AS and A-level FURTHER MATHS

Circular motion

Mark scheme

Specification content coverage: MD1, MD2, MD3

Question	Solutions	Mark
1 (a)	Use $\omega = v/r$ $\omega = \frac{4}{0.5} = 8$ rad s^{-1}	1
	Total	**1**
1 (b)	Use $a = \frac{v^2}{r}$ or $a = r\omega^2$ $a = \frac{4^2}{0.5} = 32$ m s^{-2} or $4(8^2) = 32$ m s^{-2}	1
	Total	**1**
2 (a)	Use $\omega = \frac{2\pi}{\text{s}}$ $\omega = \frac{2\pi}{5}$ rad s^{-1} or 0.4π rad s^{-1}	1
	Total	**1**
2 (b)	Use $v = r\omega$ $v = \frac{6\pi}{5}$ m s^{-1} or 1.2π m s^{-1}	1
	Total	**1**
3 (a)	Use $\omega = \frac{\theta}{t}$ eg $\frac{\pi/2}{12}$ or $P = 24$ $\omega = \frac{\pi}{12}$ rad s^{-1}	1 1
	Total	**2**
3 (b)	Use $a = r\omega^2$ $a = \frac{\pi^2}{24}$ m s^{-2}	1 1
	Total	**2**

4	Use $T = \frac{mv^2}{r}$	1
	$80 = 2 \times \frac{5^2}{r}$	1
	$r = \frac{5}{8}$ m or 0.625 m	1
	Total	**3**
5	$R = 2mg$	1
	$F = 2m(3a)\left(\sqrt{\frac{g}{6a}}\right)^2$	1
	$2\mu mg \geq 2m(3a)\left(\sqrt{\frac{g}{6a}}\right)^2$	1
	$\mu \geq \frac{1}{2}$	1
	Total	**4**
6	$R = mg$	1
	$F = m \times \frac{12^2}{35} = \frac{144m}{35}$	1
	$\frac{144m}{35} = \mu mg$	1
	$\mu = \frac{144}{35g}$	1
	$\mu = 0.42$ (correct rounding to 2 significant figures)	1
	Total	**5**
7	$R = 4mg$	1
	$F = 4mr\left(2\sqrt{\frac{g}{5a}}\right)^2$	1
	$= \frac{16mrg}{5a}$	1
	$\frac{16mrg}{5a} = 0.6 \times 4mg$	1
	$r = \frac{3a}{4}$ or $0.75a$	1
	Total	**5**

8	Resolving vertically on Q $T = 3g$ (= 29.4)	1
	Resolving vertically on P $R = 2g$ (= 19.6)	1
	(For min speed) $29.4 - \mathbf{5.88} = \frac{2v^2}{0.8}$	1
	$v = 3.1$ m s^{-1} (correct rounding to 2 significant figures)	1
	(For max speed) $29.4 + \mathbf{5.88} = \frac{2v^2}{0.8}$	1
	$v = 3.8$ m s^{-1} (correct rounding to 2 significant figures)	1
	$3.1 \leq v \leq 3.8$	1
	Total	**7**