PH1 Mark Scheme – June 2007

Question			Answers / Explanatory notes	Marks available
1	(a)		Repeated units / monomers [accept particles/atoms] **or** long molecular chains. Not: randomly packed molecules or particles joined together	1
	(b)	(i)	molecules unravel / unfold [and align by rotation about single C–C bonds](1). Not steep because [small] force → large extension [or equiv] **or** ….. because little/no resistive force between molecules / small force needed to rotate bonds (1)	2
		(ii)	Molecules fully aligned (1). Steep because ratio of stress/strain high / [large] force → small extension **or** …..because applied force resisted by [covalent] bonds/forces within molecules [or monomers / atoms] (1).	2
	(c)	(i)	$\frac{\text{stress}}{\text{strain}}$ [accept $\frac{Fl}{Ae}$ or equiv.]	1
		(ii)	Rubber: Large strain/extension (1) for [small] stress / force (1) [or steel: converse]	2
	(d)	(i)	e.g. flexible / tough / highly resilient / durable	1
		(ii)	hard / rigid / strong	1
				[10]
2	(a)		$\frac{\text{Force}}{\text{extension}}$ / force per unit extension. [accept $k = \frac{F}{x}, \frac{F}{\Delta l}, \frac{F}{e}$]	1
	(b)		12 Nm^{-1} [or ½ of each] (1) because the extension is doubled [or equiv.] (1) for a given F (1)	3
	(c)	(i)	extension = 0·1 m (1) $F = k \times$ extension [or by impl.] (1) $F = 12 \times 0{\cdot}1 = 1{\cdot}2$ N (1)	3
	(d)	(ii)	Principle of Moments correct [allow dist to C of M] (1) $1{\cdot}2 \times 0{\cdot}8 = 0{\cdot}5$ (1) + $4x$ $x = 0{\cdot}12$ m (1)	3
				[10]

Question			Answers / Explanatory notes	Marks available
3	(a)		Resultant / net force / [vector] sum of forces (1) [accept total force] Correct example showing the resultant of two or more forces	1
	(b)	(i)	9800 N [N.B. Use of g = 10 N kg^{-1} penalised only once]	1
		(ii)	$a = \frac{[\Sigma]F}{m}$ [or by impl.] (1) $= \frac{(12000-9800)(1)}{1000} = 2\cdot2\,\text{m}\,\text{s}^{-2}(1)$	3
	(c)	(i)	$\sigma = E \times \varepsilon$ [or by impl.] $= 2\times10^{11} \times 3\cdot75\times10^{-5}(1)[= 7\cdot5\times10^{6}\,\text{Pa}]$ $T = \sigma \times A$[or by impl.]$= 7\cdot5\times10^{6}$(e.c.f.)$\times 1\cdot2\times10^{-3}(1)$ $= 9000$ N(1)	3
		(ii)	Deceleration <u>because T < 9800 N</u> [explanation needed] e.c.f.	1 [10]
4	(a)		$\frac{\sin\theta_1}{\sin\theta_2}(1) = \text{constant}(1)$ [or equiv. e.g. $n_1 \sin\theta_1 = n_2 \sin\theta_2$]	2
	(b)	(i)	$\frac{\sin 45^\circ}{\sin 26^\circ}(1) = 1\cdot6(1)$	2
		(ii)	1 < n < 1·6 [e.c.f.] (1) [accept e.g. 1·2 – 1·5, **not** 1·3 – 1·6] for TIR to occur [accept: reflection] (1)	2
		(iii)	$c_{\text{fibre}} = \frac{3\cdot0\times10^{8}}{1\cdot6[\text{e.c.f.}]}(1); t = \frac{10\times10^{3}}{c_{\text{fibre}}} = 5\cdot3\times10^{-5}\text{s}(1)$	2
	(c)		Any 2 × 1 of: ▪ larger information-carrying capacity / bandwidth ✓ ▪ Lighter [∴ easier/cheaper to install] ✓ ▪ less cross-talk / more secure ✓ ▪ lower cost raw materials / production ✓ ▪ resistant to corrosion ✓ ▪ greater distance before boosting required ✓ N.B. **not** "faster"	2 [10]

