1.8 Pressure

01. 0625_s23_qp_42 Q: 3

(a) Fig. 3.1 shows a person moving across an ice-covered pond to reach a ball on the ice.

Fig. 3.1

Explain why this way of moving across the ice is safer than walking. Use your understanding of pressure in your answer.

....

....

....

.... [3]

(b) Fig. 3.2 shows a side view of the pond with a layer of ice floating freely on the water.

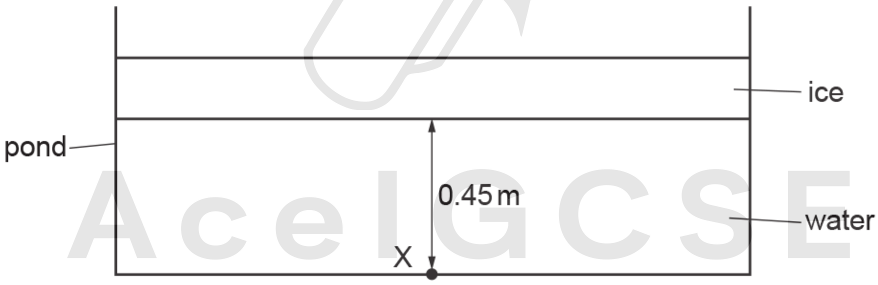

Fig. 3.2

The surface area of the pond is 5.0 m^2.
The mass of the ice is 690 kg.
The density of water is 1000 kg / m^3.
Point X is 0.45 m below the ice.

Calculate the pressure at point X due to the ice and the water.

pressure = ... [4]

02. 0625_s23_qp_43 Q: 2

(a) **(i)** Define pressure.

....

.... [1]

(ii) Describe how pressure in a liquid varies with its depth and with its density.

variation with depth

....

....

variation with density

....

....
[2]

(b) State **two** energy resources for which the Sun is **not** the main source.

1 ....

2 ....
[2]

(c) State and explain whether each of the following methods of electrical power generation is renewable.

(i) power generation in a nuclear power station

statement ....

explanation ....

....
[2]

(ii) power generation from waves in the sea

statement ....

explanation ....

....
[2]

03. 0625_s22_qp_41 Q: 2

Fig. 2.1 shows water stored in a reservoir behind a hydroelectric dam.

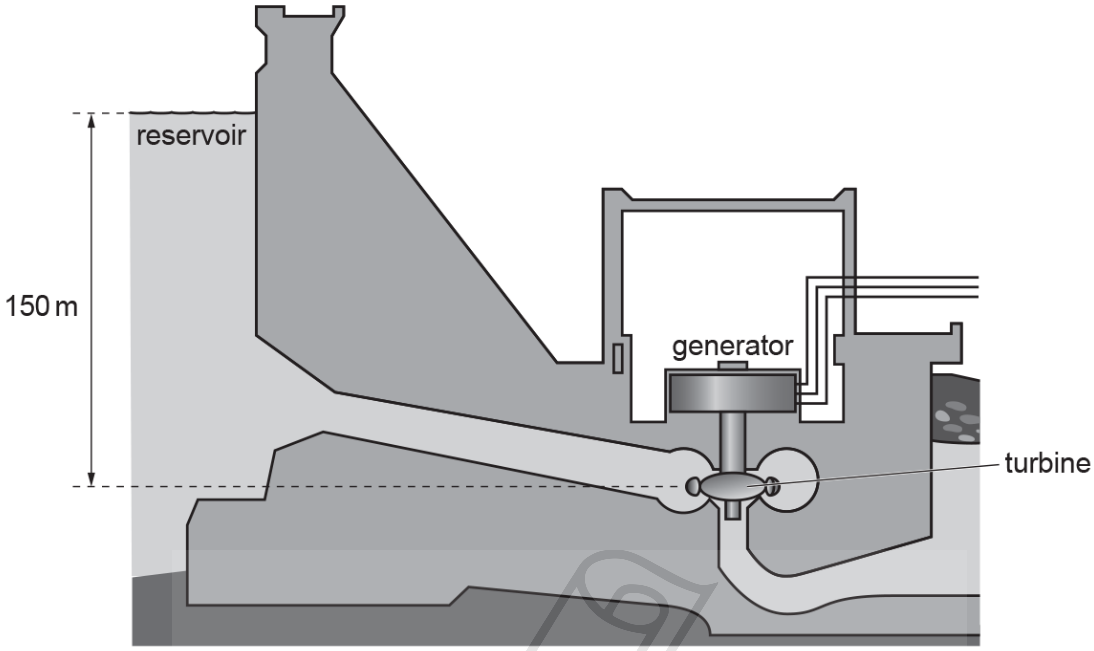

Fig. 2.1 (not to scale)

(a) State the form of the energy stored in the water in the reservoir that is used to generate electricity.

.... [1]

(b) The turbine is 150 m below the level of the water in the reservoir.

Atmospheric pressure is 1.0×10^5 Pa. The density of water is 1000 kg/m^3.

(i) Calculate the total pressure in the water at the turbine.

pressure = ... [3]

(ii) The turbine has a cross-sectional area of $3.5\,m^2$.

Calculate the force exerted on the turbine by the water.

force = ... [2]

(c) The water flows to the turbine through a pipe of constant cross-sectional area.

