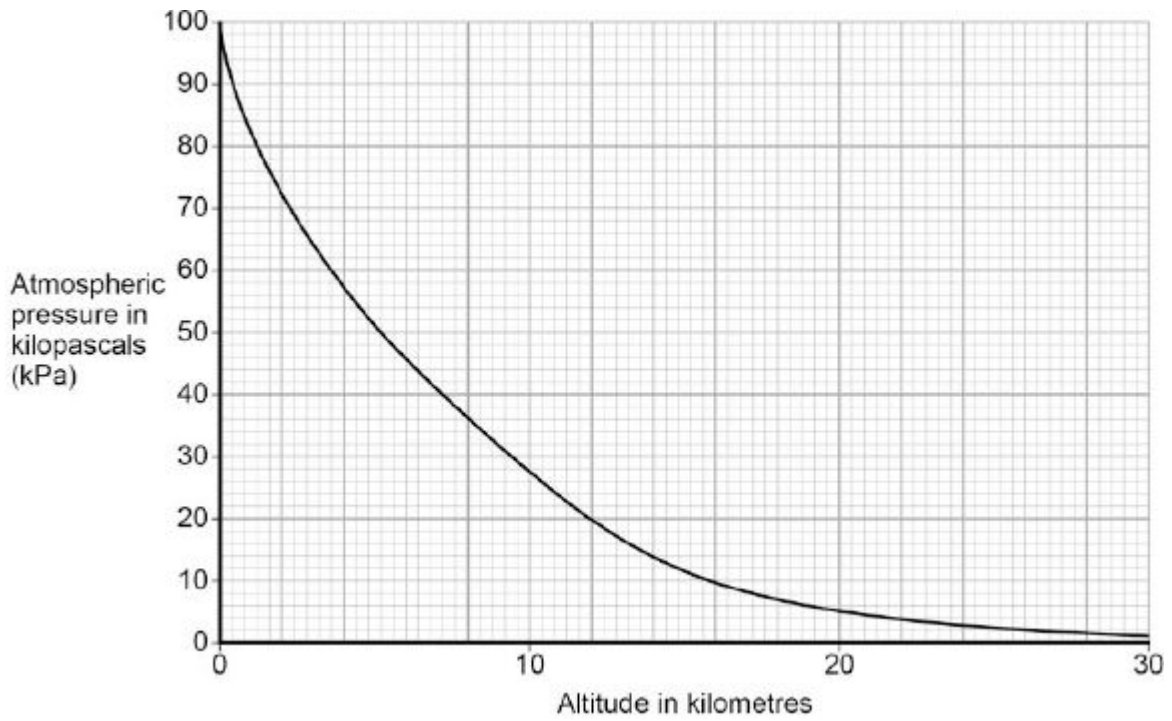


1

Figure 1 shows how atmospheric pressure varies with altitude.

Figure 1



(a) Explain why atmospheric pressure decreases with increasing altitude.

.....

.....

.....

.....

.....

.....

(3)

(b) When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 810 cm².

Use data from **Figure 1** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

Give your answer to two significant figures

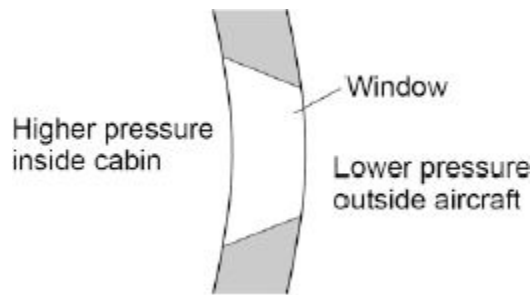
.....
.....
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.....
.....
.....

Resultant force = N

(5)

(c) **Figure 2** shows the cross-section of one type of aircraft window.

Figure 2



Explain why the window has been designed to have this shape.

.....
.....
.....

