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GCE O Level Physics (7540)

June 2005

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PHYSICS 7540, MARK SCHEME

Abbreviations used in the mark schemes

UP unit penalty
OWTTE or words to that effect
nwn no working needed
ecf error carried forward
ora or reverse argument.

Paper 1

1.	(a)	**Motion**	(uniform) acceleration		1
	(b)	**Distance**	(3.0+0)/2 x 1.5 = 2.25 m **UP**		1 1
			Allow use of $s = ut + ½ at^2$ Allow 1 mark for 4.5m only		
	(c)	**Speed**	(i)	1.5 (m/s) or half as much	1
			(ii)	9 (m/s) or three times as much **one UP only for <u>incorrect</u> unit**	1
				(Total 5 marks)	
2.	(a)	**Momentum of trolley A**	(i)	3 x 5 = 15 kg m/s or Ns **UP**	1 1
		Momentum of trolley B	(ii)	0 or zero or nothing or no momentum (No **UP**, ie ignore unit)	1
	(b)	**Momentum after collision**	(i)	Must be same as (a)(i) **UP only once**	1
		Velocity after collision	(ii)	15 = 5 x v ecf from (b)(i)or start from scratch v = 3 m/s **UP**	1 1
				(Total 6 marks)	
3.	(a)	**Heat transfer**	(i)	(heat or thermal) radiation	1
			(ii)	(only one that) can travel through a vacuum or does not need air/medium to travel. not just because there is no air **ora** **dop**	1
			(iii)	make sphere shiny/white/silver or make <u>inside</u> of box shiny/white/silver **not** 'shiny black'. **NOT** heating box or insulating sphere or cooling sphere.	1

	(b)	**Method**	(i)	Convection only.	1
		Process	(ii)	Air or molecules (near sphere) is/are warmed / heated.	1
		Allow credit for a correct description of the incorrect process named in b(i)		(Conduction - air/molecules near sphere heated) (Radiation - infra red emitted).	
				Warm air / fluid expands / less dense (not molecules). (Conduction - molecules move faster/gain KE) **not** 'vibrate'. (Radiation - energy carried by waves/rays).	1
				(Warm air / fluid/molecules) rises (Conduction -pass energy onto other molecules) (Radiation - energy absorbed by box) If b(i) blank must describe convection	1
				(Total 7 marks)	
4.	(a)	**Length**	(i)	4(.0) (cm) **No UP**	1
		Force	(ii)	125 or 1250N	1
				force = 1.25 N **UP** (scores both marks)	1
	(b)	**Mass of L**		1.25 x 40 = L x 15 or 125 (x g) x 40 = L (x g) x 15 ecf from (a) or start from scratch	1
				rearrange L = (125 x 40)/15 or L = 3.3 N **no UP**	1
				= 333 g (330g allow rounding to 300 g or 0.3 kg) 333 1/3 g is okay **UP**	1
				(Total 6 marks)	
5.	(a)	**Size**		1×10^{-9} m to 1×10^{-10}m **UP**	1
	(b)	**2 minutes**	(i)	Temperature change = 70 - 20 = 50 only	1
				Energy = 30 x 2.4 x their temperature change	1
				= 3600 J **UP** (ecf from their temperature change)	1
				0.3 x 2.4 x 50 = 36 J treat as **UP**	
		5-15 minutes	(ii)	melting / changing (from solid) to liquid **owtte**	1

		17 minutes **Allow credit for a correct description of gas only if given in b(ii)**	(iii) Moving around / over each other (gas - moving freely/ randomly)	1
			No fixed position / irregular/ arranged in no fixed shape (gas no fixed position or arranged randomly)	1
			Close together /slightly apart (gas - far apart) If b(ii) blank liquid only	1
				(Total 8 marks)
6.	(a)	**Charged?**	Uncharged	1
		Reason	Equal number of + and - Not protons and electrons **dop**	1
	(b)	**Distribution**	At least 4 + left of centre	1
			At least 4 - right of centre	1
		Explain	Electrons/negative (charges) move to the right *'positives moving' undoes 3rd mark, ignore positives attracting*	1
			Like charges repel *ignore unlike charges attract*	1
	(c)	**Rod taken away**	Charges go back to original positions /neutral/ uncharged	1
				(Total 7 marks)
7.	(a)	**Voltage**	$6 \div 3$	1
			= 2 V **UP only once**	1
	(b)	**Voltages**	(i) 3 V	1
			(ii) 3 V	1
			(iii) 0 (V) No ecf from (a)	1
	(c)	**Brightness**	(i) Greater	**(1)**
			(ii) Greater	**(1)**
			(iii) Less /off	**(1)**
			Must ecf from (a)and (b) in which case any two correct scores 1 and all three correct scores 2 eg (a) 2V (b) 3V, 3V, 6V scores 2 (c) greater, greater, greater scores 2	**max 2**
				(Total 7 marks)
8.	(a)	**Explain**	(Relative) movement between coil and magnet	1
			(Coil) change or cut flux / field lines / magnetic lines	1
			e.m.f. / voltage induced	1

