

PHYS178 – Assignment 6 Rough Model Answers

Due: Monday 13 October 2008

This assignment contributes 2% to your final grade. Please write brief answers directly on the sheet in the spaces provided (and on the back if necessary). The assignment should be turned into the PHYS 178 assignment box on level 2 of E7B, just outside the doorway to E7A.

1. What is meteor shower and why do they seem to originate from a point?

Earth's orbit sweeps it through bands of debris and dust from comets and asteroids. Since they all enter the atmosphere around same time there are many meteors seen hence a 'shower'. They seem to originate from a point in the same was a railway track seems to originate from a point due to perspective.

2. Why have asteroids accumulated in two clusters 60° before and after Jupiter in its orbit (i.e. the Trojan asteroids)?

There are two stable points there called the Lagrange points L4 and L5. Here the gravitational attraction of Jupiter and the Sun balance with the 'fictional' (because of the rotation) centrifugal and coriolis forces.

3. Why do we often see two tails on a comet – what causes these tails?

Material is evaporating off the comet as it heats up. One tail is due to dust particles that are swept behind the comet and also away from the sun due to radiation pressure, and the other due to lighter ionized gas which points directly away from the sun due to interaction with the solar wind.

4. Calculate the kinetic energy in an asteroid 200m in diameter made of iron (8000 Kg/m³) travelling at a typical 20km/s in megatons of TNT (1 Mt TNT = 4.2 x 10¹⁵ J) [hint: see slides]

Volume of sphere
$$\frac{4}{3}\pi r^3 = \frac{\pi}{6} d^3$$

$$E_k = \frac{1}{2}mv^2$$

$$E_k = \frac{\pi}{12} v^2 (\text{density}) d^3 = 1600 \text{ Mt TNT}$$

$$1 \text{ Mt TNT} \equiv 4.2 \times 10^{15} \text{ J}$$

5. Why is it important to find and track Near Earth Objects?

Basically, because they can hit us. The calculation in 4 gives an indication of the vast amount of energy released in a collision with even a small object, and there is plenty of evidence of past impacts and some resulting extinction events. With sufficient warning we might be able to divert some of these objects.