Name: _____ Class: _____ Date: _____

Chapter 1 Introducing Science

Worksheet 1.1	For Science Matters Textbook Volume A, sections: 1.1 What is Science? 1.3 Life-long Skills and Attitudes 1.2 What is Technology?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. What is science?

   A The study of how people live and work
   B The study of matter, energy and their interactions
   C The study of numbers
   D The study of past events (B)

2. Which of the following scientific applications benefits us?

   A Creation of radioactive wastes **B** Excessive use of pesticides
   C Invention of the light bulb **D** Production of nuclear bomb (C)

3. Which of the following **is not** one of the qualities of a good scientific thinking?

   A Ability to accept other ideas
   B Perseverance in obtaining an answer
   C Sticking fast to old beliefs
   D Willingness to work hard for a solution (C)

4. A good scientist needs to think of _____.

   A ways to become famous
   B ways to solve a problem
   C who noticed the problem first
   D ways to make money out of new discoveries (B)

5. What are the three main branches of science?

   Biology, Chemistry and Physics

Note to Teacher:
Other branches of science include geology (the study of rocks and the earth's structure) and astronomy (the study of natural space objects).

6. Complete the table using the words in the box below. Each word may be used more than once.

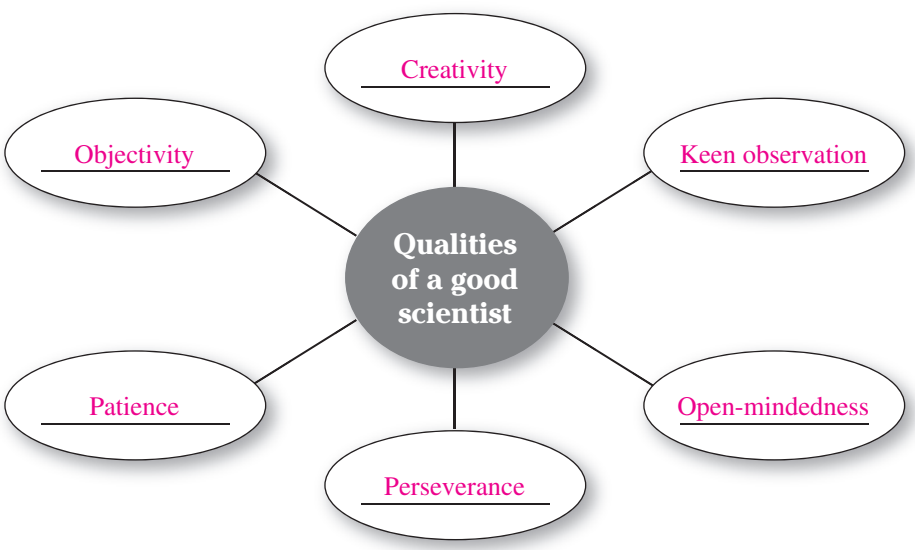
physicist biologist chemist astronomer

Thing(s) the scientist studies	The scientist is called a/an …
Acids	Chemist
A star	Astronomer
A rainbow	Physicist
The moon	Astronomer
The speed of a bullet	Physicist
Crystals	Chemist
Starfish	Biologist
A skeleton	Biologist
The blue sky	Physicist
The sky at night	Astronomer

Map It Out

Complete the graphic organiser that follows the question below.

What are some of the qualities a scientist should have?



Note to Teacher:
Accept any other reasonable answers.

Challenge Yourself • 15 min •

Attempt the following questions within the time allocated.

1. The Internet is a very useful communication tool for people around the world. But it can also cause problems in society.

   a) Describe some advantages and disadvantages of using the Internet.

   Advantages:

   I can keep in touch with my friends by e-mail. I can be close to them even when they are very far away. I don't have to wait a long time for a reply to my mails like when I wrote and sent by post. I don't have to depend on one textbook for my learning as there are many websites on a topic.

   Disadvantages:

   Some of the things on the Net are junk. I may learn the wrong thing. I get hooked on games and surfing and waste a lot of time. Some websites teach people to do wrong or harmful things. Books, movies and musics get pirated.

   b) List some ways to use the Internet safely and wisely.

   Use the Internet only when necessary so that time is spent wisely. / Download or install programmes which can protect your computer from viruses. / Check more than one website to obtain the information you need in case some of these websites are not trustworthy.

2. Scientific discoveries and advances in technology are supposed to make our lives better. However, science often comprises the study of things around you for the sake of knowing more about our world. This in itself seems like a good end to aim for. Is it always necessary that what you learn in science is useful? Discuss.

Most discoveries have no use at the start. Einstein discovered that matter can be converted into energy with his famous equation $E = mc^2$. However, it was other scientists who made an atomic bomb out of this discovery.

Sir Alexander Fleming noticed that the mould on his germ culture dishes killed the germs. However, it was only later that the first antibiotic, called penicillin, was extracted from the mould to kill germs and save lives. Hence, we will never know how useful a discovery is, until more work is done on it.

Note to Teacher:
Students may learn from the attitudes of scientists in the past by doing the exercises given in the Idea Bank. It is hoped that by doing these exercises, they will learn to adopt these attitudes in their daily lives.

Name: _____ Class: _____ Date: _____

Worksheet 1.2	For Science Matters Textbook Volume A, section: 1.4 Where Do Scientists Work?

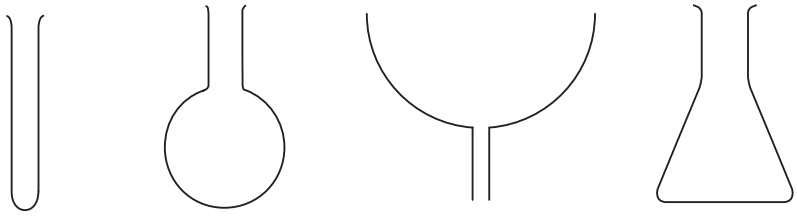
Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. An experiment is _____.

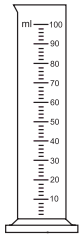
   A a procedure carried out to find the truth
   B a recipe for finding the best answer to a question
   C any activity done on a laboratory table
   D the gathering of information (A)

2. Which of the following is an **incorrect** drawing of laboratory equipment?



A **B** **C** **D** (C)

3. What is the apparatus shown on the right used for?



   A Evaporating a liquid from a solution
   B Measuring the volume of liquid
   C Measuring volume of gas
   D Separating different types of liquids (B)

4. If you accidentally touch a corrosive acid, you should _____.

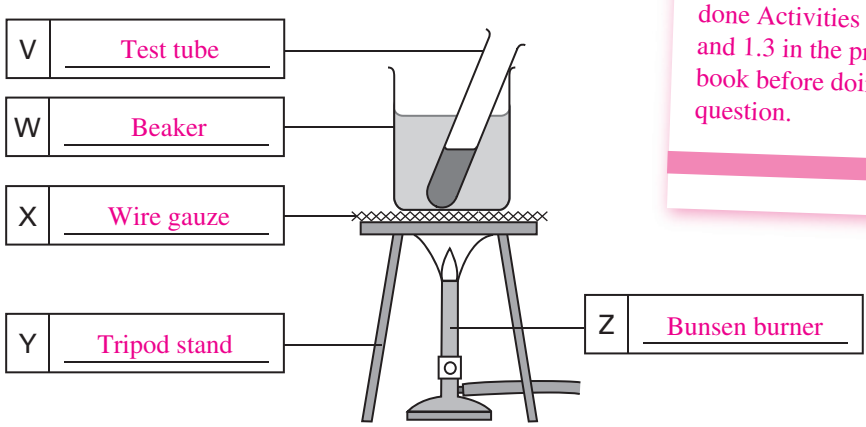
   A leave it alone
   B pour an alkali over your hand
   C wash your hands with plenty of water
   D wipe off the acid with a piece of tissue paper (C)

5. What should you **not** do if some chemical gets into your mouth accidentally?

   A Report the incident to your teacher
   B Rinse your mouth with plenty of water
   C Spit it out immediately
   D Swallow it (D)

6. The diagram below shows the set-up of an experiment.

Note to Teacher: Students should have done Activities 1.2 and 1.3 in the practical book before doing this question.



a) Name the apparatus labelled in the diagram above.

b) Suggest some reasons why the substance in V is heated in a water bath.

