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GCE O Level Physics (7540)

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PHYSICS 7540, MARK SCHEME

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) 0.008 x 10 **(1)**
= 0.08 N **UP** nwn **(1)**

(b) arrow pointing vertically upwards **(1)**
arrow on string or within width of mass.
Allowing arrowhead within balloon if touching string

(c) 0.08 N only one UP / same as (a) **(1)**

(d) downwards **(1)**
accelerates/accelerating **(1)**
unbalanced <u>force</u> OWTTE *dependent on 1st mark*
ie comparison **(1)**

Total 7 marks

2. (a) (i) area (under graph) **(1)**
(ii) 1.5 x 4 **(1)**
= 6 mm **UP** nwn **(1)**

(b) (i) implied line (4,0) to (6,0) showing zero velocity **(1)**
line at height 1.5 and length 4 seen anywhere to the right of (4,0) **(1)**
(ii) 6 + 6 or area under candidate's graph **(1)**
÷ 10 or total time for journey shown **(1)**
= 1.2 mm/s **UP** ecf from 1st and 2nd marks **(1)**

if m and m/s shown in (a)(ii) and (b)(ii) respectively only one UP
allow ecf from (a)(ii) eg 2 x (a)(ii) where 3 mm is shown and 6 mm shown in (b)(ii)

Total 8 marks

3. (a) black is an absorber of infra red radiation/radiation/heat/light **(1)**
good absorber *independent marks* **(1)**
(rate of) evaporation greater/faster/easier/quicker **(1)**

(b) air or water vapour is hotter (than surrounding air or water vapour) **(1)**
less dense (than surrounding water vapour / air) **(1)**
rise up **(1)**
independent marks *'molecules'* 0 0 1

(c) stop salt (water)/ impurities reaching outlet for drinking water / remove or collect salt (water) **(1)**

Total 7 marks

4.	(a)	force <u>multiplied</u> by (perpendicular) distance (of force) from <u>point/pivot</u> *can only be scored if seen in (a)*	**(1)**
	(b)(i)	4 x 0.09 = 0.36 Nm or 36 N cm **UP** **nwn**	**(1)** **(1)**
	(ii)	increases/extends/longer	**(1)**
	(iii)	so <u>handle</u> returns to its original position **ora** or spring returns to original length **ora** when force is removed / handle let go	**(1)** **(1)**
			Total 6 marks
5.	(a)	<u>Brownian</u> motion (not Bromine)	**(1)**
	(b)	(bright) dots/specks/points/sparks **not** smoke particles moving haphazardly/randomly/erratically/jerkily/irregularly/zig zag independent marks – '*smoke particles moving haphazardly*' scores 1	**(1)** **(1)**
	(c)	gas and liquid molecules able to move about/not in fixed positions *not randomly* solids molecules in fixed positions / not free to move OWTTE *strong bonds 'close packed' not sufficient.*	**(1)** **(1)**
			Total 5 marks
6.	(a)	two <u>complete</u> waves filling *x*-axis same amplitude *independent marks* must be about central line/*x*-axis	**(1)** **(1)**
	(b)	one wave filling *x*-axis <u>double</u> amplitude *independent marks* must be central about central line/*x*-axis	**(1)** **(1)**
	(c)	<u>horizontal</u> line <u>above or below</u> *x*-axis	**(1)**
			Total 5 marks
7.	(a)	(i) <u>0 to</u> 4 (V) / <u>up to</u> 4 (V) (ii) straight line part / gradient constant *independent of (i)* accept *I proportional to V*	**(1)** **(1)**
	(b)	(i) resistance = 4/0.5 = 8 ohms **UP** **nwn** (ii) resistance = 8V / 0.6A = 13.3 ohms (**UP** only once) 13.33, 13.333 etc 13 1/3	**(1)** **(1)** **(1)**
	(c)	wire gets hot/ temperature rises *not heat of wire increases* resistance <u>changes</u> with <u>temperature</u> / <u>heat</u>	**(1)** **(1)**
			Total 7 marks
8.	(a)	100/20 = V_2/50 (or equivalent) = 250 V **UP** **nwn**	**(1)** **(1)**
	(b)	(i) smaller (reading) / half *not <u>current</u> smaller*	**(1)**

