edexcel INTERNATIONAL

Mark Scheme with Examiners' Report

GCE O Level Physics (7540)

January 2006

delivered locally, recognised globally

Mark Scheme with Examiners' Report

January 2006

PHYSICS 7540 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
dop	dependent on previous

Paper 1

1.	(a)	**arrow**	Single arrow towards the left	1
			horizontal (by eye) and labelled F **dop**	1
			Left or right of runner and vertically within parachute	
	(b)	**size**	Bigger/larger/increases/more/ gets longer	1
		direction	Same/still to left/remains constant/still opposes motion must ecf from (a)	1
	(c)	**another force**	weight/pull or force of gravity/ gravitational force/ (normal) reaction /friction (with ground)/air resistance acting on athlete not gravity/g/ GFS	1
	(d)	**zero force**	stops / constant or steady speed or velocity/ not accelerating Ignore no air resistance/vacuum/terminal velocity or when forward and backward forces are equal	1
				(6 marks)
2.	(a)	**slope**	Velocity only not speed eg velocity(speed)scores 0	1
	(b)(i)	**distance**	2m UP	1
	(ii)	**velocity**	2/4 must ecf or start from scratch (3-1)/4 = 0.5 m/s UP	1 1
	(c)	**graph**	straight/horizontal line from (4,3) to (6,3)	1
			line from (6,3) to (7,0) or from end of horizontal line to zero displacement in 1 second	1
			straight line dependent on previous mark	1
				(7 marks)

3.	(a)	**moment**	12 x 0.15 or 12 x 15	1
			= 1.8 Nm or 180 Ncm **UP** ***accept N-m or N-cm***	1
			No credit for answer to (b)(ii) here	
			Allow 1.8Nm if seen as part of a calculation in (a)	
	(b)(i)	**left hand force**	Friction (only)	1
	(ii)	**value of F**	F x 0.04 = 1.8 ecf or start from scratch	1
			F = 1.8 ÷ 0.04	1
			F = 45 N **UP**	1
	(c)	**unsuitable**	(45 N is a) Large/big/strong/ force	1
			(elderly people)can't provide large enough grip or force /not strong enough/can't hold tightly enough/are weak Ignore pressure	1
			independent marks	
				(8 marks)
4.	(a)	**pressure**	bombardment by molecules (with walls – ignore all references to bombardment with other molecules)	1
			Must be seen here	
			(allow only words that mean hitting, striking or short impact so ignore "push against walls")	
	(b)	**temp reduced**	1. (Pressure) falls	1
			2. slower molecular speed/<u>K</u>E	1
			3. less <u>frequent</u> bombardment /lower <u>rate</u> of collisions /less hard collisions	1
			(look only for "collisions" in (b) accept "with other molecules" here but not lower speed of vibration)	
			(reduced rate of change of momentum scores 2nd and 3rd marks)	
			If no mention of molecules:	
			Allow attempt to use a gas law including P for second mark	
			Allow correct use of pressure law or $P \propto T$ for third	
	(c)	**temperature**	absolute zero / 0 K/ -273^{0}C **UP** allow ^{0}K and C	1
			If more than one of the answers given they must not contradict/ not absolute temperature	
				(5 marks)

5.	(a)(i)	**heat energy**	39 - 36 = 3 **No UP** 0.1 x 4200 x candidates temperature = 1260 J **ECF** for candidate's wrong temperature e.g. 0.1 x 4200 x 276 = 115 920 J scores 2 marks	1 1 1
	(ii)	**rate**	1260 ÷120 or 1260 ÷2 ecf eg 115970/120 or 115970/2 = 10.5 W or J/s or 630 J / min **UP** ecf 960W or 57960 J/min Ignore any further calculations leading to kWh	1 1
	(b)	**conversion**	electrical to heat/thermal/ internal not electromagnetic **Note one mark only**	1
	(c)	**reason**	not all electrical energy converted to heat /heat or energy lost to surroundings/walls (not just lost) Allow not all energy produced is absorbed by the animal.	1
				(7 marks)
6.	(a)	**sign of charge**	Negative /-ve / or just – (minus sign)	1
	(b)	**Explanation**	1. Electrons are negative(ly charged)	1
		Not dop	2. like charges repel /negative repels negative	1
			3. electrons move/repelled from cap to leaf / downwards	1
			4. larger charge /more electrons (on leaf) so more deflection	1
	(c)	**material**	Polythene /polyethene/ polyethylene (accept ebon Allow ECF from (a) here only (Perspex, glass, cellulose acetate)	1
				(6 marks)
7.	(a)(i)	**resistance**	6.0 / 4 = 1.5 ohms UP accept O instead of Ω	1 1
	(ii)	**assumption**	zero/negligible/very small	1
	(b)(i)	**appearance**	goes out /very dim/glows dimly not none	1
	(ii)	**reading**	Zero very small/negligible not none	1