Question			Answers / Explanatory notes	Marks available
5	(a)		[particle] vibration along wave direction[**not** particles move...]	1
	(b)	(i)	$v = 5189$ m s^{-1}	1
		(ii)	LHS: m^2 s^{-2} **or** (m s^{-1})^2 (1) RHS: $\frac{\text{Nm}}{\text{m}^2\text{kg}}$ (1)[or by impl.] $= \frac{\text{kg m s}^{-2}\text{(1)m}^3}{\text{m}^2\text{kg}} =$ m^2 s^{-2} shown (1) [or equiv. in dimensions]	4
		(iii)	$d = 5189\ t$ [e.c.f.] (1); and $d = 330(t + 0{\cdot}4)$ (1) Working (1) $\rightarrow t = 141$ m (1) e.g. [substituting for d] $5189\ t = 330\ (t + 0{\cdot}4)$ [e.c.f. on $t - 0{\cdot}4$] $\therefore\ t = 0{\cdot}027$ s ✓ then substitution $\rightarrow t = 141$ m ✓	4
				[10]

Question			Answers / Explanatory notes	Marks available
6	(a)		Speed has magnitude only (1); velocity has direction <u>too</u> (1). [**or** speed is a scalar (1); velocity is a vector (1)] [accept for 1 mark: velocity is speed in a specific direction]	1
	(b)	(i)	$s=\frac{u+v}{t}$ (1); $\therefore 3\cdot4=\frac{u+0}{2}\times2\cdot13$ (1) [or eqiv.] manipulation (1)$\rightarrow$ u = 3·4 m s^{-1} [accept: inserting all figures and showing that, e.g. 3·6 = 3·6]	3
		(ii)	$v=u+at$ [or equiv.] $0=3\cdot4\pm2\cdot13a$ (1) $a=\pm1\cdot6\,\text{m s}^{-1}$ (1) N.B. Use of other equations of motion equally acceptable.	3
		(iii)	4·26 – 0·90 [or 2·13 + 1·23] [or by impl.](1) = 3·36 s (1)	2
		(iv)	3 × diagram with **only** weight or [force due to] gravity shown (3 × 1) [3 correct diagrams with no labels → (2)]	3
		(v)	No (1) because air resistance / drag would affect result (1) [Accept: Yes ✓ because air resistance has only small effect✓] [N.B. No [or yes] unqualified → 0]	2
	(c)	(i)	$v_R=\sqrt{3\cdot4^2+2\cdot0^2}$ [or by impl](1) $=3\cdot9\,\text{m s}^{-1}$ (1) θ = 59·5° to horizontal [direction must be clear] (1)	3
		(ii)	On vehicle (1) because no horizontal forces / v_h const. (1)	2
				[20]

<table>
<tr><th colspan="3">Question</th><th>Answers / Explanatory notes</th><th>Marks available</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)
(ii)</td><td>maximum displacement [accept: height]
interact / overlap / interfere / combine / occupy same region</td><td>1
1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Direction: up [or down] / vertical (1)
Amplitude: Q > P [not just different] (1)
In phase (1)</td><td>3</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>$2 \times 1{\cdot}8$ (✓) = 3·6 m</td><td>1</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Top diagram: 2 loops shown ~ equal (1)
Bottom diagram: 3 loops shown equal (1)
nodes shown at ends (1)</td><td>3</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><td>1</td><td>2</td><td>3</td><td></td></tr><tr><td>3·6</td><td>1·8 (1)</td><td>1·2 (1)</td><td></td></tr><tr><td>0·28</td><td>0·56</td><td>0·83</td><td>(1) all $^1/_\lambda$</td></tr><tr><td>4·32</td><td>4·32</td><td>4·32</td><td>(1) e.c.f.</td></tr></table></td><td>4</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Graph: Scale + plotting (1); line (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>inverse proportion [accept $f = \frac{c}{\lambda}$, with c = const or speed]</td><td>1</td></tr>
<tr><td></td><td></td><td></td><td>4·2 [e.c.f. from graph] (1); speed of wave (1)</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td></td><td>[20]</td></tr>
</table>