		(ii)	secondary/output PD or EMF smaller / resistor gets smaller voltage	(1)
			current smaller *must be seen here*	(1)
	(c)	(i)	no reading *not 'no effect'*	(1)
		(ii)	no (secondary) PD or EMF/no induced current (in secondary)	(1)
			transformer needs changing PD or voltage / changing magnetic field / d.c. will not give a changing PD / flux / voltage	(1)
			independent marks	
				Total 8 marks
9.	(a)	(i)	beta	(1)
		(ii)	alpha stopped by 4cm air / won't reach counter	(1)
			gamma not affected by thin aluminium	(1)
			not "too powerful for aluminium"	
			consider each radiation separately	
			no ecf from (i)	
	(b)		2 half lives	(1)
			half life = 20 minutes **UP**	(1)
			must show how answer was obtained	
				Total 5 marks
10.	(a)		transverse	(1)
	(b)		correct distance shown on diagram	(1)
			6.5 - 6.7 cm (varies on operational paper)	(1)
			wavelength = (65 - 67 cm) or candidate's length x 10 **UP** nwn	
	(c)		speed = 2 x candidate's wavelength	(1)
			= 130 to 134 cm/s **UP** ECF	(1)
				Total 5 marks
11.	(a)		-ray parallel to axis refracts through F	(1)
			-ray through centre passing straight on	(1)
			-ray to bottom tip of lens refracts parallel to principal axis	(1)
				MAX two
			inverted image shown on or within 2mm of screen (ie arrow)	(1)
	(b)		lens inverts image	(1)
			(upside down slide) produces upright image (on screen)	(1)
			independent marks	
	(c)		move screen away from lens /to right/ increase *v* or image distance	(1)
			move slide closer or nearer to lens /to right/ decrease *u*	(1)
			not '*move lens or screen forwards or backwards*'	
			'*move lens to the left*' scores 1 only	
				Total 7 marks

TOTAL FOR PAPER: 70 MARKS

Paper 2

1. (a) where /point/place/position (1)
mass / weight of body/ pull or force of gravity appears to be (1)
2^{nd} mark dependent on 1^{st}

(b) (i) Potential/ PE/ E_p (kinetic 0/2) (1)
Gravitational/ GPE/ E_{gp} (1)
2^{nd} mark dependent on 1st

(ii) 60 x 10 x 7 (use of ½mv^2 0/2) (1)
= 4200 J 4116 J **UP** (1)

(iii) 4200 ÷ 15 ecf for energy eg 6.54 from using ½mv^2 (1)
= 280 W or J/s ecf 0.44 W or J/s **UP** (1)

8 marks

(c) (i) choice of A, B, C only (1)
C = A + B or A + B - C = 0 (1)
balanced / zero net force (1)
(in direction of motion / in horizontal direction)
3^{rd} mark dependent on 1^{st}

(ii) drag / friction / resistance (1)
air (1)
speed/ velocity constant / no acceleration (not constant motion) (1)
2^{nd} and 3^{rd} marks dependent on 1^{st}

6 marks

(d)

(i)	8 = (5/2) *t*	Accept use of $v^2 = u^2 + 2as$ to calculate d(ii) correctly then v= u+at to calculate d(i) correctly. Apply scheme in each case 1^{st} mark for correct substitution into equation, 2^{nd} mark for correct answer with unit and **UP**	(1)
	t = 3.2 s **UP**		(1)
(ii)	5 ÷ 3.2 **ecf**		(1)
	1.56 m/s^2 1.5625 1.6 **UP**		(1)
(iii)	Use of KE = work done	Or determination of *m* = 1200 kg from15000 = ½ x *m* x 5^2	
	15 000 = F x 8	*F* = *m* x *a* = 1200 x 1.56	(1)
	F = 1875 N **UP**	ecf for a = 1872 1875 1920 N **UP**	(1)

6 marks

Total 20 marks

2. (a) (i) decreases / gets filled (1)
lines expand (not molecules or linear expansivity) (1)

(ii) expansion is greater than gap / keep expanding after filling gap/ need more space than provided by gap (1)

