

Mark Scheme

Summer 2016

Pearson Edexcel International GCSE  
Physics (4PH0) Paper 1P  
Science Double Award (4SC0) Paper 1P

Pearson Edexcel Level 1/Level 2 Certificate  
Physics (KPH0) Paper 1P  
Science (Double Award) (KSC0) Paper 1P

## Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information, please visit our website at [www.edexcel.com](http://www.edexcel.com).

Our website subject pages hold useful resources, support material and live feeds from our subject advisors giving you access to a portal of information. If you have any subject specific questions about this specification that require the help of a subject specialist, you may find our Ask The Expert email service helpful. [www.edexcel.com/contactus](http://www.edexcel.com/contactus)

### **Pearson: helping people progress, everywhere**

Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

Summer 2016

Publications Code 4PH0\_1P\_1606\_MS

All the material in this publication is copyright

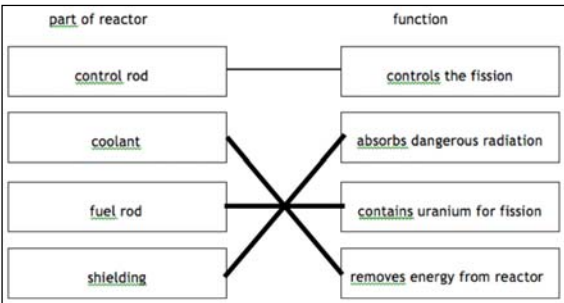
© Pearson Education Ltd 2016

## General Marking Guidance

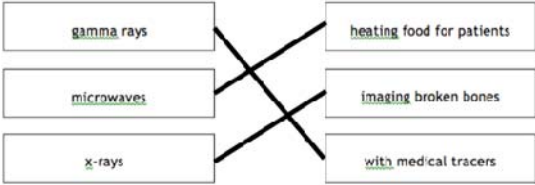
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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)	B – the horizontal part of the line;		1
(b)	A – the area under the line;		1
(c)	B – the distance moved divided by the time taken;		1

Total 3 marks

Question number	Answer	Notes	Marks
2 (a)	<p>All lines correct = 2 marks Any correct added line = 1 mark</p> 		2
(b)	kinetic energy;		1
(c)	<p>slows <u>neutrons</u>/reduces KE of <u>neutrons</u>;</p> <p>and any one from</p> <p>(which)allows fission to continue; (which) causes (induced) fission; (so) neutrons can be absorbed by <u>uranium</u>;</p>	<p>makes the neutrons thermal/eq ignore moderator absorbs neutrons</p> <p>ignore</p> <ul style="list-style-type: none"> <li>neutrons collide with uranium</li> <li>successful collisions</li> </ul>	2
(d)	<p>any three of -</p> <p>MP1 each fission (of a nucleus) caused by a single neutron;</p> <p>MP2 each fission releases more than one neutron;</p> <p>MP3 excess neutrons can speed up the reaction;</p> <p>MP4 (more) fissions release excess energy;</p> <p>MP5 control rods absorb neutrons;</p> <p>MP6 control rods regulate the rate of fission/reaction;</p>	<p>e.g. a nucleus splits when neutron has been absorbed</p> <p>ignore 'block'/ eq allow control rods speed up/slow down rate of fission</p>	3

Total 8 marks

Question number	Answer	Notes	Marks
3 (a) (i)	C – speed in free space;		1
(ii)	All lines correct = 2 marks Any correct line = 1 mark  <div style="display: flex; justify-content: space-around; font-size: small;"> <span>type of electromagnetic wave</span> <span>use</span> </div> 		2
(iii)	(direction of vibration) perpendicular to (direction in which the wave travels);	allow at right angles to or 90° to	1
(b) (i)	D – 45 000 Hz;		1
(ii)	Any two of -  wave travels there and back; depth is half total distance travelled; time (to target) is half total (travel) time;	ignore phrase about reflection received as in stem	2
(iii)	wavelength is longer in patient or wavelength shorter in air;  and <b>one</b> of:-  (because) $v = f \times \lambda$ ;  OR  (because) frequency does not change;	allow wavelength is longer in more dense medium  ignore <ul style="list-style-type: none"> <li>• speed related to medium</li> <li>• as speed increases wavelength increases</li> </ul>	2
Total 9 marks			

