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| ccc-logo | **12 ATAR Physics**  **Gravity & Satellites**  **Test 2016**   |  |  | | --- | --- | | Student name: |  | |

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| **1.** An asteroid of mass 2.55 x 1022 kg and diameter of 772 km orbits the sun with a speed of 17.9 kms−1. |  |

a. Calculate the gravitational field strength at any point on the surface of the asteroid? **[4 marks]**

b. Calculate the orbital radius of the asteroid. **[3 marks]**

c. With what force does the asteroid attract the sun? **[4 marks]**

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| **2.** The solar system consists of a number of planets in approximately circular orbits around the sun. The quotient, r3 /T2, for each planet has the same value. |  |

a. Show, by using algebraic manipulation of the equations learned in class, that the relationship r3 /T2, is a constant value. **[4 marks]**

b. What is the numerical value of this constant, (r3/T2)? **[3 marks]**

c. Mercury takes 88 days to orbit the sun, while Venus takes 225 days. Calculate the maximum distance that could ever exist between Mercury and Venus. (If you did not calculate a value in Part (b), use a value of 4x1018) **[5 marks]**

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| 3. Just after lift-off a space shuttle rocket is accelerating vertically upwards. An astronaut inside states that she feels heavier. |  |

a. Explain, in terms of the forces acting on her, why she feels heavier. **[3 marks]**

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b. As the shuttle continues to accelerate vertically upwards, **at the same rate**, she notices she feels her weight decreasing. Explain why. **[3 marks]**

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c. The space shuttle launches from Cape Canaveral, Florida, USA. This is the location on mainland USA, closest to the equator. Explain how this might assist with the launch. **[3 marks]**

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**4.** Callisto is the largest moon orbiting Jupiter. Callisto takes 16 days to complete each orbit, at a distance of 1.88 x 109 metres from the centre of Jupiter. Use this data to calculate the mass of Jupiter. **[4 marks]**

**5.** The planet Mercury has a radius of 1.30 x 106 m, a mass of 3.30 x 1023 kg and its day is 58.65 earth days. A 25 kg satellite is positioned into a geostationary orbit. How high above the surface of Mercury is the satellite orbiting? **[6 marks]**

**6.** The table shown below gives astronomical data for a planet currently orbiting the sun.

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| jupiter | **Mass**: 1.90 X 1027 kg (317.9 Earths) **Radius (equatorial)**: 71 492 km **Mean density**: 1.33 g cm3 **Distance from Sun**: 778 330 000 km **Rotational period**: 0.4135 days **Orbital Period**: 4332.71 days **Escape velocity**: 59.56 kms-1 **Apparent magnitude**: -2.70 **Surface temperature**: -121°C (cloud) **Atmospheric composition**: hydrogen (90%), helium (10%) |

a. What is the least massive planet in the solar system? **[1 mark]**

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b. Calculate the escape velocity of the planet Jupiter. **[x marks]**