



## New Document 1

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **36 minutes**

Marks: **35 marks**

Comments:

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**Q1.**

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 m<sup>2</sup>.

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

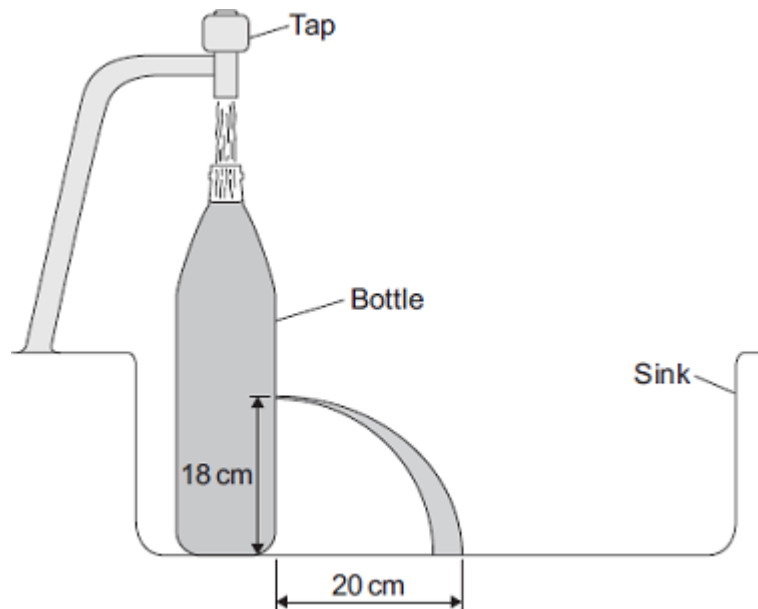
\_\_\_\_\_

\_\_\_\_\_

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

<b>M</b>	6	40
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(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.

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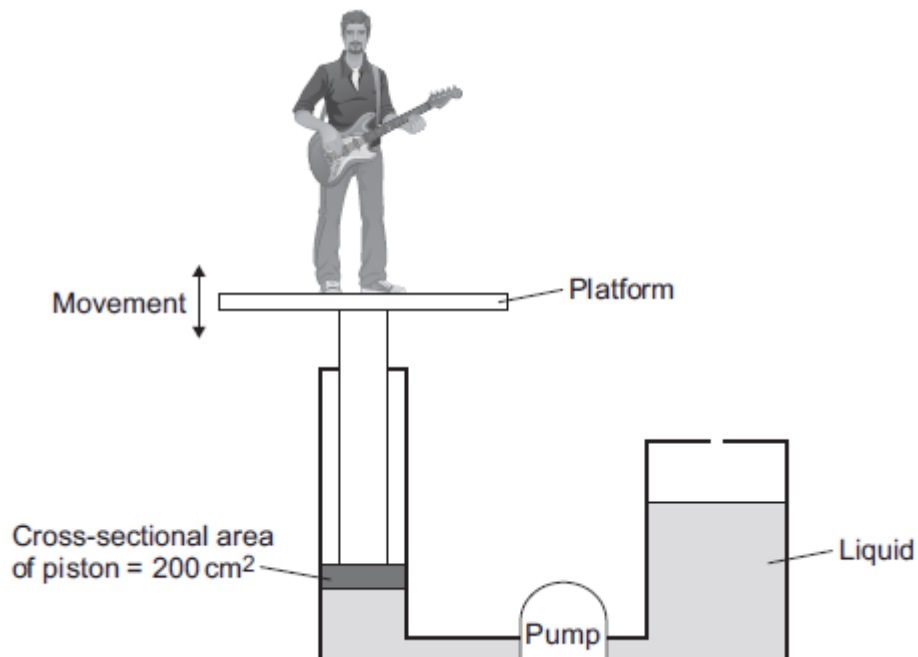
(1)

(Total 7 marks)

**Q2.**

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 cm<sup>2</sup>.

Calculate the pressure in the liquid, in N / cm<sup>2</sup>, when the platform moves.

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Pressure = \_\_\_\_\_ N / cm<sup>2</sup>

(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)

