

20 For a given liquid at atmospheric pressure, which process can occur at any temperature?

9702/1/M/J/02

- A boiling
- B evaporation
- C melting
- D solidification

21 A mass of a liquid of density ρ is thoroughly mixed with an equal mass of another liquid of density 2ρ . No change of the total volume occurs.

What is the density of the liquid mixture?

9702/1/M/J/02

- A $\frac{4}{3}\rho$ B $\frac{3}{2}\rho$ C $\frac{5}{3}\rho$ D 3ρ

20 Pollen grains are suspended in a liquid and are illuminated strongly. When observed under a microscope they are seen to be in continuous random motion.

What is the reason for this?

9702/1/O/N/02

- A convection currents in the liquid
- B evaporation of the liquid
- C molecules of the liquid colliding with the pollen grains
- D pollen grains colliding with each other

21 At a depth of 20 cm in a liquid of density 1800 kg m^{-3} , the pressure due to the liquid is p .

Another liquid has a density of 1200 kg m^{-3} .

9702/1/O/N/02

What is the pressure due to this liquid at a depth of 60 cm?

- A $\frac{p}{2}$ B $\frac{3p}{2}$ C $2p$ D $3p$

22 Which line in the table gives approximate ratios of density and molecular spacing for a substance in its solid, liquid and gas phases?

9702/1/O/N/02

	density	molecular spacing
	solid : liquid : gas	solid : liquid : gas
A	1000 : 1000 : 1	1 : 1 : 10
B	1000 : 100 : 1	1 : 10 : 1000
C	1000 : 1000 : 1	1 : 1 : 1000
D	1000 : 100 : 1	1 : 10 : 100

- 20** A child drinks a liquid of density ρ through a vertical straw.

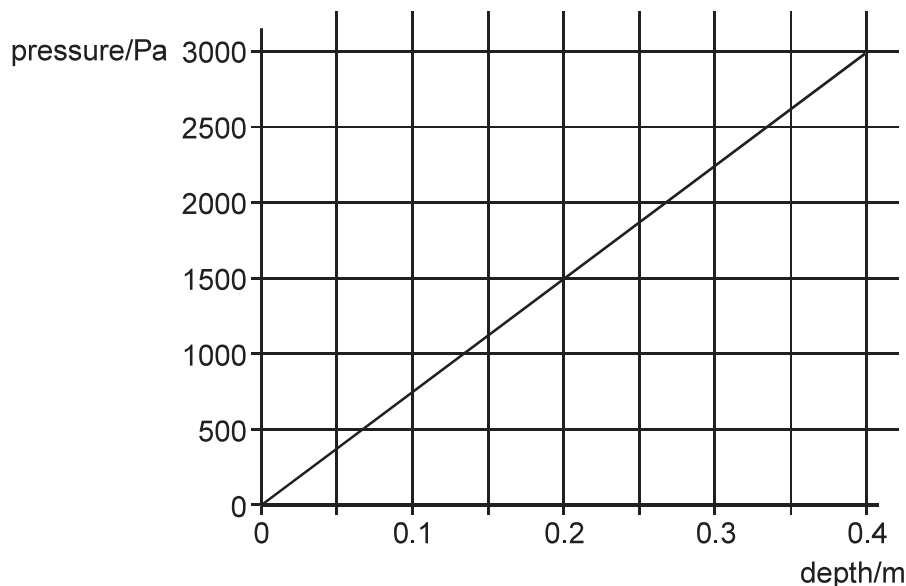
Atmospheric pressure is p_0 and the child is capable of lowering the pressure at the top of the straw by 10%. The acceleration of free fall is g .

What is the maximum length of straw that would enable the child to drink the liquid?

9702/01/M/J/03

- A** $\frac{p_0}{10\rho g}$ **B** $\frac{9p_0}{10\rho g}$ **C** $\frac{p_0}{\rho g}$ **D** $\frac{10p_0}{\rho g}$

- 19** The graph shows how the pressure exerted by a liquid varies with depth below the surface.



9702/01/O/N/03

What is the density of the liquid?

- A** 600 kg m^{-3} **B** 760 kg m^{-3} **C** 5900 kg m^{-3} **D** 7500 kg m^{-3}

- 20** In an experiment to demonstrate Brownian motion, smoke particles in a container are illuminated by a strong light source and observed through a microscope.

The particles are seen as small specks of light that are in motion.

9702/01/O/N/03

What causes this motion?

- A** collisions between the smoke particles and air molecules
B collisions between the smoke particles and the walls of the container
C convection currents within the air as it is warmed by the light source
D kinetic energy gained by the smoke particles on absorption of light

19 Com aring t e ro erties o soi s i ui s an gases ic o tion is correct

	ro ert	soi s	i ui s	gases
A	or ering o mo ecues	ig	not so ig	ran om
B	s acing o mo ecues	c ose	ar	ar
C	trans ation o mo ecues	no	no	es
D	i ration o mo ecues	no	es	es

9702 01 04

20 artices o ust sus en e in ater are ie e t roug a microscop e e artices can e seen to mo e irregu ar

is mo ement is ue to

- A con ection currents in t e ater
- B e a oration o t e ater near t e ust artices
- C gra itationa orces acting on t e artices o ust
- D ater mo ecues itting t e ust artices in a ran om a

9702 01 04

21 o soi su stances an a e atoms o mass an res ecti e e a e an atoms er unit ume

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ic o t e o o ing e uctions rom t is e eriment must e correct

9702 01 04

- A
- B
- C
- D — —

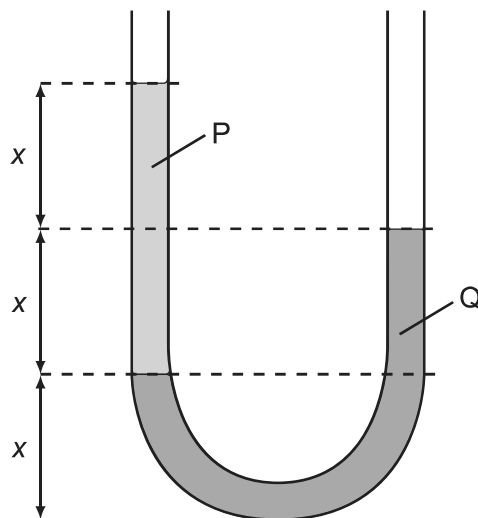
19 ic statement a ies to t e oi ing ut not to t e e a oration o a i ui

- A A t e on s et een mo ecues in t e i ui are ro en
- B At norma atmos eric ressure t e rocess occurs at one tem erature on
- C nerg must e ro i e ort e rocess to a en
- D e se aration o t e mo ecues increases great

9702 01 04

20 The diagram shows two identical U-tube manometers. The left manometer contains a liquid of density ρ and the right manometer contains a liquid of density 2ρ . The liquids are in equilibrium. The height of the liquid in the left arm is x and the height of the liquid in the right arm is x .

9702 01 04



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

- A $\frac{1}{2}$ B $\frac{2}{1}$ C $\frac{1}{\sqrt{2}}$ D $\sqrt{2}$

21 Which substances are normally crystalline?

- A carbon diammonium
B carbon dioxide
C ammonium carbonate
D ammonium chloride

9702 01 04

18 The hydrostatic pressure at a depth h in a liquid of density ρ is given by the formula $p = \rho gh$. This equation or principle is used in the derivation of this formula.