Explain why the kinetic energy of the water in the pipe remains constant as it flows through the pipe.

....

....

.... [2]

04. 0625_w22_qp_42 Q: 1

Fig. 1.1 shows sea water flowing down a channel into a tank without splashing. The water is flowing at a rate of 800 kg / min. The length and width of the tank are 3.10 m and 1.20 m. The density of the sea water is 1020 kg / m^3.

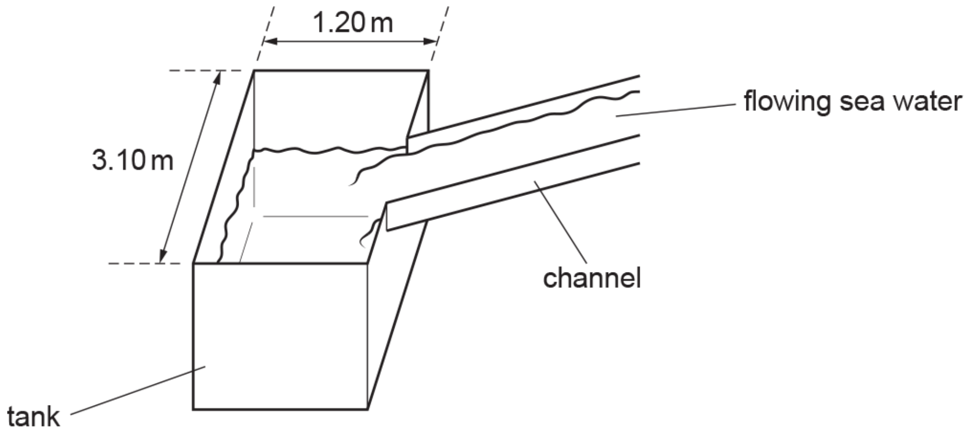

Fig. 1.1 (not to scale)

(a) Initially, the tank is empty.

Calculate the depth of water in the tank after 1.00 minute. Give your answer to three significant figures.

depth = ... [3]

(b) The height of the water decreases by 0.420 m as it flows down the channel.

Calculate the decrease in gravitational potential energy of the water each second.

decrease in gravitational potential energy = ... [3]

(c) The water stops flowing. The depth of water in the tank is 0.800 m.

Calculate the pressure at the bottom of the tank due to the water.

pressure = ... [3]

05. 0625_m21_qp_42 Q: 1

(a) Fig. 1.1 shows a piece of glass of thickness 2.0 cm and area 0.15 m^2.

The density of the glass is 2.6×10^3 kg / m^3.

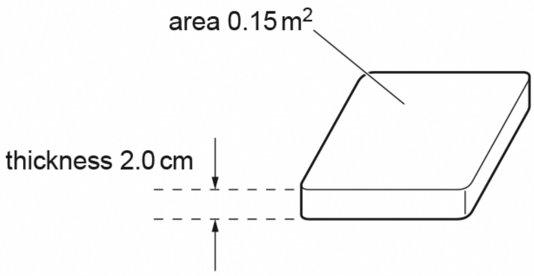

Fig. 1.1 (not to scale)

Calculate the weight of the piece of glass.

weight = ... [3]

(b) The piece of glass shown in Fig. 1.1 is used as the vertical viewing window of an aquarium. The atmospheric pressure outside the aquarium is 1.0×10^5 Pa. The average pressure on the inside of the aquarium window is 1.3×10^5 Pa.

Calculate the resultant force acting on the window due to these pressures and state the direction in which it acts.

force = ...

direction of force ....
[4]

(c) Fig. 1.2 shows a vacuum pump connected to the top of a vertical tube with its lower end immersed in a tank of liquid. The pump reduces the pressure above the column to zero and the pressure at point X is 9.6×10^4 Pa.

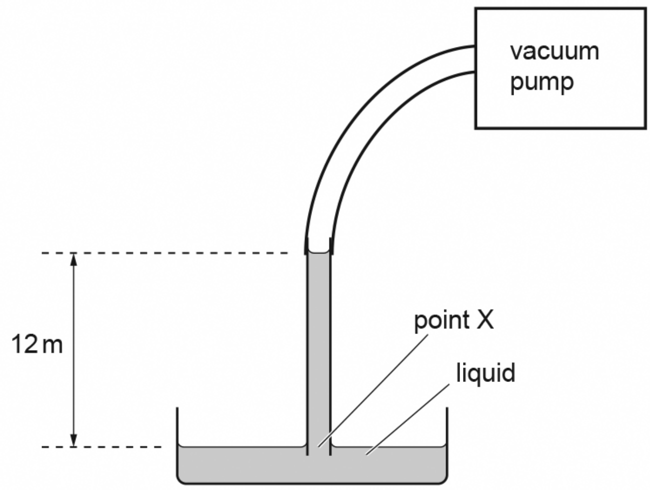

Fig. 1.2 (not to scale)

Calculate the density of the liquid.

density = ... [3]

[Total: 10]

06. 0625_s21_qp_43 Q: 2

(a) Fig. 2.1 shows a bookshelf with two groups of books A and B on it. There are six books in each group of books. All the books are identical. The mass of each book is 0.52 kg.