	(b)	**Effect**	Electromagnetic induction / induction Not magnetic induction	**1**
	(c)	**Energy conversion**	Any combination of chemical, (gravitational) potential, kinetic, electrical, light, heat <u>and</u> in the correct order *scores 2 or 0* Not magnetic, sound, mechanical, movement	**2**
				(Total 6 marks)
9.	(a)	**Detector**	Geiger-Muller tube / G-M / Geiger etc. Allow any phonetic spelling	**1**
	(b)	**Distance**	3 - 10 cm **UP** <u>not</u> 'a few cm'	**1**
	(c)	**Magnetic field**	Charged (particle) / negative(ly charged)	**1**
			Deflected /deviated / bent / path changed in magnetic field Attracted or repelled or diffracted loses 2nd mark (independent marks)	**1**
	(d)	**Safety precaution**	Don't point at anyone / short exposure /lead shielding /large distance / behind thick glass / do not handle directly / use tongs /forceps **Not** use goggles or unqualified protective clothing	**1**
				(Total 5 marks)
10.	(a)	**Resonance**	<u>Natural</u> or <u>fundamental</u> frequency (of wire) Maximum response to/large amplitude	**1**
			(Equal to frequency) (of a nearby object) at which it is being forced Independent marks	**1**
	(b)(i)	**Tension**	100 N (or 95N) **UP only once for N**	**1**
	(ii)	**Increase in tension**	400 (1) (400 - 100 =) 300 N or 290 N (2) **UP** **UP for 100/N** quadrupled (2) Increase by three times scores zero	**1** **1**
	(c)	**Factor**	Any two from: • Mass/weight per unit length • Mass/weight • Length • Thickness / diameter / c.s.a. • Density Ignore 'material' 'temperature'	**2**
				(Total 7 marks)

11.	(a)	**Lines**	(i)	Middle dot labelled Z	**1**
			(ii)	From Y continuing on left of mirror as if coming <u>from their Z</u>	**2**
				Straight line from their Z to Y only scores (1)	
	(b)	**Incidence**	(i)	Show correct *i* and correct normal	**1**
		Reflection	(ii)	Show their correct *r*	**1**
	(c)	**Image**	Virtual		**1**

(Total 6 marks)

Total for Paper 1: 70 marks

Paper 2

1.	(a)	(i)	**Maximum speed**	9.7 x 28 (not using 10 or 9.8) = 271.6 m/s or 272 m/s only **UP** Ignore further rounding. Allow use of s = ½ a t^2 or v^2 = 2as used correctly	1 1
		(ii)	**Assumption**	Acceleration was constant/uniform or steady /stays the same	1
		(iii)	**Distance**	(271.6+0)/2 (allow 270/2) ecf from a(i) x 28 = 3802.4 m (3780 if 270 used) Allow 7604.8 or 7616 or 7560 for 1 mark **UP**	1 1 1
				OR Attempt to use ½ a t^2 or $v^2 = u^2 + 2as$ ½ × 9.7 × 28^2 or $(271.6)^2$ = 2 x 9.7 x s = 3802.4 m or 3758 if 270 used **UP**	**OR** 1 1 1
					(6 marks)
	(b)	(i)	**Two forces**	Weight/ pull of Earth/ pull of gravity/ force of gravity/ gravitational pull - not just gravity/gravitation(al)	1
				Air (or wind) friction or drag or resistance /push of air on parachutist Ignore pressure or upthrust	1
		(ii)	**Maximum speed**	Terminal velocity/speed (allow misspelling)	1
		(iii)	**Explanation**	Weight remains constant /acts downwards Push of air or air friction increases with speed / acts upwards (When) AF = weight /forces balanced / no resultant force / in equilibrium Independent marks	1 1 1
		(iv)	**Graph**	Initial rising (straight) line Curving over towards time axis or horizontal line Horizontal line at 53 m/s	1 1 1
				Marks 2 and 3 only for on labelled axes, eg 53m/s 28s	
					(9 marks)

