Pressure in liquids

Worked solutions

GCSE science calculations

This topic online

1 **Higher tier**

The deep end of a swimming pool is 2.0 m deep. The density of the water is 1000 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the water at the bottom of the deep end. (2 marks)

Pressure = height x density x gravitational field strength

$p = 2.0 \times 1000 \times 9.8$

19 600 Pa

2 **Higher tier**

Mrs Nowak's garden pond is 3.5 m long, 2.2 m wide and 1.4 m deep. It is full of water of density 1000 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the water at the bottom of the pond. (2 marks)

Use the depth (1.4 m), not the length or width

Pressure = height x density x gravitational field strength

$p = 1.4 \times 1000 \times 9.8$

13 720 Pa

3 **Higher tier**

Kwame is snorkelling off the coast of Pembrokeshire. He dives to a depth of 6.0 m. The density of seawater is 1030 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the seawater at this depth in kPa.

Give your answer to 3 significant figures. (3 marks)

Pressure = height x density x gravitational field strength

$p = 6.0 \times 1030 \times 9.8$

$p = 60\,564$ Pa

1 kPa = 1000 Pa

$p = 60\,564 \div 1000 = 60.564$ kPa

60.6 kPa

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4 **Higher tier**

A tall measuring cylinder contains glycerol to a height of 35 cm. The density of glycerol is 1260 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the glycerol at the bottom of the cylinder.

Give your answer to 3 significant figures.

(3 marks)

1 m = 100 cm

$h = 35 \div 100 = 0.35$ m

Pressure = height x density x gravitational field strength

$p = 0.35 \times 1260 \times 9.8$

$p = 4321.8$ Pa

4320 Pa

5 **Higher tier**

In a hospital lab, a beaker holds ethanol to a depth of 25 cm. The density of ethanol is 0.79 g/cm^3.

1 g/cm^3 = 1000 kg/m^3

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the ethanol at the bottom of the beaker.

Give your answer to 2 significant figures.

(3 marks)

1 g/cm^3 = 1000 kg/m^3

$\rho = 0.79 \times 1000 = 790$ kg/m^3

1 m = 100 cm

$h = 25 \div 100 = 0.25$ m

Pressure = height x density x gravitational field strength

$p = 0.25 \times 790 \times 9.8$

$p = 1935.5$ Pa

1900 Pa

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6 **Higher tier**

A water tank at a water treatment works is filled to a depth of 3.0 m. A pressure sensor is fixed to the side of the tank, 0.40 m above the bottom. The density of the water is 1000 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the pressure due to the water at the sensor.

(3 marks)

h is the depth below the surface, not the height above the bottom

$h = 3.0 - 0.40 = 2.6$ m

Pressure = height x density x gravitational field strength

$p = 2.6 \times 1000 \times 9.8$

25 480 Pa

7 **Higher tier**

A marine biologist leaves a recorder on the seabed in the Firth of Forth. The pressure due to the seawater above the recorder is 206 000 Pa. The density of seawater is 1030 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the depth of the recorder.

Give your answer to 3 significant figures.

(3 marks)

Pressure = height x density x gravitational field strength

$206\,000 = h \times 1030 \times 9.8$

$206\,000 = h \times 10\,094$

Divide both sides by 10 094

$h = 206\,000 \div 10\,094$

$h = 20.408...$ m

20.4 m

8 **Higher tier**

Rahul pours an unknown oil into a tall tube to a height of 0.60 m. A pressure sensor at the bottom shows that the pressure due to the oil is 4998 Pa.

Gravitational field strength = 9.8 N/kg

Calculate the density of the oil.

(3 marks)

Pressure = height x density x gravitational field strength

$4998 = 0.60 \times \rho \times 9.8$

$4998 = 5.88 \times \rho$

Divide both sides by 5.88

$\rho = 4998 \div 5.88$

850 kg/m^3

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9 **Higher tier**

A diver in a flooded quarry in Cumbria reads her depth gauge. It shows that the pressure due to the water above her is 294 kPa. The density of the water is 1000 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate how deep the diver is.

(3 marks)

1 kPa = 1000 Pa

$p = 294 \times 1000 = 294\,000$ Pa

Pressure = height x density x gravitational field strength

$294\,000 = h \times 1000 \times 9.8$

$294\,000 = h \times 9800$

Divide both sides by 9800

$h = 294\,000 \div 9800$

30 m

10 **Higher tier**

A scuba diver swims 18 m below the surface of the sea. The density of seawater is 1030 kg/m^3. The atmosphere presses on the surface of the sea with a pressure of 101 000 Pa.

Gravitational field strength = 9.8 N/kg

Calculate the total pressure on the diver in kPa.

Give your answer to 3 significant figures. Show your working.

(4 marks)

Pressure due to the water = height x density x gravitational field strength

$p = 18 \times 1030 \times 9.8$

$p = 181\,692$ Pa

Total pressure = water pressure + atmospheric pressure

total pressure = 181 692 + 101 000

total pressure = 282 692 Pa

1 kPa = 1000 Pa

total pressure = 282 692 ÷ 1000 = 282.692 kPa

283 kPa

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11 **Higher tier**

A rectangular fish tank has a base that is 0.80 m long and 0.50 m wide. The tank is filled with water to a depth of 0.60 m. The density of the water is 1000 kg/m^3.

Gravitational field strength = 9.8 N/kg

a. Calculate the pressure due to the water on the base of the tank.

b. Calculate the force the water exerts on the base of the tank. Show your working. (4 marks)

a)

Use the depth of the water, 0.60 m

Pressure = height x density x gravitational field strength

$p = 0.60 \times 1000 \times 9.8$

5880 Pa

b)

Area of the base = length x width

$A = 0.80 \times 0.50 = 0.40\ m^2$

Pressure = force ÷ area, so force = pressure x area

$F = 5880 \times 0.40$

2352 N

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12 **Higher tier**

The window of a small research submarine can withstand a total pressure of 5.0 MPa. The atmosphere presses on the surface of the sea with a pressure of 1.0×10^5 Pa. The density of seawater is 1030 kg/m^3.

Gravitational field strength = 9.8 N/kg

Calculate the greatest depth the submarine can safely dive to.

Give your answer to 2 significant figures. Show your working.

(5 marks)

1 MPa = 1 000 000 Pa

total pressure = 5.0 x 1 000 000 = 5 000 000 Pa

Take away atmospheric pressure to get the pressure due to the water

p = 5 000 000 - 100 000 = 4 900 000 Pa

Pressure = height x density x gravitational field strength

4 900 000 = h x 1030 x 9.8

4 900 000 = h x 10 094

Divide both sides by 10 094

h = 4 900 000 ÷ 10 094

h = 485.4... m

490 m

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