Pressure Difference In A Fluid

These practice questions can be used by students and teachers and is

Suitable for GCSE AQA Physics Topic Question 8463

Level: GSCE AQA 8463

Subject: Physics

Exam Board: GCSE AQA

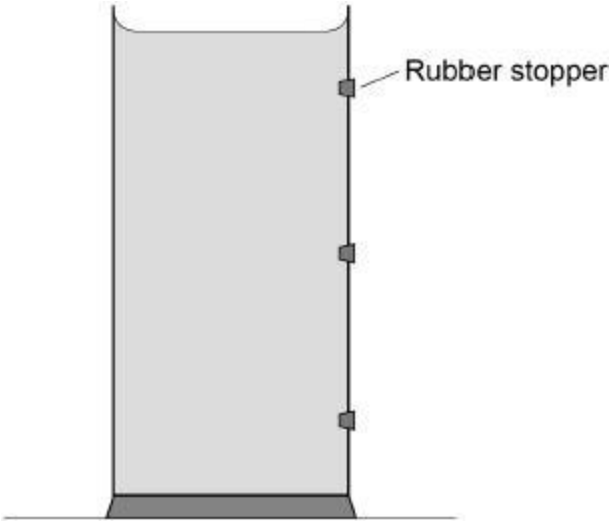
Topic: Pressure Difference In A Fluid

Q1.

Figure 1 shows a container filled with water.

The three holes in the side of the container are sealed with rubber stoppers.

Figure 1



(a) The water exerts a force of 27 N on the bottom of the container.
The cross-sectional area of the bottom of the container is 0.009 m^2.

Calculate the pressure exerted by the water on the bottom of the container.

Use the equation:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Choose the unit.

kg/m³	**N/m**	**Pa**

_____

_____

_____

_____

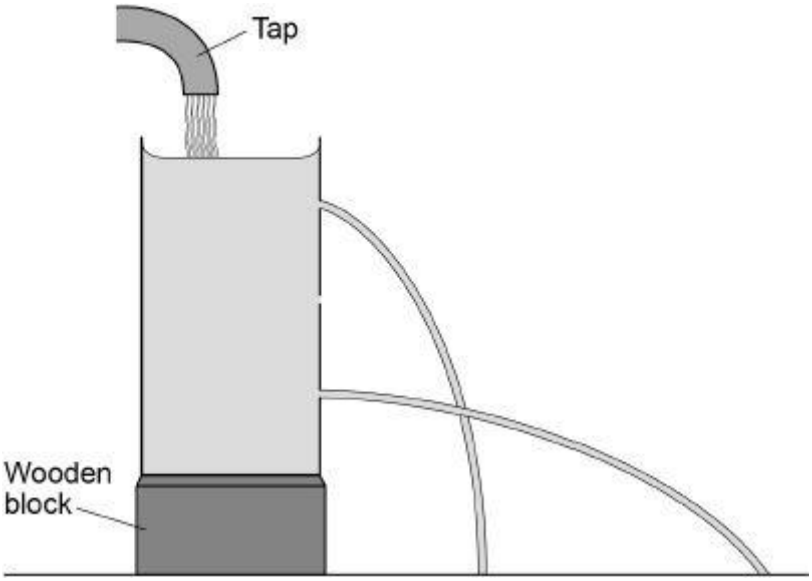
Pressure = _____ Unit = _____

(3)

The container is put under running water from a tap and the three rubber stoppers removed.

Figure 2 shows the path taken by the water escaping from the top and bottom holes.

Figure 2



(b) Complete **Figure 2** to show the path taken by the water escaping from the centre hole.

(1)

(c) What can be concluded from **Figure 2** about the pressure in a liquid?

_____

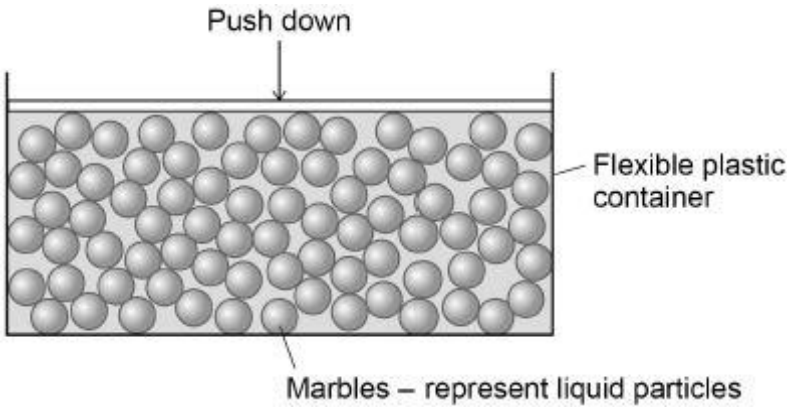
_____

(1)

(d) **Figure 3** shows a simple model of a liquid.

When a force pushes down on the marbles, the marbles push the sides and bottom of the container outwards.

Figure 3



What can be concluded from this model about the pressure in a liquid?