3 marks

(b)		heat / energy / heat energy required to raise temperature of 1 kg or unit mass /suitable equation using H, Q, E c, C T, t, θ	(1)
		through 1K or 1°C or 1 degree or symbols explained *dependent on 1st mark*	(1)
(c)	(i)	150 x 1050 x any temperature	(1)
		(x) 22 *independent of 1st mark*	(1)
		= 3 465 000 J **UP** *only answer*	(1)
	(ii)	3 465 000 / 300 **ecf**	(1)
		= 11 550 seconds **UP** (192.5 min) (3.2 hours)	(1)
	(iii)	heat / energy / heat energy needed to melt ice /change state	(1)
		heat / energy / heat energy needed to heat water/ice	(1)
			9 marks
(d)	(i)	diagram showing:	
		correct circuit with supply, ammeter (joulemeter) and heater in series	(1)
		voltmeter correctly connected	(1)
	(ii)	thermometer	(1)
		timer	(1)
		balance	(1)
		(metal) block	(1)
		lagging	(1)
		can be scored if <u>labelled</u> on diagram	**Max three**
	(iii)	mass of block	(1)
		<u>initial</u> and <u>final</u> temperatures	(1)
		meter readings / current and voltage readings	(1)
		time taken (for heating)	(1)
			Max three
			8 marks

Total 20 marks

3.	(a)	(i)	positively charged	movement of <u>electrons</u>	(1)
				(negative charges moving) in correct direction / away from leaf /to cap/ upwards	(1)
				(<u>positive</u> electrons or charges moving 0/2)	
		(ii)	leaf rises	<u>both</u> or rod <u>and</u> leaf have same charge/ positive	(1)
				like charges repel (on its own scores 1/2)	(1)
				(poles in either line loses that mark)	
		(iii)	Disconnects	Leaf stays up/ allow falls <u>slightly/no effect</u>	(1)
				Positive charge remains/electrons cannot return	(1)
				(no credit for electrons flow to earth)	
					6 marks

Treat (b)(i) and (b)(ii) as separate and independent parts of the question and apply scheme

			Correct (or no) charge(s) on rod		Incorrect charge(s) on rod	
(b)	(i)	Poly-thene	polythene negative leaf falls electrons repelled to leaf and or rod less (+) charge on leaf/rod /turns leaf neutral	(1) (1) (1) (1)	polythene positive leaf rises electrons attracted to cap more (+) charge on leaf/rod	(0) (1) (1) (1)
	(ii)	perspex	perspex positive leaf rises electrons attracted to cap more (+) charge on leaf/rod	(1) (1) (1) (1)	perspex negative leaf falls electrons repelled to leaf and or rod less (+) charge on leaf/rod /turns leaf neutral	(0) (1) (1) (1)

8 marks

(c)	(i)	charge	2 x 30	(1)
			60 C **UP must be seen to gain marks**	(1)
	(ii)	PD	360 = 60 x V ecf	(1)
			V = 6 V **UP must be seen to gain marks**	(1)
	(iii)	power	6 x 2 or 360/30 ecf	(1)
			12 W **UP**	(1)

6 marks

Total 20 marks

4. (a)	(i)	Circuit	2 cells in series with each other	(1)
			connected to 2 bulbs in parallel	(1)
			switch in series with <u>each</u> bulb	(1)
			(switches open or closed)	
			(Ignore ammeter or voltmeter but any resistor loses second mark)(separate circuits 0/3)	
	(ii)	power	Attempt to <u>use</u> P=VI eg 2.4 x 0.35 x 2	(1)
			or 2.4 x .35 or 4.8 x .35 or 4.8 x .70 **or** I^2R	
			Correct answer only 1.68 W 1.7 W **UP**	(1)
	(iii)	Graph	Axes correct orientation and correct scale	(1)
			Axes labelled power and time with units	(1)
			Plots (-1 each incorrect) +/- 1 mm	(2)
			(Smooth) curve ie not dot to dot	(1)
			minimum scale 4cm = 2hr, 4cm = 1W	
	(iv)	Time	correct full or dotted or line(s) shown on graph	(1)
			(Not just a dot)	
			tolerance 1.4 to 1.7 (hours)	(1)

