OCR
RECOGNISING ACHIEVEMENT

GCE

Physics A

Advanced GCE **H558**

Advanced Subsidiary GCE **H158**

Mark Scheme for the Units

June 2009

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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Advanced Subsidiary GCE Physics (H158)

MARK SCHEMES FOR THE UNITS

G481 Mechanics

CATEGORISATION OF MARKS

The marking schemes categorise marks on the MACB scheme.

B marks: These are awarded as independent marks, which do not depend on other marks. For a **B**-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

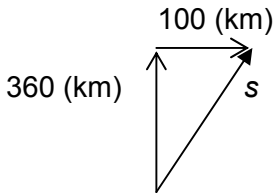
M marks: These are method marks upon which **A**-marks (accuracy marks) later depend. For an **M**-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular **M**-mark, then none of the dependent **A**-marks can be scored.

C marks: These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a **C**-mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C**-mark is given.

A marks: These are accuracy or answer marks, which either depend on an **M**-mark, or allow a **C**-mark to be scored.

SIGNIFICANT FIGURES

In general, there is no penalty when the candidate's answer is more than the sf of the data given in the question.
For example, in a question where the data is given to 2 sf, the answer can be 2 sf or more. An answer given to 1 sf may be penalised.

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	Both measured in metre/m	B1	**Allow**: Both have the same unit/Both have 'magnitude' **Not**: Both are distance/length
		(ii)	Distance is a scalar/does not have direction or Displacement is a vector/has direction	B1	**Not**: One is a vector and the other a scalar
	(b)	(i)	time = $\frac{3.6\times10^5}{170}$ time = 2.1(18) $\times$ 10^3 (s) or 2.1 $\times$ 10^3 (s)	B1	**Note**: Answer to 2sf or more is required
		(ii)	Correct vector triangle Eg:  $s^2 = 360^2 + 100^2$ / $s = \sqrt{(360^2 + 100^2)}$ *s* = 373.6 (km) / 370 (km)	B1 C1 A1	The vector triangle must have at least two labels (360, 100 and *s* – allow *x* or *d* for *s*). The 'orientation' of the triangle must be as shown. Ignore the direction of the arrows. **Allow**: Full credit can be given for a scale drawing 2 marks if answer in the range (370 – 380) 1 mark if answer in the range (360 – 370) or (380 - 390) **Note**: Bald answer to 2sf or more and no diagram scores 2/3 marks.
			Total	**6**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	*a* = gradient/slope (of the line)	B1	**Allow**: *a* = change in velocity/time or 'rate of change of velocity' **Allow**: Correct equation plus labels; $a = (v-u)/t$; *v* = final velocity, *u* = initial velocity and *t* = time **Note**: The term *gradient*/*slope*/*change*/ *initial* to be included and spelled correctly to gain mark
		(ii)	*s* = area (under the graph)	B1	
	(b)		area of 'rectangle' = '*ut*' area of 'triangle' = $\frac{1}{2} \times t \times (v-u)$ area of 'triangle' = $\frac{1}{2} \times t \times at$	M1 M1	**Note**: The second M1 mark is **not** for '½ at^2' but for ' ½ × *t* × *at*' **Allow**: 'Area of trapezium method': $s = \frac{1}{2}(u+v)t$ and $v = u + at$ M1 Correct substitution leading to correct answer M1 **Note**: Substitution method starting with $v^2 = u^2 + 2as$ scores zero
	(c)	(i)	$32 = \frac{1}{2} \times a \times 2.8^2$ $a = \frac{32 \times 2}{2.8^2}$ *a* = 8.16 (m s^{-2}) or 8.2 (m s^{-2})	C1 A1	**Note**: The C1 mark is for substitution into the equation given in **(b)** with *u* = 0 **Note**: Bald answer of 8.16 (m s^{-2}) or 8.2 (m s^{-2}) scores 2/2 marks Bald 8 (m s^{-2}) scores 1/2
		(ii)	Drag/air resistance/air friction (makes the time longer)	B1	**Not:** 'Reaction time'/'wind'
			Total	**7**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		… ***immediately*** *after jumping* Only force is the weight/drag = 0/net force = weight acceleration = *g*/9.8(1 m s^{-2}) (Allow '*mg*' for weight. Do not allow 'gravity' for weight.) … ***before*** *terminal velocity is reached* Any **<u>two</u>** from: Drag increases (with speed) /drag $\propto$ $speed^2$ Net or resultant or total force decreases / weight > drag Acceleration is less than *g* … ***at*** *terminal velocity* weight = drag / net force = 0 acceleration = 0 /<u>constant</u> speed or velocity (AW)	B1 B1 B1 B1 B1 B1 B1	**Alternatives** accepted for *drag* are: friction/air resistance **Allow**: 'Has acceleration of free-fall/due to gravity' as alternative for second B1 mark **Allow**: velocity instead of speed. **Allow**: 'drag $\propto$ speed' as BOD. **Allow**: Acceleration decreases **Allow**: upward force(s) = downward force/'forces balanced'