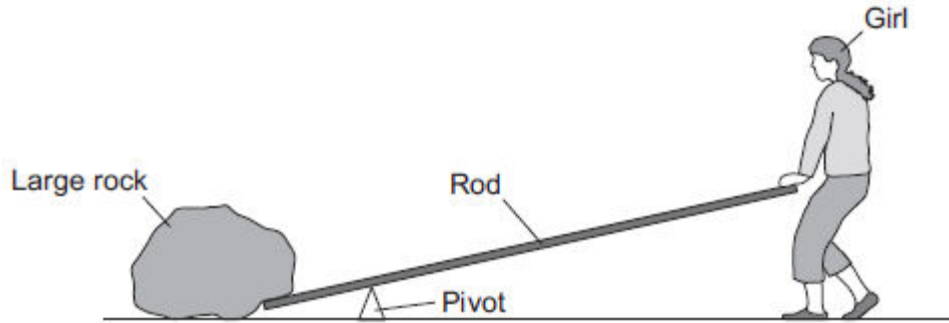
(2)
(Total 10 marks)

2

Levers and hydraulic systems can act as force multipliers.

(a) **Figure 1** shows a girl trying to lift a large rock using a long rod as a lever.

Figure 1



The girl is pushing down on the rod but is just unable to lift the rock.

Which of the following changes would allow her to lift the rock?

Tick (✓) **two** boxes.

Change	Tick (✓)
Move the pivot away from the rock	
Make the rod longer	
Push the rod upwards	
Push down on the rod with a greater force	

(2)

(b) Liquids are used in hydraulic systems because they are virtually incompressible.

Explain how the spacing of particles in a liquid cause it to be virtually incompressible.

.....

.....

.....

.....

(2)

(c) **Figure 2** shows a man using a car jack to lift his car.

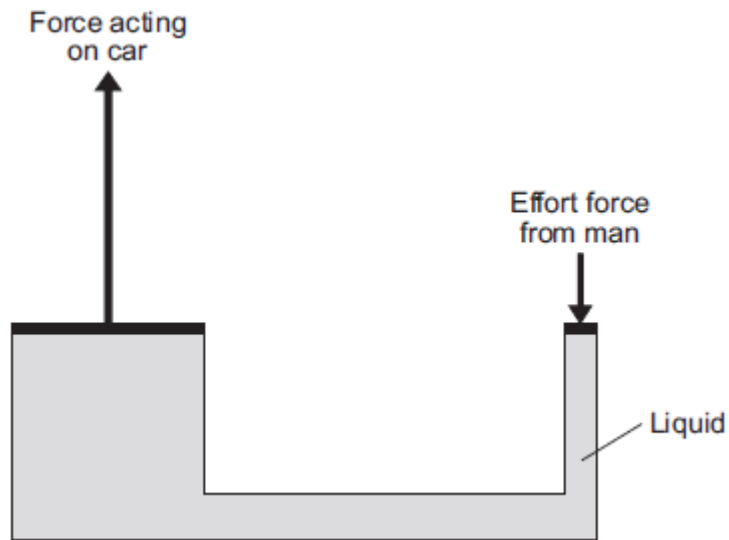
Figure 2



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Figure 3 shows a simple diagram of a car jack.

Figure 3



(i) The man pushes down with an effort force. This results in a much larger force acting upwards on the car.

Use information from **Figure 3** to explain how.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(ii) Which of the following statements about the forces in **Figure 3** is correct?

Tick (✓) **one** box.

	Tick (✓)
The force acting on the car moves a greater distance than the effort force.	
The force acting on the car moves less distance than the effort force.	
The force acting on the car moves the same distance as the effort force.	

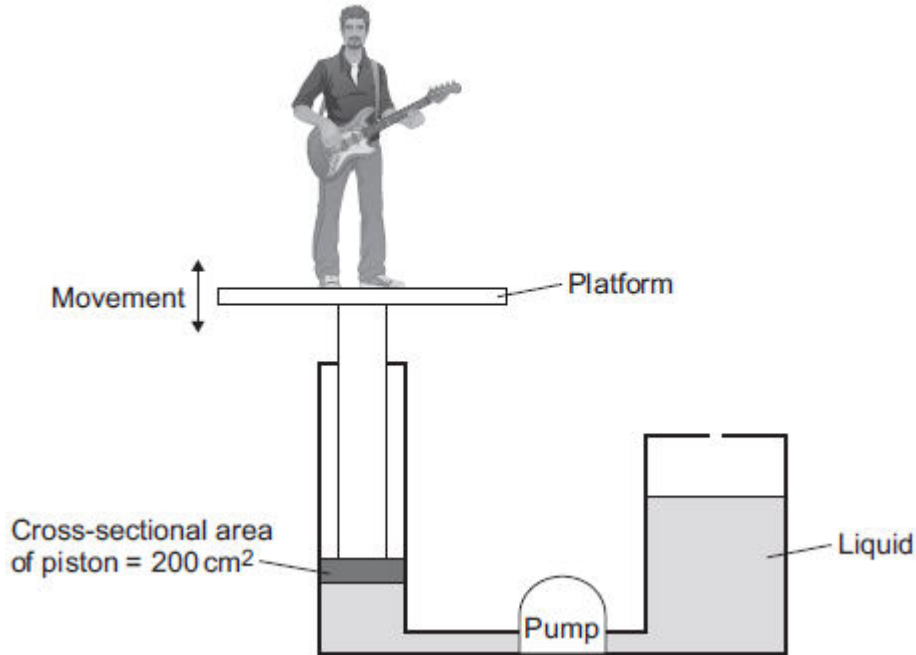
(1)