It might just melt when heated in hot water, but decompose when the test tube is heated directly on the flame.

c) State the function of each X and Y.

X : To ensure heat is evenly distributed over the bottom of the beaker

Y : To support apparatus that is being heated

d) State three points to note when using Z.

Adjust the air hole opening to obtain the desired flame. Light up the match right before turning on the gas or shortly after. Turn off the gas after use.

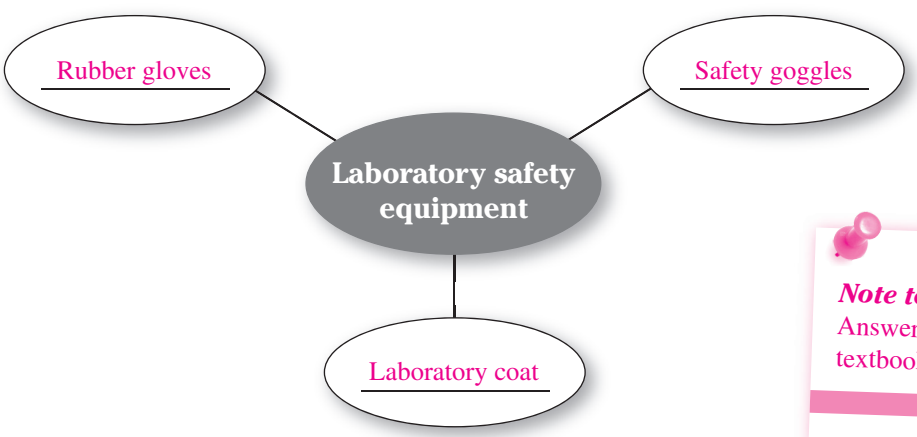
7. Many substances in the laboratory are hazardous. For such substances, hazard symbols are shown on the container. Draw lines to match the symbols below with the nature of the hazardous substance.

Symbol	Hazard
	**Flammable:** Catches fire easily
	**Corrosive:** Substance will eat away other substances
	**Poisonous:** Substance that is harmful in small doses
	**Biohazardous:** Poisonous substance of a biological nature
	**Irritable:** Substance produces gases which irritate the eyes, nose and throat
	**Explosive:** Will react violently when heated or struck

Map It Out

Complete the graphic organiser that follows the question below.

When you carry out a practical activity in the science laboratory, you may have to put on some laboratory safety equipment. What are these equipment?



Note to Teacher:
Answers are not in the textbook.

Challenge Yourself • 5 min •

Attempt the following question within the time allocated.

Isaac had a science practical lesson after recess. He was late for the lesson and missed his teacher's explanation on how to handle corrosive chemicals. However, he went ahead and carried out the experiment. While doing the experiment, he spilled some chemical on the table and on his clothes, but ignored it. After the lesson ended, Isaac poured the chemical into the sink. The apparatus were left in the sink when he left.

a) What mistakes did Isaac make during the science practical lesson?

1. When the chemical spilled on the table and on his clothes, Isaac ignored it.
2. Isaac should not have poured the chemical into the sink without washing it away with water.
3. Isaac should not leave the apparatus in the sink.

b) What should Isaac have done instead?

When Isaac spilled the chemical, he should have reported the incident to his teacher. He should have asked his teacher if there was a need to dilute the spill before wiping it off. He should also ask his teacher if he should immediately change his clothes and wash them with plenty of water. He should, at the first place, wear a lab coat. After the lesson, Isaac should pour the chemical into the sink and wash the test tube. He should then dry the apparatus and place them back into their storage place.

Name: _____ Class: _____ Date: _____

Worksheet 1.3	For Science Matters Textbook Volume A, section: 1.5 The Scientific Method

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Which of the following **is not** a scientific method?

   A Doing experiments to test ideas
   B Discussing ideas and making inferences
   C Giving attention and sympathy
   D Taking down notes and recording data (C)

2. What is a hypothesis?

   A An experiment
   B A good guess based on observations
   C A scientific statement
   D A well-written article (B)

3. When carrying out experiments, we make observations to _____.

   A help us make use of our five senses
   B help us gather data and information
   C make sure we do not spill things accidentally
   D predict the future (B)

4. Which of the following **is not** a scientific experiment?

   A Baking three cakes — one using one egg, one using two eggs and one using three eggs — to see how the number of eggs used can affect the cake
   B Driving a car at different speeds — from 40 kph (kilometres per hour) to 60 kph and to 80 kph — to find out the speed at which the car can stop most smoothly.
   C Dyeing your hair — yellow for a month, brown for the next month, and then pink in the following month — to see which colour looks best on you
   D Watering three plants — one with a quarter cup of water, one with half a cup of water and one with a full cup of water — to see which plant can survive the longest (C)

5. Which of the following questions might be suitable for a scientific study?

A Can plants grow faster with the help of music?
B How can love overcome all odds?
C How many prime numbers are there between 1 and 2,000?
D What can be done to persuade people not to shoplift? (A)

6. The scientific method is a step-by-step way of thinking or acting. When you apply the scientific method, you analyse a problem or situation by moving through a series of steps.

Stage	Action
1	**Observe:** Make an observation.
2	**Question:** Ask a question.
3	**Make a hypothesis:** Attempt to answer the question with a guess.
4	**Test:** Carry out an experiment to test your hypothesis.
5	**Check:** Does the guess answer your question? If not, discard the guess and repeat stages 3 and 4 with another guess. If it answers your question, proceed to stage 6.
6	**Conclude:** If your guess answers the question, proceed to draw a conclusion about your question.

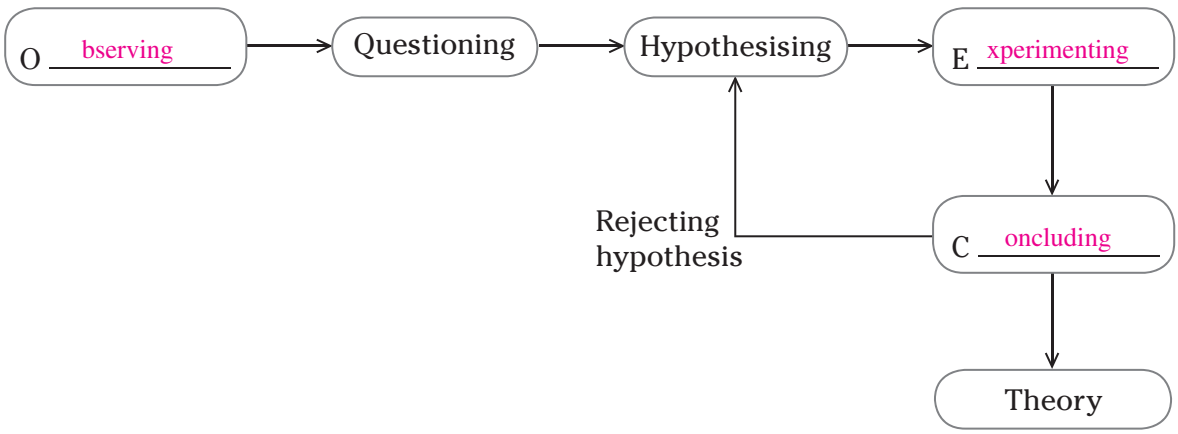
Here are some statements that a person used to describe a scientific way of solving a problem. Study each statement and identify which stage of the scientific method the person was at. Write the number down in the last column of the table below.

