

Mark Scheme Summer 2008

GCE

GCE O level Physics (7540)

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information please call our Customer Services on + 44 1204 770 696, or visit our website at www.edexcel-international.org.uk.

Summer 2008

All the material in this publication is copyright
© Edexcel Ltd 2008

Contents

	Page
1. 7540/01 (Paper 1) Mark Scheme	1
2. 7540/02 (Paper 2) Mark Scheme	14

7540/01 O-LEVEL PHYSICS MARK SCHEME - JUNE 2008

Question Number	Answer	Mark
1(a)	<ul style="list-style-type: none"> • 25 000 N or 24 500 N or 24 525 N UP <p>Notes</p> <ul style="list-style-type: none"> - Unit required N kgms⁻² kgm/s² 	<p>1</p> <p style="text-align: right;">(1)</p>

Question Number	Answer	Mark
1(b)	<ul style="list-style-type: none"> • single <u>downward</u> arrow intended to be vertical and straight passing through or in line with C labelled W or mg (or 25 000 N, 24 500 N or 24 525 N) 	<p>1</p> <p style="text-align: right;">(1)</p>
1(c)	<ul style="list-style-type: none"> • single arrow parallel to slope pointing <u>up</u> the slope • between lower half of front wheel and bottom of road surface labelled F dop <p>Note</p> <ul style="list-style-type: none"> - maximum of 1 mark if shown on back wheel only - pointing down the slope scores zero 	<p>1</p> <p>1</p> <p style="text-align: right;">(2)</p>
1(d)	<ul style="list-style-type: none"> • single <u>upward</u> arrow intended to be straight and <u>perpendicular</u> to ground/slope • passing through or in line with front tyre labelled R dop <p>Note</p> <ul style="list-style-type: none"> - maximum of 1 mark if shown on back wheel only 	<p>1</p> <p>1</p> <p style="text-align: right;">(2)</p>

Question Number	Answer	Reject	Mark
1(e)	<ul style="list-style-type: none"> tip / fall over/ roll / turn over/ tumble/topple/tipple /tilt/rotate OWTTE 	move backwards or downwards	1 (1)

(Total 7 marks)

Question Number	Answer	Acceptable Answers	Mark
2(a)	<ul style="list-style-type: none"> zero <p>Note</p> <ul style="list-style-type: none"> ignore units 	<ul style="list-style-type: none"> nothing none 0 no momentum 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(b)	<ul style="list-style-type: none"> Vector (quantity) 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(c)(i)	<ul style="list-style-type: none"> 30×3.2 $= 96 \text{ kg m/s or Ns UP nwn}$ <p>Note</p> <ul style="list-style-type: none"> ignore any minus sign 	<p>1</p> <p>1</p> <p>(2)</p>
		Acceptable Answers
2(c)(ii)	<ul style="list-style-type: none"> $96 \text{ kg m/s or Ns UP only once in (c)(i)(ii)}$ <p><i>Note</i></p> <p><i>ignore minus sign</i></p>	<ul style="list-style-type: none"> same as (i) <p>1</p> <p>(1)</p>
2(c)(iii)	<ul style="list-style-type: none"> $= 96 \text{ (ecf from (i) or (ii)/40 or } 40v = 96$ $= 2.4 \text{ m/s UP nwn}$ <p>Note</p> <ul style="list-style-type: none"> ignore any minus sign 	<p>1</p> <p>1</p> <p>(2)</p>

(Total 7 marks)

Question Number	Answer	Mark
3(a)	<ul style="list-style-type: none"> 1.5 mm or 1½ mm or 0.15 cm UP 	1 (1)

Question Number	Answer	Acceptable Answers	Mark
3(b)(i)	<ul style="list-style-type: none"> 0 to 16 (N) 	<ul style="list-style-type: none"> up to 16 (N) 0 to 2 (mm) up to 2 (mm) <p><i>Reject</i> 4 to 16(N)/0.5 to 2(mm) 16 or 0-2 N</p>	1 (1)
3(b)(ii)	<ul style="list-style-type: none"> (extension not load) goes up in even steps/uniformly/constantly/extension (directly) proportional to weight* <p>ora at value ≥ 16 (or 2) extension is not proportional to weight / extension at 20 should be 2.5 / weight at 3.4 should be 27.2 <i>reference to elastic limit should be ignored here</i></p> <p>*allow load/mass/force/tension as alternative for weight</p>		1 (1)