	(c)	(i)	**Boyle's law**	101 000 x 1 = 300 V_2 V_2 = 336.666 **no UP**	Or 101000/300 **No sf penalty, allow 336**	1 1
		(ii)	**Charles' law**	$340/T_1 = V_2/T_2$ T_1 = 290 and T_2 = 250 V_2 = 293 **no UP** **Ecf for their value**	$336.7 / T_1 = V_2/T_2$ T_1 = 290 and T_2 = 250 V_2 = 290.17 **no UP**	1 1 1
				Correct use of ideal gas equation in (ii) to obtain 290.23 scores all three marks 1st mark could be score for working in °C		
						(5 marks)
						Total 20 marks
2.	(a)	(i)	**Process**	Conduction only		1
		(ii)	**Motion**	Vibrating / oscillating / to and fro at or about fixed/mean positions/points/spots **dop**		1 1
		(iii)	**Transfer of energy**	Molecules (near liquid) vibrate more (allow vibrate if not mentioned in (ii)) Energy transferred / passed to neighbouring or other molecules (Molecules move around 0/2) **OR** Free electrons travel quickly/easily through metals		1 1
		(iv)	**Greater heat loss**	Aluminium thin(ner) Aluminium is a (better) conductor **ora** **Not** 'a bad insulator'		 1 1
						(7 marks)
	(b)	(i)	**Convection**	Convection (ignore conduction and radiation) Colder water / fluid contracts (not molecules) Becomes more dense (not molecules) (Cold water/fluid/air) sinks (allow molecules here) **ora**		1 1 1 1
		(ii)	**Anomalous expansion**	Anomalous expansion of water OWTTE Maximum density/minimum volume At 4°C or this temperature Then water (below 4°C) expands. **Not** 'above' Less dense (than at 4°C) (Liquid) rises to top. **Not** 'cold rises' **ora** **Not** 'no natural convection'		(1) (1) (1) (1) (1) (1) **Max 4**

(iii)	**Latent heat**	Water <u>changing</u> to ice/ freezing / liquid to solid Latent heat (released) Heat released = heat lost to the surroundings (Independent marks)	1 1 1
(iv)	**Unwise**	Ice/solid has greater volume **OR** liquid/water/ ice expands (when it freezes) **Not** just because it will all freeze (in 2 hours)	1
		Crack/ break/ burst/ blast/explode beaker Ignore 'beaker contracts' Independent marks	1

(13 marks)

Total 20 marks

3.	(a)	**Soft iron**	Quick/easy to magnetise Quick/easy to demagnetise/ unmagnetise Reference to temporary magnet can score 2nd mark **ora**, ie 'not permanent'	1 1

(2 marks)

(b)	**Why pointer moves**	Bar/coil is magnetised/ (coil) magnetises soft iron /coil has a magnetic field/ becomes electromagnet	1
		Soft iron attracted (to coil) Moves <u>to</u> coil	1 1
		Pointer moves in a clockwise direction /pointer moves in opposite direction to iron/ moves to the right	1

(max 3 marks)

(c)	**Pole on soft iron**	S pole Bottom end of coil is N pole *N pole followed by bottom end of coil is S pole scores (1)*	1 1

(2 marks)

(d)	(i)	**a.c.**	Current in both directions/ current moves to and fro/ current reverses direction Allow current changes direction but **not** varying current. Allow an unlabelled sine wave graph crossing the axis	1
	(ii)	**Can measure a.c?**	Yes Polarity opposite Opposites attract 3rd mark dependent on 2nd If they say no, 0/3	1 1 1

(4 marks)