Question number	Answer	Notes	Marks
4 (a)	<p>Substitution into given equation;</p> <p>Rearrangement;</p> <p>Calculation; e.g. <math>101 \times 1700 = p_2 \times 12</math> <math>p_2 = 101 \times 1700 \div 12</math> <math>= 14\ 000</math> (kPa)</p>	<p>NB Equation is given on page 2 of QP</p> <p>Substitution and rearrangement in either order</p> <p>Accept working in Pa or kPa, litres and/or m<sup>3</sup>. POT error = -1 mark</p> <p>14300 (kPa) 14 MPa correct answer without working scores 3 marks</p>	3
(b) (i)	In words or $p = h \times \rho \times g$ ;	<p>For <math>g</math> Accept "acceleration due to gravity" Reject "gravity"</p> <p>For <math>h</math> Accept depth or height</p> <p>For <math>p</math> accept pressure or pressure difference or as <math>\Delta p</math></p>	1
(ii)	<p>Substitution; Calculation; e.g. <math>p = 11 \times 1028 \times 10</math>  <math>= 110</math> (kPa)</p>	<p>Allow <math>g = 9.8 \text{ m/s}^2</math></p> <p>113 (kPa) 113080 Pa</p> <p>Allow 111 kPa or 110818 Pa (from <math>g = 9.8 \text{ m/s}^2</math>)</p>	2
(iii)	Answer to (b)(ii) + 101 (kPa);	<p>Allow 210 (kPa) 211 214 Reject answer if new PoT error</p>	1

Question number	Answer	Notes	Marks
(c)	<p>EITHER</p> <p>MP1 pressure decreases (with decreasing depth)/ <math>p = h \times \rho \times g</math>;</p> <p>MP2 <math>pV</math> is constant (for fixed mass of gas)/ <math>p_1 \times V_1 = p_2 \times V_2</math>;</p> <p>OR</p> <p>MP3 Sea may be warmer near the surface;</p> <p>MP4 (causing the pressure inside the bubble to increase)which causes the volume to increase</p>	<p><math>v</math> is inversely proportional to <math>p</math></p> <p>MP4 is DOP on MP3</p>	2

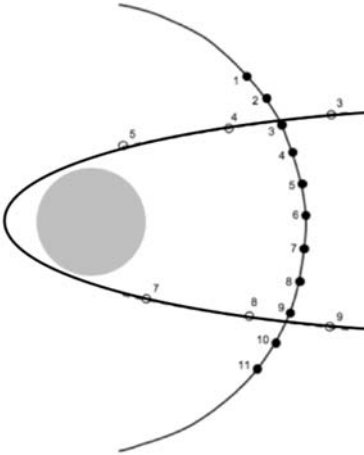
Total 9 marks



Question number	Answer	Notes	Marks
5 (a)	(i) Voltmeter connected in parallel with a component; component is LDR;	not in parallel with wire	2
	(ii) measure current / take current reading; divide voltage (reading) by current (reading);	accept <ul style="list-style-type: none"> <li>• number of amps for current</li> <li>• p.d. or number of volts for voltage</li> <li>• <math>R = V/I</math></li> </ul> Ignore triangle mnemonics	2
(b)	(i) B – the diameter of the hole;		1
	(ii) C – the distance from the card to the LDR;		1
	(iii) Any one of - Move ruler to cover half the hole/halfway down the hole;  Draw guide lines;  Use set square;	idea of measuring across/over the diameter at right angles to ruler Placed against ruler Ignore: move ruler nearer the hole/start from 0 on the ruler	1

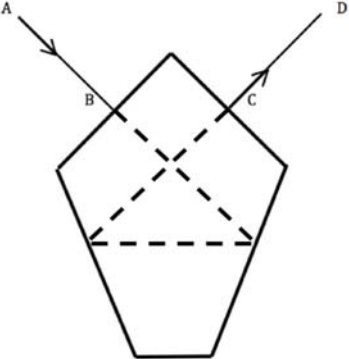
Continued



Question number	Answer	Notes	Marks
6 (a) (i)	Comet orbit behind Sun completed correctly;	Dashed or solid curved line	1
	(ii) X marked anywhere in grey area;  e.g. <div data-bbox="605 646 967 1098" data-label="Image">  </div>	No need to label X as "Sun" X should be left of the imaginary 5-7 line, reject X placed outside the orbit  the curve should be 'pointy' not a part of a circle, such that distance week6-week 5 > distance week 5-week4	1
	(iii) Any one of the following ideas- MP1. comet was behind/near the Sun; MP2. comet was obscured/eclipsed by Sun; MP3. light from comet could not reach astronomer; MP4. Sun too bright to allow observation; MP5. we should not look directly at the Sun;	Allow labelled sketch	1
	(iv) C – week 9;		1
	(v) Any two of - MP1. Same time between observations;  MP2. Different distances between observations; MP3. Speed = distance ÷ time;	Allow specific reference to 'a week' as the same time between observations	2

