Unit 4: Forces, density and pressure:

Subunit 4.3: Density and pressure:

Topical Question No: 1

14 A giant squid of length 20.0 m is vertical in seawater, with the top of the squid at a depth of 8.00 m. The density of seawater is 1050 kg m^{-3}.

What is the difference in pressure between the top and the bottom of the squid?

A 82 000 Pa **B** 206 000 Pa **C** 288 000 Pa **D** 389 000 Pa

Topical Question No: 2

1 Which expression has the same SI base units as pressure?

A $\frac{\text{force}}{\text{length} \times \text{speed}}$

B $\frac{\text{force}}{\text{length} \times \text{time}}$

C $\frac{\text{mass}}{\text{length} \times (\text{time})^2}$

D $\frac{\text{mass} \times (\text{time})^2}{\text{length}}$

Topical Question No: 3

15 Which force is caused only by a pressure difference?

A friction

B upthrust

C viscous force

D weight

Topical Question No: 4

4 The density of paper is 800 kg m^{-3}. A typical sheet of paper has a width of 210 mm and a length of 300 mm.

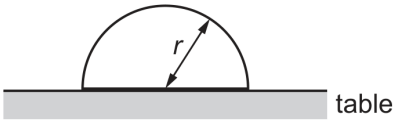
The thickness of a pack of 500 sheets of paper is 50 mm.

What is the mass of a single sheet of paper?

A 0.5 g **B** 5 g **C** 50 g **D** 500 g

Topical Question No: 5

14 An object shaped as a hemisphere rests with its flat surface on a table. The object has radius r and density ρ.



The volume of a sphere is $\frac{4}{3}\pi r^3$.

Which average pressure does the object exert on the table?

A $\frac{1}{3}\rho r^2$ **B** $\frac{1}{3}\rho r^2 g$ **C** $\frac{2}{3}\rho r$ **D** $\frac{2}{3}\rho rg$

Topical Question No: 6

1 What is a reasonable estimate for the density of sand?

A $2 \times 10^2\,\text{g cm}^{-3}$

B $2 \times 10^3\,\text{g cm}^{-3}$

C $2 \times 10^1\,\text{kg m}^{-3}$

D $2 \times 10^3\,\text{kg m}^{-3}$

Topical Question No: 7

13 A rigid sphere is held at rest on the sea bed. When the sphere is released, it rises to the surface of the sea. The seawater has a uniform density.

Which statement about the sphere, from its release until it reaches the surface, is correct?

A The sphere always moves with constant acceleration.

B The sphere always moves with constant velocity.

C The upthrust on the sphere always decreases.

D The upthrust on the sphere is always constant.

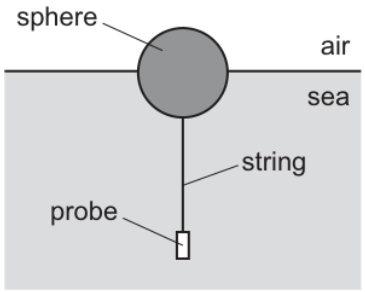
Topical Question No: 8

14 What is a unit for density?

A N m^{-3} **B** g mm^{-1} **C** kg cm^{-2} **D** $\mu\text{g mm}^{-3}$

Topical Question No: 9

14 A probe is used to monitor the quality of the water in the sea. The probe is suspended by a vertical string which is attached to a sphere. The stationary sphere floats in equilibrium on the surface of the sea, as shown.



The sphere has a weight of 5.00 N. The probe and string have a combined weight of 2.00 N.

The density of the seawater is $1.03 \times 10^3\,\text{kg m}^{-3}$. The upthrust acting on the probe and thread is negligible.

What is the volume of the sphere below the surface of the sea?

