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Examiners' Report
IGCSE Physics (4420)

June 2006

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Examiners' Report

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PHYSICS 4420, CHIEF EXAMINER'S REPORT

Paper 1F

General Comments

Questions 1 to 8 only appear on this paper and were targeted at candidates likely to achieve grade F. Questions 9 to 16 were targeted at grade C candidates and are common with the Higher Tier paper. The great majority of the candidates taking this paper had been entered for the most appropriate tier.

Question 1
In part (a) most realised that the magnets would attract. However a small minority lost their first mark because they ignored, or overlooked, the instruction to 'Add an arrow to each magnet…'.
In (b) most selected the drawing pin and the needle and nearly all of these made the same choice in (ii).
Most followed the instructions in (c). Some used the dotted box to show the pattern of the magnetic field around a bar magnet, but they generally obtained all three marks.

Question 2
This question was well answered with only the occasional candidate giving half dimensions in (i) or arriving at an answer of 0.2 Hz or 80 Hz in (b)(ii).

Question 3
It seemed that many candidates should have given themselves time to think before answering this question. For example, many did not seem to realise that the wall heater must be on the wall near to the temperature of 50 ˚C in Room A.

Question 4
This question was better answered than a question on the same section of the specification in 2005. However, only a minority gained full marks.

Question 5
In (a) few realised that the diagram shows that energy is conserved. However, other parts were much better answered with nearly all gaining the mark in (b).

Question 6
This question was generally well answered but in (d) some gave a unit of energy rather than a unit of power.

Question 7
Most selected perspex and polythene in (a) but in (b) only a minority knew that rubbing with a cloth is an example of charging by friction. In (c) some wrongly suggested that positive charge is able to move.
In (d)(i) many knew that the danger was that a spark could trigger an explosion, but in (d)(ii) fewer knew that either the tank and nozzle should be connected by means of an electrical conductor or that both should be earthed.

Question 8
This was generally well answered with most candidates showing, in their 'gas' diagram, four or more particles moving at random and more spaced out than in the 'liquid' diagram. However in their 'solid' diagram, although nearly all showed the

particles closer than in the liquid, a minority failed to indicate that the particles are vibrating.

Question 9
Part (a), on the uses of electromagnetic radiation, proved slightly easier than (b), about the harm caused, but both were generally well answered.

Question 10
In (b)(i) only a minority knew that the other end of the earth wire from the plug is connected to the metal frame/case of the appliance. In (d) there were some imaginative suggestions about what double insulation might be because it was confused with double glazing or some feature of heat transfer.

Question 11
Surprisingly few realised that arrow C points downwards from the centre of gravity even though almost all candidates identified force C as ‘weight’. In (a)(iii) air resistance (or drag) was the answer expected but many restricted themselves to just ‘friction’. In (b), some who knew the feature was the gradient spoiled their answers by describing it as an ‘increasing gradient’. In (b)(ii) some secured one mark for ‘area under the graph’ but were not able to calculate this.

Question 12
Generally well answered. In (b), increasing frequency of the echo as the ship neared the cliff was a more popular answer than the increasing volume of the echo.

Question 13
A generally good response, though in (c) few seemed to realise that all vacuum flasks lose heat from their hot contents but that metal flasks are likely to do so more quickly.

Question 14
Most candidates identified the dimensions of the base of the block but only a small minority converted from centimetres to metres.

Question 15
This question was generally well answered. However, many were not able to locate a step-up transformer in the system to transmit electrical energy from power stations and only a minority could state why the voltage is increased. Some tried to explain how it is increased in a transformer, which is not the question that was asked.

Question 16
A well answered question, but some did not seem to understand that if a megabecquerel really does equal 1000 becquerels it would be a kilobecquerel. A minority produced uncertain decay curves. Their efforts would be improved if they used the technique of rotating the page to put the wrist on the inside of the curve.

Paper 2H

General Comments

Questions 1 to 8 were common to this paper and the Foundation Tier paper. Much of the content of questions 9 to18 was from the 'Higher Tier only' parts of the specification. Some work of a very high standard was seen, with the vast majority of candidates entered for the correct tier.

