Pearson Edexcel

Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE

In Science Double Award (4SD0) Paper 1P

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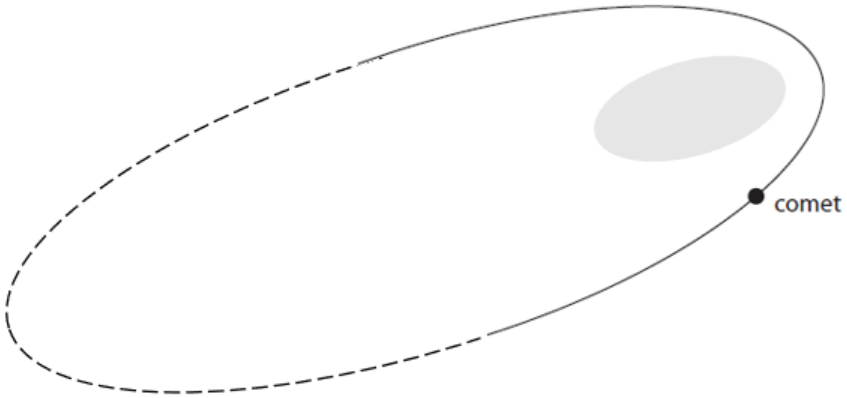
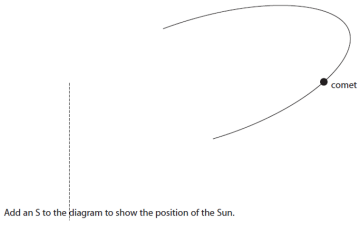
General Marking Guidance

- 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)			
(i)	centre of S marked in the grey region shown;	allow if centre of S marked in a similar position on the other side of the drawn orbit	1
(ii)	closed path drawn with curve; total size approximately twice size of original diagram;	curve should extend at least as far as the start of the word "diagram" in sentence below i.e. 	2
(iii)	X marked on part of path closest to candidate's S;	reject if another <u>contradictory</u> cross drawn	1
(b)	any three from: MP1. comet's orbit is more elliptical/oval; MP2. (orbital) path of comet is longer; MP3. idea that speed of comet varies but speed of planet does not; MP4. both planet and comet orbit a star; MP5. idea that orbital radius of comet varies but orbital radius of planet does not; MP6. plane of comet's orbit different to plane of planet's orbit; MP7. star is at centre of planet orbit but not at centre of comet orbit;	comparison needs to be seen allow planet's orbit is more circular allow distance for path allow period of orbit of comet is longer allow the Sun for star allow (star's) gravitational force is constant for planet but varies for comet	3

