

OXFORD

INTERNATIONAL  
AQA EXAMINATIONS

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# INTERNATIONAL GCSE COMBINED SCIENCE 9204/PE

Paper 3 Physics Extended

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Mark scheme

June 2019

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Version: 1.0 Final



J U N 1 9 9 2 0 4 / P E / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [oxfordaqaexams.org.uk](http://oxfordaqaexams.org.uk)

## Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

### Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Mark	AO / Spec. Ref.
01.1	<b>Level 3:</b> The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO4 3.20.2c/d
	<b>Level 2:</b> The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	<b>Level 1:</b> The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	<p><b>Indicative content</b></p> <p><b>Measurements</b></p> <ul style="list-style-type: none"> <li>• time using a timer / stopwatch</li> <li>• temperature using a thermometer</li> <li>• record starting temperature</li> <li>• record temperature after 5 minutes</li> <li>• vary the starting temperature</li> </ul> <p><b>Control variables</b></p> <ul style="list-style-type: none"> <li>• volume of water</li> <li>• sensible suggestion of volume eg 200 ml</li> <li>• volume / surface area of the beaker</li> <li>• material of the beaker</li> </ul> <p><b>Safety</b></p> <ul style="list-style-type: none"> <li>• hot water</li> <li>• risk of burns</li> <li>• glass risk of breakage</li> <li>• risk of cuts</li> </ul> <p>To access level 3 students must correctly describe the use of a thermometer and stop watch and mention at least one control variable</p>		

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<b>01.2</b>	1 °C		1	AO4 3.20.2d
<b>01.3</b>	the greater the starting temperature the greater the temperature change  so the rate of cooling increases when the starting temperature is greater	allow converse  an explanation of how the difference in temperature between the water and the surroundings affects rate of cooling can score 2 marks	1  1	AO3 3.20.2d
<b>01.4</b>	shiny surfaces are poor emitters / good reflectors (of radiation)  so the rate of energy transfer is reduced	allow converse for matt, black surfaces	1  1	AO2/AO1 3.20.2a
<b>Total</b>			<b>11</b>	




<p><b>02.3</b></p>	<p>12 kHz = 12 000 Hz</p> <p>2.8 cm = 0.028 m</p> <p>speed = 12 000 × 0.028</p> <p>speed = 336 (m/s)</p>	<p>an answer of 336 (m/s) or 340 (m/s) scores 4 marks</p> <p>allow correct substitution of incorrectly/not converted values for frequency and wavelength</p> <p>allow a correctly calculated answer using incorrectly/not converted values for frequency and wavelength</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO2 3.19.1h</p>
<p><b>02.4</b></p>	<p>to calculate a mean</p> <p>which reduces the effect of random errors</p>	<p>allow to identify anomalous results</p>	<p>1</p> <p>1</p>	<p>AO3 3.19.3c</p>
<p><b>02.5</b></p>	<p>improvement : use a greater distance</p> <p>reason: reduces the effect of timing errors starting and stopping the stop watch</p> <p><b>OR</b></p> <p>improvement: electronic sensor/timer that calculates the time automatically (1)</p> <p>reason: avoids reaction time errors (1)</p>	<p>do not allow stand closer to the wall</p>	<p>1</p> <p>1</p>	<p>AO4 3.19.3c</p>
<p><b>Total</b></p>			<p><b>16</b></p>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(mains) electricity is (often) generated using fossil fuels so carbon dioxide is emitted (at the power station)	allow production of the car/battery requires the burning of fossil fuels	1 1	AO2 3.18.3c
03.2	petrol car uses 1/3 of a tank <b>and</b> electric car needs charging once  (cost of petrol = $\frac{1}{3} \times 50 \times 1.17$ )  cost of petrol = \$19.5    (cost of charging = $\$0.2 \times 40$ ) cost of charging = \$8  difference in cost = \$11.5	an answer of \$11.5(0) gains 4 marks    this and subsequent marks may be awarded if the cost of a full tank of fuel is used    allow a correct calculation if incorrect number of charges used   allow a correct subtraction using an incorrect calculated value for the cost of the petrol  allow max 3 marks if diesel car is used	1  1  1  1	AO2 3.18.3a

