Pressure

Question Paper 3

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	General Physics
Sub-Topic	Pressure
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 3

Time Allowed: **80 minutes**

Score: **/67**

Percentage: **/100**

1 **(a)** A student carries out an experiment to find the relationship between the pressure p and the volume V of a fixed mass of gas. The table contains four of her sets of measurements.

$p/$kPa	250	500	750	1000
$V/$cm^3	30.0	15.2	9.8	7.6

(i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

....

....

....

....[2]

(ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

....[1]

(b) A lake is 5.0 m deep. The density of the water is 1000 kg/m^3.

(i) Calculate the pressure at the bottom of the lake due to this depth of water.

pressure = ...[2]

(ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble			
mass of gas in bubble			
density of gas in bubble			

[2]

[Total: 7]

2 **(a)** A water tank has a rectangular base of dimensions 1.5 m by 1.2 m and contains 1440 kg of water.

Calculate

(i) the weight of the water,

weight = ... [1]

(ii) the pressure exerted by the water on the base of the tank.

pressure = ... [2]

(b) Fig. 5.1 shows two water tanks **P** and **Q** of different shape. Both tanks are circular when viewed from above. The tanks each contain the same volume of water. The depth of water in both tanks is 1.4 m.
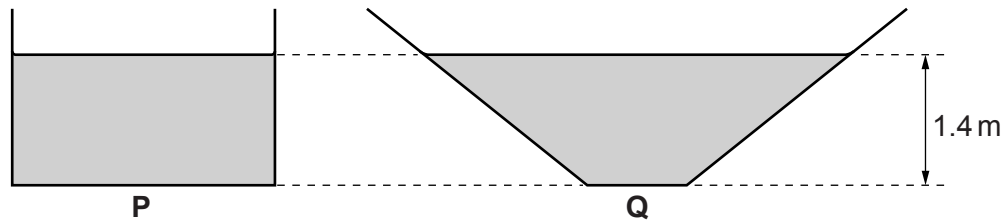

P   **Q**   1.4 m

Fig. 5.1

(i) The density of water is 1000 kg/m^3. The pressures exerted by the water on the base of the two tanks are equal.

Calculate this pressure.

pressure = ... [2]

(ii) Equal small volumes of water are removed from each tank.

State which tank, **P** or **Q**, now has the greater water pressure on its base. Explain your answer.

....

....

.... [2]

[Total: 7]

3 Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.
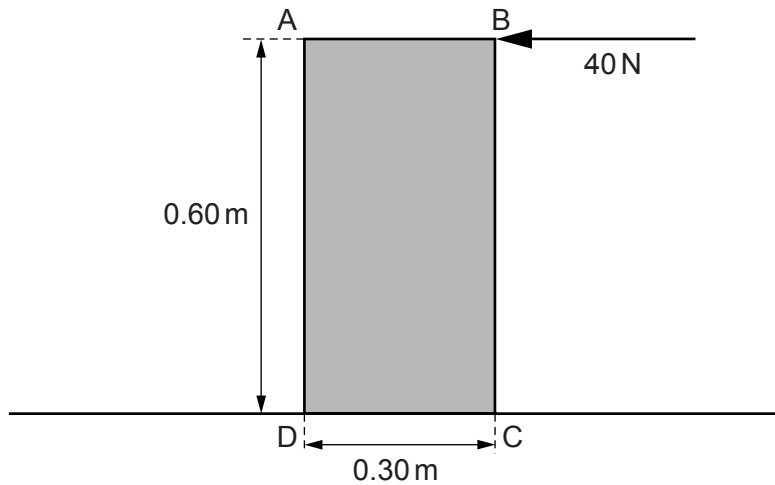

Fig. 2.1

(a) **(i)** Calculate the weight W of the concrete slab.

W = ... [1]

(ii) The thickness of the slab is 0.040 m.

Calculate the pressure exerted by the slab on the ground.

pressure = ... [2]

(b) (i) On Fig. 2.1, draw and label an arrow to show the weight *W* of the slab acting at its centre of mass. [1]

(ii) Calculate

    1. the moment of the 40 N force about point D,

moment = ...

    2. the moment of *W* about point D.

moment = ...

[3]

(iii) The ground is rough so that the slab does not slide.

State and explain what happens to the slab as the horizontal force at B is gradually increased.

....

....