	(e)	(i)	**Graph**	Axes correct orientation and suitable scale *2 cm = 6° 2 cm = 0.1 A minimum*	1
				Axes labelled with units. **No UP for degrees**	1
				Points plotted to within 1mm (0,0) not needed	2
				Best straight line or curve considering <u>all</u> points All reasonable attempts except point-to-point to get credit	1
		(ii)	**Value**	0.22 - 0.24 A **UP**	1
		(iii)	**20A**	Shown on graph (line across at 15 and/or down)	1
				Current large or high	1
				Melts / heats coil / goes off scale /scale too small / gets jammed	1
					(9 marks)
					Total 20 marks
4.	(a)	(i)	**OP**	Goes straight through a region of same r.i. / (optical) density / same speed	1
				Enters region of different r.i. / (optical) density/changes speed	1
		(ii)	**OQ**	Refracts/bends away from normal in air/ in less dense medium / speeds up /enters larger r.i.	1
				Refracts/bends towards normal in glass/ in more dense medium / slows down	1
				Refracts/bends away from normal in air/ in less dense medium / speeds up	1
					(5 marks)
	(b)	(i)	**A**	sin 26.7° / sin A = 1.52	1
				sin A = sin 26.7° / 1.52	1
				A = (17.2 or 17.1(9)) must be seen **No UP** in (b) *Allow use of 17.2°, 17.1° or 17° in (ii) and (iii)* Use of 1.5 to get 17.4° can score 2nd and 3rd marks	1
		(ii)	**B**	90° - 17.2° Can ecf from their raw value or use 17	1
				= 72.8° or 73	1
				180° - (45° + 72.8°)	1
				= 62.2° allow 62 if rounds to 73	1
		(iii)	**C**	90° - 62.2° = 27.8° ecf from (ii)	1
				sin C ÷ sin 27.8° = 1.52	1
				C = 45° / 45° (9') / 45(.15)°	1
					(10 marks)

	(c)	(i)	**1.frequency**	f = 50 ÷ 2.5 = 20 Hz **UP**	**1** **1**
			2.speed	v = 20 x 1.5 ecf from (i) = 30 cm/s **UP**	**1** **1**
		(ii)	**Why no change?**	Angle of incidence is zero / waves enter normally / waves direction is perpendicular to boundary(not barrier) / wavefronts parallel to boundary	**1**
					(5 marks)
					Total 20 marks
5.	(a)	(i)	**Force**	20 + 5 = 25 (kg) = 250 N **UP** or 245 N if 9.8 used	**1** **1**
		(ii)	**Pressure**	*p* = 250 ÷ 0.02 ecf eg 25/0.02 = 12 500 Pa **UP** = 1250 Pa Scores 2	**1** **1**
					(4 marks)
	(b)	(i)	**apparatus**	1. masses 2. rule 3. balance 4. ammeter <u>and</u> voltmeter or ohmeter 5. (low voltage) power supply /battery / cell	**(1)** **(1)** **(1)** **(1)** **(1)** **max 4**
				But not pressure gauge or unqualified multimeter *4 and 5 can be scored on a circuit diagram*	
		(ii)	**Measure-ments**	1. length/area 2. current/ammeter reading 3. voltage/ voltmeter reading 4. mass 5. resistance/ohmmeter reading	**(1)** **(1)** **(1)** **(1)** **(1)** **max 3**
		(iii)	**Description**	1. turn on current 2. add mass/weight (to upper block) 3. note/ calculate pressure 4. read meter<u>s</u> 5. note R or calculate V ÷ I 6. change mass/weight 7. repeat readings	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **max 5**
		(iv)	**Table - column headings with units**	Mass / kg or pressure/ Pa or force or weight/N Voltage / V <u>and</u> current / A or Resistance /Ω *Extra columns must have correct unit - maximum penalty 1 mark*	**1** **1**

(c)	**Graph**	Axes labelled, allow either orientation	**1**
		Showing *p* decreasing, *R* increasing	**1**
			(Total 20 marks)

Total for Paper 2: 100 Marks

PHYSICS 7540, CHIEF EXAMINER'S REPORT

Paper 1

General Comments

Some very good work was seen on this paper. Calculations were performed well, as was descriptive work. In particular the drawing required in Questions 6 and 11 was of a high standard this time although this has sometimes been an area of weakness in the past.

Most candidates were able to attempt all parts of the paper in the time allocated. Some candidates found parts of the paper demanding although those who had been fully prepared could score very high marks. Questions involving calculations were usually answered well although units were still being missed off or written incorrectly.