	(c)	**reason**	Switch/wire has low/zero resistance /is in parallel with bulb /current divided / (now a) parallel circuit	1
			(not lower resistance)	
			some /all / most current passes through switch /wire **ora**	1
			(7 marks)	
8.	(a)	**graph**	At least two complete waves (not half or full wave rectification)	1
			crossing time axis only at 0, 0.1, 0.2, 0.3, 0.4	1
			centred about time axis (correct amplitude by eye)	1
			independent marks	
	(b)	**effects**	**any TWO from**	
			more waves/wavelengths or oscillations /frequency increased	1
			twice as many waves /four waves/ time for one/each wave halved	1
			higher waves/ larger amplitude/larger voltage not larger, larger waves, larger or higher graph (for straight line allow steeper)	1
			amplitude/peak/trough value/voltage twice as great	1
			not current (for straight line allow twice as steep) **max 2**	
			An incorrect answer cancels a correct one. If marks 1 and 2 scored and then go on to say "amplitude smaller", this is contradictory so would score 2-1 = 1/2. If marks 1 and 2 scored and then go on to say e.g. "amplitude zero", this would score 2-2 = 0/2	
			(5 marks)	
9.	(a)(i)	**protons**	86	1
	(ii)	**neutrons**	134	1
	(b)(i)	**composition of lead nucleus**	Mark (b) as a whole	
			82 protons	1
			130 neutrons or 212 nucleons	1
			give both marks for $^{212}_{82}Pb$	

	(ii)	reason	alpha has 2 protons and 2 neutrons/ 2 protons and 4 nucleons/ is ${}^{4}_{2}He$ or ${}^{4}_{2}\alpha$	1
			(two alphas) proton number reduced by 4 or nucleon number reduced by 8	1
			all four marks can come from equation ${}^{220}_{86}Rn + {}^{4}_{2}He = {}^{216}_{84}X + {}^{4}_{2}He = {}^{212}_{82}Pb$	
				(6 marks)
10.	(a)	(i) **time**	15.2 seconds/ physics teacher **no UP**	1
		(ii) **reason**	light travels (much) faster than sound or sound 330 m/s light 300000 km/s (must compare)	1
	(b)		Physics teacher started at correct time/ history teacher started watch 0.3 seconds later/ sound took time /0.3 seconds to reach history teacher Independent marks	1
		speed	100 / 0.3 No ecf from a(i)	1
			333 (or 333.33)m/s **UP**	1
	(c)	**reason**	Wind /air moves/ wind or air speed changes	1
			travelling from finish to start line/ in direction of sound **owtte dop**	1
			Ignore change of temperature, weather or moisture	
				(7 marks)
11.	(a)	(i) **depth**	1.75 m **no UP**	1
		(ii) **explanation**	(image) same distance behind surface/mirror image distance = object distance	1
	(b)	(i) **real depth**	1.32 = real depth/1.75 or real depth = 1.32 x 1.75	1
			ECF from (a)(i)	1
			real depth = 2.3 m (2.31 m) **UP**	
		(ii) **change**	Velocity/ speed or wavelength	1
			less or smaller **dop**	1
			(frequency changes 0/2 ignore refraction)	
				(6 marks)

