OCR
Oxford Cambridge and RSA

GCSE

Physics A / Additional Science A

Unit **A182/02**: Modules P4, P5, P6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

Used in the detailed Mark Scheme:

Annotation	**Meaning**
/	alternative and acceptable answers for the same marking point
(1)	separates marking points
not/reject	answers which are not worthy of credit
ignore	statements which are irrelevant - applies to neutral answers
allow/accept	answers that can be accepted
(words)	words which are not essential to gain credit
words	underlined words must be present in answer to score a mark
ecf	error carried forward
AW/owtte	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in RM Assessor to annotate scripts:

	indicate uncertainty or ambiguity
BOD	benefit of doubt
CON	contradiction
	incorrect response
ECF	error carried forward
	draw attention to particular part of candidate's response
NBOD	no benefit of doubt
R	reject
	correct response

L1 , L2 , L3	draw attention to particular part of candidate's response
^	information omitted

	indicate uncertainty or ambiguity
BOD	benefit of doubt
CON	contradiction
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	correct response
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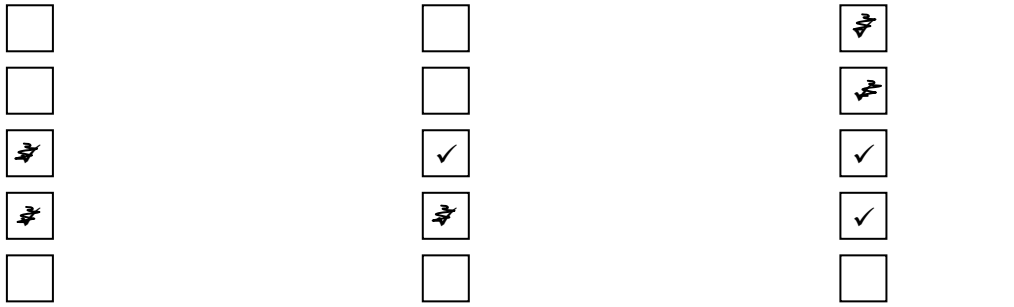
^	information omitted

Subject-specific Marking Instructions

a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).

b. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

e.g. for a one-mark question where ticks in the third <u>and</u> fourth boxes are required for the mark:



This would be worth 1 mark.

This would be worth 0 marks.

This would be worth 1 mark.

c. The list principle:
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, e.g. one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

d. Marking method for tick-box questions:

If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
If there is at least one tick, ignore crosses and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

e.g. if a question requires candidates to identify cities in England:

Edinburgh	
Manchester	
Paris	
Southampton	

the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	**2**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**NR**

e. For answers marked by levels of response:

i. **Read through the whole answer from start to finish**

ii. **Decide the level** that **best fits** the answer – match the quality of the answer to the closest level descriptor

iii. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

iv. Use the **L1**, **L2**, **L3** annotations in RM Assessor to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions include:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing

Question			Answer	Marks	Guidance
1	(a)		upward arrow same length as weight arrow (1); upward arrow labelled (normal) reaction (1); arrow pointing to left labelled friction/drag / air- resistance (1)	3	Part of arrow needs to be touching or near or inside the box **ALLOW** push of floor/ground, but **NOT** just 'push' **IGNORE** upthrust Part of arrow needs to be touching or near or inside the box **IGNORE** counter force **IGNORE** arrows pointing to the right but **NOT** if it is same size or larger than the friction arrow (negates this mark point)
	(b)		Any ***TWO*** from: forces in an interaction pair are the same size; an interaction force pair acts on different objects; these forces are not an interaction pair because they are different types of force; the ball travels at constant speed/terminal velocity because the forces are equal and opposite/resultant is zero	2	 Do **NOT** allow the idea that equal (and opposite) forces imply it must be an interaction pair **ALLOW** these forces are not an interaction pair because these forces act on the same object
			Total	5	