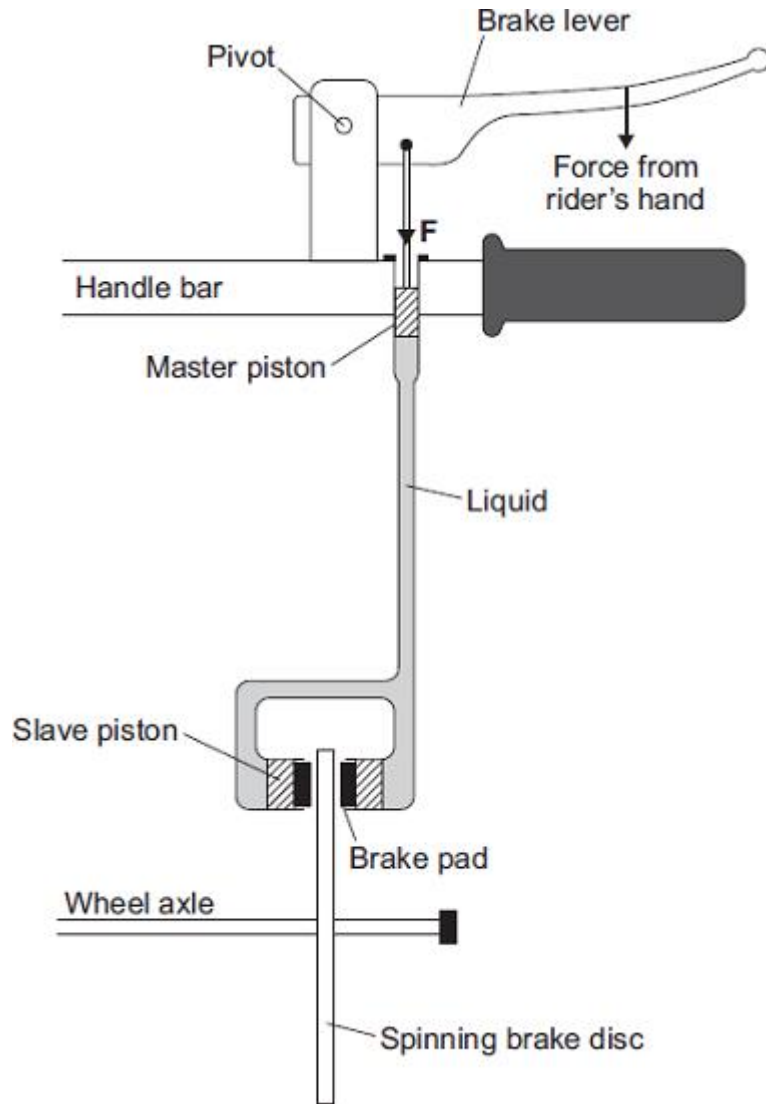
(Total 4 marks)

### Q3.

Mountain bike riders use brakes to slow down.



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

are incompressible.
can flow.
take the shape of the container.

(1)

(ii)

The pressure in the liquid is transmitted

against force <b>F</b> only.
downwards only.
in all directions.

(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 mm<sup>2</sup>.

Calculate the pressure, in N/mm<sup>2</sup>, exerted on the liquid by the master piston.

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Pressure = \_\_\_\_\_ N/mm<sup>2</sup>

(2)

- (c) The unit N/mm<sup>2</sup> is **not** the usual unit of pressure.

Which unit is usually used when calculating pressure?

Draw a ring around the correct answer.

N                      Nm<sup>2</sup>                      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?

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(1)

(Total 6 marks)

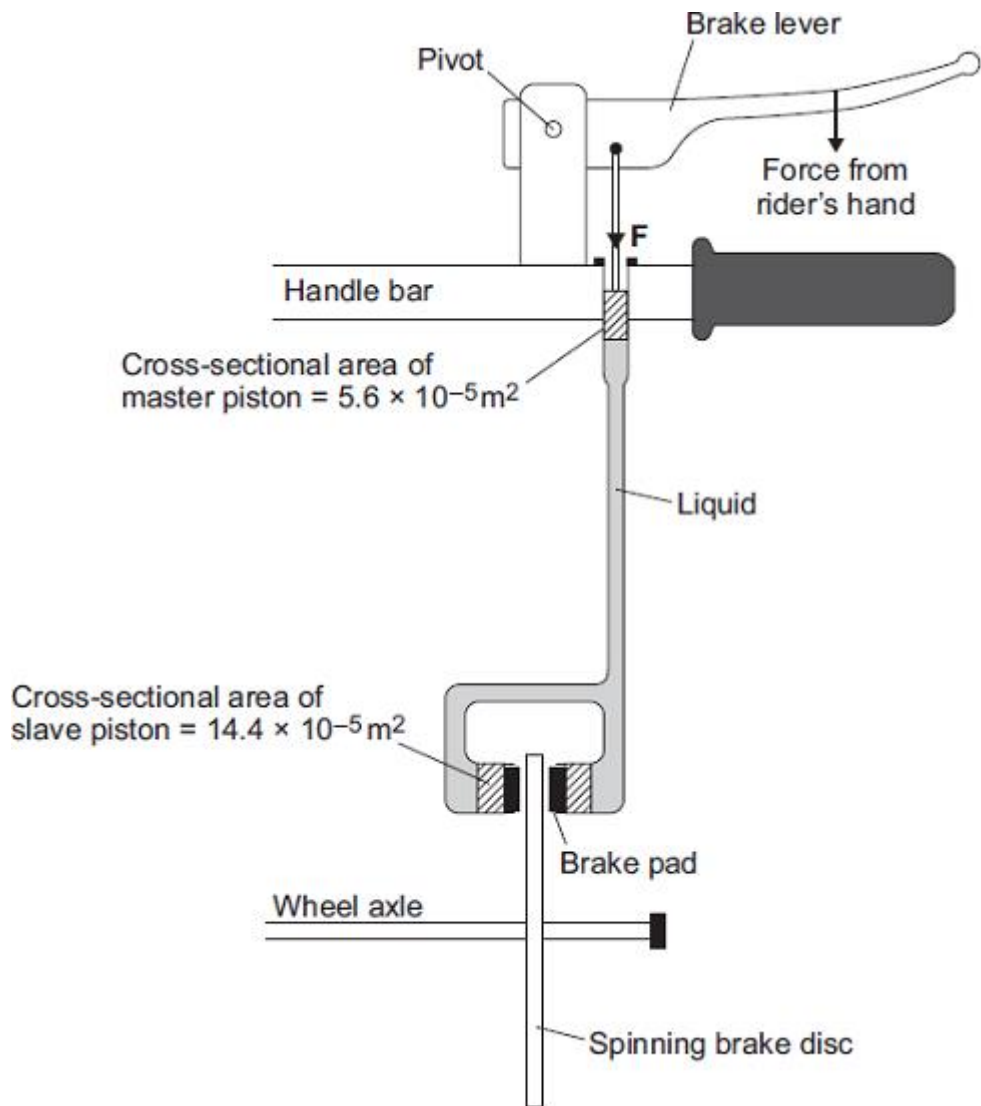
#### Q4.

