Solids Liquids and Gasses 1

1) During a period of hot weather, the atmospheric pressure on the pond in Fig. 3.1 remains constant. Water evaporates from the pond, so that the depth *h* decreases.

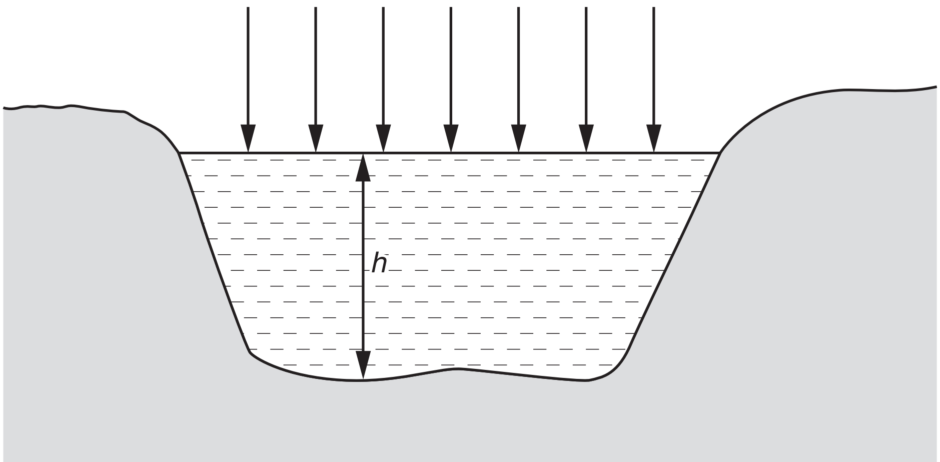


Fig. 3.1

(a) Study the diagram and state, giving your reason, what happens during this hot period to

(i) the force of the air on the surface of the pond,

....

....[1]

(ii) the pressure at the bottom of the pond.

....

....[1]

(b) On a certain day, the pond is 12 m deep.

(i) Water has a density of 1000 kg/m^3.

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

pressure due to the water = ...[2]

(ii) Atmospheric pressure on that day is 1.0×10^5 Pa.

Calculate the total pressure at the bottom of the pond.

total pressure = ...[1]

(iii) A bubble of gas is released from the mud at the bottom of the pond. Its initial volume is $0.5\,cm^3$.

Ignoring any temperature differences in the water, calculate the volume of the bubble as it reaches the surface.

volume = ...[2]

(iv) In fact, the temperature of the water is greater at the top than at the bottom of the pond.

Comment on the bubble volume you have calculated in **(b)(iii)**.

....

....

....[1]

[Total: 8]

2) Fig. 5.1 shows a gas contained in a cylinder enclosed by a piston.

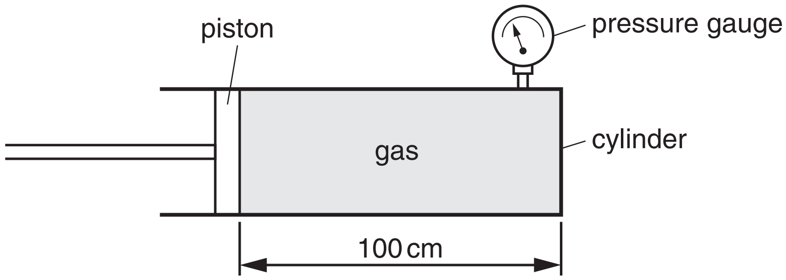


Fig. 5.1

At first, the length of cylinder containing the gas is 100 cm. The pressure of the gas, shown by the pressure gauge, is 300 kPa. The area of cross-section of the cylinder is 0.12 m^2.

(a) **(i)** Describe the motion of the molecules of the gas.

....

....

....[1]

(ii) Explain how the molecules exert a force on the walls of the cylinder.

....

....[1]

(iii) Calculate the force exerted by the gas on the piston.

force = ...[2]

(b) The piston is moved so that the new length of cylinder occupied by the gas is 50 cm. The temperature of the gas is unchanged.

(i) Calculate the new pressure of the gas.

pressure = ...[2]

(ii) Explain, in terms of the behaviour of the molecules, why the pressure has changed.

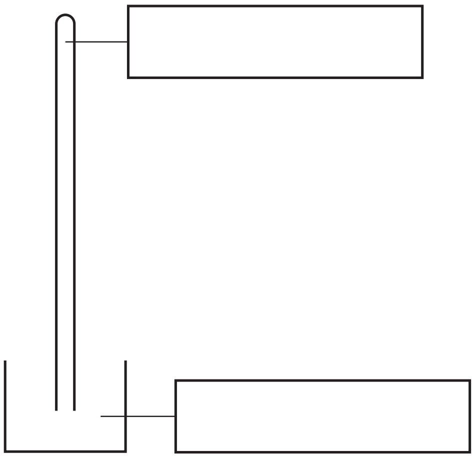
....

