

# Mark Scheme (Results)

Summer 2013

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

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

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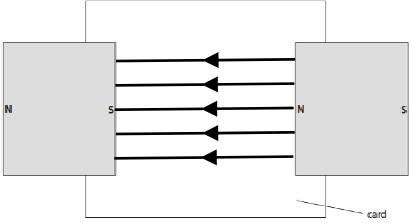
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Question number	Answer	Notes	Marks
1 (a) (i)	B - 1 joule per second (1 J/s)		1
(ii)	C - 1 newton per square metre (1 N/m <sup>2</sup> )		1
(b) (i)	A - the direction of a magnetic field		1
(ii)	A - has uniform strength		1
		<b>Total</b>	<b>4</b>

Question number	Answer	Notes	Marks						
2 (a)	<table border="1" data-bbox="434 276 1216 470"> <tr> <td data-bbox="434 276 707 373">longest wavelength</td> <td data-bbox="707 276 949 373" style="text-align: center;">→</td> <td data-bbox="949 276 1216 373">shortest wavelength</td> </tr> <tr> <td data-bbox="434 373 707 470">infrared</td> <td data-bbox="707 373 949 470">visible (light)</td> <td data-bbox="949 373 1216 470">ultraviolet</td> </tr> </table>	longest wavelength	→	shortest wavelength	infrared	visible (light)	ultraviolet	<p>All three must be correct for the mark</p> <p>Allow IR for infrared Allow visible (without light) Allow UV for ultraviolet</p>	1
longest wavelength	→	shortest wavelength							
infrared	visible (light)	ultraviolet							
(b)	<p>Any two of:</p> <p>Radio (waves); Microwave(s); x-rays; Gamma (rays);</p>	<p>Allow T-rays</p> <p><math>\gamma</math> - rays or <math>\gamma</math></p>	2						
(c) (i)	<p>Any two of</p> <ol style="list-style-type: none"> <li>1. killing bacteria e.g. in water purification OR in hand driers in toilets OR sterilisation of equipment;</li> <li>2. medical uses e.g. setting dental fillings OR detection of bacteria OR treatment of (named) skin diseases;</li> <li>3. security markings e.g. for checking banknotes;</li> <li>4. fluorescent lamp e.g. tanning machines, black-light, detecting blood /other body fluids;</li> <li>5. data reading e.g. blu-ray devices</li> </ol>	<p>Must be specific, ignore vague answers such as 'used in a hospital', 'for CSI'</p> <p>Allow other sensible suggestions for each MP</p>	2						

Question number	Answer	Notes	Marks
2 (ii)	Any two of  1. cell damage e.g. (skin) cancer, cell mutation; 2. Sunburn/skin aging; 3. eye damage e.g. cataracts, blindness;	Must be specific, do not allow vague answers such as 'causes burns' 'danger to skin' 'burns skin'	2
		<b>Total</b>	<b>7</b>

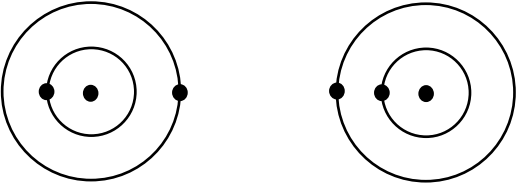
Question number	Answer	Notes	Marks
3 (a) (i)	<p>1. at least one arrow showing direction from N to S (right to left);</p> <p>2. one <b>horizontal</b> line between shaded faces;</p> <p>3. minimum of 3 horizontal lines evenly spaced (by eye);</p> <p>e.g.</p> 	<p>Reject contradictory arrows</p> <p>For MP2,3 ignore any lines outside the rectangle between the shaded faces</p> <p>allow field lines that almost touch the faces</p>	3
(ii)	<p>1. a method <b>to show shape</b>;</p> <p>e.g. use compass(es) Use of iron <b>filings/ powder</b></p> <p>2. Use of (plotting) compass <b>to show direction</b>;</p> <p>3. a further <b>method detail</b>;</p> <p>e.g. mark card /move compass/multiple compasses idea of another line or lines added sprinkle (iron filings evenly on card) tap card (to distribute iron filings)</p>	<p><b>Ignore</b> Position of card /Cling film</p> <p><b>Ignore</b> pour/place/ drop /spill</p>	3