9702 01 0

- A density mass volume
B potential energy mass
C atmospheric pressure decreases with height
D density increases with depth

17 Does the pressure increase when a sealed container of gas is heated?

- A the gas molecules collide more often with each other
B the gas molecules expand and are heated
C the gas molecules travel faster and hit the walls of the container more often
D there are more gas molecules present to collide with the walls of the container

9702 01 0

- 19 When grains are suspended in a liquid, they are illuminated strongly and so seen under a microscope they are seen to be in continuous random motion

What is the reason for this?

9702 01 0

- A convection currents in the liquid
- B evaporation of the liquid
- C molecules of the liquid colliding with the grains
- D grains colliding with each other

- 18 Liquids are stored in large containers. Liquids have densities of 800 kg m⁻³ and 1200 kg m⁻³ respectively.

At what depths are the pressures equal?

9702 01 0

	Depth in liquid	Depth in liquid
A	8 m	12 m
B	10 m	10 m
C	1 m	10 m
D	18 m	8 m

- 19 When fine sugar granules are placed in water, the particles move randomly. This is because

of the structure of the sugar crystals.

9702 01 0

- A amorphous to crystalline
- B crystalline to amorphous
- C crystalline to crystalline
- D crystalline to amorphous

- 19 Be able to sort particles describing the molecules in a beaker of water at 0°C

Which arrangement correctly describes the molecules?

9702 01 0

- A The molecules are at the same speed. The speed is not large enough for any of the molecules to leave the surface of the water. There are attractive forces between the molecules.
- B The molecules are at a range of speeds. Some molecules have sufficient speed to leave the surface of the water. There are no forces between the molecules.
- C The molecules are at a range of speeds. Some molecules have sufficient speed to leave the surface of the water. There are attractive forces between the molecules.
- D The molecules are at a range of speeds. The fastest molecules are unable to leave the surface of the water. There are attractive forces between the molecules.

- 20 In an experiment to demonstrate Brownian motion, smoke particles in a container are illuminated by a strong light source and observed through a microscope.

The particles are seen as small, dark spots of light that are in motion.

9702 01 0

What causes the Brownian motion?

- A collisions between the smoke particles and air molecules
 B collisions between the smoke particles and the glass of the container
 C convection currents in the air as it is warmed by the light source
 D kinetic energy gained by the smoke particles on absorption of light

- 19 Which statement defines the density of a substance?

9702 01 0

- A the force per unit area acting on the substance
 B the increase in length per unit length of the substance
 C the mass per unit volume of the substance
 D the volume per unit time of the substance

- 20 The table summarises some properties of the evaporation of a liquid.

9702 01 0

Which row of the table is correct?

	involves a change in state from liquid to a gas	occurs at a fixed temperature	involves a reduction in the average kinetic energy of the remaining atoms
A	true	true	true
B	true	false	true
C	true	false	false
D	false	true	false

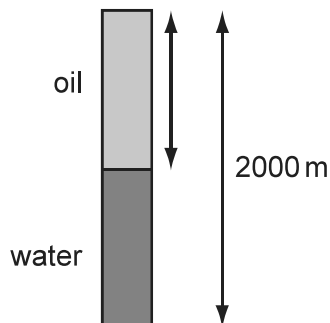
- 1 The density of mercury is $13.6 \times 10^3 \text{ kg m}^{-3}$.

The pressure difference between the bottom and the top of a column of mercury is 100 Pa. What is the height of the column?

9702 01 07

- A 0.7 m B 1 m C 7.4 m D 72 m

- 21 A ore o e o e t 2000 m contains ot oi an ater as s o n e ressure at t e ottom is 17 a e ensit o t e oi is 8 0 gm an t e ensit o t e ater is 1000 gm



9702 01 0

at ist e e t o t e oi

- A 907m B 1000m C 1090m D 1270m

- 1 ic grou o statements a ies on to t e i ui state

9702 01 07

A

atoms se arate man atomic iameters
ositions o atoms can c ange
atoms i rate

B

atoms se arate man atomic iameters
atoms are in i e ositions
atoms are in continuous ran om motion

C

atoms can touc eac ot er
ositions o atoms can c ange
some ran om motion o atoms

D

atoms can touc eac ot er
atoms are in i e ositions
some ran om motion o atoms

- 17 o soi su stances an a e atoms o mass an res ecti e ere are n an n atoms er unit o ume res ecti e

t is oun e eriment t at t e ensit o is greater t an t at o

9702 01 07

ic e uction rom t is e eriment must e correct

A

B n n

C n n

D $\frac{\quad}{n}$ $\frac{\quad}{n}$

- 18 A submarine carries a pressure meter so that the crew can work out what the pressure is at the surface of the sea. At the surface the meter indicates a pressure of 100 kPa. The density of sea water is 1000 kg m^{-3} .

What is the depth of the sea when the meter reads 400 kPa?

9702 01 07

- A 4 m B 44 m C 40 m D 47 m

- 20 What does an ideal gas exert pressure on its container?

- A The molecules of the gas collide continuously with each other.
 B The molecules of the gas collide continuously with the walls of the container.
 C The molecules of the gas collide inelastically with the walls of the container.
 D The weight of the molecules exerts a force on the walls of the container.

9702 01 08

- 21 The formula for hydrostatic pressure is ρgh .

Which equation or principle of physics is used in the derivation of this formula?

9702 01 08

- A Density $\times$ mass $\times$ volume
 B Potential energy $\times$ mass
 C Atmospheric pressure decreases with height
 D Density increases with height

- 1 Which row best describes the motion of molecules in solids, liquids and gases?

9702 01 09

	solids	liquids	gases
A	vibrate in position	move randomly	move randomly
B	move in all directions	move in all directions	move in all directions
C	vibrate about mean position	vibrate and move about	move randomly
D	vibrate in one direction only	vibrate in two directions	vibrate in all three directions

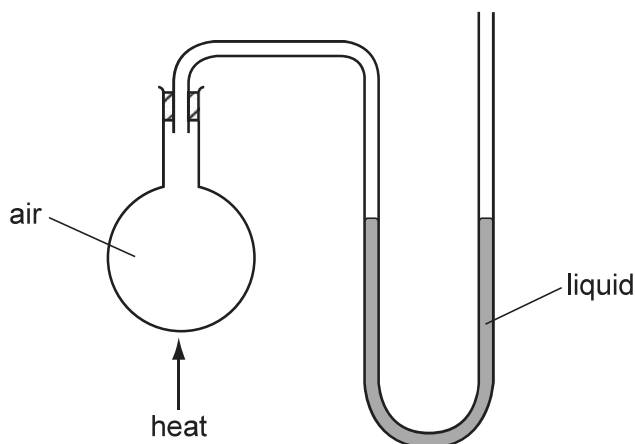
- 17 Water can exist in three states: solid, liquid or gas. Transitions between these states can involve melting, freezing, evaporation or condensation.

Under conditions of constant pressure, which transition can occur over a range of temperatures rather than at one fixed temperature?