_____

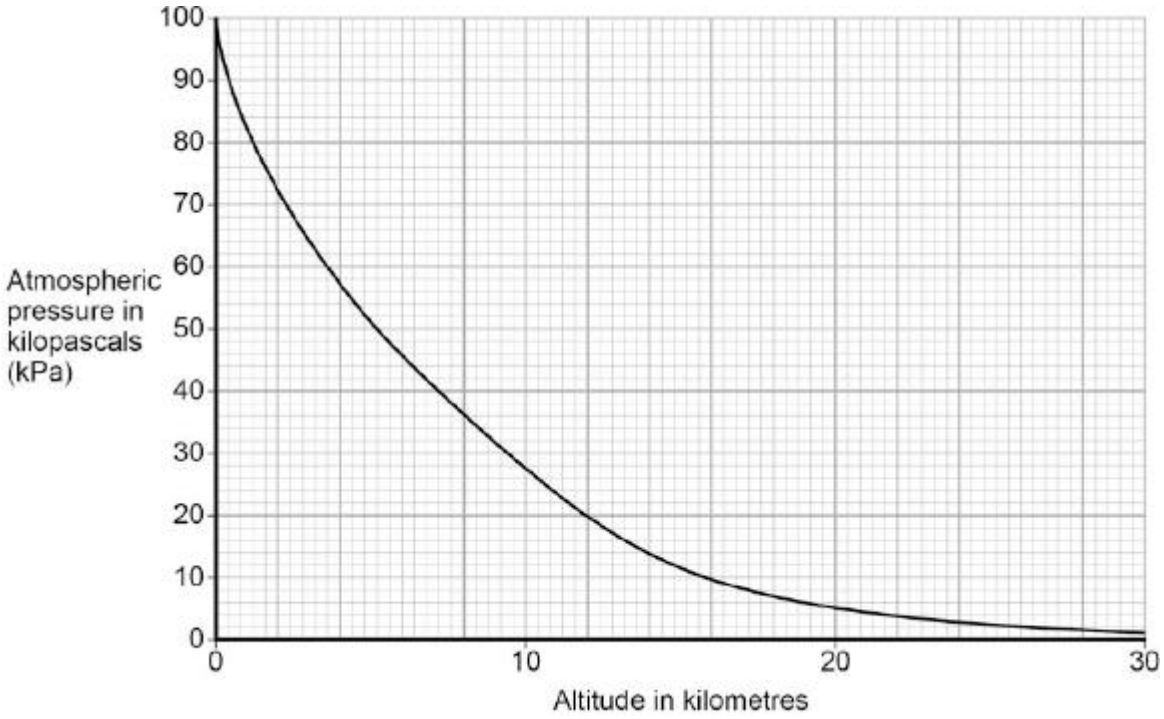
(1)

(Total 6 marks)

Q2.

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 cm^2.

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.

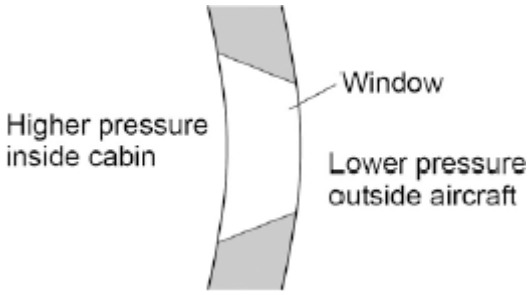
Give your answer to two significant figures

Resultant force = _____ N

(5)

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

Figure 2



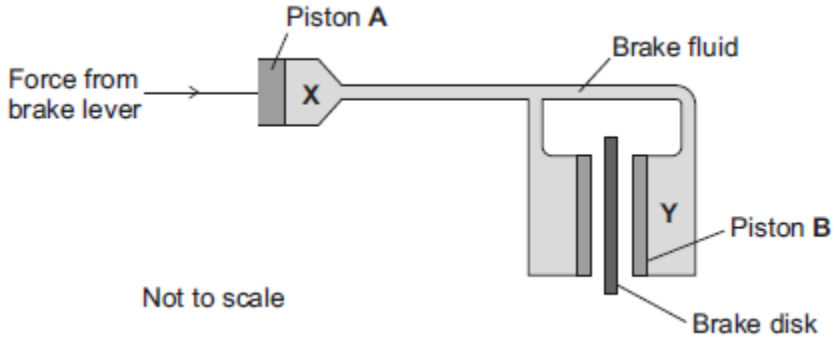
Explain why the window has been designed to have this shape.

(2)

(Total 10 marks)

Q3.

The figure below is a simplified diagram of a hydraulic brake system.



(a) Which is the correct statement about the pressure at **X** and the pressure at **Y**?

Tick (✔) **one** box.

The pressure at **X** is greater than at **Y** ☐

The pressure at **X** is the same as at **Y** ☐

The pressure at **X** is less than at **Y** ☐

(1)

(b) Piston **B** is larger than piston **A**.

How will this affect the size of the force on piston **B**?

Use the correct answer from the box to complete the sentence.

smaller than	**the same as**	**larger than**

The force on piston **B** will be _____ the force on piston **A**.

