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GCE O Level Physics (7540)

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June 2004

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PHYSICS 7540/01, MARK SCHEME

Abbreviations used in the mark scheme

UP	unit penalty
TE	transmits the error
OWTTE	or words to that effect
SF	significant figures
SFP	significant figure penalty
MAX	maximum

Paper 1

1. (a) 900 N or kg m / s^2 **UP** accept 882 N or 882.9 N using *g* = 9.8 or 9.81 **(1)**

(b) (i) sum of P + Q = 900 (N) / same as (a) (no **UP) must TE from (a)** **(1)**

(ii) W halfway between P and Q/ in centre of P and Q **(1)**

'W in centre', 'W equidistant from P and Q' and 'weight evenly distributed' **not** sufficient.

(c) Use of *a* = force / mass 450/90 or 450/75 or 450/15 **(1)**

= 5 (m/s^2) only answer acceptable No **UP** (mark in Q.2) **(1)**

(d) small(er) braking / backward / decelerating force OWTTE **(1)**

road slippery / less friction / water is a lubricant / skids / less grip **(1)**

'less force of friction' scores 2nd mark

independent marks

Total 7 marks

2. velocity (not speed) **(1)**
m/s, cm/s, mm/s, km/s accept km/h not mph **(1)**

acceleration **(1)**
m/s^2, cm/s^2, mm/s^2, km/s^2 not N/kg or km/h^2 **(1)**

momentum (not impulse) **(1)**
kg m/s or Ns (not kg/m/s) **(1)**

Total 6 marks

3. (a) 4 x 10 x 210 **(1)**

= 8400 J (or j) **UP** **(1)**

(b) (i) (G)PE/KE transferred to heat / internal energy **(1)**
ignore sound

(ii) 8400 = mass x *c* x temperature (change) ECF from (a) **(1)**

insertion of correct numbers i.e. 8400 = 4 x *c* x 0.4 **(1)**
c = 8400/1.6 or 8400/4 x 0.4(scores both marks)

=5250 J / (kg K) **no UP** (given in question) **(1)**

(iii) (heat) (energy) lost/wasted to surroundings (ignore sound) **(1)**
not just 'Not all PE converted to heat'

Total 7 marks

4. (a) 880-900 kPa or 880 00 – 900 000 Pa **UP** **(1)**

(b) Force = 900 000 x 2 or 900 x 2 **must TE from (a)** **(1)**
= 1 800 000 N or kgm/s^2 **UP** **(1)**

(c) atmospheric pressure / pressure due to air(molecules) **(1)**

(d) large force / large pressure difference (greater outside than inside) **(1)**

stops crushing / breaking / collapsing / being deformed **(1)**
independent marks

ignore stops damage / to maintain lower pressure inside / stop water getting in / keep air in

Total 6 marks

5. decrease / get smaller / reduce / diminish / compress **(1)**

large / big /distant / lot of **(1)**

halved **(1)**

slowly / gradually / not quickly/in stages **Not** 'carefully' **(1)**

no / little / negligible / very small / much less / very low **(1)**

close together / close packed / near each other / close / packed together / touching. **Not** closer or molecules incompressible **(1)**

Total 6 marks

6. (a) black particles at top (two or more) **(1)**

white particles at bottom **(1)**

+ in top plate **and** – in bottom plate **(1)**

positive / white attracted to negative **(1)**
or negative / black attracted to positive
or opposite / unlike charges attract

(b) less / weaker / smaller (force between particles and plates) **(1)**

(c) simple description of d.c. **(1)**

simple description of a.c. **(1)**

effect of d.c. OR a.c on particle movement or quality of print **(1)**

only the 3rd mark can be scored if magnetic field / flux / poles mentioned

Total 8 marks

7. (a) 1. ammeter in <u>parallel</u> / should be in <u>series</u> **(1)**

(too) large (current) (drawn from d.c. supply) **(1)**
what it will do not what it won't do

