GCE AS Level Further Mathematics (8FM0)
– Shadow Paper (Set 1)

8FM0-25 Further Mechanics 1

June 2022 Shadow Paper mark scheme

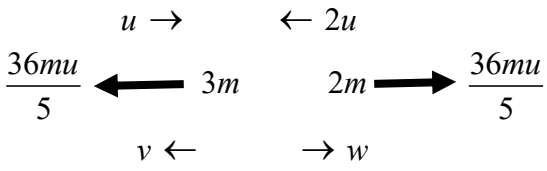
Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide, indicating where marks are given for correct answers. As such, it may not show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme from the original paper.

This document is intended for guidance only and may differ significantly from the examiners' final mark scheme for the original paper, which was published in August 2022.

Guidance on the use of codes within this document
M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect. A1 – accuracy mark. This mark is generally given for a correct answer following correct working. B1 – working mark. This mark is usually given when working and the answer cannot easily be separated. Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

Question	Scheme	Marks	AOs
1.	$F = \dfrac{36000}{18}$	M1	3.3
	Equation of motion	M1	3.1b
	$F - 1500g\sin\alpha - R = 1500\times 0.4$	A1	1.1b
	Substitute for g, trig and F and solve for R	DM1	1.1b
	$R = 350$ (N)	A1	1.1b
		(5)	
			(5 marks)

Question	Scheme	Marks	AOs
2(a)			
	Use of Impulse-momentum principle for A or B	M1	3.4
	A: $\frac{36mu}{5} = 3m(v--u)$ **or** B: $\frac{36mu}{5} = 2m(w--2u)$	A1	1.1b
	Use of Impulse-momentum principle for B or A or CLM	M1	3.4
	$\frac{36mu}{5} = 2m(w--2u)$ **or** $\frac{36mu}{5} = 3m(v--u)$ **or** $3mu-4mu=-3mv+2mw$	A1	1.1b
	$v=\frac{7u}{5}$ and $w=\frac{8u}{5}$	A1	1.1b
	$e=\frac{\frac{7u}{5}+\frac{8u}{5}}{u+2u}$	M1	3.1a
	$e=1$	A1cso	1.1b
	ALTERNATIVE:		
	NEL is written down before v and w are found: $v+w=4ue$	3rd M1	
	Use of Impulse-momentum principle for A or B	1st M1	
	A: $\frac{36mu}{5} = 3m(v--u)$ **or** B: $\frac{36mu}{5} = 2m(w--2u)$	1st A1	
	Use of Impulse-momentum principle for B or A or CLM	2nd M1	
	$\frac{36mu}{5} = 2m(w--2u)$ **or** $\frac{36mu}{5} = 3m(v--u)$ **or** $3mu-4mu=-3mv+2mw$	2nd A1	
	An equation (not an identity) in u and e only is produced	3rd A1	
	$e=1$	A1cso	
		(7)	

Question	Scheme	Marks	AOs
2(b)	Perfectly elastic (or the coefficient of restitution is 1) so no loss in kinetic energy. Allow a direct evaluation of the KE loss i.e. $\frac{1}{2}\times 3mu^2+\frac{1}{2}\times 2m(2u)^2-\left(\frac{1}{2}\times 3m\left(\frac{7u}{5}\right)^2+\frac{1}{2}\times 2m\left(\frac{8u}{5}\right)^2\right)=0$ B0 if incorrect extras	DB1	2.4
		(1)	
			(8 marks)

Question	Scheme	Marks	AOs
3(a)	$mg\times\frac{91}{10}\sin\alpha$	B1	1.1b
	Use of the principle of conservation of mechanical energy	M1	3.4
	$\frac{1}{2}m\times 20^2-\frac{1}{2}mv^2=mg\times\frac{91}{10}\sin\alpha$	A1	1.1b
	$v=18.2\ (\mathrm{m\,s^{-1}})$	A1	1.1b
		(4)	
3(b)	Resolve perpendicular to the plane	M1	3.1a
	$R=mg\cos\alpha$	A1	1.1b
	$F=\frac{2}{5}R$	B1	3.4
	WD against friction = $F\times\frac{91}{10}$	B1	3.4
	Use of work-energy principle	M1	3.1a
	$\frac{1}{2}m\times 20^2-\frac{1}{2}mv^2=mg\times\frac{91}{10}\sin\alpha+\frac{2}{5}\times mg\cos\alpha\times\frac{91}{10}$	A1 A1	1.1b 1.1b
	$v=16.3\ \ (\mathrm{m\,s^{-1}})$	A1	1.1b
		(8)	
			(12 marks)

Question	Scheme	Marks	AOs
4(a)	$3u \rightarrow$ 0 $P\ (3m)$ $Q(4m)$ $w \leftarrow$ $\rightarrow v$		
	Use of CLM	M1	3.4
	$3m \times 3u = -3mw + 4mv$	A1	1.1b
	Use of NEL	M1	3.4
	$3ue = w + v$	A1	1.1b
	Solve for v	D M1	1.1b
	$v = \frac{9u(1+e)}{7}$ *	A1*	2.2a
		(6)	
4(b)	Since $0 \leq e \leq 1$, $\frac{9u(1+0)}{7} \leq v \leq \frac{9u(1+1)}{7}$	M1	3.1a
	i.e. $\frac{9u}{7} \leq v \leq \frac{18u}{7}$ *	A1*	2.2a
		(2)	
4(c)	Solve for w	M1	1.1b
	$w = \frac{3u(4e-3)}{7}$ oe (m s^{-1})	A1	1.1b
		(2)	
4(d)	Speed of Q after hitting the wall = $\frac{1}{7}v$ (m s^{-1})	M1	3.4
	For a further collision between P and Q, $\frac{1}{7}v > w$	M1	3.1a
	Substitute for v and w and solve for e	M1	1.1b
	$e < \frac{24}{25}$	A1	1.1b
	$\frac{3}{4} < e < \frac{24}{25}$	A1	1.1b
		(5)	
			(15 marks)