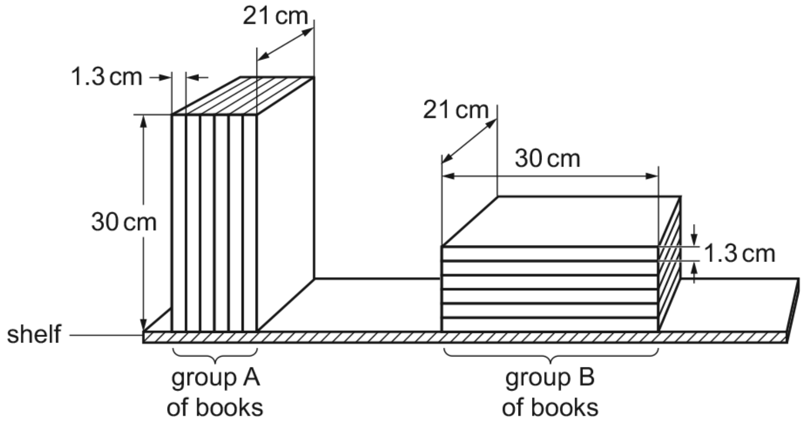

Fig. 2.1

(i) Explain why the pressure exerted on the shelf by the books in group B is less than the pressure exerted on the shelf by the books in group A.

....

....

.... [3]

(ii) Calculate the pressure exerted on the shelf by the books in group A.

pressure = ... [3]

(b) A diver dives to a depth below the surface of the sea where the total pressure is 3.0×10^5 Pa. The atmospheric pressure is 1.0×10^5 Pa. The density of the sea water is 1030 kg / m^3.

Calculate the depth of the diver below the surface of the sea.

depth = ... [3]

[Total: 9]

07. 0625_s20_qp_43 Q: 2

A scientist fills a container with sea water. The container has dimensions 30 cm × 30 cm × 40 cm. The density of sea water is 1020 kg / m^3.

(a) Calculate the mass of the sea water in the container.

mass = ... [3]

(b) Fig. 2.1 shows a submarine. The submarine is fully submerged in the sea.

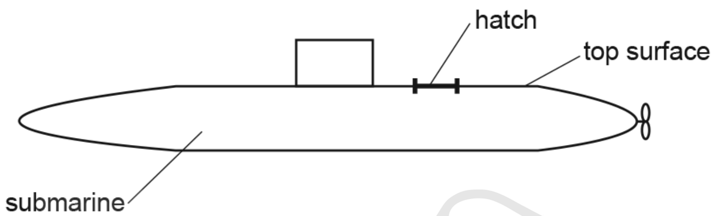

Fig. 2.1

(i) The atmospheric pressure is 100 kPa and the total pressure on the top surface of the submarine is 500 kPa.

Calculate the depth of the top surface of the submarine below the surface of the sea.

depth = ... [3]

(ii) A hatch (an opening door) on the top surface of the submarine has an area of 0.62 m^2.

Calculate the downward force on the hatch due to the total pressure on the top surface of the submarine.

force = ... [2]

[Total: 8]

08. 0625_w20_qp_41 Q: 3

A U-shaped tube of constant cross-sectional area contains water of density 1000 kg/m^3. Both sides of the U-tube are open to the atmosphere.

Fig. 3.1 shows that the water levels in the two sides of the tube are equal.

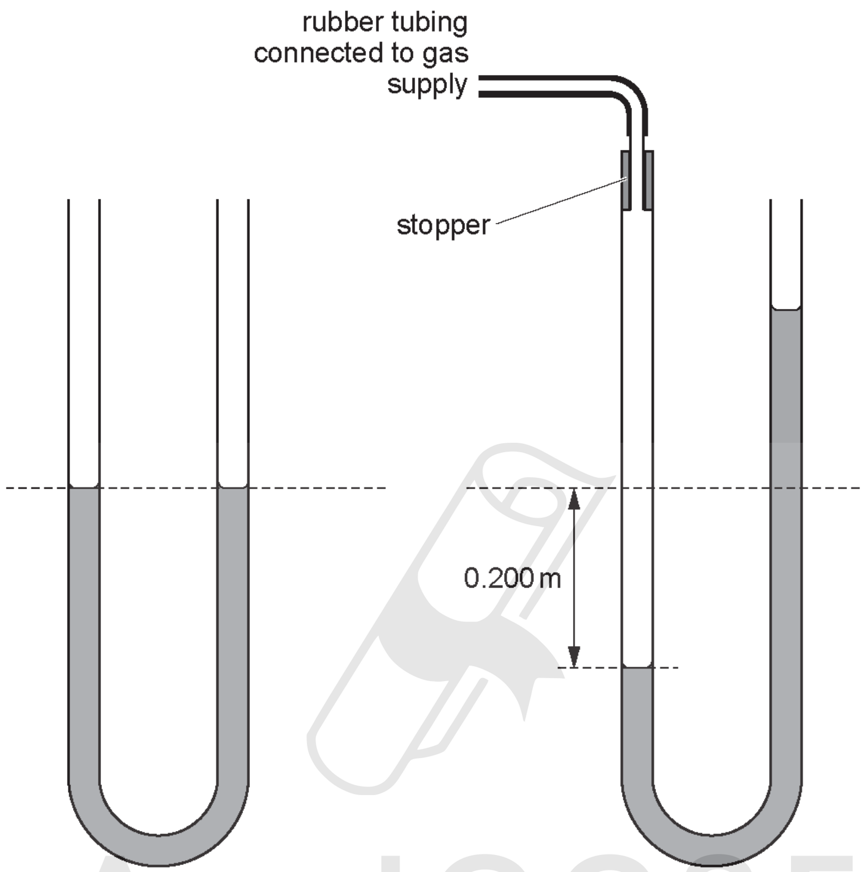

Fig. 3.1 **Fig. 3.2**

The atmospheric pressure is 1.00×10^5 Pa.