Question Number	Answer	Mark
3(c)(i)	<ul style="list-style-type: none"> returns to original length/shape/state/extension zero <p><i>do not allow 'length' returns to zero</i></p>	1 (1)
3(c)(ii)	<ul style="list-style-type: none"> permanently stretched/ does not fully return / none / same <p><i>do not allow 'longer'</i></p>	1 (1)
3(d)	<ul style="list-style-type: none"> 1 (mm)/ 8 (N) / (c)(i) not passed <u>elastic</u> limit 3.4 (mm)/ 20 (N) / (c)(ii) had passed <u>elastic</u> limit <p>Note maximum of 1 mark if one reference is made to a point or limit without calling it elastic limit 'elastic limit' must be seen once to get both marks <i>independent of (c)</i></p>	1 1 (2)

(Total 7 marks)

Question Number	Answer	Acceptable Answers	Reject	Mark
5(a)	<ul style="list-style-type: none"> (move) faster 	<ul style="list-style-type: none"> quicker greater speed greater velocity increased <u>kinetic</u> energy 	<p>more</p> <p>vibrate faster</p> <p>increases</p> <p>fast</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
5(b)	<ul style="list-style-type: none"> any reference to Kelvin temperature or attempted conversion using 273 Kelvin temperature does not double <p>or 50° C (in K) is not double 25° C (in K)</p> <p>Note</p> <p>50° C = 323 K and 25° C = 298 K so 323 K is not double 298 K</p> <p>or 596K (323°C) is double 298 K</p> <p><i>scores both marks</i></p>	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
5(c)	<p><i>action of removing moisture e.g.</i></p> <ul style="list-style-type: none"> absorbs or removes moisture/ water /water vapour/ dehydrating agent/drying agent <p><i>consequence</i></p> <ul style="list-style-type: none"> dries (trapped) <u>air</u> 	<p>1</p> <p>1</p> <p>(2)</p>

(Total 5 marks)

Question Number	Answer	Mark
6(a)(i)	<ul style="list-style-type: none"> • repulsion / repel • similar charges/both negative/negative charges <p>Notes 'like charges repel' scores 2 marks 'unlike charges repel' scores 1st mark</p>	1 1 (2)

Question Number	Answer	Mark
6(a)(ii)	<ul style="list-style-type: none"> • <u>bigger</u> 	1 (1)

Question Number	Answer	Mark
6(b)(i)	<ul style="list-style-type: none"> • $0.0080 = 5000 \times Q$ • $Q = 0.0000016 \text{ C}$ UP/ $1.6 \times 10^{-6} \text{ C}$ 	1 1 (2)
6(b)(ii)	<ul style="list-style-type: none"> • $0.0080 = 2 \times t$ • $t = 0.004 \text{ s}$ / 4.0×10^{-3} UP <p><i>Reject</i> $2 = 5000 \times t$, $t = 0.0004 \text{ s}$ (4.0×10^{-4})</p>	1 1 (2)

(Total 7 marks)

Question Number	Answer	Mark
7(a)	<ul style="list-style-type: none"> • ammeter in correct position • voltmeter in correct position appropriate to candidate's circuit <p>Notes</p> <ul style="list-style-type: none"> - incomplete circuit with one connecting lead missing scores zero - ignore 'small' gaps in circuit. - V may be across power supply provided there is no added resistance in the circuit - V may be across A and resistor - both meters in series scores 1st mark - ignore switches and other components 	<p>1 1</p> <p>(2)</p>

Question Number	Answer	Mark
7(b)	<ul style="list-style-type: none"> • voltmeter or V or  <p>allow phonetic spelling</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark												
7(c)(i)	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">A</th> <th style="width: 50%; text-align: center;">B</th> <th style="width: 5%;"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$4 + 4 = \underline{8}$</td> <td style="text-align: center;">$\frac{1}{4} + \frac{1}{4} = \underline{\frac{1}{2}}$</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">$\frac{1}{8} + \frac{1}{4} = \frac{3}{8}$</td> <td style="text-align: center;">R = 2</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">total = $\frac{8}{3}$ (Ω) or 2.67 (Ω) allow 2.6 or 2.66 or 2.7 or $2 \frac{2}{3}$</td> <td style="text-align: center;">total = $4 + 2 = 6$ (Ω)</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p>Note</p> <ul style="list-style-type: none"> - No UP - <u>A or B</u> correct scores 2 - <u>A and B</u> correct scores 3 - If neither <u>A</u> nor <u>B</u> is correct but the top line is correct for <u>either</u> <u>A</u> or <u>B</u> (8 or $\frac{1}{2}$ seen) scores 1 	A	B		$4 + 4 = \underline{8}$	$\frac{1}{4} + \frac{1}{4} = \underline{\frac{1}{2}}$	1	$\frac{1}{8} + \frac{1}{4} = \frac{3}{8}$	R = 2	1	total = $\frac{8}{3}$ (Ω) or 2.67 (Ω) allow 2.6 or 2.66 or 2.7 or $2 \frac{2}{3}$	total = $4 + 2 = 6$ (Ω)	1	<p>(3)</p>
A	B													
$4 + 4 = \underline{8}$	$\frac{1}{4} + \frac{1}{4} = \underline{\frac{1}{2}}$	1												
$\frac{1}{8} + \frac{1}{4} = \frac{3}{8}$	R = 2	1												
total = $\frac{8}{3}$ (Ω) or 2.67 (Ω) allow 2.6 or 2.66 or 2.7 or $2 \frac{2}{3}$	total = $4 + 2 = 6$ (Ω)	1												

