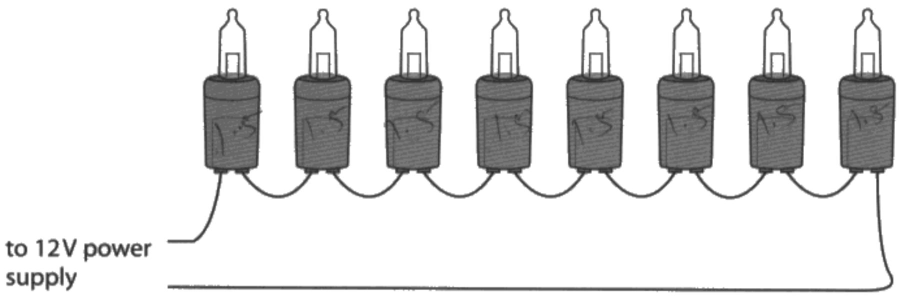


Figure 18

(i) Calculate the potential difference across each lamp.

(1)

potential difference = 1.5 V

(ii) The power output of each lamp is 0.75 W

Calculate the resistance of each lamp.

② $V = I \times R$
① $P = I \times V$

(4)

① $0.75 = I \times 1.5$
$I = 0.5A$

② $1.5V = 0.5A \times R$
$R = 3\,\Omega$

$P = I^2 \times R$
$0.75 = 0.5^2 \times R$
$\frac{0.75}{0.5^2} = 3$

resistance = 3 Ω

ResultsPlus
Examiner Comments

A nicely laid out answer that the examiner could easily follow.

3 out of 3 marks

10 (a) Figure 18 shows identical filament lamps connected together to a 12V power supply.

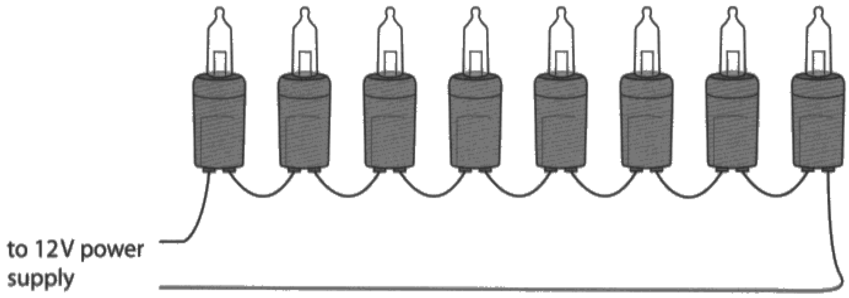


Figure 18

(i) Calculate the potential difference across each lamp.

(1)

potential difference = 1.5 V

(ii) The power output of each lamp is 0.75W

Calculate the resistance of each lamp.

(4)

P = IV   V = 12 $\frac{0.75}{12}$ = 0.625

V = IR   P = 0.75

I = 0.625 $\frac{0.75}{0.625}$ = 1.2

resistance = 1.2 Ω

ResultsPlus
Examiner Comments

Although the candidate has recalled two equations, it is not clear how they have been used.

There is no clear evidence of substitution or rearrangement. This did not score any marks.

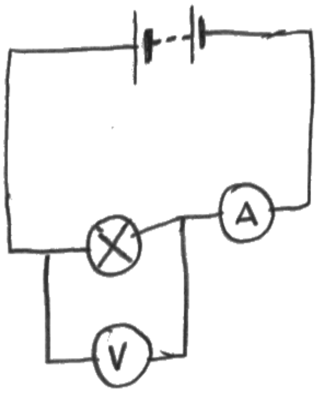
Question 10 (b)

In this extended open response question, candidates were required to describe how to carry out this Core Practical and support their description with a circuit diagram. They were not required to describe the way in which the resistance of a lamp varied with the current through the lamp.

Level 2 responses included an accurate circuit diagram, a description of how current and potential difference is measured and a clear reference to how a set of readings could be obtained by varying the potential difference across the lamp.

*(b) Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

(6)



They could create a series circuit containing a ~~bulb and an~~ lamp and an ammeter with a voltmeter in parallel to the lamp. They could then ~~use~~ increase the potential difference by adding more cells and each time, measure the resistance across the lamp.

ResultsPlus
Examiner Comments

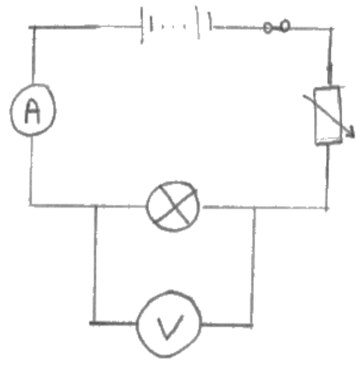
Correct circuit diagram with a description that includes how to vary the potential difference across the lamp.

Level 2 for 4 marks.

Level 3 responses were those that continued the description to include detail about how the resistance could be calculated from the measurements made.

*(b) Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

(6)



$V = I \times R$

$R = \frac{V}{I}$

Firstly, set up the equipment as shown in the diagram. Then measure the reading on the Ammeter to find out the size of the circuit's current. Next, measure the voltage on the voltmeter. Calculate the resistance using ($R = \frac{V}{I}$) Gradually change the amount of voltage being supplied into the circuit and continue the calculations. Plot the recordings on a graph.

ResultsPlus
Examiner Comments

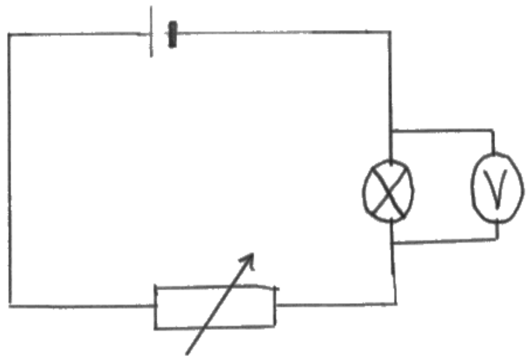
Correct circuit diagram with a description that includes how to find the resistance of the lamp for different potential differences across the lamp.

Level 3 for 6 marks

Level 1 answers contained some details about the procedure but either had incomplete or incorrect circuit diagrams and/or did not give sufficient detail about how the measurements could be made.

*(b) Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

(6)



Using a circuit like the one above can be used to determine how resistance changes across the lamp. Using a variable resistor can change the resistance, which in turn ~~decre~~ ~~de~~ decreases the current due to the heating effect. Thus therefore increases the voltage or potential difference due to the ~~f~~ equation V = IR. The voltage of the lamp can be read and recorded off the voltmeter placed in ~~series~~ parallel across the bulb. Then the student should repeat this using a range of different resistances ~~which~~ while each time recording the voltage. To see the changes ~~the~~ the result can be plotted on a graph

(Total for Question 10 = 11 marks)

ResultsPlus
Examiner Comments

The circuit diagram is missing an ammeter and the description makes no reference to using an ammeter to measure the current.

Level 1 for 2 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
- identify the known and unknown quantities in a numerical problem before selecting a formula to use for the calculation
- make sure that they recognise SI prefixes such as m and K 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
- practise describing practical methods including a clear description of how to use scientific apparatus to make measurements

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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