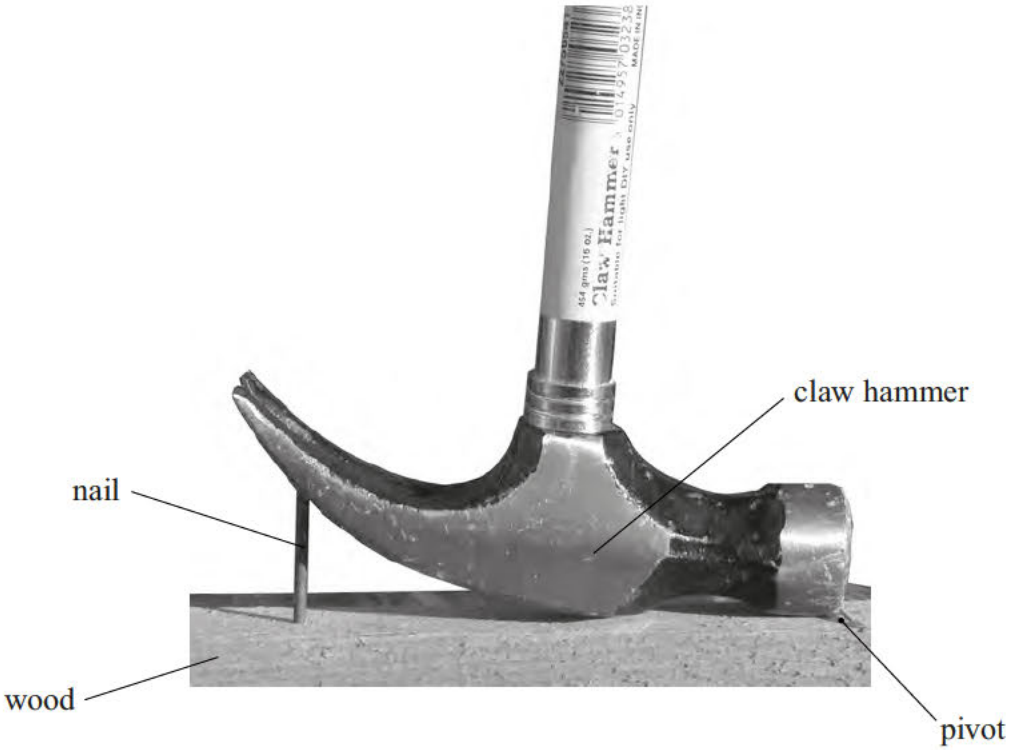
1 Photograph **C** shows how a student can use a claw hammer to pull a nail from a piece of wood.



Photograph C

(a) The mass of the hammer is 0.454 kg.

(i) Calculate the weight of the hammer.

(2)