Question Number	Answer	Mark
7(c)(ii)	<ul style="list-style-type: none">• A	1 (1)

(Total 7 marks)

Question Number	Answer	Mark
8(a)(i)	<ul style="list-style-type: none"> line with arrow going N to S <p>Note</p> <ul style="list-style-type: none"> line may be straight or curved line must be seen both above and below wheel length of line must be greater than half SN distance line may be invisible where passing through wheel additional lines must not cross or have an arrow pointing S to N 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
8(a)(ii)	<ul style="list-style-type: none"> (lines) of flux / magnetic field (lines) are cut voltage/emf / current <u>induced</u> metal is conductor 	<p>1</p> <p>1</p> <p>1</p> <p>(3)</p>

Question Number	Answer	Mark
8(b)	<ul style="list-style-type: none"> any part slopes downwards correct curvature throughout <p>Note</p> <ul style="list-style-type: none"> graph consisting of two straight lines sloping downwards scores 1st mark 	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
8(c)(i)	Yes	1 (1)

Question Number	Answer	Mark
8(c)(ii)	<ul style="list-style-type: none"> electrical or kinetic energy to heat / internal energy dop <p><i>allow</i> 'when a current flows heat is produced' / 'current heats up'</p> <p><i>ignore</i> 'friction'</p>	<p>1</p> <p>(1)</p>

(Total 8 marks)

Question Number	Answer	Mark						
9(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>proton</td> <td>1800 - 2000</td> <td>1 or +1</td> </tr> <tr> <td>neutron</td> <td>1800 - 2000</td> <td>0 or zero or no charge or neutral</td> </tr> </table> <ul style="list-style-type: none"> • both charges correct • both masses correct 	proton	1800 - 2000	1 or +1	neutron	1800 - 2000	0 or zero or no charge or neutral	1 1 (2)
proton	1800 - 2000	1 or +1						
neutron	1800 - 2000	0 or zero or no charge or neutral						

Question Number	Answer	Mark
9(b)	<ul style="list-style-type: none"> • gamma (rays) / γ / X-rays / X /ultra violet/UV / gama 	1 (1)

Question Number	Answer	Mark
9(c)(i)	<ul style="list-style-type: none"> • electron 	1 (1)

Question Number	Answer	Mark
9(c)(ii)	<ul style="list-style-type: none"> • greatest charge: mass ratio or smallest mass /size or smaller mass/size ora <p>Note <i>independent of (i)</i> i.e ‘protons(or neutrons) because they have least mass’ scores the mark</p>	1 (1)

(Total 5 marks)

Question Number	Answer	Mark
10(a)(i)	<ul style="list-style-type: none"> • diffraction <p>Notes <i>Allow</i></p> <ul style="list-style-type: none"> - diffraction - defraction - deffraction 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
10(a)(ii)	<ul style="list-style-type: none"> • wavelength and gap of similar size /wavelength larger than gap ora 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
10(b)(i)	<ul style="list-style-type: none"> • $300\,000\,000 = f \times 0.060$ • $f = 5\,000\,000\,000 \text{ Hz or } s^{-1} \text{ or } 5 \times 10^9 \text{ Hz or } s^{-1}$ <p>UP</p>	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
10(b)(ii)	<ul style="list-style-type: none"> • wavelength small(er)/gap bigger than wavelength/frequency high(er) 	<p>1</p> <p>(1)</p>

(Total 5 marks)