Question number	Answer	Notes	Marks
(b)	any <b>two</b> of 1. (Fleming's) Left Hand (Motor) rule OR (current generates) magnetic field <b>around</b> the rod; 2. Idea that there is a force (on rod); 3. (translational) movement of rod; 4. Correct direction given, i.e. out of the paper;	allow LHM rule/LH rule/motor rule/ motor effect  <b>Ignore</b> upwards rod is magnetic	2
		<b>Total</b>	<b>8</b>

Question number	Answer	Notes	Marks
4 (a)	Student is right / wrong = no mark Any <b>two</b> of  1. Balance might not be levelled; 2. zero error; 3. mass could be worn; 4. mass could be mislabelled; 5. value could be within acceptable accuracy of the mass (e.g. $\pm 2\text{g}$ ); 6. battery of scales is running down/eq;	Ignore idea of anomaly accept  tare, reset error rusty inaccurate marking it rounds to 500 g	2
(b)	Any <b>two</b> of  MP1 - Measure/find volume; MP2 - Using a displacement method; MP3 - A sensible experimental <b>precaution</b> e.g. tied to thread OR awareness of meniscus OR repeat readings OR average;  <i>PLUS</i>  Any <b>one</b> of MP4 - Formula to use (density = mass $\div$ volume); MP5 - A correct density unit mentioned (e.g. $\text{kg/m}^3$ );	For MP2 Ignore calculation of volume geometry	3
		<b>Total</b>	<b>5</b>

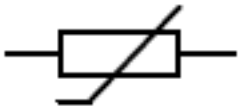
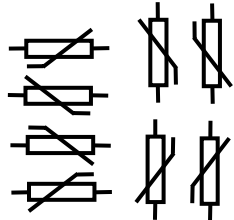
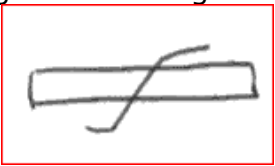
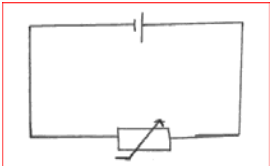



Question number	Answer	Notes	Marks
5	Any 5 of 1. determine / measure distance; 2. determine / measure time; 3. Appropriate measuring instrument for distance <b>OR</b> time; 4. Use a suitable distance /count laps (of known length); 5. repeat experiment/ <b>calculate</b> average; 6. Speed = distance / time OR finding the gradient ; 7. Suitable experimental precaution, e.g. reaction time considered, consistent height on track, time from a predetermined consistent point;	Allow idea of published track length use of split times e.g. 1 lap or circuit Ignore 'human error'	5
		<b>Total</b>	<b>5</b>

Question number	Answer	Notes	Marks
6 (a)	D – the Sun		1
6 (b) (i)	Substitution; Calculation; $\text{speed} = \frac{2 \times \pi \times 250\,000\,000}{690}$ $= 2\,300\,000 \text{ (km/day) (correct to 2SF)}$	If answer given to more than 2SF, then allow range of 2 275 000 → 2 280 000  max 1 for POT error in bald answer <b>Accept</b> appropriate labelled diagrams <b>Allow</b> for one mark: elliptical if no other mark scored e.g, orbit of Mars is more elliptical than Earth's	2
6 (b) (ii)	Any two of 1. Idea of different speeds; 2. idea of different orbits /radii; 3. Idea of variable relative motion, e.g. both on the same side of the Sun and then on opposite sides of the Sun; 4. Appropriate calculation e.g. difference or sum of radii, attempt to calculate speed of Earth;  e.g. Diagram showing understanding of MP2 and MP3  	<b>ignore</b> Mars labelled inside Earth's orbit	2

Question number	Answer	Notes	Marks
6 (c) (i)	<p>Working;; e.g.</p> $300\,000 = \frac{170\,000\,000}{t} \quad 1 \text{ working mark (sub ONLY)}$ $t = \frac{170\,000\,000}{300\,000} \quad \text{both working marks (sub AND rearrange)}$ <p>Calculation; e.g.</p> $= 570 \text{ (566.7) (s)} \quad 1 \text{ mark (ans to } > 1 \text{ SF)}$	<p>'show that' question, working must be shown for full marks</p> <p>REVERSE CALCS: maximum mark =2 (correct calc plus a comparison statement e.g. <math>283\,333 \equiv 300\,000</math> <math>180\,000\,000 \equiv 170\,000\,000</math>)</p> <p>Allow (without the subject of the equation) for 2 marks, <math>\frac{170\,000\,000}{300\,000}</math></p>	3