The left-hand side of the tube is now connected to a gas supply using a length of rubber tubing. This causes the level of the water in the left-hand side of the tube to drop by 0.200 m, as shown in Fig. 3.2.

(a) Calculate the pressure of the gas supply. Give your answer to 3 significant figures.

pressure = ... [3]

(b) Fig. 3.3 shows that the gas supply is now connected to a cylinder that contains a piston.

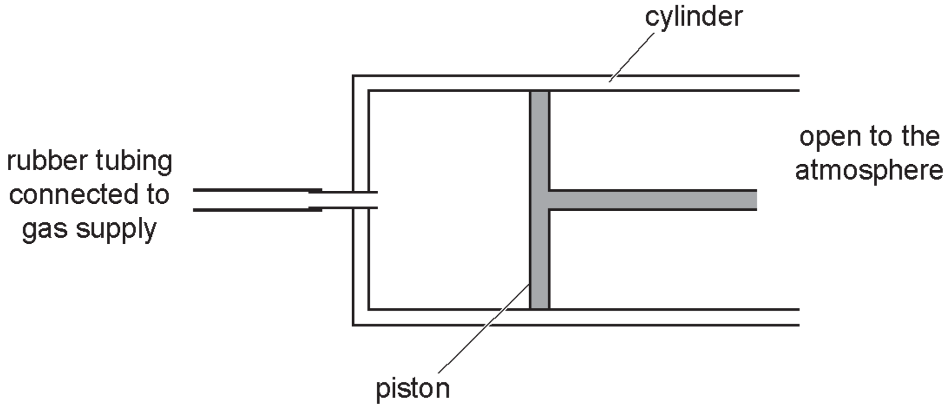

Fig. 3.3

The pressure of the gas moves the piston to the right.

(i) The area of the piston in contact with the gas is 0.025 m^2.

Calculate the resultant force on the piston.

resultant force = ... [2]

(ii) The pressure of the gas causes the piston to move a distance of 0.50 m to the right.

Calculate the work done by the gas from the supply on the piston.

work done = ... [2]

09. 0625_m19_qp_42 Q: 4

(a) Fig. 4.1 shows a mercury barometer. The tube containing the mercury is vertical.

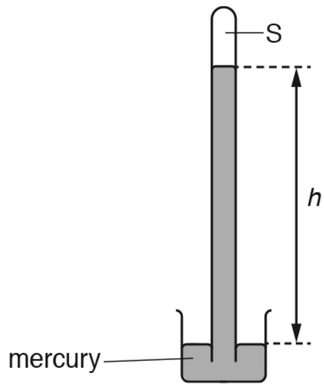

Fig. 4.1

(i) The height *h* indicates a value of the atmospheric pressure.

State what is contained in the space labelled S.

.... [1]

(ii) On a particular day the atmospheric pressure is 1.02×10^5 Pa. The density of mercury is 13 600 kg / m^3.

Calculate the value of *h* indicated by the barometer.

h = ... [2]

(iii) The tube containing mercury is now tilted so that it makes an angle of 10° with the vertical. After tilting, there continues to be a space above the mercury in the tube.

State and explain whether the vertical height of mercury in the tube is smaller, the same, or greater than the value calculated in **(a)(ii)**.

....

....

.... [2]

(b) Another mercury barometer in the same room at the same time shows a lower value of *h* than the barometer in **(a)**.

Suggest and explain a reason for the lower value.

....

....

.... [2]

[Total: 7]

10. 0625_w19_qp_42 Q: 1

Fig. 1.1 is the top view of a rectangular paddling pool of constant depth. The pool is filled with sea water.

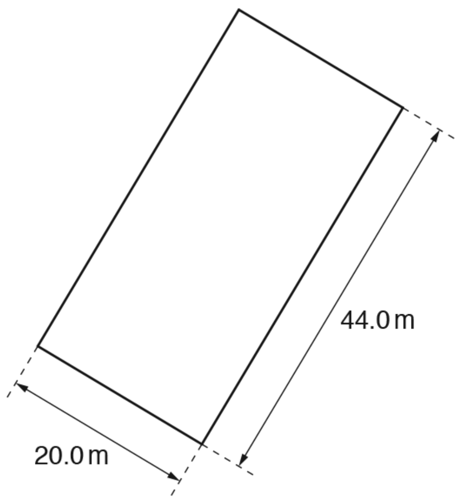

Fig. 1.1 (not to scale)

(a) The volume of the sea water in the pool is 264 m^3.