Question Number	Answer	Mark
11(a)(i)	<ul style="list-style-type: none"> through centre of lens parallel to principal axis to LL then through principal focus <p>Notes</p> <ul style="list-style-type: none"> allow any correctly drawn ray from any part of object to corresponding part of image <p><i>ignore</i></p> <ul style="list-style-type: none"> arrows further rays rays along principal axis drawn outline of lens 	<p>1 1</p> <p>(2)</p>
11(a)(ii)	<ul style="list-style-type: none"> F in appropriate place with evidence e.g. where appropriate ray cuts principal axis 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
11(a)(iii)	<ul style="list-style-type: none"> real 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
11(b)(i)	<ul style="list-style-type: none"> The size of the image is less than before 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
11(b)(ii)	<ul style="list-style-type: none"> real 	<p>1</p> <p>(1)</p>

(Total 6 marks)

TOTAL FOR PAPER: 70 MARKS

7540/02 O-LEVEL PHYSICS MARK SCHEME - JUNE 2008

Question Number	Answer	Mark
1(a)(i)	<ul style="list-style-type: none"> • $8000 - 340 = 7660$ • $a = 7660 / 2560$ • $= 2.992/2.99 \text{ m/s}^2$ UP <p>Notes: Award 3 marks for a correct numerical answer of $2.992/2.99 \text{ m/s}^2$ without working.</p> <p>If ground friction missed award 2 marks as shown below</p> <ul style="list-style-type: none"> • $a = 8000/2560$ • $= 3.125 / 3.12/3.13/3.1/3(.0) \text{ m/s}^2$ UP <p>If ground friction is added award 2 marks as shown below</p> <ul style="list-style-type: none"> • $a = (8000+340)/2560$ • $= 3.2578/3.258/3.26/3.3 \text{ m/s}^2$ UP <p>Award 2 marks for a correct numerical answer of $3.125 / 3.12/3.13/3.1/3(.0) \text{ m/s}^2$ UP without working.</p>	<p>1 1 1</p> <p>1 1</p> <p>(1) (1)</p> <p>(1) (1)</p> <p style="text-align: right;">(3)</p>

Question Number	Answer	Mark
1(a)(ii)	<ul style="list-style-type: none"> • <u>air drag/ air friction/air resistance</u> • <u>(air drag) increases with speed/velocity</u> <p>Notes</p> <ul style="list-style-type: none"> • ignore ground friction 	<p>1 1</p> <p style="text-align: right;">(2)</p>

Question Number	Answer	Mark
1(a)(iii)	<p>2 marks for the correct calculation - see below.</p> <ul style="list-style-type: none"> • $55 = 2.2 \times t$ or $t=55/2.2$ • $=25 \text{ s}$ UP <p>Notes award both marks for 25 s without working</p>	<p>1 1</p> <p style="text-align: right;">(2)</p>

Question Number	Answer	Mark
1(a)(iv)	<p>2 mark for the correct calculation using one of the methods shown below.</p> <p>Using average speed x time</p> <ul style="list-style-type: none"> • $55/2 \times 25$ • $= 687.5/688 \text{ (m)}$ <p>or using $s = \frac{1}{2} at^2$</p> <ul style="list-style-type: none"> • $s = \frac{1}{2} \times 2.2 \times (25)^2$ • $= 687.5/688 \text{ (m)}$ <p>or using $v^2 = 2as$</p> <ul style="list-style-type: none"> • $55^2 = 2 \times 2.2 \times s$ • $s = 687.5/688 \text{ (m)}$ <p>Notes Allow reverse argument to show that in 700 m plane reaches 55.5/56 m/s at 700 m or takes 25.2/25.23/25.226 s to reach 700 m</p>	<p>1 1 or 1 1 or 1 1 (2)</p>

Question Number	Answer	Mark
1(a)(v)	<p>Any two points from the list below -</p> <ul style="list-style-type: none"> • <u>less</u> area/ <u>more</u> streamlined/smooth surface/ aerodynamic • <u>less</u> (air) drag/(air) friction/(air)resistance • <u>larger</u> unbalanced/net/resultant force <p>Notes</p> <ul style="list-style-type: none"> • Allow reverse argument eg otherwise area would be greater (than if not folded) • Ignore wheels not needed • ignore ground friction 	<p>1 1 1 (2)</p>

Question Number	Answer	Mark
1(b)(i)	<p>Any two points from the list below</p> <ul style="list-style-type: none"> • metre rule/ruler/measuring tape/ allow <u>distance</u> scale • blocks/books/wedges (to raise/compensate) • (more) (ticker) tapes or power supply (for timer) <p>Note Do not accept “a ramp”, balance or elastic bands or weights or masses</p>	<p>1</p> <p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
1(b)(ii)	<p>4 marks for the correct description of method - . Any four points from the list below - maximum 4 marks.</p> <ol style="list-style-type: none"> 1. turn on (ticker) timer 2. pull trolley (with newtonmeter not elastics) 3. keeping force constant/note (measure) force 4. <u>measure</u> distance/spaces/dots on (ticker) <u>tape</u> 5. calculate acceleration (from tape <u>not</u> $f=ma$) 6. repeat for same force not mass 7. repeat for different forces not masses <p>Notes</p> <ul style="list-style-type: none"> • Ignore compensation for friction here 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>(4)</p>

