

GCE

Edexcel GCE

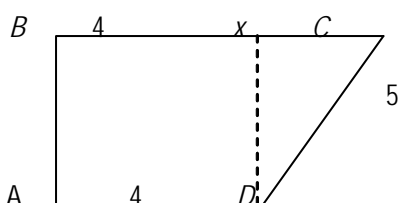
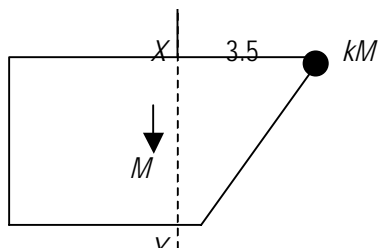
Mechanics M2 (6678)

Summer 2005

advancing learning, changing lives

Mark Scheme (Results)

June 2005
6678 Mechanics M2
Mark Scheme

Question Number	Scheme	Marks
1 (a)	$\text{Driving force} = \frac{P}{v}$ $\frac{21000}{v} = 600 \Rightarrow v = 35 \text{ m s}^{-1}$	B1 M1 A1 (3)
(b)	$\frac{P}{v} = 600 + 1200 \cdot g \cdot \frac{1}{14}$ $(\text{= } 1440 \text{ N})$ $\frac{21000}{v} = 1440 \Rightarrow v = \frac{21000}{1440} \approx 14.6 \text{ or } 15 \text{ m s}^{-1}$	M1 A1 M1 A1 (4)
2 (a)	 <p style="text-align: right;">($x = 3$)</p> $M(AB): 7 \times 3.5 + 5 \times 5.5 + 4 \times 2 = 20 \times \bar{x}$ $\Rightarrow 20\bar{x} = 24.5 + 27.5 + 8 = 60 \Rightarrow \bar{x} = 3 \text{ cm}$	M1 A2,1,0 dep M1 A1 (5)
(b)	 $M(XY):$ $M \times (3.5 - 3) = kM \times 3.5$ $\Rightarrow k = \frac{1}{7}$	M1 A1 \checkmark A1 (3)

3 (a)

$$\mathbf{v} = (18 - 12t)\mathbf{i} + 2c\mathbf{j}$$

M1 A1 A1

$$t = \frac{3}{2}: \quad \mathbf{v} = -9\mathbf{i} + 3c\mathbf{j}$$

M1

$$|\mathbf{v}| = 15 \Rightarrow 9^2 + (3c)^2 = 15^2$$

M1

$$\Rightarrow (3c)^2 = 144 \Rightarrow c = 4$$

A1

(6)

(b)

$$\mathbf{a} = -24\mathbf{i} + 8\mathbf{j}$$

M1

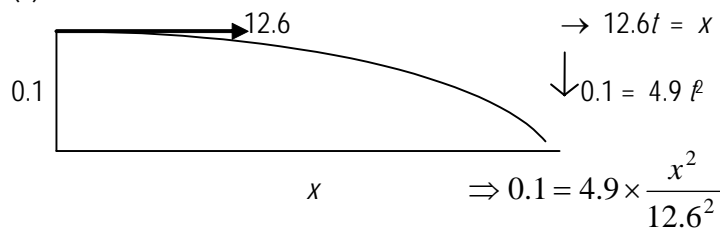
$$t = \frac{3}{2}: \quad \mathbf{a} = -36\mathbf{i} + 8\mathbf{j}$$

M1

A1 \checkmark

(3)

4 (a)



B1

B1

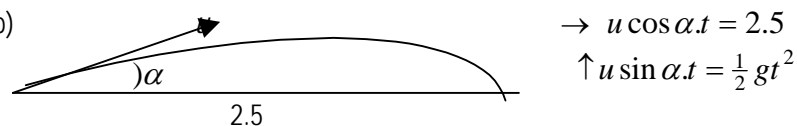
M1

$$\Rightarrow x = 1.8 \text{ m}$$

A1

(4)

(b)