Statement	Stage
Rest is required to keep the mind alert.	6
Why do I feel sleepy when I study?	2
I feel sleepy when I study for long hours.	1
I take a ten-minute break for every hour I study.	4
Yes! I don't feel sleepy anymore when I study.	5
Perhaps I feel sleepy when I study for long hours without rest.	3

Map It Out

Complete the graphic organiser that follows the question below.

The scientific method comprises many steps. What are the most common steps in the scientific method?



Challenge Yourself • 25 min •

Attempt the following questions within the time allocated.

1. A hypothesis is a good guess as to the reason for an observation.

   For example, I **observed** that my sister's shoes and umbrella were not at their usual places. I formed several possible **hypotheses**:
   1) She has gone out, taking her umbrella and wearing those shoes.
   2) They are both drying in the sun because it rained today.
   3) She gave both away to charity.
   4) Her friend who stayed overnight borrowed both of them.

   My next observation was that the shoes and the umbrella were found in the dustbin, even though they were in good condition. From this I drew the **conclusion** that:

   All my previous hypotheses were wrong.

   I proceed to form several new hypotheses, taking note of my observation:
   1) She didn't want them anymore and threw them away.
   2) They fell into the dustbin by accident.
   3) There is some other reason yet unknown.

I then proceed to make further observations that either support or weaken each hypothesis, discarding hypotheses that are wrong, until I arrive at the most likely hypothesis.

Now you try!

Write down some simple hypotheses for the following observations.

a) You observe a leaf outside your window floating upwards in the air.

A gust of wind blows it upwards.

Someone is raking leaves and has stirred this one up.

Someone is scattering leaves about and has thrown this one up.

b) You observe a withered plant that appears to be dying.

Someone forgot to water it.

Worms are eating away at its insides.

The fertiliser used was too strong and thus the plant is suffering from dehydration.

Some pest has eaten its roots.

c) You observe no stars in the night sky.

The sky is cloudy and all the stars are covered.

The moon is too bright and overpowers the starlight.

Light from the earth is scattered by dust in the atmosphere so that the scattered light is brighter than the starlight even without clouds in the sky. (This is generally true in Singapore.)

d) You observe this evening's sunset to be very red.

The atmosphere is laden with moisture. It is going to rain.

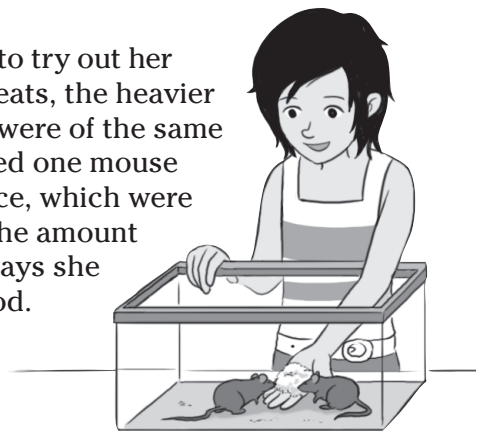
The scientific truth is that blue light has been scattered away from the white light coming from the sun, so that only red light is left to be seen by the eye. The agents of scattering are dust particles and water vapour in the atmosphere.

Note to Teacher:
Remind students not to confuse observations with inferences. Inferences are something that we deduce from observations.

Get It Right

Marie wanted to find out whether the amount of food consumed has an effect on weight gain. So, she decided to test this out with mice.

She chose two mice from the same litter to try out her hypothesis that the more food a mouse eats, the heavier and fatter it is. The two mice she chose were of the same gender and have the same weight. She fed one mouse the usual amount she always fed her mice, which were all thin. She fed the other mouse twice the amount she gave to the first mouse. Every two days she weighed the mice before giving them food. She recorded their weights.



a) In this experiment, what is the independent variable?

The number of days since the experiment started

b) What is the dependent variable?

The weight of the mice

Recall the definitions of variables. Refer to the Science Matters Textbook, section 1.5 on The Scientific Method.

c) Why did she weigh them before they were fed?

So that the weight of the food they ate will not be counted

d) Why did she choose to feed two mice?

So that the first mouse, eating the usual amount of food, became the control to compare with the second mouse.

e) Why did she weigh the mice at the start of the experiment and choose two from the same litter, of the same gender, and of the same weight?

To keep the two mice as similar as possible. In this way, we cannot say that one mouse grew fatter because it came from a family of fat mice, or because it was a male, or that it was fat to start with.

Analyse what is required in an experiment. Ask yourself, "Is the same starting condition required?" and "What is the control set-up or condition?"

f) Scientific studies on mice have shown that in similar experiments done with many mice, the thin mice lived longer, were healthier and were more intelligent. From the results of these studies, what inference can you make on the health of human beings?

We should avoid overeating so that we will be healthier in the long run.

Predict what would happen to a human being who eats more than what he or she should have.

Name: _____ Class: _____ Date: _____

Chapter 2 Measurement and Units

Worksheet 2.1	For Science Matters Textbook Volume A, sections:
	2.1 The Importance of Accurate Measurement and Standard Units 2.2 Units of Measurement 2.3 Measuring Length 2.4 Measuring Area

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. You are given four instruments, A, B, C and D.

A

B

C

D

Which instrument would you use to measure each of the following objects?

a) Length of a book (A)

b) Thickness of a book (D)

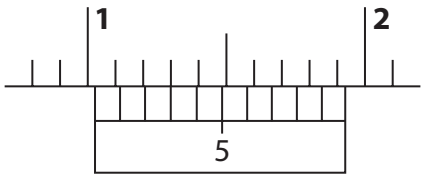
c) Height of a cupboard (C)

d) Length of a pendulum (A)

e) Width of a hole in a bowling ball (D)

f) Waist measurement of a person (B)

2. The external diameter of a pipe was measured. The figure below shows the reading on the vernier calipers. What is the external diameter of the pipe?



A 1.00 cm
B 1.03 cm
C 1.30 cm
D 3.00 cm

(B)

3. The diameter of a thin wire was measured with a pair of vernier calipers. Figure A shows the reading when the wire was measured. Figure B shows the reading when the wire was removed and the jaws were fully closed.