The high quality of many answers indicates that candidates are benefiting from the advice given in examiners' reports. However, some candidates are still crowding their answers together too much. Teachers should advise them to leave a blank line between each part of a question and to leave at least two blank lines between questions, or even to start each question on a fresh page. This would make it easier for candidates to return to a question to complete it and to spot errors when checking through towards the end of the examination. It would also make it easier for examiners to follow their reasoning and to give appropriate credit where due.

Question 1

Surprisingly, a lot of candidates thought that a frictionless trolley on a horizontal table subjected to a constant force moved with uniform velocity rather than uniform acceleration. Further errors in the next section were related to those shown earlier, and many candidates determined the distance travelled by the trolley as if it was travelling with constant velocity. The resulting value, which was twice the expected answer, was not awarded follow through marks.
In part (c) the speed of the trolley after a time of 1.5 seconds was calculated for two different sets of values of mass and force. This section was well answered.

Question 2

This question on momentum was very well answered, with many scoring full marks. A trolley collided with a stationary trolley, resulting in them sticking together and moving forward. Given the speed of one trolley and both masses, the calculations were performed well with due regard to correct units. This topic is well understood by nearly all candidates.

Question 3

Most candidates knew that heat energy was transferred from a metal sphere in an evacuated box by radiation. The reason given was often insufficient. With this in mind, 'it can travel through a vacuum' is a better answer than 'it is a vacuum'.
The answer to part (a)(iii), stating how the rate of heat transferred could be reduced to a minimum, was not so well known. Correct answers included 'make the sphere shiny' or 'make the inside of the box shiny', but many answers referred to insulating the sphere or letting air into the box.
A description of convection was required in part (b). Those who thought that this process of heat transfer was not responsible for heat loss once air had been introduced, and named conduction or radiation in part (b)(i), could still score full marks in part (b)(ii) for correctly describing their named process.

Note: The marking strategy used was that if (b)(i) had been left blank then marks in (b)(ii) could only be scored for 'convection'. This occurred in Question 5 as well.

Question 4

Results for different masses hung from a spring, and the length of the spring, were given in a table and enabled candidates to determine the length of the unstretched spring. The force needed to produce a particular length required candidates to extract more data from the table and convert a mass in grams to a force in newtons. This was beyond many candidates, but in part (b) a good understanding of moments enabled many candidates to correctly solve a problem using the same spring. Many candidates only dropped one mark overall by working with masses throughout and not converting to newtons.

Question 5

The correct value for the typical size of a molecule is being given more often than in the past, although some answers giving the correct power of ten lacked a unit. The value for the Avogadro constant was given by a small number of candidates.
A calculation to determine heat energy absorbed, given mass and specific heat capacity, required candidates to find the value for temperature rise from a graph. This value was the difference between 20°C and 70°C and was often given as 70K or 323K instead of 50K. Giving candidates the mass in grams did not help as many converted to kg and introduced a power of ten error.
The temperature - time graph represented solid stearic acid being heated and melted. Asked for the arrangement and motion of the stearic acid molecules after melting, some candidates, instead of describing the liquid state, described a mixture of liquid and gas states.
These descriptions can sometimes be rendered incorrect by the inclusion or lack of a single word. The marking scheme was as follows:

Liquid
moving around or moving over each other
no fixed position, or irregular, or arranged in no fixed shape
close together or slightly apart

Gas
moving freely or randomly
no fixed position or arranged randomly
far apart

As in Question 3, if (b)(ii) was left blank, the three marks in (b)(iii) could only be scored for describing a liquid.

Question 6

Part (a) showed the charge distribution on a metal conductor supported by an insulated stand. Candidates were asked if the conductor was charged or uncharged. No other term such as 'neutral' was acceptable in this case. The reason for it being uncharged was because the number of evenly distributed positive and negative charges shown was equal. This was not always stated in the answer.
The introduction of a negatively-charged rod redistributed the charges, and the new positions of the charges were well drawn by nearly all candidates. This shows an improvement compared with previous years.
Explanations were also more accurate with less reference to 'protons' and 'positive charges moving' than seen in previous sessions. This point is obviously getting through to candidates because several answers made reference to the positive charges definitely not moving, even when the rest of the answer was not completely correct.

A small number of candidates thought that the removal of the rod would leave the charges permanently in their polarised state.