(Total 9 marks)

3

Musicians sometimes perform on a moving platform.

The figure below shows the parts of the lifting machine used to move the platform up and down.



(a) What name is given to a system that uses liquids to transmit forces?

Draw a ring around the correct answer.

electromagnetic

hydraulic

ionising

(1)

(b) To move the platform upwards, the liquid must cause a force of 1800 N to act on the piston.

The cross-sectional area of the piston is 200 cm².

Calculate the pressure in the liquid, in N / cm², when the platform moves.

.....
.....
.....

Pressure = N / cm²

(2)

(c) A new development is to use oil from plants as the liquid in the machine.

Growing plants and extracting the oil requires **less energy** than producing the liquid usually used in the machine.

Draw a ring around the correct answer to complete the sentence.

Using the oil from the plants gives

- an environmental
- an ethical
- a social

advantage over the liquid

usually used.

(1)

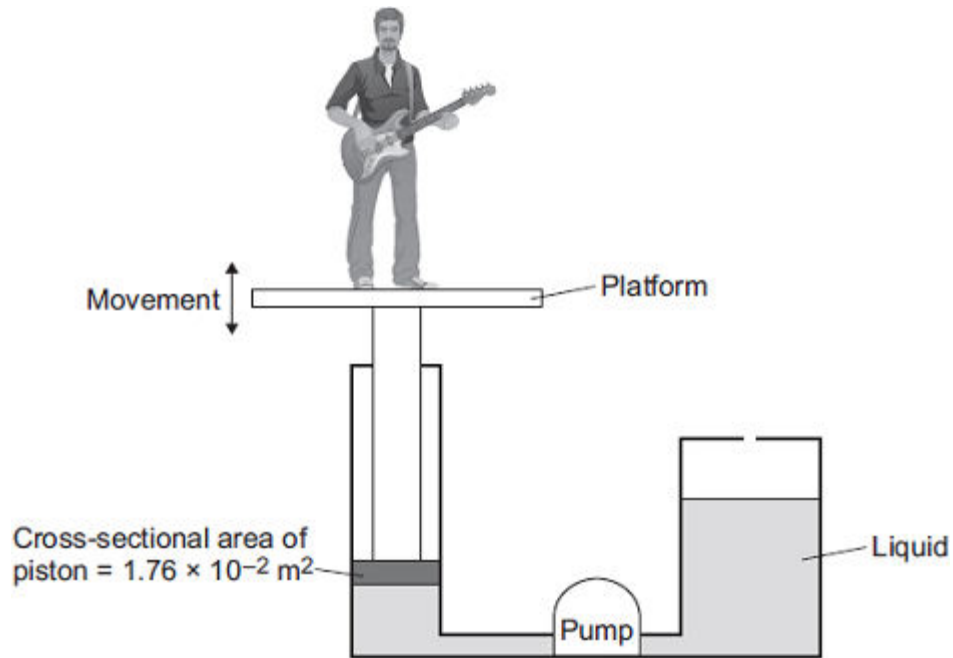
(Total 4 marks)

4

Musicians sometimes perform on a moving platform.

Figure 1 shows the parts of the lifting machine used to move the platform up and down.

Figure 1



(a) What type of system uses a liquid to transmit a force?

.....

(1)

(b) The pump creates a pressure in the liquid of $8.75 \times 10^4 \text{ Pa}$ to move the platform upwards.

