



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme

June 2003

GCE

Physics B

Unit PHB4

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PHB4

Question 1

- (a)(i) Unchanged B1
- (ii) $\frac{1}{2}$ OWTTE B1
- (iii) $T = 2\pi\sqrt{M/k}$ B1
 $T^2 = 4\pi^2 \times M/k$ (square and re-arrange) B1
- (iv) $T = 1/0.91$ [= 1.1 s] C1
 $1.1^2 \times 190000 / 4\pi^2$ A1
 So $m_{\text{platform}} =$ (cand ans for $M - 5300$) leading to correctly evaluated answer B1
- (b) v shape correct [cos graph] B2
 or v shape inverted [-cos graph] B1
- k.e. always +ve M1
 k.e. freq doubles M1
 k.e. shape acceptable A1
- (c) **max 4 from:**
 mention of forced oscillation
 platform frequency always matches lorry's frequency
 mention of resonance
 small amplitude when well away from resonant frequency
 large amplitude at resonance [do not infer small amp point from this]
 resonant freq close to 0.91 Hz B4 **16**

Question 2

- (a) $35 \times 10^3 \times 4200 \times 24$ C1
 $= 3.53 \times 10^9$ W A1
- (b) $3.53 \times 10^9 / 2.4 \times 10^6$ [ecf; ans to (a) / 2.4×10^6] C1
 $= 1.47 \times 10^3$ kg s⁻¹ [allow kg] A1
- (c) 800 MW/sensible power C1
 $= 0.8 / (3.53 + 0.8) = 0.185$ or 18.5 % [ecf from ai] A1 **6**

Question 3

- (a)(i) 15 rev/s = 30π rad/s **or** $v = 51/52 \text{ m s}^{-1}$ [could appear in subst] B1
 $F = mw^2r$ [or mv^2/r & $v = \omega r$] B1
 appropriate sub leading to 7.33 kN [2+sf evaluation mandatory] B1
- (ii) to centre of rotor OWTTE B1
- (iii) $stress = F/A$ B1
 correct substitution from ai B1
- (iv) $0.55 \times 2.09 \times 10^7 / 6 \times 10^{10}$ [or $\epsilon = 3.3 \times 10^{-4}$] C1
 = 0.192 mm A1
- (v) $\frac{1}{2} \times 7.32 \times 10^3 \times 1.92 \times 10^{-4}$ [ecf] C1
 = 0.702 J A1
- (b)(i) volume pushed down [per second] = Av [mass = $\rho \times$ volume] B1
 Change of momentum [per second] = mass pushed down per second B1
 $\times v$
- (ii) Upward force = 900 N OWTTE [penalise use of 900g] C1
 OR area swept out by blades = $\pi \times 0.55^2$
 $900 = (0.55)^2 \pi 1.3v^2$ C1
 = 27 m s^{-1} A1

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Question 4

- (a)(i) = $0.35 \times 0.45 \times 6 \times 8.9 \times 10^{-12} / 3 \times 10^{-3}$ C1
 = $2.8 \times 10^{-9} \text{ F}$ A1
- (ii) $12/10 [\times 10^3]$ C1
 = 1.2 mA A1
- (iii) $10^4 \times 2.8 \times 10^{-9} = 2.8 \times 10^{-5} \text{ s}$ B1
- (iv) correct curvature, goes thru I_0 , not asymptotic to I axis M1
 value about 1/3 after 1 time constant [between 0.3 and 0.4] A1
 evidence of attempt to make ratios same at equal time intervals B1
- (v) capacitance increases B1
 justification for C change (expect $C \propto 1/d$; inversely prop, or equⁿ) B1
 current increases B1
 justification for current increase B1

Use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar and gains at least 3 marks for physics	B2	
Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor and gains at least 1 mark for physics	B1	
Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar	B0	14

Question 5

(a)	Use of 4×10^{14} Use of $c = f\lambda$ 7.5×10^{-7} m	C1 C1 A1	
(b)	line parallel to first intersecting x -axis at twice threshold freq	B1	
(i)	gradient is h so unchanged	B1	
(ii)	intersection with x -axis is double because $hf = \phi$ at zero ke for e^-	B1	6

Question 6

(a)	$1.8/1.81 \times 10^{-11}$ m	B1	
(b)	circular bands of light on diagram diffraction/interference effect or electron $\lambda \approx$ atomic spacing in graphite	B1 B1	
(c)	state correct and appropriate particulate aspect quote evidence <i>from this expt</i> that shows electrons possess aspect	B1 B1	5
	e.g. electrons carry momentum/kinetic energy to screen excite other electrons in atoms/cause emission of energy/light or electrons carry charge can be accelerated by electric field/p.d. etc		

Question 7

(a)(i)	use of $pV = \text{constant}$ or $p_1V_1 = p_2V_2$ $p = 99 \times 3.50/4.15$ $= 83.5$ kPa	C1 C1 A1	
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(ii)	change occurs quickly so cannot remain in thermal equilibrium <i>or</i> no time for heat to be lost; gas does work as it expands/adiabatic	B1	
(b)	$99 [\times 10^3] \times 3.5 \times 10^{-4} / 8.31 \times 291$ $= 1.4(3) \times 10^{-2}$ moles	C1 A1	
(c)	molecules/particles have momentum momentum change at wall momentum change at wall/collisions at wall leads to force [allow impulse arguments]	B1 B1 B1	
	less air so fewer molecules so change in momentum per second /rate of change is less [<i>or</i> per unit time]	B1 B1	
	use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar and gains at least 3 marks for physics	B2	
	Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor and gains at least 1 mark for physics	B1	
	Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar	B0	13