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Mark Scheme (Results)

Summer 2023

Pearson Edexcel International GCSE
In Physics (4PH1) Paper 1PR

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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.

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<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td>3 correct ticks;;;
2 correct ticks;;
1 correct tick;
<table><tr><th>Statement</th><th>Correct</th></tr><tr><td>all electromagnetic waves are longitudinal</td><td></td></tr><tr><td>all electromagnetic waves travel at the same speed in free space</td><td>✓</td></tr><tr><td>radio waves have the longest wavelength in the electromagnetic spectrum</td><td>✓</td></tr><tr><td>x-rays have the highest frequency in the electromagnetic spectrum</td><td></td></tr><tr><td>all electromagnetic waves transfer energy</td><td>✓</td></tr><tr><td>all electromagnetic waves can cause cancer</td><td></td></tr></table></td><td>-1 for each additional tick if more than three ticks shown</td><td>3</td></tr>
<tr><td>(b) (i)</td><td>microwaves:
one valid use;
• communication /eq
• heating food /eq
one valid harmful effect;
• internal heating (of body tissue) / eq</td><td>allow other valid uses e.g. radar, locating rain clouds etc.
reject "cancer"
apply "list principle"</td><td>2</td></tr>
<tr><td>(ii)</td><td>gamma rays:
one valid use;
• sterilising {food / medical equipment}
• kill microbes or bacteria;
• treating cancer / radiotherapy;
• medical tracing
one valid harmful effect;
• ionisation / mutation of cells /eq
• risk of cancer</td><td>allow other valid uses e.g. gamma photography, identifying cancer etc.
condone damages or kills cells or tissues</td><td>2</td></tr>
</table>

Total for Question 1 = 7 marks

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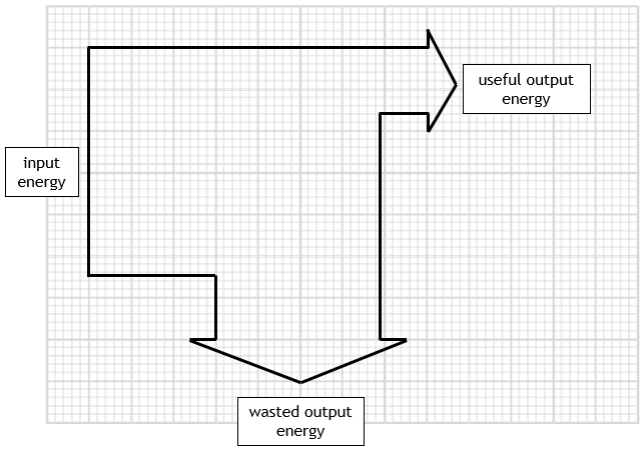
Question number	Answer	Notes	Marks
2 (a)	C (the Moon); A is incorrect because comets orbit stars B is incorrect because Mars orbits the Sun D is incorrect because the Sun orbits in the Milky Way galaxy		1
(b)	D (gravitational); A is incorrect because there is no air in space; B is incorrect because the ISS is not charged; C is incorrect because friction would act in the opposite direction to motion, not towards Earth		1
(c) (i)	substitution into given formula ($v= 2\pi r/T$); conversion of minutes to seconds; evaluation; e.g. orbital speed = $2 \times \pi \times 6.8\times10^3$ / 93(×60) 93 minutes = 93 × 60 (= 5580 seconds) (orbital speed =) 7.7 (km/s)	mark independently -1 for POT errors if km/s changed to m/s unnecessarily allow 7.656… 459.4, 15.31, 27565, 7.6 scores 2 marks	3
(ii)	successful conversion of orbital period and a day into the same unit; evaluation of ratio to 15.48… to at least 3 sf; e.g. 1 day = 24 × 60 = 1440 minutes 1440/93 =15.5	e.g. 1 day = 24 hours = 1440 mins = 86400 seconds, 1 orbit = 0.0645 days=1.55 hours=5580 seconds, allow use of number of orbits = distance travelled in 24 hours ÷ circumference of orbit	2