Question Number	Answer	Mark
1(b)(iii)	<p>1 mark for the correct reason - shown below.</p> <ul style="list-style-type: none"> • not friction compensated/not allowed for friction/some force is used to overcome friction/there is friction <p>note</p> <ul style="list-style-type: none"> • ignore “because force is not directly proportional to acceleration • this mark may be awarded here if friction compensated is seen in b(iv) 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
1(b)(iv)	<ul style="list-style-type: none"> - tilt/raise (left hand end of) runway or A/use a ramp/ use a smooth surface/lubricate the surface - so trolley runs at constant speed/moves with no acceleration <p>Notes</p> <ul style="list-style-type: none"> • independent of answer to (iii) • if compensate for friction is seen here and if no marks awarded in b(iii) then return to b(iii) and award that mark in b(iii) only not here 	<p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">(2)</p>

(Total 20 marks)

Question Number	Answer	Mark
2(a)(i)	<ul style="list-style-type: none"> • mass = 1.2×7 • = 8.4 (kg) (UP only if given as final answer) • weight = 84 N UP <p>Notes</p> <p>84 N with no working scores 3 marks 84 with no working scores 2 marks 8.4 kg with or without working scores 2 marks 8.4 N with or without working scores 1 mark 8.4 with or without working scores 1 mark</p>	<p>1 1 1</p> <p>(3)</p>

Question Number	Answer	Mark
2(a)(ii)	<ul style="list-style-type: none"> • Attempt to convert temperatures to Kelvin (eg use of 237 or -273) • $7/288 = V_2 / 327$ correct conversion only • $V_2 = \underline{7.9479/7.948/ 7.95 /7.9} \text{ m}^3$ UP <p>Notes</p> <p>Working and answer must be seen for 3 marks. ignore <u>further</u> rounding to 8m^3</p> <p>or allow 1 mark only for the following working shown below</p> <ul style="list-style-type: none"> • temperature in Celsius • $7/15 = V_2 / 54$ • $V_2 = 25.2/25 \text{ m}^3$ • 	<p>1 1 1</p> <p>or (0) (1) (0)</p> <p>(3)</p>

Question Number	Answer	Mark
2(a)(iii)	<p>1 mark for each correct effect - shown below.</p> <p>Density smaller/less/reduced/decreases</p> <p>Weight same/unchanged/does not change/ no effect</p>	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
2(b)(i)	<p>1 mark for the correct process - shown below.</p> <ul style="list-style-type: none"> Radiation/heat radiation/thermal radiation /infra red/ infra red radiation <p>Note Do not accept nuclear radiation/atomic radiation/radioactivity</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(b)(ii)	<p>1 mark for the correct process - shown below.</p> <ul style="list-style-type: none"> conduction/convection <p>Note allow phonetic spelling</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(b)(iii)	<ul style="list-style-type: none"> molecules/particles move faster/gain KE/gain kinetic energy (not just "gain energy") more frequent collisions (with walls) harder collisions (with walls)/greater rate of change of momentum 	<p>1</p> <p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
2(c)(i)	<ul style="list-style-type: none"> • correct scale for x axis - 2cm = 5 °C (only) • labels and units on both axes (minimum upthrust N and temperature °C) • plots (-1 each incorrect ± 1mm or outside grid) • straight line (not joining the plots with straight lines) <p>Notes:</p> <ul style="list-style-type: none"> • Use of an x axis scale of 1cm=5°C or better can score up to 4 marks. X axis scale less than this cannot score plotting marks • Linear graph can only score label and units mark • Accept °C or C for unit 	<p>1 1 2 1</p> <p>(5)</p>

Question Number	Answer	Mark
2(c)(ii)	<ul style="list-style-type: none"> • 32.5 °C accept <u>32 °C to 33 °C UP</u> <p>Notes: Accept °C or C for unit</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(c)(iii)	<p>1 mark for correct method (shown on graph)</p> <ul style="list-style-type: none"> • correct line across and/or down (not just a dot) 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
2(c)(iv)	<p>1 mark for the correct reason - shown below.</p> <ul style="list-style-type: none"> • <u>upthrust</u> bigger/larger/more than <u>weight</u> / 106.7 (N) is greater than 100(N) 	<p>1</p> <p>(1)</p>