Question number	Answer	Notes	Marks
6 (c) (ii)	<p>Any <b>two</b> of</p> <ol style="list-style-type: none"> <li>1. IDEA of HOW THE LOW SPEED AFFECTS DRIVING; <b>low speed</b> reduces stopping distance <b>low speed</b> helps to avoid obstacle</li> <li>2. IDEA of THE EFFECT OF LOW SPEED ON COLLISION; momentum /low speed / low (kinetic) energy reduces damage if in collision</li> <li>3. IDEA of WHAT THE TIME DELAY DOES; <b>time delay</b> affecting reaction time / stopping distance / steering</li> <li>4. IDEA of WHAT THE TIME (DELAY) IS; it takes a <b>long</b> time to get the signal (the communication delay is) <math>\approx 1200</math> (s) (we see images which are) <b>600s</b> delayed light and radio waves travel at the same speed in a vacuum</li> </ol>	<p>Allow idea that rover could travel up to 48 m between commands RA</p> <p>ignore better photos/detail of the planet /eq</p>	2
		<b>Total</b>	<b>10</b>

Question number	Answer	Notes	Marks
7 (a)	 <p>Symbol can be in any orientation, e.g.</p> 	<p>the line through the rectangle <b>must</b> be correct</p>  =0 <p>Ignore the size Ignore the rest of the circuit</p>  =0 as the line through is incorrect <p>Allow without the connection leads</p>  =1	1
(b)	<p>(i) Voltage = current x resistance;</p> <p>(ii) Convert milliamps to amps OR kilo-ohms to ohms; Substitution into <i>correct</i> equation &amp; rearrangement; Calculation to greater than 1SF;</p> <p>2.6 mA = 0.0026 A</p> $(R) = \frac{13.2}{0.0026}$ $= 5077 (\Omega)$	<p>Allow <math>V = IR</math> Allow rearrangements ignore a bald 'triangle'</p> <p>'show that' question, working must be shown for full mark</p> <p>Allow 5080, 5076 (truncation) 5.080 with working is worth 2 marks 5.08 with no working is worth 1 mark</p>	1  3

Question number	Answer	Notes	Marks
7 (c)	<p>Any <b>five</b> of <i>ABOUT A</i></p> <ol style="list-style-type: none"> <li>1. Resistance of A decreases with temperature;</li> <li>2. For A, {largest slope / rate of change} is at lower temperature ORA {smallest slope /rate of change} is at higher temperature;</li> <li>3. A is a thermistor (ntc);</li> </ol> <p><i>ABOUT B</i></p> <ol style="list-style-type: none"> <li>4. Resistance of B increases with temperature;</li> <li>5. For B, {largest slope / rate of change} is at higher temperature(s) ORA {smallest slope /rate of change} is at lower temperature;</li> <li>6. For B, resistance is constant below 50 °C;</li> </ol> <p><i>ABOUT BOTH</i></p> <ol style="list-style-type: none"> <li>7. More results for B/ fewer results for A;</li> <li>8. stated both relationships are non-linear;</li> <li>9. Range of (temperature/resistance) values for both is similar;</li> <li>10.data comparison e.g. both have the same resistance at 80 °C;</li> </ol>	<p><b>Accept</b></p> <ul style="list-style-type: none"> <li>• (MP1) for A, when the temperature is low, the resistance is high, ORA</li> <li>• (MP4) for B, when the temperature is low, the resistance is low, ORA</li> </ul> <p><b>Allow</b> component B is a ptc thermistor ORA Up to 60 °C</p> <p><b>Ignore:</b> inversely proportional positive/negative correlation</p> <p>Do <b>not</b> take implication of MP8 when MP 1,2,4,5 is given</p>	5
		<b>Total</b>	<b>10</b>

Question number	Answer	Notes	Marks
8 (a) (i)	work done = force x distance moved ;	Accept $W = F \times d$ Allow rearrangements do not accept eqn in units only	1
(ii)	Substitution into correct equation; Calculation; $170 \times 110$ $19\ 000$ (J)		2
(iii)	exactly same as their answer to (ii);	Accept <b>18 700</b> (J)	1