12 marks

(b)	(i)	beta	(fast) electron (not just a negative particle)	(1)
	(ii)		$^{63}_{28}\text{Ni} \rightarrow {}^{63}_{29}\text{Cu} + {}^{0}_{-1}\text{e}$	
			$^{63}_{29}\text{Cu}$	(1)
			$^{0}_{-1}\text{e}$ or $^{0}_{-1}\beta$	(1)
			correct order - dependent on marks 1 and 2 accept numbers either side of correct symbol	(1)
	(iii)	safety	beta stopped by (4mm) plastic	(1)
			beta can't get out / reach/affect children (no credit for "no harm" – given in question)	(1)
	(iv)	advantage	illumination constant / lasts a long time/ bulbs/batteries wear out quickly (not cost)	(1)
			Nickel has long half life/ (allow half life = 100 years as equivalent)	(1)

8 marks

Total 20 marks

5.	(a)	(i)	ray bends towards (but not beyond) normal / downwards	(1)
		(ii)	1st correct angle labelled	(1)
			2nd correct angle labelled (normal needs to be drawn but label not needed)	(1)
		(iii)	RI = sin i / sin r or candidate's symbols used correctly Independent mark	(1)

4 marks

(b) (i) **diagram**

	Plane mirror	u – v method	Distant object	
1.	illuminated object	illuminated object	Distant object/sun	**(1)**
2.	converging lens	converging lens	converging lens	**(1)**
3.	plane mirror	screen	screen	**(1)**
4.	image on raybox / on screen next to raybox	image on screen	image on screen	**(1)**
5.	ruler shown	ruler shown	ruler shown	**(1)**
6.	correct optical arrangement	correct optical arrangement	correct optical arrangement	**(1)**

Maximum 5D

(ii) **Adjustment**

	Plane mirror	u – v method	Distant object	
1.	lens + mirror adjusted	lens or screen adjusted	lens or screen adjusted	**(1)**
2.	clear/sharp image	clear/sharp image	clear/sharp image	**(1)**
3.	on screen	on screen	on screen	**(1)**

3A

(iii) **measure** (if not seen here can award in b(ii) but not b(i))

	Plane mirror	u – v method	Distant object	
1.	distance from lens to ray box	measure u and v	measure from lens to screen	(1)
2.	This is focal length	use 1/u + 1/v = 1/f	this is focal length	(1)
3.	repeat readings	repeat readings	repeat readings	(1)
			*Any **two** from marks 1 to 3*	
4.	repeat for different RI/ lenses	repeat for different RI/ lenses	repeat for different RI/lenses	(1)

Maximum 3M

(iv) **graph**

1.	axes labelled RI, and f / RI and 1/f **ORA**	(1)
2.	downward line or curve /upward line or curve	(1)

2G

(c) expensive glass (1.8 gives) strong(er) lens / large(r) correction / more refraction /shorter f (1)

1.8 means thinner lens (1)

lighter / better appearance (1)

3 Marks

Total 20 marks

TOTAL FOR PAPER: 100 MARKS

PHYSICS 7540, EXAMINER'S REPORT

General Comments

Paper 1

Some good work was seen with most candidates scoring well on certain questions. Question 2 was such a question, mostly calculation in which candidates handled formulae, numbers and units competently. The paper required quite a lot of explanation and Question 3 was completely descriptive. This question was answered well, especially as it represented an unfamiliar situation. However the description of convection was disappointingly dealt with and Question 8 from section 8 of the syllabus was poorly answered.

Question 1
Most candidates could calculate the weight of a 0.0080 mass and give the correct unit. In part (b) the arrow representing the tension in the string was often incorrectly drawn, sometimes appearing detached from the diagram. Part (d) was poorly answered by nearly all candidates. A stationary balloon had its gas changed to air from a gas of lower density. Candidates were asked to describe and explain the motion of the balloon. The expected response was:

Motion	downwards accelerating
Explanation	unbalanced force

Few candidates scored more than the first mark, with many describing an upward motion. Some candidates may have considered the stationary balloon to be on the ground. In cases where the ground is an important factor in a diagram it is shown and labelled.

