OCR
RECOGNISING ACHIEVEMENT

GCE

Physics B (Advancing Physics)

Advanced Subsidiary GCE

Unit **G491:** Physics in Action

Mark Scheme for June 2013

Oxford Cambridge and RSA Examinations

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

1. **Annotations available in scoris**

Annotation	Meaning
BOD	Benefit of doubt given
CON	Contradiction
	Incorrect response
ECF	Error carried forward
FT	Follow through
NAQ	Not answered question
NBOD	Benefit of doubt not given
POT	Power of 10 error
^	Omission mark
RE	Rounding error
SF	Error in number of significant figures
	Correct response
AE	Arithmetic error
	Wrong physics or equation

2. Subject-specific Marking Instructions

Annotations used in detailed mark scheme

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
(1)	Separates marking points
reject	Answers which are not worthy of credit
not	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ecf	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Please annotate all marking as fully as possible, the annotations are helpful for TLs monitoring marking, but also helps centres.
Always annotate on the long written answers where ticks should show where marks are awarded. Q9c & Q10aii also place **X** on pen symbol if QoWC mark not awarded.
Otherwise: i) Where full marks are given no annotation necessary.
ii) Where part marks given use a tick at point of award for each mark awarded so that ticks = marks total for that part.
iii) Where no marks are given and there is working a **X**/**^** to show the error/omission and nothing awarded.

Apply S.F. penalty only to Q9bii Penalise 1 mark for 4 or more S.F. 8.333×10^8 (Hz)/treat recurring sign as S.F. error.

Rounding Error RE should only be applied once per candidate if appropriate. See e.g. Q9bii RE for 8.4×10^8 (Hz) scores max 1.

Press Fit to Height button to inspect additional pages/additional objects easily, apply a **^** annotation to show a blank page has been seen.

Section A

Question			Answer	Marks	Guidance
1			**D R L**	2	3 correct scores 2 1 correct scores 1
			Total	**2**	

Question			Answer	Marks	Guidance
2	**(a)**		$P = 1/f$ / 1/0.2 ; 5.(0) (D)	2	method ; evaluation
	(b)		curvature = -0.4 + 5.0 / curvature out = curvature in + curvature added by lens ; = 4.6 (D)	1 1	method **accept** words curvature added by lens / state equation $1 / v = 1/ u + 1/ f$ in this format / numbers evaluation **allow** ecf on (a)
			Total	**4**	

Question			Answer	Marks	Guidance
3	**(a)**		5 waves in 100 μs ; 20 x 10^{-6} (s) / 20 μ(s) OR main *f* at 50 ± 2 kHz ; 1/ 50 x 10^{3} = 2 x 10^{-5} (s)	2	method **allow** 6 waves in 100 μs / 5 in 110 μs for max 1 ; evaluation **accept** 2 x 10^{-5} (s) **accept** 20 ± 1 μs **allow** 20 (s) / 0.02 (s) POT 1 mark **not** 100 μs for time of pulse / $1/f$ with incorrect value
	(b)		140 (kHz)	1	
	(c)		1000 / 10^{3}	1	**accept** any correct ratio: 1000/1 / 10^{3} /1 / 10^{9} /10^{6} **not** 1/1000 / 1:10^{3}
			Total	**4**	

Question			Answer	Marks	Guidance
4	**(a)**		difficult to scratch / dent	1	**not** difficult to crack / not soft / no deformation **not** how easy to scratch or dent / it cannot be scratched
	(b)		helps the axe head stay sharp / keep its edge	1	**not** stops cracks forming / prevents damage / durable / long-lasting / can chop harder materials **must** clearly relate to the edge e.g. **not** "it" wont be damaged

Question			Answer	Marks	Guidance
	(c)		e.g. stiff / high YM ; so does not distort under impact **OR** strong ; so does not break / tough ; so does not crack / shatter (during impact) / needs high energy to break	2	**expect** appropriate property ; justification to match **accept** not brittle (tough) **ignore** malleable / corrosion free / economic reasons / reference to microstructure
			Total	**4**	

Question			Answer	Marks	Guidance
5	(a)		$E = QV$ / 2900 x 3.7 ; = 10730 (J) / 10.7(3) k(J) / 11 x 10^3 (J) / 11 k(J)	1 1	method: words / equation / numbers any correct evaluation (no method) scores max 2 marks
	(b)		$P = E / t$ / = 10730 / 540 / I = 2900 / 540 = 5.37 A ; = 19.9 (W) / 20 (W)	1 1	method : words / equation / numbers **allow** (a) / 540 ecf **accept** 20.(4) (W) / 19.8 (W) from rounded calculations
			Total	**4**	