9702 01 09

- A Condensation
 B Evaporation
 C Freezing
 D Melting

- 18 The diagram shows a gas connected to a tube containing liquid. The gas contains air at atmospheric pressure.



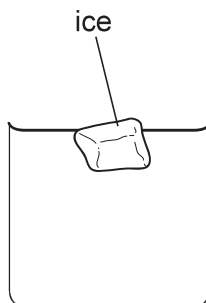
The gas is now gently heated and the liquid in the right-hand side of the tube rises through a distance h . The density of the liquid is ρ .

What is the increase in pressure of the heated air in the gas?

9702 01 09

- A ρ B $\frac{1}{2} \rho g$ C ρg D $2 \rho g$

- 17 The diagram shows an ice cube floating in water.



Both the ice cube and the water are at 0°C .

9702 11 09

Which statement correctly compares the molecular properties of the ice and those of the water?

- A The mean intermolecular potential energies are the same for both the ice molecules and the water molecules.
- B The mean intermolecular separations are the same for both the ice and the water.
- C The mean kinetic energies are the same for both the ice molecules and the water molecules.
- D The mean total energies are the same for both the ice molecules and the water molecules.

- 17 Atmospheric pressure at sea level is 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 ?

9702 11 10

- A 10 m B 9.8 m C 10 m D 11 m

18 The kinetic energy of gases at a pressure p is due to

9702 11 09

- A the number of atoms hitting an area of 1 m^2 of the gas container
- B the number of atoms hitting an area of 1 m^2 of the gas container surface
- C the force exerted by the atoms hitting an area of 1 m^2 of the gas container
- D the force exerted by the atoms hitting an area of 1 m^2 of the gas container surface

19 A rectangular metal plate exerts a pressure of $1.2 \times 10^5 \text{ Pa}$ on the horizontal surface on which it rests. The weight of the metal plate is 80 N . What is the area of the metal plate?

9702 11 09

- A 190 m^2
- B 1900 m^2
- C $19\,000 \text{ m}^2$
- D $190\,000 \text{ m}^2$

14 An object immersed in a fluid in a tank experiences an upthrust

What is the main reason for this upthrust?

9702 11 10

- A the density of the object is less than that of the fluid
- B the density of the fluid increases with depth
- C the pressure in the fluid increases with depth
- D the area of contact with the fluid increases with depth

18 When ice melts it contracts

Which statement is correct for ice turning into water?

9702 11 10

	Distance between atoms	Density
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 Atmospheric pressure at sea level is $1.0 \times 10^5 \text{ Pa}$. The density of sea water is 1020 kg m^{-3} .

9702 12 10

At what depth in the sea is the total pressure $1.1 \times 10^6 \text{ Pa}$?

- A 10 m
- B 98 m
- C 10 m
- D 11 m

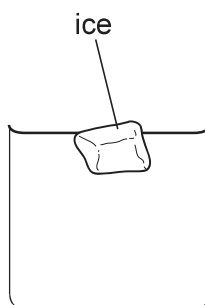
17 When ice melts it contracts

Which statement is correct for ice turning into water

9702/12/010

	Distance between atoms	Density
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 The diagram shows an ice cube floating in water



Both the ice cube and the water are at 0 °C

9702/12/009

Which statement is correct concerning the molecular properties of the ice and those of the water

- A The mean intermolecular potential energies are the same for both the ice molecules and the water molecules
- B The mean intermolecular separations are the same for both the ice and the water
- C The mean kinetic energies are the same for both the ice molecules and the water molecules
- D The mean total energies are the same for both the ice molecules and the water molecules

19 The kinetic model of gases states that the pressure is due to

9702/12/009

- A the number of atoms hitting and rebounding from a surface of the gas container
- B the number of atoms hitting and rebounding from a unit area of the gas container surface
- C the force exerted by the atoms hitting and rebounding from a surface of the gas container
- D the force exerted by the atoms hitting and rebounding from a unit area of the gas container surface

18 A rectangular metal plate rests at a pressure of $1.200 \times 10^5 \text{ Pa}$ on a horizontal surface on which it rests. The weight of the metal plate is 80 N . What is the area of the plate?

9702 12 09

- A 190 m^2
- B 1900 m^2
- C $19\,000 \text{ m}^2$
- D $190\,000 \text{ m}^2$

19 The Mariana Trench in the Pacific Ocean is about 10 km deep.

9702 11 10

Assuming that seawater is incompressible and has a density of 1020 kg m^{-3} , what is the absolute pressure at the bottom of the trench?

- A 10^5 Pa
- B 10^6 Pa
- C 10^7 Pa
- D 10^8 Pa

20 A student writes some statements about solids, liquids and gases.

- 1 Solids are rigid because the molecules in a solid vibrate.
- 2 Liquids flow because the molecules in a liquid are closer together than in a gas.
- 3 Gases are compressible because the molecules in a gas move randomly.

Which statements are correct?

9702 11 10

- A 1 only
- B 1 and 2 only
- C 2 and 3 only
- D none of the above

18 Below are four statements describing the molecules in a liquid at 0°C .

Which statement correctly describes the molecules?

9702 12 10

- A The molecules are at the same speed. The speed is not large enough for any of the molecules to leave the surface of the liquid. There are attractive forces between the molecules.
- B The molecules are at a range of speeds. Some molecules travel sufficiently fast to leave the surface of the liquid. There are no forces between the molecules.
- C The molecules are at a range of speeds. Some molecules travel sufficiently fast to leave the surface of the liquid. There are attractive forces between the molecules.
- D The molecules are at a range of speeds. The fastest molecules are unable to leave the surface of the liquid. There are attractive forces between the molecules.

19 Which group of materials contains two solids?

9702 12 10

- A copper, sand, aluminium
- B glass, oil, aluminium
- C iron, sugar, rubber
- D stone, diamond, steel

20 The pressure at sea level is approximately 100 000 Pa. The density of seawater is 1020 kg m⁻³. At what depth is the pressure 800 000 Pa?

9702 12 10

- A 100 000 Pa B 180 000 Pa C 800 000 Pa D 900 000 Pa

20 The Mariana Trench in the Pacific Ocean is about 10 km deep.

9702 1 10

Assuming that seawater is incompressible and has a density of 1020 kg m⁻³, what is the approximate pressure at the bottom?

- A 10 Pa B 10 Pa C 10⁷ Pa D 10⁸ Pa

22 A student writes some statements about solids, liquids and gases.

9702 1 10

1 Solids are rigid because the molecules in a solid vibrate.

2 Liquids flow because the molecules in a liquid are closer together than in a gas.

Gases are compressible because the molecules in a gas move randomly.

Which statements are correct?