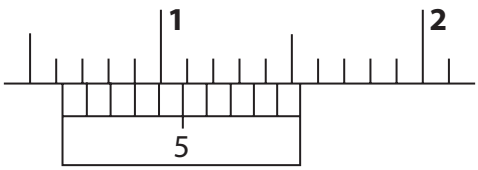


Figure A

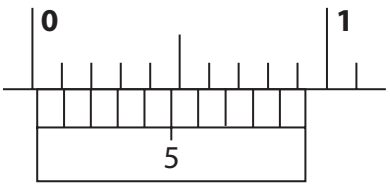


Figure B

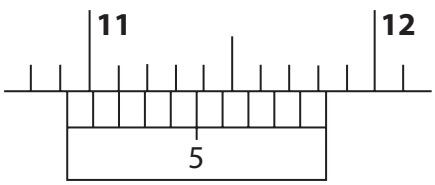
What is the diameter of the wire?

A 0.25 cm
B 0.61 cm
C 0.93 cm
D 1.53 cm

(B)

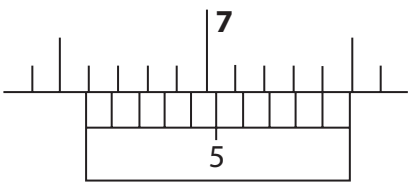
4. State the readings given by the following vernier scales:

a)



Answer: 10.92 cm

b)



Answer: 6.59 cm

5. Convert the following quantities into the units given.

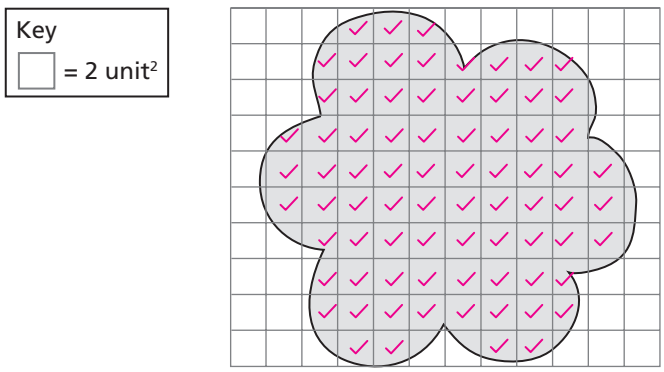
a) 1.25 km = 1.25 × 1,000 m = 1,250 m

b) 850 m = 850 × 0.001 km = 0.85 km

c) 120 m = 120 × 100 cm = 12,000 cm

d) 15 cm = 15 × 0.001 m = 0.015 m

6. The outline of a flower is shown in the grid below. Find its area.



No. of ticks = 77

Area = 154 unit²

7. Outline how you would go about obtaining the most accurate reading for the following:

a) Height of a person

Paste a measuring tape on the wall, with the zero mark at the floor level. Ask the person to stand against the measuring tape. Slide a flat folder (or book) onto the person's head and take the reading where the folder touches the tape. This is to avoid parallax error.

b) Depth of a hole in the wall made by a drill

Insert the tail end of the vernier calipers to the bottom of the hole and take readings from the vernier calipers. Check for zero error and take an average of several readings.

c) Diameter of a bowling ball [Hint: Use the formula for calculating circumference to help you.]

Measure the circumference of the ball with a measuring tape. Take an average of several readings at different positions. Calculate the diameter, d, with the following formula: Circumference, $c = \pi d$.

d) Thickness of a razorblade, given a packet of ten

Measure the thickness of the pack of razorblades with a pair of vernier calipers or a micrometer. Divide by ten to get the average thickness of each blade.

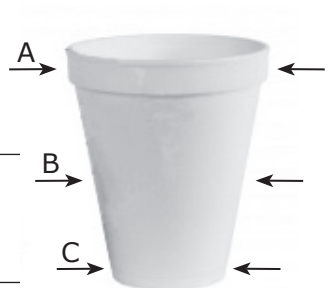
8. You are given a cup (shown on the right), a flexible measuring tape, vernier calipers and a ruler.

a) What would you use to measure the circumference of the band around the mouth of the cup?

Measuring tape

b) What would you use to measure the depth of the cup?

Ruler/vernier calipers (with its tail)



c) What would you use to measure the average internal diameter of the cup?

Use the inside jaws of the calipers to grip the internal wall of the cup at B.

d) What would you use to measure the thickness of the cup at its mouth?

Vernier calipers with jaws gripping the thickness of the cup at its mouth (at A).

9. Figure A shows the reading of a pair of vernier calipers when it is closed fully. Figure B shows the reading when there is a steel pipe clamped between its jaws.

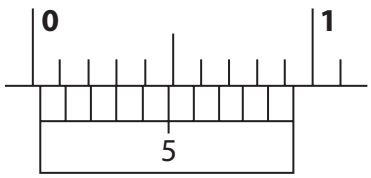


Figure A

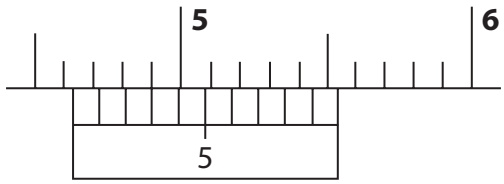


Figure B

a) What is the zero error? + 0.03 cm

b) What is the diameter of the steel pipe?

Reading on figure B = 4.63 cm

Hence, diameter = 4.63 – (+0.03) = 4.60 cm

c) What would the answers be to parts (a) and (b), if the zero error had been different, as shown in figure C?

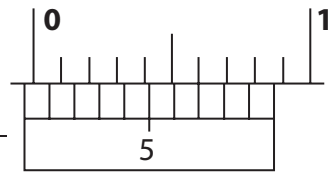


Figure C

The new zero error = –0.03 cm (by reading backwards from "10")

The diameter of the steel pipe = 4.63 cm – (–0.03 cm)
= 4.63 + 0.03 = 4.66 cm

Challenge Yourself • 5 min •

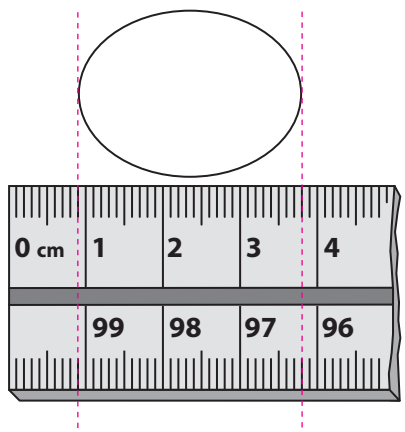
Attempt the following question within the time allocated.

a) What is the length of this egg?

Reading on left = 0.9 cm

Reading on right = 3.8 cm

Length of egg = 3.8 cm – 0.9 cm = 2.9 cm



b) If you were looking at a real egg instead of a picture, explain how you can minimise parallax error when measuring the diameter of the egg.

Use a set-square to align the ends of the egg with the scale readings.

Name: _____ Class: _____ Date: _____

Worksheet 2.2	For Science Matters Textbook Volume A, sections:	
	2.5 Measuring Volume	2.7 What is Density?
	2.6 What is Mass?	2.8 Temperature

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Mr Ng is rebuilding his home. When he designs his garden hedge, his swimming pool and grass carpet for his garden, he is likely to be dealing with measurements in _____ respectively.