2. voltmeter in <u>series</u> /should be in <u>parallel</u> **(1)**

no reading as switch is not closed/ unaffected (still connected across supply) **(1)**
what it will do not what it won't do

(b) 4.0 x 1.5 x 60 or 4.0 x 1.5 x 1 **(1)**

= 360 J UP **(1)**

Total 6 marks

8. (a) direction downwards **(1)**

(b) S N top **(1)**

N S bottom **(1)**

direction of line is from N to S **not** 'opposite poles attract' **(1)**

the following scores 2 out of 3 with ECF from the 1st answer :
NS top
SN bottom
lines go from S to N

(c) two lines of correct shape (in the space represented by the dotted lines below) not crossing any other lines **(1)**

correct direction shown by arrows on both lines consistent with the two given lines **(1)**

Total 6 marks

9. (a) 79 **(1)**
0 **(1)**
-1 **(1)**
199 **(1)**
in correct positions

(b) 90 = 3 x half life / 90/3 = 3 **(1)**

any reference to 1/8 **(1)**

7/8 gone (*gets three marks*) **(1)**
7/8 left gets 1st and 2nd marks

Total 7 marks

10. (a) two curved wavefronts wider than gap **(1)**

(all) correctly spaced (by eye or stated) **(1)**
2nd mark dependent on 1st

(b) diffraction **(1)**

(c) wavelengths are (too) small / gap (too) big or correct comparison **(1)**

waves are: -
invisible / cannot be seen / need a GM tube for detection **(1)**
(too) penetrative **(1)**
cannot be produced in a ripple tank **(1)**
(1 mark each for any two)

MAX 2

Total 6 marks

11. (a) correct refraction at front and back of lens or bending at centre line only for <u>both</u> rays **(1)**

both rays after refraction go to the same point on the <u>principal axis</u> to the right of the lens **(1)**

that point is the 25 cm mark on the rule/anywhere on the vertical line at '25' **(1)**
(up to the left hand of the '2' of '25' or equivalent on left of the line) **(1)**

F is labelled TE from 2nd mark or at '5'

(b) S is anywhere within the lens **(1)**

Total 5 marks

TOTAL FOR PAPER 70 MARKS

Paper 2

1. (a) (i) force x (not load – force stated in question) **(1)**
perpendicular distance from pivot/point/fulcrum/hinge **(1)**
(distance may be obtained from a labelled diagram)

Moment – turning effect of a force **or** causes an object to rotate/turn (not just move) **(1)**

(ii)
1. move ruler/ place ruler on pivot **(1)**
2. until balanced/stays horizontal **(1)**
3. so weight of ruler can be ignored (dependent on 2) **(1)**
4. place weights/masses either/each side **(1)**
5. move weights/masses until rule balanced **(1)**
6. measure/note/record distances from pivot (to mass) **(1)**
7. measure masses/calculate weights on each side **(1)**
8. repeat for other masses or positions (can be shown on table) **(1)**

(Any 4: 1 mark each)

MAX 4

$m_1 \times (g) \times d_1 = m_2 \times (g) \times d_2$ **or** $F_1 \times d_1 = F_2 \times d_2$ **or** (sum of) clockwise moments equals (sum of) anticlockwise moments (in words or numbers) **(1)**

8 marks

(b) (i) 50 x 0.2 **(1)**
10 N m **UP** (Must give this answer) **(1)**

(ii) F x 0.3 **(1)**

(iii) rearrange F = 10 / 0.3 ecf **(1)**
F = 33.3 N **UP** only once for N **(1)**
If (i) to (iii) done in one step award one mark for each step seen)

(iv) Graph
axes correct orientation and correct scale (1cm = 1m/s, 1cm = 5N or better) **(1)**
axes labelled with unit (accept force / N and speed / m/s) **(1)**
plot (-1 each incorrect) (ignore 0, 0) **(2)**
smooth curve including point 0, 0 **(1)**