Question 7

This question proved unexpectedly difficult for many candidates.
Three identical lamps were connected in series with a 6 V d.c. power supply. The voltage across each lamp was sometimes given as 6 V and even as 18V. One lamp was short-circuited, leaving 3 V across each of the other two lamps. Many candidates interpreted this as the third lamp being connected in parallel across the other two.
In part (c), comparing the brightness of the lamps before and after short-circuiting one of them, follow through marks were allowed from parts (a) and (b) and many candidates picked up two marks here.

Question 8

Questions on this section of the syllabus are often poorly answered because electromagnetic induction is not well understood. This time marks were lost for a different reason.
A torch works by a coil moving over a magnet, cutting lines of flux and inducing a voltage. Candidates picked up at least two out of three marks in part (a) but in the final section, asking for an energy conversion taking place, incorrect answers included 'mechanical' and 'magnetic' energy. The only permissible energy forms in this case are:

- potential, gravitational potential, kinetic, electrical, light, heat and chemical.
- So 'chemical' to 'heat' scored 2 marks but 'mechanical' to 'electrical' scored zero.

Question 9

Most candidates could identify a G-M tube from a diagram and slightly fewer were able to give an approximate value for the range of alpha particles. Any value between 3 cm and 10 cm was acceptable. These numbers often appeared followed by metre or millimetre as the unit. Note that 'a few cm' or 'more than 6 cm' were not acceptable answers.
Most candidates knew that beta radiation was deflected in a magnetic field applied at right angles to its direction, although some spoiled their answer by referring to attraction or repulsion. There is still a substantial number of candidates who think that north poles and negative charges repel each other. Many candidates forgot to add that deflection was also due to the particles possessing charge. Merely stating that they were electrons was not sufficient explanation.
In part (d) candidates were asked for one safety precaution when using a source emitting gamma radiation. Enclosure in a lead box was not accepted since this referred to storage rather than use. Less cumbersome options than 'wearing a lead suit' are given in the mark scheme.
Candidates seemed to miss the opportunity of scoring high marks on this easy question.

Question 10

This question on resonance was well answered with many full explanations. Candidates had little difficulty taking readings from a graph and were able to name two factors affecting resonant frequency other than tension.

Question 11

Identification of an image position, given the object position and the surface of a plane mirror, proved straightforward. Drawing a line from the image position through the point of incidence on the mirror and extending it to show the reflected ray was also well executed. Thankfully very few candidates were without a ruler. Marking the normal and the angles of incidence and reflection was not always correct and seemed to depend on the centre. Most candidates knew that the image was virtual.

Paper 2

Question 1

Well prepared candidates scored well on this question but some lost marks by failing to follow the instructions.

(a) Most candidates multiplied the given value of 9.7 by 28 but only scored the second mark if they showed the final answer, rather than assuming it would be equal to 270 m/s. Most stated that the acceleration was constant but some ignored the question and talked about air friction being negligible. In calculating the distance, too many assumed the velocity was constant and so stated that the distance was about 7600 m rather than 3800 m, and so scored only one of the three marks available. The syllabus does not require candidates to know the equations of motion but those who used them correctly were allowed full credit.

(b) Too many candidates gave incomplete responses to the first part, simply saying gravity and friction or drag, neither of which was accepted. Pull or force of gravity were acceptable alternatives to weight; air drag or air friction was also needed. Few used the correct term of 'terminal velocity'. Very few candidates stated that the weight remained constant although rather more realised that the air friction increased with speed. Credit was given to those who stated that weight acted downwards and air drag acted upwards. A majority did state that the maximum speed was reached when the two forces were balanced, but then most went on to sketch a straight line graph rather than the expected one showing the speed increasing but then flattening out at 53 m/s.

(c) (i) This was a simple Boyle's law calculation requiring evaluation of V_2. Candidates again lost the second mark if they did not show the actual result, instead writing the value given in the text. Questions of this sort, asking candidates to show that the answer is approximately 340 litres, will always have a result that differs from but is close to that given. Since the question asked them to evaluate the calculation, no credit was given for those who started from 340 and went on to prove that the starting value was approximately one litre; that was a different question.

(ii) This question required candidates to apply Charles' law to show that the actual volume was about 290 litres. A significant number failed to convert temperatures to Kelvin and also lost the final mark if they did not show the actual result of the calculation. Although the ideal gas equation is not on the syllabus, candidates were not penalised if they used it correctly.

Question 2

Responses to this question were disappointing, especially when candidates applied molecular explanations incorrectly.