   A area, length and volume **B** length, volume and area
   C volume, area and length **D** volume, length and area (B)

2. Convert the given readings into new units by completing the following table.

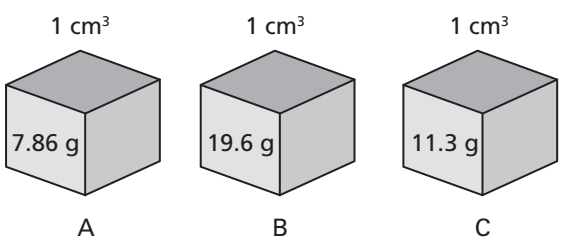
	litre (ℓ)	millilitre (mℓ)	cubic centimetre (cm^3)	cubic metre (m^3)
a)	0.063	63.0	63.0	0.000063
b)	2.03	2,030	2,030	0.00203
c)	0.025	25.0	25.0	0.000025

3. How many cartons of orange juice, each marked 1.5 ℓ, are needed to fill up a glass tank at a drink stall if the tank measures 40 cm × 50 cm × 30 cm?

   Volume of tank = (40 × 50 × 30) cm^3 = 60,000 cm^3 = 60 ℓ

   Number of cartons of orange juice needed = $\frac{60\ \ell}{1.5\ \ell}$ = 40 cartons

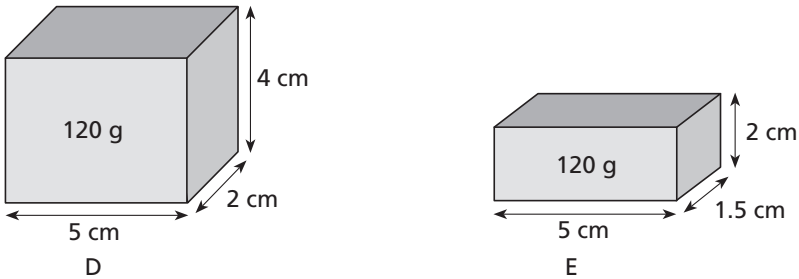
4. a) Which material is the densest, A, B or C?



   Answer: B

   How did you arrive at your answer? I compared their masses.

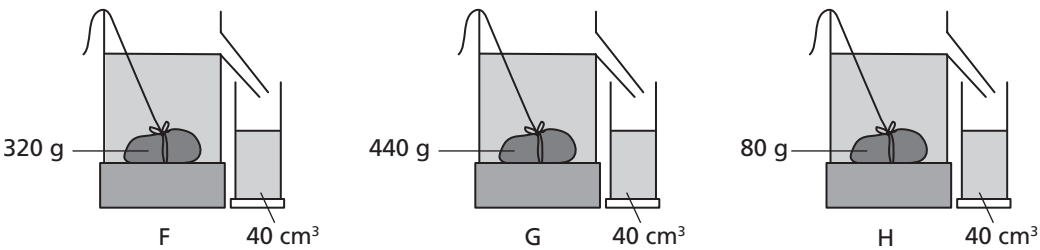
b) Which material is denser, D or E?



Answer: E

How did you arrive at your answer? I compared their volumes.

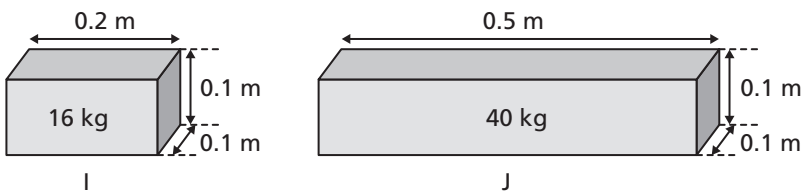
c) Which material is the densest, F, G or H?



Answer: G

How did you arrive at your answer? I compared their masses.

d) Which material is denser, I or J?



Answer: They have the same density.

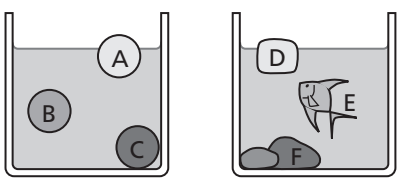
How did you arrive at your answer? I calculated the density of each of the two blocks using their masses and volumes. I then compared their densities.

5. In the two vessels of water, which of the objects marked A, B, C, D, E, and F are:

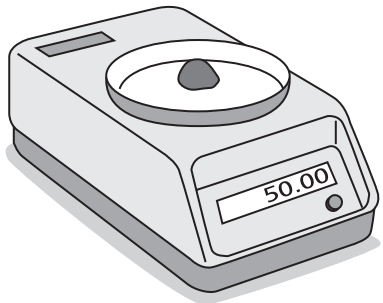
a) denser than water? C and F

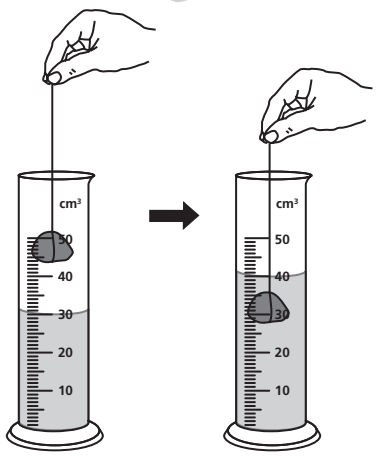
b) less dense than water? A and D

c) as dense as water? B and E



6. The mass of a stone is measured as shown. The stone is attached to a string and lowered into a cylinder of water.





a) What is the volume of the stone?

10 cm^3

b) What is the density of the stone?

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$= \frac{50\ \text{g}}{10\ \text{cm}^3}$$

$$= 5\ \text{g/cm}^3$$

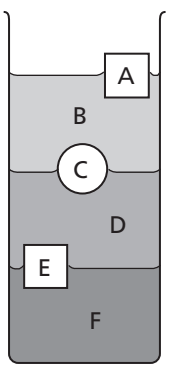
c) Why can't you use this method to find the density of a piece of cork?

Cork floats on water and will not displace a volume of water equal to its volume. Hence, the volume measured is not accurate.

7. Six substances, solids and liquids, were put into a tall cylinder and allowed to settle. They are marked as A, B, C, D, E and F in the diagram. In this table, fill in the correct letters against the names of the substances.

Substance	Density (g/cm^3)	Letter
Oil	0.8	B
Polythene*	0.9	C
Steel	8.0	E
Water	1.0	D
Mercury	13.6	F
Cork	0.2	A

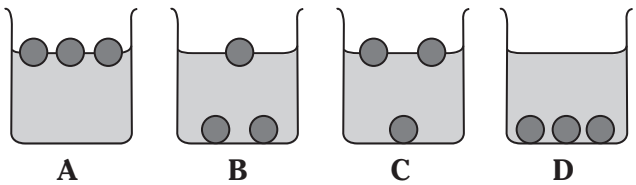
* A plastic material



Challenge Yourself • 25 min •

Attempt the following questions within the time allocated.

1. Three balls have densities of 0.9 g/cm^3, 1.1 g/cm^3 and 1.3 g/cm^3 respectively. They are immersed in turn in four beakers carrying different liquids.

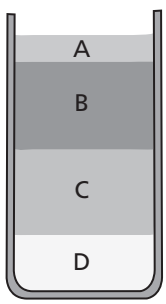


a) Which of these beakers holds a liquid of density 1.2 g/cm^3? (C)

b) The other beakers hold oil of density 0.8 g/cm^3, water of density 1.0 g/cm^3 and mercury of density 13.6 g/cm^3. These are shown respectively as _____.

A A, B and D **B** B, D and C
C C, D and B **D** D, B and A (D)

2. Mercury, cooking oil and water are placed together in a tall glass jar. Their densities are 13.6 g/cm^3, 0.8 g/cm^3 and 1.0 g/cm^3 respectively. Here they are shown together with a fourth layer, which may either be a cylindrical slab of wood in (a) or a thick oil in (b) and (c).

