OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

PHYSICS B (ADVANCING PHYSICS) G492 MS

Unit G492: Understanding Processes and Experimentation and Data Handling

Specimen Mark Scheme

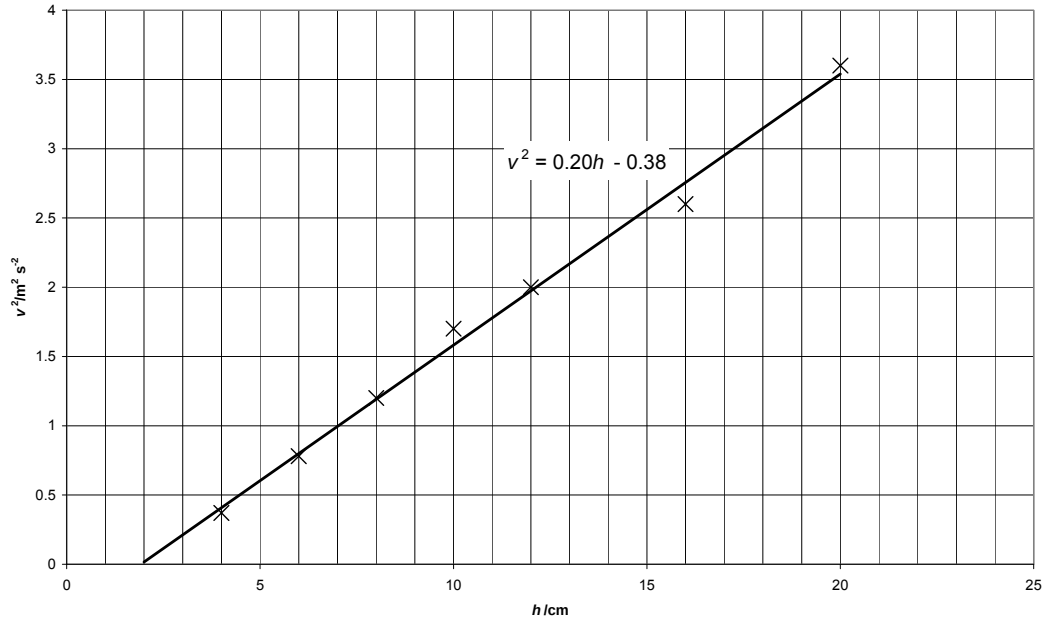
The maximum mark for this paper is 100.

Section A		
Question Number	**Answer**	**Max Mark**
1 (a)	B ✓	**[1]**
(b)	A ✓	**[1]**
2	B ✓	**[1]**
3 (a)	20 ✓ (m s^{-1})	**[1]**
(b)	0.5 ✓ (s)	**[1]**
(c)	(20 x 0.5) + ($^1/_2$ x 20 x 3.5) ✓m = 45 (m) ✓e 45 m ✓✓	**[2]**
4 (a)	energy (= 6.6 x 10^{-34} x 3.2 x 10^{14}) = 2.1 x 10^{-19} ✓ (J) 2 or 3 **S.F.** only	**[1]**
(b)	(1.0 x 10^{-7})/(2.1 x 10^{-19}) ✓ = 4.8 x 10^{11} ✓ **ecf** from (a)	**[2]**
5	Either s = $^1/_2at^2$ ⇒ t^2 = (2 x 0.15)/9.8 ⇒ t = 0.18 s ✓m✓e Or directly using t = 0.2 s to find s = 0.196 m ✓method✓evaluation allow g = 10 N kg^{-1}, giving t =0.17 s or s = 200 mm then explaining why he can't catch the note ✓	**[3]**
6(a)	F = 10 000 x 3.1 ✓ = 31 000 ✓ (N)	**[2]**
(b)	weight = 75 000 – 31 000 = 44 000 (N) ✓	**[1]**
(c)	g = 44 000 / 10 000 = 4.4 ✓ (N kg^{-1}) ecf from (b) no ecf if g = 9.8 N kg^{-1} assumed in (b)	**[1]**
7	test proposed e.g. calculate k = y/x^2 to see if constant, ✓ carried out on all data ✓ conclusion based on test: not constant (values 0.099,0.076,0.056) <u>because</u> variation too great/value of k gets progressively smaller, so not random variation✓ test can be implicit in working	**[3]**
	Section A total	**[20]**
8(a)	$v^2 = 2gh$ approach v^2 = 2 × 9.8 × 169 ✓ v = 58✓ (m s^{-1})	[2]
(b)	v = 100/2.12 = 47m s^{-1} ✓ 47m s^{-1} = 47× 60 × 60 /1000 km h^{-1} = 170 km h^{-1} (> 160 km h^{-1})✓	[2]
(c)(i)	weight = 72 x 9.8 = 710 N ✓ (accept 2 or 3 S.F.) Accept use of g = 10 N kg^{-1} to give 720 N	[1]
(ii)	Scale drawing: 15° right-angled triangle with opposite side shown as weight (**ecf** from (c)(i) ✓ hypotenuse correctly measured to scale including ecf to give 180 N ±10 N ✓ **or** 710 sin 15° ✓ = 180N ✓ **ecf** from (c)(i)	[2]
(iii)	balanced forces idea (resultant force = zero) ✓ argued in terms of forces	[1]
	Total	**[8]**
9 (a)(i)	Any three points from: symmetrical about central max central maximum is brightest intensity decreases with 'order' maxima are equally spaced peaks (much) narrower than spacing ✓✓✓	[3]