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?

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(1)

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

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

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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?

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Give a reason for your answer.

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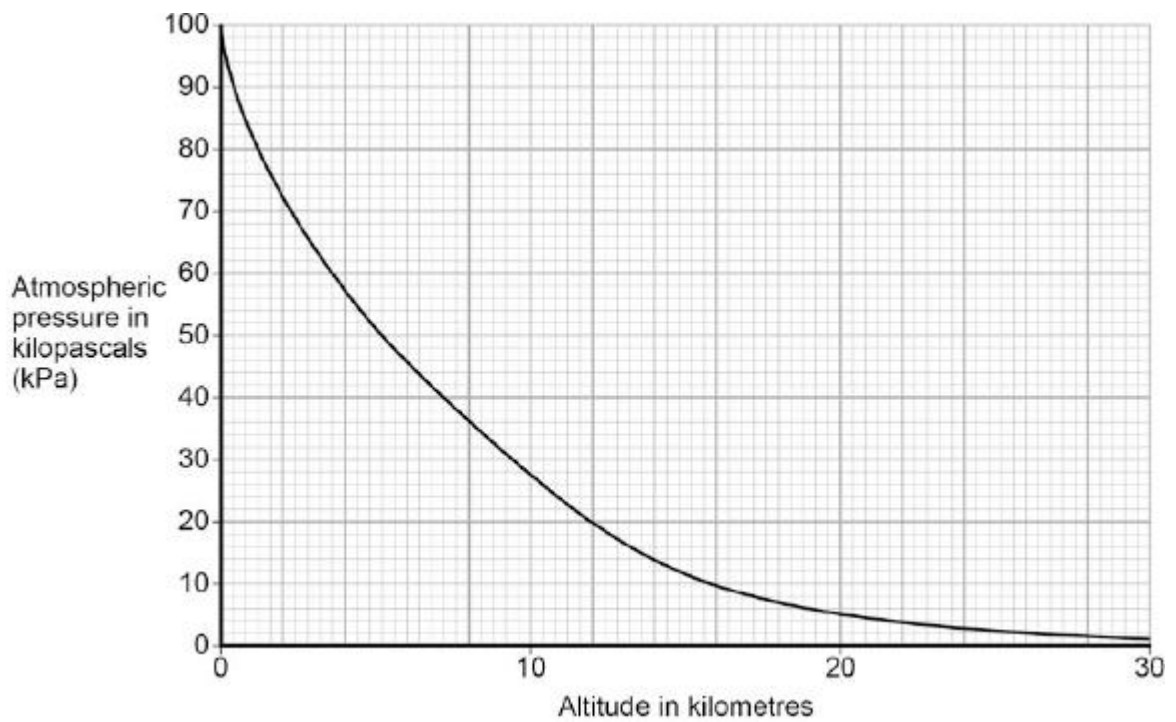
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(2)  
(Total 5 marks)

**Q5.**

**Figure 1** shows how atmospheric pressure varies with altitude.

**Figure 1**



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

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(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 cm<sup>2</sup>.