....[2]

[Total: 9]

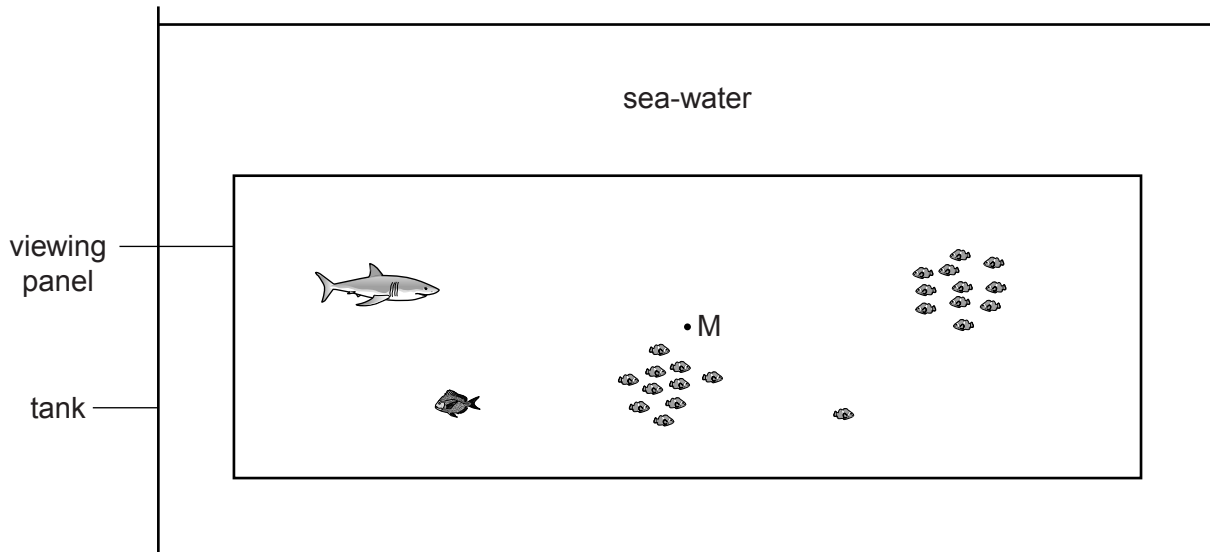4   Fig. 1.1 shows a side view of a large tank in a marine visitor attraction.

Fig. 1.1 (not to scale)

The tank is 51 m long and 20 m wide. The sea-water in the tank is 11 m deep and has a density of 1030 kg/m^3.

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

mass = ... [3]

(b) The pressure at point M, halfway down the large viewing panel, is 60 kPa more than atmospheric pressure.

Calculate the depth of M below the surface of the water.

depth = ... [2]

(c) The viewing panel is 32.8 m wide and 8.3 m high.

Calculate the outward force of the water on the panel. Assume that the pressure at M is the average pressure on the whole panel.

force = ... [2]

[Total: 7]

5   A large crane has a mass of 8500 kg. Fig. 4.1 shows the crane on a muddy building-site.
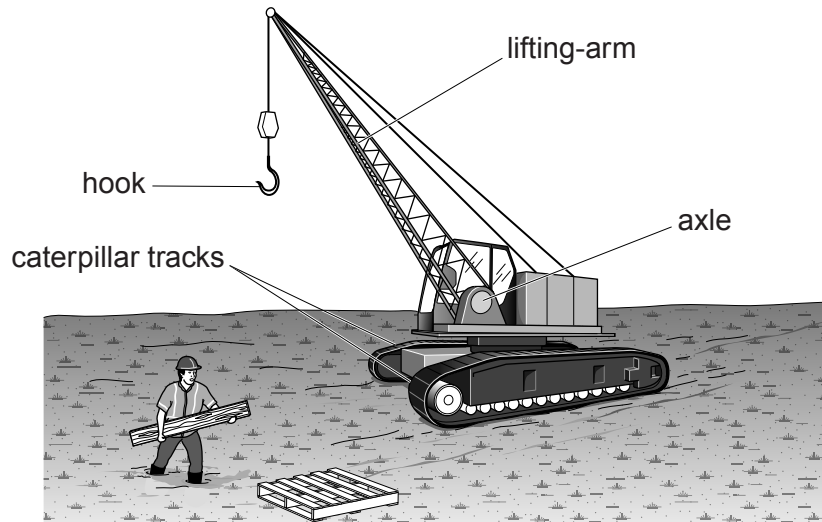
Fig. 4.1

(a) Calculate the weight of the crane.

weight = ... [1]

(b) The crane rests on two caterpillar tracks each of which has a contact area with the ground of 3.4 m².

(i)   Calculate the pressure that the crane exerts on the ground.

pressure = ... [2]

(ii) As the crane driver walks towards the crane, he starts to sink into the mud. He lays a wide plank of wood on the mud and he walks along the plank.

