OCR
RECOGNISING ACHIEVEMENT

GCE

Physics B (Advancing Physics)

Advanced GCE **A2 H559**

Advanced Subsidiary GCE **AS H159**

Mark Scheme for the Units

January 2009

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MARK SCHEMES FOR THE UNITS

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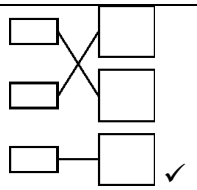
G491 Physics in Action

Question			Expected Answers	Marks	Additional Guidance
1	a		C s^{-1} ✓	1	**not** A
1	b		J C^{-1} ✓	1	**not** V
2			diameter in pixels D 3300 < D < 3800 pixels ✓ 400 × diameter in pixels / 1000 (km) ✓ m	1 1	**accept** direct estimate method **accept** ruler method 7 cm / 8 cm x 4100 ≈ 3600 pixels **method** ecf on other pixel values ≤ 4100 **must** convert to km **accept** correct bare final diameter estimate within range 1.3 x 10^3 to 1.5 x 10^3 (km) for 2 marks
3	a		 ✓	1	3 correct links for 1 mark otherwise zero
3	b		same period of waveform / same lowest frequency / lowest component of spectrum✓	1	**accept** same fundamental frequency **not** same wavelength / any reference to wavelength **not** same main frequency **not** all have 500 Hz
4	a		$R = V/I$ = 90 / 0.5 × 10^{-3} ✓ = 180 000 (Ω) ✓	1 1	method evaluation **accept** 180 (kΩ) / 1.8 × 10^5 (Ω) **allow** ecf on powers of ten e.g. 180 (Ω) for missing mA

Question			Expected Answers	Marks	Additional Guidance
4	b		$N = I / e$ / $= Qt / e$ / = 0.5×10^{-3} / 1.6×10^{-19} ✓ $= 3.1(3) \times 10^{15}$ (electrons s^{-1}) ✓	1 1	method **accept** symbols / words / correct numbers evaluation **allow** both marks for correct evaluation if no method
5	a		= 44 100 × 16 × 2 / 8 = 176 400 (bytes s-1) ✓	1	**accept** also 176 000 / 180 000 / 1.8×10^5 (bytes s^{-1})
5	b		ratio of voltages = $0.2 / 2 \times 10^{-6} = 10^5$ ✓ $\log_2 (10^5) = 16.6$ (so 16 bits adequate) / $2^{16} = 65\,536 < 10^5$ / $2^{17} = 131\,072 > 10^5$ ✓	1 1	**allow** one mark for stating / unsuccessful attempt to evaluate correct equation : $b \leq \log_2 (V_{total} / V_{noise})$ / $2^b \leq (V_{total} / V_{noise})$ **accept** ora i.e. calculation of voltage resolutions with 16 or 17 bits with sensible comment for full credit **not** any credit for only qualitative answers
6	a b		(G = 1/2.5) = 0.4 ✓ S ✓ (G_{total} = 3 × 0.4) = 1.2 ✓ S	2 1	**accept** correct answer without method **allow** unit mark from either line but credit in **a** **accept** Ω^{-1} / A V^{-1} for unit mark **not** unit mark for con units in **a** and **b**
7	a		constant ratio / factor (of scale divisions) ✓	1	**accept** × 10 / times 10 / goes up in powers of ten **not** goes up in tens
7	b		glasses have smaller range of cost **and** a smaller range of recyclable fraction than metals ✓	1	must mention **both** features and comparison explicitly clear **not** any similarity **ora**
7	c		metals can be melted or reformed <u>more easily</u> ✓ / metals are <u>easier</u> to separate e.g. by magnet / ceramics undergo irreversible change once formed but <u>metals don't</u>	1	**allow** any sensible reasoned <u>comparison</u> pro metal / anti ceramics identifying any problem with recycling **not** metals are malleable / ceramics are brittle ignore incorrect physics if basic idea is correct e.g. bonding reasoning
			Section A total	**19**	