Question number	Answer	Notes	Marks
8 (b) (i)	$KE = \frac{1}{2}mv^2$	Accept word equation	1
(ii)	addition of masses before OR addition of energies after; Substitution into correct equation; Calculation;  $1650 + 950 = 2600$ (OR $436\,425 + 251\,275 = 687\,700$ ) $\frac{1}{2} \times 2600 \times 23^2$ 688 000	Accept for 1 mark - either 436 000 or 251 000  accept for 2 marks - both 436 000 and 251 000 Accept for 3 marks- 687 700	3
(c)	Any <b>three</b> of  1. idea that mass and acceleration are inversely related;  2. Idea that (total) mass is less;  3. Idea of less (air) resistance / friction;  4. Idea of less work done/less energy used;  5. Idea of amount work related to amount of (chemical) energy from fuel;	allow  F = m x a mentioned  weight for mass  drag  doesn't have to use energy to pull the caravan	3
		<b>Total</b>	<b>11</b>



Question number	Answer	Notes	Marks
9 (a)	Any two of 1. ruler has a <b>mm</b> scale ; 2. idea of inappropriate precision; 3. paper is (very) thin;	<b>ignore</b> vague statements e.g. the ruler is too big <b>allow</b>  scale is too big paper is thinner than 1 <b>mm</b>	2
(b) (i)	C 0.1 mm		1
(ii)	Any two of 1. parallax error; 2. gap left between ruler and paper; 3. ruler not perpendicular; 4. zero error;	<b>allow</b> • misreading or inaccurate reading of the ruler • damaged ruler • top sheet not flat <b>ignore</b> air gaps between sheets folded paper miscounting sheets different sizes of paper incorrect recording of measurements need for more precise instrument human error	2

Question number	Answer	Notes	Marks
(c) (i)	<p>An explanation including any 2 of</p> <p>1. acceleration needs an unbalanced force;</p> <p>2. (constant velocity means) the aeroplane is not accelerating;</p> <p>3. idea of absence of unbalanced/overall force;</p>	<p>ignore idea that the forces are acting at different points on the plane</p> <p><b>allow</b> Newton I or Newton II unbalanced forces cause acceleration /deceleration / change of <i>velocity</i></p> <p>flying straight or not changing speed /direction</p> <p>'no resultant force' statement that there is a suitable pair of named balanced forces</p>	2
(ii)	weight arrow vertically down; lift arrow upwards; drag arrow to the left;	<p>allow labelled arrows anywhere on the diagram</p> <p>vertical to 45deg to the right inside the angle of the plane wings</p>	3
(iii)	lost as (/dissipated to) heat, sound etc	<p><b>allow</b> lost to the surroundings/air absorbed by surroundings/air <b>ignore</b> kinetic energy 'other types of energy'</p>	1
		<b>Total</b>	<b>11</b>

Question number	Answer	Notes	Marks
10 (a) (i)	42 (m/s)	Allow range 42 - 43	1
	(ii) Attempt to calculate slope; Answer; Unit;  $42 \div 15$  2.8  $\text{m/s}^2$	Allow value from (i) e.g. $43 \text{ m/s} \rightarrow 2.9 \text{ m/s}^2$ $42.5 \rightarrow 2.83 \text{ m/s}^2$ $45 \rightarrow 3 \text{ m/s}^2$  not $42/120$ allow $42/20$	3
	(iii) Attempt to calculate an area under graph line; Appropriate further working (e.g. adding areas); Answer;  $(\frac{1}{2} \times 15 \times 42) + (80 \times 42) + (\frac{1}{2} \times 25 \times 42)$  $315 + 3360 + 525$  4200 (m)	Allow value from (i) e.g. $43 \text{ m/s} \rightarrow 4300 \text{ m}$  first 2 MP may be gained using the trapezium method, i.e. $42 \times (120+80)/2$  Bald correct answer scores 3	3

Question number	Answer	Notes	Marks
(b)	Any <b>three</b> from 1. Stopping distance affected by speed or mass; 2. For faster plane, stopping distance greater/ runway too short ; 3. for heavier plane stopping distance greater/ runway too short; 4. Attempt to calculate stopping distance from graph; 5. Data shows most/all of runway already used;	ignore time = $500/40$  Allow a momentum argument for MP1, 2, 3	3
		<b>Total</b>	<b>10</b>

Question number	Answer	Notes	Marks
11 (a)	Idea of (correct) change of speed OR wavelength; (Refractive) index / (optical) density of glass > that of air (ORA);	Allow for 1 mark speed slower in glass OR wavelength shorter in glass (ORA)  allow RI, n for refractive index	2
(b) (i)	$\sin c = 1/n$ ;	Allow rearrangements ( $n = 1/\sin c$ ) in words (incl critical angle)	1