(1)

(c) (i) A force of 24 N acts on piston **A**. The cross-sectional area of piston **A** is 8 mm^2.

Calculate the pressure in N/mm^2 at position **X**.

_____

_____

_____

_____

Pressure = _____ N/mm^2

(2)

(ii) The unit N/mm^2 is not often used to measure pressure.

Which unit is usually used to measure pressure?

Tick (✔) **one** box.

newton ☐

pascal ☐

watt ☐

(1)

(d) The liquid used in the hydraulic brake system freezes at –30 °C.

Suggest **one** effect a temperature below –30 °C would have on the brake system.

_____

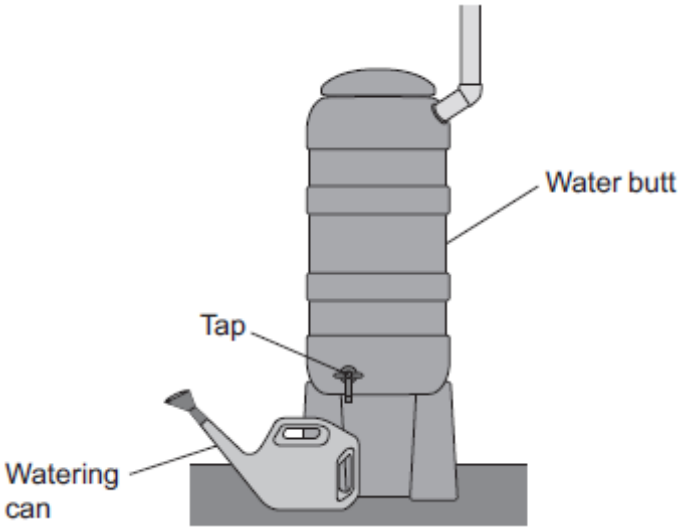
_____

(1)

(Total 6 marks)

Q4.

The diagram shows a water butt used to collect rainwater.



A tap allows water to be collected from the water butt in a watering can.

(a) If the tap was placed higher up on the water butt, what difference would it make to the rate of flow of water from the tap?

Explain your answer.

_____

_____

_____

_____

(2)

(b) A hosepipe is now attached to the tap. The hosepipe takes water to where it is needed.

A gardener did an investigation to see how the rate of flow of water through a hosepipe, from a water butt, varies with the length of the hosepipe.

His results are shown in below table.

Length of hosepipe in metres	Water collected in 10 seconds in cm^3
2.0	500
3.0	500
4.0	500
5.0	500
10.0	250
15.0	170

(i) What conclusions can you make based on the results in the table above?

(2)

(ii) Suggest further readings that should be taken to improve the investigation.

Give reasons for your answers.

(4)

(c) **In this question you will be assessed on using good English, organising**

information clearly and using specialist terms where appropriate.

You are provided with a water butt and lengths of hosepipe of different diameter.

Describe how you would investigate how the rate of flow of water through a hosepipe varies with the diameter of the hosepipe.

In your description you should include:

- any additional equipment that you would use
- any measurements you would make using the equipmentz
- any variables that need to be controlled and how this would be achieved.

(6)

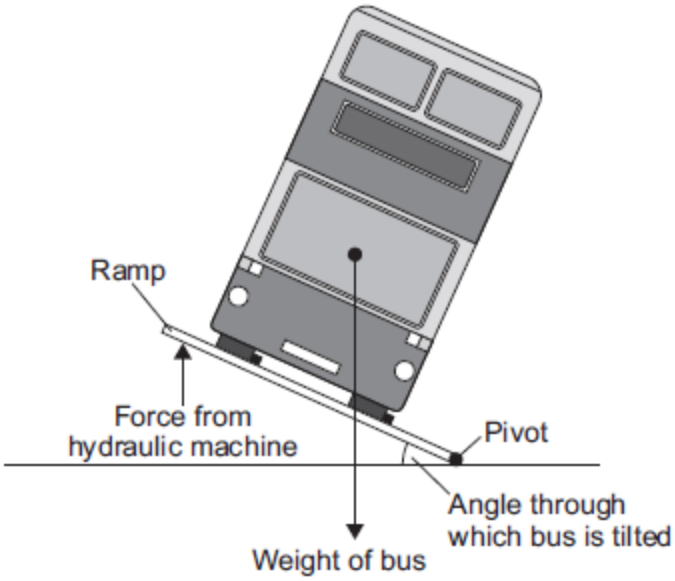
(Total 14 marks)

Q5.

Before a new bus can be used on the roads, it must pass a stability test.
Figure 1 shows how the bus is tested.

Figure 1

Front view



(a) (i) The bus will topple over if the ramp is tilted at too great an angle.

Explain why.

_____

_____

_____

_____

(2)

(ii) The bus is tested to angles of tilt far greater than it would experience in normal use.

Suggest **two** reasons why.