TOTAL FOR PAPER 70 MARKS

Paper 2

1	(a)	(i)	distance	9 × 3 (× 3600)	1
				= 97 200 m (97000 m) UP 9 × 3 = 27 or 9 × 3 ×60 = 1620 scores 1/2	1
		(ii)	reasons	Ground not always horizontal/obstacles/ hills	1
				Comment on nature of surface/ground or friction	1
				Less power available as fuel runs out	1
				Might not go in a straight line	1
				Air resistance/drag	1
				Don't credit references to weight carried **MAX 3**	
					5 marks
	(b)	(i)	**Kinetic energy before**	$\frac{1}{2} \times 16 \times 9^2$	1
				= 648 J UP for J once only	1
		(ii)	**Kinetic energy after**	$\frac{1}{2} \times 36 \times 4^2$	1
				= 288 J	1
		(iii)	**comment explain**	<u>Kinetic</u> energy converted /lost	1
				to heat **dop**	1
					6 marks
	(c)	(i)	graph	Axes correct orientation and suitable scale Minimum 2 cm = 20 kg 4 cm = 1 m/s	1
				Axes labelled with units (sensible abbreviations)	1
				Points plotted to within 1 mm	2
				Curve through points	1
		(ii)	value	Indication on graph by correct line across and/or down	1
				Value of *v* when mass = 50 kg 2.15 - 2.30 m/s UP no UP if value on y axis	1
		(iii)	upper limit	Break/ bend	1
				too heavy/ unlikely that anyone that heavy will use skateboard	1
				/	
				goes too slowly/ stops /has a problem to continue moving (not 'doesn't start')	1
					max 2
					9 marks

(Total 20 marks)

2.	(a)	(i)	**pressure**	122 × 1000 × 10 (9.81)	1
				= 1 220 000 (1196820) UP if final answer	1
				+ 100 000	1
				= 1 320 000 Pa **ecf** from 2nd mark UP	1
		(ii)	**direction**	At least three non-parallel arrows towards her body **dop**	1 1
					6 marks
	(b)	(i)	**spacing**	Liquids - close(ly) packed /close	1
				Gases - big/ far apart / <u>much</u> further apart than liquids	1
		(ii)	**Effect of pressure change**	Liquids - none/very little/negligible Gases - volume change Correct volume change 'inversely proportional' scores 1	1 1 1
					5 marks
	(c)	(i)	**diagram**	Showing possibility of measurement of p Showing possibility of measurement of V *or* h (Ignore thermometer)	1 1
		(ii)	**description**	1. Note pressure 2. Note volume 3. Change pressure (or volume) 4. Note new pressure (or volume) 5. Note new volume (or pressure) or volume (or pressure) change 6. Change slowly /wait to take reading 7. To maintain constant temperature **dop** **MAX 4** (table can score marks 1 to 5)	1 1 1 1 1 1 1
		(iii)	**graph**	Hyperbolic shape (no labels required) Or P v $1/V$ (labels required)	**1**
	(d)		**difference**	Not constant mass/amount (of air)	1
				Because swimmer is breathing out Or not constant temperature (ignore breathing in)	1
					9 marks
					(Total 20 marks)

3.	(a)	(i)	**power**	240 x 8.8	1
				<u>2112</u> W **UP** ora must see calculated value	1
		(ii)	**energy transferred**	2112 x 4.8 (ecf) allow 2000 x 4.8	1
				x 60	1
				= 608 000 J (608 256) **UP**	1
				(576 000 J if 2000 used)	
		(iii)	**kilowatt hours**	2112 /1000 or 2.112 (convert to kW)	1
				x 4.8/60 or (convert to hours)	1
				= <u>0.169</u> kWh (0.16 if using 2000 W)**NO UP** must see calculated value	1
				ora 0.17 x 1000 (1) x 3600 (1) = 612 000 J (1)	
					8 marks
	(b)	(i)	**heat energy transferred**	100 - 20 = 80	1
				1.7 x 4200 x their temp rise	1
				= 571 200 J **up** only once	1
		(ii)	**difference**	Energy/ heat /thermal energy lost to surroundings/ air/to kettle (not internal energy) (must give a suitable heat sink)	1
		(iii)	**efficiency**	571 200 / 608 000 (ECF/ECF)	1
				= 0.94 or 94% (ECF unless >100%) **UP**	1
				(0.99 or 99% if 2000 used)	
				(Not 0.93 or 93%)	**6 marks**