Question 1

In part (a) candidates were asked to link named electromagnetic radiations to the uses of these radiations. The use of gamma rays and ultraviolet was well known although a few candidates mixed up the uses of infra-red and microwaves.
In part (b), boxes with the above named radiations had to be linked to the harm that they could cause. A common error was to link ultraviolet to skin burns and infra-red to blindness instead of the other way round.
The entire question was drawn from the phrases used in the specification.

Question 2

A drawing of a three-pin plug was shown. Candidates were asked what the pins were made of, the colour of the insulation of the earth wire, what this wire was connected to and its purpose.
It is appreciated that these plugs are not in use worldwide but an attempt has been made in the recommended books to show clearly the structure of these plugs. Apart from a few candidates who were unclear about the colours used, these parts were well answered.
Part (d) showed that many candidates were unclear about the use of double insulation. Two marks were awarded for stating that the cover of the appliance is made from an insulator but many candidates thought that the connecting wires had an extra layer of insulation since the term 'insulation' had been used in (b)(i). A small number of candidates misinterpreted the symbol and described cavity wall insulation.

Question 3

Part (a)(i) required candidates to mark with an **X** the centre of gravity of a racing car whose diagram showed an unlabelled vertical arrow pointing downwards to represent its weight. A significant number of candidates did not answer the question. Of those who did, many marked the **X** too far from the vertical line in question.
Part (a)(ii) asked candidates to complete a table linking named forces acting on the car to letters on the diagrams. Errors were very rare.
Part (b)(i) showed a velocity-time graph for a racing car accelerating from an initial velocity of 10 m/s. Asked what feature of the graph showed acceleration, candidates were expected to comment on the slope of the line. Instead many simply wrote that it speeds or that it accelerates. Some answers just mentioned a straight line without any reference to slope.
Part (b)(ii) required a calculation of the distance moved. Few candidates got the right answer because although they correctly calculated the area of a triangle (300 m) they forgot to add the area of the rectangle (200 m) due to the car not starting from rest.

Question 4

A drawing showed a stationary ship and a distant cliff. In (a)(i) practically all candidates knew that the echo from the cliff of the sound from the ship's foghorn was due to reflection.

In (a)(ii) most candidates knew that the time taken for the sound to travel back from the cliff to the ship was half the value of the time lapse between the foghorn sounding and its echo being heard back on the ship.
In (a)(iii) calculations of the distance of the ship from the cliff given the speed of sound were almost always correct. A small number of candidates mistakenly used a speed of 300 m/s rather than the given value of 330 m/s. This type of error is thankfully rare but is penalised.
In part (d) candidates were asked how the captain could tell that the moving ship was getting closer to the cliff when the foghorn was sounded every ten seconds. Many good answers were seen, referring to the increased loudness, the increased frequency or the shorter time delay. Answers stating that the sound travelled back faster were less satisfactory.

Question 5

In (a) practically all candidates knew that heat cannot be transferred through a vacuum by conduction or convection.
In (b) most knew that the feature shown in a diagram of a vacuum flask that reduced energy transfer by radiation was the double-walled container made of silvered glass.
In (c) candidates were asked to explain one disadvantage, apart from weight, of a vacuum flask in which the case and double-walled container were both made from metal. Some very good answers were seen but a few candidates still referred to the weight and the possibility of it breaking when dropped on the floor due to its weight, even though the stem of the question stated that such flasks were both heavier and stronger than plastic ones.

Question 6

A diagram showed a rectangular block, giving its dimensions. In (a) candidates had to calculate the area under the block. The dimensions were given in cm and the answer was expected in m^2. An error at this stage was carried through and lost a maximum of one mark.
In (b) candidates were asked to state the equation which relates area, force and pressure and a number of mistakes were seen. If candidates had been asked a similar question relating pressure, force and area many more would have been successful, giving $p = F/A$ (in words). However, because convention dictates that the quantities must be given in alphabetical order a number of candidates tried but failed to get an unfamiliar expression with A as the subject ($A = F/p$). Candidates need to know that they should present the more familiar expression in situations like this.

Question 7

In (a) practically all candidates knew what the letters d.c. stood for and that fewer coils are needed on the output coil than the input coil of a step-down transformer.
In (b)(i) candidates were asked where step-up transformers were used in the system to transmit electrical energy. Some vague answers such as ‘at the power station’ were credited.
In (b)(ii) many candidates knew that the voltage was increased to reduce current or energy loss or increase efficiency but some answers went on to refer to a reduction in resistance. A small number of candidates wrote that a voltage increase leads to a larger current.