Total for question 2 = 7 marks

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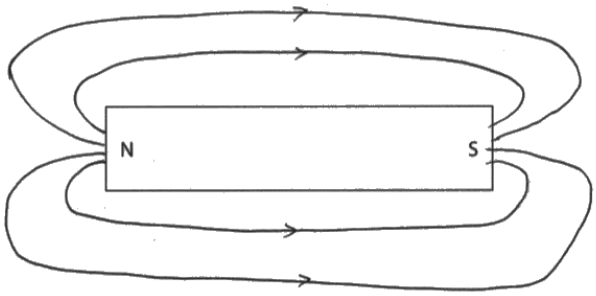
Question number	Answer	Notes	Marks
3 (a) (i)	GPE = mass × *g* × height;	allow standard symbols and rearrangements e.g. h = GPE / m×*g* ignore 'gravity' for *g*	1
(ii)	substitution; rearrangement; evaluation; e.g. 3.2 = 0.40 × 10 × h h = 3.2 / 0.40 × 10 (h =) 0.80 (m)	in either order -1 for POT error due to not converting g to kg but not if due to physics error such as missing *g* accept use of *g* = 9.8(1) accept 1sf answer i.e. 0.8 (m) 0.815 or 0.816 or 0.82 if g used is 9.8(1) and then rounded	3
(iii)	3.2 (J);	this answer only	1
(b)	downward arrow labelled "weight"/"W"/"mg"; vertically downward arrow drawn equal in length to lifting force arrow;	ignore starting position of arrow ignore 'gravity/g/gravitational field strength' allow 'gravitational force' reject if both gravity force and weight force shown mark independently by eye reject any other labelled arrows for second mark	2
(c) (i)	recall of efficiency formula; substitution; evaluation; e.g. efficiency = <u>useful energy output</u> total energy output efficiency = 3.2 / 11.0 (×100%) efficiency = 0.29 or 29%	may be implied from substitution allow 0.29, 0.2909…, 29%, 29.09…% 29 without % is PoT 2 marks	3
(ii)	idea that energy must be conserved; demonstration that 7.8 + 3.2 = 11(.0);	comparison in words e.g total = useful + wasted /eq allow 11(.0) – 3.2 = 7.8	2

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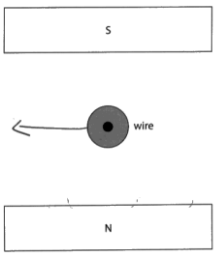
(iii)	only one additional arrow drawn pointing to the right; labelled “useful output (energy)” width of arrow drawn = 8 small squares; e.g.  	allow “gravitational (potential energy)”, “GPE” etc. reject reference to power by eye	3

Total for question 3 = 15 marks

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Question number	Answer	Notes	Mark
4 (a)	B (copper); A is incorrect because it is magnetic C is incorrect because it is magnetic D is incorrect because it is magnetic		1
(b)	field line connecting one pole to the other; at least two complete field lines, but none touching / crossing; all directions shown on field lines correct (N to S);  	allow small gap where field line joins magnet ignore field lines inside the magnet ignore field lines that start outside the pole region only one arrow required for the mark but contradictory directions negates the mark ignore arrow(s) inside the magnet	3
(c)	steel is magnetic / eq; (therefore) magnet stays magnetised (for a long period of time) /eq ;	allow 'steel is a hard magnetic material' for both marks reject reference to charge	2

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(d)	(i)	arrow drawn is horizontal; arrow drawn is to the left; 	ignore starting position of arrow judge by eye ignore field lines	2
	(ii)	Any two from: MP1 reference to weaker field MP2 moving magnets further apart MP3 use weaker magnets MP4 reference to lower current MP5 decreasing diameter of wire MP6 decrease voltage (of supply)	 increasing length of wire (in circuit)	2

Total for Question 4 = 10 marks

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Question number	Answer	Notes	Marks
5	at least one from: **in relation to driver:** MP1. (frequency) does not change; MP2. no (relative) movement between driver and horn; PLUS up to five from: **in relation to person at the side of the road:** MP3. recognition that the Doppler effect applies; MP4. frequency heard by person at side of the road is different to that heard by driver; MP5. frequency is higher as car approaches; MP6. because wavefronts become closer together; MP7. frequency is lower as car moves away; MP8. because wavefronts become further apart; MP9. speed of sound remains constant; MP10. relevant mention of $v = f \times \lambda$;	 allow pitch does not change i.e. driver and car travelling at same speed / distance between car (horn) and driver constant allow pitch as alternative to frequency reject just 'different' allow pitch of sound is higher allow wavelength decreases allow pitch of sound is lower allow wavelength increases must link to a previous MP, not merely quoting the formula	6

