**NAME: ……..…….……..……**

**SCHOOL:……**

**DATE: .....**

# CIRCULAR MOTION

## INSTRUCTIONS TO CANDIDATES

*Answer **ALL** questions in this paper in the spaces provided.*

**1.** A stone on a string is whirled in a vertical circle of radius 80 cm at a constant angular speed of 16 radians per second.

Calculate the speed of the stone along its circular path.

……

……

……

……

……

……

Speed = .....

**(2)**

Calculate its centripetal acceleration when the string is horizontal.

.....

.....

.....

Acceleration = .....

**(2)**

Calculate the resultant acceleration of the stone at the same point.

.....

.....

.....

Resultant acceleration = .....

**(3)**

Explain why the string is most likely to break when the stone is nearest the ground.

.....

.....

.....

.....

.....

.....

**(2)**
**(Total 9 marks)**

**2.** State the period of the Earth about the Sun.

.....

.....

.....

Use this value to calculate the angular speed of the earth about the Sun in rad $s^{-1}$.

.....

.....

.....

Angular speed = .....

**(2)**

The mass of the Earth is $5.98 \times 10^{24}$ kg and its average distance from the Sun is $1.50 \times 10^{11}$ m. Calculate the centripetal force acting on the Earth.

.....

.....

.....

**(2)**

What provides this centripetal force?

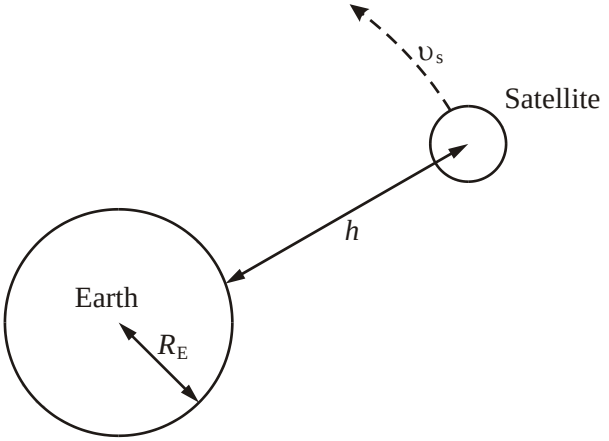
.....

.....

.....

**(1)**
**(Total 5 marks)**

**3.** The diagram (not to scale) shows a satellite of mass $m_s$ in circular orbit at speed $v_s$ around the Earth, mass $M_E$. The satellite is at a height $h$ above the Earth's surface and the radius of the Earth is $R_E$.




Using the symbols above write down an expression for the centripetal force needed to maintain the satellite in this orbit.

.....

.....

.....

**(2)**

Write down an expression for the gravitational field strength in the region of the satellite.

.....

.....

.....

State an appropriate unit for this quantity.

.....

**(3)**

Use your two expressions to show that the greater the height of the satellite above the Earth, the smaller will be its orbital speed.

.....

.....

.....

.....

.....

.....

**(3)**

Explain why, if a satellite slows down in its orbit, it nevertheless gradually spirals in towards the Earth's surface.

.....

.....

.....

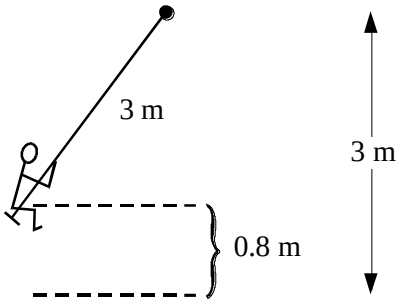
.....

.....

.....

**(2)**
**(Total 10 marks)**

**4.** A child of mass 21 kg sits on a swing of length 3.0 m and swings through a vertical height of 0.80 m.




Calculate the speed of the child at a moment when the child is moving through the lowest position.

.....

.....

.....

**(2)**

Calculate the force exerted on the child by the seat of the swing at a moment when the child is moving through the lowest position.

.....

.....

.....

Force = .....

**(3)**

Explain why, as the amplitude of the motion increases, children may lose touch with the seat of the swing.

.....

.....

.....

**(2)**
**(Total 7 marks)**

**5.** A satellite S orbits the Earth once every 87 minutes.

Show that its angular speed is approximately $1 \times 10^{-3}$ radians per second.

.....

.....

.....

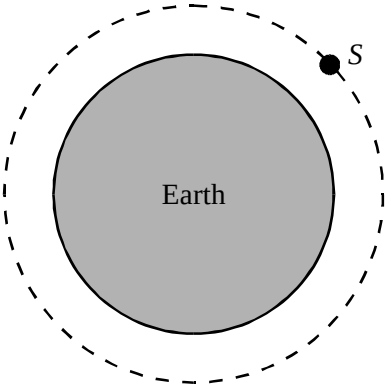
.....

.....

.....

**(2)**

In the space on the right draw a free-body force diagram for the satellite in the position shown.




**(1)**

With reference to your free-body force diagram, explain why the satellite is accelerating.

.....

.....

.....

**(1)**

The radius of the satellite's orbit is 6500 km. Calculate the magnitude of its acceleration.

.....

.....

.....

.....

.....

.....

Acceleration = .....

**(2)**

**(Total 6 marks)**