Section B		
Question Number	**Answer**	**Max Mark**
(ii)	A: constructive interference/waves add/waves superimpose IN PHASE / path difference is a whole number of λ /AW AND B: destructive interference/waves cancel/ waves in ANTIPHASE (out of phase)/ pd is an odd number of half wavelengths ✓	**[1]**
(b)(i)	1 / 80 000 or $(1 \times 10^{-3})/80$ ✓ (= 1.25×10^{-5}m)	**[1]**
(ii)	$\tan\theta = 0.06 / 1.2 \Rightarrow \theta = 2.86^{\circ}$ ✓method✓evaluation AW e.g. Pythagoras and then find sin θ from the triangle for ✓✓ allow tan θ = **sin** θ if reason given e.g. angles small $\lambda = 1.25 \times 10^{-5} \times \sin 2.9^{o}$ ✓ = 6.3×10^{-7} **m** ✓ **[deduce 2nd mark if no unit]** (allow use of 3^{o} giving 6.5×10^{-7})	**[4]**
(c)	sensible change ✓ justified ✓ e.g. more lines mm^{-1} ✓ larger spacing between maxima to measure ✓ or move screen further ✓ smaller % error in distances✓ measure to higher order ✓ smaller % error in distances✓	**[2]**
	Total	**[11]**
10	$N/kg \times kg/m^3 \times m^2 = N\ m^{-1}$ ✓ (beware fudge)	
(a)	$J = N\ m$ so $J\ m^{-2} = N\ m\ m^{-2} = N\ m^{-1}$ ✓ or reverse working from N=J/m Stages must be **shown** clearly	**[2]**
(b)(i)	0.9 m ✓	**[1]**
(ii)	½ x 9.8 x 1030 x $(0.9)^2$ ✓ = 4090 ✓ ($J\ m^{-2}$) ~ 4100 **ecf** from (b)(i)	**[2]**
(iii)	4090 x 12 ✓ = 49 000 ≈ 50 kW ✓ (W) (ecf from (b)(ii)) 49 000 x 500 ✓ = 24 500 000 = 24.5 MW ✓ **ecf**	**[4]**
(iv)	lots of damage/erosion / for conversion to electrical power ✓	**[1]**
	Total	**[10]**
11(a)	increases and decreases ✓ (can be stated or implied) Between 0% and 16%✓ One of: cyclic/repeating / equally spaced / no sign of dying out ✓ QWC: spelling, punctuation & grammar✓	**[4]**
(b)(i)	x: resultant phasor amplitude = 4 ✓ y: resultant phasor amplitude = $(4 + 4)^{½}$ = 2.8 ✓method✓evaluation (scale drawing tolerance 2.6 to 3.0) for missing scale factor (x=2, y = 1.4) 2 marks max	**[3]**
(ii)	prob related to $(amplitude)^2$ idea ✓ 16 for x, 8 for y ✓ 4 for x, 2 for y ✓ (ecf) from (b)(i)	**[2]**
(iii)	Phasors antiphase ✓ so prob / resultant phasor amplitude =0 ✓ (quantum explanation only) 'photons' are out of phase gets no marks	**[2]**
	Total	**[11]**
	Section B total	**[40]**

