Circular Motion - Mark Scheme

Q1.

Question Number	Answer	Mark
	The only correct answer is **C** A is not the correct answer because it is $570 \div (60 \times 2\pi)$ B is not the correct answer because it is $570 \div 60$ D is not the correct answer because it is $570 \times 2\pi$)	**1**

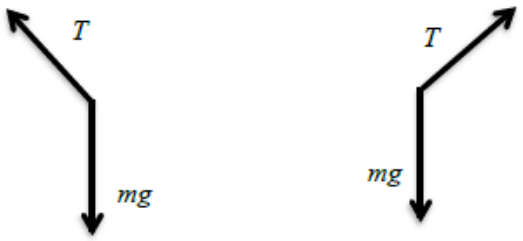
Q2.

Question Number	Answer		Mark
(a)	Use of $\omega = \frac{2\pi}{T}$	(1)	
	$\omega = 1.2 \times 10^{-3}$ (rad s^{-1})	(1)	**2**
	Example of calculation $\omega = \frac{2\pi \times 16 \text{ rad}}{(24 \times 60 \times 60 \text{ s})} = 1.16 \times 10^{-3}$ rad s^{-1}		
(b)	Use of $a = r\omega^2$ **Or** use of $v = r\omega$ **and** $a = v^2/r$ (ecf from (a))	(1)	
	$a = 9.7$ m s^{-2} ("show that" answer gives 6.7 m s^{-2}) (using $\omega = 1.16 \times 10^{-3}$ gives 9.1 m s^{-2})	(1)	**2**
	Example of calculation $a = (330 + 6400) \times 10^3 \text{ m} \times (1.2 \times 10^{-3} \text{rad s}^{-1})^2 = 9.7 \text{ m s}^{-2}$		
	Total for question		**4**

Q3.

Question Number	Answer		Mark
(a)(i)	Use of $v = 2\pi r/T$ **Or** Use of $v = 2\pi rf$ **Or** Use of $v = \omega r$ and $\omega = 2\pi/T$	(1)	
	$v = 35.2$ (m s^{-1})	(1)	**2**
	Example of calculation $v = 2\pi \times 0.240$ m / (60 / 1400) s $v = 35.2$ m s^{-1}		
(a)(ii)	Use of $F = mv^2/r$ **Or** $F = m\omega^2 r$	(1)	
	$F = 7.2$ N (allow full ecf for answer in a) ('Show that' value gives 7.1 N)	(1)	**2**
	Example of calculation $F = 0.0014$ kg $\times$ (35.2 m s^{-1})^2 / 0.240 m $F = 7.23$ N		
(b)	Water has no resultant/centripetal force **Or** The clothes experience a centripetal force from the drum **Or** The clothes experience a resultant force towards the centre of the drum	(1)	
	Water continues its motion in a straight line **Or** Water leaves drum along a tangent	(1)	**2**
	Total for question		**6**

Q4.

Question Number	Answer		Mark
(a)	Line vertically down labelled *mg* / weight / *W* / gravitational force	(1)	
	Force *T* / tension labelled along "lever direction"	(1)	
	Example of diagram  		**(2)**

(b)	Use of $\omega = 2\pi / T$ **Or** $\omega = 2\pi f$	(1)	
	State or use time for revolution = 60 s / 62 **Or** f = 62 / 60 s	(1)	
	State or use $mg = T\cos\theta$	(1)	
	State or use $T\sin\theta = mr\omega^2$ **Or** State or use $T\sin\theta = mv^2 / r$ **and** $v = \omega r$	(1)	
	State or use $r = l\sin\theta$	(1)	
	$\theta = 30°$ **Or** 0.53 radians Example of calculation $\omega = 2\pi f = 2\pi \times 62$ s / 60 = 6.49 radian s^{-1} $T\cos\theta = mg$ $T\sin\theta = mr\omega^2 = = ml\sin\theta\,\omega^2$ $T = ml\omega^2$ $ml\omega^2\cos\theta = mg$ $\cos\theta = g/l\omega^2$ $\cos\theta$ = 9.81 N kg^{-1} / 0.27 m × (6.49 radian s^{-1})^2 θ = 30.3° or 0.53 radians		(6)
	Total for question 13		**8**

Q5.

	Answer	Mark
	D	**1**