Calculate the depth of the pool.

depth = ... [3]

(b) The mass of the sea water in the pool is 2.70×10^5 kg.
Calculate the density of the sea water. Give your answer to 3 significant figures.

density = ... [2]

(c) Calculate the pressure due to the sea water at the bottom of the pool.

pressure = ... [2]

(d) State a suitable instrument for measuring the dimensions given in Fig. 1.1.

.... [1]

[Total: 8]

11. 0625_w19_qp_43 Q: 1

Fig. 1.1 is the top view of a tank in an aquarium. The tank is filled with salt water.

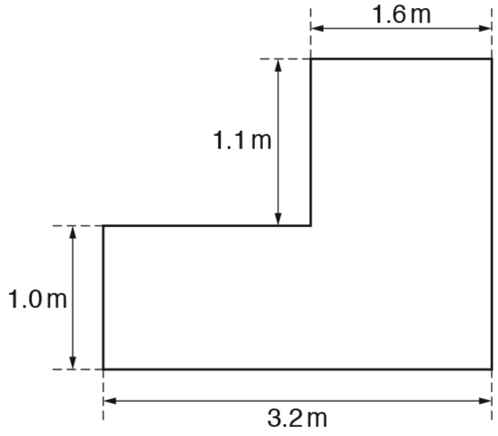

Fig. 1.1 (not to scale)

The depth of the water in the tank is 2.0 m.

(a) Calculate the volume of the water in the tank.

volume = ... [3]

(b) The density of the water in the tank is $1.1 \times 10^3\,kg/m^3$.

Calculate the mass of the water in the tank.

mass = ... [2]

(c) Calculate the pressure due to the water at a level of 0.80 m above the base of the tank.

pressure = ... [3]

[Total: 8]

12. 0625_s18_qp_41 Q: 3

A rectangular container has a base of dimensions 0.12 m × 0.16 m. The container is filled with a liquid. The mass of the liquid in the container is 4.8 kg.

(a) Calculate

(i) the weight of liquid in the container,

weight = ... [1]

(ii) the pressure due to the liquid on the base of the container.

pressure = ... [2]

(b) Explain why the total pressure on the base of the container is greater than the value calculated in **(a)(ii)**.

....

.... [1]

(c) The depth of liquid in the container is 0.32 m.

Calculate the density of the liquid.

density = ... [2]

[Total: 6]

13. 0625_s18_qp_42 Q: 2

Fig. 2.1 shows a hollow metal cylinder containing air, floating in the sea.

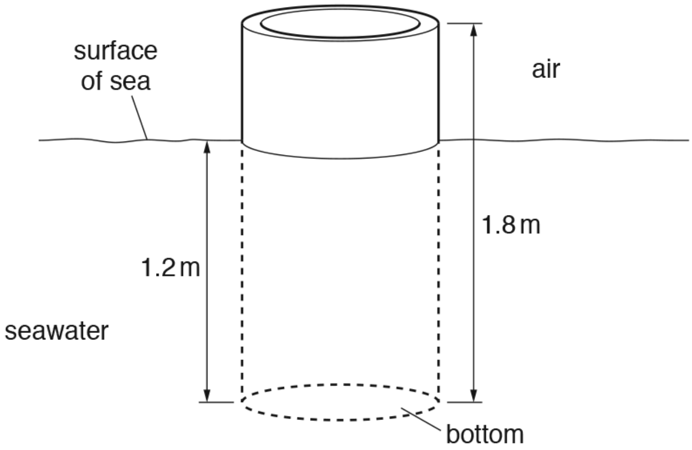

Fig. 2.1

(a) The density of the metal used to make the cylinder is greater than the density of seawater.

Explain why the cylinder floats.

....

....[1]

(b) The cylinder has a length of 1.8 m. It floats with 1.2 m submerged in the sea. The bottom of the cylinder has an area of cross-section of 0.80 m^2.

The density of seawater is 1020 kg / m^3. Calculate the force exerted on the bottom of the cylinder due to the depth of the seawater.

force = ...[4]

(c) Deduce the weight of the cylinder. Explain your answer.

weight = ...

explanation ....

....
[2]

[Total: 7]

14. 0625_w18_qp_41 Q: 4

(a) Fig. 4.1 shows liquid in a cylinder.

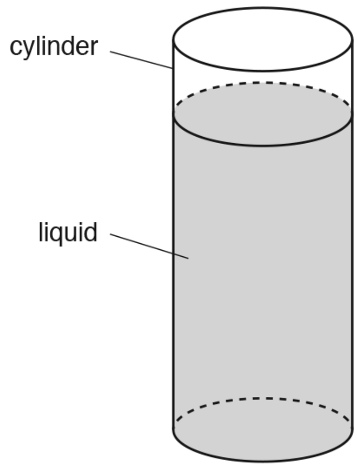

Fig. 4.1

The depth of the liquid is 10 cm and the radius of the cylinder is 3.0 cm. The weight of the liquid in the cylinder is 2.5 N.

Calculate the density of the liquid.

density = ...[3]

(b) Fig. 4.2 shows a device that measures the pressure of a gas supply.