Total for Question 1 = 7 marks

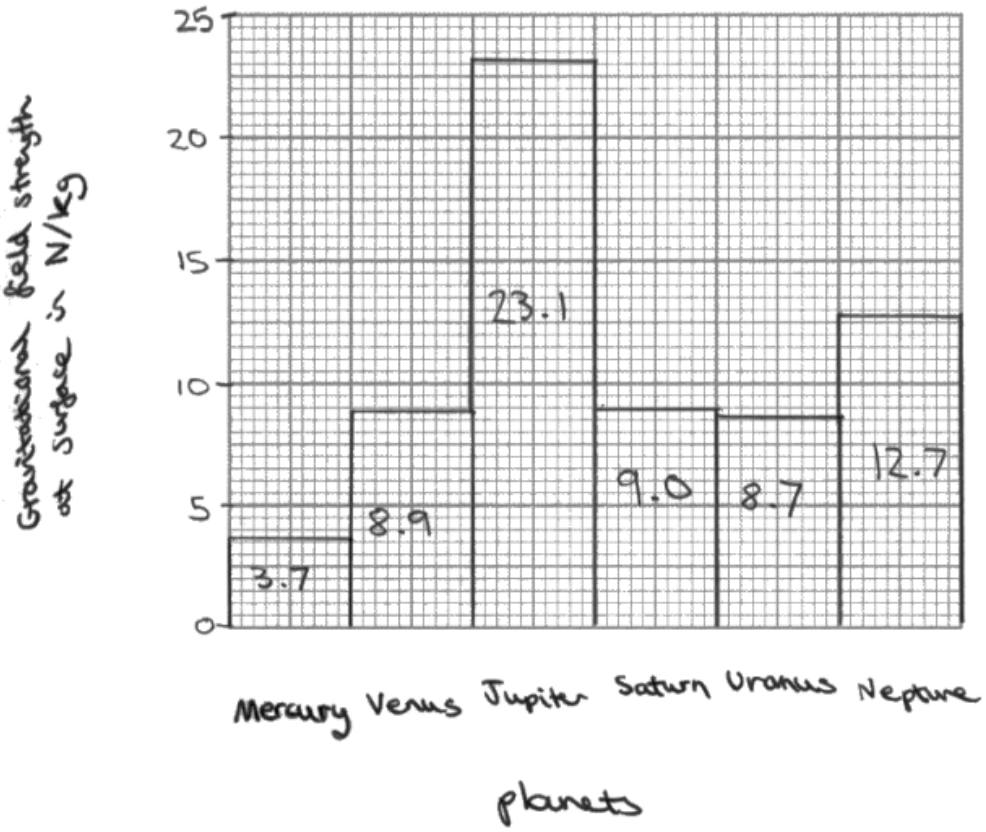
Question number	Answer	Notes	Marks
2 (a)	C (number of protons in the nucleus); A is incorrect because electrons are not found in the nucleus B is incorrect because this is deduced from the mass number D is incorrect because this is the mass number		1
(b)	D (number of protons and neutrons in the nucleus); A is incorrect because electrons are not found in the nucleus B is incorrect because this is determined from the mass number and is not the mass number itself C is incorrect because this is the atomic number		1
(c)	D (atoms with the same number of protons but a different number of neutrons; A is incorrect because isotopes must have the same number of protons B is incorrect because isotopes have a different number of neutrons to each other C is incorrect because isotopes must have the same number of protons		1
(d)	A (adding an electron); B is incorrect because this will change the element and make it positively charged C is incorrect because this will create a positively charged ion D is incorrect because this will change the element		1
(e)	B (radioactive decay happens at random); A is incorrect because this is a consequence of radioactive decay C is incorrect because it does not explain the random nature of radioactive decay D is incorrect because this explains why radioactive decay happens in the first place		1
(f)	A (becquerel (Bq); B is incorrect because this is the unit for charge C is incorrect because this is the unit for energy D is incorrect because this is the unit for power		1

Total for Question 2 = 6 marks

Question number	Answer	Notes	Marks
3 (a)	40 000 {waves / vibrations / oscillations}; in 1 second / unit time;	allow 40 000 wavelengths / wavefronts allow per second	2
(b) (i)	(wave) speed = frequency × wavelength;	allow standard symbols and rearrangements e.g. $\lambda = v / f$ condone s for speed ignore incorrect symbols e.g wl for wavelength, ws for wave speed	1
(ii)	substitution; rearrangement; evaluation; e.g. $345 = 40\,(000) \times \lambda$ $\lambda = 345/40\,(000)$ $(\lambda =)\ 8.6 \times 10^{-3}$ (m)	 POT error = -1 correct answer with no working gains full marks 8.6, 8.62, 8.63, 8.625 = 2 marks allow 9×10^{-3}, 8.62×10^{-3}, 8.63×10^{-3}, 8.625×10^{-3} (m)	3
(iii)	use of speed = distance/time seen or implied; factor of 2 seen; substitution; evaluation; e.g. speed = distance/time distance should be doubled 345 = 4.70 ÷ time (time =) 0.0136 (s)	allow any rearrangement or in correct symbols allow d, s, x for distance allow v for speed condone s for speed 0.007, 0.0068… scores 3 marks (no factor of 2 used) allow 0.01, 0.014, 0.01362… (s)	4
(c)	idea that the person can see/know what (distance) they are measuring/eq;	e.g. marks the position that (distance) is being measured to	1

(d)	any three from: MP1. sound is longitudinal light is transverse; MP2. sound vibrations are in the direction of travel, light vibrations are perpendicular to the direction of travel; MP3. light is electromagnetic, sound is not; MP4. light can travel through a vacuum/space, sound cannot; MP5. light travels (much) faster (in air) than sound; MP6. light slows down in denser medium but sound speeds up;	allow points shown on a labelled diagram allow higher level ideas i.e. light can be polarised but sound can't allow reverse argument (RA) for all marking points can be given from diagram showing longitudinal and transverse waves allow oscillations, displacements for vibrations allow direction of energy transfer for direction of travel allow sound is mechanical, light is not allow sound needs a medium but light does not allow quoted speeds for comparison	3