(c)

	Route 1		Route 2	
(i) **resistance of thicker wire**	smaller	1	Larger	0
	half as much	1	Twice as much	0
(ii) **new current**	Larger	1	Smaller	1
	twice as much or 17.6A	1	Half as much or 4.4A	1
(iii) **power**	greater / more	1	Smaller less	1
	twice as much or 4000W	1	Half as much	1

If (i) is 'the same' or left blank follow Route 1

6 marks

(Total 20 marks)

4.	(a)	(i)	**I-123 unsuitable**	(gamma has) low ionising power **ignore** short half life or penetrating power	1
				destroys few/no/ not enough cells	1
		(ii)	**I-136 unsuitable**	<u>half life</u> is short or <u>only</u> 1.4 min	1
				decay very quickly/ before reaching thyroid /won't have time to destroy cells /time very short	1
		(iii)	**adults 2 m away**	reduce radiation reaching adults beta radiation ignore gamma stopped by value of 1 to 2 m (in air)	1 1 1
			adults for 2 weeks	less radiation emitted /close to zero / finished two weeks is about 2 half lives	1 1
		(iv)	**children 24 days**	3 (half lives) (must be seen) 1/8 (left) 7/8 decayed (gains marks 2 and 3 on its own)	1 1 1
					12 marks
	(b)	(i)	**decay equation**	$^{131}_{53}I = ^{131}_{54}Xe + ^{0}_{-1}\beta$ ignore neutrinos and energy	
				131 and 54 for Xe (not I) 0 and -1 for beta (or e) correct order of terms ie minus beta on left or + beta on right	1 1 1
		(ii)	**change to nucleus**	neutron splits or decays or changes or lost	1
				into proton (+ electron) or extra proton (ignore use of atomic and mass number) *independent mark*	1
		(iii)	**count after 1 year**	many half lives or 45 half lives	1
				all/ most iodine decayed or negligible amount left calculation of amount left can score both marks	1
			cause	background (radiation)/ suitable named source of background radiation	1
					8 marks

(Total 20 marks)

5.	(a)	(i)	**wave type**	Transverse	1
		(ii)	**reason**	Tray moves/ vibration/ displacement/ oscillations <u>perpendicular</u> to direction of wave (travel/propagation) **dop**	1 1
		(iii)	**graph**	At least two complete waves drawn contiguously λ/ wavelength marked correctly (not *w*) Allow two plane or circular wavefronts (or crests)viewed from above and <u>labelled</u> for first mark	1 1
					5 marks
	(b)	(i)	**apparatus**	1. Ruler /tape/ metre stick 2. (Stop)clock / (stop)watch / timer 3. water 4. Tray(s) of different depth(s) /glass sheet(s) or slab(s) of different thickness to change depth	1 1 1 1
					Max 3E
		(ii)	**description**	1. measure length of tray 2. measure depth of water (not tray) 3. lift one end/ produce **one** wave 4. lower (after lifting) 5. start stopclock /timing 6. stop clock when wave returns /reaches end /measure time (of travel) 7. repeat reading for this depth/average value 8. repeat for a different depth of water 9. At least three depths / several 10. $v = d/t$	1 1 1 1 1 1 1 1 1 1
				Independent marks but statement of a series of readings at different depths can score 8 AND 9	
					max 7 D
		(iii)	**sketch graph**	Axes labelled depth and speed line or curve showing speed increasing with increasing depth	1 1
					2G
		(iv)	**effect of amplitude**	1. keep depth constant 2. change height end raised or equivalent i.e lift it faster 3. for several different heights	1 1 1
					3A
					(Total 20 marks)

TOTAL FOR PAPER 100 MARKS

PHYSICS 7540, CHIEF EXAMINER'S REPORT

PAPER 1

General Comments

The difficulty of the paper was comparable with previous examination series. Most candidates were able to attempt all parts of all the questions in the time allowed and many presented their ideas very well. High quality answers were often seen, indicating that well prepared candidates continue to score well. Questions involving calculations were usually answered well although units were still being missed off or written incorrectly.