1. _____

_____

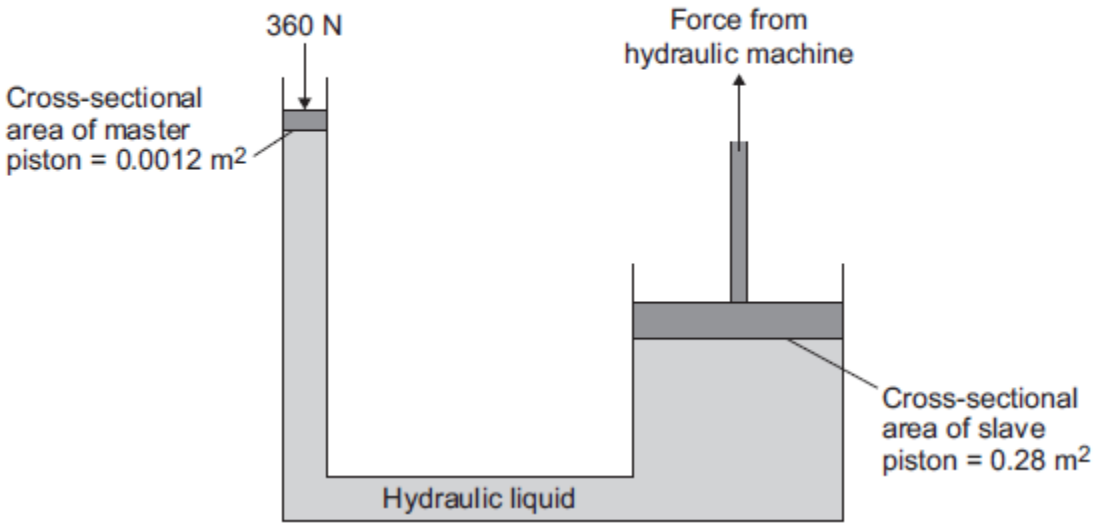
2. _____

_____

(2)

(b) **Figure 2** shows the hydraulic machine that is used to make the ramp tilt.

Figure 2



The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

(i) State the property of the liquid that keeps the pressure at both pistons the same.

_____

(1)

(ii) A 360 N force acts on the master piston.

Use information from **Figure 2** to calculate the force applied by the hydraulic liquid to the slave piston.

_____

_____

_____

_____

Force = _____ N

(3)

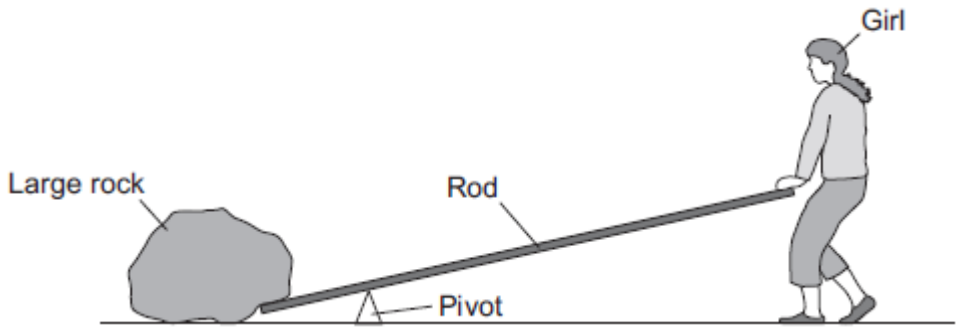
(Total 8 marks)

Q6.

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.

_____

_____

_____

_____

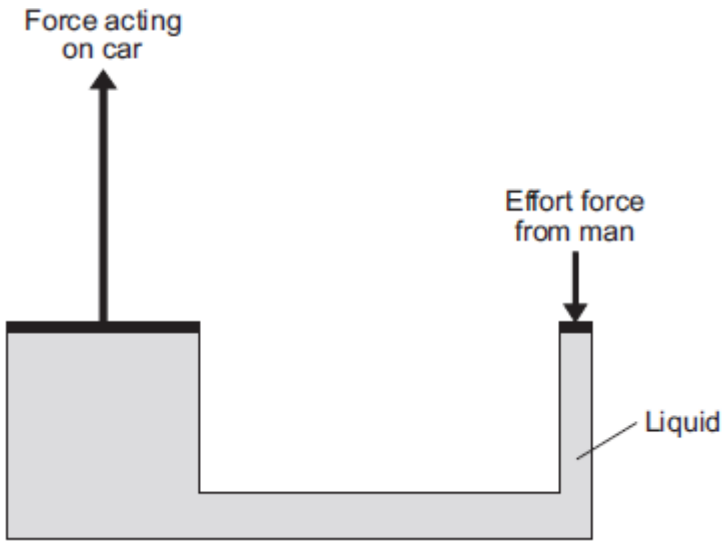
(2)

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

Figure 2

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.	