Question 2
This question was very well answered by nearly all candidates. Most knew that the area under a velocity-time graph could be used to determine the distance travelled.
A snail travelled at a velocity of 1.5 m/s for 4 seconds. After a rest of 2 seconds it continued at the same velocity for another 4 seconds, travelling a distance of 12 mm in a total of 10 seconds. Many candidates were able to draw the complete velocity-time graph but, in calculating the average speed for the entire journey, considered the time for the journey to be 8 seconds instead of 10 seconds. Only one mark was deducted for this error and many candidates scored at least 7 out of 8 marks for this question.

Question 3
The diagram showed apparatus for converting salt water to drinking water. A black cloth had one end in salt water while absorbing the Sun's rays. The advantage of using a black cloth is that black is a good absorber of radiation and that the process of evaporation is faster. Many candidates thought that black being a good emitter or conductor was the advantage.

Part (b) asked for a description of convection and many familiar errors such as 'molecules becoming hot and lighter' appeared.

In part (c) it was particularly pleasing to see many candidates able to explain the reason for an outlet for draining off salt water.

Question 4

A definition of **the moment of a force about a point** must refer to a distance from a point or a pivot. Some loose responses mentioned a distance moved.

The calculation in part (b)(i) required the product of 4.0 N and 9.0 cm to calculate a moment of force. Several unit and powers of ten errors were seen, such as N/cm.
All candidates knew that the length of the spring increased when the door handle was turned; however, the term 'expanded' should be avoided in this context.

In part (b)(iii) most candidates understood the meaning of elastic behaviour but many gave an incomplete description. When asked why it is helpful for a spring, which is part of a door mechanism, to show elastic behaviour an expected response is:

- so that the handle returns to its original position
- when the force is removed or when the handle is let go.

The second point was not often seen. Candidates should be encouraged to give more detailed responses and should also be guided by the number of marks allocated for each answer.

Question 5

This question on Brownian motion required the name of the motion for one mark in part (a). Practically all candidates scored this mark, but in part (b) they were asked what was seen when looking through a microscope. The expected response of:

- dots or specks or points
- moving haphazardly or randomly or erratically (or words to that effect)

was rarely seen.
The second mark was scored but not the first. Practically all candidates stated that smoke particles were seen moving randomly.

In part (c) many candidates were able to explain why Brownian motion could be shown using gases and liquids but not solids.

Question 6

Answers to this question showed a lot of confused thinking. Poor drawing was taken into account provided that there was sufficient evidence to show that the candidates knew what they were doing.
A diagram showed the appearance of the screen of an oscilloscope when an alternating voltage was connected to its input terminals.
Candidates were asked to show the appearance of a signal of:

(a) the same voltage and double the frequency, and
(b) the same frequency and double the voltage.

Many candidates mixed up the effects of doubling frequency and voltage.

Part (c) asked for the appearance of a steady direct voltage. Instead of a horizontal line drawn across the entire grid through a point other than the centre-line, the appearance of a fully rectified wave was more commonly seen.

Question 7

A graph of current against potential difference for a filament lamp was shown. From the point (4.0 V, 0.5 A) the graph deviated from a straight line.

Candidates were asked to state the range of potential differences for which the resistance of the lamp was constant, and to give a reason. The expected response of '0 V to 4 V' or 'up to 4 V' was often seen together with the reason that the 'line is straight'. The examiners reluctantly accepted 'current is proportional to potential difference' because experience shows that candidates do not always understand the full implication of 'proportional', often ascribing proportionality to any straight line.

The calculations of resistance in part (b) were extremely well done but candidates did not always do themselves credit in part (c).

Candidates were asked to explain a change in resistance of the lamp filament. The wire gets hot and the resistance changes with temperature. Usually one out of two marks was scored, and this was one of several places on the paper where able candidates dropped single marks.

Question 8

Questions from this section of the syllabus usually score poorly and this was no exception. Again the calculation, to find the potential difference across a resistor in the secondary circuit of a transformer, scored better than the other parts which required description and explanation.

There is a distinction between asking for the effect on an ammeter reading and for an explanation of the effect. The former should be answered in terms of the reading and the latter in terms of electric current.