(v) Force 34.5 N to 36 N **UP only once for N** **(1)**

(vi) Change
- heavier / solid base /fill base with suitable material/add weights to base
- wider/ larger base
- shorter / narrower noticeboard/make holes in board(not just decrease surface area) **(1)**
- fix board on springs so it tilts

(Not wedge the board or fix to ground)

12 marks
Total 20 marks

2. (a) energy 1.10 x 450 **(1)**
= 495 MJ **UP** only once for J (allow rounding to 500 MJ) **(1)**

(b) (i) Power 36.8 / 4 **(1)**
= 9.2 x 10^6 W or J/s **UP** only once for W **(1)**

(ii) Total energy 36.8 x 50 **(1)**
= 1840 MJ/ 1800 MJ **(1)**

(iii) Difference (chemical) energy to heat / internal energy **(1)**
lost to surroundings/air **(1)**
(ignore sound)

(iv) Efficiency 495/1840 (x 100) **ecf (a) and (b(i))** **(1)**
= 26.9% (27%) or 0.27 **UP** **(1)**

Allow rounding throughout

10 marks

(c) (i) Power 240 x 18 **(1)**
= 4320 W **UP (**4300 W) **(1)**

(ii) Time 126 x 10^6 / 4320 **(1)**
= 2.92 x 10^4 s **(1)**
= 8.1 hours **UP** **(1)**
126/4320 scores 1 out of 3)

(iii) Distance 126 x 0.7 **(1)**
/1.10 **(1)**
= 80(.2) km **UP** **(1)**

(d) Advantage less/no pollution / fuel cheaper / quieter **(1)**
(ignore efficiency)

Disadvantage short range / long time to recharge/must be recharged often **(1)**

(No ecf on range or time for incorrect calculations)
Mark references to the electric car only

10 marks
Total 20 marks

3. (a) - have to reach higher temperatures / needs large amount of heat or energy
- before metals melt
- heat energy conducted away **MAX**
(Any two: 1 mark each) **(2)**

have high(er) melting points / not enough energy to melt metals
score 2

(b) two cycles **(1)**
axes labelled as displacement and time – ignore units **(1)**

correct value(s) shown on y-axis – must see at least +3 –ignore unit **(1)**
correct value(s) shown on x-axis e.g. 0.01, 1/100 etc – ignore unit **(1)**

(c) (i) softer / quieter / less / less loudness / less volume **(1)**
less amplitude **(1)**
Independent marks but mention of frequency here loses 2nd mark

(ii) higher / sharper / greater **(1)**
greater frequency **(1)**
Independent marks but mention of amplitude here loses 2nd mark
Do not allow 'is proportional to' in (i) and (ii)

10 marks

(d) (i) resonance **(1)**
natural frequency of wire **(1)**
= 200 Hz / same frequency as vibrating sheets OWTTE **(1)**
(3rd mark dependent on 2nd)

(ii) decrease tension / longer wire / thicker wire / heavier wire **(1)**
decreases (resonant) frequency *(dependent on first mark)* **(1)**

5 marks

(e) 1. Suitable source of sound **(1)**

2. suitable distance at least 300 m in straight line or 150 m for single reflection / using several claps **(1)**

3. record/measure/note distance **(1)**

4. distance is doubled for calculation if appropriate or repeated in opposite direction **(1)**

5. measure time **(1)**

speed = distance / time
independent marks **MAX 5**
(Attempt to use a resonance tube or other resonance method can only score marks 1 and 3)

5 marks
Total 20 marks

4. (a) (i) same number of protons/atomic number **(1)**
different number of neutrons/nucleon number/(atomic) mass (number) (*not mass on its own)* **(1)**

(ii) (production of) charged particle / separation of charges/ positive or negative ions **(1)**
removal or addition of electron **(1)**

(b) both have 17 protons / atomic number 17 **(1)**
(Cl – 37)/ one has 20 neutrons **(1)**
(Cl – 35)/ one has 18 neutrons **(1)**
ignore electrons
independent marks