	(b)		(Transformed to) heat/thermal (energy)	B1	**Not**: 'Friction'/sound
	(c)		Any **<u>two</u>** from: 1. The terminal velocity increases 2. Initial gradient/slope is the same/equal to *g* 3. Time taken to reach terminal velocity is longer	B1 $\times$ 2	 **Allow**: Initial acceleration is the same/*g*/9.8(1 m s^{-2})
			Total	**9**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		work done = force × distance <u>moved</u> in the direction of the force	M1 A1	**Allow**: 'displacement' instead of 'distance' **Allow**: 1 mark for 'force × distance in the direction of the force' **Not**: work done = energy transfer
	(b)		power = work (done)/time or power = energy/time or power = rate of work done	B1	**Not**: Mixture of quantities and units, e.g: 'energy per second'
	(c)		This is because of heat/thermal energy/friction	B1	**Not**: sound/vibrations
	(d)	(i)	$E_k = \frac{1}{2}mv^2$ / $E_k = \frac{1}{2} \times 810 \times 30^2$ $E_k = 3.645 \times 10^5$ (J) or 3.65×10^5 (J)	C1 A1	**Note**: Bald answer 3.645×10^5 (J) or 3.6×10^5 (J) scores 2/2 marks **Allow**: 1 mark for wrongly rounded answer of 3.7×10^5 (J)
		(ii)	power = $\frac{3.65 \times 10^5}{12}$ power = 3.04×10^4 (W) ≈ 3.0×10^4 (W)	B1	Possible ecf
		(iii) 1.	work done = 500 × 30 work done = 15000 (J s^{-1})	B1	
		2.	'output energy' = $18 \times 46 \times 10^6 \times 0.25$ (= 2.07×10^8 J) total drive time = $\frac{18 \times 46 \times 10^6 \times 0.25}{15000}$ (= 1.38×10^4s) total drive distance = $1.38 \times 10^4 \times 30$ = 4.1×10^5 (m)	C1 C1 A1	**Allow**: 'input energy' = $18 \times 46 \times 10^6$ (= 8.28×10^8 J) This C1 mark can also be scored using: 'distance = $2.07 \times 10^8/500$' Possible ecf from **iii 1.** **Allow**: Bald 4.1×10^5 (m) scores 3/3 2/3 for 1.66×10^6 m if 25% efficiency is not used 2/3 if 30 kW from **ii** is used; answer 2.0 or 2.1×10^5 (m)
			Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	*N* is normal to the ramp (judged by eye) *F* is parallel and up the ramp	B1 B1	Allow marks even if the labels *N* and *F* are omitted
		(ii)	$F = W\sin\theta$	B1	
	(b)	(i)	Expected answer: '*For equilibrium of an object the sum of clockwise moments about a point = sum of anticlockwise moments about the same point*.' clockwise moment(s) = anticlockwise moment(s) Reference to one of the moments taken about a point/'equilibrium'/sum (or total or net or Σ) mentioned once	 M1 A1	**Note**: The term '*clockwise*' to be included and spelled correctly to gain the M1 mark **Note**: 'net moment = 0' is equivalent to the M1 mark **Note**: If M1 is lost for incorrect spelling of 'clockwise', then allow this A1 mark
		(ii)	$200\times12 = F\times75$ $F = 32$ (N)	C1 A1	**Note**: Bald answer of 32 (N) scores 2/2 marks
		(iii)	$p = \frac{32}{6.0\times10^{-5}}$ pressure = 5.3×10^5 (Pa)	C1 A1	Possible ecf **Note**: Bald answer of 5.3×10^5 (Pa) scores 2/2 marks
		(iv)	(Pressure is) greater because the force/*F* is larger (to provide the same moment)	B1 B1	
			Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)		time = $6.9 \times 3.16 \times 10^7$ (= 2.18×10^8 s) average speed = $\frac{5.0 \times 10^{12}}{6.9 \times 3.16 \times 10^7}$ average speed = 2.29×10^4 or 2.3×10^4 (m s^{-1})	C1 A1	**Allow**: 1 mark for $5.0 \times 10^{12}/6.9 = 7.2(46) \times 10^{11}$ (m y^{-1}) **Allow**: 1 mark for $\frac{5.0 \times 10^{12}}{3.16 \times 10^7} = 1.58 \times 10^5$ (m s^{-1})
	(b)		distance = 0.70×200 (= 140 mm) or KE = ½ $\times 4.0 \times 10^{-6} \times 6100^2$ (= 74.4 J) work done = change in KE $F \times (0.70 \times 10^{-3} \times 200) = \frac{1}{2} \times 4.0 \times 10^{-6} \times 6100^2$ *F* = 530 (N) ---------- or ---------- *F* = *ma* $a = \frac{6100^2}{2 \times (0.70 \times 10^{-3} \times 200)}$ (=1.33×10^8) *F* = $4.0 \times 10^{-6} \times 1.33 \times 10^8$ *F* = 530 (N)	C1 C1 A1 C1 C1 A1	**Note**: Bald answer scores 3/3 marks **Note**: 0.53 (N) scores 2/3 because of 10^n error in distance 1.06×10^5 (N) scores 2/3 because '200' not taken into account 106 (N) scores 1/3 because '200' missed out and 10^n error
			Total	**5**	