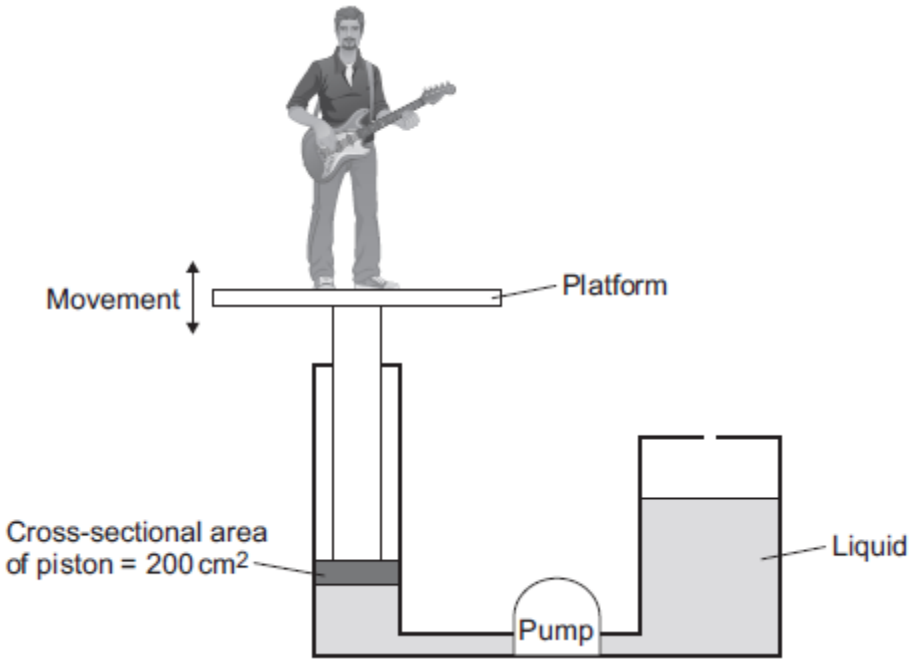
(1)

(Total 9 marks)

Q7.

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^2.

Calculate the pressure in the liquid, in N / cm^2, when the platform moves.

_____

_____

_____

Pressure = _____ N / cm^2

(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)

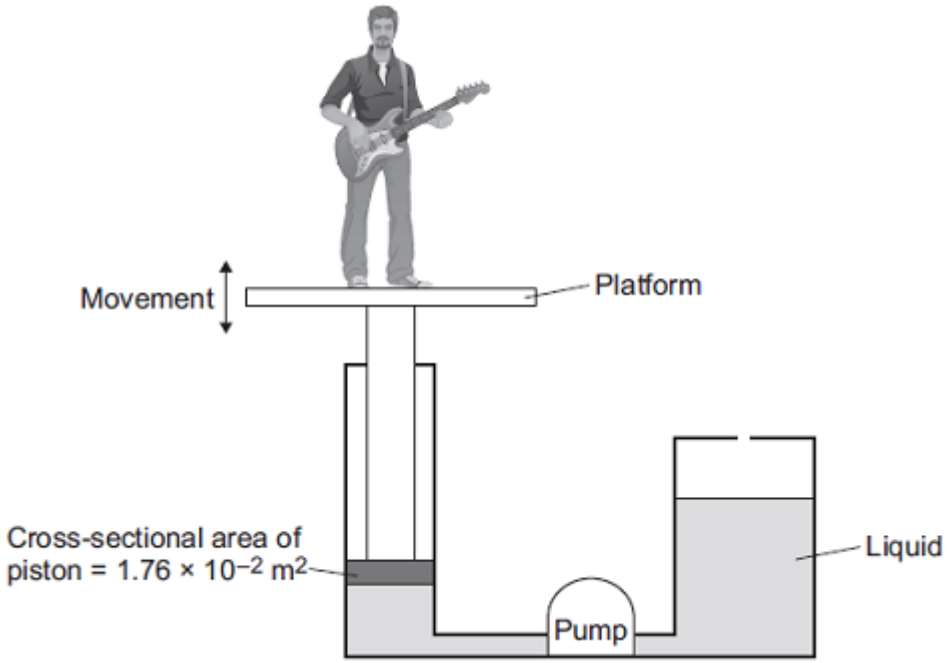
(Total 4 marks)

Q8.

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 x 10^4 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.

_____

_____

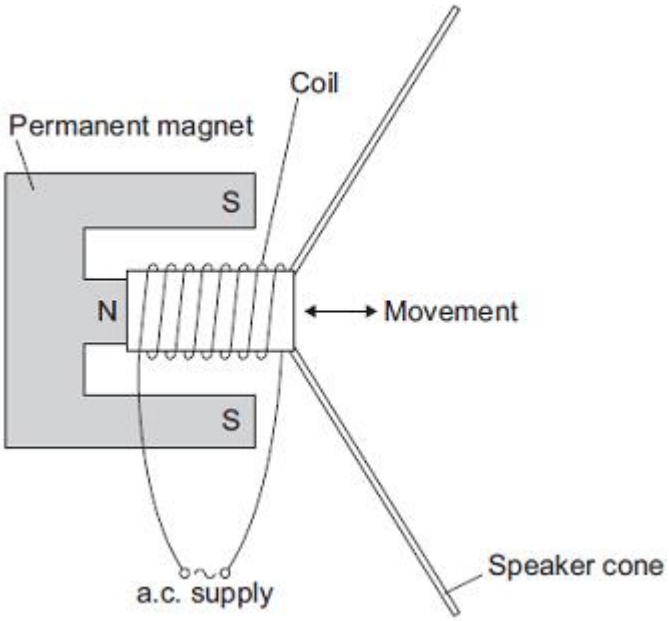
_____

(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.