Question			Answer	Marks	Guidance
6	(a)		$I = VG$ / 3 x 45 x 10^{-3} / $R = (1/G)$ = 22.(2) Ω ; = 0.14 (A)	1 1	method evaluation **accept** 135 m(A) / 0.135 (A)
	(b)		15 mS	1	**accept** underlined / other obvious indications if unambiguous
			Total	**3**	

Question			Answer	Marks	Guidance
7	(a)		table values: 0 ; 252	1 1	
	(b)		contrast improved / better	1	**accept** contrast / range of greyscale increased **not just** change brightness / intensity level **ignore** sharper / edge detection / clearer
			Total	**3**	

Section A Total: 24

Section B

Question			Answer	Marks	Guidance
8	(a)	(i)	(directly) proportional / $\propto$	1	**accept** linear through origin **not** as *P* increases p.d. increases / strong + correlation / Ohmic / just increase at constant rate / just linear
		(ii)	ΔV / ΔP / Δoutput / Δinput / e.g. 300 / 200 ; = 1.5 (mV/mmHg)	1 1	method **accept** other graph values to ± ½ graph squares evaluation **accept** in range 1.45 to 1.54 (mV/mmHg)
	(b)	(i)	**1** e.g. 12 beats in 10 s / 18 beats in 15 s 72 (beats min^{-1}) **2** e.g. (120 +108)/2 114 (mmHg) **Make sure to mark both parts 8(b)(i)1 & 2**	1 1 1 1	method **allow** max 1 for correct method with miscounted beats e.g. 13 beats in 10 s gives 78 (beats min^{-1}) evaluation **accept** in range 70 to 74 (beats min^{-1}) method evidence of at least 2 data in average process / on graph / within correct range evaluation **accept** in range 112 to 116 (mmHg) **not** any credit for 120 (mmHg)
		(ii)	fluctuation of: max / min pressure ; fluctuation of heart rate ; max pressure range is 13 ± 1 / min p range 6 ± 1 mmHg ; with period of ≈ 8 ± 1 s ; *p* rises rapidly falls more slowly during each beat ; minor amplitude oscillation of *p* during each drop ; each heartbeat has 3 / 4 separate pressure peaks	2	**accept** any **2** correct qualitative / quantitative points **accept** lower / higher frequency oscillation present **accept** amplitude modulated **not** trivial features e.g. p varies / pressure differences / small pressure jumps / there is a max and a min of blood pressure / one data point identified e.g. lowest pressure is 80 mmHg at 4.5 s **allow** 2 marks to be awarded in either section
	(c)		$\log_2$ 400 (= 8.6) ; so 9 bits	1 1	method: must show calculation using 400 levels / alternatives **accept** $2^9 = 512 > 400$ / $2^8 = 256 < 400$ **accept** 401 levels evaluation just correct answer score max 2
			Total	**11**	

