1. Motion, forces and energy

1.8 Pressure

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates

1 **(c)** In **(a)**, the weight of the pushchair and child is 240 N.
The total area of contact with the ground is 38 cm^2.

Calculate the pressure on the ground due to the pushchair and child.

pressure on ground = ... N/cm^2 [3]

[Total: 10]

2 **(c)** The student places the torch on its base on a shelf. The area of the base of the torch is 44 cm^2. The weight of the torch is 8.5 N.

Calculate the pressure on the shelf due to the torch.

pressure on shelf = ... N/cm^2 [3]

[Total: 9]

3 Fig. 5.1 shows a plastic bottle on a bench. The plastic bottle contains a liquid.

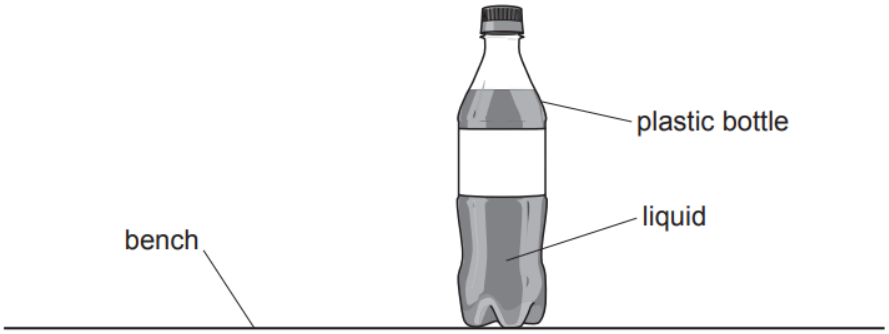

Fig. 5.1

(a) The weight of the bottle and liquid is 12 N. The area of the bottle in contact with the bench is 25 cm^2.

Calculate the pressure of the bottle on the bench.

pressure on bench = ... N/cm^2 [3]

4 Fig. 3.1 shows an archer pulling the string of a bow.

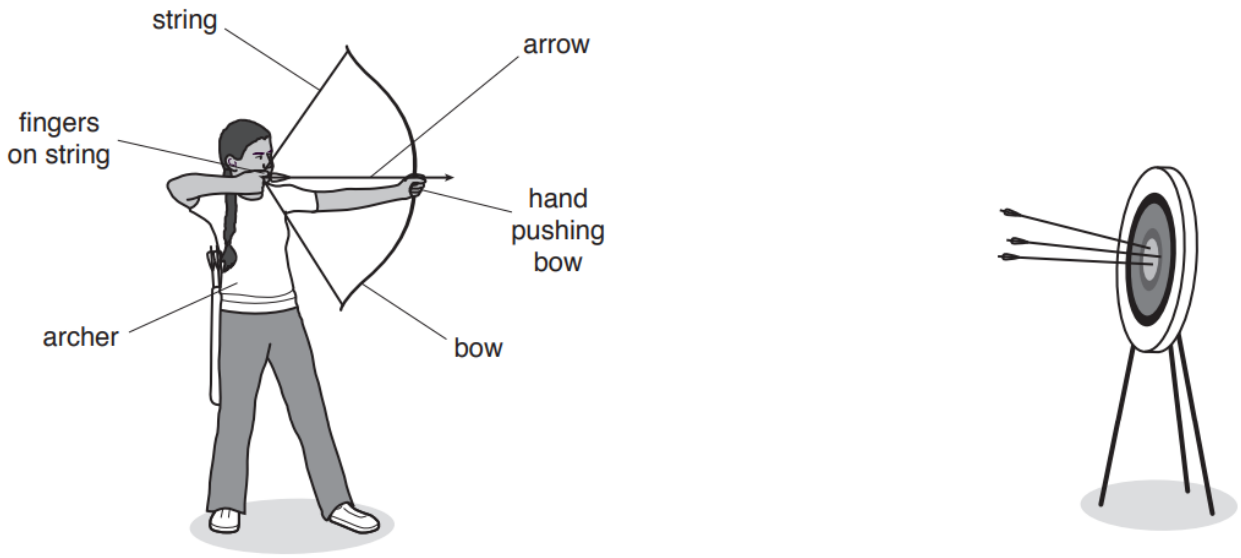

Fig. 3.1

(a) The archer uses a force of 120 N. The force acts on an area of 0.5 cm^2 on the archer's fingers.

