12. Motion in a Circle

12.1 Kinematics of uniform circular motion

Paper 4

Marking Scheme

Q1.

(a)	angle (subtended at the centre of a circle) when arc (length) = radius	**B1**
(b)(i)	arrow, labelled V, pointing in NE direction	**B1**
(c)(i)	$v = r\omega$	**C1**
	$\omega = 0.68 / (0.093 - 0.012)$ $= 8.4$ rad s^{-1}	**A1**
(d)	angular speed: same for both pieces	**B1**
	linear speed: less for second piece than first piece	**B1**
	acceleration: less for second piece than first piece	**B1**

Q2.

(a)(i)	$v = r\omega$	**C1**
	$= 0.85 \times 140$ $= 120$ m s^{-1}	**A1**
(b)(ii)	$T = 2\pi / \omega$ $= 2\pi / 140 = 0.045$ s $= 45$ ms	**A1**

Q3.

(d)(i)	$\omega = 2\pi / T$	**C1**
	$= 2\pi / (24 \times 60 \times 60)$ $= 7.3 \times 10^{-5}$ rad s^{-1}	**A1**

Q4.

(a)	angle (subtended at centre of circle) when arc length = radius	**B1**
(b)	$\omega = 2\pi / T$	**C1**
	$= 2\pi / (1.0 \times 60 \times 60)$ $= 1.7 \times 10^{-3}$ rad s^{-1}	**A1**
(c)(i)	angle $= 1.7 \times 10^{-3} \times 1400$ $= 2.4$ rad	**A1**
(c)(ii)	L = arc length / angle $= 0.44 / 2.4$ **or** $L = 0.44 \times (3600 / 1400) / 2\pi$	**C1**
	$L = 0.18$ m	**A1**

Q5.

(b)	arc length $= r\theta$ $d = 1.5 \times 10^{17} \times 1.2 \times 10^{-5} = 1.8 \times 10^{12}$ m	**A1**
(c)(i)	$\omega = 2\pi / T$	**C1**
	$= 2\pi / (44.2 \times 365 \times 24 \times 3600)$ $= 4.5 \times 10^{-9}$ rad s^{-1}	**A1**

Q6.

(b)(i)	angle = $(1.2 \times 10^{-3}) / (8.0 \times 10^{-2}) = 1.5 \times 10^{-2}$ (rad)	**B1**