PH1 Mark Scheme – January 2008

Question			Marking details	Marks Available
1.	*(a)*	(i)	[The centre of gravity is] the point where the [entire] weight [accept: force of gravity] can be considered to act.	1
		(ii)	X marked at centre of top surface [accept: dot with no label]	1
	(b)		Correct reasoning given, e.g. $\Sigma F_{\text{horizontal}} = 0$ (1) [Accept: forces cancel] $F_{\text{Friction}} = 8.2 \cos 20°$ (1) [or by impl.] = 7.7 N (1) } unit penalty if 1 or more units missing/incorrect	3
	(c)	(i)	8.2 sin 20° (1) [or by impl.] = 2.8 N (1) [N.B. No e.c.f. on sin/cos confusion]	2
		(ii)	25 – 2.8 (e.c.f.) (1) = 22.2 N (1) [vertically] downwards (1)	3
				[10]
2.	*(a)*	(i)	Δl and l have same units / units cancel / "strain $= \frac{\Delta l}{l}$ which is a ratio"	1
		(ii)	$E = \frac{\text{stress}}{\text{strain}}$ [or impl.] **or** gradient attempted (1) $E = 8.0 \times 10^{10}$ Pa / 80 GPa (1)	2
		(iii)	Elastic (1); strain ∝ stress [accept: linear] (1) [Accept: elastic limit not reached / follows Hookes' Law]	2
		(iv)	Fractures / breaks [**not** cracks]	1
	(b)	(i)	[Surface] cracks / imperfections / broken bonds (1) propagate through sample (1) [**or** e.g. Bonds break at surface (1) increasing load on still intact bonds (1)]	2
		(ii)	Outside surface(s) in compression (1). It is more difficult for cracks to widen / propagate / develop (1)	2
				[10]
3.	*(a)*	(i)	Many / all <u>planes</u> of <u>vibration</u> (1) [accept directions of vibration]	1
		(ii)	Polaroid placed in path of ray **or** light passed through Polaroid [accept <u>strong</u> impl.]. Polaroid rotated (1) Light/dark or variation (1) every 90° / 90° between light and dark] (1)	4
		(iii)	Reflected light is polarised (1). Plane of (polarisation of) polaroid is <u>orientated</u> (1) (at 90°) to that of the reflected light) to absorb / not transmit some of the light (1)	3
	(b)		$\frac{\sin\theta_1}{\sin\theta_2} = n$ **or** $n_1 \sin\theta_1 = n_2 \sin\theta_2$ **or** $n = \frac{\sin 53^\circ}{\sin 38^\circ}$ (1) n = 1.3 (1)	2
				[10]

Question			Marking details	Marks Available
4.	*(a)*		Progressive waves (accept: waves travel) from speaker to barrier (1) These are reflected (1) and the reflected waves interfere (1) (with waves from the speaker. [Accept: superpose / combine / add but **not** create nodes and antinodes].	3
	(b)	(i)	$\lambda = \frac{c}{f}$ [or by impl.] (1); λ = 0.2 m (1)	
			Separation of nodes = 0.1 m (1) ((**unit**))	3
		(ii)	Graph drawn with zeros / minima at 0, 2 and 4 seconds (1) Maxima at 1 and 3 seconds (1) Shape roughly correct [ignore shape and value at minima] (1)	3
		(iii)	antinodes	1
				[10]
5.	*(a)*		Magnitude (size) and direction.	1
		(i)	Use of $v^2 = u^2 + 2as$ [or equiv. method or by impl.] (1) $0 = 11.8^2 - 2 \times 9.8s$ (1) [N.B. Evidence of correct use req^d] s = 7.1 m (1)	3
		(ii)	Use of $v = u + at$ [or by impl. or equiv. method](1) $\left[t = \frac{-11.8}{-9.8} = 1.2s \right] \therefore$ Time of flight = 2.4 s (1)	2
	(b)		v axis label [inc. unit] and scale (1) [N.B. + and − required] t axis label [inc. unit]and scale (1) Line from (0,11.8) to (1.2,0) (e.c.f.) (1) Line from (1.2,0) to (2.4,−11.8) (e.c.f.)(1)	4
				[10]

Question			Marking details	Marks Available
6	*(a)*		If a body A exerts a force on body B, then body B exerts an equal and opposite force on body A. [Accept action/reaction if it is clear the forces act on different bodies]	1
	(b)	(i)	A labelled as, e.g. (force of) skydiver on air. (1) D labelled as gravitational force of skydiver on (the) Earth.(1)	2
		(ii)	Two valid comments e.g. Force has very little effect on Earth; force is equivalent to weight of skydiver; Earth moves a very small distance towards the skydiver. (2 × 1)	2
		(iii)	(At start) gravitational force of Earth > force of air on skydiver, (producing acceleration). (1) Force of air on skydiver increases (1). Eventually these forces become equal (in magnitude) (1) (so the velocity becomes constant)	3
	(c)	(i)	weight – $F_{air} = ma$ (1) [or by impl.] $F_{air} = (70 \times 9.8)(\checkmark) - 70\ (\times 1)(\checkmark)$ $= 616$ N (1)	4
		(ii)	$F_{air} = mg$ (1) = 686 N (1) [N.B. Insufficient just to calculate mg. Ref. to $F_{air} = 686$ N needed]	2
		(iii)	Attempt at calculating any identified area to right of 60 s [accept to rt. of Q](1) Height = $\frac{1}{2} \times 5 \times 55 + 20 \times 5$ [or equiv.](1) = 237.5 m (1)	3
		(iv)	$\frac{237.5(\text{e.c.f.})}{20}(1) = 11.9\ \text{m s}^{-1}(1)$	2
		(v)	686 N [e.c.f. from (ii)]	1
				[20]

Question			Marking details	Marks Available
7.	*(a)*	(i)	Two points marked 10 m apart.	1
		(ii)	Two points marked 10 s apart	1
		(iii)	$c = f\lambda$ [or by impl.] (1) $f = \frac{1}{40}$ s (1); $\lambda = 4$ m (1) $c = 0.1$ m s^{-1} ((**unit**)) (1) Alternatively: $c = \frac{s}{t}$ (1) Correct s and corresponding t (2) $c = 0.1$ m s^{-1} ((**unit**)) (1)	4
		(iv)	At least one cycle drawn with a reasonable sinusoidal shape (1) Correct amplitude [i.e. 1 cm] (1) λ doubled [i.e. 8 m] (1)	3
	(b)	(i)	(Further) maxima $\rightarrow$ minima (etc.) [accept Lound/quiet]	1
		(ii)	Constant [accept: no] phase difference [Accept: 'always in phase' but **not** just 'in phase']	1
		(iii)	$\lambda = \frac{ay}{D}$ [or by impl.] (1); $y = 1.25$ m (1) $\lambda = \frac{1.25 \times 1.25}{4.60}$ (e.c.f. on y) (1) $= 0.34$ m (1)	4
	(c)	(i)	Diffraction (1) (Sound) waves spread out when they pass through doorway (1) [Can be credited from diagram]	2
		(ii)	Maximum diffraction (with no minimum) when $\lambda \sim$ [or >] 2 m (1) Corresponding $f = \frac{340}{2} \rightarrow f = 170$ Hz (1) Statement / calculation / argument to show higher frequencies <u>lead to lower wavelengths</u> and less diffraction (1)	3
				[20]