(4)

(Total 8 marks)

Q9.

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^2.

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

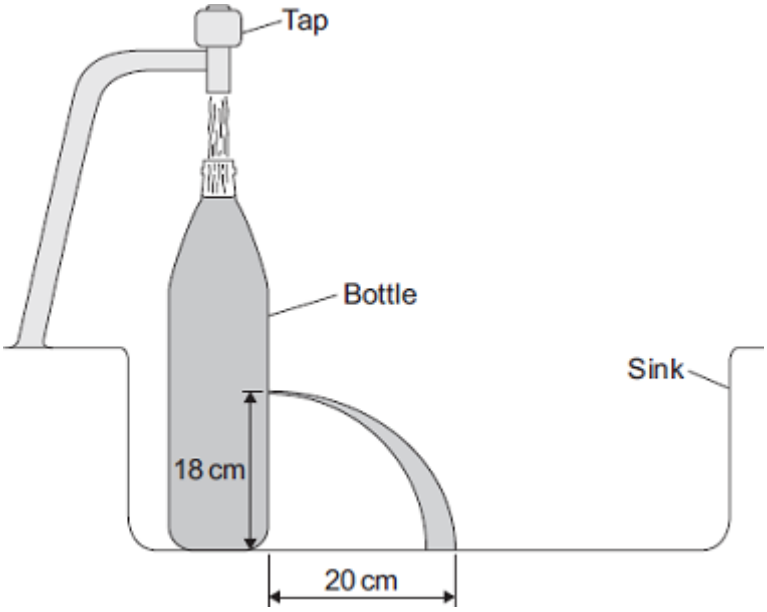
_____

_____

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)

Q10.

Mountain bike riders use brakes to slow down.

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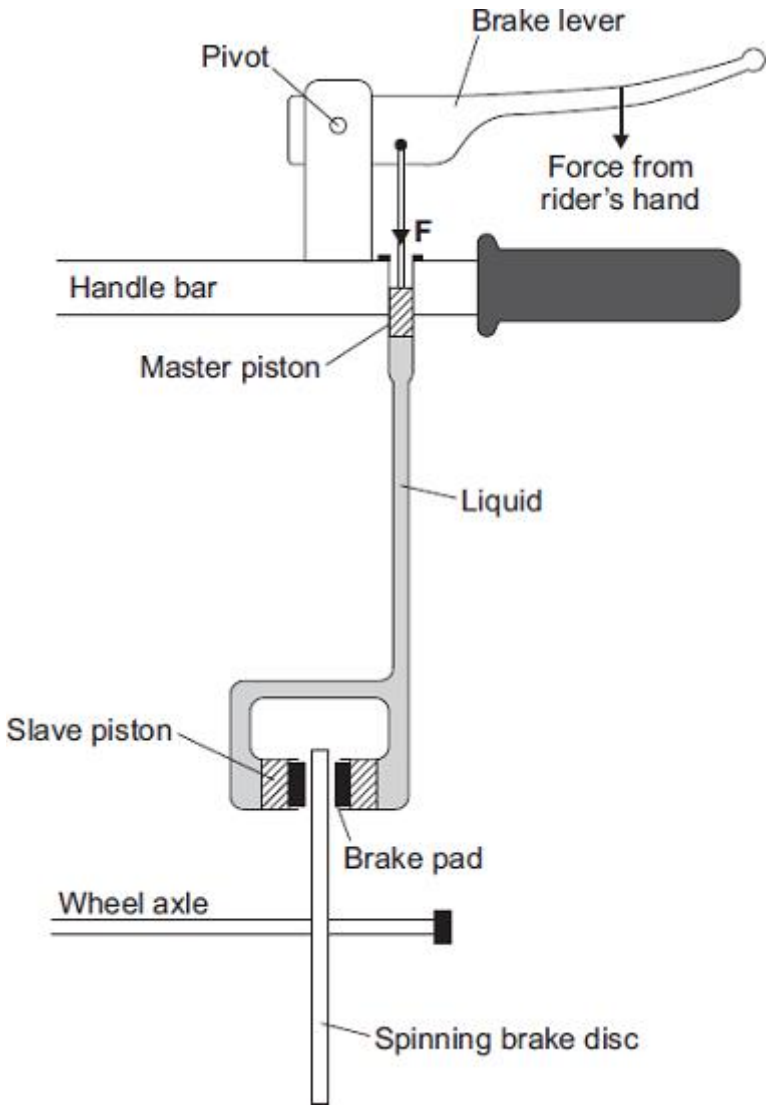
Some mountain bikes use liquid-filled pipes to transmit the force from the rider's hand on the brake lever to the brake pads. These brakes are called hydraulic brakes.



(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

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

(1)

(ii)

The pressure in the liquid is transmitted

against force **F** 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^2.