Question			Answer	Marks	Guidance
9	(a)	(i)	$3 \times 10^9 / 3500 = 8.6 \times 10^5$ (bytes) / ORA $3 \times 10^9 / 10^6$ = 3000 books if 1 Mbyte book^{-1} (so less than 1 Mbyte book^{-1})	1	**accept** 8.57×10^5 (bytes) / 9.2×10^5 (bytes) / 0.878 Mbytes (based on 1k = 1024)
		(ii)	pages AND words 100 - 1000 5 – 20 ; e.g. 400 x 30 x 9 x 6 = 6.5×10^5 (bytes)	 1 1	both estimates in ranges for first mark **expect** in range 9×10^4 to 3.6×10^6 **not** any a.e. check value = p x w x 180 **accept** ecf on estimates outside range if arithmetic correct **allow** sensible adjustment for spaces if applied
	(b)	(i)	$8.6 \times 10^5 \times 8/60$ / rate = info / time ; = 1.1×10^5 (bit s^{-1})	1 1	method **accept** ecf (ai) x 8/60 **allow** ecf on (aii) x 8/60 / 1 Mbyte x 8/60 [for quick check x 8/60 = 0.133] **allow** max 1 for incorrect / omitted bit conversion **accept** 1.14×10^5 / 1.15×10^5 / 1.3×10^5 (bit s^{-1}) **allow** 14300 max 1 mark (no conversion to bits)
		(ii)	$f = v / \lambda$ / $3 \times 10^8 / 0.36$; 8.3×10^8 (Hz) / 830 M(Hz) / 830×10^6 (Hz)	1 1	method: words / equation / numbers evaluation **SF** penalty on 1 or 4 or more e.g. 8.333×10^8 (Hz) max 1 / RE 8.34×10^8 (Hz) max 1 per candidate
		(iii)	yes because frequency >> / > bit rate ; bandwidth needs to be ≈ bit rate - **allow** factors of x2 /x ½ here bandwidth or bit rate ≈ 1/ 7500 of carrier frequency	1 1	1st mark minimum acceptable statement must compare and confirm **accept** could download in shorter time as confirmation 2nd mark for: correct use of bandwidth / ratio calculated: $f_{carrier}$ /bandwidth or $f_{carrier}$ /bit rate **allow** ecf on (bi) & (bii) **expect** units of calcs to be clear **not** anything about sampling for second mark
	(c)		advantage: e-book does not require paper and many trees can be saved / benefits the environment / books never out of print / more people may read more books making society more cultivated/knowledgeable ; disadvantage: information in digital format is easily transferred and this may encourage piracy / law breaking / copyright infringement / can't transfer info to a friend's e-book / bookshops and employment may disappear	2	1st mark for identifying an advantage **and** disadvantage can be to society or individual **allow** plausible cost suggestions / energy arguments (to produce / to run) **accept** interpretations of e-book as digital content or h/ware 2nd mark awarded if either adv or disadvantage to society developed and correct QoWC for all text (penalise > 1 error of spelling, punctuation, grammar) **expect** sentences, bullet points are acceptable for lists
			Total	**11**	

Question			Answer	Marks	Guidance
10	(a)	(i)	it is made from two (or more) materials ; aggregate / stone / sand with cement / mortar ; matrix with inclusions / bonded together	2	**not** any reference to mixture means max 1 **accept** 2 **(**or more) named components scores 2 **ignore** particles of different size
		(ii)	under tension it suffers brittle fracture because: amorphous / random structure / no dislocations so no slip ; strong / directional / bonds break if near (micro-) crack ; (micro-)cracks open under tension ; stress concentrates at crack tip ; due to less cross-sectional area to bear load ; leading to crack propagation ; under compression: (micro-)cracks close ; aggregate takes the load / strong non-directional / ionic / covalent bonds give compressive strength	4	any 4 points: (max 2/4 if listed points not related to tension or compression) **ignore** grains / concrete is not plastic so breaks under tension candidates can gain credit for directional / non-directional bonds because: covalent directional bonds within $(SiO_4)^{4-}$ and the group is ionically charged so also non-directional bonding QoWC correct use of **two** technical terms and correct explanation of tension and compression otherwise max 3
	(b)	(i)	*E* ratio = σ ratio (at same strain) = 300 (MPa) / 60 (MPa) = 5	3	**accept** any valid ratio leading to answer 5 if no units OR correct moduli score 1 mark each so $2.0 \times 10^{11} / 4 \times 10^{10} = 5$ for 3 marks **allow** max 2 for 1 graph reading error **accept** correct bare answer for max 3
		(ii)	60 (MPa) / 20 (MPa) = 3	1 1	breaking stresses read from graph **accept** breaking strains read from graph 0.15(%) /0.05(%) (due to proportionality) and correct bare answer for max 2 evaluation of ratio
	(c)	(i)	forces on anchor plates are equal in size (and opposite in direction) $\sigma = F / A$ linked with argument to $\sigma \propto 1/A$	1 1	**accept** forces balanced / in equilibrium **allow** same force **not** same tension **accept** arguments worked through numerically to show inverse proportionality and equality of force for full marks
		(ii)	30 MPa x 5 = 1.5×10^8 (Pa) / 150 M(Pa)	1	**allow** tolerance 130 to 170 M(Pa) from graph reading **accept** reading direct from steel graph at same strain ≈ 160 M(Pa) **accept** negative signs
			Total	**14**	

Section B Total: 36
Paper Total: 60

Additional Guidance for visually modified papers only

1. The Young modulus of concrete in Q10bi - accept for full marks values which lead to any ratio of stiffness in the range 4 to 6. Credit a modulus in the range 3.3×10^{10} Pa to 5×10^{10} Pa.

2. The compressive and tensile breaking stresses required to calculate the ratio in Q10bii - if estimating from stress credit fully answers in the range 2.5 to 3.5 instead of 3.0.

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