Question			Expected Answers	Marks	Additional Guidance
7	(a)		Straight line through origin (judge by eye) Correct shape of curve in the plastic region	B1 B1	
	(b)		Copper	B1	
	(c)		Maximum stress material can withstand (before fracture)	B1	**Allow**: UTS = breaking stress **Allow**: UTS = breaking force /(cross-sectional) area
	(d)		extension (or compression) $\propto$ force (as long as elastic limit is not exceeded)	B1	**Allow**: 'load' instead of force **Not**: $x \propto F$, unless the labels are defined
	(e)	(i)	force = 75×0.085 F = 6.38 (N) $\approx$ 6.4 (N)	C1 A1	
		(ii)	acceleration = $\frac{6.38}{2.5\times10^{-3}}$ acceleration = 2550 (m s^{-2})	B1	**Note**: $a = \frac{kx - mg}{m}$ gives 2540 (m s^{-2}) Possible ecf
		(iii)	Correct selection of equation: mgh / $\frac{1}{2}kx^2$ / $\frac{1}{2}Fx$ $0.0025\times9.81\times h = \frac{1}{2}\times75\times0.085^2$ height = 11 (m)	C1 C1 A1	 **Note**: Bald answer of 11 (m) scores 3/3 marks
			Total	**11**	

G482 Electrons, Waves and Photons

CATEGORISATION OF MARKS

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Question			Expected Answers	Marks	Additional Guidance
1	(a)		resistance = p.d./current	B1	**accept** voltage instead of p.d.; ratio of voltage to current; voltage per (unit) current **not** R = V/I or p.d. = current x resistance or p.d. per amp or answer in units or voltage over current
	(b)	(i)	6 V	B1	
		(ii)	R = V/I = 6/0.25 = 24 (Ω)	C1 A1	**ecf (b)(i)** 240 V gives 960 Ω **award** 0.024 Ω 1 mark only (POT error)
	(c)	(i)	6 V supply with potential divider 'input' across it and lamp across p.d. 'output' ammeter in series with lamp voltmeter across lamp	B1 B1 B1	**accept** 0 – 6 V variable supply with lamp across it **not** variable R in series with supply circuit with no battery present can only score voltmeter mark
		(ii)	non-zero intercept line indicating increasing value of R with current	B1 B1	curve must reach y-axis **accept** straight line or upward curve
		(iii)	resistivity/resistance of filament wire increases with temperature the temperature of the lamp increases with current/voltage increase more frequent electron-ion/atom collisions/AW increased ion vibrations	B1 B1	**accept** any two of the four statements **accept** AW, e.g the lamp heats up because of the current
	(d)	(i)	lamps do not light	B1	**ignore** reasons unless too contrary
			remaining lamps are lit with qualification	B1	qualification could be more dimly or sensible explanation
		(ii)	using resistors in parallel formula to obtain a value of R per unit R per unit = 19.4 Ω or R total = 774 Ω I = 6/19.4 or 240/774 = 0.31 A	C1 C1 A1	eg takes R of bulb = 10 Ω giving R per unit = 9.1 Ω gains first mark only **ecf (b)(i)(ii)** **accept** R of resistors = 4000 Ω; current in chain = 0.06 A; total current = 0.06 + 0.25 = 0.31 A 0.3 A is SF error so gains 2 marks only apply **SF error only once** in paper
			Total question 1	**16**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		E = I(R + r)	B1	
	(b)	(i) 1 2	0.80 Ω 6.4 V	B1 B1	
