

AP Physics 1
Gravitation Practice Problems

Name	Average radius (m)	Mass (kg)	Mean Distance from the Sun (m)
Sun	6.96×10^8	1.99×10^{30}	-----
Earth	6.38×10^6	5.98×10^{24}	1.5×10^{11}
Mars	3.38×10^6	6.42×10^{23}	2.3×10^{11}
Jupiter	6.98×10^7	1.90×10^{27}	7.8×10^{11}
Pluto	1.15×10^6	1.5×10^{22}	5.9×10^{12}

- 1.) Compute the gravitational force the Sun exerts on Jupiter.
- 2.) Calculate the force of gravity on a spacecraft 12,800 km above the Earth's surface if its mass is 1400 kg.
- 3.) A hypothetical planet has a radius 2.5 times that of Earth, but has the same mass. What is the acceleration due to gravity near its surface?
- 4.) The radius of the Moon is 1740 km and its mass is 7.35×10^{22} kg. Calculate the acceleration of gravity on the surface of the Moon.
- 5.) Given that the acceleration of gravity at the surface of Mercury is 3.61 m/s^2 and that Mercury's radius is 2430 km, determine the mass of Mercury.
- 6.) Two masses m_1 and m_2 are separated by distance r . The force of gravitational attraction between the two masses is F_1 . Find the gravitational attraction F_2 in terms of F_1 if:
 - a.) m_1 is doubled .
 - b.) neither of the masses changed, but r is doubled.
 - c.) r is not changed, but both masses are doubled.
 - d.) r is halved and both masses are doubled.
- 7.) Apollo 11's orbit around the Moon was about 100 km above its surface. The radius of the Moon is 1740 km and the mass of the Moon is 7.35×10^{22} kg.
 - a.) How many minutes did it take to orbit once?
 - b.) At what velocity did it orbit the Moon?
- 8.) Calculate the value of g , the acceleration of gravity at a distance of 3200 km above the Earth's surface.
- 9.) If you weigh 637 N on Earth's surface, how much would you weigh on the planet Mars?
- 10.) How many Earth days does it take Mars to complete one orbit around the Sun?
- 11.) What is the gravitational potential energy between the Sun and Jupiter?
- 12.) How much energy is required to move a 1000 kg mass from Pluto's surface to an altitude twice Pluto's radius?
- 13.) An artillery shell with mass m is fired vertically upward from the surface of the Earth. If the shell's initial speed is $6.00 \times 10^3 \text{ m/s}$, to what height above the surface of the Earth will it rise? (Neglect the effect of the drag force exerted by air, so that the only force acting on the shell is assumed to be gravity.)
- 14.) Rat fires an artillery shell with mass m vertically upward from the surface of the Pluto. If the shell's initial speed is 800 m/s, what is the shell's speed when it is 500 km above the surface of Pluto? (Neglect the effect of the drag force exerted by air, so that the only force acting on the shell is assumed to be gravity.)