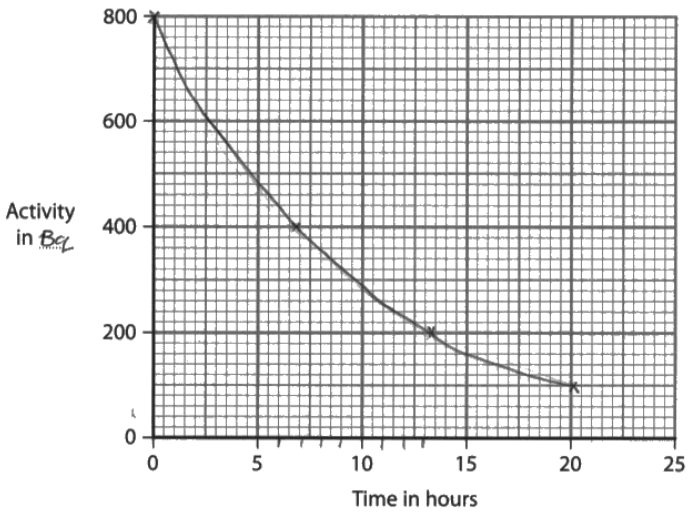
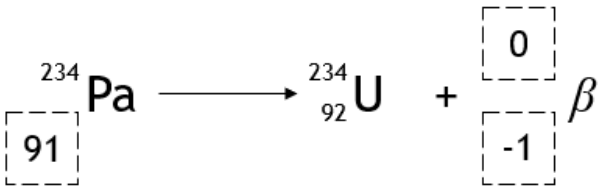
Total for Question 5 = 6 marks

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Question number	Answer	Notes	Marks
6 (a)	resistor, battery, voltmeter, ammeter all present in a complete circuit	all four symbols drawn correctly condone use of cell or dc power supply symbol for battery	4
	variable resistor connected in series with resistor;	symbol drawn correctly	
	ammeter in series with resistor;	condone incorrect yet identifiable ammeter symbol	
	voltmeter in parallel with 60 ohm resistor;	condone incorrect yet identifiable voltmeter symbol accept higher level answers involving potential divider circuits	
(b)	any four from: MP1. measure voltage and current; MP2. idea of varying voltage (across resistor); MP3. take repeat readings and average (at each voltage); MP4. switch off circuit in between readings; MP5. other reasonable safety measure relating to equipment heating up	 e.g. by altering the resistance of the variable resistor e.g. not using full range of voltages so current doesn't get too high ignore references to graph	4
(c) (i)	line passes through origin; line is straight throughout; line passes/would pass through the point (12,0.20);	 by eye	3
(ii)	any three from: MP1. line will be same shape / straight line through origin / both components are resistors; MP2. line (for 120Ω resistor) will have a lower gradient; MP3. line (for 120Ω resistor) will have **half** the gradient; MP4. (because) larger resistance will result in a lower current in the circuit;	 allow (still) directly proportional also award MP2 allow relevant justification by V=IR all three marks can be awarded from a correct new line on the graph.	3

Total for Question 6 = 14 marks

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Question number	Answer	Notes	Mark
7 (a) (i)	becquerel(s);	allow kilobecquerels, Bq, kBq, curie, Ci allow recognisable spelling allow mixed case letters	1
(ii)			3
	evidence that sketch starts at (0,800)	accept plotted point	
	evidence sketch passes through (6.7,400)	accept plotted point	
	smooth curve decreases with decreasing steepness  		
(iii)	both numbers for beta correct; atomic number of protactinium = 91; e.g.  		2

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(b)	(i)	A (count measured by the detector); B is incorrect because this is a control variable C is incorrect because this is the independent variable D is incorrect because this is a control variable		1
	(ii)	idea of removing source (from the experiment); measure count(for a minute); subtract background count from results;	e.g. pointing source away, keeping source in its box, (huge) increase in distance, take count before using source	3
	(iii)	idea of repeating measurements (of count); to determine a mean value;	allow idea of using repeats to identify anomalies condone average for mean	2
	(iv)	count decreases (significantly) using paper; no (additional) effect on the count when using aluminium AND lead / eq; radiation must be alpha consistent with candidate's discussion;	both must be mentioned for this mark allow idea that count with aluminium and lead is background radiation / in the range of 11-14	3

Total for Question 7 = 15 marks

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Question number			Answer	Notes	Marks
8	(a)	(i)	3.1 (cm);		1
		(ii)	any value above candidate's answer for (a)(i) up to and including 14.6cm;		1
	(b)	(i)	idea that speed is the gradient/slope of the graph;		3
			gradient is not constant;	e.g. "it's a curve"/"it's not a straight line"	
			(therefore) speed is not constant;	allow description of how the speed is varying e.g. zero at turning points, maximum when steepest	
		(ii)	any cross drawn at a peak/trough on the curve;	reject if contradicted by a cross drawn in an incorrect place by eye	2
			crosses drawn at all three peaks and all three troughs;		

