

# Mark Scheme (Results) Summer 2010

GCE O

## GCE O Physics (7540) Paper 02

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7540/02 O-LEVEL PHYSICS MARK SCHEME - SUMMER 2010

aps	accept phonetic spelling
ecf	error carried forward
dna	do not allow
dop	depend on previous
nwn	no working necessary
ora	or reverse argument
owtte	or words to that effect

Question Number		Answer	Mark
1 (a) (i)	pressure	same/equal	(1)
		<ul style="list-style-type: none"> <li>(air) pressure changes as plane lands/descends or (air) Pressure at ground higher than at altitude</li> </ul>	(1)
		<ul style="list-style-type: none"> <li>greater pressure (outside)(than inside) not just “large”</li> </ul> <p>The (air) pressure (outside) increases as the plane lands scores both marks Near the ground the pressure outside is greater than inside scores both marks</p>	(1)
(ii)	molecules	<ul style="list-style-type: none"> <li>(Molecules /particles/ atoms) move around/move randomly/ travel at great speed/ possess kinetic energy</li> </ul> <p>Ignore move vigorously</p>	(1)
		<ul style="list-style-type: none"> <li>collide/ hit /strike / bang / bombard (with surface) bounce off</li> </ul> <p>ignore push or collide with each other</p> <p><i>independent marks</i></p>	(1)
(iii)	water molecules	<ul style="list-style-type: none"> <li>molecules close together/close packed/touching</li> </ul> <p>Reject Closer than gas / further apart from solid / not much space between them /not tightly packed/ any mention of spaces</p>	(1)
		<ul style="list-style-type: none"> <li>Can move over each other/ exchange partners/ slide past</li> </ul> <p>Reject free to move/ move about/ move randomly</p> <p><i>independent marks</i></p>	(1)

(b) (i)	graph	<p>Axes labelled with units (<i>minimum</i> altitude m and pressure kPa)  Only suitable scale for x axis 2cm = 500 (m)  Plots (within 1 mm)  straight line through all points</p> <p>Plots must be visible at correct positions</p>	(1) (1) (2) (1)
(ii)	Value	Line across (at 82) and/or down on grid 1800 m $\pm$ 50 UP ( <i>from graph</i> )	(1) (1)
(c) (i)	new pressure	<p>Attempt to use correct formula with P and T using correct temperatures  Correct conversion to K - 300 and 780  = <u>52</u> MPa / <u>52 000 000</u> Pa UP</p> <p>allow first mark only for using correct formula without conversion e.g.  20/27 = P/507 seen or rearranged  or bald 376 MPa or 376 000 000 Pa UP</p> <p>Accept any number of dp which round to 376 (MPa)</p>	(1) (1) (1)
(ii)	keep well away	<p>(cylinder) could explode / burst / blow up</p> <p>Ignore gas would burn or make fire worse or people would burn or pressure too high</p>	(1)
(iii)	pressure increase	<p>Molecules move faster / more KE  reject vibrate faster</p> <p><u>More frequent</u> collisions / collide <u>more frequently</u>/  collide <u>more often</u>/ <u>more times per second</u>  Or <u>harder</u> collisions (with the inside surface)/ accept collide with walls with <u>more</u> force</p> <p>Reject molecules expand or bald more collisions</p>	(1)  (1)

(Total 20 marks)

