This print-out should have 7 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Distant Star and Planet

001 10.0 points

A distant star has a single planet circling it in a circular orbit of radius 7.94×10^{11} m. The period of the planet's motion about the star is 875 days.

What is the mass of the star? The value of the universal gravitational constant is $6.67259 \times 10^{-11}\ \text{N} \cdot \text{m}^2/\text{kg}^2$.

Correct answer: 5.18183×10^{31} kg.

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002 10.0 points

An object is dropped from rest from a height 6.6×10^6 m above the surface of the earth.

If there is no air resistance, what is its speed when it strikes the earth? The acceleration of gravity is $9.81\ \text{m/s}^2$ and the radius of the Earth is 6.37×10^6 m.

Correct answer: 7.97483 km/s.

Apollo 11 in Orbit

003 (part 1 of 2) 10.0 points

When it orbited the Moon, the *Apollo 11* spacecraft's mass was 11800 kg, its period was 131 min, and its mean distance from the Moon's center was 1.97342×10^6 m. Assume its orbit was circular and the Moon to be a uniform sphere of mass 7.36×10^{22} kg.

Given the gravitational constant G is $6.67259 \times 10^{-11}\ \text{N}\,\text{m}^2/\text{kg}^2$, calculate the orbital speed of the spacecraft.

Correct answer: 1577.53 m/s.

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004 (part 2 of 2) 10.0 points

What is the minimum energy required for the craft to leave the orbit and escape the Moon's gravitational field?

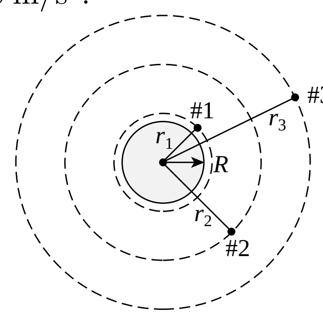
Correct answer: 1.46827×10^{10} J.

Satellites of Planet I

005 (part 1 of 3) 10.0 points

Assume: For this problem, which consists of 3 parts, we assume that we are on Planet-I. The satellites considered below are moving along circular orbits which are concentric to the center of Planet-I. The gravitational constant $G = 6.67259 \times 10^{-11}\ \text{N}\,\text{m}^2/\text{kg}^2$.

The radius of Planet-I is R =4370 km, the gravitational acceleration at the surface is $g_I = 5.68\ \text{m/s}^2$.



Satellite #1, $r_1 \approx R$
Satellite #2, $r_2 = nR$
Satellite #3, $r_3 = 10R$
(The sketch is not to scale)

Consider the first satellite which is moving very close to the surface of Planet-I (*i.e.*, $r_1 \approx R$), where the gravitational acceleration may be approximated by $g_I = 5.68\ \text{m/s}^2$.

Determine its period (which in the remainder of this problem will be referred to as T_0).

Correct answer: 1.53089 hr.

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006 (part 2 of 3) 10.0 points

Note: Even if you did not get the value of T_0 in part 1, you may still be able to work on this part.

Consider a second satellite whose orbit has a radius $r_2 = n\,R = 5.26\,R = 22986.2$ km and a period T.

Find the ratio $\dfrac{T}{T_0}$.

Correct answer: 12.0636.

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007 (part 3 of 3) 10.0 points

Note: You may work on this part even if you don't get previous results.

What is the kinetic energy of a third satellite which has a radius $r_3 = 10\,R = 43700$ km, assuming that the satellite has a mass of m =5860 kg?

Correct answer: 7.27273×10^9 J.