Total for Question 8 = 7 marks

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Question number	Answer	Notes	Marks
9 (a) (i)	recall of (unbalanced) force = mass × acceleration; substitution and rearrangement; evaluation to 2 s.f. or more; e.g. F = m × a a = 41000 / 830 a = 49 (m/s^2)	allow symbols can be implied from valid substitution of data allow 49.39…	3
(ii)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $26^2 = 72^2 + 2\times(-50)\times s$ (distance =) 5184-676 / 100 (distance =) 45 (m)	allow ecf from (i) expect answers in range 45-46 (m) reject 72-26 = 46 (wrong physics) accept 46 if unqualified	3
(b)	kinetic energy (store) **of car** decreases; thermal energy (store) **of brake(s)** increases; energy transferred mechanically;	kinetic energy/ KE **of car** transforms to {heat/thermal} energy **of brakes** due to work done **by {friction / brakes}** NB only award from either the answer column or notes column, not from a mix of the two.	3
(c)	any two from: MP1. idea that insulating materials are poor conductors; MP2. layers trap air; MP3. air itself is a poor conductor/(good) insulator MP4. (energy transfer due to / rate of) conduction reduces; MP5. idea increased thickness reduces (rate of) conduction	 condone idea of stopping conduction	2

Total for Question 9 = 11 marks

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Question number	Answer	Notes	Marks
10 (a) (i)	pressure difference = height × density × *g*;	allow in words or standard symbols e.g. p = h × ρ × *g* condone d for density	1
(ii)	substitution; evaluation of pressure difference in kPa; evaluation of total pressure by adding 100 (kPa); e.g. (pressure difference =) 35 × 1000 × 10 (pressure difference =) 350 (kPa) (pressure = 350 + 100 =) 450 (kPa)	 allow 343 (kPa) for use of g=9.8 N/kg ECF candidate's water pressure allow 443 (kPa) for use of g=9.8(1) N/kg allow 450 000 Pa with clear intent from candidate i.e. removal of 'k' from unit on answer line. -1 for POT error but not if due to physics error such as missing *g*, substitution of 100 (kPa) for g 350 kPa gets 2 marks 350 100 kPa gets 2 marks unqualified 350 000 (kPa) gets 1 mark	3
(b) (i)	pressure = force ÷ area;	allow in words or standard symbols e.g. p = F / A	1
(ii)	substitution; rearrangement; evaluation; corresponding unit of area; e.g. 260 000 = 430 / area (area =) 430 / 260 000 (area =) 0.0017 m^2	condone pressure in Pa or kPa accept standard form i.e. 1.7×10^{-3} (m^2) allow 0.0016538… m^2 etc allow 17, 16.5… (cm^2) etc allow 1.65... m^2 scores 3 allow 1.65...cm^2 scores 2	4
(c)	pressure (at bottom) is greater than before / eq; wider base /eq;	 allow stronger material/eq ignore taller	2

Total for Question 10 = 11 marks

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<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>11 (a)</td><td>substitution into given formula;
evaluation of constant;

evaluation of constant for a second set of data;
conclusion consistent with candidate's evidence;
e.g. calculated value of constant doesn't change (much) so formula is justified
constant decreases so formula isn't justified

<table><tr><th>Distance from centre of Mars in km</th><th>Gravitational field strength in N/kg</th><th>Constant</th></tr><tr><td>4000</td><td>2.66</td><td>42560000</td></tr><tr><td>5000</td><td>1.70</td><td>42500000</td></tr><tr><td>6000</td><td>1.18</td><td>42480000</td></tr><tr><td>7000</td><td>0.87</td><td>42630000</td></tr><tr><td>8000</td><td>0.67</td><td>42880000</td></tr><tr><td>9000</td><td>0.53</td><td>42930000</td></tr></table></td><td>allow any consistent PoT

DOP</td><td>4</td></tr>
<tr><td>(b)</td><td>rearrangement of given formula;
substitution of constant and distance;

evaluation;

e.g.
gravitational field strength = constant / distance^2
gravitational field strength = 42 700 000 / 3410^2

gravitational field strength = 3.67 (N/kg)</td><td>allow ecf from (a)
allow mean constant
condone 3.7

allow range of 42 500 000 to 42 900 000 for constant
allow range of 3.65-3.69</td><td>3</td></tr>
</table>

Total for Question 11 = 7 marks

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