Question Number		Answer	Mark
2 (a) (i)	height	$H = \frac{1}{2} \times 10 \times 4^2 / (\frac{1}{2} \times 9.8 \times 4^2) / (1/2 \times 9.81 \times 4^2)$ = 80 m (78.4 m / 78.48)UP	(1) (1)
	(ii) vertical velocity	$v = (0 +) 10 \times 4 / (9.8 \times 4) / (9.81 \times 4)$ = 40 m/s / (39.2) / (39.24)UP	(1) (1)
	(iii) resultant velocity	$v^2 = 2500 + 1600 (2500 + 1537)$ <u>Must ECF</u> from a(ii) $v^2 = 4100 (4037)$ (UP if given as final answer) $v = 64 \text{ m/s } (63.5) \text{ UP}$  <b>Common ecf</b> $v = 206 \text{ m/s for a(ii) = 200}$ $V = 111.8/112 \text{ for a(ii) = 100}$ $v = 80.6/81 \text{ m/s for a(ii) 63.2}$ $v = 70.7\text{m/s for a(ii) = 50}$ $v = 53.85 \text{ for a(ii) = 20}$ $v = 51\text{m/s for a(ii) =10}$	(1) (1) (1)
	(iv) kinetic energy	$KE = \frac{1}{2} \times 40 \times 64^2$ <u>must ECF</u> from a(ii) = 82 000 J/81920 J (80 733) UP  <b>Reject use of mgh</b> <b>Common ecf</b> 850 000J for a(iii) =206 250 000J for a(iii) = 111.8 129 885 J for a(iii) = 80/80.5/81 99 969.8/100 000 J for a(iii) = 70.7 58000J for a(iii) = 53.85 52 000J for a(iii) = 51  In all cases allow a number which rounds to one of the above e.g. 52 020 for 51m/s	(1) (1)
	(v) distance	$d = 50 \times 4$ = 200 m UP	(1) (1)
	(vi) path	Curve below first throughout  Accept curve that goes vertical for last part reject straight line or curve that visibly goes backwards or more than one line	(1)

(b) (i)	apparatus	Ruler, metre ruler, metre stick, measuring tape  ignore stopwatch Allow phonetic spellings	(1)
(ii)	experiment	<ol style="list-style-type: none"> <li>1. Measure/calculate/ record height</li> <li>2. from (bottom of) ball to trapdoor</li> <li>3. operate switch/release ball/ cause ball to fall</li> <li>4. timer starts/ start timer</li> <li>5. <u>Timer stops when ball stops/hits trapdoor</u></li> <li>6. record/calculate/ use time</li> <li>7. use of <math>S=ut+1/2gt^2</math> or <math>g=2S/t^2</math></li> <li>8. repeat experiment</li> </ol> <p>Any 5</p> <p>Ignore measuring initial or final velocities or substituting u into equation</p>	(1) (1) (1) (1) (1) (1) (1) (1)
(iii)	iron ball	<p>iron easily demagnetised/released quickly/ steel would stay magnetised/ remain attached to magnet /steel will take more time to demagnetise</p> <p>ignore iron conducts electricity or magnetises easily or is soft</p>	(1)
(iv)	large reading	<p>g value (too) small(er)/ will decrease /g will be underestimated</p> <p>ignore “value of g would not be accurate”</p>	(1)

Question Number	Answer	Mark
3(a)(i)	<ul style="list-style-type: none"> <li>• <math>24 \div 3</math></li> <li>• <math>= 8 \Omega</math> UP</li> </ul>	(1) (1)
3(a)(ii)	<ul style="list-style-type: none"> <li>• <math>24 \times 3</math></li> <li>• <math>= 72 \text{ W}</math> UP</li> </ul>	(1) (1)
3(b)	<p>This is a “show that” question so candidates must show all steps in their calculations to gain marks. Watch for incorrect working leading to 30V</p> <p>Either</p> <ul style="list-style-type: none"> <li>• (voltage across wires) = <math>3 \times 2 = 6 \text{ (V)}</math></li> <li>• (Total voltage) = <math>24 + 6 (= 30 \text{ V})</math> dop</li> </ul> <p>Or</p> <p>(Total resistance) = <math>8 + 2 = 10 \text{ (}\Omega\text{)}</math></p> <p>(Voltage) = <math>10 \times 3 (=30\text{V})</math> dop</p> <p>Or</p> <p>(Total resistance) = <math>8 + 2 = 10 \text{ (}\Omega\text{)}</math></p> <p>(Voltage) = <math>30 = \text{current} \times 10</math> so <math>I = 3\text{(A)}</math> dop</p>	(1) (1)  (1) (1)  (1) (1)
3(c)(i)	<ul style="list-style-type: none"> <li>• <math>(2 \times 2 \times 2) = 8 \text{ (}\Omega\text{)}</math></li> </ul>	(1)
3(c)(ii)	<ul style="list-style-type: none"> <li>• <math>(24 / 2) = 12 \text{ (V)}</math></li> </ul> <p>Reject <math>3 \times 4 = 12\text{V}</math></p>	(1)
3(c)(iii)	<p>Any two from</p> <ul style="list-style-type: none"> <li>• lamp has reduced brightness</li> <li>• (wires will) get hot / melt</li> <li>• Energy or power wasted /lost</li> </ul> <p>Ignore lamp will overheat / lamp will not light / less current or voltage will “reach” lamp/ <u>electricity is wasted</u> / it is not efficient</p>	(1) (1) (1)