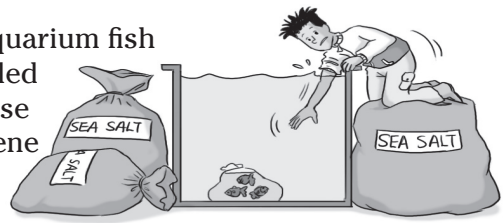


a) If a cylindrical slab of wood (having a density of 1.12 g/cm^3) with the same diameter as the internal diameter of the glass jar is the fourth layer in the jar, which is the most likely position it will occupy? (C)

b) If thick oil of density 0.98 g/cm^3 that does not mix with the other liquids is the fourth layer in the glass jar, which position will it occupy ? (B)

c) An iron nail of density 7.8 g/cm^3 is then dropped into the glass jar with the thick oil as the fourth layer. The nail would finally sink to a level at the bottom of one of the liquids — A, B, C, or D. Which liquid is it? (C)

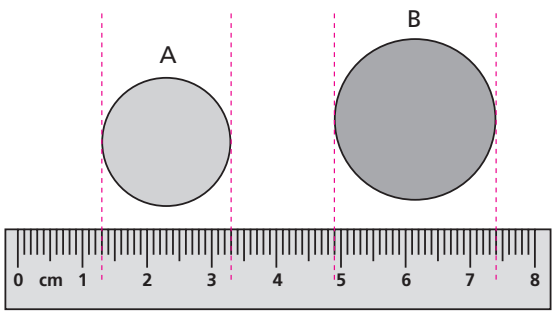
3. Isaac bought a few packets of sea salt and some aquarium fish that were put in a tightly knotted polythene bag filled with water. He was about to untie the knot to release the fish into a deep tank of water when the polythene bag slipped and fell to the bottom of the tank.



His arms are not long enough to reach the bag and he has no tools with him. What can Isaac do to get the bag out of the tank?

He can put some of the sea salt into the tank, and stir the water such that the salt dissolves. The density of the salt solution will be greater than that of the polythene bag filled with water. The polythene bag will then float to the surface.

4. a) Using the scale below, find the diameters of circles A and B.



	Left reading (cm)	Right reading (cm)	Diameter (cm)
A	1.3	3.3	2.0
B	4.9	7.4	2.5

b) If circle A is the cross-section of sphere X and circle B is the cross-section of sphere Y, find the volumes of these spheres.

Volume of sphere X = $\left(\frac{4}{3}\right)(\pi\ 1^3) = 4.19\ cm^3$

Volume of sphere Y = $\left(\frac{4}{3}\right)(\pi\ 1.25^3) = 8.18\ cm^3$

c) Take note of the volumes of the two spheres, X and Y. Make an observation on how one sphere is different from the other in terms of its cross-sectional diameter and volume.

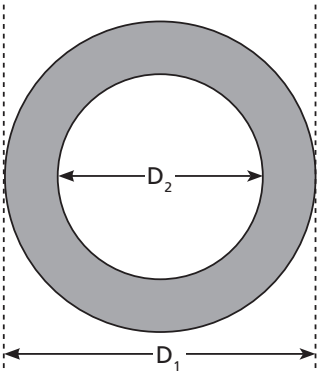
What can you say about the change in the volume of the spheres as compared to the change in the cross-sectional diameter?

The diameter of sphere Y is only slightly larger than that of sphere X, but its volume is about twice that of sphere A.

d) How can you apply this observation in everyday life?

When shopping, choose the slightly larger round objects (e.g. fruits, eggs, fishball and potatoes) if they are sold per piece. You may get double the volume for the same price.

Get It Right

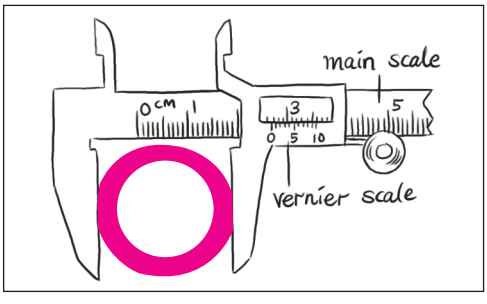


The diagram shows the cross-section of a large iron pipe.
Its internal and external diameters are shown.

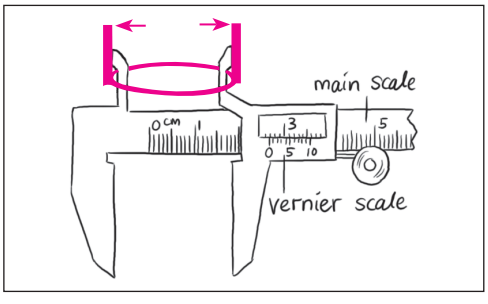
a) What instrument would you use to measure these diameters?

Vernier calipers

b) Sketch the iron pipe in these diagrams to show how the instrument is used to measure the diameters.

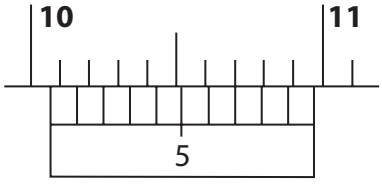


Measuring D_1

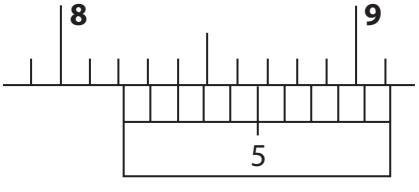


Measuring D_2

c) The corresponding settings of the vernier scale obtained when measuring external and internal diameters are shown below.



D_1



D_2

Read and record the diameters.

i) External diameter = 10.07 cm

ii) Internal diameter = 8.22 cm

d) Calculate the value of the thickness of the pipe from these readings.

$$\text{Thickness of the pipe} = \frac{\text{External diameter} - \text{Internal diameter}}{2}$$

$$= \frac{10.07 - 8.22}{2}$$

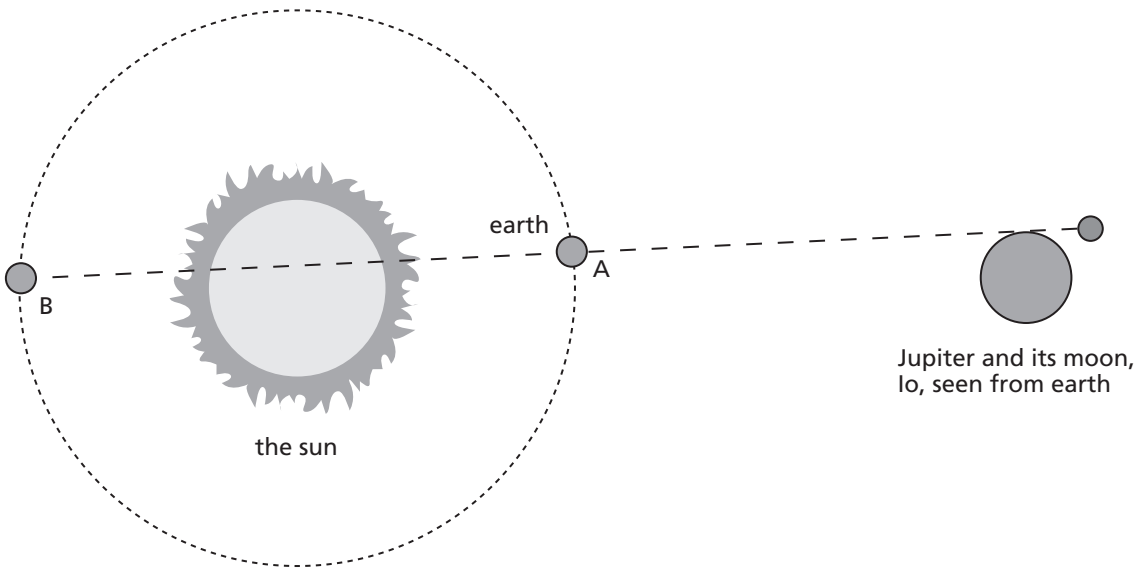
$$= \frac{1.85}{2}$$

$$= 0.925 \text{ cm}$$

Refer to the Science Matters Textbook Volume A, section 2.3 on Measuring Length.

