1. Find the gravitational force on a 1 kg object that is 50 cm from a 1000 kg object.
2. How strong is the gravitational force exerted by a 2 kg body on a 10 kg body that is 2 meters away?
3. From above, if the separation between two objects is quadrupled, then how strong is the gravitational force?

Honors only

4. An object weighs 400 N on the surface of the Earth. If the diameter of the Earth shrank to 1/3 its original size, then what will the weight of the object on the shrunken Earth?
5. Two spaceships, each with a mass of 4×10^5 kg, are separated by a distance of 3×10^3 m. How strong is the gravitational force? What is the acceleration of one of the ships? What will happen to the acceleration as the get nearer?

Honors only

6. A tenth planet was recently discovered orbiting sun, beyond Pluto, with a period of 350 years. What do you predict the average distance from the sun to be?
7. Two pencils are 10 cm apart from each other. Each pencil has a mass of 30 gm. Find the gravitational force of one pencil on the other. Find the acceleration of the pencil.
8. How long will it take the pencil to travel from rest through a distance of 5 cm? Assume the acceleration would not change.

Honors only

9. Find the speed necessary for a satellite, mass m_s, circular orbit around a planet, mass m_p. Hint: use the fact that since the orbit is circular, there must be a centripetal force acting on it.

Honors only

10. Find how fast a satellite must be moving in a stable circular orbit around the Earth at a distance of 13600 km from the surface of the Earth.
11. Find the linear velocity of an object that has a radius of 6.4×10^3 km and period of 24 hours.

Honors only

12. What speed is necessary to escape Earth's orbit?
13. Find the gravitational force from 200 km ABOVE the Earth's surface on a jet that has a mass of 5×10^3 kg.
14. Sirius B is a white dwarf, in orbit around another star Sirius, has a mass of 2×10^{30} kg. It has a radius of 5×10^{31} kg. What is the gravitational force of a 1 kg mass on Sirius B? What is the acceleration due to gravity on Sirius B?
15. An object with a mass of 5 kg is swung in a circle above the ground. Its radius is 2 m and it makes .6 revolutions every second. Neglecting its weight, find the centripetal force on the on the object.
16. The Earth makes one revolution every 365.25 days. Find the centripetal force that holds the Earth in orbit.
17. Find the gravitational force of the Sun on the Earth. Use the Earth's average distance from the Sun as their separation.

Honors only

18. A car, is moving in a circle, radius 30 m. The coefficient of friction of the surface is .4. How fast can the car go to stay in the circle?
19. A car, mass 1000 kg, is moving in a circle, radius 30 m. The coefficient of friction of the surface is .4. What is normal force on the car. What is the frictional force on the car? If the frictional force is equal to the centripetal force on the car, then how fast can the car go to stay in the circle?
20. A truck, mass 2500 kg, is moving in a circle, radius 30 m. The coefficient of friction of the surface is .4. What is normal force on the car. What is the frictional force on the car? If the frictional force is equal to the centripetal force on the car, then how fast can the car go to stay in the circle?

Honors only

21. A car that has a mass 1600 kg is traveling in a flat circle, radius 190 m. If the car travels at a constant speed of 20 m/sec, then what should μ be?

Honors only

22. You can not always depend on the friction to keep you on a curve; this is the reason why many roads are banked. Suppose a car of mass m moves at a constant speed of 20 m/sec around a banked curve, whose radius is 190 m. Find the angle at which the curve must be banked. Neglect friction.

Honors only 23. The coefficient of friction between a passenger an the wall of a rotating platform is .2 and the radius of the platform is 8 m. With what frequency must the platform be rotating in order for the passengers to not fall out when the bottom is pulled out?

24. In a 1901 circus performance, Allo Diavolo introduced a stunt of riding a bicycle in a loop the loop. Assuming the loop is circular and has a radius of 2.7 m, then what is the minimum speed necessary for him to remain in contact with the loop?

25. A spring is elongated to a displacement of 5 cm. If a force of .5 N was applied, then what is the spring constant?

26. A spring with spring constant 1.2 N/m is stretched to 12 cm, then what force is needed?

27. A spring is compressed a distance of 5 cm from its rest position. If a force of .5 N was applied, then what is the spring constant?

28. A spring is compressed a distance of 25 cm from its rest position. If a force of 2 N was applied, then what is the spring constant?

29. What must the separation be between a 5.2 kg particle and a 2.4 kg particle in order for their gravitational attraction be 2.3×10^{-12}?

30. Some believe that the positions of the planets at the time of birth influence the newborn. Others deride this belief and claim the gravitational force exerted by the obstetrician is greater than of the planets. To check this, find the gravitational force exerted on a 3 kg newborn by a 70 kg obstetrician that is 1 m away.

31. Now find the gravitational force exerted by Jupiter, mass 2×10^{27} kg, when it is 6×10^{11} m away. This is the closest Jupiter is ever to Earth.

32. Now find the gravitational force exerted by Jupiter, mass 2×10^{27} kg, when it is 9×10^{11} m away. This is the farthest Jupiter is ever to Earth.

Honors only 33. The Sun and Earth exert a gravitational force on the moon. What is the ratio of these forces? The average Sun/moon distance is the equal to the Sun/Earth distance.

Honors only 34. A spaceship is on a straight line path between Earth and the moon. At what distance is the net gravitational force zero?

Honors only 35. Four spheres, with masses $m_1 = 400$ kg, $m_2 = 350kg$, and $m_3 = 500$ are arranged in a square. The distance between any two of the masses is 2 cm. If a 250 kg mass is placed in the center, then what is the net gravitational force on the 250 kg mass?

36. At what altitude above the Earth's surface would the gravitational acceleration be 4.9 m/sec^2?

Honors only 37. Determine the constant in Kepler's thrid law.

Honors only 38. Use your answer above, determine the approximate mass of the Earth from the following data: A satellite is in a circular orbit at a height of 230 km above the surface of the Earth. Its period 89 min.

Honors only 39. Observations of the light from a certain star indicate it is a part of a binary star system. The visble star has an orbital speed of 270 km/sec, orbital period 1.70 days, and an approximate mass of $6M_s$, where M_s is the mass of the sun. Determine the approximate mass of the second star.[1]

Honors only 40. Suppose a tunnel runs through the Earth from pole to pole. Assuming the Earth is not rotating and a uniform sphere, find the graviational force on a particle that has a mass m dropped into the tunnel when it reaches a distance r from the center.

41. A neutron star is a star that has collapsed after a spernova. Calculate the the graviational force on a 70 kg person standing on the surface of a neutron star. A typical neutron star has a mass of 2×10^{30} kg and a radius of 1×10^4 m.

[1] In order to do this problem, you must know that a two star system orbits around their center of mass - a central point if you will. Assume one star makes a cirular orbit around this central point, and the other star has diffeent, but still circular, orbit around this central point.