(Total 20 marks)

Question Number	Answer	Mark
3(a)(i)	<ul style="list-style-type: none"> • reflection/ (ray) A reflected/ reflective • $i = r$ / <u>angle of incidence</u> = angle of reflection <p>Notes</p> <ul style="list-style-type: none"> • (total) internal reflection loses first mark • angle of incidence = angle of reflection could gain both marks • independent marks 	<p>1 1</p> <p>(2)</p>

Question Number	Answer	Mark
3(a)(ii)	<ul style="list-style-type: none"> • refraction • bends towards normal/ slows down (in glass)/ refractive index of glass more than n of air / accept less dense to more dense/ <p>Notes</p> <ul style="list-style-type: none"> • independent marks • do not accept diffraction or reflection • do not accept $n = \sin i / \sin r$ on its own 	<p>1 1</p> <p>(2)</p>

Question Number	Answer	Mark
3(a)(iii)	<p>1 mark for the correct answer.</p> <ul style="list-style-type: none"> • B 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
3(b)(i)	<p>1 mark for correctly drawn arrows on both diagrams.</p> <ul style="list-style-type: none"> • minimum of <u>two</u> out of three correct arrows on air rays on <u>each</u> diagram <p>Notes all arrows must be in correct direction to score.</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
3(b)(ii)	<ul style="list-style-type: none"> reflection/ to reflect light /otherwise light would not be reflected /silver is a good reflector <p>Do not accept total internal reflection here</p>	<p>1</p> <p>(1)</p>
Question Number	Answer	Mark
3(b)(iii)	<p>1 mark for each correct reason</p> <ul style="list-style-type: none"> too much light entering eye (from headlights)/person would be blinded/driver will have glare eye would to be in wrong position (for driving) / driver would be looking down (instead of forwards) . 	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
3(c)(i)	<p>2 marks for the correct calculation - shown below.</p> <ul style="list-style-type: none"> $\sin 17^\circ \div \sin 11^\circ$ $= 1.5/1.53/1.532/ 1.5323$ <p>Notes</p> <ul style="list-style-type: none"> award both marks for correct answer with no working but 1.5 with no working scores 0/2 $17/11=1.545$ scores 0/2 	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
3(c)(ii)	<p>1 mark for the correct answer .</p> <ul style="list-style-type: none"> <u>total internal reflection</u> 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
3(c)(iii)	<ul style="list-style-type: none"> • $1.53 = 1 \div \sin x / x = \sin^{-1}(1/1.53)$ must ECF from c(i) • $x = 41/40.7^\circ/40.8^\circ / 40.81/40.74/40.739$ <p>Notes</p> <ul style="list-style-type: none"> • actual answers depend on value entered in calculators • ecf for 1.5 from c(i) allow 42/41.8/41.81 • correct answers from list with no working score both marks • degree symbol not required • ignore a further angle slightly larger than calculated value • 41 obtained using protractor to measure diagram scores 0/2 	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
3(c)(iv)	<p>1 mark for the correct explanation from list below below.</p> <ul style="list-style-type: none"> • angle x must be greater than critical angle • incident angle greater than critical or 40.7/40.8 • angle x <u>is</u> the critical angle so anything bigger gives TIR or is reflected <p>Notes</p> <ul style="list-style-type: none"> • allow c or C for critical angle if used in c(iii) • allow greater than or equal to c • allow reverse argument 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
3(d)	<p>Apply scheme in bold to raybox method and italics answers to real and apparent depth method</p> <p>Award any 4 points from items 1 to 7 and any one point from 8 to 9</p> <ol style="list-style-type: none"> 1. use or place (rectangular glass) block on paper 2. use raybox/pins/ <i>over mark on paper</i> 3. indicate record/measure/note <i>i /measure actual or real depth of block</i> 4. measured between normal and incident ray/ <i>look down through block</i> 5. indicate/ record/measure /note <i>r/locate position of image</i> 6. use of protractor/ <i>measure apparent depth or distance from top surface</i> 7. repeat for different <i>i / repeat readings</i> 8. n = sin <i>i / sin r / Calculate RI= real/apparent depth</i> 9. slope of sin <i>i v sin r graph/ average values of RI/ take average of values</i> <p>Note</p> <ul style="list-style-type: none"> • Marks 1 to 6 can be given if seen on labelled diagram for both methods 	<p>1</p> <p>(5)</p>

(Total 20 marks)