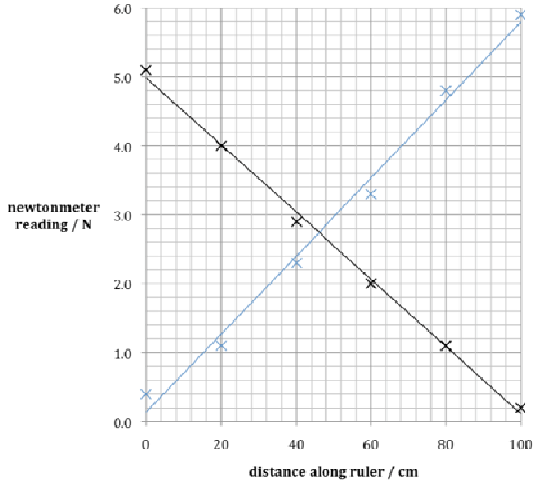
Question number	Answer	Notes	Marks
11	(ii) $(n=) 1/\sin 43$ OR $\sin 43^\circ = 0.682$ ; $n = 1.47 (\approx 1.5)$ ;	(0.68199836) (1.466279) Refractive index must be shown to > 2 sig fig Allow truncated values Reverse calculation can score 1 mark Reverse calculation with comparison can score both marks Bald answer can score 1 mark	1
	(iii) Any <b>three</b> of  1. larger RI means smaller $c$ ;  2. TIR when $i > c$ ;  3. for diamond larger range of angles for TIR ;  4. Some appropriate calculation, e.g. for diamond $c = 25^\circ$ ;  5. $43^\circ$ to $90^\circ$ for TIR in opal;	<b>allow</b>  $c$ is smaller in diamond  TIR happens at angles <b>smaller than</b> in opal/ $43^\circ$  ( $1/2.4 = 0.417 \rightarrow c=24.6^\circ$ )  Accept for 2 marks <b><math>25^\circ</math> to <math>90^\circ</math> for TIR in diamond; (MP2,4)</b>  <b>Ignore</b> more of the rays going TIR (repeat of stem) diamond has a higher RI than opal	2
			3
		<b>Total</b>	<b>8</b>

Question number	Answer			Notes	Marks
12 (a) (i)	Isotope	Proton number	Neutron number		2
	Uranium-234	92	142		
	Uranium-235	<b>92</b>	143		
	Uranium-238	92	<b>146</b>		
	92 as shown; 146 as show;				
	(ii) Time taken;  and either of <ul style="list-style-type: none"> <li>• For <b>half</b> of (radioactive) nuclei / atoms /isotope to decay;</li> </ul> For (radio)activity to halve;			<b>Reject</b> for the relevant mark 'half the time' particles molecules 'break down' 'reactivity' nucleus halve in mass to completely/fully decay	2
	(iii) any <b>one</b> from:  <ul style="list-style-type: none"> <li>• Other isotopes have decayed more quickly;</li> <li>• It has the <b>longest</b> half-life;</li> </ul>			Allow how long it takes  Allow <ul style="list-style-type: none"> <li>• reverse arguments</li> <li>• comparative e.g. longer rather than longest</li> </ul> Ignore <ul style="list-style-type: none"> <li>• number of neutrons</li> </ul> purity /concentration	1

Question number	Answer	Notes	Marks
12 (b)	any <b>three</b> from 1. Neutrons; 2. (product) nuclei/a named nucleus; 3. <b>Appropriate</b> qualification of <b>either</b> term above(DOP); 4. gamma (radiation)/thermal energy  e.g. of MP3 neutrons - 2, 3, fast, high energy nuclei – daughter, lighter, e.g. for MP2 allowed nuclei include : krypton, barium, xenon,	Allow two correct named nuclei as MP2 & MP3  <b>Ignore</b> extra as a qualifier for neutrons helium alpha beta atoms daughter atoms/cells	3
(c) (i)	Any one of to slow down neutrons/eq; to increase rate of fission; to increase absorption of neutrons by uranium/fuel;	allow reduce the (kinetic) energy of neutrons	1
(ii)	Any two of 1. rate of reaction increases; 2. fewer neutrons absorbed by control rod OR more neutrons collide with uranium; 3. temperature <u>increases</u> ;	allow rate of fission increases control rods absorb neutrons  <u>more</u> heat released (need for comparative) ignore risk of explosion	2