Question			Expected Answers	Marks	Additional Guidance
8	a		neoprene has (fairly) uniform stiffness / neo stiffness increases slightly (with strain) ✓ rubber has more variable stiffness ✓ specific qualification of rubber graph into either 2 or 3 regions e.g. stiff then stiffer or stiff then less stiff then more stiff ✓ rubber is harder to stretch than neo / neoprene easier to pull ✓	1 1 1	any 3 out of 4 correct points: at least one from second material take stiffness to mean difficulty to stretch **accept** discussion of stress / force / difficulty of stretching remember 6 x original length means strain = 5 **not** neoprene fractures at strain greater than 6 **not** any credit or mention of quicker / speed **not** double award for a statement repeated as its converse
8	bi		(E = Δstress / Δstrain) = $30 \times 10^6 / 4$ ✓ m $= 7.5 \times 10^6$ (Pa) ✓ e standalone mark for correct SF ✓ 2 SF	1 1 1	**accept** gradient at (4,30) giving (1.5 to 1.9) × 10^7 Pa **not** taken from wrong graph treat SF mark as standalone for other incorrect evaluations **allow** missing M as 1 error so 7.5 Pa scores 2 by ecf **allow** 3 marks for bare answer 7.5×10^6 (Pa)
8	ii		less since $17.5 \times 10^6/3 = 5.8(3) \times 10^6$ / $5.8(3) \times 10^6 < 7.5 \times 10^6$ ✓	1	**accept** less since gradient is less / less since graph curves upwards (beyond strain of 3) / less since stress is a smaller proportion of the strain must have less and reason
8	ci		strain = 80 cm / 20 cm = 4.(0) ✓	1	**not** 5
8	ii		stress = 18 MPa ✓ (from rubber graph) $A = F$ / stress / = $30/18 \times 10^6$ ✓ m $= 1.7 \times 10^{-6}$ m^2 ✓ e	1 1 1	**allow** ecf from (**i**) e.g. strain of 5.0 ⇒ 29 MPa and $A = 1.0(3) \times 10^{-6}$ m^2 for 3 **accept** ecf on dropped M for 1.7 m^2 for 2 marks **allow** max 1 ($A = F$ / stress) if correct stress taken from wrong graph
			Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
9	ai		(u) measurable to accuracy ≈ 1 mm / is very much less than the uncertainty in v / is very much less than the value of u ✓	1	**accept** ora because (the value of) u is large compared to the uncertainty **accept** light source can be placed at a (precisely) known distance from lens / image position is judged with difficulty AW **not** because u is the variable that is changed / because uncertainties in u are not significant
9	ii		Smaller lul / larger v leads to increase in uncertainty ✓	1	**not** just uncertainty increases **accept** less negative u means object nearer lens etc. **allow** any reference to u as meaning lul if not specified
9	bi		both points plotted correctly ✓ uncertainty bar for larger uncertainty ✓ best-fit straight line (never more than 2 small squares away from perfect line) ✓	1 1 1	both points to nearest small graph square credit if correct vertical length (4 small graph squares) even if wrongly placed **accept** well plotted line even if no intercept(s) **not** curved lines of best fit / free-hand lines (by eye)
9	ii		P = intercept = 5.5 ± 0.1 (D) ✓ / $P = 1/v - 1/u$ e.g. = 4.5 - (-1.0) = 5.5 $f = 1/P$ = 0.18 to 0.19 m ✓	1 1	**allow** e.c.f. from **bi** graph **not** credit for 5.5 (m) in answer line **allow** for calculation to 1 graph square from their graph **not** incorrect signs e.g. = 4.5 – 1.0 = 3.5 (D) **allow** e.c.f. for incorrect P
9	ci		less uncertainty ✓	1	
9	ii		answer must be on the behaviour of the lens different colours focussed at different lengths from lens ✓ lens focuses rays from near centre of lens to a single point (but nearer the edge focal point varies) ✓	 1 1	 One mark for chromatic aberration improved AW One mark for spherical aberration improved AW **not** lens is thicker hence more powerful near the centre **not** is better near the centre
			Total	**10**	