Calculate the pressure on the archer's fingers.

pressure on fingers = ... N/cm^2 [3]

(b) The archer's other hand is pushing the bow with the same force of 120 N. This force acts on a larger area than the force in **(a)**.

State whether the pressure on this hand is greater than, the same as or less than the pressure on the fingers holding the string.

..... [1]

(c) State the type of energy stored in the bow when the archer bends it as shown in Fig. 3.1.

..... [1]

[Total: 5]

5 **(b)** The student uses a pump to inflate another balloon.

Fig. 4.2 shows the student inflating a balloon.

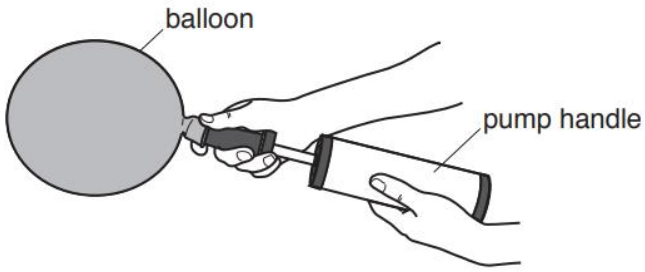

Fig. 4.2

The student applies a force of 30 N to the pump handle. The force acts on an area of 12 cm^2.

Calculate the pressure on the pump handle. Include the unit.

pressure = ... [4]

6 **(c)** The weight of a table is 280 N. The table has four legs. The area of each table leg in contact with the floor is 18 cm^2.

Calculate the pressure of the table on the floor. Give the correct unit.

pressure on the floor = ... unit ..... [5]

[Total: 8]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

7 Liquids are difficult to compress whereas gases can be compressed easily.

(a) Explain, in terms of particles, why it is difficult to compress liquids.

.....

.....

..... [2]

(b) Fig. 3.1 shows a rectangular block floating in water. The density of the water is 1000 kg/m^3.

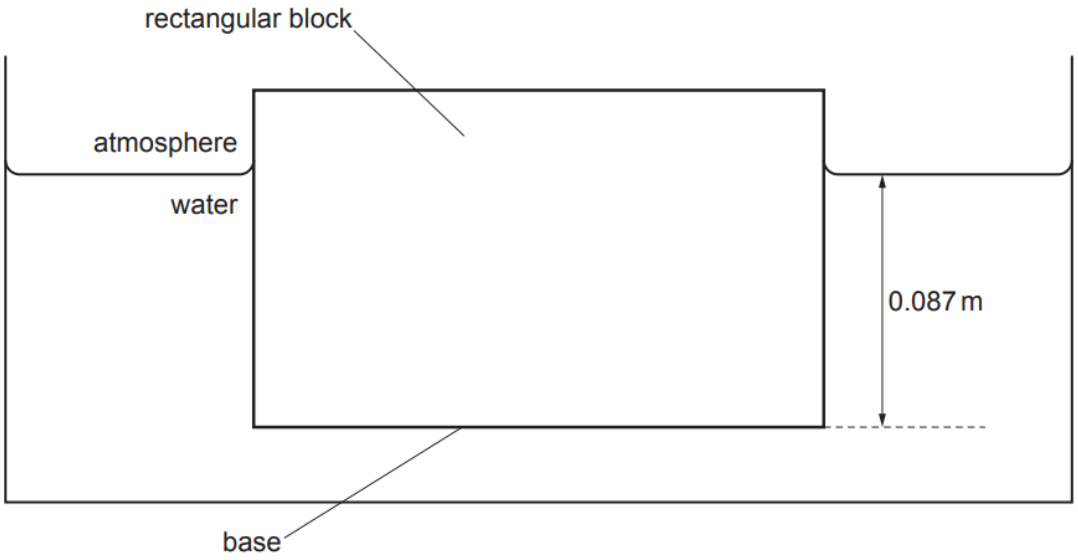

Fig. 3.1

The area of the base of the block is 0.014 m^2. The base of the block is at a depth of 0.087 m below the surface of the water.