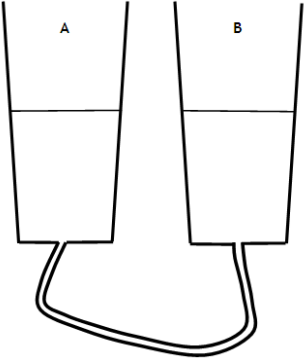


Question number	Answer	Notes	Marks
12 (d)	<p>Any <b>five</b> of the following ideas</p> <p><i>facts about radioactivity</i></p> <ol style="list-style-type: none"> <li>1. idea of harmful nature of radiation / danger to life;</li> <li>2. high (activity) levels;</li> <li>3. long half-life / half-lives;</li> </ol> <p><i>consequences</i></p> <ol style="list-style-type: none"> <li>4. difficulties for (emergency) workers to access the area, e.g. short safe working times / need for protective clothing;</li> <li>5. (requirement for) special handling equipment OR difficulty in removing material;</li> <li>6. idea of extensive time OR distance (exclusion/hazardous) zone;</li> </ol> <p><i>environmental effects local and distant</i></p> <ol style="list-style-type: none"> <li>7. idea of radioactive material mixing with the local environment e.g. soil, plants, water, air;</li> </ol> <p>idea of further /more distant spreading of material e.g. by fire, wind, water;</p>	<p><b>Ignore</b> repeat of the stem, i.e. radioactive material has been spread into the surrounding area can't be seen</p> <p><b>allow</b> MP1 toxic, can kill, causes mutation, ionises cells</p> <p>MP5 a lot of (contaminated) material to deal with</p> <p>MP6 still radioactive after a long time takes a long time to go away</p>	5
		<b>Total</b>	<b>16</b>

Question number	Answer	Notes	Marks												
13 (a) (i)	A – distance A		1												
	(ii) D – force D		1												
(b) (i)	Force (C) in N; or Force in newtons;	Allow: Reading from newton-meter in N	1												
(ii)	Plotting ;; Line of best fit;  <table border="1" data-bbox="1090 595 1285 839"> <tbody> <tr> <td>0</td> <td>5.1</td> </tr> <tr> <td>20</td> <td>4.0</td> </tr> <tr> <td>40</td> <td>2.9</td> </tr> <tr> <td>60</td> <td>2.0</td> </tr> <tr> <td>80</td> <td>1.1</td> </tr> <tr> <td>100</td> <td>0.2</td> </tr> </tbody> </table>	0	5.1	20	4.0	40	2.9	60	2.0	80	1.1	100	0.2	To nearest ½ square, penalise errors up to two marks Suited to candidate's plotting (allow a smooth curve) no double lines judge LoBF by balance of points about the line	3
0	5.1														
20	4.0														
40	2.9														
60	2.0														
80	1.1														
100	0.2														
(iii)	Reading from graph to ± 1 cm;  e.g. 46	To nearest ½ small square	1												

Question number	Answer	Notes	Marks
13 (c)	weight of ruler;	Accept other valid reasons allow force for weight ignore 'it's got a force acting' 'because of gravity'	1
		<b>Total</b>	<b>8</b>

Question number	Answer	Notes	Marks
14 (a) (i)	pressure difference = height x density x g	Accept $P = h\rho g$ $P = h d g$	1
	(ii) Substitution into correct equation; Calculation;  $0.91 \times 1000 \times 10$ 9100 Pa	correct answer with no working scores 2 marks  Accept: <ul style="list-style-type: none"> <li>• 9.1 kPa</li> <li>• 8918 Pa (from <math>g = 9.8 \text{ m/s}^2</math>)</li> <li>• 8927 Pa (from <math>g = 9.81 \text{ m/s}^2</math>)</li> <li>• h in cm / 910 000 Pa for a max of 1</li> </ul>	2

Question number	Answer	Notes	Marks
14 (b) (i)	 <p>the water level is the same on both sides</p>	allow some wobbles on the B side area shaded	1
(ii)	<p>Any <b>three</b> of the following ideas</p> <ol style="list-style-type: none"> <li>1. pressure difference (relating to flow);</li> <li>2. pressure equality (relating to flow ending);</li> <li>3. reference to relevant pressure equation ; e.g. pressure causes force on water, pressure = force / area pressure = <math>h\rho g</math>;</li> <li>4. (more) gravitational potential energy (in A) /ORA; (fluid) <u>pressure</u> acts in all directions;</li> </ol>	<p>Allow force or weight instead of pressure for either MP1 OR MP2 but not both</p> <p>MP3 allow 'pressure pushes water' 'height difference pushes water'</p>	3
		<b>Total</b>	<b>7</b>
		<b>Total for paper</b>	<b>120</b>



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