Explain why he does not sink into the mud when he walks along the plank.

....

....

.... [2]

(c) When the crane lifts a heavy load with its hook, the load exerts a moment on the lifting-arm about the axle.

(i) Explain what is meant by *moment* of a force.

....

.... [1]

(ii) Despite the moment exerted on the lifting-arm, the crane remains in equilibrium.

State the two conditions required for any object to be in equilibrium.

1. ....

2. ....

[2]

[Total: 8]

6 **(a)** A stationary body is acted upon by a number of forces. State the two conditions which must apply for the body to remain at rest.

1. ....

2. ....

[2]

(b) Fig. 3.1 shows a device used for compressing crushed material.
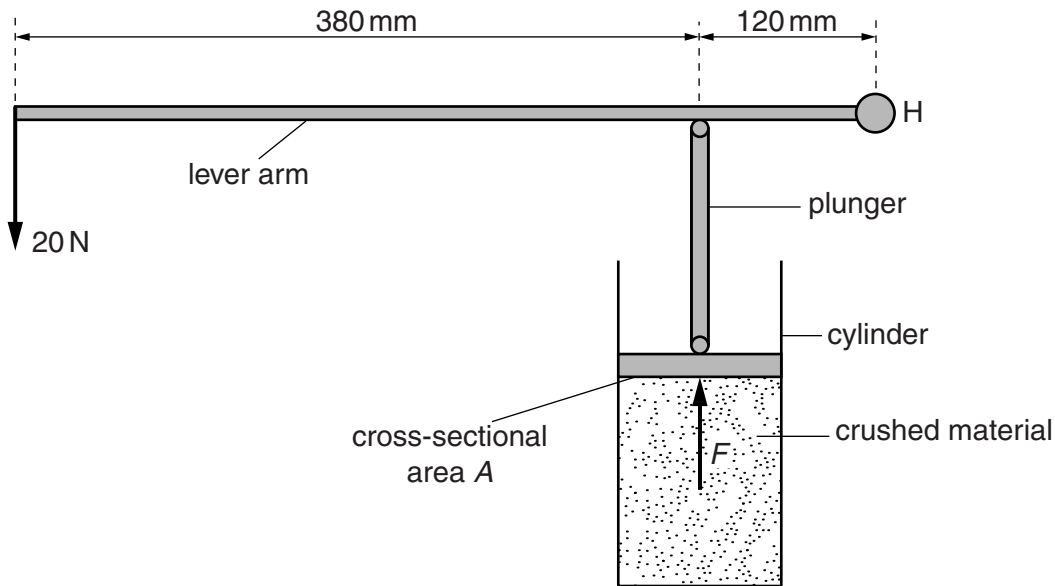

Fig. 3.1

The lever arm rotates about the hinge H at its right-hand end. A force of 20 N acts downwards on the left-hand end of the lever arm. The force *F* of the crushed material on the plunger acts upwards. Ignore the weight of the lever arm.

(i) Use the clockwise and anticlockwise moments about H to calculate the upward force *F* which the crushed material exerts on the plunger. The distances are shown on Fig. 3.1.

force *F* = ... [3]

(ii) The cross-sectional area *A* of the plunger in contact with the crushed material is 0.0036 m². Calculate the pressure exerted on the crushed material by the plunger.

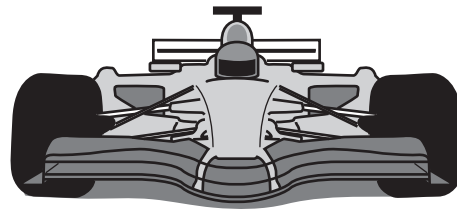pressure = ... [2]

[Total: 7]

7 The front views of two cars are shown in Fig. 5.1, to the same scale.

family car   racing car

Fig. 5.1

(a) Suggest which car has the greater stability, and give two reasons.

car ....

reason 1 ....

....

reason 2 ....

.... [2]

(b) The cars have the same weight.

Study Fig. 5.1 and suggest why the stationary racing car exerts less pressure on the ground.

....

.... [1]

(c) The family car's tyres each have an area of $0.012\,m^2$ in contact with the ground.

The weight of the car and its contents is 9600 N.

