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## **Mark Scheme (Results)**

January 2017

Pearson Edexcel International GCSE in  
Physics (4PH0) Paper 1P  
Science Double Award (4SC0) Paper 1P

Pearson Edexcel Certificate in  
Physics (KPH0) Paper 1P  
Science (Double Award) (KSC0) Paper 1P

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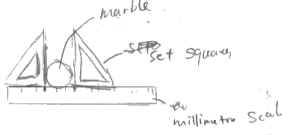
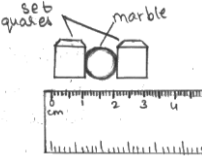
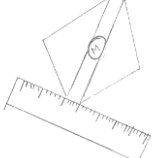

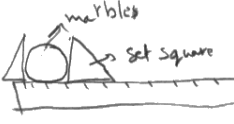
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## **General Marking Guidance**

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Notes	Marks															
1 (a)	1 mark for each correct tick;;; <table border="1" data-bbox="352 360 1265 741"> <thead> <tr> <th data-bbox="352 360 657 432">Radiation</th> <th data-bbox="657 360 962 432">Ionising</th> <th data-bbox="962 360 1265 432">Non-ionising</th> </tr> </thead> <tbody> <tr> <td data-bbox="352 432 657 510">alpha</td> <td data-bbox="657 432 962 510">✓ given</td> <td data-bbox="962 432 1265 510"></td> </tr> <tr> <td data-bbox="352 510 657 589">beta</td> <td data-bbox="657 510 962 589">✓</td> <td data-bbox="962 510 1265 589"></td> </tr> <tr> <td data-bbox="352 589 657 667">gamma</td> <td data-bbox="657 589 962 667">✓</td> <td data-bbox="962 589 1265 667"></td> </tr> <tr> <td data-bbox="352 667 657 741">ultrasound</td> <td data-bbox="657 667 962 741"></td> <td data-bbox="962 667 1265 741">✓</td> </tr> </tbody> </table>	Radiation	Ionising	Non-ionising	alpha	✓ given		beta	✓		gamma	✓		ultrasound		✓		3
Radiation	Ionising	Non-ionising																
alpha	✓ given																	
beta	✓																	
gamma	✓																	
ultrasound		✓																
(b)	any two sensible ideas e.g. <ul style="list-style-type: none"> <li>• keep time exposure short;</li> <li>• store source in lead container;</li> <li>• keep distance exposure as long as possible;</li> <li>• wear protective clothing (1 MAX);</li> </ul>	ignore idea of ingestion  condone short half-life for short time exposure  allow tongs or barrier for distance  e.g. goggles, lab coat, gloves, mask, etc	2															

Question number	Answer	Notes	Marks
2 (a)	<p>MP1. set squares used correctly to mark diameter of marble;</p> <p>MP2. Set squares measured against ruler;</p> <p>MP3. EITHER repeat and find average (mean); OR measure 2 or more marbles (in a line);</p>	<p>allow labelled diagram</p>  <p>=mp1 + 2</p>  <p>=mp1 + 2</p>  <p>=mp2</p>  <p>=0</p>  <p>= mp1 + 2</p>	3
(b)	<p>Any 5 from</p> <p>MP1. mass measured;</p> <p>MP2. suitable device for measuring mass;</p> <p>MP3. suitable container named e.g. measuring cylinder, displacement can;</p> <p>MP4. displacement method described (can be shown on diagram);</p> <p>MP5. volume determined e.g. =volume after-volume before or volume displaced;</p>	<p>Allow</p> <p>labelled/annotated diagram</p> <p>uses diameter to calculate the volume</p> <p>states <math>V = \frac{4}{3} \pi r^3</math></p>	5

	MP6. repeats and averages OR more than 2 marbles used;		
	MP7. uses density= mass/volume;	allow recognisable symbols	

**Total 8 marks**

Question number	Answer	Notes	Marks
3 (a)	i	3.1 ONLY circled in the table;	1
	ii	(average) speed = distance (moved)/time (taken);	1 accept words or standard symbols
	iii	discards anomalous result; calculates mean time for B; substitution; evaluation; e.g. average time = 4.7 average time = 5.5 speed = $20/5.5$ =3.7	4  gets 1 marks gets 2 marks gets 3 marks gets 4 marks  allow 4.67 Allow 5.45 allow $20/5.45$ Allow 3.67  answers which round to 4.3 get 3 marks
	iv	explanation including the following ideas EITHER bar chart; because woodpeckers are discrete / eq; OR mass is a continuous variable; therefore scatter-gram / eq;	2  condone histogram DOP  DOP allow line graph
	b	discussion to include any 3 ideas from:  MP1. there is no (discernible) pattern;  MP2. supporting data quoted;  MP3. discussion of why prediction is wrong/ C should be fastest;  MP4. three data sets is insufficient to decide;  MP5. need for further data to extend range of results;	3  no mark for unqualified 'yes' or 'no' results don't go in order/eq allow calculated speeds (cm/s) A= 1.8 B= 3.7 (4.3) C = 2.3 A heaviest,slowest; B middle, fastest; C lightest, middle  ignore discussion of anomalies

