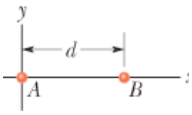
Chapter 13 – Problem Day

5. In the figure, two point particles are fixed on an *x*-axis separated by distance *d*. Particle *A* has mass m_A and particle *B* has mass $3m_A$. A third particle *C*, of mass $75m_A$, is to be placed on the *x*-axis and near particles *A* and *B*. In terms of distance *d*, at what *x* coordinate should *C* be placed so that the net gravitational force on particle *A* from particles *B* and *C* is zero?



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

36. A projectile is shot directly away from Earth's surface. What multiple of Earth's radius R_E gives the radial distance a projectile reaches if (a) its initial speed is 0.500 of the escape speed from Earth and (b) its initial kinetic energy is 0.500 of the kinetic energy required to escape Earth? (c) What is the least initial mechanical energy required at launch if the projectile is to escape Earth?

37. (a) What is the escape speed on a spherical asteroid whose radius is 500 km and whose gravitational acceleration at the surface is 3.0 m/s^2? (b) How far from the surface will a particle go if it leaves the asteroid's surface with a radial speed of 1000 m/s? (c) With what speed will an object hit the asteroid if it is dropped from 1000 km above the surface?

40. In deep space, sphere *A* of mass 20 kg is located at the origin of an *x* axis and sphere *B* of mass 10 kg is located on the axis at *x* = 0.8 m. Sphere *B* is released from rest while sphere *A* is held at the origin. (a) What is the gravitational potential energy of the two-sphere system just as *B* is released? (b) What is the kinetic energy of *B* when it has moved 0.20 m toward *A*?

49. (a) What linear speed must an Earth satellite have to be in a circular orbit at an altitude of 160 km above Earth's surface? (b) What is the period of revolution?

57. A 20 kg satellite has a circular orbit with a period of 2.4 h and a radius of 8.0×10^6 m around a planet of unknown mass. If the magnitude of the gravitational acceleration on the surface of the planet is 8.0 m/s^2, is the radius of the planet?

87. The orbit of Earth around the Sun is *almost* circular: The closest and farthest distances are 1.47×10^5 km and 1.52×10^5 km respectively. Determine the corresponding variations in (a) total energy, (b) gravitational potential energy, (c) kinetic energy, and (d) orbital speed. *(Hint:* Use conservation of energy and conservation of angular momentum.)

Chapter 13 Answers

5) $-5d$

17) 2.64×10^{6} m

36a) 1.33
36b) 2.00
36c) zero

37a) 1732 m/s
37b) 2.5×10^{5} m
37c) 1500 m/s

40a) -1.67×10^{-8} J
40b) 5.6×10^{-9} J

49a) 7820 m/s
49b) 87.5 min

57) 5.82×10^{6} m

87b) 1.8×10^{32} J
87c) 1.8×10^{32} J
87d) 0.99 km/s