- A 1 only
- B 1 and 2 only
- C 2 and 3 only
- D none of the above

18 Which process does not require energy to be supplied?

9702 11 11

- A Boiling
- B Evaporation
- C Freezing
- D Melting

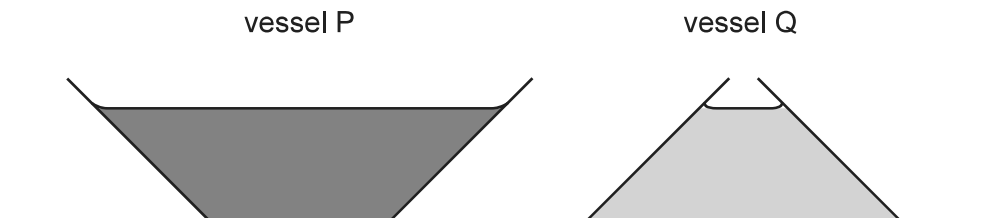
19 1 m³ of water is mixed with 0.0 m³ of alcohol. The density of water is 1000 kg m⁻³ and the density of alcohol is 800 kg m⁻³.

What is the density of the mixture if the volume is 2.0 m³?

9702 11 11

- A 800 kg m⁻³ B 900 kg m⁻³ C 940 kg m⁻³ D 900 kg m⁻³

20 Two identical vessels, P and Q, are tilted at 45° to the horizontal.



The vessels contain the same liquid to the same height.

9702/12/11

Both vessels contain the same liquid to the same height. The pressure at the base of the liquid in vessel P is p_P and the pressure at the base of the liquid in vessel Q is p_Q .

What is the ratio $\frac{p_P}{p_Q}$?

- A $\frac{2}{1}$ B $\frac{\sqrt{2}}{1}$ C $\frac{1}{\sqrt{2}}$ D $\frac{1}{2}$

21 Two substances, P and Q, are made of atoms of the same mass. The density of substance P is ρ_P and the density of substance Q is ρ_Q .

The density of substance P is greater than the density of substance Q.

9702/12/11

Which of the following must be correct?

- A $\rho_P < \rho_Q$
 B $n_P < n_Q$
 C $n_P > n_Q$
 D $\frac{P}{n_P} < \frac{Q}{n_Q}$

22 The table summarises some descriptions of the evaporation of a liquid.

Which of the following is correct?

9702/12/11

	in which there is a change in state from liquid to gas	occurs at a fixed temperature	in which there is a reduction in the average kinetic energy of the remaining atoms
A	true	true	true
B	true	false	true
C	true	false	false
D	false	true	false

- 18 Which process does not require energy to take place?
 A Boiling
 B Evaporation
 C Freezing
 D Melting
- 19 100 ml of water is mixed with 100 ml of alcohol. The density of water is 1000 g m⁻³ and the density of alcohol is 800 g m⁻³.
 What is the density of the mixture if the volume is 200 ml?
 A 800 g m⁻³ B 900 g m⁻³ C 940 g m⁻³ D 960 g m⁻³
- 21 What does the pressure increase when a sealed container of gas is heated?
 A The gas molecules collide more often with each other.
 B The gas molecules expand and therefore are heated.
 C The gas molecules travel faster and hit the walls of the container more often.
 D There are more gas molecules present to collide with the walls of the container.
- 22 When grains are suspended in a liquid and illuminated strongly, they appear to undergo a random motion.
 What is the reason for this?
 A Convection currents in the liquid.
 B Evaporation of the liquid.
 C Molecules of the liquid colliding with the grains.
 D Grains colliding with each other.
- 19 In an experiment to demonstrate Brownian motion, smoke particles in a container are illuminated by a strong light source and observed through a microscope.
 The particles are seen as small dots so light that they are in motion.
 What causes the Brownian motion?
 A Collisions between the smoke particles and air molecules.
 B Collisions between the smoke particles and the walls of the container.
 C Convection currents in the air as it is warmed by the light source.
 D Kinetic energy gained by the smoke particles on absorption of light.

- 20 A horizontal plate of area 0.0 m^2 is held at the surface of a liquid of density 900 kg m^{-3} . The force on the plate due to the pressure of the liquid is 290 N .

What is the depth of the plate below the surface of the liquid?

9702 12 11

- A 0.88 m B 1.1 m C 8.7 m D 9.1 m

- 20 When grains are suspended in a liquid and illuminated strongly, they appear to be in continuous random motion.

What is the reason for this?

9702 1 11

- A convection currents in the liquid
B evaporation of the liquid
C molecules of the liquid colliding with the grains
D grains colliding with each other

- 24 The pressure increases in a sealed container of gas if the

- A gas molecules collide more often with each other
B gas molecules expand and are heated
C gas molecules travel faster and hit the walls of the container more often
D there are more gas molecules present to collide with the walls of the container

9702 1 11

- 21 At room temperature the density of liquid mercury is 13.6 times greater than the density of solid aluminium.

9702 11 12

What is the reason for this?

- A Aluminium atoms are spaced further apart
B Aluminium atoms move more freely than mercury atoms
C Atoms in liquid metal are less spaced than atoms in solid
D Mercury atoms have a greater mass than aluminium atoms

- 22 When table sugar granules are heated, the melting point of the solid decreases. This is because

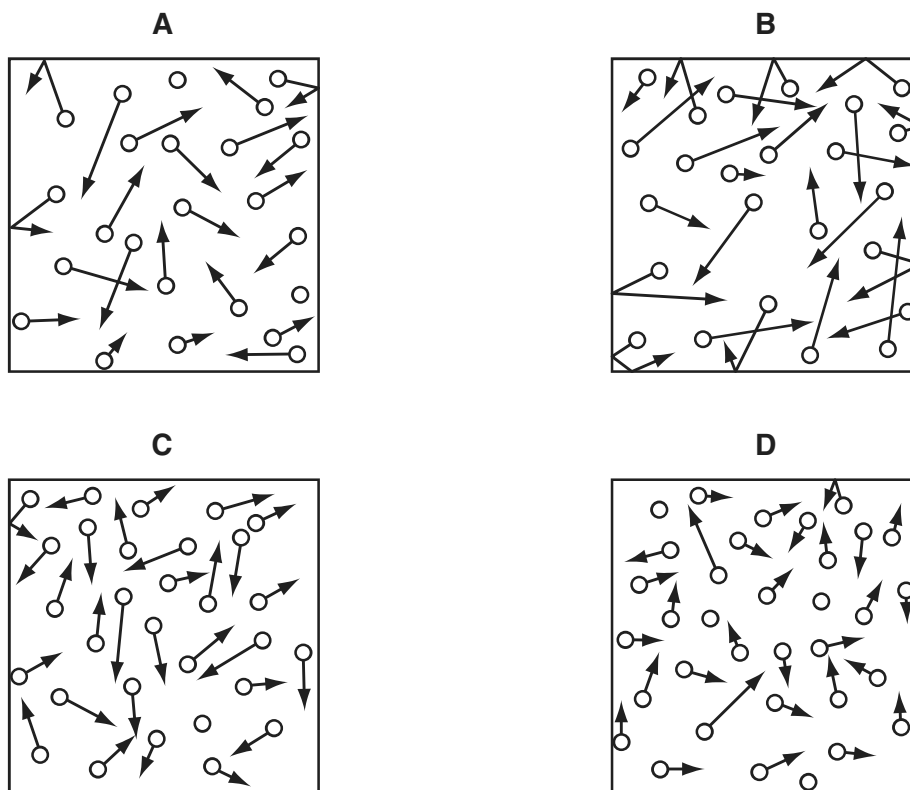
9702 11 12

the structure of the sugar changes.

