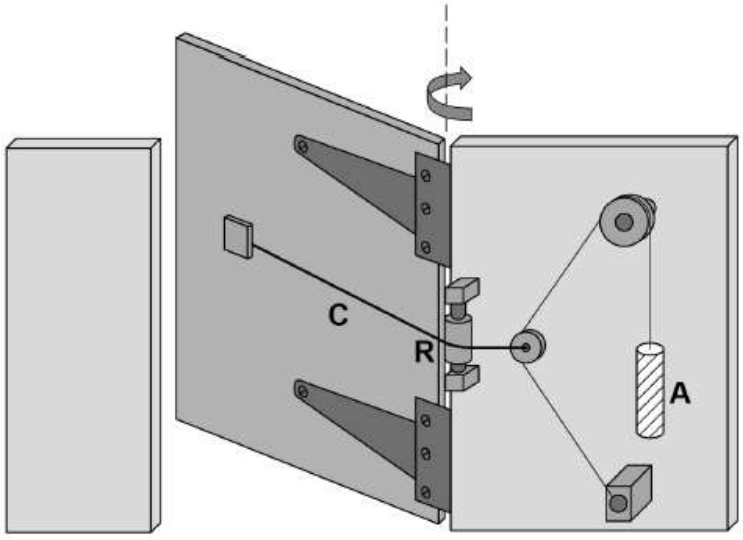
Force, energy and momentum – A2 Physics P1

1. No.3

0	3

Figure 3 shows a garden gate with a pulley system designed to close the gate.

Figure 3



The pulley system raises weight **A** when the gate is opened. When the gate is released, **A** falls. The horizontal cable **C** passes over pulley **R**. The tension in cable **C** causes the gate to close.

Weight **A** is a solid cylinder with the following properties:

diameter = 4.8×10^{-2} m
length = 0.23 m
weight = 35 N

Table 2 gives the density of three available materials.

Table 2

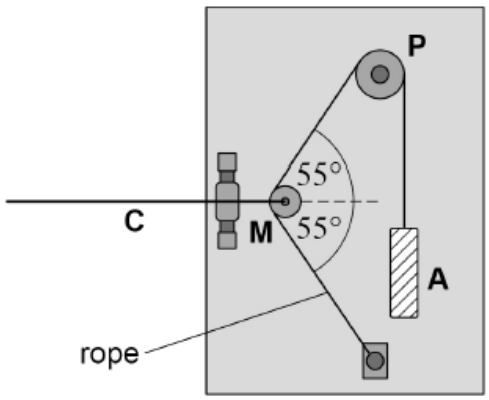
Material	Density / kg m^{-3}
concrete	2.4×10^3
iron	7.8×10^3
brass	8.6×10^3

0 3 . 1 Deduce which **one** of the three materials is used for **A**.

[3 marks]

Figure 4 shows the pulley arrangement when the gate is closed.

Figure 4



Pulleys **P** and **M** are frictionless so that the tension in the rope attached to **A** is equal to the weight of **A**.
A weighs 35 N and the weight of moveable pulley **M** is negligible.

0 3 . 2 Calculate the tension in the horizontal cable **C** when the gate is closed.

[2 marks]

tension = _____ N

0 3 . 3 Pulley **M** is pulled to the left as the gate is opened.

Explain why this increases the tension in the horizontal cable **C**.

[2 marks]

_____

_____

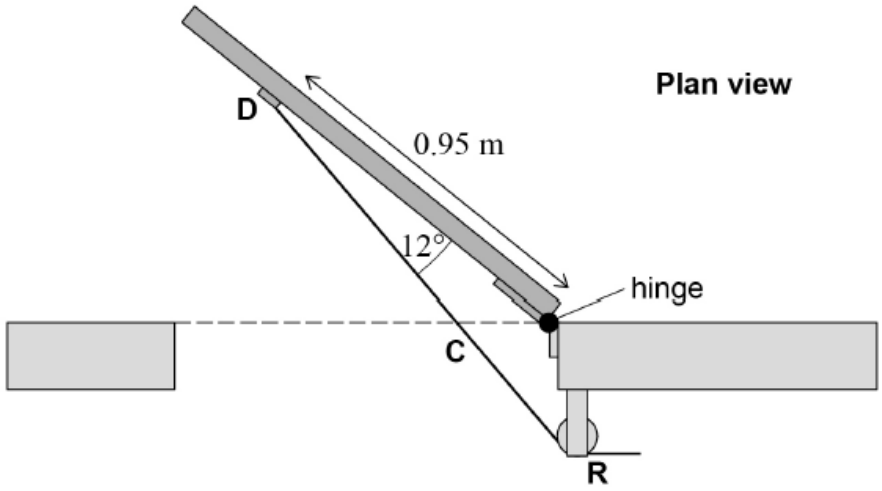
_____

_____

0 3 . 4 **Figure 5** shows a plan view with the gate open. The horizontal cable **C** passes over pulley **R** and is attached to the door at **D**.
The angle between the door and the horizontal cable **C** is 12°.

The horizontal distance between the hinge and **D** is 0.95 m.

Figure 5



The tension in the horizontal cable **C** is now 41 N.

Calculate the moment of the tension about the hinge.

[2 marks]

moment = _____ N m

0 3 . 5 The same system is attached to an identical gate with stiffer hinges. Now the system does not supply a sufficiently large moment to close the gate.

Discuss **two** independent changes to the design to increase the moment about the hinges due to horizontal cable **C**.

[4 marks]

1 _____

_____

_____

_____

_____

2 _____

_____

_____

_____

_____

2. No.9

A car travels at $100\ \text{km h}^{-1}$ on a motorway.

What is an estimate of its kinetic energy?

[1 mark]

A 10^4 J ⬭

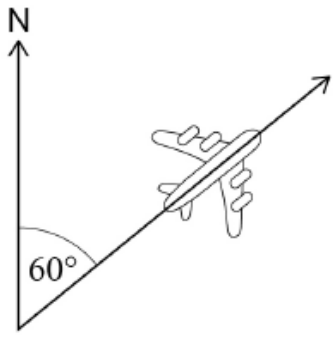
B 10^6 J ⬭

C 10^8 J ⬭

D 10^{10} J ⬭

3. No.22

An aeroplane flies horizontally at $150\ \text{m s}^{-1}$ along a bearing $60°$ east of north.



How far north from its starting position is the aeroplane after one hour?

[1 mark]

A 270 km ⬭

B 470 km ⬭

C 510 km ⬭

D 540 km ⬭

4. No.23

A ball is thrown vertically upwards and returns to its original position 2.4 s later.
The effect of air resistance is negligible.

What is the total distance travelled by the ball?

[1 mark]

A 5.9 m ⬭

B 7.1 m ⬭

C 14 m ⬭

D 28 m ⬭

5. No.25

A parachutist descends to the ground at a constant speed with the parachute open.

Which force, together with the parachutist's weight, makes a pair according to Newton's third law of motion?

[1 mark]

A the drag force on the parachutist from the air ⬭

B the tension in the strings of the parachute ⬭

C the gravitational force of the parachutist on the Earth ⬭

D the lift force on the parachute from the air ⬭

6. No.26

A tennis ball has a mass of 58 g.
The ball is dropped from rest from a height of 1.8 m above the ground and falls vertically.
The ball rebounds vertically to a height of 1.1 m.
The effect of air resistance is negligible.

What is the change in momentum of the ball during its collision with the ground?

[1 mark]

A 0.040 N s ⬭

B 0.075 N s ⬭

C 0.215 N s ⬭

D 0.614 N s ⬭