A $1.98 \times 10^{-4}\,\text{m}^3$

B $2.97 \times 10^{-4}\,\text{m}^3$

C $4.95 \times 10^{-4}\,\text{m}^3$

D $6.93 \times 10^{-4}\,\text{m}^3$

Topical Question No: 10

6 A student finds the density of a liquid by measuring its mass and its volume. The following is a summary of his measurements.

mass of empty beaker = $(20 \pm 1)\,\text{g}$

mass of beaker + liquid = $(70 \pm 1)\,\text{g}$

volume of liquid = $(10.0 \pm 0.6)\,\text{cm}^3$

He correctly calculates the density of the liquid as $5.0\,\text{g cm}^{-3}$.

What is the uncertainty in this value?

A $0.3\,\text{g cm}^{-3}$ **B** $0.5\,\text{g cm}^{-3}$ **C** $0.6\,\text{g cm}^{-3}$ **D** $2.6\,\text{g cm}^{-3}$

Topical Question No: 11

14 An object, immersed in a liquid in a tank, experiences an upthrust.

What is the physical reason for this upthrust?

A The density of the body differs from that of the liquid.

B The density of the liquid increases with depth.

C The pressure in the liquid increases with depth.

D The value of *g* in the liquid increases with depth.

Topical Question No: 12

17 Atmospheric pressure at sea level has a value of 100 kPa.
The density of sea water is 1020 kg m^{-3}.

At what depth in the sea would the total pressure be 110 kPa?

A 1.0 m **B** 9.8 m **C** 10 m **D** 11 m

Space for working

Topical Question No: 13

18 When ice melts, it contracts.

Which row is correct for ice turning into water?

	distance between atoms	density
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

Topical Question No: 14

17 When ice melts, it contracts.

Which row is correct for ice turning into water?

	distance between atoms	density
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

Space for working

Topical Question No: 15

18 Atmospheric pressure at sea level has a value of 100 kPa.
The density of sea water is 1020 kg m^{-3}.

At what depth in the sea would the total pressure be 110 kPa?

A 1.0 m **B** 9.8 m **C** 10 m **D** 11 m

Topical Question No: 16

1 The product of pressure and volume has the same SI base units as

A energy.

B force.

C $\frac{\text{force}}{\text{area}}$.

D $\frac{\text{force}}{\text{length}}$.

Topical Question No: 17

4 A student finds the density of a liquid by measuring its mass and its volume. The following is a summary of his measurements.

mass of empty beaker = $(20 \pm 1)\,\text{g}$

mass of beaker + liquid = $(70 \pm 1)\,\text{g}$

volume of liquid = $(10.0 \pm 0.6)\,\text{cm}^3$

He correctly calculates the density of the liquid as $5.0\,\text{g cm}^{-3}$.

What is the uncertainty in this value?

A $0.3\,\text{g cm}^{-3}$ **B** $0.5\,\text{g cm}^{-3}$ **C** $0.6\,\text{g cm}^{-3}$ **D** $2.6\,\text{g cm}^{-3}$

Space for working

Topical Question No: 18

17 Ice at a temperature of $0\,^{\circ}\text{C}$ is a rare example of a solid that floats on its liquid form, in this case water, when they are both at the same temperature.

What is the explanation for this?

A The average speed of the molecules in the ice is greater than the average speed of the molecules in the water.

B The average speed of the molecules in the water is greater than the average speed of the molecules in the ice.

C The mean separation of the molecules in the ice is greater than the mean separation of the molecules in the water.

D The mean separation of the molecules in the water is greater than the mean separation of the molecules in the ice.

Space for working

Topical Question No: 19

15 A volume of 1.5 m^3 of water is mixed with 0.50 m^3 of alcohol. The density of water is 1000 $kg\,m^{-3}$ and the density of alcohol is 800 $kg\,m^{-3}$.

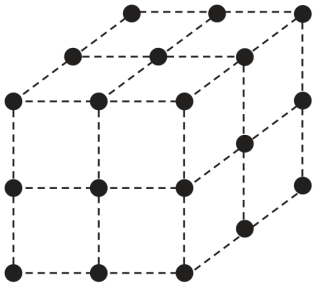
The volume of the mixture is 2.0 m^3.

What is the density of the mixture?