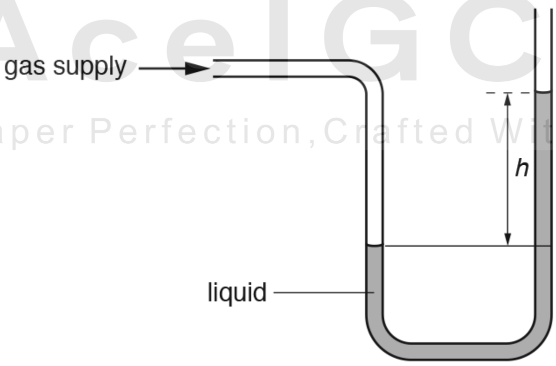

Fig. 4.2

(i) State the name of the device. ....[1]

(ii) The difference *h* between the two liquid levels is 2.0 cm. The density of the liquid is 800 kg / m^3.

Calculate the difference between the pressure of the gas and atmospheric pressure.

pressure difference = ...[2]

(iii) A similar device with a tube of smaller cross-sectional area is connected to a gas supply at the same pressure.

State and explain any effect on the value of *h*.

....

....

....[2]

[Total: 8]

15. 0625_w18_qp_42 Q: 2

(a) Fig 2.1 shows liquid in a cylinder.

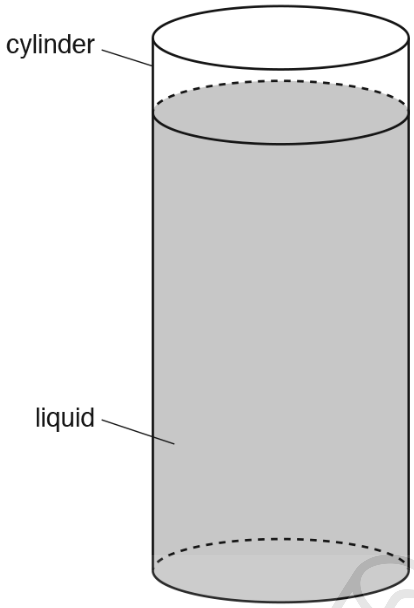

Fig. 2.1

Table 2.1 gives some data about the cylinder and the liquid.

Table 2.1

radius of cylinder	3.5 cm
weight of empty cylinder	2.5 N
depth of liquid	12.0 cm
density of liquid	900 kg / m^3

The cylinder containing liquid is placed on a digital balance that displays the mass in kg.

Calculate the reading shown on the balance.

reading .... kg [4]

(b) Fig. 2.2 shows a device that measures the pressure of a gas.

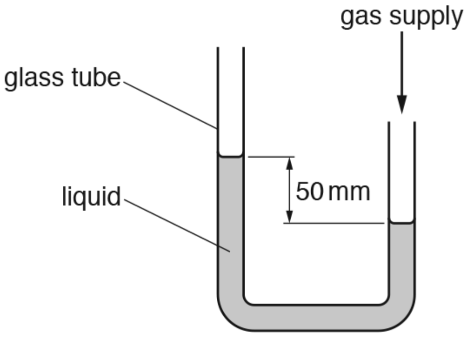

Fig. 2.2

(i) State the name of the device. ....[1]

(ii) The pressure of the gas is 400 Pa greater than atmospheric pressure.

Calculate the density of the liquid.

density = ...[2]

(iii) With the gas supply connected, the top of the tube on the left of the device is sealed securely with a rubber stopper. The gas pressure is then increased.

State and explain what happens to the liquid in the device.

....

....

....

....[2]

[Total: 9]

16. 0625_w18_qp_43 Q: 3

The density of mercury is 1.4×10^4 kg / m^3.

(a) Fig. 3.1 shows an instrument that is being used to determine the atmospheric pressure.

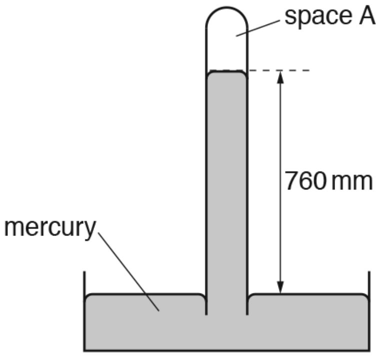

Fig. 3.1 (not to scale)

(i) State the name of the instrument.

....[1]

(ii) State what is in space A.

....[1]

(iii) Calculate the atmospheric pressure.

atmospheric pressure = ...[2]

(b) Fig. 3.2 shows mercury stored in a cylindrical glass jar of internal radius 4.0 cm. The depth of mercury in the jar is 12 cm.

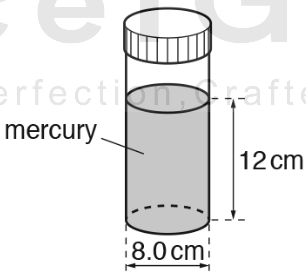

Fig. 3.2 (not to scale)

Calculate the weight of mercury in the jar.

weight = ...[3]

[Total: 7]

17. 0625_s17_qp_42 Q: 2

Fig. 2.1 shows a vehicle designed to be used on the Moon.