Question 8

In (a)(i) the data from a table showing activity against time for a radioactive isotope was plotted and a curve of best fit drawn. Very few errors such as misplotting were seen. A small number of candidates joined neighbouring points with a ruler.
For the determination of half life in (a)(ii) practically all candidates used the data from the table rather than taking values from the graph. This gave the correct, exact

answer of 2 hours. Some successfully used the graph but a few candidates, having successfully plotted the point (0, 64 000), incorrectly halved 64 000 to draw a horizontal line from 34 000 instead of 32 000, even though again they had just successfully plotted the point (2, 32 000).
In (b) most candidates did not know that 1 MBq is equal to 1 000 Bq, more often thinking it was 1 000 Bq.

Question 9

In (a) candidates were asked to calculate the deceleration of a car passenger wearing a seat belt. Given the values of force and mass, practically all candidates were able to do this successfully and give its unit.
In (b) candidates were asked to draw on the diagram of the passenger an arrow showing the direction and line of action of the given force.
In (c) most candidates were able to gain full marks by stating that force is an example of vector quantity.

Question 10

In (a)(i) many candidates were unable to show the correct direction of flow of electrons in a circuit consisting of a battery with its positive terminal labelled, an ammeter and metal plate. Hence they were unable to give an explanation of their answer for a further two marks.
In (b) candidates were told that voltage is energy transferred per unit charge passed and asked to state the relationship between the volt, the joule and the coulomb. Answers were expected in terms of units but many featured a mixture of quantities and units, in particular voltage instead of volt.
In (c) it was hoped that the previous parts would lead candidates to an answer including energy when asked to explain why a glass plate of the same size replacing the metal plate does not get warm. Many candidates scored two marks for noting that this insulator does not allow a current in it, but hardly any went on to state that as a result little or no energy was transferred to the glass slide.

Question 11

In (a)(i) many realised that only one of the angles shown could be greater than the critical angle but in part (ii) did not include the term ‘total internal reflection’ in their explanation.
In part (b)(i) the request to state the relationship between critical angle and refractive index produced the same uncertain response seen in a previous examination series. The following was seen disconcertingly often:
c = 1 / sin n.
Part (c) required the drawing and explanation of a ray with an angle of incidence less than the critical angle leaving a tank of water and emerging into air. This was very well answered.

Question 12

In (a) the calculation of kinetic energy (5J) given the mass and speed of a hammer hitting a nail was competently done and the appropriate unit given.
In (b) the gravitational potential energy (3J) of the stationary hammer at a given height was also very well done, especially as a value for *g* was not provided.
In (c) candidates were expected to account for the difference in their calculated values as the work done by the person using the hammer. Instead of determining this by 5J – 3J = 2J, many candidates repeated the previous calculation to determine the work done using ‘force × distance’ and so were unable to gain a further two marks for an explanation based on the conservation of energy.

Question 13

In (a) candidates showed a good understanding of the idea that the pitch of a sound depends on frequency and that the loudness depends on amplitude.

In (b) candidates had to match sinusoidal wave patterns to descriptions relating to the volume and pitch of the sound. This was exceptionally well done with very few candidates failing to score three marks.

In (c) candidates were shown the wave pattern received by a microphone close to a source of sound and asked to draw, on a grid alongside, the pattern for the sound received by a second microphone after the sound had reflected off a wooden board. An explanation was required. Many accurate, well drawn responses were seen with many candidates scoring all nine marks for this question. A few had explanations that contradicted their drawings. For example, an erroneously drawn wave with the same amplitude as the first one was referred to as being quieter and even having a smaller amplitude.

Question 14

In (a)(i) a calculation using Boyle’s law was uncharacteristically badly answered with a substantial number of candidates trying to use the relationship p/V = constant. Furthermore, when an initial pressure of 120 kPa was increased by 20 kPa, the second pressure was often taken as 20 kPa instead of 140 kPa. Many candidates were unable to state two assumptions made in the calculations.

In (b)(i) the definition of density occasionally referred to weight and area instead of mass and volume. The explanation as to why the density of air in a balloon increases when taken to the bottom of a swimming pool allowed for follow through marks from previous errors, but many candidates did not mention that mass remains unchanged.