Question 1
Most candidates added a single arrow labelled F as instructed. A few lost marks by either not drawing the arrow horizontally or by drawing more than one arrow. Similarly most candidates stated that the force would increase and that the direction would remain unchanged. Many failed to name another specific force acting on the athlete and very few appreciated the implication of the term 'condition'. These candidates talked in terms of forces being equal rather than the requirement of zero acceleration. A few suggested that the athlete should run in a vacuum, ignoring the implications on the health of the athlete.

Question 2
A pleasing number of candidates gave the correct response of velocity but some still gave acceleration or speed or undid their efforts by giving velocity and speed. Many were able to determine the distance moved correctly and then went on to calculate the correct velocity. Weaker candidates often gave 3 m instead, and credit was given for a velocity of 0.75 m/s. Those who lost the mark for distance were also given credit if they started from scratch and showed all working that would lead to the correct answer of 0.5 m/s. Candidates should remember that answers should be evaluated fully and expressed as a decimal rather than a fraction.
The graph was disappointing as, although most drew a correct horizontal line for the first 2 seconds, they frequently drew a line that stopped 1 m from the wall or even going back in time, and this lost both the marks available. Most candidates used a ruler to draw the lines.

Question 3
A majority of candidates were able to calculate the moment in part (a) and the force in part (b)(ii) correctly and usually gave the correct unit for each one. Very few identified the force from the left hand as being frictional, which was disappointing. The answers to (c) were variable with few stating that 45 N was a large force or that elderly people would be unable to exert enough force. A few misunderstood the significance and suggested that such people would exert too much force and break the jar, and many answers referred to the 12 N force.

Question 4
There are still too many candidates who think that pressure is due to collisions between molecules rather than collisions by molecules with the walls of the container. A majority realised that the pressure would fall but some failed to apply a molecular explanation. Those who did usually stated that the molecules would move more slowly but then lost the next mark by just saying that there would be fewer collisions, rather than less frequent collisions. A surprising number lost the final mark by either quoting an incorrect temperature, e.g. -273 K or 0^0C, or by giving more than one contradictory value. Some also just stated Absolute temperature rather than Absolute **zero**.

Question 5
The calculations in this question also scored well but some candidates are still using the incorrect temperature change, insisting on adding 273, showing a lack of understanding of the relationship between Celsius and Kelvin. The unit for (a)(ii) was frequently incorrect, the most common one being 630 W rather than the correct 630 J/min. Many gave the correct energy transfer but the vague "energy lost" did not score, and candidates were expected to state that some energy was transferred to the walls of the oven or to the surroundings.

Question 6
Most candidates stated correctly that the charge was negative. Some good attempts were then made at part (b) but marks were often lost through lack of detail, especially for not explaining in terms of electrons rather than just charges. There were five lines given for four marks and candidates should consider writing their answers as a logical list with four points made. An example would be:

> Electrons are negative.
> Like charges repel or the negative rod repels the negative electrons.
> Electrons would move from the cap to the leaf.
> The greater number of electrons on the leaf would produce a greater deflection.

Some good answers were seen where a mark was lost for not stating that electrons are negatively charged.
Candidates who had identified the correct charge on the rod could usually name polythene as the appropriate material, as required in the syllabus. It is surprising to see some still using ebonite, which was accepted.

Question 7
This question was very poorly answered. Most candidates were able to calculate the resistance of the bulb but occasionally omitted the unit. Many recalled that ammeters should have no or negligible resistance. However, parts (b) and (c) showed a general inability to interpret an unfamiliar circuit diagram. Although many guessed that the current through the bulb would reduce they did not appreciate that the switch circuit would have a very low resistance. As a result, little or no current would pass through the bulb which would go out, and the reading on the type of ammeter used in schools would be zero. The explanations seen were often poor, with some even stating that current would only flow through the bulb when the switch was closed.