A 850 $kg\,m^{-3}$ **B** 900 $kg\,m^{-3}$ **C** 940 $kg\,m^{-3}$ **D** 950 $kg\,m^{-3}$

Topical Question No: 20

21 The diagram shows the arrangement of atoms in a particular crystal.



Each atom is at the corner of a cube.

The mass of each atom is 3.5×10^{-25} kg. The density of the crystal is 9.2×10^{3} $kg\,m^{-3}$.

What is the shortest distance between the centres of two adjacent atoms?

A 3.8×10^{-29} m

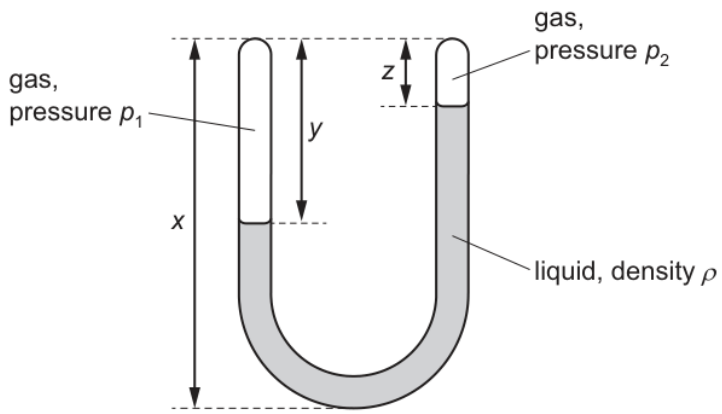
B 6.2×10^{-15} m

C 3.4×10^{-10} m

D 3.0×10^{-9} m

Topical Question No: 21

15 A closed U-shaped tube contains a stationary liquid of density ρ. One side of the tube contains a gas at pressure p_1 and the other side contains a gas at pressure p_2, as shown.



The acceleration of free fall is g.

Which equation is correct?

A $p_1 = \rho g y$

B $p_2 = \rho g(x - z)$

C $p_1 - p_2 = \rho g(y - z)$

D $p_1 + p_2 = \rho g x$

Topical Question No: 22

3 A student calculates the density of a solid steel cube in an experiment.

The measured mass is $975\,\text{g} \pm 10\,\text{g}$ and the measured length of side is $50\,\text{mm} \pm 1\,\text{mm}$.

What is the density of the steel?

A $7.8\,\text{g cm}^{-3} \pm 3.0\%$

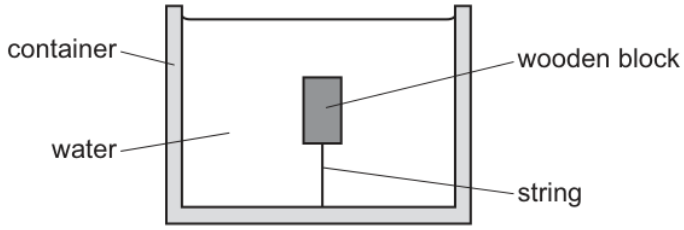
B $7.8\,\text{g cm}^{-3} \pm 7.0\%$

C $7.8\,\text{g cm}^{-3} \pm 11\%$

D $7.8\,\text{g cm}^{-3} \pm 13\%$

Topical Question No: 23

14 A wooden block is held stationary in a container of water using a string that is attached to both the wooden block and the bottom of the container.



The wooden block has mass m and volume V. The water has density ρ. The acceleration of free fall is g.