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

_____

_____

_____

Pressure = _____ N/mm^2

(2)

(c) The unit N/mm^2 is **not** the usual unit of pressure.

Which unit is usually used when calculating pressure?

Draw a ring around the correct answer.

N Nm^2 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)

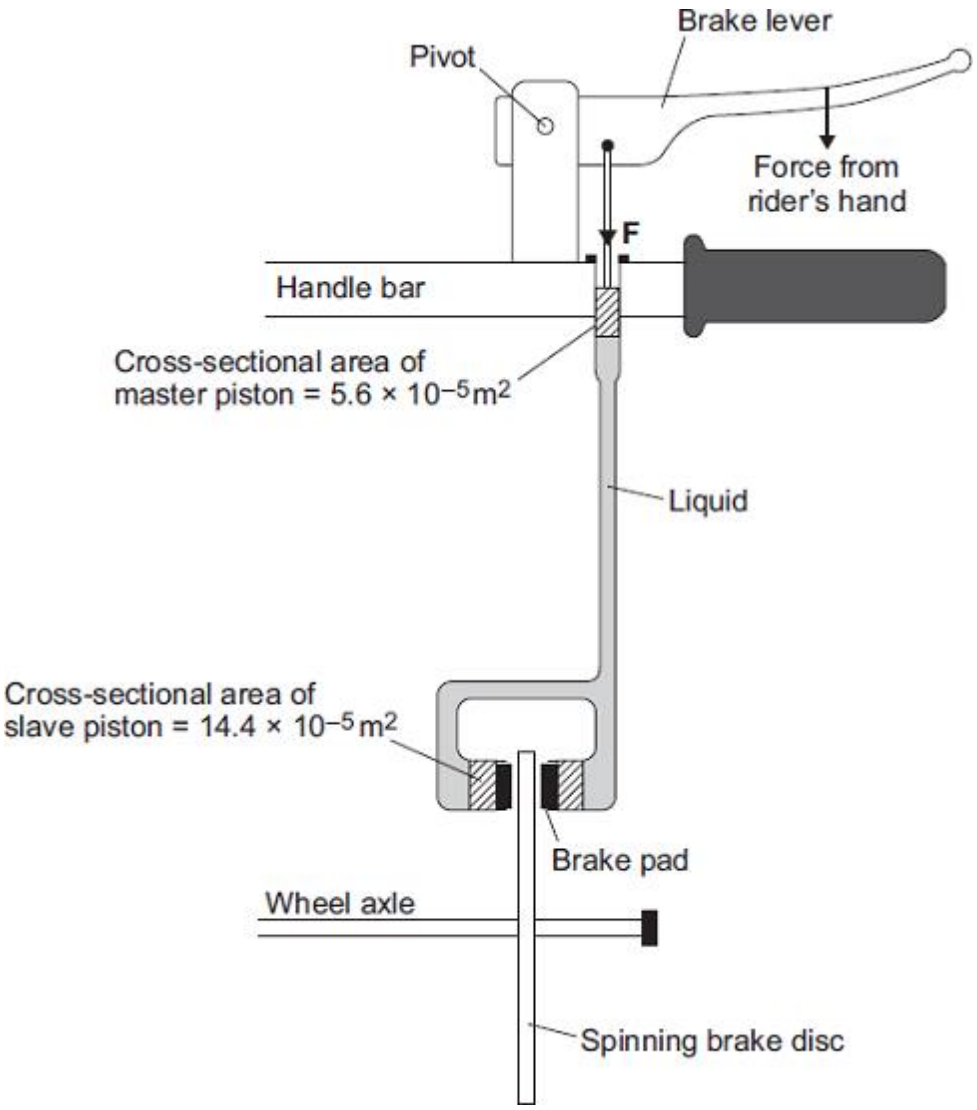
(Total 6 marks)

Q11.

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)

Mark schemes

Q1.

(a) $p = \frac{27}{0.009}$

1

p = 3000

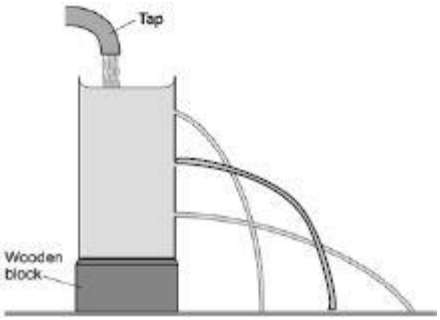
1

Pa

1

*an answer of 3000 scores **2** marks*

(b)



the water path hits the surface somewhere between the other two paths

1

(c) pressure increases with depth

allow when the pressure is higher, the water travels further

1

(d) pressure acts in all directions
or
pressure causes a force on (all) the surfaces

ignore liquids cannot be compressed

1

[6]

Q2.

(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^2 to 0.081 m^2

allow ecf for an incorrect value clearly obtained from the graph

1

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

1

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

1

4050

1

4100 (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]

Q3.