Question Number	Answer	Mark
4(a)(i)	<p>2 marks for the correct answer - shown below.</p> <p>0.10 x 1000 or 100 x 60 x 60 or 3600 = 360 000 (no mark)</p> <p>OR reverse argument</p> <p>360 (000) (no mark) /1000 x 60 x 60) = <u>0.1</u> (kWh) no mark</p> <p>Notes</p> <ul style="list-style-type: none"> • first mark is for conversion of kW to W and second mark for conversion of hours to seconds 	<p>1 1 1 1 1 1 (2)</p>

Question Number	Answer	Mark
4(a)(ii)	<p>2 marks for the correct calculation from two options shown below.</p> <ul style="list-style-type: none"> • 360 (000) × 0.025 • = 9000 J /9kJ UP <p>or</p> <ul style="list-style-type: none"> • 0.10 x 0.025 • = 0.0025 kWh (2.5 Wh) UP <p>Notes</p> <ul style="list-style-type: none"> • treat 360 x 0.025 = 9<u>J</u> as UP so scores 1 mark • allow answer by ratios 	<p>1 1 (2)</p>

Question Number	Answer	Mark
4(a)(iii)	<p>2 marks for the correct calculation - shown below.</p> <ul style="list-style-type: none"> • 9000 ÷ 5.0 ecf • = 1800 s /30 minutes/ 0.5 Hour UP <p>or</p> <ul style="list-style-type: none"> • 2.5 / 5.0 ecf from (ii) • = 0.5 hour UP 	<p>1 1 (2)</p>

Question Number	Answer	Mark
4(b)(i)	4 marks for the correctly completed equation - <ul style="list-style-type: none"> • Pu (238) bottom number is 94 • alpha top number is 4 bottom number is 2 • U (92) top number is 234 	1 1 1 1 (4)

Question Number	Answer	Mark
4(b)(ii)	<ul style="list-style-type: none"> • 2 half lives/ 1 : $\frac{1}{2}$: $\frac{1}{4}$ • 176 years UP <p>Note mark each point separately</p>	1 1 (2)

Question Number	Answer	Mark
4(b)(iii)	1 mark for the correct answer- shown below. <ul style="list-style-type: none"> • Box 1 nuclear or atomic • Box 3 heat/thermal/internal <p>Note</p> <ul style="list-style-type: none"> • both must be correct to score • accept more than one of the correct responses in a correct box. eg nuclear and atomic in box 1 and/or heat and thermal in box 2 • do not accept an incorrect response in either box eg nuclear and chemical in box one 	1 (1)

Question Number	Answer	Mark
4(c)	<ul style="list-style-type: none"> • <u>alpha</u> has short range/ stopped by 4 cm to 10 cm air • alpha cannot penetrate/is stopped by aluminium/is absorbed by aluminium <p>Note</p> <ul style="list-style-type: none"> • 2nd line on its own scores both marks • ignore other radiations or other irrelevant facts 	<p>1</p> <p>1</p> <p>(2)</p>

Question Number	Answer	Mark
4(d)(i)	<p>3 marks for the correct calculation from one method shown below.</p> $200 \times 1000 \times 0.0020$ $\times 0.05 \text{ or } 5/100$ $\div 5.0$ <p>(= 4 h)</p> <p>or</p> $200 \times 1000 \times 0.0020$ $\div 5.0$ $\times 0.05 \text{ or } 5/100$ <p>(= 4 h)</p> <p>or</p> <p>Energy used = 5.0 x 4 (= 20 Wh / 0.02 kWh) Energy needed = 20 x (100/5) (= 400 Wh/0.4kWh) Energy available = 200 x (1000 x) 0.0020 (=400 Wh/0.4kWh)</p> <p>or</p> <p>energy used = 5/1000 x 4 = 0.02 kWh energy supplied = 200 x .0020 x 5/100 (.05) = .02kWh</p> <p>Note</p> <p>There are a large number of variations as well as those above. In general award one mark for a correct calculation of the total energy transferred in the battery. One mark for applying the 5% efficiency and one mark for using 5 W to calculate a time all in appropriate units. Allow reverse calculation</p>	<p>1</p> <p>1</p> <p>1</p> <p>or</p> <p>1</p> <p>1</p> <p>1</p> <p>or</p> <p>1</p> <p>1</p> <p>1</p> <p>or</p> <p>1</p> <p>1</p> <p>1</p> <p>(3)</p>

Question Number	Answer	Mark
4(d)(ii)	2 marks for the correct reasons - shown below. <ul style="list-style-type: none"> • source is (radio)active/Pu still emits alpha after 4 hours • long half life/ 4h is (much) less than half life/ half life is 88 years 	1 1 (2)