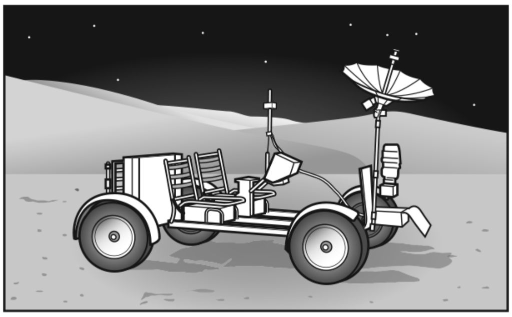

Fig. 2.1

The brakes of the vehicle are tested on Earth.

(a) The acceleration of free fall on the Moon is one sixth ($\frac{1}{6}$) of its value on Earth.

Tick **one** box in each column of the table to predict the value of that quantity when the vehicle is used on the Moon, compared to the test on Earth.

	mass of vehicle on Moon	weight of vehicle on Moon	deceleration of vehicle on Moon with same braking force
10 × value on Earth			
6 × value on Earth			
same as value on Earth			
$\frac{1}{6}$ × value on Earth			
$\frac{1}{10}$ × value on Earth			

[3]

(b) Fig. 2.2 shows the brake pedal of the vehicle.

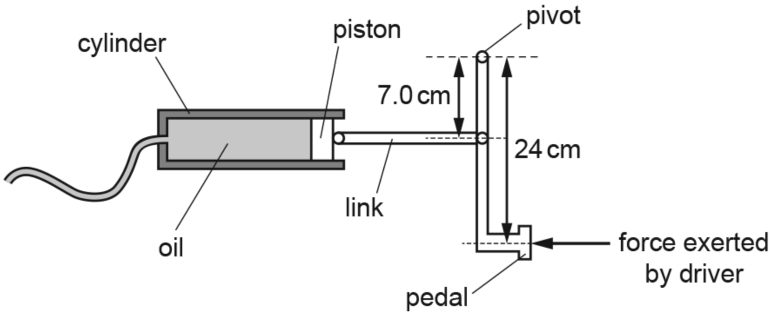

Fig. 2.2 (not to scale)

The driver exerts a force on the pedal, which increases the pressure in the oil to operate the brakes.

The area of the piston in the cylinder is $6.5 \times 10^{-4}\,m^2$ ($0.00065\,m^2$). The pressure increase in the oil is 5.0×10^5 Pa (500 000 Pa).

Calculate the force exerted by the driver on the brake pedal.

force = ...[4]

[Total: 7]

18. 0625_s17_qp_43 Q: 4

In the braking system of a car, the brake pedal rotates about a pivot when the pedal is pressed. Fig. 4.1 shows part of the braking system.

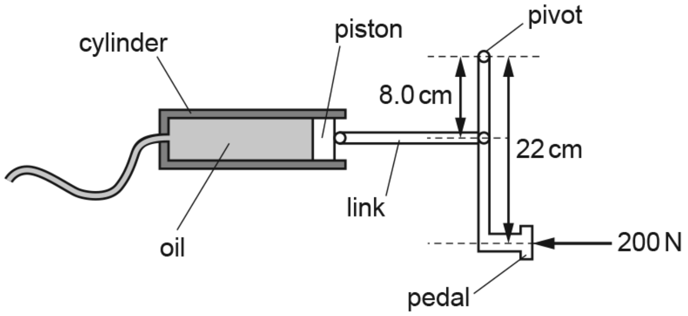

Fig. 4.1 (not to scale)

The driver exerts a force of 200 N on the pedal at a distance 22 cm from the pivot. As the pedal rotates about the pivot, a force is exerted on the piston and the pressure of the oil increases.

The area of the piston in the cylinder is $5.0 \times 10^{-4}\,m^2$ ($0.00050\,m^2$).

Calculate the increase in the pressure of the oil.

increase in pressure = ...[4]

[Total: 4]

19. 0625_w17_qp_41 Q: 3

All the sides of a plastic cube are 8.0 cm long. Fig. 3.1 shows the cube.

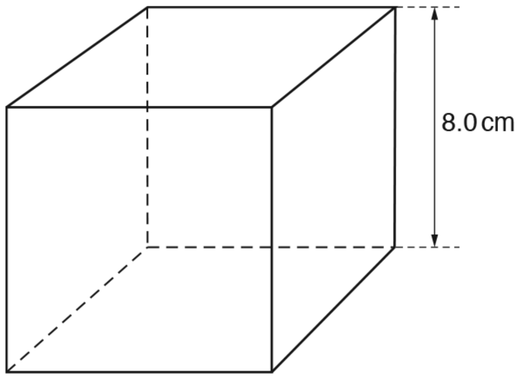

Fig. 3.1 (not to scale)

The mass of the cube is 0.44 kg.

(a) Explain what is meant by *mass*.

....[1]

(b) **(i)** Calculate the density of the plastic from which the cube is made.

density = ...[2]

(ii) The density of one type of oil is 850 kg / m^3.

State and explain whether the cube floats or sinks when placed in a container of this oil.

....

....[1]

(c) On the Moon, the weight of the cube is 0.70 N.

(i) Calculate the gravitational field strength on the Moon.

gravitational field strength = ...[2]

(ii) In a laboratory on the Moon, the plastic cube is held stationary, using a clamp, in a beaker of the oil of density 850 kg / m^3.

The arrangement is shown in Fig. 3.2.

