edexcel
advancing learning, changing lives

Mark Scheme (Pre-Standardisation)
January 2008

GCE

GCE Mathematics (6678/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

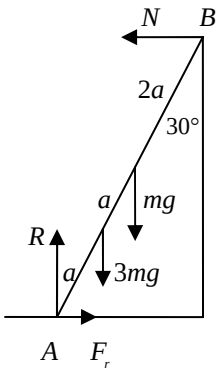
General Marking Guidance

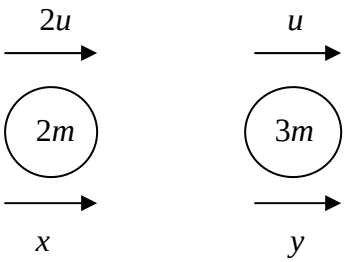
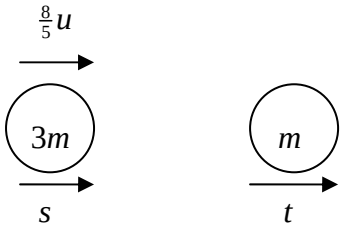
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

January 2008
6678 Mechanics M2
Mark Scheme

Question Number	Scheme	Marks
1.	(a) KE lost is $\frac{1}{2}\times 2.5\times 8^2 = 80 \ (\text{J})$	M1 A1 **(2)**
	(b) Work energy $80 = R\times 20$ ft their (a) $R = 4$	M1 A1 ft A1 **(3)** **[5]**
	Alternative to (b) $0^2 = 8^2 - 2\times a\times 20 \ \Rightarrow \ a = (-)1.6$ N2L $R = 2.5\times 1.6$ ft their a $= 4$	M1 A1ft A1 **(3)**
2.	(a) $\dot{\mathbf{p}} = (6t-6)\mathbf{i} + (9t^2-4)\mathbf{j} \quad (\text{m s}^{-1})$	M1 A1 **(2)**
	(b) $9t^2 - 4 = 0$ $t = \frac{2}{3}$	M1 M1 A1 **(3)**
	(c) $t = 1 \ \Rightarrow \ \dot{\mathbf{p}} = 5\mathbf{j}$ $2\mathbf{i} - 6\mathbf{j} = 0.5(\mathbf{v} - 5\mathbf{j})$ $\mathbf{v} = 4\mathbf{i} - 7\mathbf{j} \quad (\text{m s}^{-1})$	B1 M1 M1 A1 **(4)** **[9]**

Question Number	Scheme	Marks
3.	(a) $20\,000 = 16F \quad (F = 1250)$	M1 A1
	Z $F = 550 + 1000 \times 9.8 \sin\theta$ ft their F	M1 A1ft
	Leading to $\sin\theta = \frac{1}{14}$ ✱ cso	A1 **(5)**
	(b) N2L Z $550 + 1000 \times 9.8 \times \frac{1}{14} = 1000a$	M1 A1
	$(a = (-)1.25)$	
	$v^2 = u^2 + 2as \Rightarrow 16^2 = 2 \times 1.25 \times y$	M1
	$y \approx 102$ accept 100	A1 **(4)**
		[9]
	Alternative to (b)	
	Work-Energy $\frac{1}{2} \times 1000 \times 16^2 - 1000 \times 9.8 \times \frac{1}{14} y = 550y$	M1 A1
	$y \approx 102$ accept 100	M1 A1 **(4)**
4.	(a) Triangle Circle S	
	Mass ratio 126 9π $126 - 9\pi$	B1 B1ft
	$\bar{x}$ 7 5 $\bar{x}$	
	$\bar{y}$ 4 5 $\bar{y}$ all four	B1
	$126 \times 7 = 9\pi \times 5 + (126 - 9\pi) \times \bar{x}$ ft their mass ratios	M1 A1ft
	$\bar{x} \approx 7.58$ awrt 7.6	A1
	$126 \times 4 = 9\pi \times 5 + (126 - 9\pi) \times \bar{y}$ ft their mass ratios	M1 A1ft
	$\bar{y} \approx 3.71$ awrt 3.7	A1 **(9)**
	(b) $\tan\theta = \frac{\bar{y}}{21 - \bar{x}}$ ft their $\bar{x}$, $\bar{y}$	M1 A1ft
	$\theta \approx 15°$ awrt 15°	A1 **(3)**
		[12]

Question Number	Scheme	Marks
5.	(a) 	
	M(A) $N \times 4a\cos 30° = 3mg \times a\sin 30° + mg \times 2a\sin 30°$	M1 A2(1,0)
	$N = \frac{5}{4}mg\tan 30° = \frac{5}{4\sqrt{3}}mg$	M1 A1
	$\uparrow\ R = 4mg$, $\rightarrow\ F_r = N$	B1, B1
	Using $F_r = \mu R$	B1
	$\frac{5}{4\sqrt{3}}mg = \mu R$	M1
	$\mu = \frac{5}{16\sqrt{3}}$ awrt 0.18	A1 **(10)**
		[10]
6.	(a) $\rightarrow\ 30 = 2ut$	B1
	$\uparrow\ -47.5 = 5ut - 4.9t^2$	M1 A1
	$-47.5 = 75 - 4.9t^2$ eliminating u	M1
	$t^2 = \frac{75+47.5}{4.9}(=25)$	M1
	$t = 5$ ✱ cso	A1 **(6)**
	(b) $30 = 2ut \Rightarrow 30 = 10u \Rightarrow u = 3$	M1 A1 **(2)**
	(c) $\uparrow\ \dot{y} = 5u - 9.8t = -34$	M1 A1
	$\rightarrow\ \dot{x} = 2u = 6$	A1
	$v^2 = 6^2 + (-34)^2$	M1
	$v \approx 34.5\ \left(\text{m s}^{-1}\right)$ accept 35	A1 **(5)**
		[13]
	Alternative to (c) $v_A^2 = 6^2 + 15^2 = 261$	
	$\frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2 = m \times g \times 47.5$	M1 A1
	$v_B^2 = 261 + 2 \times 9.8 \times 47.5\ (=1192)$	M1 A1
	$v_B \approx 34.5\ \left(\text{m s}^{-1}\right)$ accept 35	A1 **(5)**

Question Number	Scheme	Marks
7.	(a) 	
	LM $4mu+3mu=2mx+3my$	M1 A1
	NEL $y-x=\frac{1}{2}u$	B1
	Solving to $y=\frac{8}{5}u$ ∗ cso	M1 A1 **(5)**
	(b) $x=\frac{11}{10}u$ or equivalent	B1
	Energy loss $\frac{1}{2}\times 2m\left(\left(2u\right)^2-\left(\frac{11}{10}u\right)^2\right)+\frac{1}{2}\times 3m\left(u^2-\left(\frac{8}{5}u\right)^2\right)$	M1 A1+A1
	$=\frac{9}{20}mu^2$	A1 **(5)**
	(c) 	
	LM $\frac{24}{5}mu=3ms+mt$	M1 A1
	NEL $t-s=\frac{8}{5}eu$	B1
	Solving to $s=\frac{2}{5}u\left(3-e\right)$	M1 A1
	For a further collision $\frac{11}{10}u>\frac{2}{5}u\left(3-e\right)$	M1
	$e>\frac{1}{4}$ ignore $e\leq 1$	A1 **(7)**
		[17]