(a) The pressure at X is the same as at Y

1

(b) larger than

1

(c) (i) 3 (N/mm^2)

accept 3 000 000 Pa (correct unit must be given)
*allow **1** mark for correct*
substitution, ie

$\frac{24}{8}$

provided no subsequent step

2

(ii) pascal

1

(d) the brakes would not work

allow the vehicle (car/bike etc) would not stop

accept they would freeze solid ***or*** *seize up*

1

[6]

Q4.

(a) rate of flow of water less

1

because pressure is less
or
because force acting is less
or
because height of water above tap is less

1

(b) (i) at short lengths water collected is the same

accept rate of flow for water collected

1

at longer lengths water collected decreases as the length of pipe increases

if no other mark gained allow as the length increases the flow decreases for ***1*** *mark*

1

(ii) **max 4 marks**
take more readings to calculate a mean (1)

take more readings is insufficient

to reduce effect of random errors (1)
or
take more readings between 5.0 m and 10.0 m (1)
see where the change occurs (1)
or
take more readings above 15.0 m (1)

accept take more readings at longer lengths

to see if trend continues (1)

maximum of ***2*** *marks for more readings and max* ***2*** *for reasons*

4

(c) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1−2 marks)
There is a basic description of the measurement of time **or** volume **or** diameter of pipe

Level 2 (3–4 marks)
There is a description of the measurement of the time taken to collect a fixed volume **or** the volume collected in a fixed time
and a description of an additional control variable

Level 3 (5–6 marks)
There is a description of the measurement of the time taken to collect a fixed volume
or the volume collected in a fixed time
and a description of an additional control variable
and a description of appropriate equipment

examples of the points made in the response
equipment
- tape measure or rule
- stopwatch
- container for collecting water
- measuring cylinder.

measurements
- diameter of hosepipe
- length of hosepipe
- volume of water collected
- time taken for collecting water
- repeat for different diameters.

control factors
- height of water in water butt (achieved by using a tap)
- length of hosepipe and how it is achieved by measuring and cutting.

6

[14]

Q5.

(a) (i) the line of action of the weight (of the bus) lies / acts outside of the base (of the bus)

allow line of action through the centre of mass lies / acts outside the base

1

there is a resultant moment (acting on the bus)

1

(ii) in normal use the centre of mass may be in a different position

1

or
passengers on the bus may affect the position of the centre of mass

for safety, buses should always be tested beyond the normal operating conditions / parameters

for safety is insufficient

accept in case something unexpected happens

1

(b) (i) a liquid is (virtually) incompressible

accept a liquid cannot be squashed

a liquid is difficult to compress is insufficient

1

(ii) 84000

*award **2** marks for*

$$\frac{F}{0.28} = \frac{360}{0.0012}$$

or

$$\frac{F}{0.28} = 300\ 000$$

***or** award **1** mark for*

$$P = \frac{360}{0.0012}$$

or

300 000 (Pa)

seen anywhere

3

[8]

Q6.

(a) make the rod longer

1

push down on the rod with a greater force

1

(b) particles are close together

1

so no room for more movement

dependent on 1st marking point

1

(c) (i) downward force produces pressure in liquid

reference to compression of liquid negates this mark

1

this pressure is the same at all points in a liquid
or
this pressure is transmitted equally through the liquid

*and P = F / A **or** F = P × A*

1

area (at load) bigger *(so force bigger)*

1

(ii) the force acting on the car moves less distance than the effort force

1

[9]

Q7.

(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]

Q8.

(a) hydraulic (system)

1

(b) 15.40×10^2
or
1540

*allow **1** mark for correct substitution, ie*

$8.75 \times 10^4 = \frac{F}{1.76 \times 10^{-2}}$

or

$87\ 500 = \frac{F}{0.0176}$

or

$F = 8.75 \times 10^4 \times 1.76 \times 10^{-2}$

or

$F = 87\ 500 \times 0.0176$

2

(c) any **one** environmental **advantage**:

stating a converse statement is insufficient, or a disadvantage of the usual oil, ie the usual oil is non-renewable

plant oil is renewable

using plant oil will conserve (limited) supplies **or** extend lifetime of the usual / crude oil.

plant oil releases less carbon dioxide (when it is being produced / processed)

plant oil will add less carbon dioxide to the atmosphere (when it is being produced / processed, than the usual oil)

plant oil removes carbon dioxide from **or** adds oxygen to the air when it is growing

stating that plant oil is carbon neutral is insufficient

1

(d) (the current flowing through the coil) creates a magnetic field (around the coil)

1

(this magnetic field) interacts with the permanent magnetic field
or
current carrying conductor is in a (permanent) magnetic field

it must be clear which magnetic field is which

1

this produces a (resultant) force (and coil / cone moves)

1

when the direction of the current changes, the direction of the force changes to the opposite direction

*accept for **2** marks the magnetic field of the coil interacts with the permanent magnetic field*

1

[8]

Q9.

(a) 3000

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

2

N / m^2 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]

Q10.

(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]

Q11.

(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

$1\ 500\ 000 = F \frac{}{0.000\ 056}$

*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 5×10^{-5} and the slave piston is 14.4×10^{-5} is insufficient

1

[5]