7 marks

(c) (i) positive **(1)**
deflection according to left hand rule **(1)**
2nd mark dependent on 1st

(ii) collisions/bombardment with air molecules **(1)**
slower speed of ions / shorter path **(1)**
affect direction of ions / change of curve of path **(1)**

(iii) smaller radius /more curved/more deflection **(1)**
stronger field **(1)**

7 marks

(d) (i) rod is cutting lines of flux / experiencing changing flux **(1)**
e.m.f. / voltage/current induced across rod **(1)**
Statement of electromagnetic induction scores zero
rod is a conductor **(1)**

(ii) implied no movement/ stationary (rod) **(1)**
no lines cut/ no change of flux (experienced) **(1)**
no induced e.m.f. / voltage/current **(1)**

6 marks
Total 20 marks

5. (a) Fig. 1 **Describe** refraction/ bends away from normal **(1)**
transmission not sufficient

Explain higher to lower n/more dense to less dense/ speeds up/higher wavelength **(1)**
dependent on 1st mark

light strikes boundary at angle less than c **(1)**

Fig. 2 **Describe** (total internal) reflection
Scores zero if a mirror or reflecting surface is mentioned **(1)**

Explain light strikes boundary at angle greater than c **(1)**

(b) (i) thermometer **(1)**
heater / heat source / Bunsen / hot water but not 'heat' **(1)**
ice **(1)**
stirrer **(1)**
(Any 3: 1 mark each) **MAX 3**

(ii) constant current/voltage/setting/power of power supply **(1)**
OR intensity of light

level/position of / distance of light source from end of fibre **(1)**

level/ position of / distance of detector from end of fibre **(1)**
'position of all apparatus remains constant' scores 1

level/volume/depth of water / amount of fibre exposed to water **(1)**
MAX 3
(Any 3: 1 mark each)

(iii) 1. switch on light / power supply **(1)**
2. note milliameter reading/current **(1)**
3. note thermometer reading/temperature **(1)**
4. change temperature of water/heat **(1)**
5. evidence of water at 0°C and / or 100°C **(1)**
6. repeat readings of current and temperature or meter and thermometer *(Note milliameter reading at 10^0C intervals scores 2, 3 and 6)* **(1)**
MAX 5
(Any 5: 1 mark each)

(iv) table with units (current/mA and temperature/°C) **(1)**
units either shown in column heading or in body of table
(Only these two columns shown)

(c) axes labelled – no units required but some label e.g. temp, current, milliammeter reading **(1)**
as temperature increases **(1)**
light detected / ability to transmit light decreases or less light is reflected **(1)**
or vice versa 2nd and 3rd marks are dependent
'inverse relation(ship)' or 'inverse proportion between temp and ability to transmit light' OWTTE scores 2nd and 3rd marks

Total 20 marks

TOTAL FOR PAPER 100 MARKS

PHYSICS 7540, CHIEF EXAMINER'S REPORT

PAPER 1

General Comments

Some excellent work was seen. Calculations were tackled competently and candidates displayed a good knowledge of units. Answers to questions involving drawing were also impressively presented. Most candidates could improve their marks even further with extra care in descriptive answers. Sometimes just the addition of an appropriate word could make a response considerably clearer.

Question 1

Few candidates scored more than five marks out of seven. In part (a), most candidates showed 900 N for the size of force *W.* In part (b) the expected answer of 900 N scored the mark. Candidates should be aware that the answer to part (b) (i) had to be exactly the same as that in part (a), regardless of its value or its unit.
Answers to part (b) (ii) were often too vague. *W* is halfway between *P* and *Q,* not 'in the centre' or even 'equidistant from *P* and *Q*'.
In part (c), for using $a = F / m$, one mark was available for the correct value of force and either of the incorrect values of mass, 75 and 15 kg respectively. Only the correct answer scored both marks.
In part (d) most candidates referred to 'less friction' or a 'slippery road' as a reason for a smaller deceleration. The second mark was for stating that a smaller braking force was operating. Some who did try for a second mark mistakenly wrote that a smaller force was **needed**.

