Answer Key

7. A 1500 kg pick-up truck is acted upon by an external force which reduces it's velocity from 8.6 m/s to 4.3 m/s in 6.7 s. What is the value of this retarding force? 793 N

8. A 15500 kg bus is traveling at 85 km/h (*23.6 m/s*). It is brought to a stop in 145 m. What force do the brakes on the bus provide in stopping the bus? 29800 N

9. A 4.5 kg cannon shell is shot out of a 2.3 m long cannon. The exploding gun powder generates a force of 6.66×10^6 N on the cannon shell. How fast does the cannon shell leave the gun barrel? 2610 m/s

10. A 52 kg bag of cement is dragged across a cement floor. The coefficient of friction between the bag of cement and the floor is 0.42.
    a. Sherry exerts a horizontal force of 165 N. Will the bag move? Explain. No, Friction is greater
    b. Tom exerts a horizontal force of 275 N. Will the bag now move? If so determine the acceleration of the bag of cement. Yes, $a = 1.17 m/s^2$
    c. Tom exerts his force for 5.0 s. How far did he move the bag of cement? 14.7 m

6. A 45 kg girl and 65 kg girl feel some attraction towards each other when sitting on a park bench. If they feel 1.3×10^{-7} N of attractive force (you know how sensitive some teens can be), how far apart are they? 1.5 m

12. A box of mass 30.0 kg is placed on the floor of an elevator. Answer each of the following questions:
    a. What force does the floor place on the box (F_N) when the elevator is still? 294 N
    b. What force does the floor place on the box (F_N) when the elevator is moving at a constant speed? Does it matter whether the elevator is moving up or down? 294 N, Nope
    c. What force does the floor place on the box (F_N) when the elevator is accelerating upwards at 2.0 m/s^2? 354 N
    d. What force does the floor place on the box (F_N) when the elevator is accelerating downwards at 3.0 m/s^2? 204 N
    e. What force does the floor place on the box (F_N) when the elevator support cable breaks causing the elevator to free-fall (accelerate at "g") down the elevator shaft? 0 N

13. A 16000 kg rocket carrying a satellite produces 185000 N of thrust.
    a. What is the initial acceleration of this rocket? 11.6 m/s^2
    b. Just before flame-out (where all the fuel is spent) the rocket only weighs 950 kg. What is the acceleration of the rocket just before flame-out? 195 m/s^2
    c. Why do you have such a large change in acceleration for this rocket? While the thrust is the same, the mass of rocket decreases as Feul is being used.

Two Difficult Friction Problems

A 100 kg object is on grass. You are pulling it with a horizontal force of 833 N, and the object is sliding at 1.5 m/s. Suppose, through divine intervention perhaps, that the constant of acceleration near the Earth changed suddenly to half its current value (i.e. to 4.9 m/s/s). What force would you need to be applying to keep the object moving at 1.5 m/s? What force would be required to keep the object moving at a new constant speed of 4.5 m/s?

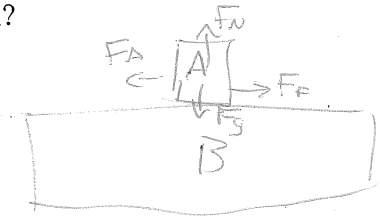
a) Before Change.
Object is sliding at a constant velocity.
$\therefore F_{net} = 0$ $\therefore F_A = F_F$.
When gravity changes, it is halved, so F_N is halved which halves F_F.
To keep it going at a constant velocity F_A must match F_F.

$F_A = 416.5\,N$

b) Says constant speed, so after a bit of force to accelerate it to 4.5 m/s, it will take 416.5 N to maintain that velocity.

Object A (weight = 50 N) slides on top of the much larger object B (weight 10,000 N). The coefficient of sliding friction between the two objects is 0.25. The objects are transported to a distant planet which has a diameter of 8000 km and a mass of 8×10^{25} kg. How much force would it take to slide A along B at constant velocity on this new planet? How much force would it take on the new planet to accelerate object A along B from 1 m/s/s to 10 m/s/s in a 5 second interval?

$r = 4000\,km$ or $r = 4 \times 10^6\,m$



$F_g = \frac{G M_1 m_2}{r^2}$

$ma = \frac{G M_1 m_2}{r^2}$

$a = \frac{G M_1}{r^2}$

mass of a

$F_g = 50\,N = mg$

$50 = m(9.8)$

$m = 5.102\,kg$

$a = \frac{6.67 \times 10^{-11}(8 \times 10^{25})}{(4 \times 10^6)^2}$

$a = 333.5\,m/s^2$

$F_g = m \cdot a$

$F_g = (5.102\,kg)(333.5\,m/s^2)$

$F_g = 1700\,N = F_N$

$F_F = \mu F_N = (0.25)(1700) = 425\,N$

$V_i = 1$
$V_f = 10$
$a = ?$
$t = 5$

$a = \frac{V_f - V_i}{t}$

$a = \frac{10-1}{5}$

$a = 1.8\,m/s^2$

$ma = F_A - F_F$

$(5.102)(1.8) = F_A - 425$

$F_A = 434\,N$