(vi)	<p>Any one of - Energy argument – transfer of GPE to KE (ORA);</p> <p>Force argument, e.g. pulled by the Sun’s gravitational force;</p>	<p>Ignore</p> <ul style="list-style-type: none"> <li>unqualified ‘pulled by gravity’</li> <li>gravitation from other bodies</li> </ul>	1
(b)	<p>Substitution into given formula;</p> <p>Conversion from days to hours; Calculation; e.g. <math>v = 2 \times \pi \times 150\,000\,000 \div (365 \times 24)</math> = 110 000 (km/hour)</p>	<p>24 seen</p> <p>107 589/108 000 (km/hour) Allow due <math>\pi</math> (ONLY) a number that rounds to 110 000</p> <p>2 582 130 = 2 (no 24 hr) 43 036 = 2 (used 60 instead of 24)</p>	3

Total 10 marks

Question number	Answer	Notes	Marks												
7 (a)	<p>3 or more correct lines = 2 marks Any two correct lines = 1 mark</p> <table border="1" data-bbox="440 394 1029 1171"> <thead> <tr> <th data-bbox="440 394 870 506">Notes about the total internal reflection of light</th> <th data-bbox="870 394 1029 506">Right or wrong</th> </tr> </thead> <tbody> <tr> <td data-bbox="440 506 870 646">the angle of incidence equals the angle of reflection</td> <td data-bbox="870 506 1029 646">✓</td> </tr> <tr> <td data-bbox="440 646 870 747">light changes speed when it is internally reflected</td> <td data-bbox="870 646 1029 747">x</td> </tr> <tr> <td data-bbox="440 747 870 926">every ray entering the semicircular glass block is reflected by total internal reflection</td> <td data-bbox="870 747 1029 926">x</td> </tr> <tr> <td data-bbox="440 926 870 1031">if <math>i = 0</math> then the ray does not deviate</td> <td data-bbox="870 926 1029 1031">✓</td> </tr> <tr> <td data-bbox="440 1031 870 1171">the refractive index of glass is bigger than the refractive index of air</td> <td data-bbox="870 1031 1029 1171">✓</td> </tr> </tbody> </table>	Notes about the total internal reflection of light	Right or wrong	the angle of incidence equals the angle of reflection	✓	light changes speed when it is internally reflected	x	every ray entering the semicircular glass block is reflected by total internal reflection	x	if $i = 0$ then the ray does not deviate	✓	the refractive index of glass is bigger than the refractive index of air	✓		2
Notes about the total internal reflection of light	Right or wrong														
the angle of incidence equals the angle of reflection	✓														
light changes speed when it is internally reflected	x														
every ray entering the semicircular glass block is reflected by total internal reflection	x														
if $i = 0$ then the ray does not deviate	✓														
the refractive index of glass is bigger than the refractive index of air	✓														
(b)	<p>MP1 only <b>two</b> internal reflections attempted; MP2 horizontal line from first TIR to second TIR; MP3 ray does not deviate on exit;</p> 	<p>horizontal line by eye ignore arrows</p>	3												

Question number	Answer	Notes	Marks
7 (c) (i)	Statement of $\sin c = 1/n$ ; Substitution; Calculation;  e.g. $\sin c = 1/n$ .....worth 1 $\sin c = 1/1.5$ .....worth 2 (= 0.667) so $c = 41.8^\circ$ .....worth 3	Value of c (or n) to at least 3 s.f.  Allow reverse argument for max 2. $\sin 42^\circ = 0.669$ , giving $n = 1.49$ ("about 1.5") $\sin 42 \times 1.5 = 1.0036 \approx 1$ ( $\sin 42 = 1/1.5$ ) Beware spurious maths that gives about 42 degrees	3
(ii)	Any two of the following ideas:-  • $RI = \sin i / \sin r$  • $RI(n)$ is (only) a <u>number /ratio</u> ;  • a sine is a number /ratio;	allow  $n = \text{speed}_1 / \text{speed}_2$ $n = 1 / \sin c$  proportion for ratio  units cancel out	2
(d) (i)	Plot at 1.5, 42;	no tolerance	1
(ii)	Any one of - Fits the trend/pattern; (point is on) an extrapolation of line to;	May be shown on graph OR e.g. "where the line would go"	1
(iii)	Any two of - MP1. Idea that a reduced scale gives full(er) use of grid;  MP2. $RI$ is always more than 1 (for incidence in air) MP3. angle c greater than $\sim 20^\circ$ ;	allow reduced scale fits the data ranges (of $RI$ or $c$ ) ignore $RI > 0$  allow angle c never zero	2