Get It Right

Here is a diagram showing the earth going round the sun. The radius of the earth's circular orbit is 150,000,000 km. The planet Jupiter also orbits around the sun. One of its moons, Io, is shown below.



When the earth was at point A (near to Jupiter), the Danish Astronomer, Ole Romer, observed the moon Io going behind Jupiter (an eclipse). This occurred in a regular pattern such that Romer could predict exactly when it would happen.

However, when the earth was at point B six months later, Romer noticed that the eclipse of this moon was observed 1,000 seconds late. From this observation, Romer was able to calculate the speed of light.

a) Why do you think there was a 1,000 seconds delay in Romer's observation of the eclipse?

Light from Io travelled a greater distance when the earth was at point B than when it was at point A.

Distance = speed x time. When distance increases, time taken by an object to travel at a constant speed also increases. This causes the time delay.

b) Calculate the extra distance travelled by light from the moon Io to point B as compared to when it travelled to point A.

Extra distance travelled by light is equal to the diameter of the earth's orbital circumference.

Extra distance travelled by light = 2 × 150,000,000 km
= 300,000,000 km

Extra distance travelled by light is the difference between the distance light travelled from the moon to point B and the distance it travelled to point A.

c) What is the speed of light?

$$\text{Speed of light} = \frac{300{,}000{,}000 \text{ km}}{1{,}000 \text{ s}}$$

= 300,000 km/s
= 300,000,000 m/s

Use the value of time delay and extra distance travelled to calculate the speed of light. This is because the values of time taken for light to travel from the moon to A and to B were not known.

Note to Teacher:
We have simplified this activity for students. We have ignored the fact that Jupiter, whose "year' is 12 earth years, has moved $\frac{1}{24}$ of its orbit in 6 earth months. We have also changed the actual delay Romer observed so that students obtain the exact speed of light. The speed of light Romer obtained was 225,000,000 m/s. Was it due to inaccuracy of his instruments? Or did he miscount the number of cycles taken by Io in orbitting Jupiter? Expect the query "How to look at Jupiter when the sun is blocking? This is because the sun and the orbits of earth and Jupiter are not on the same plane.

Name: _____ Class: _____ Date: _____

Chapter 3 Time, Rate and Speed

Worksheet 3.1	For Science Matters Textbook Volume A, sections: 3.1 Measuring Time 3.2 What is Rate?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. To measure the time of an athlete's performance, the best equipment to use is _____.

   A a clock **B** an egg-timer
   C a watch **D** a stopwatch (D)

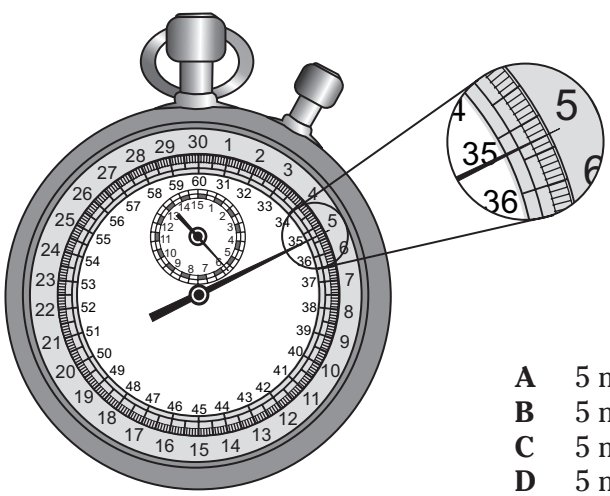
2. What can you use to measure the time required to cook broccoli?

   A An egg-timer **B** A pendulum
   C A stopwatch **D** Any of the above (D)

3. A man board a bus at 12.48 p.m. and alighted at the end of his journey at 2.15 p.m. How long did the journey take?

   A 1 h 3 min **B** 1 h 27 min
   C 2 h 33 min **D** 10 h 33 min (B)

4. The reading of the stopwatch is _____.



   A 5 min
   B 5 min 4 s
   C 5 min 5.3 s
   D 5 min 35.3 s (D)

5. Which of the following statements **does not** express a rate?

A The heart beats seventy times per minute.
B The leg gets cramped every time it exercises.
C The lungs breathe in and out 20 times per minute.
D The stomach gets food four times a day. (B)

6. Which of the following statements **does not** express a frequency?

A He tidies the attic once in a blue moon.
B My mother goes to her hairdresser once a month.
C The MRT train comes once every seven minutes.
D We go swimming once a week. (A)

7. A drip machine delivers drops of liquid medicine, each drop having a volume of 0.005 mℓ. A nurse was asked to give a patient medication at the rate of 6 mℓ per hour.

a) How many drops of liquid medicine are delivered into the patient's body in one hour?

In one hour, the total number of drops required = $\frac{6\ \text{m}\ell}{0.005\ \text{m}\ell}$ = 1,200 drops

b) How many drops of medicine are delivered into the patient's body in one minute?

1 hour = 60 minutes

Number of drops delivered in one minute = $\frac{1{,}200\ \text{drops}}{60}$ = 20 drops

8. The following is a list of Geno's monthly expenses.

- Weekly servicing of his parts, per visit: \$120
- Motor oil for knee and elbow joints: \$60
- Burnt fuses, bulbs and wiring: \$30
- Portable batteries: \$24

How much money does Geno spend per week?

Total monthly expenses = (\$120 × 4) + \$60 + \$30 + \$24
= \$480 + \$60 + \$30 + \$24
= \$594

1 month = 4 weeks

Therefore, Geno's total expenses per week = $\frac{\$594}{4}$ = \$148.50

9. At the chocolate factory, Amy can pack 1,410 chocolates per hour. Bob can pack 408 boxes in an 8-hour working day. If each box holds 30 chocolates, who can pack faster?