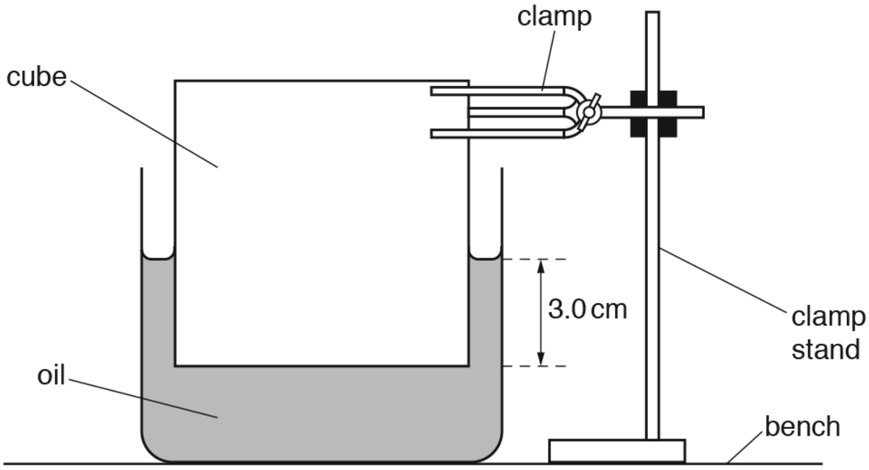

Fig. 3.2

The lower face of the cube is 3.0 cm below the surface of the oil.

Use your answer to **(c)(i)** to calculate the pressure due to the oil on the lower face of the cube.

pressure = ...[2]

[Total: 8]

20. 0625_w17_qp_42 Q: 1

Fig. 1.1 shows a cylinder made from copper of density 9000 kg / m^3.

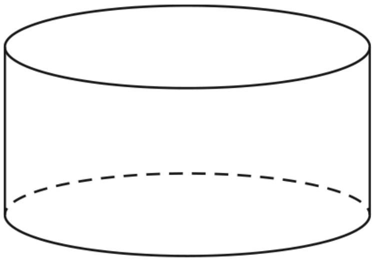

Fig. 1.1

The volume of the cylinder is 75 cm^3.

(a) Calculate the mass of the cylinder.

mass = ... [2]

(b) The gravitational field strength is 10 N / kg.

(i) Calculate the weight of the cylinder.

weight = ... [2]

(ii) State **one** way in which weight differs from mass.

....

....

.... [1]

(c) Fig. 1.2 shows the cylinder immersed in a liquid.

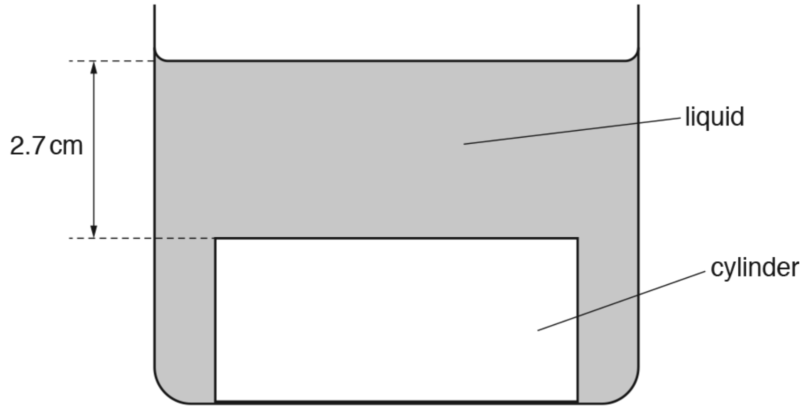

Fig. 1.2 (not to scale)

The upper face of the cylinder is at a depth of 2.7 cm below the surface of the liquid.

The pressure due to the liquid at the upper face of the cylinder is 560 Pa.

(i) Calculate the density of the liquid.

density = ...[2]

(ii) Explain why the cylinder does **not** float in this liquid.

....

....[1]

[Total: 8]

21. 0625_w17_qp_43 Q: 2

Fig. 2.1 shows a measuring cylinder that contains a coloured liquid.

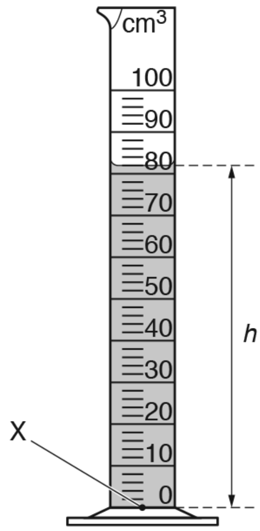

Fig. 2.1

The measuring cylinder contains 82 cm^3 of the liquid. The density of the liquid is 950 kg / m^3.

(a) Calculate the mass of the liquid.

mass = ...[3]

(b) The height *h* of the liquid in the measuring cylinder is 0.094 m.

(i) Calculate the pressure due to the liquid at point X in Fig. 2.1.

pressure = ...[2]

(ii) The true pressure at point X is different from the value calculated in **(b)(i)**.
Explain why.

....

....[1]

(c) A small object is made of steel. It is placed level with the top surface of the liquid in the measuring cylinder and then released. The object sinks in this liquid.

(i) Explain why the object sinks in this liquid.

....

....[1]

(ii) Describe how the volume of the object can now be determined.

....

....

....[1]

[Total: 8]