In part (c) only a minority of candidates could explain the effect of connecting a D.C. voltage to the primary of a transformer, although some excellent answers described a momentary ammeter reading at switch-on followed by zero reading resulting from a further lack of changing flux.

In part (c)(i), when asked for the effect on the ammeter reading, candidates should be aware that 'no effect' is not regarded as the same as 'no reading'.

Question 9

Part (a) required candidates to recognise that beta radiation would be affected by a thin sheet of aluminium placed 14 cm away from a radioactive source, and give reasons why alpha and gamma radiation would not be affected. Unfortunately candidates often referred to the effect of sheets of paper and lead, for which no credit was given.

The calculation in part (b) on half-life was poorly done – an exception on this paper. Even some of those candidates who showed that successively halving 600 cpm to get 150 cpm was indicative of the passage of two half lives could not get the final answer for half life.

Question 10

In part (a) not all candidates knew that a wave shown on a long spring was a transverse wave. Measurements of wavelength showed a good understanding of this topic but unfortunately the scale factor of 1/10 full scale was often ignored, or operated as a reduction of 1/10 to find the actual wavelength. Most candidates showed a knowledge of speed = frequency x wavelength although some unit errors appeared. Furthermore candidates should aim to give an appropriate unit for speed here rather than, for example, Hz.cm following on from the calculation.

Question 11
Some careful drawing in part (a) saw an encouraging number of candidates draw two rays from the top of an object meeting at a screen after passing through a converging lens; but then they missed an easy mark by not drawing the image as requested.

In part (b) the slide should be placed upside down because, as it is, the image is inverted, and an upright image can only be viewed if the slide is inverted. Some expressions for upright such as 'erect' are acceptable, but others such as 'laterally inverted' or 'right way' or 'real' are not.

In part (c) the image size can be increased by:

- moving the lens and slide closer together
- moving the screen and lens further apart.

Many answers referred to changing the focal length of the lens or described the same adjustment twice.
It was particularly disappointing that many strong candidates dropped a mark in each part of this question.

Paper 2

Most candidates were able to answer all the questions in the time allowed and many presented their ideas very well, with high quality answers. Questions involving calculations were usually answered well although units were still missed off or written incorrectly.

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

Question 1
Most candidates scored well on this question.

(a) Most candidates knew that the centre of gravity was a point in an object but some were confused about the force involved.

(b) (i) Most candidates realised that potential energy was gained; good candidates gave the full name of Gravitational Potential energy.

The calculations in parts (ii) and (iii) frequently scored full marks although units were occasionally missed. A minority of candidates attempted to calculate the kinetic energy for part (ii) even though the data given was inappropriate; provided that working was shown they could still score both marks in part (iii).

(c) (i) Most candidates realised that forces A, B and C were the only ones involved but many were unable to write the correct equation, often wanting to add additional forces. Very few were able to say that the resultant horizontal force was zero or that the horizontal forces were balanced.

(ii) Candidates often scored all three marks. Candidates should avoid vague terms such as 'constant motion' when they mean constant speed or acceleration.

(d) The calculations were often well tackled although many candidates did not use the equations expected in the syllabus. Those who did usually scored full marks. Candidates used $v^2 = u^2 + 2as$ to find the acceleration required for part (ii) and then used this together with $v = u + at$ to find the time. Full credit was given to this approach if carried out correctly. Similarly, in part (iii) many candidates failed to use change in KE = work done but instead calculated the mass and then used $F = ma$. Again this was allowed, although this method took longer and gave more opportunities for errors.

Question 2
Candidates who knew the equations and read the question carefully scored well. It was very pleasing to see how many coped with the large quantities involved.

(a) (i) Most candidates scored the two marks. Some stated that molecules expand or tried to use the term linear expansivity and lost the second mark.

(ii) Very few correct answers were seen; many thought the ends of the rails would melt.

(b) Candidates who had learnt the definition of specific heat capacity scored both marks but some vague answers missed out 'per unit mass' or 'per kg'.

(c) (i) It was pleasing to see how many candidates calculated the temperature change correctly and then went on to obtain the final answer.

(ii) Again this calculation scored well; credit was given for an error carried forward from (i).