Calculate the force that the liquid applies to the piston.

.....
.....
.....

Force = N

(2)

- (c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

.....

.....

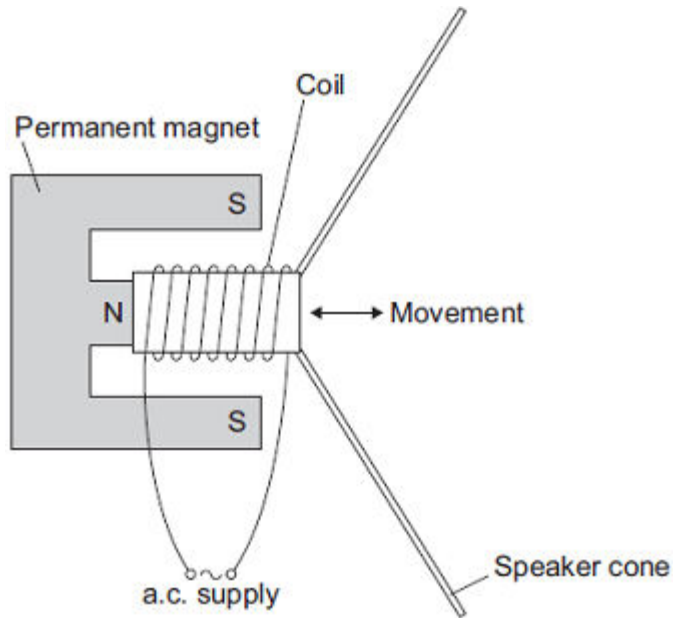
.....

(1)

(d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

Figure 2



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

.....

.....

.....

.....

.....

.....

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.....

.....

.....

.....

(4)
(Total 8 marks)

5

Some students fill an empty plastic bottle with water. The weight of the water in the bottle is 24 N and the cross-sectional area of the bottom of the bottle is 0.008 m².

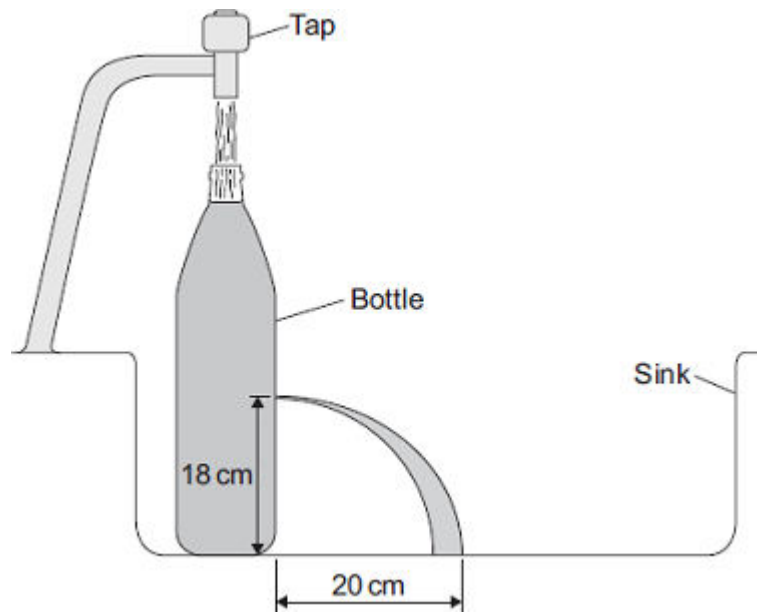
- (a) Calculate the pressure of the water on the bottom of the bottle and give the unit.

.....

Pressure =

(3)

- (b) The students made four holes in the bottle along a vertical line. They put the bottle in a sink. They used water from a tap to keep the bottle filled to the top.



The students measured and recorded the vertical heights of the holes above the sink. They also measured the horizontal distances the water landed away from the bottle. A pair of measurements for one of the holes is shown in the diagram.

The complete data from the experiment is shown in the table.

Hole	Vertical height in cm	Horizontal distance in cm
J	24	15
K	18	20
L	12	30
M	6	40

(i) Which hole is shown in the diagram?

Draw a ring around the correct answer.

J **K** **L**

(1)

(ii) On the diagram, draw the path of the water coming out of hole **M**.

Use the information in the table to help you.

