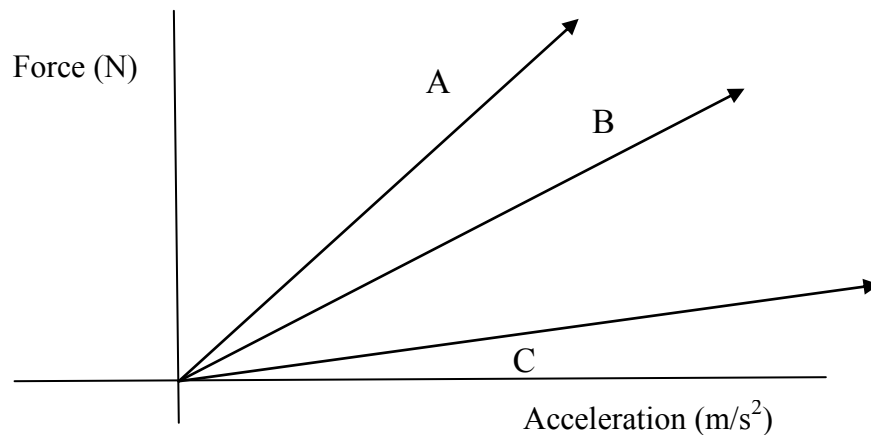## Additional Problems for Mass, Force and Gravity (answers below)

1. If you go on a diet and lose weight, will you also lose mass? Explain.
2. John weighed 980 N on Earth where gravity = 9.8 m/s^2. Before leaving for the moon, his wife cooked lots of pasta for him. When he reached the moon he weighed 167 N. How much mass did he gain from the pasta? Gravitational acceleration on the moon is 1.6 m/s^2.
3. What force is required to accelerate a 3.0 kg mass by 2.0 $/s^2$?
4. Which of the following graphs corresponds to the greatest mass? Explain.

5. A loose leaf and a lead weight are dropped from the same height in a vacuum. Which, if any, hits the floor first?

6. The different masses and radii of different planets account for different gravitational accelerations.

$$F = m_o g_p = \frac{G m_o m_p}{r^2}$$

where m_o = mass of the object on surface of planet
g_p = gravitational acceleration on planet
G = gravitational constant
m_p = mass of planet
r_p = radius of planet

a) Simplify the formula to get another formula for g. What term cancels?
b) Let $g_n = \frac{G m_n}{r_n^2}$ = gravitational acceleration on planet Neptune. Write a similar expression for Earth's gravity in terms of its radius r_e and mass m_e.
c) Divide g_n by g_e to get a formula for how much stronger gravitational acceleration is on planet Neptune. What term cancels?

Answers

1. Yes. Since weight = mg, and g does not change, then m decreases in this case when weight decreases.
2. John's mass after gaining weight from pasta:
   167 N = mg
   167 = m(1.6)
   m = 167/1.6 = 104.3 kg

   Before pasta
   980 N = mg
   980 = m(9.8)
   m = 100 kg

   mass gain = 104.3 – 100 = 4.3 kg

3. F = ma = 3(2) = 6N
4. A----it has the biggest slope. Recall: F = ma is like y = Ax, where A = slope
5. Both hit the floor at the same time in the absence of air resistance. Gravitational acceleration is equal regardless of mass.

6. a) $g_p = \dfrac{Gm_p}{r^2}$ m_o cancels

   b) $g_e = \dfrac{Gm_e}{r_e^2} =$

   c) $\dfrac{g_n}{g_e} = \dfrac{\frac{Gm_n}{r_n^2}}{\frac{Gm_e}{r_e^2}} = \dfrac{m_n}{r_n^2} \div \dfrac{m_e}{r_e^2} = \dfrac{m_n}{r_n^2} \times \dfrac{r_e^2}{m_e} = \dfrac{m_n r_e^2}{m_e r_n^2}$