OCR
Oxford Cambridge and RSA

GCSE

Physics A

Unit **A181/02:** Unit 1 – Modules P1, P2, P3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2014

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.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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	alternative wording
ORA	or reverse argument

Available in scoris to annotate scripts

	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response

NBOD	no benefit of doubt
R	reject
✓	correct response
	draw attention to particular part of candidate's response
^	information omitted

Subject-specific Marking Instructions

a. If a candidate alters his/her response, examiners should accept the alteration.

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 boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.

This would be worth 1 mark.

Put ticks (✓) in the two correct boxes.

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

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 boxes:

Always check the additional guidance.

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. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses.
Credit should be given for each box correctly ticked. 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 a city in England, then in the boxes

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**

Question			Answer	Mark	Guidance
1	a	i	(time delay = 49 – 12 =) 37 (s) (1); (distance = 8 × 37 =) 296 (km) (1)	2	Ignore incorrect or missing units allow ± 1 s on difference, i.e. 36, 37 or 38 gets the first mark ecf own time delay : 2nd mark is for 8 x (whatever) = result 36 s gives 288 km & 38 s gives 304 km Correct answer with no working gets both marks
	a	ii	A calculation from data for 2000 km confirming the rule (1); Shows that data for 4000 km does not confirm the rule (1)	2	Calculation needed e.g. 250 x 8 = 2000 (km), 2000/8 = 250 (s) or 2000/250 = 8 (km/s) – **working must be shown** e.g. (4000/400 =) 10 (km/s), (4000/8 =) 500 (s)or (400 x 8 =) 3200 (km). Accept any of the three answers linked to 4000 km as evidence of equation not working Allow 2nd mark for reference to graph curving/levelling out after 2000 km but not just 'graph curves over' with no reference to when
	b		Density/state changes (with depth) (1); idea that S waves **and** P waves change speed with depth (differently) (1)	2	e.g. becomes more liquid e.g. 'the waves go faster' **ignore** reference to core the speed change must be linked to the change in the mantle e.g. the speed of P **and** S waves changes with depth/density/state
			Total	6	

Question			Answer	Mark	Guidance
2			**(Level 3)** Describes two improved observations including the redshift-velocity relationship. **AND** describes two new scientific ideas which followed including the distance velocity relationship Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **(Level 2)** Describes two improved observations including the distance to galaxies **AND** one new scientific idea which followed **OR** Describes one improved observation **AND** two new scientific ideas which followed including the expanding universe / galaxies moving theory Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **(Level 1)** Refers to improvements in observations e.g. in telescope design /positions **OR** describes one new scientific idea. 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 related to <u>improved observation</u> may include:** **Telescopic/observational advances** • early telescopes were not accurate/powerful enough • spectral analysis determines elements in stars • avoid light pollution /atmospheric interference, e.g. telescope on high mountains orbiting telescopes • **accept** larger apertures / use of mirrors for objectives to see fainter objects (P7) **Distance measurement** • distances to remote galaxies are very great • distance is measured by brightness • distance is measured by parallax • **accept** use of period of Cepheid variables to determine their luminosity (P7) **Velocity measurement** • redshift • greater redshift means greater velocity • accept Hubble's Law (P7) **Indicative scientific points related to <u>new scientific ideas which followed</u> may include:** • measurements show that galaxies are receding / the Universe is expanding • (in general) more distant galaxies move faster • this implies that all started at one point • the "Big Bang" occurred about 14 000 million years ago • the ultimate fate of the Universe is difficult to predict due to inadequate measurements (and theory) • The Milky Way is not the only galaxy / there are many others outside the Milky Way (P7) **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>3</td><td>a</td><td>i</td><td><table><tr><td>Bigger planets slower</td><td></td></tr><tr><td>Planets closer to Sun faster</td><td>✓</td></tr><tr><td>Biggest > 100 million km</td><td></td></tr><tr><td>Diameter ∝ 1/speed</td><td></td></tr><tr><td>There is a correlation</td><td>✓</td></tr></table></td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>Earth is 4500 (and 135 000) (1);
Uranus is (19229 and) 128834 (1)</td><td>2</td><td>Ignore extra sig. figs or rounding up or down</td></tr>
<tr><td></td><td></td><td>iii</td><td>Hardy‘s constants are closer (1);
Hardy’s model is better (1)
Data is limited (1)</td><td>2</td><td>Any two points

e.g. should have done for all planets</td></tr>
<tr><td></td><td>b</td><td></td><td>Any point for comet (1);