....

....[1]

[Total: 7]

3) **(a)** Complete Fig. 4.1 to show a simple mercury barometer. Insert the correct labels in the boxes. Label with the letter h the measurement required to calculate the pressure of the atmosphere.



[3]

Fig. 4.1

(b) The value of h taken using this barometer is 0.73 m. The density of mercury is 13 600 kg/m^3. Calculate the value of the atmospheric pressure suggested by this measurement. Use g = 10 m/s^2.

atmospheric pressure = ...[2]

(c) Standard atmospheric pressure is 0.76 m of mercury. Suggest a reason why the value of h in **(b)** is lower than this.

....

....[1]

[Total: 6]

Solids Liquids and Gasses 1

4) **(a)** Equal volumes of a gas held at constant pressure, a liquid and a solid undergo the same temperature rise.

(i) State which of the three, solid, liquid or gas,

1. expands the most, ...

2. expands the least. ....

(ii) Explain why the pressure of the gas must be kept constant for this comparison.

....

....[2]

(b) Fig. 5.1 shows an alcohol thermometer.

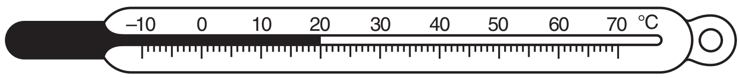


Fig. 5.1

(i) State two properties of alcohol which make it suitable for use in a thermometer.

1. ....

....

2. ....

....[2]

(ii) State **two** changes to the design of this thermometer which would make it more sensitive.

1. ....

....

2. ....

....[2]

(c) Explain why it is an advantage for the glass surrounding the alcohol in the bulb of the thermometer to be very thin.

....

....[1]

[Total: 7]

Solids Liquids and Gasses 1

5) Fig. 3.1 shows a house brick of dimensions 21.0 cm × 10.0 cm × 7.00 cm.

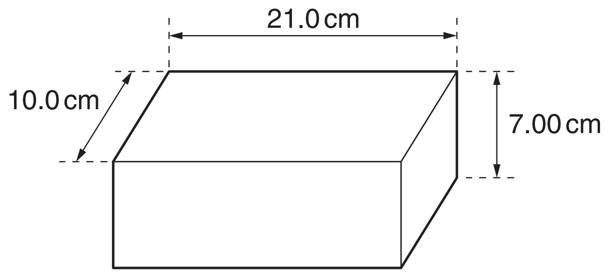


Fig. 3.1

The brick is held under water with its largest surfaces horizontal. The density of water is 1000 kg/m^3.

(a) Calculate the difference in pressure between the top and the bottom surfaces of the brick.

pressure difference = ... [2]

(b) Use your value from **(a)** to calculate the upward force exerted on the brick by the water.

upward force = ... [2]

(c) The mass of the brick is 3.09 kg. Calculate the acceleration of the brick when it is released.

acceleration = ... [3]

[Total: 7]

6) A sealed balloon containing some helium gas is released and rises into the upper atmosphere. As the balloon rises the temperature of the helium falls and the balloon expands.

Explain, in terms of atoms,

(a) the effect of the fall in temperature on the helium pressure,

....

....

....

....

.... [3]

(b) the effect of the expansion of the balloon on the helium pressure.

....

....

....

....

.... [3]

[Total: 6]

7) A soldier wears boots, each having an area of 0.016 m^2 in contact with the ground.

The soldier weighs 720 N.

(a) **(i)** Write down the equation that is used to find the pressure exerted by the soldier on the ground.

(ii) Calculate the pressure exerted by the soldier when he is standing to attention, with both boots on the ground.

pressure = ...
[2]

(b) The soldier is crossing a sandy desert.

Explain, stating the relevant Physics, why this soldier is at an advantage over another soldier who has the same weight but smaller feet.

....

....

....

....[2]

(c) The soldier's unit is sent to a cold country, and on one occasion he has to cross a frozen lake.

Suggest one way that the soldier can reduce the risk of the ice breaking under his weight.

....

....

....[1]

[Total: 5]

8) Fig. 4.1 represents part of the hydraulic braking system of a car.