Question 2

This question scored well, with a common error being the use of 'speed' instead of 'velocity' for the first answer. A small number of candidates did not know what the first two quantities were and a few had the correct unit for 'mass x velocity' without knowing that it was 'momentum'.

Question 3

The calculations in parts (a) and (b) (ii) were extremely well done but here most candidates started to lose marks for incomplete or inappropriate descriptive responses. The reason for the change in temperature of the water on reaching the bottom of the waterfall is that potential (or kinetic) energy is transferred to heat or internal energy. The reason for the difference between the correct and calculated values of specific heat capacity of water is that heat is lost to the surroundings. These responses are asked for regularly in these papers and candidates can score easy marks by understanding exactly what they mean and applying them in a variety of situations.

Question 4

The calculations in parts (a) and (b) were well done with practically all candidates reading correctly from the graph. Many knew that the reason for the graph not going through the origin was due to atmospheric pressure.
In part (d), candidates were asked why the outside walls of a submarine were usually made from thick steel. Many vague answers referred to a large pressure, and a few to the possibility of air leaking **out**. Candidates had to make quite clear that there is a large force due to a **large** pressure **difference** where the larger pressure is on the outside. The mark for stating that it was necessary to prevent crushing or collapsing was more often scored.

Question 5
A large range of responses gained marks here. For the third gap, only 'halved' or it its exact equivalent like 'divided by two' will do. 'Carefully' was not accepted for the fourth gap because it is not a description that is synonymous with 'slowly' or 'gradually'.
For the last gap 'closer' was not accepted but 'close' was, showing how the presence of a single letter can affect a mark.

Question 6
Most candidates scored three marks for drawing figure 2 as figure 1 upside down. Explanations that 'opposite charges attract' were sufficient for the fourth mark.
In part (b) the expected response was that less charge on the plates would result in less force on the particles. Unfortunately some candidates answered in terms of the forces **between** the particles themselves.
In part (c) the three marks were allocated as follows:

simple description of d.c.
simple description of a.c.
effect of d.c. or a.c. on particle movement or quality of print

Candidates must use more than the terms 'direct' and 'alternating' in the description of d.c. and a.c. These descriptions have been required in past papers and candidates must not rely on the examiner making assumptions on their behalf. Three marks, or even two, were rarely scored in this section.

Question 7
Candidates were shown a simple circuit with an ammeter and voltmeter connected in place of each other. Candidates were asked to point out the errors and explain the effect of each error on the reading of the meter concerned. Very few candidates scored four marks. It was sufficient to state that the ammeter was connected in parallel and the voltmeter in series for two marks. The mistake that nearly all candidates then made was to treat the voltmeter (connected in series) as an ammeter and to state that no current was indicated. In fact the voltmeter needed to be regarded as such where it was still effectively measuring the voltage across the d.c. supply (ignoring the resistance of the resistor by comparison to that of the voltmeter).
Credit was given to those candidates who stated that the voltmeter reading would be zero because the switch was open!
Those candidates who scored three marks usually stated that the ammeter reading would be large.
Surprisingly the calculation in part (b) using electrical energy = V x I x t was often incorrect, with the use of unsuitable formulae such as Q = I x t.

Question 8
This question was extremely well answered with many candidates scoring full marks. Candidates had to draw lines of force in the space between two magnets placed parallel to each other and also identify the poles from the lines already given.
In part (c), candidates were asked to add **two** more lines in the space **between the magnets** on the diagram. These lines had to have correct shape and arrows to show their direction.
Many candidates only showed one line in the space and other lines outside it.

Question 9
Questions of this type, where candidates have to fill in the gaps with the missing mass and atomic numbers, are usually done well, and this was no exception.
In part (b) candidates were asked what fraction of a sample with a half life of 30 minutes decays in 90 minutes. Recognition of three half lives was usually seen as a first step.