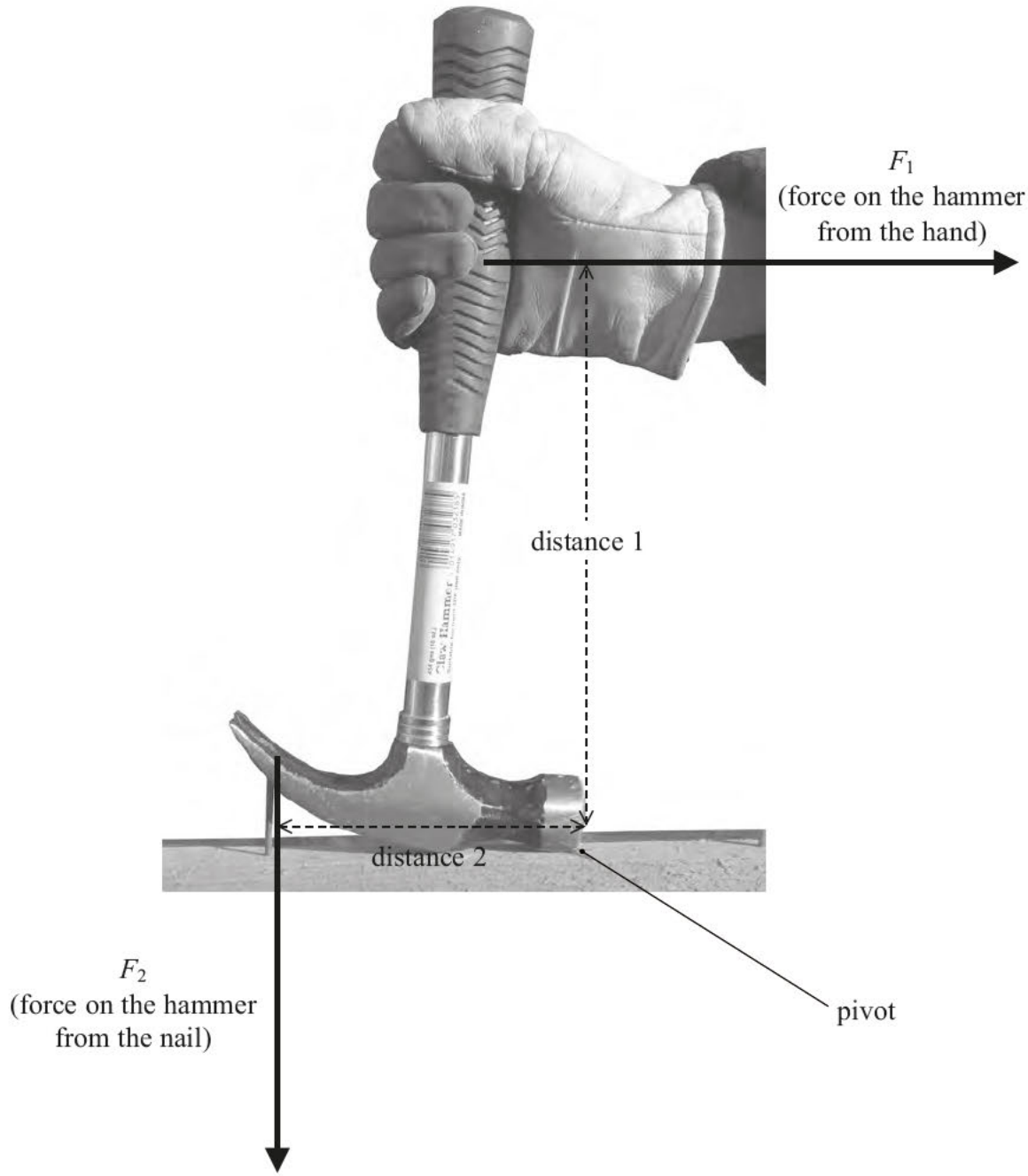
Weight ..... N

(ii) From what point does this weight act?

(1)

.....

(b) Photograph **D** shows the directions of two other forces on the hammer.



Photograph D

(i) Draw an arrow on photograph **D** to show the force on the nail from the hammer.

(2)

(ii) Suggest **two** ways that the student could increase the moment on the hammer.

(2)

1 .....

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2 .....

.....

(Total for Question 1 7 marks)