(2)

(c) Suggest **one** problem that might arise from trying to collect data from a fifth hole with a vertical height of 1 cm above the sink.

.....
.....

(1)

(Total 7 marks)

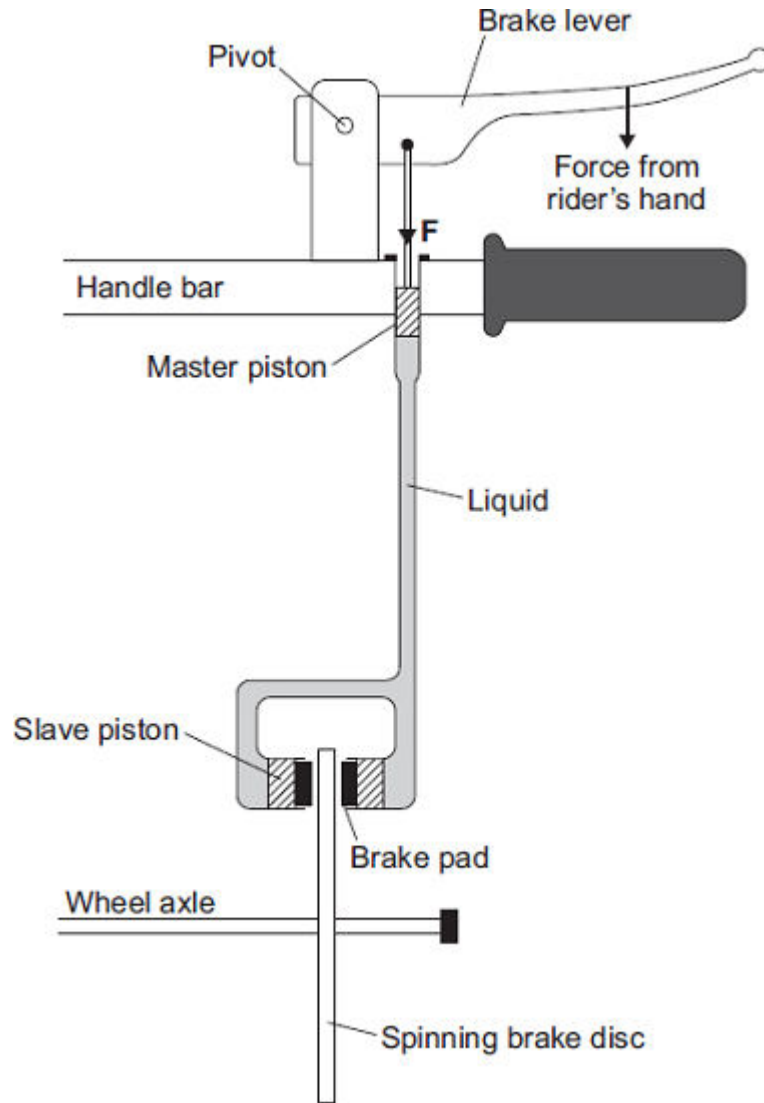
6

Mountain bike riders use brakes to slow down.



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Some mountain bikes use liquid-filled pipes to transmit the force from the rider's hand on the brake lever to the brake pads. These brakes are called hydraulic brakes.



(a) Draw a ring around the correct answer to complete each sentence.

(i) Liquids can be used to transmit the forces in a brake system,

because liquids

- | |
|---|
| <p>are incompressible.</p> <p>can flow.</p> <p>take the shape of the container.</p> |
|---|

(1)

(ii) The pressure in the liquid is transmitted

- | |
|--|
| <p>against force F only.</p> <p>downwards only.</p> <p>in all directions.</p> |
|--|

(1)

- (b) When the rider's hand pulls on the brake lever, the force **F** applied to the liquid by the master piston is 80 N. The cross-sectional area of this piston is 50 mm².

Calculate the pressure, in N/mm², exerted on the liquid by the master piston.

.....
.....
.....

Pressure = N/mm²

(2)

- (c) The unit N/mm² is **not** the usual unit of pressure.

Which unit is usually used when calculating pressure?

Draw a ring around the correct answer.

N

Nm²

Pa

(1)

- (d) The rider applies a larger force to the brake lever. How would this increase in force affect the pressure in the liquid?

.....