Occasionally the effect of three reductions by ½ resulted in 1/6 remaining rather than 1/8. Only a few candidates progressed from this correct answer for the second mark to score the third mark for the fraction decayed.

Question 10

Most candidates should be familiar with the task in part (a), the drawing of diffracted wavefronts resulting from straight waves passing through a gap of comparable size to the separation of the wavefronts. It was often drawn very well with some candidates using a compass and paying great attention to the detail required for two marks. For the majority drawing freehand, the first wavefront was expected to show curvature and extend into a region wider than the gap. However it is the drawing of the second wavefront that needs particular care. One drawn with half the wavelength might look all right but does not merit the second mark. If either wavefront showed a straight section, both marks were lost.

It was pleasing to see many correct answers in part (c) for why the ripple tank used for diffraction of water waves could not be used for gamma rays. Apart from the wavelength being too small or the gap too big, other successful responses were that the rays were invisible or could only be detected with a GM tube and that they would penetrate through the apparatus. Full credit was given for gamma rays not able to be produced in a ripple tank! Centres should be aware that examiners will give credit for responses that they have not considered themselves but which justifiably answer the question.

Question 11

Another drawing question which was well answered. Candidates were asked to continue drawing the paths of a couple of parallel rays of light incident on a converging lens parallel to the principal axis. In cases like this where the lens has some thickness, it is acceptable to show correct refraction at each face or bending from the centre line as if the lens was represented by a vertical line.

In part (b) candidates were asked to mark with an ‘S’ a point on the diagram where the light was travelling at its slowest speed. There was plenty of space inside the lens to write this but careless work on the part of some candidates who knew the correct answer probably cost them a mark.

PAPER 2

General Comments

The standard of the paper was comparable with that for previous examinations but the practice of showing the breakdown of marks for each part of the question, and careful consideration of the wording, has helped many candidates to identify the exact requirements of each question.

The majority of candidates were able to tackle all parts of all the questions in the time allowed and many presented their ideas very well. The quality of many answers was better than in previous examinations, giving the impression that centres are taking note of the advice given in the subject reports. As a result, many candidates scored high marks. Questions involving calculations were usually answered well although units were still being missed off or written incorrectly.

Candidates may find it helpful to leave a blank line between each part of a question, to leave at least two blank lines between questions and to rule a line after each question. This would make it easier for them to spot errors when checking through questions at the end and would also make it easier for examiners to follow their reasoning and to give credit where due.

Question 1

Most candidates scored well on this question.

(a) (i), most candidates knew that a moment was calculated by multiplying a force by a distance, but too many stopped there and failed to state that it was the **perpendicular** distance from the **pivot**. Fewer realised that a moment caused a turning effect, with a significant number quoting the principle of moments.

(ii) candidates were expected to describe an experiment to verify the principle of moments, giving details of the steps involved. Too many assumed the principle of moments and also wanted to place equal masses at equal distances from the pivot. Very few said that they would have to move the ruler until it balanced so that the ruler's weight could be ignored. Even fewer repeated the experiment using a different combination of masses. Fortunately the mark scheme gave credit for all the steps that would be carried out and so incomplete answers could still gain the five marks available.

(b) Most candidates answered the question that was asked in parts (i) to (iii) and many gained full marks. Marks were lost through incorrect or missed units or by answering all three parts in a single step, in which case credit was only given for the steps fully seen with the appropriate units.

The graph for part (iv) was usually completed well. The quality of graph drawing has improved and most candidates used a good scale that fully used the whole of the area of the graph paper, plotting the points correctly. Where candidates did not take enough care in drawing the curve they lost the mark for part (v) as their value was out of the acceptable range.

The final mark required candidates to make the base heavier or wider or to make the board shorter or narrower.

Question 2
This question often scored well where candidates knew the equations and read the question carefully. It was very pleasing to see how many coped with the large quantities involved by either using standard form or correct prefixes.