**Total 11 marks**

Question number		Answer	Notes	Marks
4	(a)	(however expressed) driving force > resistive force;	there is a resultant force forces are not balanced	1
	(b)	i	a = <b>change in velocity</b> ; time	1
	b	ii	substitution; evaluation;	2
			e.g. a = $\frac{24-15}{6}$ a = $9/6 = 1.5 \text{ (m/s}^2\text{)}$	
	(c)	any two from: MP1. braking force increases;  MP2. the driving / forward force becomes zero/decreases; MP3. air resistance decreases (as speed decreases); MP4. resultant force is now in opposite direction;	the overall resistive force /backwards force increases  allow resultant force increases for 1 mark	2

**Total 6 marks**



Question number	Answer	Notes	Marks
5 (a)	any four in any order voltmeter; ammeter; power supply; <b>variable</b> resistor/connecting wires/switch;	accept battery  accept variable power supply for 2 marks	4
(b) i	any 1 of the following: MP1. resistance changes with temperature; MP2. temperature affects current; MP3. the wire will get hot because of the current;		1
(b) ii	any suitable method; further detail; e.g. use a switch only on for short time allow wire to cool between readings use only low current	allow water bath	2
(c)	<p>4 correct lines score 3 marks;;; 2 or 3 correct lines score 2 marks;; 1 correct line scores 1 mark;</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>component</p> <div style="border: 1px solid black; padding: 2px; width: 100px; margin: 5px auto;">short thick copper wire</div> <div style="border: 1px solid black; padding: 2px; width: 100px; margin: 5px auto;">filament lamp</div> <div style="border: 1px solid black; padding: 2px; width: 100px; margin: 5px auto;">long thin copper wire</div> <div style="border: 1px solid black; padding: 2px; width: 100px; margin: 5px auto;">diode</div> </div> <div style="text-align: center;"> <p>graph</p> </div> </div> <p>-1 if multiple lines drawn to or from the same box</p>		3

**Total 10 marks**

Question number	Answer	Notes	Marks
6 (a)	a microphone; a loudspeaker;		2
b i	$v = f \times \lambda$ ;	in words or accepted symbols any rearranged form	1
ii	changing kHz into Hz; substitution; evaluation; e.g. $12\ 000 = 12\ 000\ 000$ $v = 25 \times 12\ 000\ 000$ $300\ 000\ 000\ (m/s)$	seen anywhere  $3.0 \times 10^8\ (m/s)$ POT error loses the conversion mark	3

**Total 6 marks**

Question number	Answer	Notes	Marks	
7 (a)	any three of the following:  MP1. current increases during first <b>0.04s</b> / to maximum of <b>0.4A</b> ; MP2. current increase is <b>linear</b> /proportionate to time; MP3. (then) current drops for next <b>0.44s</b> / by <b>0.48s</b> ; MP4. current decrease is <b>nonlinear</b> ;  MP5. (final)current constant value is <b>0.2 A</b> / from <b>0.48s</b> onwards;	allow 'at first' for first 0.04s  allow 0.5s  allow 0.5s	3	
b	i	0.2 A;	1	
	ii	V= I R;	1	
	iii	substitution; rearrangement; evaluation; unit; e.g. $12 = 0.2 \times R$ $R = 12 / 0.2$ $= 60$ $\Omega$	<b>accept ecf from bi</b>  independent mark	4
	iv	P= IV;	accept words or standard symbols	1
	v	substitution; evaluation; e.g. $P = 0.2 \times 12$ 2.4 (W)	<b>accept ecf from bi</b>	2
c		filament heats up very rapidly (at the start); causing it to melt/ break;	allow wire for filament	2

**Total 14 marks**

Question number	Answer	Notes	Marks
8 (a) i	B a 1 kg mass would weigh more on Earth than on Uranus;		1
	ii C 4 N/kg;		1
b i	conversion into s; substitution into correct equation (no mark for equation); rearrangement; evaluation; e.g. $1350 = \frac{2 \times \pi \times r}{1820 \times 60}$ $r = \frac{1350 \times 1820 \times 60}{2 \times \pi}$ $= 23\,500\,000 \text{ (m)}$	factor of 60 seen $\text{orbital speed} = \frac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$  23 462 621(m) POT error loses one mark 391 000 gains 3 marks	4
ii	A		1