Total for Question 3 = 14 marks

Question number	Answer	Notes	Marks
4 (a)	suitable linear scale chosen (>50% of grid used); axes labelled with quantities and unit; <u>all</u> bar plotting correct to nearest half square;  	ignore orientation of axes do not accept multiples of 3 for scale condone missing "planets" label if individual planets are written with bars reject if non-linear scale used bars do not need to be separated from each other or in the same order as the table condone stick graphs	3
(b)	any one from: different masses; different sizes; different densities;	ignore different orbital radius ignore weight allow different volume, radii, diameter ignore different (surface) area	1

(c)	as orbital radius increases, the orbital speed decreases;	condone idea that they are inversely proportional ignore negative correlation	1
(d)	substitution into $v = \frac{2 \times \pi \times r}{T}$; rearrangement; evaluation; e.g. $47.4 = 2 \times \pi \times 57.9 \times 10^6 / T$ $T = 2 \times \pi \times 57.9 \times 10^6 / 47.4$ (T =) 7.68×10^6 (s)	-1 for POT error allow 1s.f. answer if supported by working allow 7.7×10^6, 7.67×10^6, 7 675 030.154 (s)	3

Total for Question 4 = 8 marks

Question number	Answer	Notes	Marks
5 (a)	any suitable natural source; e.g. (the) Sun, cosmic rays, rocks, (named) food, radon etc.	reject if contradicted by a list allow named radioactive isotopes e.g. carbon-14, uranium-235, uranium-238 ignore "space", cosmic microwave background radiation (CMBR)	1
(b) (i)	any two **described** differences from: MP1. alpha has more mass; MP2. alpha has more charge; MP3. alpha is positive and beta is negative; MP4. alpha has shorter range (in air); MP5. alpha is slower; MP6. alpha is less penetrating; MP7. alpha is more ionising; MP8. alpha is a helium nucleus but beta is an electron;	allow RA throughout allow alpha is heavier allow oppositely charged allow alpha stopped by air/paper and beta stopped by aluminium/thin metal allow alpha is 2 protons and 2 neutrons but beta is an electron	2
(ii)	evidence of trying to balance nuclear equation; correct number of alphas; correct number of betas; e.g. $90 = 86 + 2\alpha$ number of alpha = 3 number of beta = 2	e.g. 232 – 220 = 12 also gains first mark also gains first mark this balances atomic number despite mass number not balancing (if no beta was present)	3
(c)	any three from: MP1. (alpha) can cause cell mutation / cancer; MP2. idea that alpha is only dangerous when inside body; MP3. alpha is blocked by skin / few cm of air; MP4. thorium can only cause irradiation (since it remains in work surface); MP5. radon / gas can cause (both) contamination (and irradiation) (since it can go inside body / food); MP6. radon / gas can be inhaled / enter body; MP7. thorium cannot enter body;	 allow both (thorium and radon) can cause irradiation	3

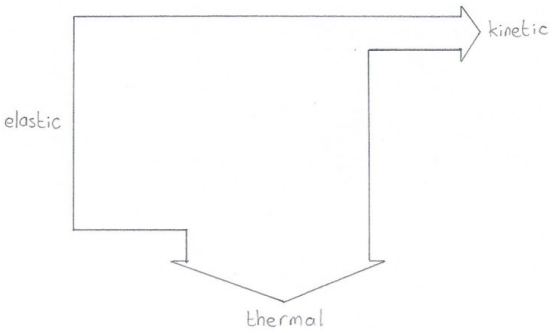
Total for Question 5 = 9 marks

Question number	Answer	Notes	Marks
6 (a)	(quantity that has both) magnitude and direction;	allow size, value, number or amount for magnitude ignore scale for magnitude	1
(b)	vertically downward arrow drawn; labelled weight; arrow drawn in opposite direction to velocity; labelled air resistance / drag / <u>air</u> friction;	ignore starting points and lengths of arrows 3 marks max. if more than two arrows drawn judge by eye dependent on previous mark being awarded (DOP) allow gravitational force, force of gravity ignore gravity, gravitational field strength, gfs DOP but allow if arrow pointing to the left condone wind resistance	4