Section C		
Question Number	**Answer**	**Max Mark**
12(a)(i)	Any two points from: Systematic error (clock 'second' is wrong) ✓ Random uncertainty due to reaction time is negligible ✓ Effect is to give an answer which is too great ✓	**[2]**
(ii)	Any two points from: No/ negligible(e.g. effect of temperature) systematic error ✓ Random uncertainty e.g. alignment problems, varying length at different places✓ Effect is to give greater confidence in the length than is justified by the measurement ✓	**[2]**
(b)	(i) Use more accurate clock /correct for incorrect duration by comparing with accurate time signal✓; get several people to measure simultaneously, and plot data to find mean/median/ reject outliers✓ OR (ii) repeat measurement several times along different parallel lines along the room✓ and plot data to find mean/median/reject outliers✓; NOT just repeat measurement	**[2]**
	Total	**[6]**
13(a)	(very fast therefore) need large distance ✓ very short interval to time✓	**[2]**
(b)	Any three points from: Very large ✓reduction in uncertainties ✓ Progression over many years ✓ Up to two examples of creative approach can be each ✓ if distinct and explained, e.g. octagonal mirror, allowing for effect of air, doing in vacuum QWC: appropriate form and style ✓	**[4]**
(c)	uncertainties in the metre greater than in λ/f measurement ✓	**[1]**
(d)	Horizontal line within one scale division of 299 790 ✓ Michelson, Middelstaedt, Anderson and Bergstrand ✓ All 4 names needed	**[2]**
	Total	**[8]**
14 (a)(i)	Angle = $\sin^{-1}$ (4.0/120) ✓ = 1.9° ≈ 2°✓ Must show a calculated result, not just quote 2°, for the second mark.	**[2]**
(ii)	$v = w/t$ = 0. 100✓/0.164 ✓= 0.610 m s^{-1} (Can be reverse argument from 0.610 m s^{-1})	**[2]**
(iii)	Both measurements used are to 3 S.F.✓ Result cannot be stated to greater precision than least precise datum ✓	**[2]**
(b)(i)	(0.1/4.0)× 100 = 2.5% ✓m✓e	**[2]**
(ii)	Absolute uncertainty in height same ✓ smaller fraction ✓of height	**[2]**
(iii)	Repeat several times ✓and take averages ✓ QWC: clear organisation✓	**[3]**
	Total	**[13]**

Section C		
Question Number	**Answer**	**Max Mark**
15 (a)(i)	$v^2/m^2\ s^{-2}$ (0.37) (0.78) (1.2) 1.7 2.0 2.6 3.6	
	All 4 correct for the mark	
	Allow 3 S.F. but not more (values 1.69, 1.96, 2.56 & 3.60 s)	**[1]**
(ii)	Sensible axes labelled with quantity and unit ✓ points✓✓ line✓	**[4]**
(iii)	No as line does not pass through origin✓(graph below) Can be numerical.	**[1]**
(b)	g.p.e. = mgh = 0.992 × 9.8 × 0.04 ✓ = 0.39 J ✓ k.e. = ½ mv^2 = ½ × 0.992 × 0.37 ✓= 0.18 J ✓ Work done against resistive forces ✓	**[6]**



	Total	**[12]**
	Section C total	**[40]**
	Paper Total	**[100]**