(Total 20 marks)

Question Number	Answer	Mark
5(a)(i)	<p>Correct definition - from list shown below.</p> <ul style="list-style-type: none"> • <u>maximum</u> displacement • <u>maximum</u> distance from mean/normal/central /rest/zero/ equilibrium position • distance between crest (or trough) and mean/normal/central /rest/zero/ equilibrium position <p>Note allow a suitable diagram</p>	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
5(a)(ii)	<p>1 mark for the correct definition</p> <ul style="list-style-type: none"> • number of cycles or vibrations or oscillations or waves in unit time or per second 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
5(a)(iii)	<p>1 mark for a correct definition - from list shown below.</p> <ul style="list-style-type: none"> • distance between two points in phase • distance between two adjacent peaks • distance between two adjacent troughs • distance between two identical points on adjacent waves <p>Note allow a suitable diagram Accept equivalent words for adjacent</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>(1)</p>

Question Number	Answer	Mark
5(a)(iv)	<p>2 marks for the correct definition - shown below.</p> <ul style="list-style-type: none"> • (maximum amplitude) when <u>driving/applied</u> frequency • equals <u>natural</u> frequency of system (wire) <p>or</p> <ul style="list-style-type: none"> • when string or system or object is <u>made</u> to vibrate • at <u>natural</u> frequency of system (wire) 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>(2)</p>

--	--	--

Question Number	Answer	Mark
5(b)(i)	<p>1 mark for the correct factor - shown below.</p> <ul style="list-style-type: none"> load / type of wire / temperature / tension / material of wire / diameter of wire / thickness of wire / mass per unit length of wire 	<p>1</p> <p>(1)</p>

Question Number	Answer	Mark
5(b)(ii)	<p>1 mark for each correct piece of equipment.</p> <ul style="list-style-type: none"> rule / metre rule / measuring tape / <u>distance scale</u> tuning fork(s) piece of paper (to put on wire) <u>balance</u> (to measure mass / weight of load or wire) thermometer <u>to see if temperature is constant</u> 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>(3)</p>

Question Number	Answer	Mark
5(b)(iii)	<p>6 marks for the correct description of method –</p> <p>Maximum <u>five</u> marks from points 1 to 9</p> <ol style="list-style-type: none"> place paper at centre of wire sound tuning fork / make fork vibrate place tuning fork on wire vary length of wire until paper falls off / wire vibrates with large amplitude record / measure / note length record / note frequency match pitch of wire and fork before placing fork on wire repeat for different <u>fork / frequency</u> <p>Notes:</p> <p>Plus one mark for correct repetition from 10 below</p> <ol style="list-style-type: none"> repeat for same <u>fork / frequency</u> 	<p>1</p> <p>(6)</p>

Question Number	Answer	Mark
5(b)(iv)	<p>2 marks for correctly drawn <u>table</u> - shown below.</p> <p>columns headed with both names both columns with suitable units eg</p> <ul style="list-style-type: none"> length - frequency m Hz <p>ignore any additional headings</p>	<p>1 1 (2)</p>

Question Number	Answer	Mark
5(c)	<p>1 mark for the correct effect - shown below.</p> <p>no mark awarded for labelling axes</p> <ul style="list-style-type: none"> as f inc / dec ora the shorter the length the higher the frequency frequency is inversely proportional to length <p>Note Do not award mark if either axis is labelled incorrectly</p>	<p>1 (1)</p>

Question Number	Answer	Mark
5(d)(i)	<p>1 mark for correctly drawn sketched graph.</p> <ul style="list-style-type: none"> horizontal <u>non-zero</u> line (by eye) 	<p>1 (1)</p>

Question Number	Answer	Mark
5(d)(ii)	<p>1 mark from list shown below. All dependent on previous answer</p> <ul style="list-style-type: none"> frequency increases, λ decreases, $f \times \lambda$ constant speed = frequency x wavelength if f inc, λ dec speed does not depend on frequency 	<p>1 1 1 (1)</p>

(Total 20 marks)

TOTAL FOR PAPER: 100 marks

Further copies of this publication are available from
Edexcel UK Regional Offices at www.edexcel.org.uk/sfc/feschools/regional/
or International Regional Offices at www.edexcel-international.org/sfc/academic/regional/

For more information on Edexcel qualifications, please visit www.edexcel-international.org/quals
Alternatively, you can contact Customer Services at www.edexcel.org.uk/ask or on + 44 1204 770 696

Edexcel Limited. Registered in England and Wales no.4496750
Registered Office: 190 High Holborn, London WC1V 7BH