- A amorphous to crystalline
B crystalline to amorphous
C crystalline to crystalline
D crystalline to amorphous

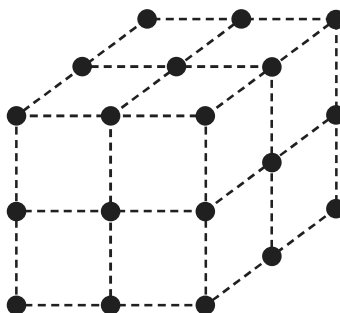
20. A container holds a gas of molecules at a certain temperature. The molecules are represented by circles with arrows showing their direction and speed. A longer arrow represents a higher speed. The container is at a higher temperature than the one shown in the previous question.

9702 11 12



22. The diagram shows the arrangement of atoms in a cubic crystal structure.

9702 12 12



Each atom is at the corner of a cube.

The mass of each atom is 10^{-26} g. The density of the crystal is 9.2×10^3 g m⁻³.

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

- A 8×10^{-29} m
 B 2×10^{-1} m
 C 4×10^{-10} m
 D 0×10^{-9} m

- 21 In an experiment to demonstrate Brownian motion a transparent container is filled with smoke particles suspended in air

9702/12/12

What can be seen when the contents of the container are strongly illuminated and viewed through a microscope

- A Air molecules that are colliding with smoke particles
- B Air molecules that are moving in straight lines
- C Smoke particles that are moving in random zigzag paths
- D Smoke particles that are moving in straight lines

- 24 At room temperature the density of liquid mercury is 13.6 times greater than the density of solid aluminium

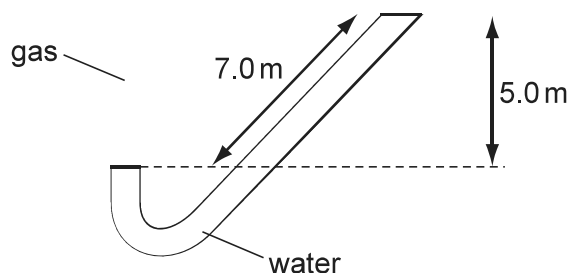
9702/11/12

What is the reason for this

- A Aluminium atoms are spaced further apart
- B Aluminium atoms move more freely than mercury atoms
- C Atoms in a liquid take up less space than atoms in a solid
- D Mercury atoms have greater mass than aluminium atoms

- 2 A pipe is closed at one end and contains gas trapped by a column of water

9702/12/12



The atmospheric pressure is 1.0×10^5 Pa and the density of water is 1000 kg m^{-3}

What is the pressure of the gas in Pa

- A 0.1×10^5 Pa
- B 0.5×10^5 Pa
- C 1.5×10^5 Pa
- D 1.7×10^5 Pa

- 2 When the sugar granules are eaten the melting point of the melting point is cooled. The particles of the solid form of the ice are produced.

9702 1 12

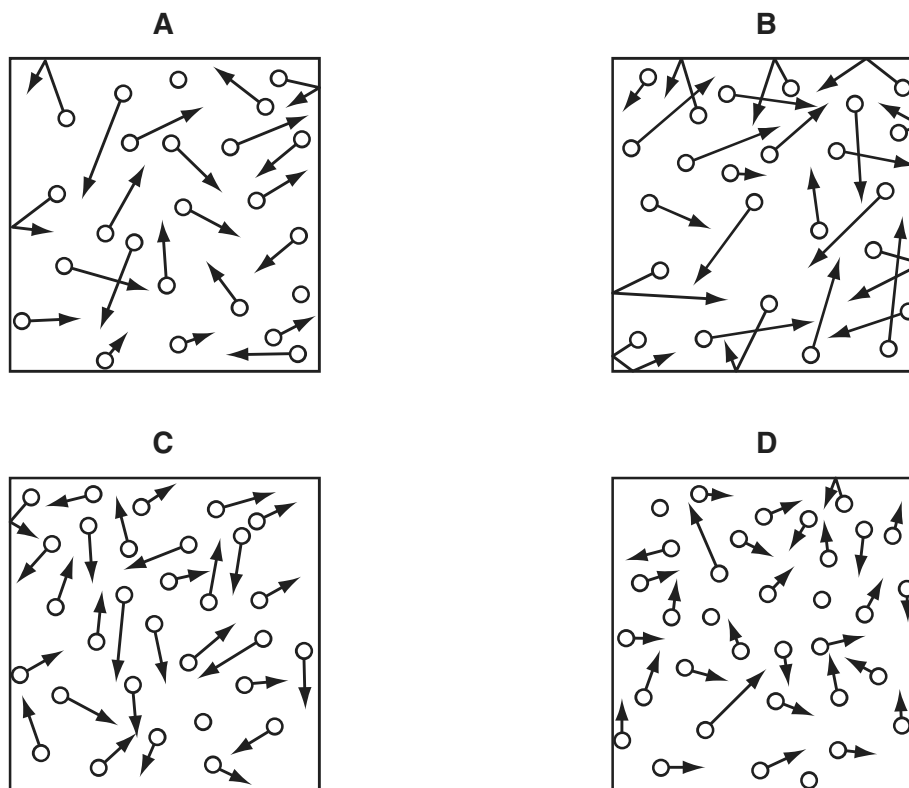
What does the structure of the sugar change?

- A amorphous to crystalline
- B crystalline to amorphous
- C crystalline to amorphous
- D amorphous to crystalline

- 2 A gas consists of molecules of a gas represented by circles. It is assumed that the direction of travel of the molecules is random. A longer arrow represents a higher speed.

Which contains a gas at the highest density and the lowest temperature?

9702 1 12



- 2 What leads to the conclusion that the movement of molecules is random?

9702 12 12

- A evaporation of water at room temperature
- B conduction of electricity in water
- C convection currents in air
- D motion of dust particles in air

- 2 Which row correctly describes the spacing and motion of the molecules in water and in ice when they are at a temperature of 0 °C

9702 12 12

	spacing	motion
A	molecules in ice are further apart than molecules in water	molecules in hot ice and water are the same average speed
B	molecules in ice are further apart than molecules in water	molecules in ice travel more slowly than those in water
C	molecules in ice are closer than molecules in water	molecules in ice travel more slowly than those in water
D	molecules in ice are closer than molecules in water	molecules in hot ice and water are the same average speed

- 24 Which row gives the correct description of the arrangement of atoms in the four types of material

9702 12 12

	atoms are not long range order	atoms form giant covalent molecules	atoms are arranged in regions but these regions are at angles to one another	atoms are arranged in an ordered pattern
A	crystalline	amorphous	amorphous	crystalline
B	amorphous	crystalline	amorphous	amorphous
C	amorphous	crystalline	crystalline	amorphous
D	amorphous	amorphous	crystalline	crystalline

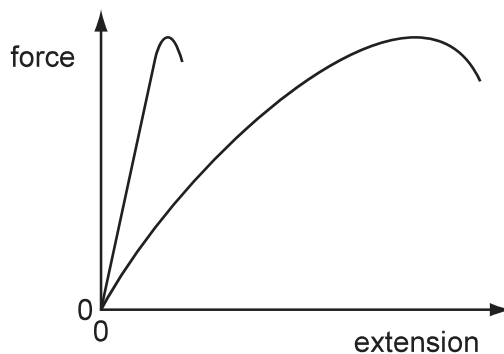
- 22 Which row correctly describes the spacing and motion of the molecules in water and in ice when they are at a temperature of 0 °C

9702 11 12

	spacing	ordering	motion
A	molecules in ice are closer together than molecules in water	a regular pattern of molecules in hot ice and water	molecules in hot ice and water are the same average speed
B	molecules in ice are closer together than molecules in water	a regular pattern of molecules in ice but not in water	molecules in ice travel more slowly than those in water
C	molecules in ice are further apart than molecules in water	a regular pattern of molecules in hot ice and water	molecules in ice travel more slowly than those in water
D	molecules in ice are further apart than molecules in water	a regular pattern of molecules in ice but not in water	molecules in hot ice and water are the same average speed

2 The diagram shows the force-extension graphs for two materials of the same dimensions and material.

9702 12 12



What describes the behavior of the materials?