**Total 8 marks**

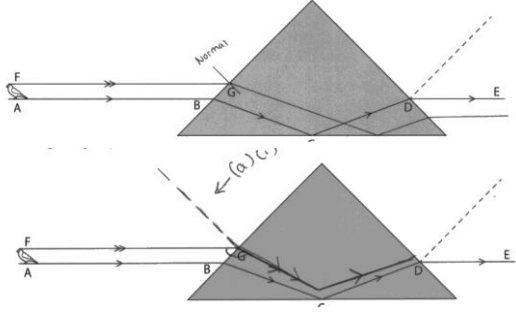
Question number	Answer	Notes	Marks
9 (a)	gravitational potential (energy);	GPE	1
b	any three of: MP1. turbine spins; MP2. (causes) coils of wire spin;  MP3. between the poles of (large) magnets; MP4. current or voltage is <b>induced</b> ; MP5. in or across the coils of wire;	allow turbines rotates magnets spin  inside coils of wire	3
c	any one of: MP1. to keep voltage or current (value) constant; MP2. voltage (or current) produced depends on the speed of rotation (of coil);	allow frequency of voltage depends on the speed of rotation	1
d i	efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$		1
ii	substitution; rearrangement; evaluation of useful energy; subtraction from input energy; e.g. $\frac{36}{100} = \frac{\text{output energy}}{1050}$ gains 1 OP energy = $\frac{36 \times 1050}{100}$ gains 2 = 378 (kJ) gains 3 wasted energy = 1050 - 378 = 672 (kJ) gains 4	allow alternative method by calc 64% of 1050 kJ  POT error (often as 36 not seen as % or fraction) loses 1st mark	4
iii	any two suitable energy forms: e.g. thermal energy (of the water); frictional heating (along the pipe/in bearings); noise/sound;	condone 'heat' not just 'friction'	2

**Total 12 marks**

Question number	Answer	Notes	Marks
10 (a) i	substitution; rearrangement; evaluation; e.g. $80 \times 1.01 \times 10^5 = 10 \times p_2$ $p_2 = \frac{80 \times 1.01 \times 10^5}{10}$ $= 8.08 \times 10^5 \text{ (Pa)}$	equation is given  accept 8 or $8.1 \times 10^5$ (Pa) 808 000 (Pa) POT error loses 1 mark allow 2 marks max for using $V_2$ as 70 (115 400)	3
	ii	the temperature is constant;	1
	iii	any two from:  MP1. friction /rubbing;  MP2. between rubber disc and walls OR air molecules and valve;  MP3. work is done on the gas;	2
	b i	work done = force X distance moved;	1
	ii	conversion of mass to N; substitution; evaluation;  e.g. 1.25 kg is 12.5N $F = 12.5 \times 8.70$ $= 109 \text{ (J)}$	3
		allow GPE calculation  accept 108.75 (J) 110 (J)  10.875 or 11 J gets 1 mark maximum	

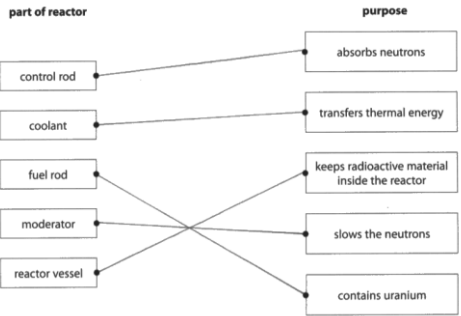
		other POT error only loses conversion mark	
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**Total 10 marks**

Question number	Answer	Notes	Marks
11 (a) i	normal drawn at G ;	by eye	1
ii	value for G ; (45) value for D; (45)	tolerance $\pm 2^\circ$	2
b	ray has been reflected; totally internally; because angle of incidence > critical angle;	allow 42 or 43°	3
c	correct refraction at G downwards; TIR on bottom surface; emergent ray parallel to and below DE;		3

**Total 10 marks**



Question number	Answer	Notes	Marks
12 (a)	<p>5 correct lines score 4 marks; ; ; ; ;            4 or 3 correct lines score 3 marks; ; ; ;            2 correct lines score 2 marks; ;            1 correct line scores 1 mark;</p> 		4
<p>b</p> <p>c</p> <p>d</p>	<p>C neutrons;</p> <p>any four from:</p> <p>MP1. neutron absorbed by;</p> <p>MP2. uranium(-235) <b>nucleus</b>;</p> <p>MP3. causing it to split;</p> <p>MP4. into 2 daughter <b>products / nuclei / isotopes</b>;</p> <p>MP5. releasing further neutrons /energy;</p> <p>any three comparisons from (however expressed):</p> <p>MP1. decay is random but fission is not;</p> <p>MP2. fission induced by input particle but decay occurs without an input particle;</p> <p>MP3. fission produces 2 daughter nuclei but decay produces only 1;</p> <p>MP4. <math>\alpha</math> or <math>\beta</math> are emitted from decay but not from fission;</p>	<p>only accept precise terminology allow hits/collides/eq</p> <p>allow named products</p>	<p>1</p> <p>4</p> <p>3</p>

MP5. decay rate can't be altered but rate of fission can;		
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MP6. Number of fissionable isotopes much less than radioactive isotopes;		
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**Total 12 marks**

Question number	Answer	Notes	Marks
13 (a)	any two from: same starting temperature; same volume of water; same time interval;		2
b i	B; because dark surfaces are good emitters;		2
ii	C; it has the greatest surface area (exposed to the air);	allow widest opening/eq	2
c	MP1. It loses the least amount of (thermal) energy; MP2. cotton wool reduces conduction;  MP3. the white/light surface (of the cotton wool) is a poor emitter (of radiation);  MP4. the lid reduces convection;	MP2, 3, 4 must include a method of thermal energy transfer  allow lid reduces evaporation for MP4  allow cotton wool is an insulator for MP2	4

**Total 10 marks**

