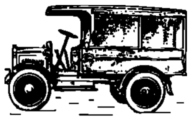
Year 12 Physics NAME___________________

Practice Test – Circular Motion and Gravitation

1. Using vector subtraction, show that the change in the velocity $\Delta\vec{v}$ of an object in circular motion is directed towards the centre of the circle. /2

2. The car below is moving on a flat road at constant speed to the left.



   (a) Draw and label the two horizontal and two vertical forces acting on the car. /2

   (b) If the car were to turn a corner of radius 112 m at a speed of 13 ms^{-1}, calculate the magnitude of the car's acceleration. /2

   (c) Identify the force causing the centripetal acceleration if the road is flat. /1

   (d) Derive the equation $\tan\theta = \frac{v^2}{rg}$, relating the banking angle θ to the speed v of the vehicle and the radius of curvature r. /4

3. Consider a satellite orbiting the Earth in uniform circular motion.

   (a) Identify the force causing the centripetal acceleration of the satellite. /1

   (b) Show that the radius of a satellite orbiting the Earth can be given by the equation $r = \sqrt[3]{\frac{GMT^2}{4\pi^2}}$, where M is the mass of the Earth, T is the period of the satellite, and r is the radius of the orbit. /2

   (c) Consider two satellites orbiting Earth. Satellite One is an equatorial-orbit satellite that orbits Earth 8 times a day. Satellite Two is a geostationary satellite.

   Using proportionality, determine the ratio $r_1 : r_2$ of their radii of orbit. /3

4.

   (a) Explain why the centres of the circular orbits of Earth satellites must coincide with the centre of the Earth. /2

   (b) Explain why low-altitude polar orbits are used in meteorology and in surveillance. /2

TOTAL /21