Total 14 marks

Question number	Answer	Notes	Marks
8 (a)	(metre) ruler;	allow set square, tape measure, digital callipers ignore metre stick	1
(b)	<p>Up to five marks, no more than 3 from each section:-</p> <p><b>Recording data</b> Any three of - MP1. measure original length; MP2. add a (known) weight/force/load/mass; MP3. measure the new length / extension; MP4. Repeat for range of values of load; MP5. Experimental detail;</p> <p><b>Handling data / conclusions</b> Any three of - MP6. Calculate extension; MP7. Plot graph of extension/length against force/weight/load; MP8. Graph should be a straight line; MP9. Extension graph should pass through origin; MP10. Force proportional to extension;</p>	<p>e.g.</p> <ul style="list-style-type: none"> <li>• distance measurements from the same point each time</li> <li>• use of pointer/indicator</li> <li>• reduce parallax</li> <li>• repeats <b>and</b> average (for each load)</li> </ul> <p>Allow length, but not mass calculate k from data k is constant</p> <p>Not for length graph</p> <p>allow load for force</p>	5

Total 6 marks

Question number	Answer	Notes	Marks
9 (a) (i)	Current that passes in one direction <b>only</b> ;	ignore current varies	1
(ii)	Any three of - MP1 provides a connection / current to the coil/commutator; MP2 idea of reverses the current in the coil;  MP3 Every half turn; MP4 Reverses (coil) field /polarity (every half turn); MP5 So that the force is always in the same direction;  MP6 So that the motor keeps turning (the same way);	allow swops the contacts/ ensures that current always flows clockwise through the coil/eq  so the moment is always in the same direction	3
(iii)	Any one of - Still spins clockwise; No (overall) effect/direction remains the same; The two changes cancel out/nothing changes;	Ignore "nothing happens" unless clear that rotation continues	1
(b) (i)	power = voltage × current;	Accept symbols $P=I \times V$ Condone a mix of correct symbols and words	1
(ii)	Substitution and calculation; Conversion to megawatts;  e.g. $P=I \times V$ $P= 4000 \times 600 = 2\,400\,000 \text{ (W)}$ $= 2\,400\,000 \div 1\,000\,000$ $= 2.4 \text{ (MW)}$	division by $10^6$ or 1 000 000 seen  correct answer without working scores two marks	2

Continued



Question number	Answer	Notes	Marks
9 (c) (i)	work done = force × distance (moved)	Accept symbols $W = F \times d$ $W = Fd$	1
(ii)	Substitution; Calculation; e.g. Work = 400 000 × 190 76 000 000 (J)	Accept 76 MJ with correct unit $7.6 \times 10^7$ (J) $76 \times 10^6$ (J)	2
(d) (i)	Substitution into given equation; $P = W/t$  Rearrangement;  Calculation; e.g. $1.9 = 67 \div t$ .....worth 1 $t = 67 \div 1.9$ .....worth 2  $= 35$ (s).....worth 3	No mark for the equation as it is given in QP Substitution and rearrangement in either order  Or (in joules and watts) $67\,000\,000 \div 1\,900\,000$ (35.26) correct answer without working =3	3
(ii)	Any one of :- Takes longer /eq;  More time needed to raise coal; Load moves more slowly;	Ignore: unqualified comments about the amount of work done	1

Total 15 marks

Question number	Answer	Notes	Marks
10 (a) (i)	<p>5.4 ± 0.1 (cm);;</p> <p>if out of range allow 1 mark for 5.4 ± 0.2 (cm)</p> <p>if answer quoted to 3 or more SF, then deduct 1 mark</p>	<p>In the range 5.3 to 5.5 = 2 marks</p> <p>5.2 OR 5.6 = 1 mark</p>	2
	(ii)	Accept 5.1	1
	(iii)	<p>Substitution;</p> <p>Calculation;</p> <p>e.g. circumference = 1.510 × 3.142 = 4.744 cm</p>	2
(b)	<p>Any four of :-</p> <p>General -</p> <p>MP1. Different precision / use of significant figures;</p> <p>MP2. Calculation error / value for <math>\pi</math> / unit error;</p> <p>MP3. Unskilled use of equipment;</p> <p>MP4. width of pen mark;</p> <p>String -</p> <p>MP5. Stretches / bends / has inconsistent tension;</p> <p>MP6. Thickness of string makes the circumference larger;</p> <p>MP7. Parallax error (when using ruler);</p> <p>Calliper -</p> <p>MP8. Zero error / calibration error;</p> <p>MP9. Pipe damaged / pipe not quite circular / equation assumes pipe is circular;</p>	<p>Allow a reverse argument where appropriate</p> <p>ignore 'accurate'</p> <p>Can't do a true circle (only a helix)</p> <p>e.g. may not draw dots in a straight enough line, may not get the calliper at 90 degrees to the pipe, may crush the pipe with calliper</p> <p>Ignore unqualified 'human error'</p> <p>Total 9 Marks</p>	4