2	**(a)**	**(i)**	mass = 40 (J) /[0.5×1600 (m^2/s^2)] **or** answer on answer line = 0.05 (1); 50 (g) (1)	**2**	m.p.1 for substitution **and** rearrangement m.p. 2 is for conversion of **their** e.c.f. mass to grams **NOT** changing g on answer line to kg even if correct numerical answer gains both marks
		(ii)	the club continues to move/has KE/gains GPE after hitting the ball (1) ; some energy is transferred to heat/sound/noise (1) ;	**2**	 **ALLOW** lost as heat/sound/noise **IGNORE** lost to surroundings
	(b)	**(i)**	(=mass × velocity = 0.05 × 40 =) 2 (1); kg m/s (1)	**2**	**ALLOW** their final answer to 2ai converted to kg as e.c.f. **ALLOW** their 2ai × 40 evaluated (gets m.p.1) with gm/s (gets ecf for m.p. 2) **ALLOW** Ns / capital letters Answers 2 kgm/s and 2 gm/s get 2 marks irrespective of working **ALLOW** unit gm/s on its own without any working/numerical answer, but NOT kgm/s or any other momentum units
		(ii)	**0.50 ms** (1st answer)	**1**	
		(iii)	longer time in contact (1); Force × time is same value / Ft = mv – mu (1)	**2**	
			TOTAL	**9**	

Question			Answer	Marks	Guidance
3			**[Level 3]** **Both** types of motion described **and both** supported by use of data **and** one type of motion is explained. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **Both** types of motion described **and** one is explained **OR both** types of motion described **and** one type is supported by use of data. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** One type of motion described **and** explained **OR** one type of motion described **and** supported with data. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** **Indicative scientific points may include:** **describe motion:** • initially constant velocity/speed / steadily increasing displacement • finally/then slowing down/negative acceleration/deceleration **use of data** • initial constant velocity e.g. 200/10 = 20 m/s / eg. 200m in 10s • finally average velocities: e.g. 40-50 =17.5; 50-60=12.5; 60-70=7.5; 70-80=2.5 • decrease in average velocity e.g. 975/50 = 19.5 m/s • (constant) deceleration = 5/10=0.5 m/s^2 • calculations show smaller increments in displacement • identifies that the motion changes at 800 m **or** at 40 s (allow between 800 and 975 / 40 to 50 s) *This point can count for either type of motion but not both* **explanation:** • constant velocity/speed: due to balanced forces • slowing down due to unbalanced/resultant force • deceleration due to braking / no driving force Look for points next to table and on sketch graph **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
			Total	6	

Question			Answer	Marks	Guidance
4	(a)	(i)	(I=*P/V*=) 30 000/200 (1); = 150 (1)	2	 correct numerical answer gains both marks **ALLOW** either 0.15 **or** 30 ÷ 200 for 1 mark
		(ii)	heat up / get hot / overheat / temperature rise	1	**IGNORE** melt / burn / glow / break / fire
		(iii)	**only electrons……..positive** (3rd box)	1	
	(b)		**both** symbols correct (1); **both** symbols in correct positions (1)	2	Symbols are free-hand circles with a capital letter in them **IGNORE** lines through symbols **IGNORE** small gaps next to symbols **If no other mark awarded ALLOW** one correct symbol in the correct position for 1 mark
	(c)		Any ***TWO*** from: voltage across each lamp equals battery voltage / current from the battery will increase / resistance of the circuit will decrease; current through each lamp is 4A / the current from the battery is shared **equally**; total current from battery is 8A	2	no marks for no/yes, only reasons – ignore references to Noah 'current is shared' is **NOT** sufficient Do **NOT** allow '2A in each branch' as this is in the question m.p.3 also gains the first m.p.
	(d)		Adv: less/no pollution / named pollutant (1) ; Disadv: pedestrians can't hear car/get hit / low availability of charging points / long time needed to recharge (1)	2	**IGNORE** any costs / more sustainable / doesn't burn fossil fuels / eco-friendly / quieter / easier to maintain / references to diesel cars **IGNORE** any costs / range / less powerful / fossil fuels are used to produce the electricity needed to power them / /need to change battery / references to diesel cars
			Total	10	

5	**(a)**		Any ***THREE*** from: alternating/changing **current** (in primary) ; magnetic field (in iron core) ; changing (magnetic field) (magnet field) cuts secondary (coil) ; Voltage/pd/emf **induced** (across secondary)	**3**	 **IGNORE** alternating voltage / AC **IGNORE** voltage produced/created **NOT** current induced **If no other mark awarded ALLOW** one mark for recognising that it is a step-down transformer or that the secondary voltage is less
	(b)		**4 V** (3rd answer) ;	**1**	
			Total	**4**	