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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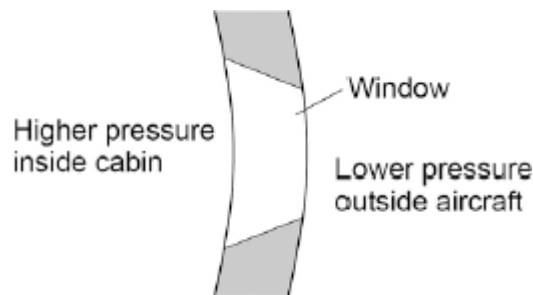
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Resultant force = \_\_\_\_\_ N

(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.

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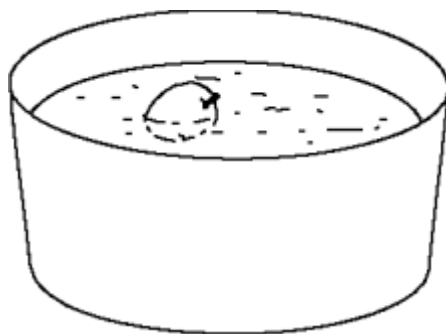
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(2)

(Total 10 marks)

**Q6.**



In a science lesson, some children float an apple on some water.

One of the children says:

“The apple is not moving. That means that there cannot be any forces acting on it.”

Do you agree?

Explain your answer as fully as you can.

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**(Total 3 marks)**

## Mark schemes

### Q1.

(a) 3000

*correct substitution of  $24 / 0.008$  gains 1 mark provided no subsequent steps are shown*

2

N / m<sup>2</sup> or Pa

1

(b) (i) K

*accept ringed K in table*

1

(ii) water exiting bottle one-third of vertical height of K

*allow less than half vertical height of spout shown, judged by eye*

1

water landing twice the distance of the spout shown in the diagram

*accept at least one and a half times further out than spout shown, judged by eye*

*do **not** accept water hitting the side of the sink  
ignore trajectory*

1

(c) water will land on the (vertical) side of the sink

*accept sink **not** long / wide / big enough*

**or**

water will dribble down very close to the bottle

**or**

that part of the bottle is curved

*do **not** accept goes out of the sink*

1

[7]

### Q2.

(a) hydraulic

1

(b) 9

*allow 1 mark for a correct substitution, ie  $\frac{1800}{200}$  provided no subsequent step*

2

(c) an environmental

1

[4]

**Q3.**

- (a) (i) are incompressible 1
- (ii) in all directions 1
- (b) 1.6
- allow 1 mark for correct substitution, ie  $\frac{80}{50}$  provided no subsequent step shown  
an answer 0.032 gains 0 marks*
- 2
- (c) Pa 1
- (d) increases 1

**[6]****Q4.**

- (a) (i) liquids are (virtually) incompressible 1
- (b) 84
- allow 1 mark for correct substitution, ie*
- $$1.5 \times 10^6 = \frac{F}{5.6 \times 10^{-5}}$$
- numbers may not be written in standard form, ie*
- $$1\,500\,000 = F \frac{0.000\,056}{F}$$
- allow 1 mark for an answer 216*
- 2
- (c) it (the force on the slave pistons) is greater / larger
- accept force (at slave piston) = 216 (N)*
- 1

the area (touching the liquid) of the slave piston is greater than the area of the master piston

*accept it has a bigger area*

*just quoting numbers, eg the master piston is  $5 \times 10^{-5}$  and the slave piston is  $14.4 \times 10^{-5}$  is insufficient*

1**[5]****Q5.**

- (a) air molecules colliding with a surface create pressure 1
- at increasing altitude distance between molecules increases

**or**

at increasing altitude fewer molecules (above a surface)

1

so number of collisions with a surface decreases

**or**

or so always less weight of air than below (the surface)

1

- (b) atmospheric pressure = 20 kPa from graph **and** conversion of 810 cm<sup>2</sup> to 0.081 m<sup>2</sup>  
*allow ecf for an incorrect value clearly obtained from the graph*

1

$$5 \times 10^4 = \frac{F}{0.081}$$

$$0.081$$

1

$$F = 5 \times 10^4 \times 0.081$$

1

$$4050$$

1

$$4100 \text{ (N)}$$

1

*allow 4100 (N) with no working shown for 5 marks*

*allow 4050 with no working shown for 4 marks*

- (c) force from air pressure acting from inside to outside bigger than force acting inwards

1

so keeps the window in position

1

[10]

### Q6.

*ideas that*

gravity/weight (downwards)

upwards/opposite force of water **or** upthrust

forces are balanced

*any three for 1 mark each*

(N.B. All these ideas may be included in a short response)

(If no marks gained but candidate makes reference to forces, award 1 mark)

[3]