(a) A majority realised that the process by which energy was transferred through the glass was conduction and stated that the molecules of aluminium vibrated about fixed points. However, many then went on to describe convection or radiation as the process, rather than the required response that molecules near the inner surface of the aluminium would vibrate more and then pass the heat energy on to neighbouring molecules. Candidates who ignored the molecular explanation and talked correctly about free electrons were allowed full credit. Many candidates stated either that the aluminium lid was thin or that it was a better conductor, fewer gave both reasons. Vague answers failed to score marks.

(b) (i) Candidates who described convection lost marks if they failed to name the process or if they talked about molecules expanding or becoming less dense.

(ii) Few were able to state that the constant 4°C was due to the 'anomalous expansion of water' but credit was given for 'unusual expansion' or other similar phrases. More realised that the maximum density occurred at this temperature, very few went on to state that below this the water begins to expand again and so becomes less dense and rises. Again, references to molecules expanding or changed density failed to score.

(iii) Few candidates talked about latent heat being released and this then being equal to the heat lost to the surroundings.

(iv) Most realised that the beaker would crack or break but many failed to say that this was because water expands when it turns to ice.

Question 3

This question often scored well for candidates who read the question carefully and who had a secure grasp of the behaviour of electromagnetic systems.

(a) To score both marks, candidates had to state that 'soft' meant easy both to magnetise and demagnetise.

(b) Vague answers which simply repeated the wording of the question failed to score marks. Candidates could usually say that the coil or the iron became magnetised and that the soft iron was attracted, but then failed to say that it moved into the coil. Where they referred to the pointer they did not state which way it would move.

(c) Although candidates managed to apply the right hand grip rule to the coil, they frequently ignored their own result and stated that T was an N pole when clearly the tip was an S pole.

(d) Candidates struggled to explain what alternating current is. Very few thought that the device could measure a.c.; those who did rarely explained that both poles would change and that as a result there would always be opposite poles which would still attract.

(e) Graphs usually score well. Candidates followed instructions and most chose sensible scales (avoiding scales involving odd numbers) and plotted the points correctly. Many thought that a best fit line had to be a straight line and frequently used only the first three points, rather than a line having points distributed evenly on both sides. A few realised that it could start as a straight line and then become a curve. Most then drew a line across at 15° and then down to the current axis, reading off a correct value within the specified tolerances. They should have recognised that 20 A was a very large current which would overheat and melt the coil and that the pointer would go off scale.

Question 4

Many candidates scored well on this question provided they could handle calculations involving sines.

(a) Most candidates scored 4 or 5 marks on this section. Those who did not wrote vague answers which did not clearly specify which interface they were referring to.

(b) (i) Candidates usually lost marks by not using sines, using 1.5 for refractive index instead of 1.52 or by not writing the actual answer of 17.2°, instead writing 17°.

(ii)Candidates must show all steps in their working; those who made errors and just wrote the final answer frequently lost all four marks.

(iii)Weaker candidates assumed that angle C was the critical angle. Others used the answer for part (ii) (62.2°) instead of using 90° - 62.2°.

(c) A majority scored the first four marks although 30 m/s was too common. Very few were able to explain why the wave fronts did not change direction.

Question 5

The quality of answers to the design question has continued to improve. This question often scored very well for those who laid out their answers in a logical fashion, using the subdivisions from the question. Where they ignored the headings it proved difficult to award all the marks they might deserve. Centres should warn candidates that in future they may only score marks if they use the headings provided.

(a) This often scored all four marks. Incorrect units were the most common error.

(b) (i) Marks were awarded for four correct items of apparatus. Many candidates wrote down the first four items that came to mind, even if they were not relevant to the experiment. Many failed to appreciate that to measure resistance both a voltmeter and an ammeter were needed, and that these counted as one item.

(ii)A majority could write down three measurements that would be taken.

(iii)Candidates often found it difficult to describe the procedure in a logical order. They should be prepared to write the steps required as a numbered list.

(iv)The expected table needed to show pressure and resistance with correct units to score. Additional columns were ignored but a one mark penalty was applied if any of these columns had missing or incorrect units.

(v)The two marks were for a graph of resistance against pressure showing a downward curve or line, but full credit was given for a graph of pressure against 1/R (or resistance against 1/p) with a straight line through the origin.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	72	61	50	45	26

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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