cookie

Practice paper: mark scheme

GCSE Double Award Science Higher, practice paper: Physics Unit P1 (CCEA style)

In the style of CCEA GCSE Science Double Award (2017) Unit P1: Physics, Higher Tier

Practice paper written by cookie in the style of CCEA GCSE Science Double Award (2017) Unit P1: Physics, Higher Tier. Not a CCEA paper; not affiliated with or endorsed by CCEA.

This mark scheme was written by cookie with its practice paper. Each row gives the answer, the marks and how they are given; where an answer is worded differently but means the same, give the mark.

Key

- Each line is one marking point, worth one mark unless it says otherwise.
- allow an answer that is also acceptable; do not accept an answer that gets no mark; ignore words that neither gain nor lose the mark
- Extended responses (6 marks) are marked by level: decide the level from the descriptors, then the mark within it.

Do it online, timed and marked:
cookie.education/past-papers/gcse/cookie/science-double-award-ccea-style

Question	Answer and marking	Marks
1(a)	**Answer: So that the volume of water that overflows equals the volume of the padlock (none of the displaced water just fills the can).** so that the volume of water collected equals the volume of the padlock / all the water displaced overflows into the cylinder; [1] *Do not accept 'to make it a fair test' or 'so there is enough water' on their own.*	**1**
1(b)	**Answer: 8.4 g/cm^3** density = mass ÷ volume / D = m ÷ V; [1] = 151.2 ÷ 18.0; [1] = 8.4; [1] g/cm^3; [1] *Allow 8400 kg/m^3 for the last two marks only if the conversion is correct. The unit mark is independent but must match the number (g/cm^3 for 8.4). An inverted calculation (18.0 ÷ 151.2 = 0.12) scores the first mark only. Do not accept g/cm or g cm^3.*	**4**
1(c)	**Answer: The particles in a gas are much further apart than the particles in a liquid, so the same mass of steam takes up a much larger volume (there is much less mass in each cm^3).** the particles / molecules in steam / a gas are (much) further apart than in liquid water / a liquid; [1] so the same mass takes up a (much) larger volume / there are fewer particles (and so less mass) in each cm^3; [1] *Do not accept 'the particles in steam are smaller' or 'the particles in steam are lighter'. Ignore references to the particles moving faster on their own. The second mark needs the link to mass and volume.*	**2**
2	**Answer: Mark a start line and a finish line on the runway and measure the distance between them with a metre rule. Raise one end and measure its height with a metre rule. Release the trolley from rest at the start line and time it to the finish line with a stopclock. Average speed = distance ÷ time. Repeat each height three times and find the mean time; use at least five different heights; keep the trolley, the runway and the distance the same.** Band A (5–6 marks): A clear method in a sensible order that covers at least five points from the indicative content, including how the average speed is calculated and how the height is changed. Specialist terms (for example average speed, distance, variable, mean) are used correctly, and the meaning is always clear, with very few errors in spelling, punctuation or grammar. Band B (3–4 marks): A method that covers three or four points from the indicative content. Some specialist terms are used correctly, and the meaning is mostly clear, though there are some errors in spelling, punctuation or grammar. Band C (1–2 marks): One or two relevant points from the indicative content. Few or no specialist terms are used, and errors in spelling, punctuation or grammar may make the meaning unclear. Band D (0 marks): Nothing worthy of credit. Indicative content: mark a start line and a finish line on the runway measure the distance between the lines with a metre rule / tape measure measure the height of the raised end (from the bench / floor) with a metre rule release the trolley from rest at the start line / do not push it start the stopclock as the trolley is released and stop it as the trolley crosses the	**6**

finish line
average speed = distance moved ÷ time taken
repeat the timing (at least) three times for each height and calculate a mean time / mean speed
change the height (using blocks / books) for at least five different heights
keep the same trolley / runway / distance between the lines (control variables)
plot a graph of average speed against height
To reach Band A the answer must include measuring both the distance and the time and calculating average speed from them. Within a band, award the higher mark where the communication is better. A method using light gates and a data logger is acceptable in place of the stopclock. Do not credit 'measure the speed with a speedometer'. Ignore safety points unless they are linked to the method, e.g. a barrier to stop the trolley at the bottom.

3(a) **Answer: 92 protons and 143 neutrons** **2**
protons = 92; [1]
neutrons = 143; [1]
Do not accept 235 neutrons. If the two numbers are given the wrong way round, award 1 mark.

3(b) **Answer: A uranium-235 nucleus absorbs a neutron and splits into two smaller nuclei, releasing energy and two or three neutrons. These neutrons are absorbed by other uranium nuclei, which split in turn: a chain reaction.** **3**
the uranium nucleus absorbs / captures a neutron;
the nucleus splits into two smaller nuclei;
energy is released / two or three neutrons are released;
the (released) neutrons go on to cause further fissions / are absorbed by other uranium nuclei (giving a chain reaction);
any three for [3]
Do not accept 'the atom splits into two atoms' for the second point unless 'nucleus' is used elsewhere. Do not accept 'a proton is absorbed'. Do not accept 'fusion' used for fission anywhere in the answer. Fission equations are not required.