Total for Question 6 = 5 marks

Question number			Answer	Notes	Marks
7	(a)		(current is the) rate of flow of charge;	allow amount of charge passing per unit time/second ignore rate of flow of electrons	1
	(b)	(i)	idea that LED shows that current is present / fuse is still working;	allow idea that it shows when the fuse has blown	1
		(ii)	correct symbol for ammeter placed in series with fuse;		1
	(c)	(i)	0.1 (A);		1
		(ii)	0.6 (A);		1
		(iii)	lamp 3; any two from: • (because) power = current × voltage; • voltage is the same for all lamps; • current is greatest;	allow ECF from (c)(i) if I_1 given as greater than 0.3(A) leading to lamp 2 being brightest allow $P = V^2 / R$ allow resistance is lowest	3

Total for Question 7 = 8 marks

Question number	Answer	Notes	Marks
8 (a)	idea that energy can't be created or destroyed;	both created and destroyed / eq need to be seen ignore lost, removed for destroyed	1
(b) (i)	efficiency = $\frac{\text{useful (energy) output}}{\text{total (energy) output}}$;	ignore ×100(%) allow rearrangements allow total (energy) input for total (energy) output	1
(ii)	substitution; rearrangement; evaluation of useful energy output; subtraction from total to find wasted energy output; e.g. $0.15 = E_{useful} / 165$ $E_{useful} = 0.15 \times 165$ $(E_{useful} =)$ 25 (J) $(E_{wasted} =) 165 - 25 = 140$ (J)	 allow 24.75 (J) allow 140.25 (J) allow alternative method of determining 85% of energy wasted, leading to correct final answer e.g. % wasted = 100 - 15 = 85 $0.85 = E_{wasted} / 165$ $(E_{wasted} =) 0.85 \times 165$ $(E_{wasted} =)$ 140 (J)	4
(iii)	diagram to show standard single input with two output arrows; input and output arrows labelled correctly; scale approximately correct; e.g.  	arrows can be in any orientation e.g. both useful and wasted arrows drawn horizontally allow elastic, input, total for initial arrow kinetic, useful (output) for narrower output thermal/heat, wasted (output) for wider output but apply ECF from (b)(ii) allow ECF from (b)(ii) judge by eye – wasted arrow should be at least 4× wider than useful arrow and they should sum to approximately the width of the input	3

(c) (i)	45 (J);		1
(ii)	substitution into work done = force × distance; rearrangement; evaluation; e.g. 45 = force × 7.5 force = 45 / 7.5 (force =) 6.0 (N)	 allow 6 (N)	3

Total for Question 8 = 13 marks

Question number	Answer	Notes	Marks
9 (a) (i)	pressure (difference) = height × density × *g*;	allow standard symbols and rearrangements e.g. h = p / (*ρ* × *g*) condone d for density	1
(ii)	substitution; rearrangement; evaluation in cm; e.g. 2300 = h × 1000 × 10 h = 2300 / (1000 × 10) (h =) 23 (cm)	allow *g* = 9.81, 9.8 -1 for POT error but check carefully due to value of *g* 0.23 (cm) gains 2 marks allow 23.46…, 23.44… (cm)	3
(b) (i)	line drawn of similar curved path and aiming towards ground to the left of path from hole B;	reject if curve drawn upwards at any point	1
(ii)	any two from: MP1. pressure is lower at A; MP2. force acting on water at A is less; MP3. water leaves the bottle at a lower speed/KE at A; OR any two from: MP1. initial velocity of water is horizontal; MP2. (force of) gravity acts on the water; MP3. water accelerates downwards;	allow “near top of bottle”/eq for A allow RA allow RA allow RA allow water leaves bottle horizontally	2
(iii)	any three from: MP1. idea that path from C is identical / symmetrical to path from B; MP2. (because) pressure is the same; MP3. (initial) speed of water is the same; MP4. idea that pressure acts (equally) in all directions;	ignore holes at same height above ground allow path is the same (as B) allow force acting on water is the same allow (initial) KE of water is the same	3
(iv)	any one from: MP1. idea that it allows **air** to enter the bottle (as water level falls); MP2. idea that it maintains equal pressure between air inside and air outside the bottle; MP3. idea that no water would come out of the holes otherwise;		1