(i) Show that the pressure due to the water at the base of the block is approximately 850 Pa. **(extended only)**

[2]

(ii) Calculate the force F on the base of the block caused by the pressure given in **(b)(i)**.

F = ... [2]

(iii) Force F is equal to the weight of the block.

Calculate the mass of the block.

mass = ... [2]

[Total: 8]

8 **(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.

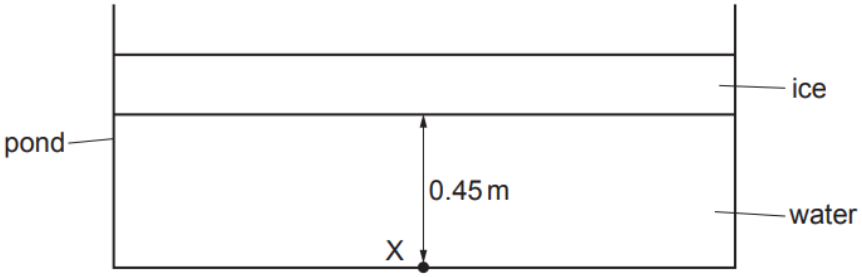

Fig. 3.2

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. **(extended only)**

pressure = ... [4]

[Total: 7]

9 A quantity of gas is trapped by a piston in a cylinder with thin metal walls. The piston is free to move without friction within the cylinder.

Fig. 4.1 shows the cylinder and piston.

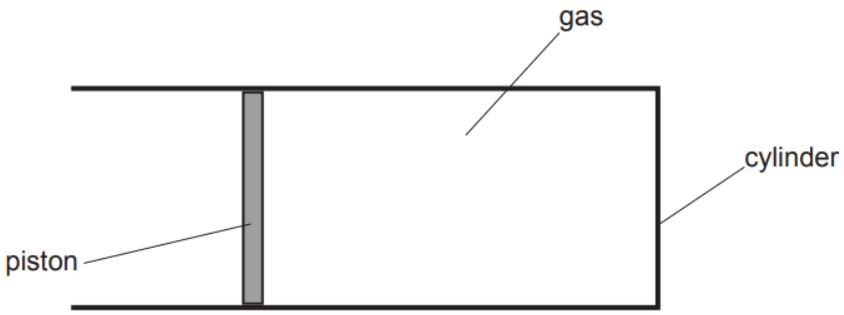

Fig. 4.1

The cylinder is placed inside a freezer.

(a) The air in the freezer is at atmospheric pressure, which is 1.0×10^5 Pa. The area of the piston in contact with the air in the freezer is 2.4×10^{-3} m^2.

(i) Calculate the force exerted on the piston by the air in the freezer.

force = ... [2]

(ii) When the cylinder is first placed into the freezer, the temperature of the gas in the cylinder decreases and the air pushes the piston into the cylinder.

Calculate the work done on the piston by the air in the freezer as the air pushes the piston a distance of 0.021 m into the cylinder.

work done = ... [2]

10 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.

