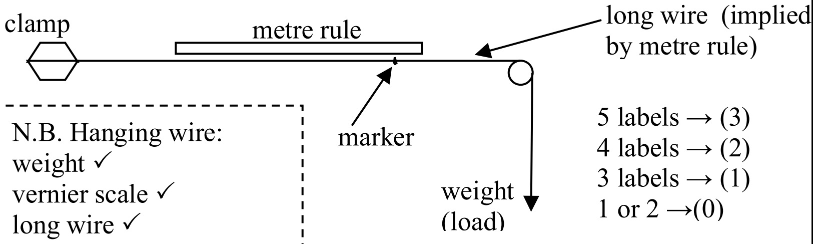
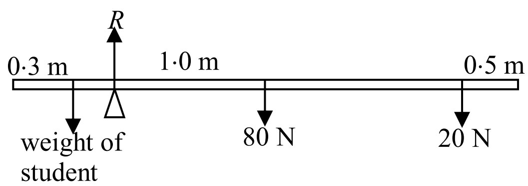
PH1 Mark Scheme – January 2007

Notes: This marking scheme, whilst reasonably complete does not give **all** the answers which were credited by the examiners. It is hoped that the scheme is self-explanatory, though it will need to be read alongside the question paper. The following clarifications may be of use:
Statements in brackets [ ] are exemplification, alternatives **or** statements which, whilst desirable in an answer were not required on this occasion for full marks.
The numbers in parentheses ( ) are the marks, usually 1, for each response.
e.c.f. stands for *error carried forward,* and indicates that the results of a previous (incorrect) calculation will be treated as correct for the current section. i.e. the mistake will only be penalised once.
The expression "or by implication" indicates that the mark is credited when subsequent credit-worthy working demonstrates that this idea/equation has been used.
Incorrect or absent units only attract a penalty when ((**unit**)) appears, otherwise they are there in the mark scheme for completeness.
No penalties for excessive significant figures are applied in this paper.
N.B. This Mark Scheme is not a set of Model Answers.

Question				
1	(a)		$F = ma$(1) $\quad\left[9\cdot8 - T = M_0 a \text{ or sim.}\right]$ $a = \frac{9\cdot8}{3\cdot5}(1)\left[= 2\cdot8\text{ m s}^{-2}\right]$	2
	(b)	(i)	Use of $s = ut + \frac{1}{2}at^2$ [or equiv.](1) t = 1·07 s (1)	2
		(ii)	Use of $v = u + at\left[\text{or } v^2 = u^2 + 2as\right]$(1) v = 3·0 m s^{-1} ((**unit**)) (1)	2
	(c)		Constant velocity (or speed) (1) No <u>resultant</u> force (1) [**or** no horizontal forces acting, or equiv.]	2
	(d)	(i)	No change	1
		(ii)	Reduced [penalise any incorrect explanation]	1
				[10]

2	(a)		 N.B. Hanging wire: weight ✓ vernier scale ✓ long wire ✓ 5 labels → (3) 4 labels → (2) 3 labels → (1) 1 or 2 →(0)	3
	(b)		[original] length ----- metre rule (1) diameter /thickness – micrometer (1) [not area / radius] extension -------------- ruler [or equiv.] (1) [or equiv.] N.B. Measuring instruments can be credited from diagram	3
	(c)		Use of a long wire → measurable extension ✓ diameter measured at various points [at 90°] ✓ keep within elastic limit ✓ reference wire [if relevant] ✓ any 1	1
	(d)		gradient = $\frac{F}{e}$ (1) [or equiv.] A from diameter [no details required – can credit from (b)] (1) $E = \text{gradient} \times \frac{l}{A}$ [or equiv involving σ and ε] (1)	3 [10]
3	(a)		No resultant / net force [**or** sum of forces / $\Sigma F = 0$]	1
	(b)	(i)	$[w_1 x_1 =] wx + w_2 x_2$	1
		(ii)	$[R =] w + w_1 + w_2$	1
	(c)	(i)	 downward forces (1) upward force (1) relevant distance for **all** downward forces (1)	3
		(ii)	$w \times 0 \cdot 2 = (80 \times 1) + (20 \times 2)$ [all terms are $F \times d$ (1), ds correct (1)] $w = 600\,\text{N}$ (1)	3
		(iii)	700 N (e.c.f.)	1 [10]

