TOPIC 6: CIRCULAR MOTION QUIZ **Time: 25 minutes** **Score: / 15**

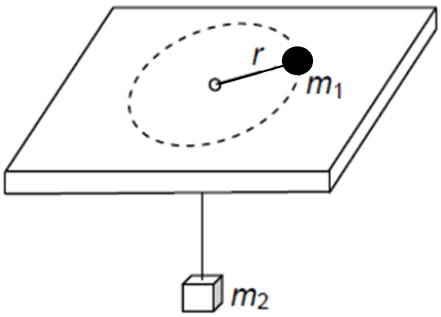
Name: _____ **C.G.: _____**

1. Calculate the mean speed and the mean angular velocity of the Earth in its orbit around the Sun? (The mean radius of the orbit is 1.50×10^{11} m.) [N12/1/11]

mean speed = ……..m s^{-1} [2]

mean angular velocity = …….. rad. s^{-1} [2]

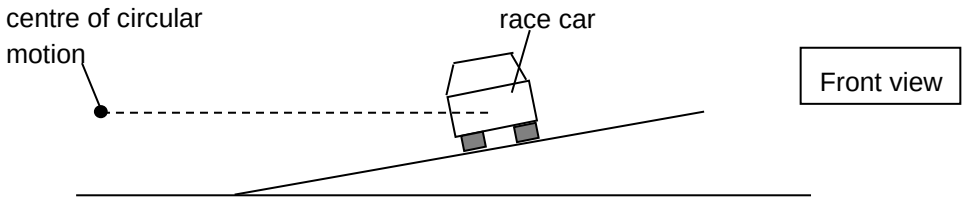
2. Mass m_1 of 0.50 kg is tied to a string and made to revolve in a circle of radius r on a frictionless horizontal table with a speed of 2.0 m s^{-1}. A load m_2 of mass 0.80 kg is tied to the other end of the string and suspended below the table.



Calculate the radius r such that m_2 maintains its vertical position? [Prelim 2012, RJC]

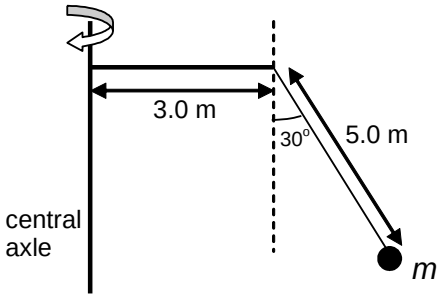
r = ……..m [2]

3. A race car moves at a high speed along a banked circular track, as shown below.



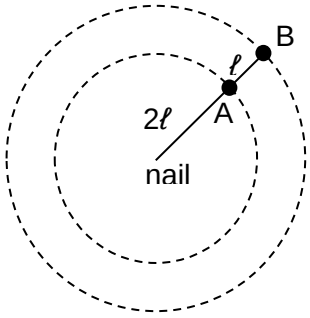
If the car does not rely on lateral friction to move on the track, sketch in the space below a labelled and accurate free-body diagram of the car. [2]

4. A mass *m*, attached to one end of an inextensible string of length 5.0 m, is made to move in a horizontal circle as the central axle is rotated. In a particular circular motion, the string makes an angle of 30^{o} with the vertical as shown below. Calculate the period of the mass' motion about the central axle.



period = ……..s [4]

5. Two small beads **A** and **B**, each of mass ***m***, are connected by a string of length ***ℓ*** as shown below. Bead **A** is tied to a nail at the centre of a smooth table by another string of length 2***ℓ***. The two spheres are then set into circular motion on the surface of the table with the same angular velocity. What is the ratio of the tension in the string connecting beads **A** and **B** to that in the string connecting bead **A** to the nail?



ratio = …….. [3]

Circular Motion Quiz Solutions

1. Mean speed, $v = \frac{\text{Distance}}{\text{Time}} = \frac{2\pi(1.50\times10^{11})}{365\times24\times60\times60}$ [1]

$= 2.99 \times 10^{4}$ m s^{-1} [1]

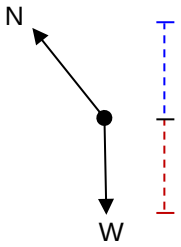
$v = r\omega \Rightarrow \omega = \frac{v}{r} = \frac{2.99\times10^{4}}{1.50\times10^{11}}$ [1]

$= 1.99 \times 10^{-7}$ rad s^{-1} [1]

2. Centripetal force = $m_2 g = m_1 \frac{v^2}{r}$ [1]

$r = \frac{m_1 v^2}{m_2 g} = \frac{0.50(2.0)^2}{0.80(9.81)} = 0.25$ m [1]

3. N = Normal Reaction on the Car
W = Weight of the Car
Above forces drawn and labelled [1]
Length of vertical component of N = Length of W [1]



4. Let *T* be the tension in the string.

For vertical equilibrium of mass,
$T\cos30^0 = mg$ (1)
For horizontal circular motion of mass,
$T\sin30^0 = mr\omega^2$ (2) [1]

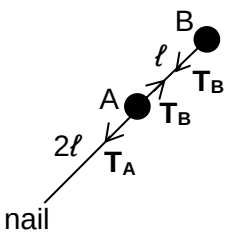
$\frac{(2)}{(1)}$ gives $\tan30^0 = r\omega^2/g$ [1]

$\tan30.0^0 = (3.0 + 5.0\sin30^0)\omega^2/9.81$ [1] for $r = (3.0 + 5.0\sin30°)$

$\omega = 1.01$ rad s^{-1}

Time for one revolution = $T = \frac{2\pi}{\omega} = 6.2$ s. [1

5.



Consider A,
Centripetal force = $T_A - T_B = m(2\ell)\omega^2$ ----(1) [1]

Consider B,
Centripetal force = $T_B = m(3\ell)\omega^2$ ----(2) [1]

Subst. (2) into (1), $T_A = 5\ m\ \ell\ \omega^2$ --- (3)

Taking $\frac{(2)}{(3)}$ gives $\frac{3}{5}$ or 0.6. (answer should be stated in decimal) [1]