Part C1 Problems

1. A 40-N force acts on an 80-kg object, initially moving at 20 m/s. How far will the object travel in the next five seconds?

2. Two perpendicular forces act on a 20-kg object initially at rest. One force is 50 N; the other is 80 N. How far (in meters) will the object move in five seconds?

3. A 4-kg falling object experiences a steady air-resistance force of 9.2 N. What is the object's acceleration?

4. What would have to be the mass of each of two identical objects, separated by 500 meters, in order that they each exert a 100 N gravitational force on the other?

5. What would have to be the separation of two objects of equal mass, m = 300 N, in order that the mutual gravitational force each experiences due to the other be one micro-newton (1.0×10^{-6} N)?

6. The gravitation force each of two asteroids in deep space exerts on the other is 400 N. What will be the new force of attraction when each object's mass has doubled, while the separation between them has halved?

7. If the Earth's radius were half of what it actually is, while its mass remains the same, what would be the acceleration due to gravity near the surface?

8. Four identical masses, each of mass M, are at the corners of square of side length L. A fifth object of equal mass is at the center of the square. What is the total force exerted on the center object by the masses at the four vertices?

Solutions

1. $a = 40/80$
$= 0.5\ m/s^2$
$x = 20(5) + ½(0.5)5^2$
$= 106.5\ m$

2. $F = (50^2+80^2)^{1/2}$
$= 94.34\ N$
$a = 94.34/20$
$= 4.72\ m/s^2$

$x = 0 + ½\ (4.72)5^2$
$= 58.96\ m$

3. $F = 9.2 - 4(9.8)$
$= -30.0\ N$
$a = -30.0/4$
$= -7.5\ m/s^2$

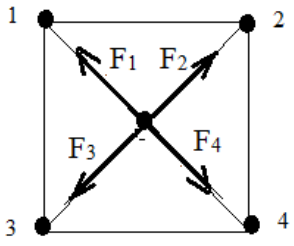
4. $Gm^2/r^2 = F$
$m = (r^2F/G)^{1/2}$
$= (500^2 \times 100/6.67^{-11})^{1/2}$
$= 6.12 \times 10^8\ kg$

5.
$F = Gm_1m_2\ /r^2$
$1 \times 10^{-6} = (6.67 \times 10^{-11})300^2/r^2$
$r = 2.45\ m$

6. Previous $F = GMm/r^2$
$= 400\ N$
New $M = 2M$
New $m = 2m$
New $F = G\ (2M)(2m)/(½\ r)^2$
$= (2)(2)/(1/2)^2\ GMm/r^2$
$= (2)\ (2)/(1/4)\ GMm/r^2$
$= 16\ GMm/r^2$
$= 16\ (400\ N)$
$= 6400\ N$

7. $ma_1 = GMm/r_1^2$
$a_1 = GM/r_1^2$
$= 9.8\ m/s^2$
$r_2 = ½\ r_1$
$a_2 = GM/(½\ r_1)^2$
$= 4\ (GM/r_1^2)$
$= 4\ a_1$
$= 4\ (9.8)$
$= 39.2\ m/s^2$

8. (a)



Pulls by 1 and 4 cancel.
Pulls by 2 and 3 cancel.
Net force = 0