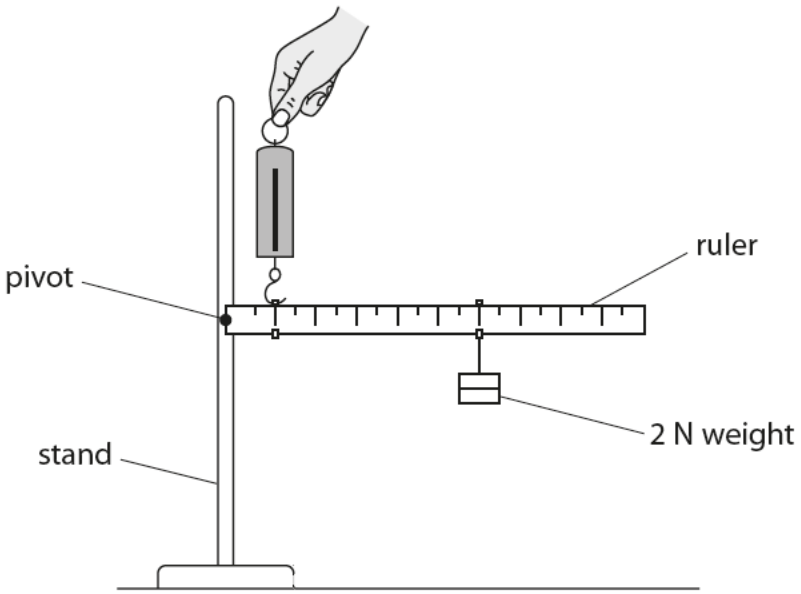
2 A student investigates the principle of moments.

He connects a ruler to a stand with a pivot.

He hangs a 2 N weight from the 60 cm mark on the ruler.

He uses a forcemeter to hold the ruler horizontal.

The scale on the forcemeter reads from 0 N to 10 N.



(a) How could the student check that the ruler is horizontal?

(2)

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(b) (i) State the equation linking moment, force and distance from the pivot.

(1)

(ii) Calculate the moment of the 2 N weight.

State the unit.

(3)

Moment = ... Unit .....

(c) The student holds the ruler horizontal with the forcemeter at the 10 cm mark.

He expects the reading on the forcemeter to be 12 N.

The actual reading is 10 N.

(i) Explain why the correct reading should be **larger** than 12 N.

(2)

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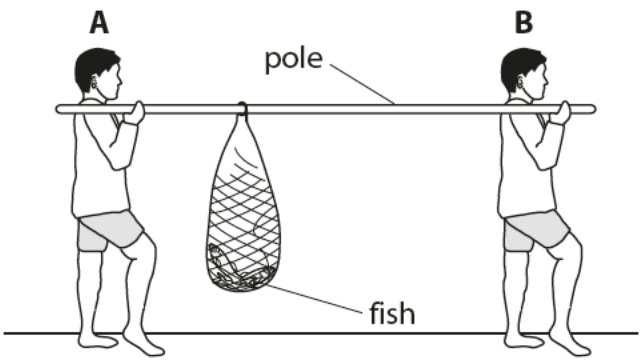
(ii) Explain why the actual reading is only 10 N.

(1)

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(d) A picture in the student's textbook shows two fishermen using a pole to carry some fish.



Fisherman **A** and fisherman **B** feel different forces on their shoulders.

Use ideas about moments to explain why fisherman **A** feels the larger force.

(3)

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(Total for Question 2 = 12 marks)

3 (a) A boy of mass 43.2 kg runs and jumps onto a stationary skateboard.



The boy lands on the skateboard with a horizontal velocity of 4.10 m/s.

(i) State the relationship between momentum, mass and velocity.

(1)

(ii) The skateboard has a mass of 2.50 kg.

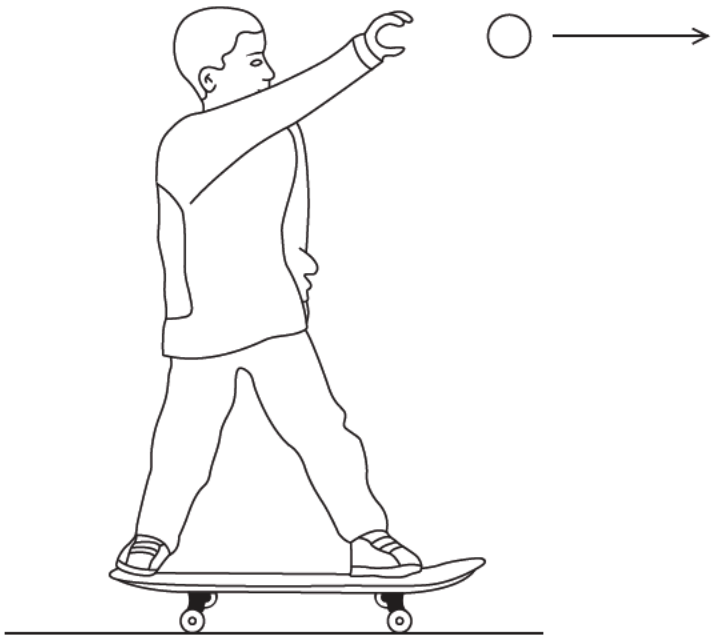
Using ideas about conservation of momentum, calculate the combined velocity of the boy and skateboard just after the boy lands on it.