- A Both materials are brittle
- B Both materials are ductile
- C Both materials are elastic
- D Both materials are at the same ultimate tensile stress

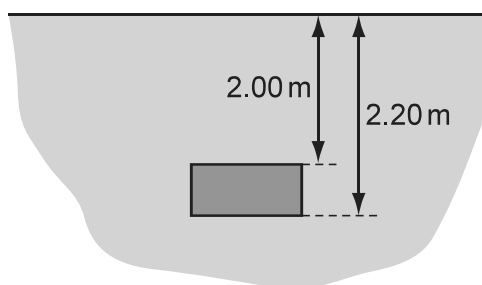
22 Which is the correct description of the motion of the molecules in water and in ice when both are at a temperature of 0 °C?

9702 1 12

	water	ice
A	a regular pattern of molecules but not in water	molecules in water are at the same average speed
B	a regular pattern of molecules but not in water	molecules in ice are more so than those in water
C	a regular pattern of molecules in both ice and water	molecules in ice are more so than those in water
D	a regular pattern of molecules in both ice and water	molecules in water are at the same average speed

- 2 The diagram shows a rectangular block of mass 82 g immersed in sea water of density 1100 kg m^{-3} .

9702/1 12



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

- A $2.2 \times 10^2\text{ Pa}$
 B $2.2 \times 10^3\text{ Pa}$
 C $1.8 \times 10^4\text{ Pa}$
 D $2 \times 10^4\text{ Pa}$

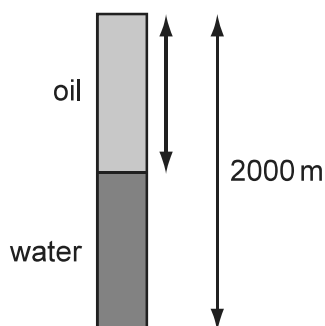
- 20 Which row correctly states the characteristics of the process of evaporation?

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	requires heat energy	occurs only at a particular temperature	can cause a change of temperature
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

- 21 A borehole of depth 2000 m contains oil and water as shown. The pressure due to the fluid at the bottom of the borehole is 17 Pa . The density of the oil is 800 kg m^{-3} and the density of the water is 1000 kg m^{-3} .

9702/11 1

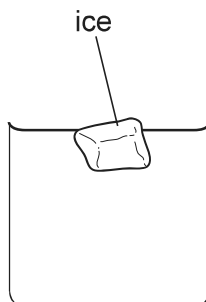


What is the depth of the oil?

- A 907 m B 1000 m C 1090 m D 1270 m

19 The diagrams show an ice cube floating in water.

9702/12/1



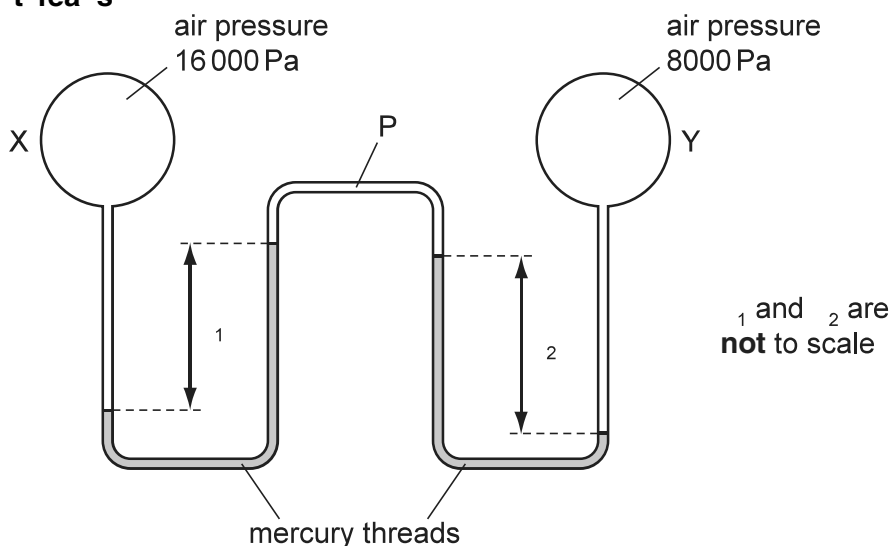
Both the ice cube and the water are at 0°C .

Which statement correctly compares the molecular properties of the ice and those of the water?

- A The mean intermolecular potential energies are the same for both the ice molecules and the water molecules.
- B The mean intermolecular separations are the same for both the ice and the water.
- C The mean kinetic energies are the same for both the ice molecules and the water molecules.
- D The mean total energies are the same for both the ice molecules and the water molecules.

20 Two glass tubes containing air at different pressures are connected to a U-tube manometer which contains mercury. The manometer is shown in the diagram.

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The density of mercury is 13600 kg m^{-3} .

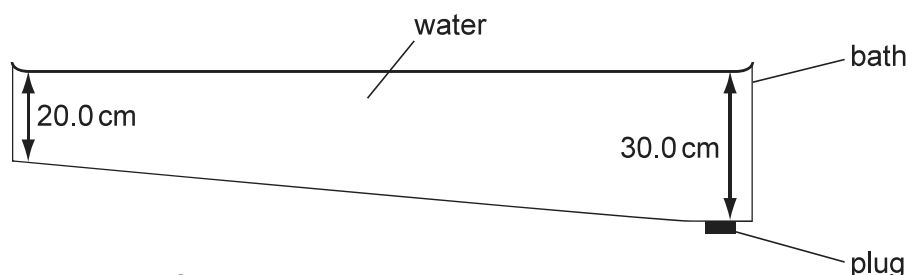
Which pair of values for h_1 and h_2 is possible?