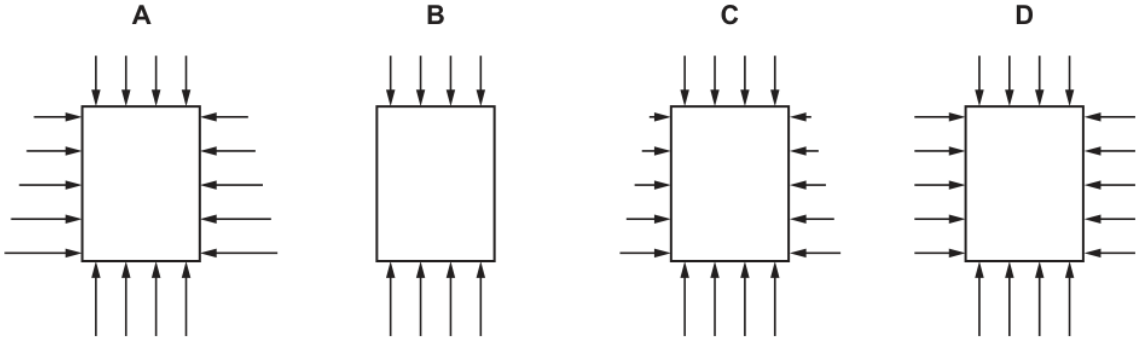
What is the magnitude of the force acting on the block due to the tension in the string?

A ρgV **B** $mg + \rho gV$ **C** mg **D** $\rho gV - mg$

Topical Question No: 24

16 A block is submerged vertically in a liquid. The four diagrams show the block viewed from the side.

Which diagram shows, to scale, the forces exerted on equal areas of the block by the liquid?



Topical Question No: 25

5 A student is given a reel of wire of diameter less than 0.2 mm and is asked to find the density of the metal.

Which pair of instruments would be most suitable for finding the **volume** of the wire?

A balance and micrometer

B metre rule and micrometer

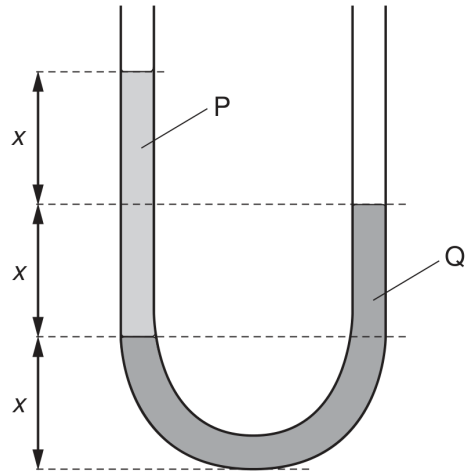
C metre rule and vernier calipers

D micrometer and vernier calipers

Space for working

Topical Question No: 26

22 The diagram shows two liquids, labelled P and Q, which do **not** mix. The liquids are in equilibrium in an open U-tube.



What is the ratio $\frac{\text{density of P}}{\text{density of Q}}$?

A $\frac{1}{2}$ **B** $\frac{2}{3}$ **C** $\frac{3}{2}$ **D** 2

Space for working

Topical Question No: 27

10 A solid sphere, which is less dense than water, is held completely immersed in water a few metres below the surface. The density of the water is uniform.

The sphere is released. Immediately after release, the sphere rises.

Which row correctly describes the changes in the upthrust on the sphere and the resultant force on the sphere?

	upthrust on the sphere	resultant force on the sphere
A	constant	increasing
B	constant	decreasing
C	decreasing	increasing
D	decreasing	decreasing

Topical Question No: 28

15 A solid cube is floating in equilibrium in liquid mercury. The cube is made of iron of density $7900\,kg\,m^{-3}$.

The cube floats with 42% of its volume above the surface of the mercury.

What is the density of the mercury?

A $3300\,kg\,m^{-3}$

B $4600\,kg\,m^{-3}$

C $14\,000\,kg\,m^{-3}$

D $19\,000\,kg\,m^{-3}$

Topical Question No: 29

16 The diagram shows two vessels, P and Q, both with sides inclined at 45° to the horizontal.

vessel P vessel Q

Answer Key

1. N/A
2. N/A
3. N/A
4. N/A
5. N/A
6. D
7. D
8. D
9. D
10. N/A
11. N/A
12. N/A
13. N/A
14. N/A
15. N/A
16. N/A
17. N/A
18. N/A
19. N/A
20. N/A
21. C
22. B
23. D
24. A
25. N/A
26. N/A
27. N/A