Question number	Answer	Notes	Marks
11 (a) (i)	kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$	Accept symbols $\text{KE} = \frac{1}{2} \times m \times v^2$	1
(ii)	Conversion of units; Substitution and rearrangement into correct formula; Calculation; e.g. $18 \text{ MJ} = 18\,000\,000 \text{ J}$ $v^2 = 18\,000\,000 \times 2 \div 250\,000 (= 144)$ $v = 12 \text{ (m/s)}$	at any stage  POT error max 2 marks e.g. $3.8 \times 10^n$ or $1.2 \times 10^n$	3
(iii)	Energy is transferred to surroundings;	Allow to heat, sound, other forms / energy decreases	1
(b) (i)	Any two of - MP1. $\text{GPE} = m.g.h$ ;  MP2. passengers have moved to a higher point/upwards; MP3. work is done to move the passengers;  MP4. passengers are further from the centre of the earth;	allow 'lift' for 'passengers' 'gravity force' (still) acts below ground level, reject 'gravity'  moved in opposite direction to force of gravity	2
(ii)	max of 3 from each list to total of 4 <b>When entering station-</b> MP1. $\text{KE} \rightarrow \text{GPE}$ ; MP2. Less work done by the brakes (to stop the train); MP3. Less (braking) force needed (to stop) ; MP4. train stops more quickly OR brakes are needed for less time (to stop);  <b>When leaving station-</b> MP5. $\text{GPE} \rightarrow \text{KE}$ ; MP6. Less work done by the motor (to accelerate); MP7. Less force needed (to accelerate	Allow  energy for work  an effect on the brakes, e.g. don't get so hot / are quieter / last longer / are less worn  Allow  less power/ current	4

	MP8. the train); train accelerates more quickly OR force needed for a shorter time (to reach a given speed);	needed motor lasts longer / is less worn	
--	---	--	--

Total 11 marks

Question number	Answer	Notes	Marks
12 (a)	two correct comparative statements about temperature:- MP1 Bear('s fur) and snow about the same temperature; MP2 Bear's head/nose/eyes warmer (than fur); MP3 Bear's eyes are warmer than eyes/nose OR bear's eyes are the warmest; MP4 Sky/air is cooler than bear/snow OR sky/air is the coldest;	allow reverse arguments  bear's nose is cooler than its eyes  bear/snow warmer than air	2
(b) (i)	Any two of - MP1. (hollow) hair / fibres contains an <u>insulator</u> ; MP2. air is an insulator/poor conductor (of thermal energy); MP3. air is kept / trapped near the body (by fur); MP4. convection currents cannot form between hairs; MP5. white fur is a poor emitter of thermal energy / I R;	hair is an insulator  only small convection currents can form	2
(ii)	Any three of - MP1. Black (skin) is a good emitter/radiator of thermal energy; MP2. White (fur) is a good reflector of thermal energy; MP3. Black (skin) is a good absorber of thermal energy; MP4. the reflected thermal energy is absorbed by the black (skin);	Allow white fur is a poor emitter.	3
(c) (i)	Any two of- MP1. Snow reflects UV OR does not absorb UV; MP2. Sky absorbs UV OR does not reflect UV; MP3. Bear('s fur) absorbs UV OR does not reflect UV; MP4. Bear's eyes reflect UV OR do not absorb UV;	ignore other verbs such as emits radiates	2

(ii)	Any one of- Sky absorbs UV;  Sky not emitting UV; Sun not included in image;	allow air or atmosphere for sky ignore 'blocks out' Accept sky doesn't reflect or only reflects UV diffusely	1
(iii)	Any two of - MP1. UV/light travels in air, not in glass or hair (material);  MP2. UV is absorbed by hair; MP3. TIR does not happen;  MP4. explanation of why TIR can't happen ;	light/UV always travels in the less dense medium ORA for optical fibre  Allow reflection in hair is external, not internal there is no critical angle	2

Total 12 marks