Question 15

In (a) candidates were shown a diagram of a flexible current-carrying copper wire dipping into a tray of mercury placed between the unlike poles of two bar magnets. They were then expected to use the Left Hand Rule to draw labelled arrows to show the directions of current, magnetic field and motion. A sizeable minority of candidates was unable to show the correct direction of the current given the positive and negative terminals of the power supply, and many showed two conflicting directions for the magnetic field. The direction of motion was often shown opposing the given direction of the current.

In (b) and (c) candidates were asked to state two changes that could be made to increase the force acting on the wire and give two reasons why mercury was suitable for this demonstration. These parts were very well answered.

Question 16

Candidates were asked to fill in gaps to show their knowledge of atomic physics and radioactivity. Many candidates scored all nine marks.

In (a) candidates were asked to pick from numbers between –4 and +4 to show the changes in atomic number and mass number during alpha, beta and gamma decay respectively. A small number of candidates gave 4 instead of
–4 for the change in mass number during alpha decay.

In (b) the method of completing a nuclear equation by writing in the missing numbers, and in (c) the meaning of the term ‘isotope’, were both well known.

Question 17

Candidates were shown the paths of three alpha particles passing through a gold atom. One went through undeviated, one was slightly deviated and the third one came back in the original direction. They were then asked to comment on the information provided by these paths on (a) the structure of the atom, (b) the size and mass of the nucleus and (c) the likely charge on the nucleus.

In (a) many candidates stated that the atom had gaps in it without specifying the nature of these gaps. In (b) the response 'small' and 'massive' or 'heavy' would have scored two marks. A response of 'large' or 'big' was only acceptable if this was in comparison with the alpha particle. Some unexpected confusion in (c) was seen, with responses such as 'negative because the alpha is positive'. There was also a tendency to refer to 'deflection' instead of 'repulsion'.
A small minority of candidates stated the properties of the alpha particle or the path(s) throughout.

Question 18

In (a) candidates were asked to complete sentences describing the process of nuclear fission. Few knew that the energy released is in the form of the kinetic energy of the fission products, referring instead to heat energy.
In (b) the relative sizes of the incoming neutron, the fissioned nucleus, the fission fragments and the extra neutrons were expected to be linked with the symbols for U-235, Ba-141, Kr-92 and the neutrons. Judging by the amount of crossing out, this produced some uncertainty. It seemed that many candidates could not bring themselves to fill in as many as three of the boxes with the symbol for the neutron.

Paper 3

Question 1

(a) Most candidates were able to measure the depth and write down an answer in the range 75.5 to 76.0 mm.
(b) In (i) most candidates recognised that X was a stand and in (ii) many were able to describe how to check that the glass tube is vertical. Responses which involved tying the string of the plumb line round the top of the glass tube or lowering the plumb line into the tube full of oil were not credited.
(c) Generally appropriately answered.
(d) Generally appropriately answered.
(e) Most candidates suggested putting the magnet next to the steel ball and carefully moving it upwards to drag the steel ball out of the oil. Responses which involved tying string to the magnet and dropping it into the oil did not get either mark; those who thought the magnet would be sufficiently powerful to lift the steel ball through the oil if placed at the open end of the tube only got one mark.
(f) Most were able to explain why the experiment should be repeated several times.
(g) This part was well answered by almost all candidates.

Question 2

(a) Almost all candidates were able to use a protractor with sufficient accuracy. For angle *i* a measurement in the range 32˚ to 34˚ was required but for angle *r*, which is easier to measure on the diagram, the only accepted measurement was 60˚.
(b) A wide range of acceptable responses was offered, from a covered torch with a slit to a laser.
(c) Most candidates constructed a suitable table and inserted the readings in order. Points were in general accurately plotted and most recognised a curved line of best fit was more appropriate than a straight line. Some 'curves' did not gain credit because they were a series of lines drawn point to point, either with or without the assistance of a ruler.
(d) A significant minority of candidates failed to extrapolate their curves to make a prediction in (iii).

Question 3

(a) Almost everyone correctly stated that the method is to measure the length of each side and to use the equation V = l x b x h, or, because it is a cube, to measure one side and to use the equation V = l3.