(1)

(Total 6 marks)

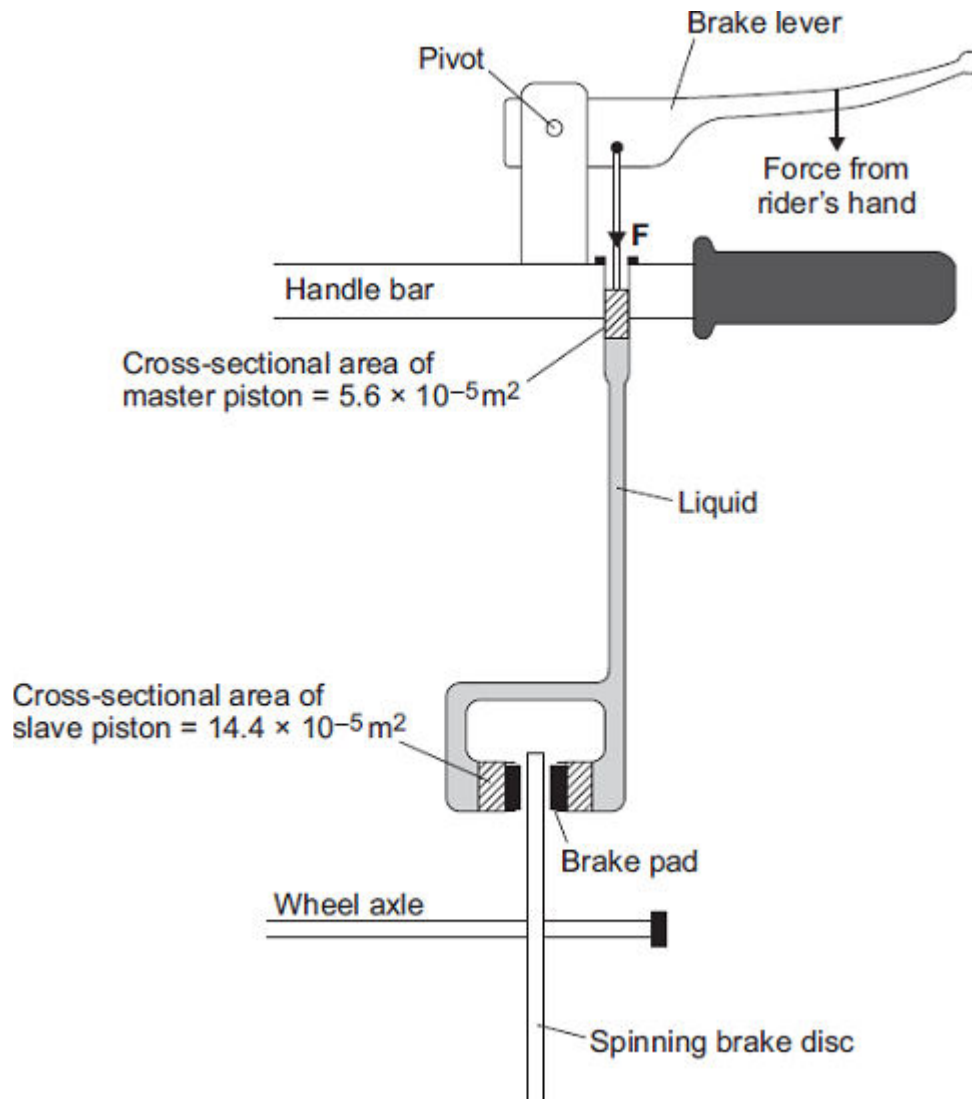
7

Mountain bike riders use brakes to slow down.



© Ljupco Smokovski/Shutterstock

Some mountain bikes have hydraulic brakes.



(a) What property of a liquid enables a hydraulic brake system to work?

.....

(1)

- (b) When the rider's hand pulls on the brake lever, the master piston applies a pressure of 1.5×10^6 pascals to the liquid.

Using information from the diagram, calculate the force **F** exerted on the liquid by the master piston.

.....

.....

.....

.....

Force **F** = N

(2)

- (c) The pressure in the liquid applies a force to move each slave piston.

How does the size of this force compare to the force **F** applied by the master piston?

.....

.....

Give a reason for your answer.

.....

.....

(2)

(Total 5 marks)