Any point for asteroid (1)</td><td>2</td><td><table><tr><th>Comet</th><th>Asteroid</th></tr><tr><td>Have a tail</td><td>No tail</td></tr><tr><td>Appear fuzzy</td><td>Look like sharp points</td></tr><tr><td>Have elliptical owtte orbits</td><td>Are (usually) more nearly circular orbits</td></tr><tr><td></td><td>Found in asteroid belt</td></tr><tr><td>Contain ice (and dust and rock)</td><td>Rocky</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
<tr><td>4</td><td>a</td><td></td><td><table><tr><td></td><td>T</td><td>F</td></tr><tr><td>The atmosphere...</td><td></td><td>✓</td></tr><tr><td>The Earth emits...</td><td>✓</td><td></td></tr><tr><td>The Sun does not emit...</td><td></td><td>✓</td></tr><tr><td>The Sun emits...</td><td></td><td>✓</td></tr><tr><td>Water vapour...</td><td>✓</td><td></td></tr></table></td><td>2</td><td>All correct = (2);
three or four correct = (1)</td></tr>
</table>

Question			Answer	Mark	Guidance
4	b		**(Level 3)** Describes the generally accepted scientific mechanism for GW, cites correlation between temperature and CO_2 levels as evidence linked to human activity and gives a reason for scientific disagreement on the issue. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **(Level 2)** May give effects of GW. Links an example of human activity to increased greenhouse gas concentrations. Suggests a reason for scientific disagreement on the issue. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **(Level 1)** Links human activity to greenhouse gases and relates to GW **OR** suggests a reason for scientific disagreement on the issue. May give an effect of GW. 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 related to <u>global warming</u> may include:** **Global warming:** • absorption of (infrared) radiation emitted by the warmed Earth by CO_2 / water vapour / methane (greenhouse effect) • CO_2 levels are increasing • global mean temperatures correlate with CO_2 levels in the atmosphere over a considerable time period • Computer models correlating with GW effects have been borne out • increased extreme weather events correlate with CO_2 levels **Human activity:** • increased burning fossil fuels by industrialisation and transport • Increased deforestation correlates with CO_2 levels as it is removed by plants **Indicative scientific points related to <u>scientific dispute</u> may include:** • correlation is not causation • old data may be unreliable • other factors (e.g. variable Sun) may cause GW • scientists may find it difficult to abandon own pet theories • scientists may not divorce scientific ideas for e.g. political commitment • might not be qualified in this area of science **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**8**	

Question			Answer	Mark	Guidance
5	a		<table><tr><td></td><td>T</td><td>F</td></tr><tr><td>A vacuum...</td><td>✓</td><td></td></tr><tr><td>Doubling the distance...</td><td></td><td>✓</td></tr><tr><td>Increasing the frequency...</td><td>✓</td><td></td></tr><tr><td>The only radiation...</td><td></td><td>✓</td></tr><tr><td>X-ray radiation...</td><td></td><td>✓</td></tr></table>	2	All correct = (2); three or four correct = (1)
	b		evidence of rule intensity = photon energy x photons per second (1) evaluating energy/s of violet = $3.0 \times 5.0 \times 10^{18} = 1.5 \times 10^{19}$ (1) photons per second for green = $1.5 \times 10^{19}/2.5 = 6.0 \times 10^{18}$ (1)	3	**accept** you need more green photons(because they have less energy) for the 1st marking point 1.5×10^{19} implies use of correct rule, so scores (2) **accept** correct answer in table or answer space with no supporting explanation for three marks
			Total	5	
6	a		ozone (in atmosphere) (1); absorbs UV/ the radiation(1)	2	
	b		valid benefit from sunbathing (1); consideration of risk/reducing risk (1)	2	e.g. warmth feels nice/ to get a tan/vitamin D production improves health/ can lower blood pressure e.g. benefit outweighs risk/people underestimate the risks/use protective measure, e.g. high factor sun cream/only do it for short times to keep risk small/ skin cancers can be easily seen and dealt with
			Total	4	
7			**Qualitative** Increased downloading/storing of music/videos/photos recently (1); Modern media files now are bigger/higher quality/contain more information (1); **Quantitative** Modern photo = 25 x bigger (1); Calculation of capacity of new or old computer (1)	3	Any three points, but two marks max in either category Can have 1 qualitative and two quantitative points e.g. showing that a 1000 MB could only hold 200 modern images / 322 songs / 83 minutes of videos / 1TB is 1000x bigger
			Total	3	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>8</td><td>a</td><td></td><td>
<table>
<tr><th rowspan="2">Energy source</th><th colspan="3">Possible disadvantages</th></tr>
<tr><th>Generates CO_2</th><th>Power station needs to pay for fuel</th><th>Cannot be used in all countries</th></tr>
<tr><td>Biofuel</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Coal</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Hydro</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>2</td><td>Mark by rows
All correct = 2
One or two correct rows = 1</td></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><th>for A</th><th>for B</th><th>neither</th></tr>
<tr><td></td><td></td><td>✓</td></tr>
<tr><td></td><td>✓</td><td></td></tr>
<tr><td>✓</td><td>✓</td><td></td></tr>
<tr><td>✓</td><td></td><td></td></tr>
</table>
</td><td>3</td><td>Mark by rows
All correct = 3
three correct rows = 2
one or two correct rows = 1</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>9</td><td>a</td><td></td><td>1300</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>Calculates power saving in kWh
7/8 the answer to (a)