Question 8
This question was often well answered although some candidates drew non-sinusoidal variations. These were accepted as long as they had the correct time period and were symmetrical about the time axis. Candidates could either describe the change in frequency or in amplitude. Many gave both but sometimes undid themselves by giving a correct response for one and an incorrect response for the other. Some failed to appreciate that where a question includes a numeric change, i.e. the speed was doubled, then the expected answer should also be numeric, i.e. the frequency and/or amplitude or voltage would also double in this case.

Question 9
Many candidates scored well on this question, correctly giving the proton and neutron numbers for radon-220. However a lot of candidates did not read the question carefully and assumed only one alpha decay. Those who did usually scored both marks for (b)(i) although some quoted 212 as the neutron number rather than the acceptable nucleon

number. In (b)(ii) many failed to state that alpha particles contain two protons and two neutrons. Good candidates wrote a complete nuclear equation for the two decays in part (i) and, provided they did not then contradict themselves, could gain all four marks for part (b) from this.

Question 10

Many candidates realised that the physics teacher's result was the correct one but failed to give an acceptable explanation. Some candidates gave 15.05 seconds, the average of the two times, as their answer in (a)(i). Some stated that sound travels faster than light or faster than smoke. The speed was often calculated correctly, but some who had quoted the speed of sound in (a)(ii) as 340 m/s then divided 100 by 15.2 to get 6.71 m/s, and happily quoted this contradictory answer as the speed of sound. Although some realised that the difference in values was due to wind travelling from the finish line to the starting line, many suggested a change of temperature or humidity without realising that these would not depend on direction.

Question 11

Candidates rarely quoted a value for the apparent depth despite being given 1.75 m in the question. Few realised that the answer to (a)(ii) required an explanation in terms of reflection rather than refraction. Part (b) was answered more successfully. Candidates who had not answered part (a) were usually still able to calculate the real depth correctly and could then usually state that the speed of the waves fell as they passed from air to water. It was disappointing that they often also stated that the light would bend, even though they were told that the light passed vertically from air to water.

PAPER 2

Question 1

This question on a motorised skateboard was accessible to all candidates with the graph exercise being particularly well done.

(a) In (i) the calculation of distance travelled by the skateboard in three hours when moving at a constant speed of 9 m/s showed that most candidates could manipulate the formula for constant speed, and it was pleasing to see most candidates converting from hours to seconds.
In (ii), reasons why the calculated distance might not be reached brought the expected responses of ground friction, air resistance and the ground not being horizontal or the occurrence of obstacles. Many candidates scored two out of three marks for the first two responses.

(b) The calculation of kinetic energy in (i) presented few difficulties. The calculation in (ii) was also well done, although this time some candidates did not include the mass of the skateboard and the dropped mass in their calculation. An occasional error seen here and in previous exams was the correct statement of and substitution into the formula for kinetic energy but neglecting to square the speed in the calculation.
In (iii) hardly any candidates scored the two marks for explaining that the difference between the two previous values was the conversion of kinetic energy into heat. Asked to explain the difference between the kinetic energy before and after dropping a mass on to the skateboard, practically all candidates stated that the speed had gone down because the mass had gone

up.

(c) The plotting and drawing of the graph in (i) was of a high standard.
The use of an inadequate scale on the *y*-axis of 2 cm = 1 m/s instead of 4 cm = 1 m/s was often seen from all candidates in the same centre. Credit was given for a curve through the points. There were fewer examples of candidates joining the points with a straight line, but centres should discourage candidates from using a ruler to join any of the neighbouring points when a curve has been asked for.
In (ii) a significant minority of candidates read off the value of speed for a mass of 70 kg, instead of 50 kg as indicated in the question. Some candidates are still dropping marks for not indicating on the graph a horizontal and/or vertical line showing how this value was determined.
In (iii) candidates gave sensible reasons why there was a limit to the mass that could be dropped on the skateboard. Responses such as :
- the skateboard would break, or
- the skateboard would stop moving

were often seen.