Question			Expected Answers	Marks	Additional Guidance
10	ai		R = 1.3 × 10^{-10} m ✓ m V = (4/3) πR^3 = 9.2(1) × 10^{-30} m^3 ✓ e	1 1	R = D /2 explicit for first method mark **accept** R = (2.1 nm /8)/2 = 1.3(1) x 10^{-10} m must evaluate correctly for 2nd 'show that' mark **allow** 9.47 × 10^{-30} m^3 based on values 2.1 nm / 8 given bare correct answer scores 1
10	aii		(density = 9.3 × 10^{-26} / 9.2 × 10^{-30}) = 1.0(1) × 10^4 (kg m^{-3}) ✓ e	1	**accept** 1.0(3) × 10^4 (kg m^{-3}) by ecf on given volume in **i** **accept** 0.98(2) x 10^4 (kg m^{-3}) by ecf on allowed volume from **i** **not** any other ecf from **i**
10	iii		(density = 1.26/(0.04×0.05×0.08)) = 7900 (kg m^{-3}) ✓ e (< **aii**)	1	**accept** 7.8(8) × 10^3 / 7875 (kg m^{-3}) density comparison not needed for the mark
10	b		spheres do not fit perfectly together / there are gaps between them / copper surface in **(a)** decreases the natural spacing in iron crystal / measurement in **(a)** done at a lower temp. so atoms closer together ✓ volume per atom is bigger than calculated in (**ai**) ✓	1 1	AW ora throughout **accept** stacked spheres do not fill the whole of the space taken up by metal
10	c		**change in structure identified** e.g. atoms closer **(c)** / more densely packed ✓ consequent **change in properties identified** e.g. so denser / so harder / so stronger / so stiffer ✓	1 1	AW throughout minimum answer: e.g. atoms closer together ∴ density rises **accept** conductivity rises or falls **QWC** mark for **c** on next page

Question			Expected Answers	Marks	Additional Guidance
10	c		consequent **change in properties clearly explained** e.g. because same mass in smaller volume / atoms bonded to more close neighbours ✓	1	**QWC** because for fixed mass volume falls / conductivity rises because charge carrier density increases / conductivity falls because scattering probability rises ora for resistivity 3rd mark is for **QWC**: is given for reference to structural changes related to diagram followed by attempt to explain consequence even if some physics details incorrect
			Total	**9**	

Question			Expected Answers	Marks	Additional Guidance
11	ai		potential divider method: $V = 6 \times 500/(260+500)$ ✓ m = 3.9(5) V (≈ 4 V) ✓ e / **OR** current method: $I = 6/(500+260) = 7.9$ mA $V = I R = 7.9 \times 10^{-3} \times 500$ ✓ m = 3.9(5) V ✓ e	1 1	may do these parts in reverse order if current method is used; mark all **a** together **allow** both marks for bare 3.9(5) V
	ii		$I = V / R = 6/(500+260) = 7.9$ mA	1	**accept** ecf 4 / 500 = 8.0 mA / 2 / 260 = 7.7 mA
11	b		potential divider method: thermistor takes a bigger share of the 6V / 500 Ω takes a smaller share ✓ so p.d. measured falls ✓ / current method: resistance of circuit increases and current falls ✓ so smaller current gives a smaller voltage across 500 Ω ✓	1 1	AW can recalculate values for full credit: V = 0.29 V $I = 9.5 \times 10^{-5}$ A
11	c		central heating operates at room temp. near 20°C while a fire operates >> 20°C ✓ resistance hardly changes near typical room temperatures ✓ / R changes rapidly once T gets much higher ✓ / low sensitivity in low T region ✓ / high sensitivity in high T region ✓ / unreliable since two temperatures give same R value between 0 and 20ºC ✓	1 2	QWC requires clear link between typical temperatures of events and graph **any** further 2 correct points **accept** e.g. sensitivity is <u>greater</u> for higher temperatures for 2 marks as comparison is explicit

11	**di**		$P = I^2R = 0.5^2 \times 260$ ✓ m $= 65$ (W) ✓ e	1 1	
11	**ii**		thermistor will heat up (rapidly) **and** its resistance will rise (significantly, and current fall) ✓	1	both points for 1 mark minimum answer: heats and *R* rises
			Total	**11**	
			Section B total:	**41**	

Grade Thresholds

Advanced GCE Physics B H159 H559
January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
G491	Raw	60	39	33	28	23	18	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

No aggregation was available in this session.

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.

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