Calculate the pressure exerted by the car on the ground.

pressure = ... [2]

[Total: 5]

8 Fig. 2.1 shows a steam safety valve. When the pressure gets too high, the steam lifts the weight W and allows steam to escape.
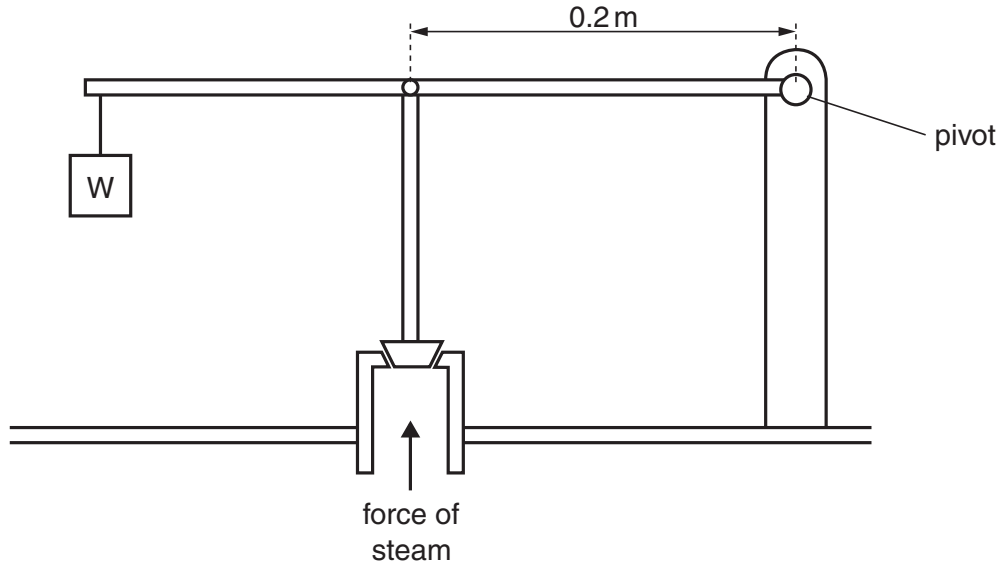

Fig. 2.1

(a) Explain, in terms of moments of forces, how the valve works.

....

....

....

.... [2]

(b) The moment of weight W about the pivot is 12 N m. The perpendicular distance of the line of action of the force of the steam on the valve from the pivot is 0.2 m.

The area of the piston is 0.0003 m^2.

Calculate

(i) the minimum steam force needed for the steam to escape,

force = ... [2]

(ii) the minimum steam pressure for the steam to escape.

pressure = ... [2]

[Total: 6]

9   A mass of 3.0 kg accelerates at 2.0 m/s^2 in a straight line.

(a) State why the velocity and the acceleration are both described as vector quantities.

....

.... [1]

(b) Calculate the force required to accelerate the mass.

force = ………………. [2]

(c) The mass hits a wall.
The average force exerted on the wall during the impact is 120 N.
The area of the mass in contact with the wall at impact is 0.050 m^2.
Calculate the average pressure that the mass exerts on the wall during the impact.

pressure = ………………. [2]

[Total : 5]
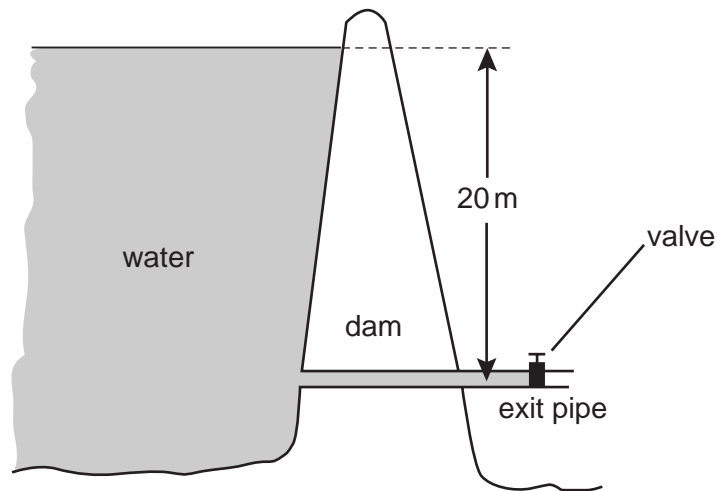
10 Fig. 2.1 shows a reservoir that stores water.

Fig. 2.1

(a) The valve in the exit pipe is closed. The density of water is $1000 \, kg/m^3$ and the acceleration of free fall is $10 \, m/s^2$.
Calculate the pressure of the water acting on the closed valve in the exit pipe.

pressure = ……………………...[2]

(b) The cross-sectional area of the pipe is $0.5 \, m^2$.
Calculate the force exerted by the water on the closed valve.

force = ……………………..[2]

(c) The valve is then opened and water, originally at the surface of the reservoir, finally flows out of the exit pipe. State the energy transformation of this water between the surface of the reservoir and the open end of the pipe.

....

....[2]

[Total : 6]