Question 2

This question on liquid pressure showed some misunderstanding of the structure and behaviour of gases and liquids.

(a) In (i) the calculation of the liquid pressure at a depth of 122 m in water was done well, with very few candidates forgetting to use the value for *g* given on the front of the paper. The addition of the given value of atmospheric pressure was also well understood. Although the unit for pressure was given in the question it is still expected to accompany the final answer.
In (ii) candidates were asked to draw a human head and show the direction and nature of the pressure acting on the head at a depth of 122 m in water. This was poorly done with very few candidates appreciating that the pressure acts equally in all directions. A minimum of three non-parallel arrows pointing towards the head was expected. Instead, parallel arrows were seen, usually pointing vertically downwards.
Often arrows labelling the head and showing the depth were in among the required arrows.

(b) In (i) candidates were asked to describe the difference in molecular spacing between gases and liquids. In (ii) they were asked to explain the effect of a change of pressure on each.
An uncertain answer to (i) often resulted in an incorrect answer in (ii). The molecules in air are far apart and those in liquids are close together, but more often comparative statements such as 'closer in liquids than in gases' were seen. Unfortunately this led a few candidates to comment on solids as well. For a gas, stating that pressure and volume are **inversely proportional** only scored one mark for indicating that volume could be changed. Some candidates who correctly stated that an increase in pressure gives rise to a decrease in volume followed by stating that pressure and volume are **directly proportional** to each other. Centres should discourage candidates from using these terms unless they know what they mean.

(c) Candidates were asked to describe an experiment to investigate the variation of volume with pressure for a fixed mass of gas at constant temperature.
Diagrams of traditional Boyle's law apparatus were seen but a significant

number of candidates were unaware of such apparatus. Descriptions of the experiment were often simple and correct with better candidates allowing a time between readings for temperature to drop back to its original value. However, many candidates did not score the four marks for a description because they did not actually state what measurements they would take. Such candidates would do well to make a numbered list of instructions in logical order. Such an approach could be used in answering similar questions in future examinations. Graphs of p against V were accurately drawn and labelled.

(d) This section tried to tease out the usual conditions for Boyle's law to apply. Constant mass and temperature had both been mentioned in the question. Unfortunately most candidates were not helped by this.

Question 3

This question was the best-answered question on the paper with many candidates scoring at least 17 marks out of 20.

(a) Candidates were asked in (i) to show that the power dissipated by a kettle is about 2000 W given values of potential difference and current.
The product of 240 V and 8.8 A is 2112 W, and this value **must** be seen to get full credit as it is the only proof that a second mark has been earned for a correct calculation. The conversion of 4.8 minutes to seconds in (ii) was successfully done.
In (iii), showing that the value of energy in joules in (ii) is 0.17 kilowatt- hours also requires proof of a calculation.
Candidates are entitled to carry forward from (i) the calculated value of 2112 W or the given value of 2000 W. The following calculation shows how many candidates dropped another mark:

2000 x 4.8 / 1000 x 60 = <u>0.17</u> is not correct - it is equal to 0.16

(b) In (i) the calculation of heat energy transferred to the kettle was well done although some candidates, given a temperature change of 100°C - 20°C, added 273 to 80°C to get 353.
In (ii) most candidates realised that the difference between the heat supplied to the kettle and that transferred to the water was the heat lost to the surroundings.
The calculation of efficiency in (iii) was successfully performed by those candidates who carried forward realistic values from previous parts of the question.

(c) Candidates were asked what effect the doubling of the cross-sectional area of the wire of the kettle's heating element would have on resistance, current and power dissipation associated with the wire.
Many candidates scored three out of six for **decrease, increase** and **increase** respectively. If they had added that this effect was **halved, doubled** and **doubled** respectively another three marks would have been scored. Candidates should be aware that such questions are likely to have a mathematical aspect to them when the relationship between, for example, resistance and cross-section area is expected to be known.

