Activity description

This activity introduces Newton's Laws of Motion and shows how they can be applied in modelling real situations.

Suitability

Level 3 (Advanced)

Time

1–2 hours

Resources

Student information sheet, worksheet,
Optional: slideshow

Equipment

Calculators

Key mathematical language

Model, force, mass, weight, gravity, acceleration, velocity, equilibrium, static equilibrium, dynamic equilibrium, tension, friction, normal reaction, magnitude, resultant

Notes on the activity

The Information sheet introduces Newton's Laws. Students are asked to think about how these apply in a range of real contexts.

The questions give practice in using Newton's Laws to solve a range of problems. These questions require students to identify the forces acting on a given object, and to apply Newton's Laws.

Students will need to draw force diagrams and write down the equation of motion of an object.

During the activity

Students can work through the information sheet in pairs or small groups.

Questions 11 and 12 are longer problems and could be regarded as extension problems. Alternatively, one or both of these could be used in discussion to review the ideas in the information sheet and the earlier questions.

Points for discussion

If an object is moving, how can you tell if it is in equilibrium? Which of Newton's Laws are you using?

How is your weight related to your acceleration due to gravity? Which of Newton's Laws are you using?

Think about a similar situation to one featured in the set of problems. What forces are acting and how can Newton's Laws be applied to this situation?

Extensions

Questions 11 and 12 can be regarded as extension questions.

If students have already completed these questions they could think about the scenario in problem 12, and explain when the weight of the suitcase appears to be the greatest and the least.

Answers on the next sheet

Acknowledgement

Based on Nuffield Advanced Mathematics *Mechanics 1*. Longman 1994. ISBN 0-582-09979-X.

Answers

All forces shown on diagrams are in newtons.

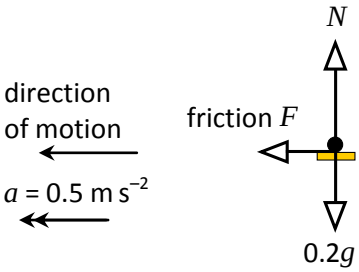
1 2 m s^{-2} **2** 20 N **3** 2000 N

4a 9.8 m s^{-2} downwards **4b** 0.539 N downwards

5 300 000 N **6** 1.4 m s^{-2}

7a 16 m s^{-2} **7b** 6.2 m s^{-2} upwards

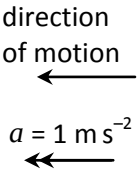
8a

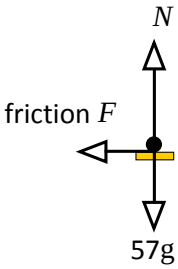


8b 0.1 N

9a

9b i

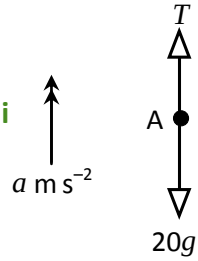




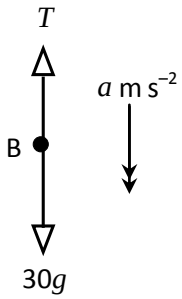
9b ii 57 N from friction (in direction of motion)

10a 4 m s^{-2} in the direction of the forces **b** 1 m s^{-2} in the direction of the largest force

11a i



a ii



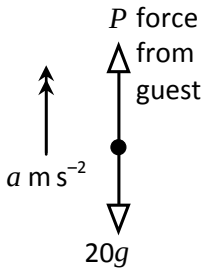
11b $T - 20g = 20a$

$30g - T = 30a$

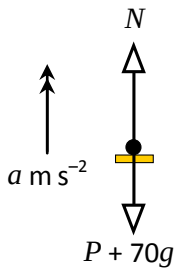
11c $a = 1.96 \text{ m s}^{-2}$

$T = 235.2 \text{ N}$

12a i



a ii



12b i 206 N **b ii** 927 N

12c i 188 N **c ii** 846 N

12d when the acceleration is 0