3(c) **Answer: Mining, transporting and purifying the uranium ore uses fossil fuels and releases greenhouse gases.** **1**
mining / transporting / purifying (processing) the uranium (ore) releases greenhouse gases / carbon dioxide; [1]
Allow building the power station (e.g. making concrete) releases carbon dioxide. Do not accept 'radioactive waste' or 'it uses up uranium'.

3(d) **Answer: 1.5 kg** **2**
fusion releases four times as much energy per kg as fission / 1 kg of fusion fuel ≡ 4 kg of uranium; [1]
6.0 ÷ 4 = 1.5 (kg); [1]
An answer of 1.5 kg scores 2 marks. An answer of 24 kg (multiplying by four) scores 1 mark only if the factor of four is stated. An answer built on 'four million times' (that compares fusion with burning fossil fuels), e.g. 1.5 × 10^{-6} kg, scores 0.

4(a) **Answer: 10.0 cm** **1**
16.0 − 6.0 = 10.0 (cm); [1]
Allow 10 cm. Do not accept 16.0 cm.

4(b) **4**

Answer: 0.40 N/cm

F = k × e / k = F ÷ e; [1]
k = 4.0 ÷ 10.0; [1]
= 0.40 / 0.4; [1]
N/cm; [1]
Carry an error through from (a): e.g. 4.0 ÷ 16.0 = 0.25 N/cm scores 3 marks. Allow any correct load and extension pair up to 5.0 N, e.g. 2.0 ÷ 5.0. The question asks for the extension in centimetres: 40 N/m with correct working scores 3 marks (the unit mark is lost). Do not accept N cm.

4(c) **2**

Answer: She was not correct. Up to 5.0 N the extension went up by 2.5 cm for each extra 1.0 N, so extension was proportional to the load; between 5.0 N and 6.0 N it went up by 3.9 cm, so the limit of proportionality had been passed.

up to 5.0 N the extension increases by 2.5 cm for every 1.0 N / extension is (directly) proportional to the load (so Hooke's law is obeyed); [1]
from 5.0 N to 6.0 N the extension increases by 3.9 cm (not 2.5 cm) / the extension at 6.0 N is 16.4 cm, not 15.0 cm, so the limit of proportionality was exceeded / she was not correct; [1]
The second mark needs the data used, not just 'the last result is wrong'. Allow 'elastic limit' for 'limit of proportionality'. 'She was not correct' with no reasoning scores 0.

5(a) **4**

Answer: 1.5 m/s^2

a = (v − u) ÷ t / acceleration = gradient (of the velocity–time graph); [1]
= (12 − 0) ÷ 8; [1]
= 1.5; [1]
m/s^2; [1]
Allow m s^{-2} or m/s/s. Do not accept m/s. An answer of 96 (12 × 8) scores 0 for the calculation marks; the unit mark is independent.

5(b) **4**

Answer: 468 m

displacement = area under the velocity–time graph / average velocity × time for each stage; [1]
any two of: ½ × 8 × 12 = 48 / 30 × 12 = 360 / ½ × 10 × 12 = 60; [1]
all three areas correct and added: 48 + 360 + 60; [1]
= 468 (m); [1]
An answer of 468 m scores 4 marks. Allow the trapezium method, ½ × (30 + 48) × 12 = 468, for full marks. Carry an error through from one wrong area for the last mark. An answer of 576 (12 × 48, the tram treated as moving at 12 m/s throughout) scores 0.

5(c) **2**

Answer: 9.75 m/s

average velocity = displacement ÷ time = 468 ÷ 48; [1]
= 9.75 (m/s); [1]
Allow 9.8 m/s. Carry an error through from (b), e.g. 576 ÷ 48 = 12 scores 2 marks. Do not accept (0 + 12) ÷ 2 = 6 m/s (that formula applies only to uniform acceleration).

6(a) **1**

Answer: The water in the lake is naturally replenished by rain, so the resource will not run out.

the water / lake is (naturally) replenished (by rain / rivers) within a human lifetime / the resource will never run out; [1]

Do not accept 'it does not cause pollution' or 'it does not produce carbon dioxide'. Do not accept 'the water can be reused' on its own.

6(b)(i) **3**

Answer: 36 000 J

Ep = mgh; [1]

= 80 × 10 × 45; [1]

= 36 000 (J); [1]

An answer of 36 000 J scores 3 marks. Allow 36 kJ. Using g = 9.8 or 9.81 (35 280 J or 35 316 J) scores 2 marks.

6(b)(ii) **3**

Answer: 75%

useful output energy each second = 27 000 (J) / 27 kW = 27 000 W seen; [1]

efficiency = useful output energy ÷ total input energy = 27 000 ÷ 36 000 (= 0.75); [1]

= 75 (%); [1]

Carry an error through from (b)(i). An answer of 0.75 scores 2 marks (not a percentage). An answer of 0.075% (27 ÷ 36 000 × 100, kW not converted) scores 1 mark for the efficiency equation. Do not accept an efficiency greater than 100%.

