Force and Acceleration Practice

1 Answer these questions, completing sentences where needed.

(a) When the forces on an object are balanced, we say that there is zero _____.

(b) What happens to a stationary object with balanced forces?

(c) What happens if balanced forces act on an object which is already moving?

(d) Why would a 3 N force affect a pencil's motion more than a suitcase's motion?

2 The diagram above shows a 10 kg school bag and a 4 kg PE bag.

(a) Calculate the resultant force on each bag.

(b) Calculate the resultant force on each kilogram for each bag.

(c) Which bag will accelerate more rapidly?

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3 A 100 N force pulls a 20 kg cycle.

(a) Force on each kilogram = ☐ ÷ ☐ = ☐ newtons

(b) Complete the sentence: The acceleration (in m/s^2) is ☐.

(c) A 150 kg llama uses a 300 N force to speed up. Work out the acceleration using an equation.

force (N)	=	mass (kg)	×	acceleration (m/s^2)
300	=	150	×	

(d) Work out the acceleration when 36 N pulls 4 kg.

(e) Work out the acceleration when 3 N pulls 150 g. (1000 g = 1 kg)

4 Buses on the road must be able to slow down at 6 m/s^2 in an emergency.

(a) Complete: The force on each kilogram needs to be ☐ newtons.

(b) Work out the force needed on a 2000 kg minibus.

force (N)	=	mass (kg)	×	acceleration (m/s^2)
☐	=	2000	×	6

(c) Work out the force needed on a 10 000 kg single deck bus using an equation.

force (N)	=	mass (kg)	×	acceleration (m/s^2)
☐	=	10 000	×	6

(d) Work out the force needed for a 20 tonne coach. $(1 \text{ tonne} = 1000 \text{ kg})$

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5 A helmet in a space station accelerates at 2 m/s^2 when an astronaut pushes it.

(a) What is the force on each kilogram of the helmet?

(b) The astronaut pushed the helmet with a 10 N force. How many 2 N forces is this?

(c) What is the mass of the helmet? Count the 2 N forces (each on 1 kg).

(d) Work out the mass if 35 N causes a 5 m/s^2 acceleration using an equation.

force (N)	=	mass (kg)	×	acceleration (m/s^2)
35	=	☐	×	5

(e) Work out the mass if 200 N causes a 0.4 m/s^2 acceleration.

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6 Complete the word equations.

(a) acceleration $=$ (b) resultant force $=$

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7 Complete these equations using symbols.

F is the resultant force, m is the mass and a is the acceleration.

(a) $F =$ (b) $a =$ (c) $m =$

8 Use your understanding of force and acceleration (including the equations) to calculate

(a) the resultant force needed to give a 60 kg cheetah a 5 m/s^2 acceleration.

(b) the acceleration when a 20 kg cycle with a 70 kg rider is pedalled with a 450 N resultant force.

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9 A 2.4 kg monitor is pulled with a 9 N force across a desk where there is 3 N of friction.

(a) Calculate the resultant force on the monitor.

(b) Calculate the acceleration of the monitor.

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10 A 0.1 kg apple and a 2 kg bag of flour fell from a high shelf at the same time. In this question, we work out which will hit the floor first. Remember: weight $=$ mass $\times 10$ N/kg.

(a) Calculate the weight of the apple and also the weight of the bag of flour.

(b) Calculate the acceleration of the apple, assuming that there is very little drag.

(c) Calculate the acceleration of the bag of flour, assuming that there is very little drag.

(d) Which hits the floor first? Or is it a draw?

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11 Students do an experiment with two identical 0.1 kg lunchboxes. One is empty, the other is filled with 1.5 kg of sand. They drop both from the top of a stairwell after checking that there is no-one underneath. Because the boxes are the same size, they have the same drag force as each other at the same speed. Here we assume that both lunch boxes face a constant 0.2 N drag force as they fall.

(a) Calculate the weight of each box (including its contents).

(b) Calculate the resultant force on each box as it falls.

(c) Calculate the acceleration of each box as it falls.

(d) Which box will hit the ground first, or is it a draw? Explain why.