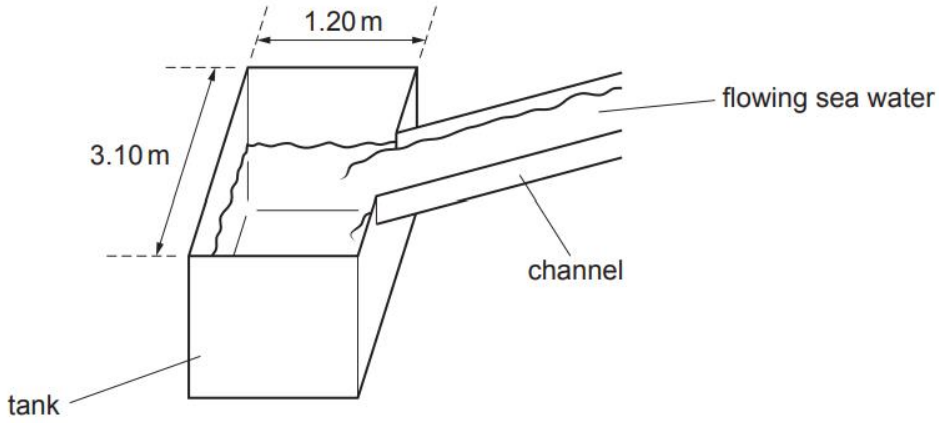

Fig. 1.1 (not to scale)

(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. **(extended only)**

pressure = ... [3]

11 **(a)** Explain, in terms of molecules, why liquids are very difficult to compress. **(extended only)**

.....

.....

..... [2]

(b) Fig. 3.1 shows a device that uses liquid pressure to lift heavy boxes.

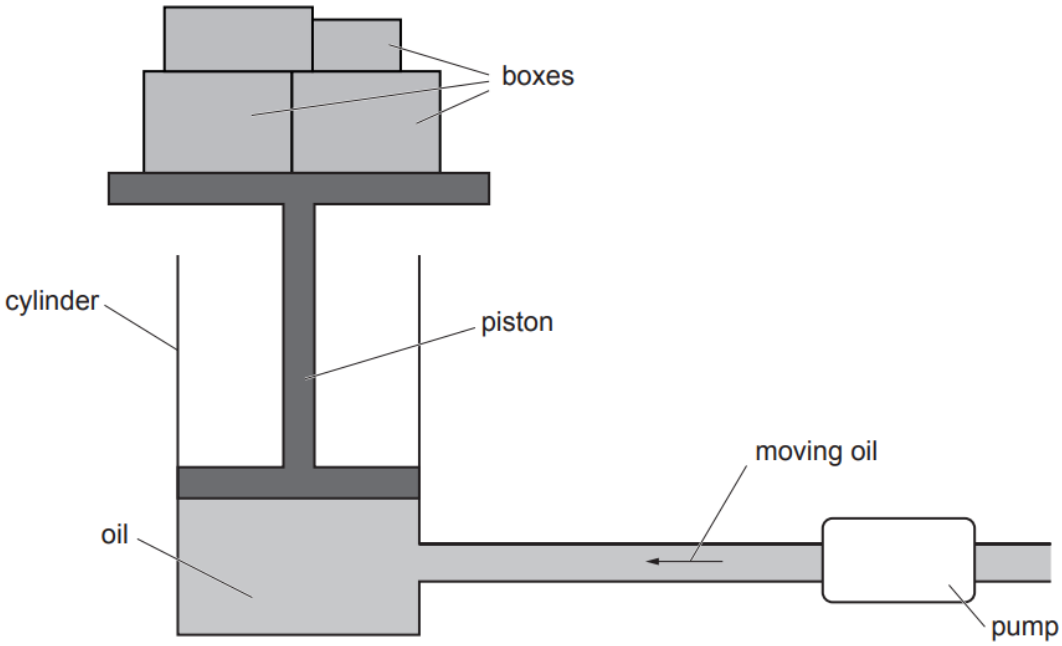

Fig. 3.1

The boxes are lifted by pumping oil into the cylinder.

The force upwards on the piston due to the oil, and the force downwards on the piston due to the air above the piston, combine to produce a constant force of 8800 N.

The pressure of the air is 1.0×10^5 Pa and the cross-sectional area of the bottom surface of the piston is $0.016\,m^2$.

(i) Calculate the pressure of the oil at the bottom surface of the piston.

pressure = ... [3]

(ii) As the boxes are lifted, the depth of the oil increases.

Explain why the pump must exert an increasing pressure on the oil as the depth of the oil increases.

.....

.....

..... [2]

(iii) Suggest **one** reason why the force of 8800 N in **(b)** cannot lift boxes of weight 8800 N.

.....

..... [1]

[Total: 8]

12 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. **(extended only)**

pressure = ...[2]

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

.....

.....[1]