Total for Question 9 = 11 marks

Question number	Answer	Notes	Marks
10 (a)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $v^2 = 0 + (2 \times 10 \times 18)$ $v = \sqrt{360}$ (v =) 19 (m/s)	allow alternative method involving changing GPE lost = KE gained e.g. sub into $mgh = ½mv^2$ allow use of 9.8, 9.81 for *g* allow 18.8, 18.78…, 18.79…,18.97… (m/s)	3
(b) (i)	kinetic energy = ½ × mass × speed^2;	allow rearrangements and standard symbols e.g. KE = ½ × m × v^2	1
(ii)	substitution; evaluation; e.g. (KE =) $0.5 \times 2100 \times 19^2$ (KE =) 380 000 (J)	allow ECF from (a) allow alternative method involving changing GPE lost = KE gain allow 370 000-372 000 from *g* = 9.8, 9.81 allow 400 000, 378 000, 379 000 1 mark only for not converting tonnes to kg e.g. KE = 380 (J), 378 (J)	2
(c)	idea that energy is transferred from a gravitational (store) to a kinetic (store); idea that energy is transferred to a thermal (store) of {car / shaft / surroundings}; idea that energy is transferred mechanically; idea that energy is transferred by radiation / by heating;	allow answers in terms of types of energy rather than stores and transfers allow GPE to KE allow heat for thermal allow energy transferred due to a named force e.g. gravity, friction allow energy transferred as sound	4

Total for Question 10 = 10 marks

Question number	Answer	Notes	Marks
11 (a)	any two from: MP1. height is <u>independent variable</u>; MP2. at least five different heights tested; MP3. range is <u>dependent variable</u>; with any two from: MP4. one control variable named; MP5. second control variable named; MP6. idea of repeating process at each height to find mean; AND: MP7. ruler used to measure height / range; MP8. suitable method to see where ball lands;	 e.g. launch speed/launch force, angle of launch, same ball allow repeating process at each height to identify anomalies allow tape measure condone metre stick e.g. record video (and playback in slow motion) cover ball in paint, material on floor to show landing point etc.	6
(b) (i)	smooth curve within one small square of data points;	ignore extrapolation of curve beyond the points take care the curve is not dot to dot straight lines	1
(ii)	height reading consistent with curve of best fit;	allow 0.15-0.25 (m) allow ECF from (b)(i)	1
(iii)	idea that (both) variables are continuous;	allow results/data are continuous	1
(iv)	pair of readings taken from graph; substitution into given formula; rearrangement; evaluation to at least 1 decimal place; e.g. range = 1.92m when height = 2.0m $1.92 = \text{launch speed} \times \sqrt{\frac{2.0}{5}}$ launch speed = $1.92 / \sqrt{0.4}$ (launch speed =) 3.0 (m/s)	allow data points or readings taken from candidate's curve allow ECF from (b)(i) and (b)(ii) 3 marks max. for reverse argument e.g. using speed of 3 m/s to calculate height or range allow range 2.9-3.1 (m/s) unless ECF from (b)(i)	4

Total for Question 11 = 13 marks

Question number	Answer	Notes	Marks
12 (a)	2.8 (mA);	allow -2.8 (mA)	1
(b) (i)	same value as (a) but opposite polarity e.g. -2.8 (mA);	allow ecf from (a)	1
(ii)	reading larger than value given in (a);	ignore polarity	1
(c)	any one from: MP1. longer needle; MP2. more turns in coil; MP3. stronger magnet; MP4. weaker return spring;	 allow idea of moving scale further up the needle ignore bigger coil, more coils ignore bigger magnet	1
(d) (i)	A (accuracy); B is incorrect because no repeats are being taken C is incorrect because no repeats are being taken D is incorrect because the scale of the ammeter is the same		1
(ii)	idea of subtracting/adding the difference/error from the measurement;	allow subtract/add a quoted value of current even if value is incorrect	1

Total for Question 12 = 6 marks

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