OR

Calculates new fridge power use in kWh
1/8 the answer to (a) (1);

Then:
Calculates the cost saving from above with due allowance for rounding errors (1)</td><td>2</td><td>Allow 7/8 or 1/8 multiplied by a recalculation using the current (0.63A) and voltage (230V)

<table><tr><td></td><td colspan="4">power saving in kWh</td></tr><tr><td>Answer to (a):</td><td>1300</td><td>3200</td><td>1 300 000</td><td>3 200 000</td></tr><tr><td>7/8</td><td>1137.5</td><td>2800</td><td>1 137 500</td><td>2 800 000</td></tr><tr><td>1/8</td><td>162.5</td><td>400</td><td>162,500</td><td>400 000</td></tr><tr><td></td><td colspan="4">cost saving</td></tr><tr><td>saving</td><td>£182</td><td>£448</td><td>£182 000</td><td>£448 000</td></tr></table>
Unexpected results: calculate to check candidate's use of own figures. Watch for POT error kilowatts to watts and pence to pounds</td></tr>
<tr><td></td><td>c</td><td></td><td>suggestion why replacing fridge is not a good idea(1);

explanation or further detail (1)</td><td>2</td><td>Mark suggestion and explanation as a pair
e.g. capital cost (1); may not have that much cash to hand (1)
e.g. wasteful of resources (1); disposing of something that works (1);
e.g. pollutes environment(1); contains toxic chemicals (1)</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
<tr><td>10</td><td>a</td><td></td><td>$0.2 \times 400^2 = 32000$ W so P delivered = 68 000 W
$0.2 \times 40^2 = 320$ W so P delivered = 99 680 W (2)</td><td>2</td><td>One correct calculation of P wasted is enough for (1)
all four powers correct for (2)</td></tr>
<tr><td></td><td>b</td><td></td><td>current will be lower (1);

(smaller current) reduces power wasted / makes transfer more efficient (1)</td><td>2</td><td>Marking points are independent

Accept reduces energy /heat wasted</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
</table>

Question			Answer	Mark	Guidance
11			**(Level 3)** Uses a correct, relevant calculation(s) and discusses both advantages and disadvantages. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **(Level 2)** May quote data without calculation. Attempts a balanced argument of advantages and disadvantages OR an unbalanced argument supported by calculation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **(Level 1)** Qualitative discussion of one side of the argument only. May not attempt a balanced argument. 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 C** **Indicative scientific points may include:** Ignore confusion between PV and solar heating panels. **Advantages** • No CO_2 / no pollution produced / won't harm environment / eco-friendly • Renewable / will not run out • Power cuts won't affect them • Reduces the household bill • Can get money for excess electricity • The electricity produced is free **Disadvantages** • Doesn't produce all of the electricity required / less electricity in winter when needed most • Needs lots of panels / not enough panels for whole bill • Initial cost / outlay of money / takes time to pay back • Variable output with light /clouds/winter/night • Other sources of energy needed • Heavy/damaging on roof • Ugly • Maintenance needed **Data calculations** • 40 panels required to provide all the electricity • 12 panels would produce 12 X 0.6 = 7.2 kWh not 24kWh/ Energy bill is reduced by a third • Total area of 12 panels is = 12 x 1.5 x 0.8 = 14.4 m^2 • The cost of 12 panels is 12 x £200 = £2400. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553