3(d)(i)	<p>Any three from</p> <ol style="list-style-type: none"> <li>1. Thin wire / low melting point</li> <li>2. (fuse) heat up</li> <li>3. (fuse) melts / breaks/ burns/ blows</li> <li>4. stops large or excessive current / breaks <u>circuit</u></li> </ol> <p>Ignore supplies or controls current or prevents wires from overheating</p>	<p>(1) (1) (1) (1)</p>
3(d)(ii)	<ul style="list-style-type: none"> <li>• total current (through all sockets)</li> <li>• would be below 30 A</li> <li>• not all sockets used at same time/ each socket takes less than 10A OWTTE</li> </ul> <p><i>ANY TWO</i></p> <p>Reject because 13A is less than 30 A Answer should refer to why 30A fuse is sufficient rather than why 13A is sufficient for each socket.</p>	<p>(1) (1) (1)</p>
3(d)(iii)	<ol style="list-style-type: none"> <li>1. each have same or equal <u>voltage</u> / <u>PD</u> (240 V) across</li> <li>2. each switch on/off independently</li> <li>3. If one breaks others still work ORA for each</li> </ol> <p>Ignore same current, energy or power to each one or 30A is more than 13A or they will have less resistance in parallel or any mention of brightness</p>	<p>(1) (1) (1)</p>
3(e)	<ol style="list-style-type: none"> <li>1. <math>(60 - 10 =) 50</math></li> <li>2. <math>0.05 \times 10 \times 7</math></li> <li>3. = <u>3.5</u> (kWh)</li> </ol> <p>OR</p> <ol style="list-style-type: none"> <li>1. <math>60/1000 \times 70 = 4.2/4200</math></li> <li>2. <math>10/1000 \times 70 = 0.7 /700</math></li> <li>3. <math>(4.2 - 0.7) = \underline{3.5}</math> (kWh)</li> </ol> <p>3500 kWh scores only marks 1 and 2 3.5 kW/h scores only marks 1 and 2 3.5 kW scores only marks 1 and 2</p>	<p>(1) (1) (1)  (1) (1) (1)</p>

(Total 20 marks)



Question Number	Answer	Mark
4(a)(i)	Mention of <ol style="list-style-type: none"> <li>1. large/greater amplitude (seen/ produced) accept double amplitude /maximum amplitude</li> <li>2. driving frequency/ driver system/ forced to vibrate/ external vibration /the forced frequency</li> <li>3. equals/ at / same as <u>natural</u> frequency</li> </ol> Ignore definitions of natural frequency Ignore fundamental frequency	 (1) (1) (1)
4(a)(ii)	Any two from <ol style="list-style-type: none"> <li>1. tension/ <u>stretching</u> force</li> <li>2. length</li> <li>3. mass / mass per unit length</li> <li>4. (cross-sectional) area / thickness /diameter</li> </ol>	 (1) (1) (1) (1)
4(b)(i)	<ul style="list-style-type: none"> <li>• B</li> </ul>	
4(b)(ii)	<ul style="list-style-type: none"> <li>• B</li> </ul>	
4(b)(iii)	<ul style="list-style-type: none"> <li>• <u>B</u> has greater/ larger /highest <u>amplitude</u> ora dop (i)</li> <li>• <u>B</u> has greater/larger <u>frequency</u>/smaller <u>wavelength</u> ora dop (ii)</li> </ul> Must relate answer to B (or A for reverse argument) reject vague statements relating amplitude to wavelength / frequency Reject larger vibrations	 (1) (1)
4(c)	<ul style="list-style-type: none"> <li>• Rotate/ turn/ move (the magnet) parallel to the field lines /turn clockwise /align with field lines</li> <li>• north pole down / <u>N</u> pointing to the south of the field lines / <u>N</u> pole pointing in direction of field lines</li> </ul> turns 180° scores first mark only Turn anticlockwise scores first mark only Ignore move north to south or straighten itself	 (1) (1)
4(d)	<ul style="list-style-type: none"> <li>• 300 000 000 / 600 000 000 or 300 000 000/600</li> </ul> Accept any substitution of 6 followed by up to 8 zeros for first mark	 (1)
	<ul style="list-style-type: none"> <li>• = 0.5 m UP (Only answer)</li> </ul>	(1)