	$h_1\text{ cm}$	$h_2\text{ cm}$
A	4.0	2.0
B	0	0
C	12.0	18.0
D	18.0	12.0

- 17 Ice at a temperature of 0°C is a rare example of a solid that contracts on its solidification. In this case, water molecules are not at the same temperature.
- 9702 1 1
- 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.
- 18 The formula for hydrostatic pressure is ρgh .
- 9702 1 1
- Which equation or principle of physics is used in the derivation of this formula?
- A Density $\frac{\text{mass}}{\text{volume}}$
- B Potential energy mgh
- C Atmospheric pressure decreases with height.
- D Density increases with height.
- 20 Be careful of your sorting of molecules in a beaker of water at 0°C .
- 9702 11 1
- Which diagram correctly describes the molecules?
- A The molecules are at the same speed. The speed is not large enough for any of the molecules to reach the surface of the water. There are attractive forces between the molecules.
- B The molecules are at a range of speeds. Some molecules travel sufficiently fast to reach the surface of the water. There are no forces between the molecules.
- C The molecules are at a range of speeds. The fastest molecules are unable to reach the surface of the water. There are attractive forces between the molecules.
- D The molecules are at a range of speeds. Some molecules travel sufficiently fast to reach the surface of the water. There are attractive forces between the molecules.
- 21 Which substances are normally not crystalline?
- 9702 11 1
- A Coal and diamond
- B Coal and glass
- C Diamond and glass
- D Diamond and rubber

- 22 Water in a bathtub varies in depth from 20.0 cm at the shallow end to 30.0 cm at the deep end. The density of water is 1000 kg m^{-3} . What is the pressure of the water acting on the plug?

9702 11 1



The density of water is 1000 kg m^{-3} .

What is the pressure of the water acting on the plug?

- A 190 Pa B 240 Pa C 2940 Pa D 4900 Pa

- 20 Gold has a density of 19.3 g cm^{-3} .

9702 11 1

The volume occupied by a single atom of gold may be considered to be a cube. It has a side length of $2.5 \times 10^{-8} \text{ cm}$.

What is the mass of a gold atom?

- A $4 \times 10^{-2} \text{ g}$
 B $4 \times 10^{-22} \text{ g}$
 C $1 \times 10^{-17} \text{ g}$
 D $1 \times 10^{-14} \text{ g}$

- 21 In an experiment to demonstrate Brownian motion, a transparent container is filled with smoke particles suspended in air.

9702 11 1

What can be seen when the contents of the container are strongly illuminated and viewed through a microscope?

- A molecules in random motion
 B molecules vibrating regularly
 C smoke particles in random motion
 D smoke particles vibrating regularly

- 17 Which statement about boiling and evaporation is correct?

9702 11 14

- A Boiling can only occur at the surface of a liquid.
 B Evaporation can only occur at a fixed temperature.
 C Boiling involves a change of phase.
 D In some cases, a liquid evaporates to the rest of the liquid becomes cooler.

- 18 There is one temperature at which water and ice can coexist in equilibrium

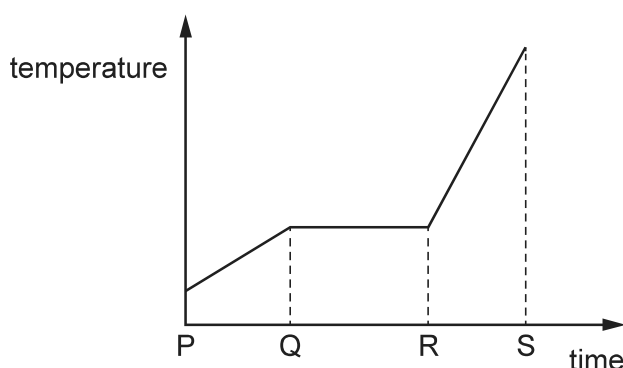
9702 11 14

Which statement about the properties of the molecules at this temperature is correct?

- A Ice molecules are closer to one another than water molecules
- B The mean kinetic energy of water molecules is greater than the mean kinetic energy of ice molecules
- C Water and ice molecules are less massive than water molecules
- D Water and ice molecules have the same mean speed as water and ice molecules

- 19 A crystalline solid is heated at a constant rate and the change of temperature with time is shown in the graph below

9702 11 14



Which statement about the particles in the material is correct?

- A In the time from P to Q the particles are arranged randomly
- B In the time from P to Q some particles are arranged regularly and some particles are arranged randomly
- C In the time from R to S the particles are in a solid state
- D The arrangement of the particles is the same in the time from P to S

- 19 When the water in a pond freezes it changes from a liquid to a solid. The change of volume and the change of energy of the surroundings when this occurs is

9702 1 14

Which row is correct?

	change of volume	energy change
A	contracts	gives out energy to the surroundings
B	contracts	takes in energy from the surroundings
C	expands	gives out energy to the surroundings
D	expands	takes in energy from the surroundings

- 17 The number of molecules in a substance increase with temperature but at an particular temperature the number of molecules in a substance as the same. Which process does not occur?

9702 12 14

- A Boiling
- B Condensation
- C Evaporation
- D Melting

- 20 Which process does not require energy to be supplied?

9702 1 14

- A Boiling
- B Evaporation
- C Freezing
- D Melting

- 18 In a gas, the pressure exerted by the gas is 4 Pa.

9702 12 14

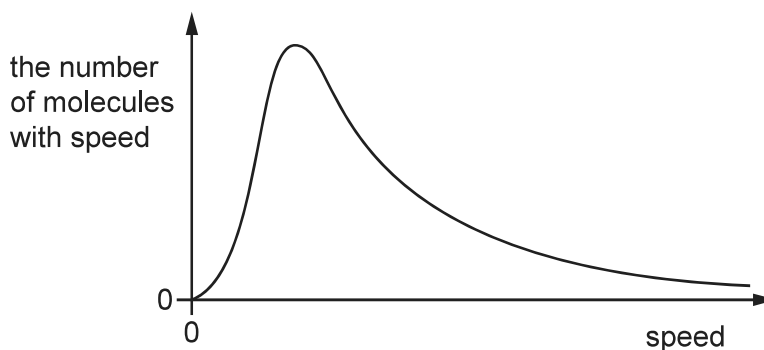
At the same time, the pressure exerted by the gas is 7 Pa.

At the same time, the pressure exerted by the gas is 7 Pa.

- A $\frac{2}{7}$
- B $\frac{7}{8}$
- C $\frac{8}{7}$
- D $\frac{7}{2}$

- 21 The graph shows the distribution of the speeds of the molecules of a gas at a particular temperature.

9702 1 14



Which statement is correct?

- A All the molecules have the same kinetic energy.
- B The commonest value of speed is also the average speed.
- C The graph shows that the molecules of a gas are in a state of constant motion.
- D The area under the graph is proportional to the total number of molecules.