(a) Most candidates scored the two marks. Some used the wrong units or just wrote 450 MJ.

(b) Parts (i) and (ii) were often well answered. Part (iii) produced some vague answers and although many realised that the chemical energy was converted to heat, too many stopped there and failed to say where it went to, simply satisfying themselves with it being lost.

(c) Candidates usually gave the correct answer in part (i) but again some gave the wrong unit. Many calculated the time correctly but often stopped before converting the time in seconds to hours. Those who had calculated the time correctly also worked out the distance correctly.

(d) Examiners expected an answer relating to the question. Many candidates scored at least one of the marks here.

Question 3
This question often scored well for candidates who read the question carefully.

(a) Most candidates realised that metals need a higher temperature to melt and scored both marks.

(b) This usually scored three marks with candidates losing marks if they did not show exactly two cycles, did not label the vertical axis as displacement, or if they did not show an amplitude of 3 mm or a periodic time of 0.01 s.

(c) Many associated the smaller amplitude with a quieter sound and a higher frequency with a higher pitch. Marks were lost by some who mixed these two relationships.

(d) (i) Many realised this was an example of resonance, but fewer used the term natural frequency which was required to score the final mark for saying that this was equal to the frequency of vibration of the plastic sheet.

(ii) This was not well answered, with many candidates wanting to shorten or tighten the wire. Few said that a reduction in natural frequency was required.

(e) This is a standard situation which has been used many times in the past. Those who gave a suitable method often scored all five marks. A number of candidates tried to use a method more suited to a measurement in a laboratory and, although some credit was given, usually missed some of the marks.

Question 4
Answers to this question were of variable quality.

(a) (i) This was a standard question and was usually correctly answered. A few candidates got the two terms **protons** and **neutrons** the wrong way round. References to electrons were ignored.

In (ii), too many candidates simply said that ionisation is the production of ions. Some

incorrectly referred to ions produced in solutions. A significant number either talked about the production of charged particles or about the addition or removal of electrons, but did not make both points.

(b) A majority gave the correct number of protons and neutrons for each isotope although too many thought that there were 37 and 35 neutrons.

(c) (i) A majority thought the ions carried a negative charge and few of those giving the correct answer could explain why.

(ii) Many tried to turn this into a Brownian motion question. The idea of collisions was often seen in answers, frequently leading to a statement that this would result in a change of direction. Very few candidates realised that the speed of the ions would reduce.

(iii) Candidates could usually state that the path would become more curved but did not always explain satisfactorily that this was because of the increased field strength.

(d) (i) The idea of cutting field lines was often applied successfully in this answer. Candidates were expected to refer to **induced** e.m.f. or current and very few mentioned that copper is a conductor. A very few thought copper became magnetised.

(ii) Similar ideas were often applied successfully, but again the term **induced** was not used and few candidates stated that the rod was not moving.

Question 5

The quality of answers to the design question has continued to improve. Answers often scored good marks except where candidates addressed a different question from that asked. Most candidates now lay out their answers in a logical fashion, using the subdivisions from the question.

(a) This section often scored four out of five marks because some candidates did not specifically refer to the change of speed, refractive index or optical density correctly. Weaker candidates talked about the angles of incidence and refraction rather than angle of incidence and critical angle.

(b) (i) Many could name three essential additional pieces of apparatus.

(ii) There was no credit for keeping the fibre itself constant or for just saying the power supply; it had to be clear that candidates meant the setting of the power supply.

(iii) The actual description of experiments has improved considerably, but few candidates write this as a list of steps and they sometimes get confused part way through or miss out essential points.

(iv) This mark was often lost as candidates did not give the title and unit for each of the two quantities they had to measure, current and temperature.

(c) Most candidates scored at least two of the three marks. Some wanted to plot a sketch graph of **light intensity** against temperature and this scored no marks. Similarly, some linked the rise in temperature with a fall in current rather than the ability for the fibre to transmit light, as was required.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	76	65	55	50	29

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

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