4	(a)	(i)	measure wavelengths / observe spectra [accept: demonstrate the wave nature of light]	1
		(ii)	division by 5000 indicated.	1
		(iii)	$n\lambda = d\sin\theta$ used (1) **Either**: θ_{green} calculate correctly (2), **or** θ_{red} calculated (1) and "green" given as answer(1) [Accept reverse calculation, i.e. λ calculated]	3
	(b)	(i)	$n\lambda = d\sin\theta$ (1) ; sin 90°=1 + rearrangement (1)	2
		(ii)	I. 3[no mark for 3·6] II. 2	1 1
		(iii)	11 (e.c.f.) [=2 × (I + II) + 1]	1
				[10]
5	(a)	(i)	Force per unit extension [accept in symbol form].	1
		(ii)	$\frac{\text{kg m s}^{-2}\,(1)}{\text{m}\ (1)}\left[\Rightarrow \text{kg s}^{-1}\right]$ [N.B. Cancellation not required]	2
	(b)	(i)	$k = \frac{20}{0 \cdot 3}(1) = 66 \cdot 7\ \text{N m}^{-1}(1)$ Assuming that Hooke's law is valid [or equiv.] (1)	2
		(ii)	0·01 m	1
	(c)	(i)	3 × 66·7 = 200 N m^{-1} (e.c.f.)	1
		(ii)	$W_{max} = kx = 200 \times 0 \cdot 75(\text{e.c.f.}) = 150\ \text{N}(1)$ $\therefore$ Maximum number of plates $= \frac{150}{6} = 25(1)$	2
				[10]

6	(a)		$\dfrac{\text{[total] distance}}{\text{[total] time}}$	1
	(b)	(i)	speed $= \dfrac{\pi r}{t}$ (1) $= \dfrac{\pi \times 3\cdot5}{11}$ (1) $\left[= 1\cdot0\,\text{m}\,\text{s}^{-1}\right]$ [accept reverse argument, i.e. showing distance = 11 m]	2
		(ii)	$v = \dfrac{7\cdot0}{11\cdot0}$ (1) $\left[= 0\cdot64\,\text{m}\,\text{s}^{-1}\right]$ East / to the right (1)	2
		(iii)	Arrows indicated ↓↑ (1) $\Delta \boldsymbol{v} = 1-(-1) = 2\,\text{m}\,\text{s}^{-1}$ (1) N [upwards] (1)	3
		(iv)	velocity changing (1) since the direction is (constantly) changing (1)	2
		(v)	North [accept, towards centre / upwards]	1
	(c)	(i)	Calculation of decelerating distance e.g. by $s = \dfrac{u+v}{2}t$ (1) Decelerating time = 4 s (1) [or by impl. from graph] Appropriate time axis labelled. Straight line drawn from (0,1) to (2,1) – (1) Straight line drawn from (2,1)e.c.f. to (6,0) e.c.f – (1)	5
		(ii)	Axes including labels and units (1) Straight line from (0,0) to (2,2) – (1) Curved continuation from (2,2) to (6,4) – (1) Graph approximately horizontal at (6,4) – (1)	4
				[20]

7	(a)	(i)	I. [Particle] vibrations/oscillations parallel to / in line with direction of motion of the wave	1
			II. Any 2 (×1) of: wave profile is seen to move; transfers energy; points within λ are out of phase with each other [**or** points in phase are $n\lambda$ apart] amplitude the same for all particles [assuming no energy losses].	2
		(ii)	I. Wavefront spreading out [or equiv.] [accept: loss of energy / damping – or equiv.]	1
			II. $\lambda = 0{\cdot}5$ m (1) $c = f\lambda = 680 \times 0 \cdot 5 = 340\ \text{m s}^{-1}$(1)	2
		(iii)	Amplitudes: at 0·125 m = 12 [units]; 1·125 m = 8 [units] (1) $I \propto A^2$ (1) $\therefore$ ratio of intensities $= \dfrac{144}{64}$ (1) $[= 2 \cdot 25]$	3
	(b)	(i)	675 Hz (1) 685 Hz (1)	2
		(ii)	675 Hz (1). <u>Increased difference</u> between f_{gen} and f_{fork} [or equiv. e.g. explanation of why 685 Hz is incorrect] (1)	2
	(c)	(i)	[It produces a] reflection [or a progressive wave].	1
		(ii)	Any 2 (×1) of: wave profile not seen to move [away from source]; energy no transferred [away from source]; λ is 2× distance between consecutive nodes [or antinodes]; points between consecutive nodes are in phase; amplitude varies between nodes.	2
	(d)		Obtain f from the signal generator (1). Measure the distance moved by the probe between two points of minimum intensity [or max. or max. to min. – or other sensible distance] (1) Show how λ is calculated from the measured distance. (1) Use of $c = f\lambda$. (1)	4
				[20]