		(ii)	(sum of) e.m.f.s = sum /total of p.d.s/sum of voltages (in a loop)	B1	
		(iii)	6.4 = 0.80I I = 8.0 A	C1 A1	**can be 2 ecf** from **(b)(i),** eg 21.6/0.8 = 27 A (1 ecf) or 21.8/0.68 = 31.8 A (2 ecf)
	(c)	(i)	Q = It = 2.5 x 6 x 60 x 60 = 54000 (C)	C1 A1	**allow** 1 mark if forgets one or two 60's giving 900 C or 15 C
		(ii)	energy = QE = 54000 x 14 = 756000 (J)	C1 A1	**allow** (use of 12 V gives) 648000 J for 1 mark
		(iii)	energy loss = I2Rt = VIt = 2 x 2.5 x 6.0 x 60 x 60= 108000 J percentage = (108000/756000) x 100 = 14%	C1 A1	**accept** QΔV = 54000 x 2.0 = 108000 J **accept** QΔV/QE = 2.0/14.0 = 14% **not** 756000/54000 = 14%
			Total question 2	**12**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	I = V/R = 8.0/200 I = 0.040 (A)	C1 A1	
		(ii)	V = 24 – 8 = 16 (V)	B1	
		(iii)	R = 16/0.04 giving R = 400 (Ω)	C1 A1	**accept** ratio of p.d.s to ratio of Rs **ecf** from **(i)** & **(ii)** ie **(a)(ii)/(a)(i)**
		(iv)	$P = VI = I^2R = V^2/R$ P = 0.640 (W)	C1 A1	**ecf** from **(i)** & **(ii)** **accept** 640 mW
	(b)	(i)	the thermistor has heated up/ its temperature has increased so its resistance has dropped so the ratio of the voltages across the potential divider changes/AW	B1 M1 A1	 **accept** so the current increases **accept** so IR of fixed resistor increases
		(ii)	voltages are equal so resistances are equal	B1	
	(c)	(ii)	straight line through origin labelled R passing through 0.06,12	B1 B1	**allow** correct lines with no labels
		(ii)	upward curve below straight line through origin labelled T passing through 0.06,12	B1 B1	
			Total question 3	**15**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	diffraction or refraction or superposition or interference	B2	**accept** any two from the four listed
		(ii)	only transverse waves can be polarised	B1	**accept** sound is a longitudinal wave or e-m waves are transverse
		(iii)	place transmitter and receiver facing each other	B1	**accept** from diagram **allow** (metal) grille/polarising filter to polarise microwaves
			rotate either transmitter or receiver through 90° about axis joining aerials **or** use two polarising filters and rotate from parallel to crossed	B1	**accept** place (metal) grille/polarising filter [**not** Polaroid] between transmitter and receiver and rotate through 90°
			observe signal fall to zero/minimum from initial high value on meter monitoring output of receiver	B1	
			explanation of observations/link between observations and polarisation	B1	QWC mark
	(b)	(i) 1	0.3 (mm)	B1	tolerance ±0.02 mm ie 0.28 – 0.32 (mm)
		2	T = 4.0 ms	C1	
			F = 1/T = 250 (Hz)	A1	**allow** 0.25 Hz or any other POT error for 1 mark
		(ii)	realisation that intensity is proportional to (amplitude)^2	B1	
			giving amplitude increase by $\sqrt{2}$, ie4(.2) mm	B1	
			sine wave of same frequency with any increased amplitude	B1	
		(iii)	microphone (to transfer mechanical motion to electrical signal/voltage)	B1	
			oscilloscope to display oscillation/wave for measurement (of period)/AW	B1	**accept** computer/datalogger/frequency meter with qualification as for oscilloscope