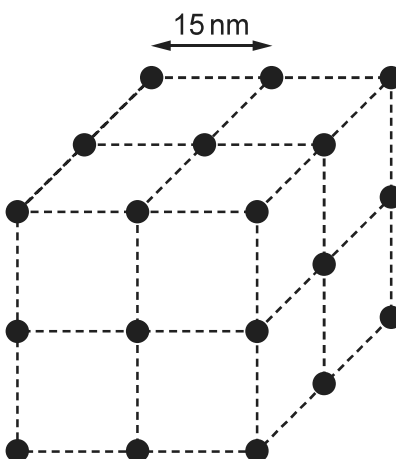
18 Which statement about molecules in a gas is correct

9702 11 14

- A In Brownian motion experiments the molecules can be seen moving randomly in all directions
- B The pressure exerted by a gas is caused by molecules bouncing against each other and changing kinetic energy
- C The pressure exerted by a gas is caused by molecules rebounding from the walls of a container and changing momentum
- D As the temperature of the molecules in a closed container increases the density must also increase

19 The diagram shows the atoms of a substance at the corners of a cube. The average separation of the atoms at a particular temperature is 1 nm

9702 11 14



As the temperature changes so that the average separation becomes 17 nm, the density of the substance changes

Which factor

- A 0.1 B 0.9 C 0.78 D 0.88

17 What is the correct name for a material containing long chain molecules that are tangled together

9702 11 14

- A Amorphous metal
- B Amorphous polymer
- C Crystalline metal
- D Crystalline polymer

20 Atmospheric pressure at sea level is a value of 100 kPa. The density of seawater is 1020 g m⁻³

9702 11 14

At which 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

21 A student is studying Brownian motion

9702 1 14

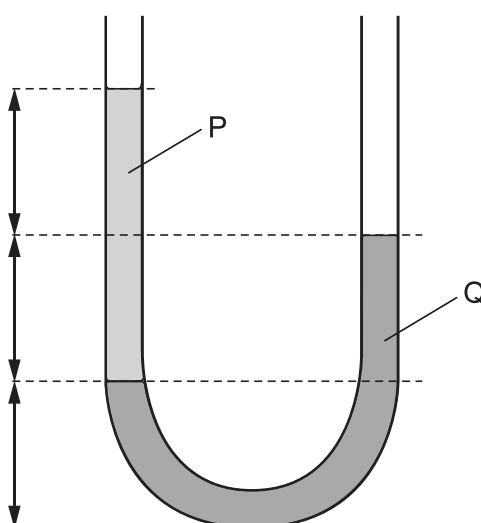
Using a microscope she observes particles of smoke in a glass container illuminated by a strong light. The particles of smoke are being agitated constantly in all directions.

What does the smoke particles in the air in the container illustrate?

- A The smoke particles become easier to see
- B The smoke particles change direction more frequently
- C The smoke particles increase in volume
- D The smoke particles move further apart

22 The diagrams show two identical containers. The water levels are in equilibrium in both.

9702 1 14



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

- A $\frac{1}{2}$
- B $\frac{2}{1}$
- C $\frac{1}{\sqrt{2}}$
- D $\sqrt{2}$

20 When ice melts it contracts

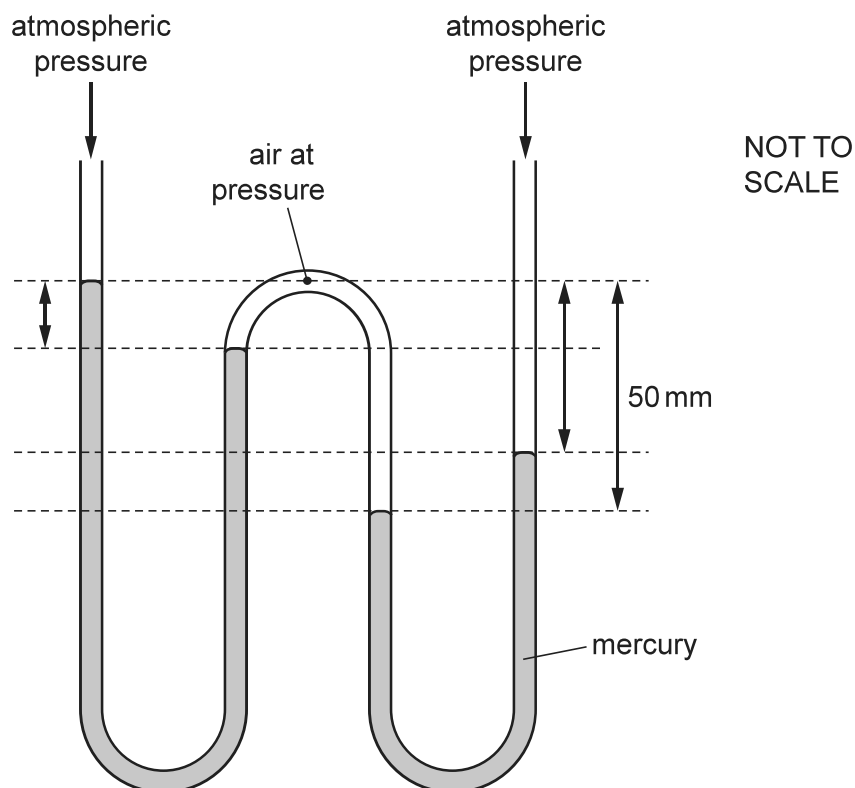
9702 1 1

Which statement is correct for ice turning into water?

	Distance between molecules	Density
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 21 A U-tube contains two amounts of mercury each open to the atmosphere. Air at pressure P_1 is introduced into the left arm. The diagram shows the vertical distances and

9702 1 1



Atmospheric pressure is equal to the pressure that would be exerted by a column of mercury of height 760 mm. The pressure is expressed in this way

in atmospheres and are also in

	mm	mm	mm of mercury
A	20	20	780
B	20	0	780
C	0	20	810
D	0	0	790

- 20 The maximum pressure that granite rock can withstand is $2.0 \times 10^8 \text{ N m}^{-2}$. A rock of this pressure the rock begins to fail. The density of granite is $2.7 \times 10^3 \text{ kg m}^{-3}$

9702 12 1

at which the rock begins to fail. The pressure of granite mountain base is just beginning to fail

- A 8.10 m B 7.10 m C 7.10⁴ m D 7.4.10⁴ m

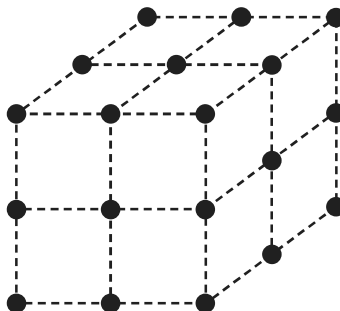
- 19 Which is correct describing the motion of the molecules in liquid water and in ice when both are at a temperature of 0°C ?

9702/12/1

	liquid	ice
A	no regular pattern of molecules but not in liquid	molecules in liquid are at the same average speed
B	no regular pattern of molecules but not in liquid	molecules in ice travel more slowly than those in liquid
C	no regular pattern of molecules in liquid and ice	molecules in ice travel more slowly than those in liquid
D	no regular pattern of molecules in liquid and ice	molecules in liquid are at the same average speed

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

9702/11/1



Each atom is at the corner of a cube.

The mass of each atom is 10^{-26} kg . The density of the crystal is $9.2 \times 10^3\text{ kg m}^{-3}$.

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

- A $8 \times 10^{-29}\text{ m}$
 B $2 \times 10^{-1}\text{ m}$
 C $4 \times 10^{-10}\text{ m}$
 D $0 \times 10^{-9}\text{ m}$

20 Descriptions of three different types of matter are listed

9702/11 1

1 a crystalline material made up of large numbers of small crystals

2 an amorphous material with little or no ordered arrangement of molecules

a polymeric material consisting of long chains of molecules

Which of the following descriptions is most likely to be a gas?

	1	2	
A	crystalline	gas	solid
B	crystalline	solid	gas
C	gas	solid	crystalline
D	solid	crystalline	gas