**HWS3 Vertical UCM & Satellites (some to be done in class…) Score /**

 1) Calculate the **mass** of the Sun given that the earth’s orbital radius is 1.5 x 1011 m [2]

35 m

15 m

1. i) Calculate the size of the **centripetal force** acting on the 550 kg coaster at the highest point on the loop.

ii) Calculate the size of the **contact force** (FR) between the track and the coaster at the highest point on the loop. [2]

3) Does a bathroom scale measure your mass or your weight? Explain your answer [1]

 4) Kelly (50 kg) sits on bathroom scale on a swing. The swing swings through an arc and rises 1.0 m vertically. What is the reading on the scale at the lowest point? The swing is 5.0 m long [2]

5) Explain which orbits are possible for a **satellite**, and which orbits are possible for a **geostationary** **satellite**. [2]

N

S

A

B

C

1. Given that the orbital radius of Pluto’s orbit is 5.91 x 1012m, show mathematically that Pluto has a longer year than earth. [1]
2. If the earth spun too fast, we would fly off at a tangent! If this happened, how long would a day be? [2]

**Scholarship Level Solutions**

1) Calculate the **mass** of the Sun given that the earth’s orbital radius is 1.5 x 1011 m



2) Use energy conservation to calculate the speed at highest point. *V = 20 ms-1*

*Fc= 29 000 N*

*Fc = Fg + FR*

*FR = 24 000 N*

*3) Scale gives reading in “kg”, which is mass. Scale measures the weight force downward onto the pressure pad. Scale has been calibrated with the acceleration due to gravity (9.81ms-2) so that the scale gives reading of mass in kg’s.*

4) 

  *So the scale reads 70 kg at the bottom.*

*5) Possible satellites:*

*B and C.*

*NOT A because centre of orbit MUST be centre of Earth. Gravity force provides centripetal force and must be in* ***same*** *direction*

*Possible Geostationary Satellite: B*

*Must be above equator to keep above same spot of Earth’s surface as Earth rotates every 24hrs.*

*6)  and  gives:  which gives:*

*= 7,835,588,758 seconds*

*7,835,588,758 seconds ÷ 60 ÷ 60 ÷ 24 ÷ 365.25 ≈ 248.3 Earth years*

7) *For us to fly off at a tangent to the Earth, the Earth must spin fast enough so that the centripetal acceleration (*

*)would be greater than the acceleration due to gravity (9.81ms-2).*

*8) The minimum velocity (where aC=9.81) is:*

*=7905.0 ms-1*

*Which gives:  = 5063.0 econds*

*Which gives a “day” of: 5063.08…seconds ÷ 60 = 84 minutes and 23 seconds*

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