Question	Answer	Marks	Guidance
6	**[Level 3]** Valid comment on Zac **and** Megan's statements, with use of data to justify **both** of the comments. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Valid comment on Zac **and** Megan's statements, with use of data to justify one of the comments. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Valid comment on Zac **and** Megan's statements **OR** makes use of data e.g. does at least one correct resistance calculation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grade D/C** **Indicative scientific points may include:** **Zac correlation:** *example comments:* • Zac is wrong • There is a correlation *example uses of data:* • as one increase so does the other / positive correlation • both increase together • Larger temperature gives larger current • Not linear/proportional / Would not give straight line graph **Megan resistance:** *example comments:* • Megan is correct • resistance does change as temp increases/gets warmer/changes *example uses of data:* • Use of resistance formula and data / Calculates resistances (20, 12, 8, 5) all kΩ **Look for resistances near table** • Resistance decreases with temperature increase • Not linear/proportional / Would not give straight line graph A contradiction will result in the lower mark at the level e.g. a correct statement and an incorrect statement within a section **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	6	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>background count varies / to see if the reading has changed/stayed the same / so mean can be calculated</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>idea that activity falls by half in half-life time (1);

(Lucy)
(take background off activity 200 – 20) = 180 (1);

Dependent mark – m.p.2 must be awarded to award this mark:
counter reading is 110 (1)</td><td>3</td><td>First mark point can be awarded whether Dan or Lucy selected

ALLOW the material decays by half in half-life time

ALLOW use of other points on the graph to demonstrate this point e.g. take 20 off each of the y values

ALLOW 90 if y values have been corrected
(Watch out for ca</td></tr>
<tr><td></td><td>(c)</td><td></td><td>any value from 2 to 2.6 inclusive</td><td>1</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td><table><tr><th>Initial reading</th><th>Half-life</th><th></th></tr><tr><td>no change</td><td>changes</td><td></td></tr><tr><td>no change</td><td>no change</td><td></td></tr><tr><td>changes</td><td>changes</td><td></td></tr><tr><td>changes</td><td>no change</td><td>✓</td></tr></table></td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
8	(a)		(radiation) all around us /(subjected to) it all the time / from the environment	1	**ALLOW** naturally occurring (but **NOT** if part of a list) **IGNORE** named sources / in the air
	(b)		contamination: contact with **source** on/in body (1); irradiation: **source** outside body / radiation stops when person moves away / exposure to radiation (1); illustrates with either radon products cause contamination **OR** granite causes irradiation (1)	3	**ALLOW** exposed to alpha, beta or gamma
	(c)		Po: 84 (1) ; α: 4 (top) **and** 2 (bottom) (1);	2	**NOT** – 4 or – 2
	(d)		Similarity: same number of protons / same atomic number / both have 86 protons (1); Difference: number of neutrons / number of nucleons (1)	2	**ALLOW** same number of electrons / 86 electrons / both alpha emitters / same **chemical** properties / same charge **ALLOW** different mass/mass number
			Total	8	

Question	Answer	Marks	Guidance
9	**[Level 3]** Describes a risk **and** a risk mechanism **and** states risk minimizations **with** use of data. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Describes a risk **and** a risk mechanism **and** states risk minimizations **OR** describes a risk **and** states risk minimizations **with** use of data. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Any TWO correct points from TWO of the four areas. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** **Indicative scientific points may include:** **risk:** • Damage/mutate living cells • kill living cells • cause cancer **risk mechanism:** • produces ions / ionisation (**NOT** ionises cells) • ions can take part in other chemical reactions **risk minimization** • protection of patient/staff by shielding • spread treatment over time/no more x-ray treatments • each beam low intensity • any other sensible precaution **use of data** • many/200 beams used • dose from each beam = 10mSV (2000/200) < 100mSv • each beam below lowest dose to cause cancer later • total dose above recommended highest dose • other calculations using data in the table **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	6	

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