Question 4
This question was poorly answered with candidates often scoring on average half the marks scored on other questions.
There was a general lack of understanding of why a radioactive source is used in treatment and what properties of the source are needed for successful treatment. The significance of such properties as half life, ionising power, penetrating power and range was not known and frequently confused.

(a) Given the properties of iodine-131 as a gamma emitter with half-life of 13 hours, candidates were asked why it was not suitable for destroying cells in the thyroid gland. Instead of stating that its poor ionising power would destroy few cells, most thought that the high penetrating power would destroy too many cells, going on to make an incorrect conclusion regarding the half life.
Asked why iodine-136 with a half-life of 1.4 minutes was also inadequate for the same task, many referred to the half-life without stating that it was too low. Just stating that it was lower than the other half-lives (13 hours and 8 days) given in the table was insufficient.
In (iii) candidates were asked why visitors to a patient receiving a large dose of iodine-131 (beta and gamma with half-life of 8 days) should stay at a distance of at least 2 metres for at least 14 days. Answers failed to separate the significance of 2 m and 14 days, one being the range of beta particles and the other allowing nearly two half lives to elapse. Candidates rarely scored more than 2 out of 5 for part (iii).
In (iv) a calculation of fraction of dose remaining after 24 days (three half-lives) was disappointingly answered. Candidates must state initially that **three** half-lives have elapsed. In some cases that would have secured at least one out of three marks for some weaker candidates. Surprisingly many candidates were unable to proceed successfully, ending up with an answer of ⅓.

(b) Completing an equation to show beta decay of I-131 to Xe was well done although many used the symbol I instead of Xe on the right hand side of the equation. The symbol and numbers associated with the beta particle were well known.
In (ii) the change occurring in the nucleus is a neutron changing to a proton and an electron. Answers using the terms 'atomic number' and 'mass number' did not address the question.
In (iii) candidates were asked why a patient treated with I-131 (half-life 8 days) would record a low count rate a year later and comment on the source of this count rate. Many answered that the I-131 would have decayed almost completely and that background count was being recorded. Only the strongest candidates also said that about 45 half-lives had elapsed.

Question 5
This question required some knowledge of transverse waves and a description of an investigation of the effect of depth of water on the speed of water waves. It was anticipated that candidates would find this exercise more straightforward than some recent examples but the responses were disappointing.

(a) Candidates were asked to recognise water waves as transverse from a description of their creation by lifting a tray of water. They were asked for reasons for their choice and then asked to draw two complete waves of this type, clearly marking the distance of one wavelength.
The second point was answered with something like:

'The vibration or displacement of the water molecules is perpendicular to the direction of the wave motion.'

Some careless answers such as 'the wave travels at right angles to the wave' suggested that with a little more attention two marks could have been scored instead of zero.
Graphs were usually well drawn but, again, the wavelength was often carelessly drawn with arrowheads stopping short of what could be awarded a mark.

(b) In recent years descriptions of these investigations have been scoring increasingly heavily but many candidates came adrift this time by describing the wrong experiment.
The context was clearly laid out with a tray of water lifted at one end but most candidates introduced ripple tanks, trays with variable depth along their length, stroboscopes, vibrators and even oscilloscopes. Hence the list of apparatus often missed off simple items such as measuring rules and stopwatches.
The method then concentrated on the determination of wavelength and frequency rather than on distance and time. A few candidates went on to describe experiments involving refraction and diffraction. Some marks could be picked up for changing the depth of water, measuring the depth and taking repeat readings but a lot of candidates wasted a lot of time in answering this part.

The graph of speed against depth generally showed that candidates understood the phenomenon that they were supposed to be investigating.
However, part (ii) was well answered by those candidates who were guided by the question. Many placed a glass sheet in the tray to change the depth of water rather than pouring in more water, without realising that the former would have no effect on the depth.
In part (iii) candidates were asked to describe how they would check whether amplitude affects speed of water waves. The word 'amplitude' occasionally saw the introduction of oscilloscopes and sources of sound. Disappointingly few mentioned that depth should remain constant throughout this check.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	68	58	48	43	24

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

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: 190 High Holborn, London WC1V 7BH,UK

edexcel
INTERNATIONAL