M1 A1

M1 A1

$$u \cdot \frac{24}{25} t = 2.5$$

$$u \cdot \frac{7}{25} = 4.9 \cdot \frac{2.5 \cdot 25}{24u}$$

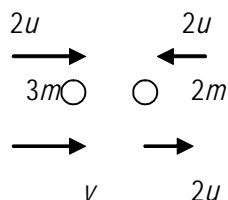
$$u^2 = \frac{4.9 \times 2.5 \times 25^2}{7 \times 24}$$

$$\Rightarrow u \approx 6.75 \text{ or } 6.8 \text{ m s}^{-1}$$

M1 A1

(6)

5 (a)



CLM:

$$6mu - 4mu = 3mv + 4mu$$

M1 A1

$$\Rightarrow v = -\frac{2}{3}u$$

A1

NLI:

$$2u - v = e \cdot 4u$$

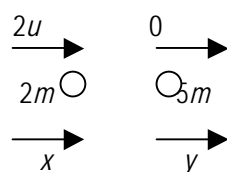
M1 A1

$$\Rightarrow 4eu = \frac{8}{3}u \Rightarrow e = \frac{2}{3}$$

M1 A1

(7)

(b)



$$5my + 2mx = 4mu$$

M1 A1

$$y - x = \frac{3}{5} \cdot 2u = \frac{6}{5}u$$

A1

Solve:

$$x = -\frac{2}{7}u$$

M1 A1

$$\frac{2}{7}u < \frac{2}{3}u \text{ so } B \text{ does not overtake } A$$

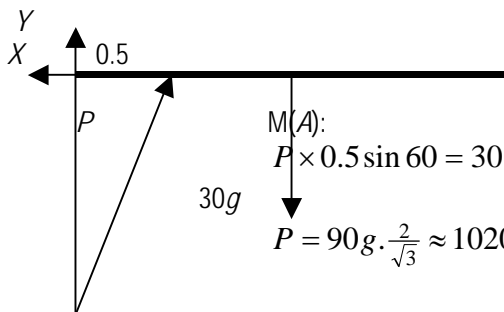
M1

So no more collisions

A1 cso

(7)

6 (a)



$$M(A): P \times 0.5 \sin 60 = 30g \times 1.5$$

M1 A2

$$P = 90g \cdot \frac{2}{\sqrt{3}} \approx 1020 \text{ N (1000N)}$$

A1

(4)

(b)

$$\rightarrow X = P \cos 60 = \frac{1}{2}P$$

$$(\approx 509 \text{ N (510N)})$$

M1 A1

$$\uparrow Y + P \cos 30 = 30g$$

$$(\Rightarrow Y = -588 \text{ N})$$

M1 A1

$$\text{resultant} = \sqrt{(X^2 + Y^2)} = \sqrt{(509^2 + 588^2)} \approx 778 \text{ N}$$

$$\text{or } 780 \text{ N}$$

M1 A1

(6)

(c) In equilibrium all forces act through a point

M1

P and weight meet at mid-point;

hence reaction also acts through mid-point so reaction horizontal

A1 cso

(2)

OR $M(\text{mid-point}): Y \times 1.5 = 0 \Rightarrow Y = 0$

M1

Hence reaction is horizontal

A1

	<p>7 (a) PE lost = $3 \times g \times 8 \sin 30 = 3 \times g \times 8 \times 0.5 = 117.6 \text{ J} \approx 118 \text{ J}$ or 120J</p> <p>(b) KE gained = $\frac{1}{2} \times 3 \times 5^2 = 37.5 \text{ J}$ Work-energy: $F \times 8 = 117.6 - 37.5 = 80.1$ $\Rightarrow F = 10.0125 \approx 10 \text{ N}$</p> <p>(c) $R = 3g \cos 30 (= 25.46 \text{ N})$ $F = \mu R \Rightarrow \mu = \frac{10}{25.46} \approx 0.393 \text{ or } 0.39$</p> <p>(d) Work done by friction = 80.1 as before Work-energy: $\frac{1}{2} \times 3 \times v^2 = \frac{1}{2} \times 3 \times 2^2 + 117.6 - 80.1$ $\Rightarrow v \approx 5.39 \text{ or } 5.4 \text{ m s}^{-1}$</p>	<p>M1 A1 (2)</p> <p>M1 A1 M1 A1√ A1 (5)</p> <p>B1 M1 A1 (3)</p> <p>M1 M1 A2,1,0√ A1 (5)</p>	
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