6(c) **1**

Answer: Flooding the valley for the lake destroys habitats.

habitat destruction (e.g. flooding land for the lake) / visual pollution (from the dam, pipes or power lines) / disrupts the flow of the river or fish movement; [1]

Do not accept 'it produces carbon dioxide' or 'it causes acid rain'. Ignore 'it is expensive to build'.

7(a) **1**

Answer: The point where all the weight of the object can be considered to act.

the point where all of the weight (of the object) can be considered to act / appears to act; [1]

Do not accept 'the middle of the object' or 'where the mass is'. Allow 'the point through which the whole weight acts'.

7(b) **4**

Answer: 160 N

clockwise moment = anticlockwise moment (about the axle) / moment = F × d; [1]

moment of the weight = 600 × 0.40 = 240 (N m); [1]

F × 1.5 = 240; [1]

F = 160 (N); [1]

An answer of 160 N scores 4 marks. An answer of 2250 N (600 × 1.5 ÷ 0.40, the distances swapped) scores 2 marks. Do not penalise working in cm if it is consistent (600 × 40 = F × 150).

7(c) **2**

Answer: The perpendicular distance from the pivot to the line of action of the weight is smaller, so the weight has a smaller moment; the gardener's force acts at the same distance, so a smaller force is needed to balance it.

the (perpendicular) distance of the weight / load from the pivot / axle is smaller, so the moment of the weight is smaller; [1]

so a smaller (upward) force is needed (at the same distance) to give an equal (balancing) moment; [1]

Do not accept 'the load is lighter' or 'the weight is smaller'. The second mark can be given only if the answer refers to moments or turning effect.

8(a) **3**

Answer: $^{90}_{38}Sr \rightarrow {}^{90}_{39}Y + {}^{0}_{-1}e$

mass number of Y = 90; [1]

atomic number of Y = 39; [1]

beta particle shown as $^{0}_{-1}e$ / $^{0}_{-1}\beta$; [1]

Allow the mass and atomic numbers of Y in any correct position (top left and bottom left). Do not accept $^{0}_{1}e$ or $^{4}_{2}He$ for the third mark. Do not accept 37 for the atomic number of Y (the change applied the wrong way) or 86 and 36 (alpha decay).

8(b) **3**

Answer: 20 minutes

background (40) subtracted from the measured count rates, e.g. 1640 − 40 = 1600; [1]

corrected count rate halves, e.g. from 1600 to 800 / from 800 to 400 / from 400 to 200; [1]

half-life = 20 (minutes); [1]

An answer of 20 minutes with the background subtracted scores 3 marks. Any correct pair of corrected values may be used, e.g. 1131 at 10 minutes to 566 at 30 minutes. An answer from uncorrected values (e.g. 1640 to 840 read as a half-life of 20 minutes without subtracting) scores 1 mark only.

8(c) **2**

Answer: 90 counts per minute

100 minutes is 5 half-lives, so the corrected count rate = $1600 \div 2^5 = 50$ / 200

halved twice = 50 (counts per minute); [1]

measured count rate = 50 + 40 = 90 (counts per minute); [1]

Carry an error through from a wrong half-life in (b). An answer of 50 scores 1 mark (background not added back). An answer of 60 (the measured 240 halved twice, background not subtracted first) scores 0.

9(a) **3**

Answer: 2000 Pa

weight = mg = 250 × 10 = 2500 (N); [1]

P = F ÷ A = 2500 ÷ 1.25; [1]

= 2000 Pa / N/m^2; [1]

The last mark needs both the number and the unit. An answer of 200 Pa (mass used as the force) scores 1 mark. Carry an error through from a wrong weight for the second mark.

9(b) **2**

Answer: 2500 N: the pallet is moving at a constant velocity, so (by Newton's first law) the forces on it are balanced and the tension equals the weight.

2500 (N) / equal to the weight of the pallet; [1]

constant velocity / no acceleration, so the forces are balanced / the resultant force is zero (Newton's first law); [1]

Carry an error through from the weight in (a). Do not accept 'the tension is greater

than the weight because the pallet is moving up'.

9(c) **Answer: 2350 N** **4**

a = (v − u) ÷ t = (0 − 0.90) ÷ 1.5 = −0.6 (m/s^2) / retardation = 0.6 (m/s^2); [1]
resultant force = ma = 250 × 0.6 = 150 (N) (downwards); [1]
tension = weight − resultant force = 2500 − 150; [1]
= 2350 (N); [1]
An answer of 2350 N scores 4 marks. An answer of 2650 N (the resultant force added to the weight) scores 2 marks. An answer of 150 N scores 2 marks. Carry an error through from a wrong acceleration or a wrong weight.

Total: 70 marks