<b>03.3</b>	<b>Level 2:</b> Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO2/AO3 3.18.3a
	<b>Level 1:</b> Relevant features are identified and differences noted.	1–3	
	<b>No relevant content</b>	0	
	<b>Indicative content</b>  <b>Petrol</b> <ul style="list-style-type: none"> <li>• least expensive to buy</li> <li>• most expensive to run</li> <li>• higher CO<sub>2</sub> emissions than others</li> <li>• contributes to global warming</li> <li>• fuel is readily available</li> <li>• fuel will run out</li> <li>• fuel costs are likely to rise</li> <li>• longer range than electric cars</li> </ul> <b>Diesel</b> <ul style="list-style-type: none"> <li>• more expensive to buy than petrol cars</li> <li>• less expensive than electric cars</li> <li>• longest range</li> <li>• cheaper to run than petrol cars</li> <li>• slightly less CO<sub>2</sub> than petrol cars</li> <li>• contributes to global warming</li> <li>• fuel is readily available</li> <li>• fuel will run out</li> <li>• fuel costs are likely to rise</li> </ul>		

	<p><b>Electric cars</b></p> <ul style="list-style-type: none"> <li>• most expensive to buy</li> <li>• cheapest to run</li> <li>• don't contribute to global warming</li> <li>• not many charging points at the moment</li> <li>• not practical for long journeys</li> <li>• renewable energy</li> </ul> <p><b>Calculations</b></p> <ul style="list-style-type: none"> <li>• any comparison may involve a calculation</li> </ul>		
<b>Total</b>			<b>12</b>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(the copper expands more than the iron so) copper is longer than the iron  this causes the bi-metallic strip to bend upwards  the contacts are pushed together  completing the electrical circuit	allow this forces the iron upwards	1   1  1  1	AO1/AO2 3.20.2e
04.2			1	AO1 3.21.1f
04.3	(when the temperature increases) the resistance of the thermistor decreases  the current in the circuit increases  and the potential difference across the variable resistor increases  this causes the air-conditioning unit to switch on	allow converse	1   1  1  1	AO1/AO2 3.21.1f



<b>04.6</b>	curved graph drawn with a steeper gradient between 20 °C and 40 °C		1	AO2 3.21.1f
<b>Total</b>			<b>15</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	mass		1	AO4 3.18.2e
05.2	<p><math>\text{gpe} = 0.050 \times 9.8 \times 1.2</math></p> <p><math>\text{gpe} = 0.59 \text{ (J)}</math></p> <p><math>\text{efficiency} = \frac{0.59}{4.4} \times 100\%</math></p> <p>efficiency = 13%</p>	<p>a correct answer that rounds to 13 % scores 4 marks</p> <p>allow a correct substitution using an incorrectly calculated value of gpe</p> <p>allow a correct calculation using an incorrect value of gpe</p> <p>max 2 marks if <math>g = 10 \text{ N/kg}</math> is used</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	AO2 3.18.1d/ 3.18.2e
05.3	<p>scales chosen so that the points fill at least half of the paper scales in sensible increments eg 1, 2</p> <p>all points plotted correctly</p> <p>a curved line of best fit passing within 1 mm of all points</p>	<p>allow 1 mark for 4 or 5 points plotted correctly</p>	<p>1</p> <p>2</p> <p>1</p>	AO2 3.18.2e
05.4	<p>as mass increases efficiency increases</p> <p>efficiency reaches a maximum value or becomes constant at a mass of 0.6 kg</p>	<p>allow (max) efficiency of 0.13 for mass of 0.6 kg</p> <p>allow the relationship is non-linear/not directly proportional</p>	<p>1</p> <p>1</p>	AO3 3.18.2e
05.5	transferred to the surroundings / air		1	AO1 3.18.2d

<b>05.6</b>	when the motor cannot lift the mass efficiency is zero		1	AO2 3.18.2e
	no useful output energy	allow no useful work is done allow all of the energy is wasted	1	
<b>05.7</b>	reverse the current	allow reverse the potential difference	1	AO1 3.22.2c
	so that the motor turns in the opposite direction	marking point two is dependent on marking point one	1	
<b>Total</b>			<b>16</b>	

Question	Answers	Mark	AO / Spec. Ref.
06.1	<b>Level 2:</b> Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 / AO3 3.18.3a/b/c/d
	<b>Level 1:</b> Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	<b>Indicative content</b>  <b>Sun</b> <ul style="list-style-type: none"> <li>• emits light / electromagnetic waves</li> <li>• is a star</li> <li>• remains in one place</li> <li>• mainly composed of hydrogen</li> <li>• releases energy through nuclear fusion</li> <li>• largest object in the solar system</li> </ul> <b>planet</b> <ul style="list-style-type: none"> <li>• does not emit its own radiation</li> <li>• reflects radiation from the sun</li> <li>• orbits the Sun</li> <li>• can be rocky or gaseous</li> <li>• smaller than the Sun</li> </ul> <b>moon</b> <ul style="list-style-type: none"> <li>• does not emit its own radiation</li> <li>• reflects radiation from the Sun</li> <li>• orbits a planet</li> <li>• made from rock left over when the solar system formed</li> <li>• caught in the gravitational field of a planet</li> <li>• smaller than the Sun / planets</li> </ul>		

