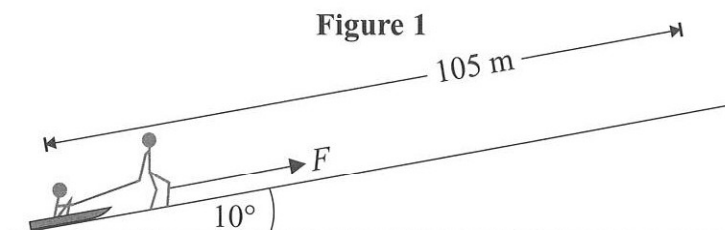


Forces and Work Done

- 1 A child in a sled is being pulled up a slope by an adult, as shown in **Figure 1**.

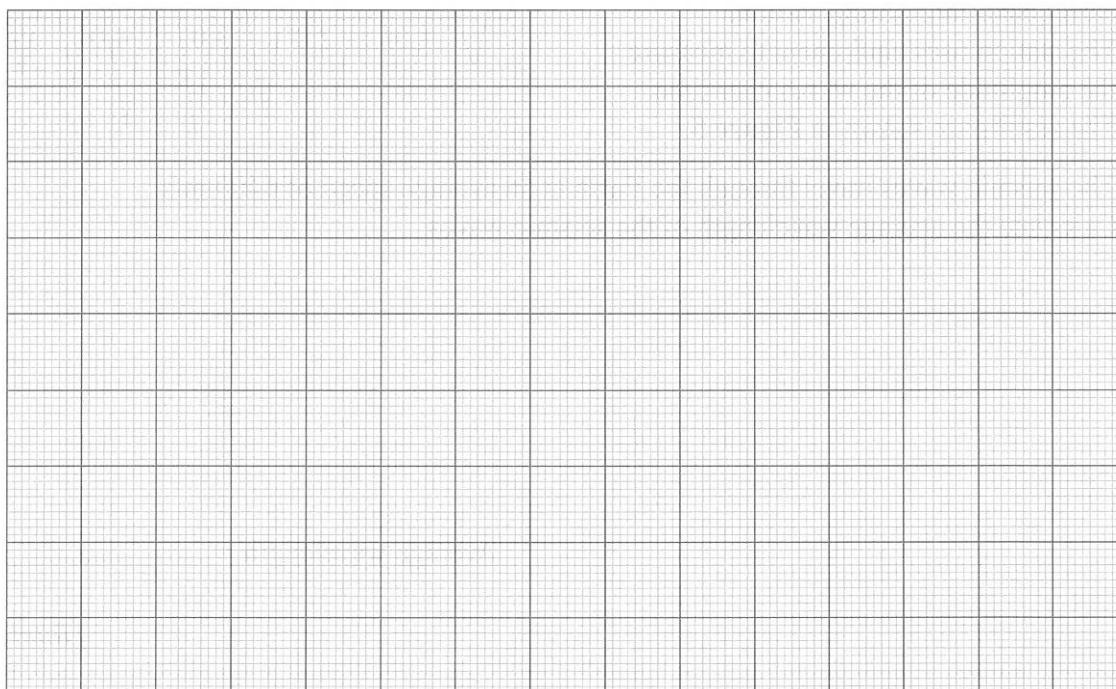


The adult applies a constant force, F , to the child and sled, parallel to the slope. The adult does work on the sled and child to pull them 105 m along the slope. In doing work, 5.44 kJ of energy is transferred to the child and sled's gravitational potential energy stores. The remaining 2270 J of work is done against resistive forces acting on the sled.

- a) Calculate the size of the force F . Give your answer to three significant figures.

Force = N
[4]

- b) The adult travels down the same slope shown in **Figure 1** on their own sled at a constant speed. The friction acting on the sled parallel to the slope is 125 N. The normal contact force acting on the adult and sled perpendicular to the slope is 710 N. Draw a scale drawing on the grid below to calculate the combined weight of the adult and sled.



Weight = N
[3]

[Total 7 marks]

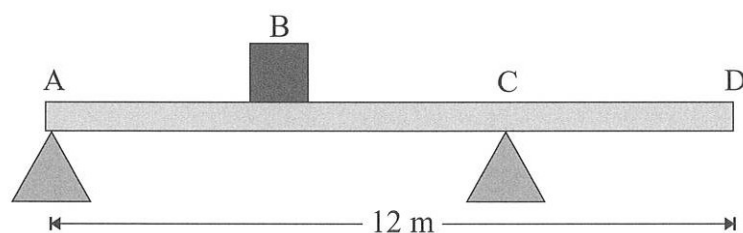
- 2 A steel girder is in equilibrium and rests on two supports.

The girder is 12 m long, has a uniform density and a weight of 3.4×10^4 N.

A concrete block weighing 6.0×10^3 N is placed on the girder at point B, as shown in **Figure 2**.

There is a support at point A, at one end of the girder. Another support is positioned at point C. The distance from A to C is twice the distance from C to the end of the girder, D. Point B is halfway between the supports.

Figure 2



- a) Calculate the upwards force acting on the girder at point A.

Force = N
[4]

Levers can be used to vary the force needed to lift a load.

The concrete block at point B can be raised in three different ways:

- by pressing down at point D and pivoting about C, or,
- by lifting up at D and pivoting about A, or,
- by lifting up at A and pivoting about C.

- b) Which of these methods requires the largest force to raise the concrete block by the same height?
Tick **one** box.

- A Pressing down on the girder at point D.
- B Lifting up the girder at point D.
- C Lifting up the girder at point A.
- D It requires the same force to move the block by all three methods.

[1]

[Total 5 marks]

- 3 Rockets A and B are moving directly upwards through the Earth's atmosphere.

Each rocket has a mass of 7.6×10^5 kg. They are both moving with a constant velocity. Assume no unwanted energy transfers take place for either rocket, and that the masses of the rockets remain constant.

- a) i) Rocket A's engine has a power of 5.0×10^8 W. Calculate the time taken for it to travel 2.0 km. (Gravitational field strength = 10 N/kg.)

Time = s
[5]

Rocket B's engine is twice as powerful as Rocket A's engine.

- ii) Explain how the time taken for Rocket B to travel 2.0 km will compare to the time taken for Rocket A to travel 2.0 km.

.....
.....
.....
[2]

- b) In reality, Rocket B's engine is only 69% efficient. Calculate the energy usefully transferred by Rocket B in 60 s.

Energy = J
[5]

[Total 12 marks]

Exam Practice Tip

Some questions involve a lot of variables and additional information. As you work through a question, it may help to add labels to the diagrams you've been given. For calculation questions, writing down all the variables can help you see which equation you're supposed to use.

Score:

24