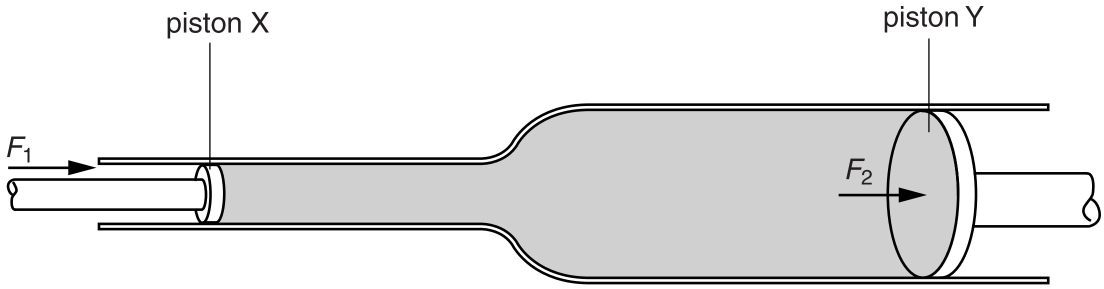


Fig. 4.1

The force F_1 of the driver's foot on the brake pedal moves piston X. The space between pistons X and Y is filled with oil which cannot be compressed. The force F_2 exerted by the oil moves piston Y. This force is applied to the brake mechanism in the wheels of the car.

The area of cross-section of piston X is 4.8 cm^2.

(a) The force F_1 is 90 N. Calculate the pressure exerted on the oil by piston X.

pressure = ... [2]

(b) The pressure on piston Y is the same as the pressure applied by piston X. Explain why the force F_2 is greater than the force F_1.

....

.... [1]

(c) Piston Y moves a smaller distance than piston X. Explain why.

....

....

.... [2]

(d) Suggest why the braking system does not work properly if the oil contains bubbles of air.

....

....

.... [2]

[Total: 7]

9) Fig. 6.1 shows a glass flask full of water at 10 °C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

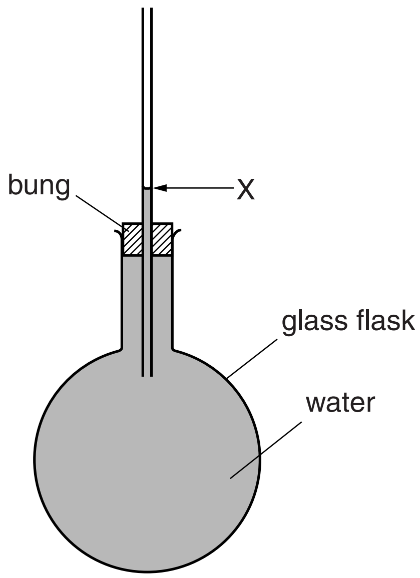


Fig. 6.1

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

(a) Suggest why

(i) the water level initially falls,

....

.... [2]

(ii) the water level then rises,

....

.... [2]

(iii) the rise is greater than the fall.

....

.... [1]

(b) Suggest a change to the apparatus that would make the fall and rise of the water level greater.

....

.... [1]

[Total: 6]

10) Fig. 2.1 shows a simple mercury barometer alongside a mercury manometer that contains some trapped gas.

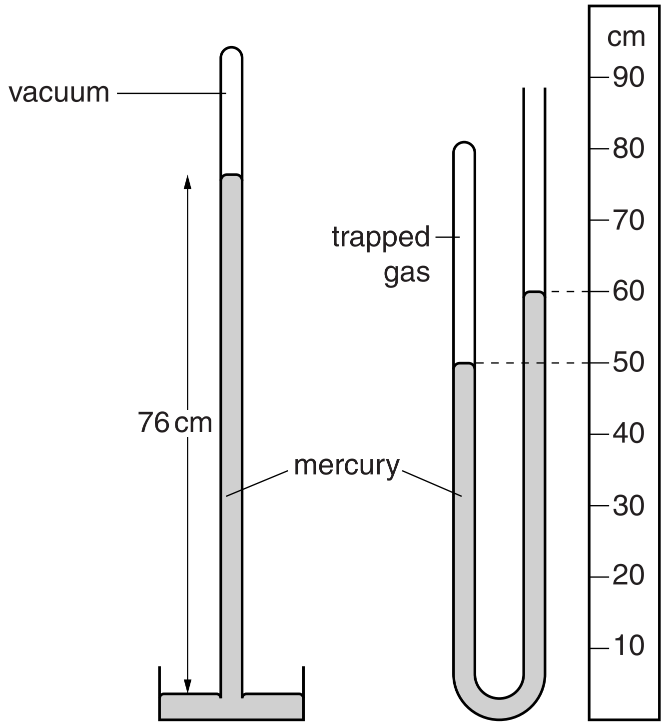


Fig. 2.1

From Fig. 2.1 find

(a) the pressure of the atmosphere,

pressure of atmosphere = ... cm of mercury [1]

(b) the pressure of the trapped gas.

pressure of trapped gas = ... cm of mercury [3]

(c) The atmospheric pressure increases.

State what happens to the levels of mercury in the manometer.

left-hand level ....

right-hand level ....

[2]

[Total: 6]