(4)

combined velocity = ... m/s

(b) The boy holds a heavy ball as he stands on a stationary skateboard.

The boy throws the ball forwards while still standing on the skateboard.



Explain what happens to the boy and the skateboard.

(2)

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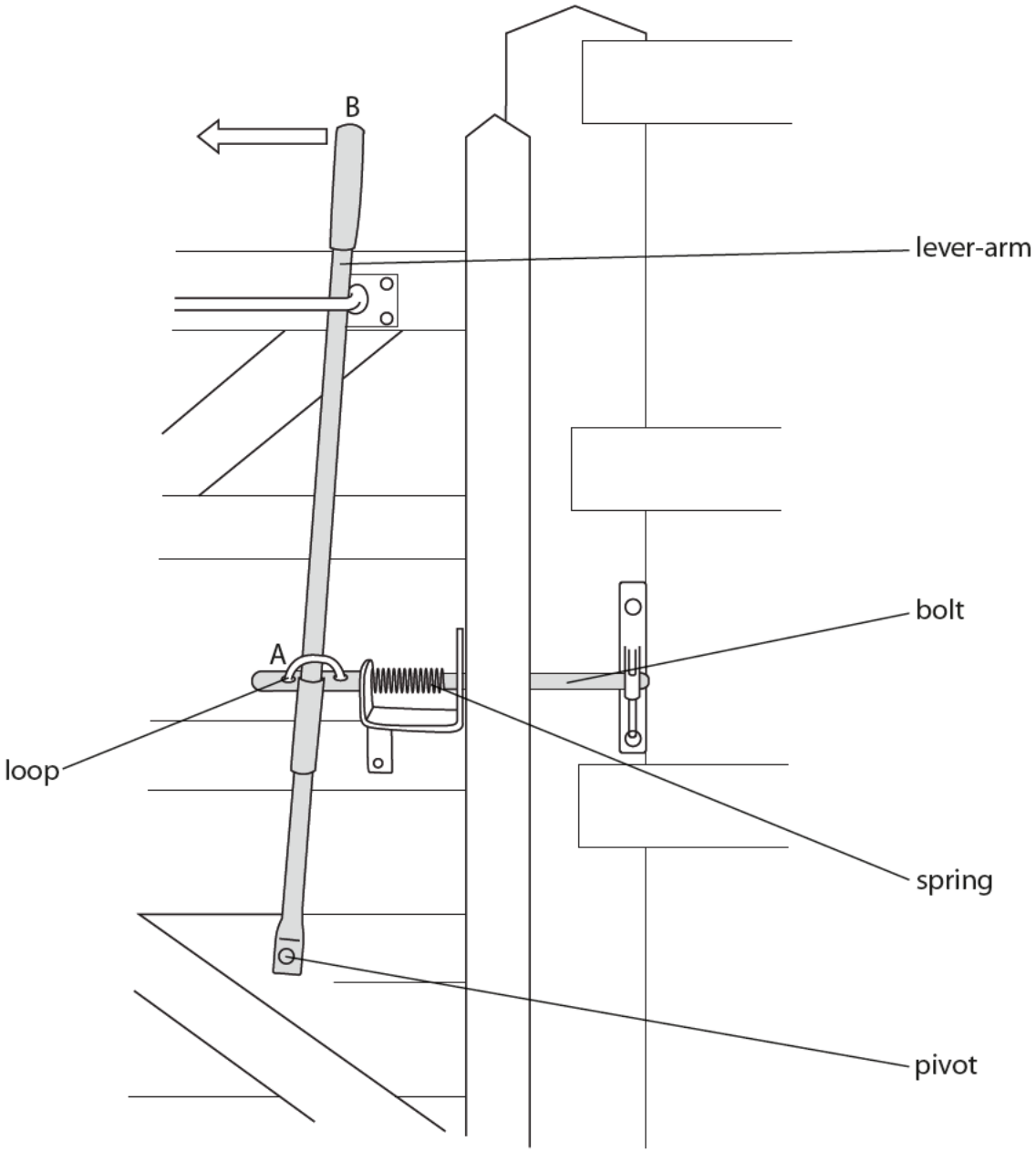
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(Total for Question 3 = 7 marks)