<p><b>06.2</b></p>	<p>(if the relationship between altitude and orbital speed is inversely proportional) height above Earth's surface <math>\times</math> orbital speed = constant</p> <p>in <b>Table 5</b> any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• HST <math>600 \times 7.56 = 4536</math></li> <li>• GPS <math>20200 \times 3.87 = 78174</math></li> <li>• TV satellite <math>35800 \times 3.07 = 109906</math></li> </ul> <p>(therefore not inversely proportional)</p>	<p>alternative for 2 marks: orbital speed of GPS is approximately half of HST altitude of GPS is more than double the altitude of HST</p>	<p>1</p> <p>1</p>	<p>AO3 3.24.2f</p>
<p><b>06.3</b></p>	<p>acceleration is rate of change of velocity</p> <p>velocity is a vector</p> <p>and the satellite changes direction (continually when in orbit)</p>	<p>allow velocity has direction</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO1 3.24.2e</p>
<p><b>06.4</b></p>	<p>(the force due to) gravity decreases as the distance from Earth increases</p> <p>so the orbital speed is lower</p>	<p>allow the converse</p>	<p>1</p> <p>1</p>	<p>AO1 3.24.2f</p>

<p><b>06.5</b></p>	<p>yes</p> <p><math>\frac{86320}{3600} = 23.98</math> hours</p> <p>a geostationary satellite orbits the Earth once in 24 hours</p>	<p>no mark for yes</p> <p>allow 24 hours</p> <p>allow any correct method</p> <p>allow 2 marks for no if 23.98 hours is less than 24 hours is seen</p>	<p>1</p> <p>1</p>	<p>AO3 3.24.2d</p>
<p><b>06.6</b></p>	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• no atmospheric effects</li> <li>• not affected by weather</li> <li>• no light pollution</li> <li>• some types of EM radiation do not pass through the atmosphere</li> <li>• can be used 24 hours a day</li> <li>• clearer image</li> </ul>	<p>ignore can see further</p> <p>ignore closer to the objects being viewed</p>	<p>1</p>	<p>AO3 3.24.2d</p>
<p><b>06.7</b></p>	<p>distance = <math>\pi \times 2 (6.4 \times 10^3 + 600)</math></p> <p>distance = <math>4.4 \times 10^4</math> km</p> <p><math>t = \frac{4.4 \times 10^4}{7.56}</math></p> <p>t = 5817 s</p>	<p>an answer of 5817 s scores 3 marks</p> <p>allow substitution of <math>4.0 \times 10^4</math> km</p> <p>allow a correct calculation using <math>4.0 \times 10^4</math> km for distance</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO1/AO2 3.24.2c</p>

<b>06.8</b>	third law		1	AO1 3.17.3a
<b>Total</b>			<b>18</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	$10^{-15}$ to $10^4$ m and beyond		1	AO1 3.19.2b
07.2	visible light has a longer wavelength and a lower frequency than X-rays		1	AO1 3.19.2b
07.3	there is little difference between the measurements so a high resolution is needed		1	AO4 3.19.2b
		allow for 2 marks all measurements would be the same if a regular protractor was used	1	
07.4	used a very narrow ray so that the middle of the ray is easier to see  <b>OR</b> used a single colour (1)  so that the edge of the ray of that wavelength can easily be seen (1)		1	AO4 3.19.2b
			1	
07.5	as wavelength decreases the angle of refraction decreases	allow the converse	1	AO3 3.19.1f

<p><b>07.6</b></p>	<p>speed of red light in glass</p> $= \frac{3 \times 10^8 \times 65}{100} \quad \text{or} \quad 1.95 \times 10^8 \text{ m/s}$ $1.95 \times 10^8 = 4.5 \times 10^{14} \times \lambda$ $\lambda = \frac{1.95 \times 10^8}{4.5 \times 10^{14}}$ $\lambda = 4.33 \times 10^{-7} \text{ m}$ $\lambda = 4.3 \times 10^{-7} \text{ m}$	<p>an answer of <math>4.3 \times 10^{-7} \text{ m}</math> scores 5 marks</p> <p>allow a correct substitution using an incorrect value for v</p> <p>allow a correct rearrangement using an incorrect value of v</p> <p>allow a correct calculation using an incorrect value of v</p> <p>allow a calculated value of <math>\lambda</math> correctly rounded to 2 significant figures</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO2 3.19.1f</p>
<p><b>Total</b></p>			<p><b>12</b></p>	