(iii) Only a few candidates realised that extra energy was needed to heat the ice and then melt it. Many thoughtlessly gave the more common answer to this type of question by giving a response of 'heat is lost to the surroundings' or that 'ice is an insulator', both of which were wrong.

(d) (i) Many candidates were able to draw a suitable circuit diagram although some failed to include a voltmeter or placed it in the wrong place. The battery symbol was often poorly drawn, looking like a capacitor.

(ii) and (iii) Most candidates could name two or three other pieces of apparatus and list the necessary measurements. Some failed to read the question and wrote a method which frequently missed making the required points. A number simply stated that they would measure the temperature difference rather than initial and final temperatures.

Question 3
This question often scored well for candidates who read the question carefully and who had a secure grasp of the behaviour of electrons in the situation. It is worrying that some candidates still talk about the movement of positive charges.

(a) (i) Many candidates gave a correct response, stating that electrons moved away from the leaf or towards the positive metal plate. Any mention of movement of positive charges or of positive electrons lost both marks.

(ii) Most candidates stated that both the rod and plate had the same type of charge and hence repelled each other.

(iii) Good candidates realised that the electroscope would now be insulated and that the leaf would remain raised.

(b) (i) and (ii) Each part was marked independently. The first mark in each case was for knowing that, when rubbed, polythene would have a negative charge and perspex a positive one. Some candidates described how the rods were charged up, which was not required. The remaining marks were given for answers relating to the charge they had linked to each rod, and again a correct description involving the movement of electrons was required.

(c) The three calculations frequently scored full marks with marks only being lost through missing or wrong units.

Question 4
Responses to this question were more variable.

(a) (i) Candidates could usually draw a correct circuit. The main errors were showing only one cell symbol, placing switches in the wrong place or using separate circuits each with one bulb and one cell, which lost all three marks.

(ii) Too many candidates failed to realise that the power was twice that of one bulb, or multiplied both PD and current by two. Those trying to use I^2R usually got in a tangle and lost both marks.

(iii) Most candidates are now drawing good graphs using a good scale, labelling the axes correctly and drawing a smooth curve rather than joining the dots. Some misplotting was seen where the values on the x-axis were given to two decimal places in the table.

(iv) Candidates who did not indicate the correct value on the curve by drawing a horizontal and/or vertical line to the curve lost that mark.

(b) (i) Candidates needed to identify a beta particle as an electron rather than giving properties of a beta particle.

(ii) The three marks were given for correct symbols shown in a correct order.

(iii) Candidates often said that beta particles were stopped by 4 mm of aluminium instead of referring to plastic. Some thought that isotopes with long half-lives would be safe.

(iv) More able candidates referred back to the answer in (a)(iv) to explain that the proposed radioactive source would provide illumination for a long time because the isotope had a long half-life. Responses relating to cost were given no credit in this question. (No-one dared to say that any use of radioactive materials in a child's toy would be unacceptable and so would be banned.)

Question 5
The quality of answers to the design question has continued to improve. This question often scored well, with most answers laid out in a logical fashion using the subdivisions from the question.

(a) This often scored all four marks. It highlighted candidates who did not clearly understand the meaning of angles of incidence and refraction. Some failed to draw the normal at right angles to the interface or thought that the angles were measured from the surface to the rays.

(b) (i) Marks were awarded for any correct method of measuring the focal length. A diagram of apparatus was expected and so ray diagrams often lost two or three of the available marks. Candidates often failed to label the diagrams fully. Some candidates gave a method of finding the refractive index using Sin i/Sin r even though they were given 'lenses of known refractive index'; such responses were ignored.
(ii) and (iii) Candidates often answered parts of (iii) in (ii) but were still given credit. The adjustments and measurements had to relate to the method shown in the diagram.

(iv) The two marks were for a graph of refractive index against focal length showing a downward curve or line, but full credit was given for a graph of focal length against 1/RI with a straight line through the origin.

(c) This part was aimed at and only successfully tackled by the most able candidates. No reference to the structure or function of the eye was expected or given credit. Candidates should have realised that high refractive index lenses would refract light more and hence result in a thinner lens for the same focal length; hence the lens would be lighter. Instead, many candidates thought that the resulting image would be clearer or sharper.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	74	63	52	47	28

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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