Question Number	Answer	Mark
5(a)(i)	<ul style="list-style-type: none"> <li>• bends towards the normal or does not bend if entering along normal</li> </ul> <p>reject “it bends” /”it refracts”/</p>	(1)
5(a)(ii)	<ol style="list-style-type: none"> <li>1. <math>\sin 51^\circ</math> (= 0.777)</li> <li>2. <math>\sin 34^\circ</math> (= 0.559)</li> <li>3. <math>n = 1.39</math></li> </ol> <p>First mark is for <math>\sin 51</math>, second mark for <math>\sin 34</math> final mark for correct calculation (resulting in answer &gt; 1.34)</p> <p>if 49 and 34 <math>n = 1.35</math> scores 2/3  If 50 and 34 <math>n = 1.37</math> scores 2/3  if 51 and 35 <math>n = 1.35</math> or 1.36 scores 2/3  if 51 and 36 <math>n = 1.32</math> scores 1/3 (as it is less than 1.34)  if 49 and 35 <math>n = 1.32</math> scores 1/3 (as above)  if 50 and 35 <math>n = 1.34</math> scores 0/3 as this was given in question</p> <p>In all cases allow any number of dp which will round to the acceptable values above</p> <p>Reject answers not using sines eg <math>51/49 = 1.04</math> scores 0/3  Reject <math>\sin 51 + \sin 36 = 1.36</math> scores 0/3  reject use of angles more than 51, less than 49, more than 36 or less than 34 0/3</p>	(3)
5(a)(iii)	<p>ANY ONE FROM</p> <ul style="list-style-type: none"> <li>• real depth <math>\div</math> apparent depth</li> <li>• <u>Speed of light in vacuum or air</u> Speed of light in medium or water</li> <li>• Accept <u>Wavelength of light in vacuum or air</u> Wavelength of light in medium or water</li> </ul> <p>Reject any answer with sines or angles</p>	(1) (1) (1)



5(b)(iii)	<p>Either</p> <p>Raybox or pins method</p> <ol style="list-style-type: none"> <li>1. measure/find/note angle of incidence (1)</li> <li>2. measure/find/note angle of refraction (1)</li> </ol> <p>Award if correct <math>i</math> , <math>r</math> and normal shown on diagram Do not award mark 2 for angle of reflection</p> <ol style="list-style-type: none"> <li>3. <math>n = \sin i \div \sin r</math> (<i>Independent mark but reject <math>r</math> is angle of reflection</i>) (1)</li> </ol> <p>Or Real/ apparent method</p> <ol style="list-style-type: none"> <li>1. measure real depth (1)</li> <li>2. measure apparent depth (1)</li> </ol> <p>Award if shown clearly on diagram</p> <ol style="list-style-type: none"> <li>3. <math>n = \text{real depth} \div \text{apparent depth}</math> (1)</li> </ol> <p>Then any three from</p> <ol style="list-style-type: none"> <li>4. known mass/measure/note mass (or volume) of water (1)</li> <li>5. known mass /measure/note mass of salt (1)</li> <li>6. repeat for different angles or amounts of water or repeat (for same amount) (1)</li> <li>7. repeat for different percentages (1)</li> </ol>	
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Question Number	Answer	Mark
5(b)(iv)	<ul style="list-style-type: none"> <li>• two columns/rows with headings either <math>i</math> and <math>r</math> or real depth and apparent depth (1)</li> <li>• mass or volume or percentage or amount of <u>salt</u> or <u>water</u> (1)</li> </ul> <p>No unit required but if given should be appropriate</p>	
5(c)	<ul style="list-style-type: none"> <li>• little/small/very less difference between (graphs/results/ RI) of salt and sugar (1)</li> <li>• There were errors/limits of <u>measurement(s)</u> OWTTE (1)</li> </ul> <p>Ignore differences in crystal size of salt and sugar, solubility/ she did not repeat/ the salt had not been mixed enough</p>	

(Total 20 marks)

TOTAL FOR PAPER: 100 marks

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