			Total question 4	**15**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	node occurs where the amplitude/displacement is (always) zero	B1	**accept** displacement for amplitude for **(i)** only
		(ii)	antinode occurs where the amplitude (of the standing wave) takes the maximum (possible) value	B1	
	(b)	(i)	wave travels to end and is reflected	B1	
			reflected wave <u>interferes/superposes</u> with incident wave	B1	**accept** 2 waves of same f travelling in opposite directions <u>interfere</u> with no reference to reflection
			always destructively at certain points to produce nodes **or** always constructively at certain points to produce antinodes	B1	
		(ii)	A and N points labelled correctly	B1	
		(iii)	3	B1	
		(iv)	30 cm = $\lambda/2$ or λ = 60 cm	C1	**allow** 1 mark for correct calculation using $v = f\lambda$ with wrong wavelength if method/reasoning clear
			$v = f\lambda = 120 \times 0.6$	C1	
			$v = 72$ (m s^{-1})	A1	
	(c)		v = 2k becomes v = 3k (k = 36)	B1	**accept** v increases by 3/2 or v = 108 m s^{-1}
			wavelength increases by 3/2 (as frequency unchanged)	B1	**accept** wavelength becomes 90 cm
			2 half wavelengths fit on the string so standing wave is set up/AW	B1	**allow ecf** correct conclusion with wrong λ
			Total question 5	**13**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)	(i)	line spacing d = 1/(300 x 1000) (= 3.3×10^{-6} (m))	B1	look for clear reasoning to award mark
		(ii)	sin θ = λ/d = $6.3 \times 10^{-7}/3.3 \times 10^{-6} = 0.19$ θ = 11 degrees	C1 C1 A1	 rounding error of 0.2 here gives 11.9^{o} 11.9^{o} gets 2 marks
		(iii)	spots can be seen where n = d sin θ/λ maximum n when sin θ = 1 (giving n = 5.3) so n =5 can be seen thus 5 spots on either side of straight through + straight through = 11	B1 B1 B1	**accept** basic idea of orders for first mark N.B. calculation not necessary
	(b)	(i)	ε = hc/λ = $6.6 \times 10^{-34} \times 3.0 \times 10^{8}/6.3 \times 10^{-7}$ = 3.14×10^{-19} (J)	C1 A1	 **accept** 3.2×10^{-19} (J)
		(ii)	$5.0 \times 10^{-4}/3.14 \times 10^{-19}$ = 1.6×10^{15}	C1 A1	**ecf** from **b(i)1**
	(c)	(i)	Electrons behave as waves/have a wavelength diffraction observable because gaps/atoms are similar to wavelength of electrons regular pattern of atoms acts as a grating allowing constructive interference to produce pattern on screen/AW rings occur because atomic 'crystals' at all possible orientations to beam/AW	B1 B1 B1 B1 B1	max 2 out of next 4 marking points **can** gain first 'waves' mark here as well as second mark if first line not written explicitly
		(ii) 1	λ = h/mv = $6.63 \times 10^{-34}/9.1 \times 10^{-31}$v v = $6.63 \times 10^{-34}/9.1 \times 10^{-31} \times 5.0 \times 10^{-11}$ v = 1.5×10^{7} (m s^{-1})	C1 A1	 using 6.6 instead of 6.63 gives 1.45×10^{7}
		2	½mv^2 = eV ½ x $9.1 \times 10^{-31} \times 2.25 \times 10^{14} = 1.6 \times 10^{-19}$V V = 6.4×10^{2} (V)	C1 C1 A1	 using v =1.45×10^{7} gives 600 V
			Total question 6	**19**	