4 The diagram shows a gate with a lever-operated catch.

A loop on the bolt fits around the lever-arm at A.



(a) (i) Describe how the lever-arm is used to move the bolt.

(1)

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(ii) Suggest why the spring is needed.

(1)

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(b) The lever-arm operates using the principle of moments.

(i) State the principle of moments.

(1)

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(ii) The force applied at point B is 22 N.

The pivot is 110 cm from point B and 38 cm from point A.

Calculate the force exerted on the lever-arm at point A by the spring.

(3)

force at point A = ... N

(iii) Explain how the force applied at point B would need to change if the distance from the pivot to point A is increased.

(2)

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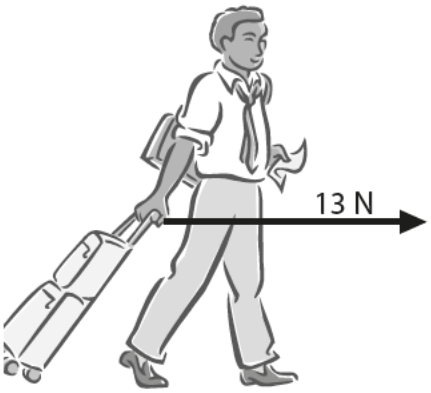
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(Total for Question 4 = 8 marks)

5 A person has a suitcase with wheels.



(a) The person pulls the suitcase with a horizontal force of 13 N for 110 m.

(i) State the equation linking work done, force and distance moved.

(1)

(ii) Calculate the work done on the suitcase by the person.

(2)

work done = ... J

(iii) How much energy is transferred to the suitcase?

(1)

energy transferred = ... J

(b) The suitcase falls over.



Explain why it loses gravitational potential energy when it falls.

(2)

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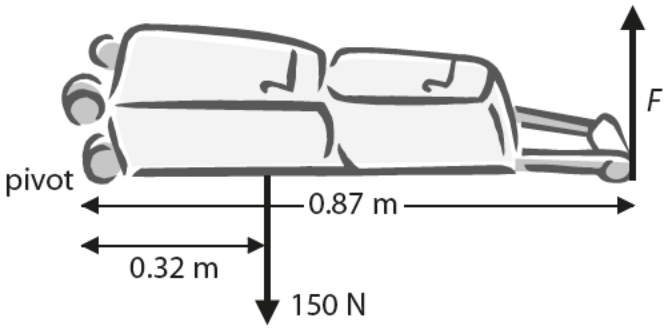
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(c) The person starts to raise the suitcase again by pulling on the handle with force *F*.

The weight of the suitcase is 150 N.



(i) State the equation linking moment, force and perpendicular distance from the pivot.

(1)

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(ii) Calculate the force *F* that the person must apply on the handle to start raising the suitcase.

(3)

force *F* = ... N

(Total for Question 5 = 10 marks)