Motion and Force in a Gravitational Field

Revision Problems 4: Universal Gravitation

Due: _____

Name: _____

1. What are mass and weight and how are they different? (3 marks)

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2. It is possible that man could be walking on the moon in as little as 20 years. If an astronaut has a mass of 165 kg on Earth just before it steps into the rocket ship, what would be his weight on Mars were the acceleration due to gravity is 38% of that of Earth? (2 marks)

3. Pluto, which is now a dwarf planet, has a mass of 1.27×10^{22} kg and a radius of 2320 km. Our moon has a radius of 3467 and a mass of 7.35×10^{22} kg. Which would have the higher acceleration due to gravity and by how much? (3 marks)

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4. One of Jupiter's moons, Io, has a radius of 4.10×10^5 kg. Io has a circular orbit and it takes 42.1 hours to orbit Jupiter.
   a. What is Io's orbital speed? (2 marks)

   b. What is the mass of the planet Jupiter? (3 marks)

5. Astronauts in orbit are considered to be "weightless".
   a. Why do you think the word "weightless" is in inverted commas? (2 marks)

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   b. Draw a free body diagram of an astronaut in a stable orbit above the Earth. (2 marks)

   c. The astronaut is in a rocket which is in a stable orbit around the Earth. Which of the following statements is always true?
      i. the period of the rocket must equal the period of the Earth's rotation.
      ii. the Earth's gravitational force does not affect the rocket.
      iii. the centripetal force acting on the rocket will be the gravitational force.
      iv. the net force on the rocket is zero

      answer: _____
      (2 marks)

      One of the above statements is sometimes correct. Which one and in what circumstance?

      _____

      _____

      _____ (1 mark)

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