In (ii) most had the right idea of partially filling the measuring cylinder with water, reading the volume, carefully adding the pebble, reading the new volume and then calculating the difference in the readings. Some correctly used a eureka can and a measuring cylinder. However, a small minority unsuccessfully proposed filling their measuring cylinder with water, adding the pebble and somehow measuring the overflow.

(b) Most named the instrument correctly. However, it is not a ‘beam balance’ or a ‘weighing machine’. Nearly all candidates gave the correct answer in part (ii).

(c) In part (i) nearly all gave the value as 2.4, and in part (ii) reasoned that this was appropriate because all the other densities have been calculated to two significant figures. This is correct and sensible and was worth one mark. However for two marks candidates needed to make the point that, as the mass and volume have only been measured to two significant figures, it is not possible sensibly to give the answer to more than two significant figures. One excellent answer stated that ‘The measurements for mass and volume are used to calculate the density and they are both to two significant figures. The density should also be to this degree of precision. To quote it to more significant figures would be implying it is more accurate than it really is’.

In parts (iii) and (iv) nearly all candidates were able to write a suitable conclusion and to explain why the student’s prediction was incorrect. The small minority who lost marks in (iii) did so because they attempted to describe false relationships between mass or volume and density, eg ‘as mass increases so does density’.

Question 4

(a) Both readings were almost always correct.

(b) In general candidates made a variety of appropriate points and a typical two mark response was ‘The candidate uses a black tube to stop reflected light coming in from the sides. You only want to measure the light which comes straight into the tube from the measured direction’.

(c) Both labels were usually completed correctly in part (i). In part (ii) a fairly high degree of accuracy was expected with answers in the ranges 276 to 280 degrees and 96 to100 degrees. Candidates who misunderstood the implication of the information at the start of the question, and who had accurate answers but in the reverse order, were awarded one of the two available marks.

(d) Candidates either made a prediction of 500 Ω by reasoning that 360˚ is equivalent to 0˚, then explaining this in part (iv) and gaining all three marks, or extrapolated their curve and read where it crossed the 360˚ vertical for just one mark.

PHYSICS 4420 COURSEWORK, PRINCIPAL MODERATOR'S REPORT

The number of students entered for this component of the IGCSE examination was as follows:

Spec Code	Subject	Number entered in 2006	Number entered in 2005
4420	Physics	97	1

All the centres which entered students for this component of the examination had their science coursework moderated by Edexcel's Co-ordinating Principal Moderator. The moderating instrument used was the Sc1 criteria as used by home centres, using exemplars provided by the JCQ (Joint Council for Qualifications) as a guide. Centres entering students for the coursework component of the IGCSE examinations in 2006 therefore had their coursework moderated to the same standards as for all home centres.

Physics 4420

A range of tasks was seen this year. The most common was resistance in wires (or filament bulbs). This is the most common Physics task seen in UK centres, and it can achieve the full range of marks.
One other appropriate task seen was 'stretching springs in parallel' .
One centre presented tasks which were not investigations. These were 'To study the reflection of light at a plane mirror' and 'To study the Principle of Moments'.
Neither of these are true investigations because they merely require the student to prove an accepted scientific law. Such tasks do not allow the students to make a valid prediction since they are not undertaking true investigations.

Centres are reminded that to fully achieve P8b, students need to clearly show how the preliminary work has affected their planning for the main task. It is not necessary to carry out the entire task as a trial run – only two values of the range chosen (normally the extremes of the range) are required, in order to see if the range chosen is appropriate.

When awarding A6b, teachers need to bear in mind that the specification requirements are that the students should explain the science behind the results they have obtained. Merely describing the shape of the graph does not result in the student achieving A6b.

For E4b, students are required to suggest at least one meaningful improvement to the technique used – and give some indication as to why the improvement(s) proposed would result in the obtaining of more accurate data.

PHYSICS 4420, GRADE BOUNDARIES

Grade	A*	A	B	C	D	E	F	G
Option 1				**60**	**48**	**36**	**25**	**14**
Option 2				**61**	**49**	**37**	**26**	**15**
Option 3	**84**	**72**	**60**	**48**	**37**	**31**		
Option 4	**85**	**73**	**61**	**49**	**38**	**32**		

Option 1: **Papers 03 / 1F**
Option 2: **Papers 04 / 1F**
Option 3: **Papers 03 / 2H**
Option 4: **Papers 04 / 2H**

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.