Question			Expected Answers	Marks	Additional Guidance
7	a		A (clean) zinc plate mounted on the cap of a gold-leaf electroscope. Plate initially charged negatively A u-v lamp shining on plate The gold leaf collapses as the charge leaks away from the plate (when ultra-violet light is incident on the zinc plate) so experiment indicates the emission of negative charge/electrons	B1 B1 B1 B1 B1	first 3 marks can be awarded from diagram or description QWC mark
		Or	A simple photocell, eg two plates in a vacuum envelope A (12 V) dc supply is connected to the photocell and (nano)ammeter. A suitable frequency/u-v lamp shining on one plate The presence of u-v /blue light causes a current in the circuit. so experiment indicates the emission of negative charge/electrons	B1 B1 B1 B1 B1	**accept** photocell made of clean magnesium ribbon surrounded by fine copper gauze first 3 marks can be awarded from diagram or description **ignore** polarity of supply QWC mark
		Or	A (potassium) photocell connected across a (high impedance) voltmeter. Incident light of different frequencies; produced either by white light source and colour filters of known spectral range or by using a diffraction grating or prism to produce a first order spectrum. Different p.d.s are set up across the electrodes of the photocell (when the photocathode is illuminated with light of different frequencies). so experiment indicates the emission of negative charge	B1 B1 B1 B1 B1	first 3 marks can be awarded from diagram or description QWC mark
	b		Individual photons are absorbed by individual electrons in the metal surface. These electrons must have absorbed sufficient energy to overcome the work function energy of the metal/to reach the minimum energy to release an electron from the surface **or** only photons with energies above the work function energy will cause photoelectron emission Concept of instantaneous emission Number of electrons emitted also depends on light intensity Einstein's photoelectric energy equation in symbols with symbols explained, ie (energy of photon) = (work function of metal) + (maximum possible kinetic energy of emitted electron)	 B1 B1 B1 B1 B1 B1	**stop marking after the first five marking points, ie ticks and crosses** **not** photons are absorbed by electrons; 1 to 1 relationship must be implied **accept** definition of work function energy **accept** shorter λ/higher f photon causes higher (kinetic) energy electron **accept** full word equation without symbols for 2 marks maximum 5 marks
			Total question 7	**10**	

Grade Thresholds

Advanced GCE Physics H158 H558
June 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
G481	Raw	60	44	39	34	29	25	0
	UMS	90	72	63	54	45	36	0
G482	Raw	100	64	56	49	42	35	0
	UMS	150	120	105	90	75	60	0
G483	Raw	40	32	29	26	23	21	0
	UMS	60	48	42	36	30	24	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H158	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H158	18.5	34.0	50.4	66.3	80.1	100	7588

7588 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553