Number of boxes Amy can pack per hour $= \frac{1{,}410}{30} = 47$ boxes

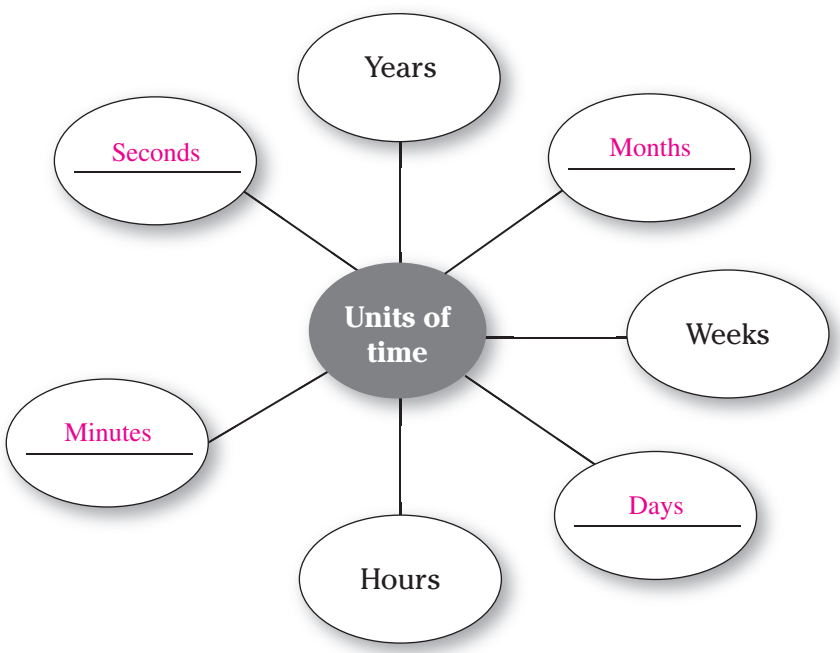
Number of boxes Bob can pack per hour $= \frac{408}{8} = 51$ boxes

Therefore, Bob can pack faster.

Map It Out

Complete the graphic organiser that follows the question below.

Time can be measured in many units. List some of these units.



Challenge Yourself • 10 min •

Attempt the following questions within the time allocated.

1. A newborn baby was measured to be 50 cm in length from head to toe. In 16 years, the baby grew to 1.8 m in height. How much did the child grow on average per year?

   A 2 cm **B** 5 cm
   C 8 cm **D** 11 cm (C)

2. The kitchen tap is dripping again. If every drop is 0.05 mℓ and it fills up a 1.5 ℓ bottle in a day, how many drops are formed per minute?

$1.5\ \ell = 1.5 \times 1{,}000\ m\ell$
$= 1{,}500\ m\ell$

Number of drops per day $= \dfrac{1{,}500\ m\ell}{0.05\ m\ell} = 30{,}000$ drops

1 day = 24 hours $= 24 \times 60$ minutes
$= 1{,}440$ minutes

Number of drops formed per minute $= \dfrac{30{,}000 \text{ drops}}{1{,}440}$

$= 20.8 \approx 21$ drops

3. During the holidays, Anna worked as a salesgirl for \$32 per day, from 9 a.m. to 5 p.m. every day. Her parents paid her sister Aniza \$5 per hour to do chores and help out at their store for six hours every day. Their brother Al works from 9 a.m. to 5 p.m. and gets paid \$1,050 per month of 30 days. Who is best paid by the hour, assuming that they work every day?

Anna's earnings per hour $= \dfrac{\$32}{8} = \$4$

Aniza's earnings per hour = \$ 5

Al's earnings per hour $= \dfrac{\$1{,}050}{(30 \times 8)} = \$4.40$

The person who is best paid by the hour is Aniza.

Name: _____ Class: _____ Date: _____

Worksheet 3.2	For Science Matters Textbook Volume A, section: 3.3 Speed

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. To measure the average speed of the wind, Isaac threw a sheet of paper in the air and watched the second hand of his wristwatch. As Isaac counted, the wind blew the sheet of paper directly towards Marie, who was 50 metre away from Isaac. He stopped counting when Marie held out her hand to show that the paper had passed her. Isaac counted only 4 seconds. What was the average speed of the wind?

A 10 m/s **B** 12 m/s
C 25 m/s **D** 50 m/s

(B)

2. Thunder occurs when the lightning strikes.

a) Light travels at 300,000,000 m/s. When lightning strikes 2 km away from your house, you will see the lightning flash _____.

A 2 s later **B** 4 s later
C 6 s later **D** almost immediately (D)

b) Sound travels at 330 m/s. From 2 km away, you will hear the thunder _____.

A 2 s later **B** 4 s later
C 6 s later **D** almost immediately (C)

3. A lorry travelled at 60 km/h for 15 min. It then slowed down to travel at 46 km/h for 45 min. What was the total distance covered by the lorry?

A 49.5 km **B** 75.0 km
C 94.5 km **D** 104.5 km (A)

4. A car travelled 60 km in 40 min and then travelled another 90 km in 1 h. What is the average speed of the car?

A 60 km/h **B** 90 km/h
C 75 km/h **D** 100 km/h (B)

5. If Marie cycles 2.5 kilometres to her friend's house from her home in 12 minutes and then cycles home quickly in 8 minutes, what is her average speed in km/h?

Total distance travelled = 2.5 km + 2.5 km = 5.0 km
Total time taken to travel this distance = 12 min + 8 min = 20 min = 1/3 h

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time taken}} = \frac{5.0 \text{ km}}{1/3 \text{ h}} = 15 \text{ km/h}$$

6. The MRT train doors closed 2 minutes after Isaac got in. The train then moved off, travelled fast and then slowed down. It stopped 6 minutes later, at the next station, 6.7 km away. Isaac waited half a minute before getting out of the train due to the crowd.

What was the average speed of his journey? Give your answer in m/s.

Total time of journey while Isaac was on the train = (2 + 6 + 0.5) min
= 8.5 min

$$\text{Average speed} = \frac{6{,}700 \text{ m}}{(8.5 \times 60 \text{ s})} = 13.1 \text{ m/s}$$

7. Becky took 45.2 s to complete a 400 m race.

a) What was her average speed in m/s?

$$\text{Her average speed} = \frac{400 \text{ m}}{45.2 \text{ s}}$$
$$= 8.85 \text{ m/s}$$

b) What is 1 m/s in km/h? Therefore, what was Becky's speed in km/h?

$$1 \text{ m/s} = \frac{0.001 \text{ km}}{1/3{,}600 \text{ h}} = 3.6 \text{ km/h}$$

Becky's speed = 8.85 × 3.6 km/h
= 31.86 km/h

8. A very light arrow moving at 96 m/s takes 1.5 s to fly from the bow to hit a target. How far away was the target?

Distance moved = 96 × 1.5 = 144 m

Map It Out

Complete the graphic organiser that follows the question below.

Rate is applied in many ways. One example is flow rate. Flow rate is the change in the volume of liquid per unit time. How does flow rate differ from speed?

Flow rate		**Speed**
The change of volume per unit time.	⟺	The change in distance travelled per unit time.
Related to a flowing fluid	⟺	Related to a moving object
Flow rate = $\frac{\text{Volume of liquid}}{\text{Time}}$	⟺	Speed = $\frac{\text{Distance}}{\text{Time}}$
S. I. unit: m^3/s	⟺	S. I. unit: m/s

Challenge Yourself • 25 min •

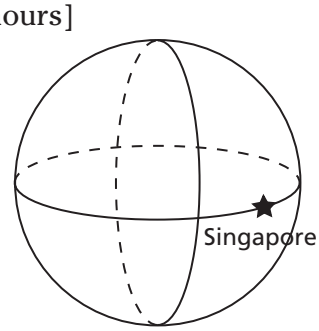
Attempt the following questions within the time allocated.

1. The earth's radius is about 6,300 km. Take π to be $\frac{22}{7}$ and Singapore to be on the equator. Calculate the speed with which we are moving round the axis of the earth. [Hint: One round about the axis of the earth = one day = 24 hours]

   Distance = $2\pi r = 2 \times \frac{22}{7} \times 6{,}300$ km = 39,600,000 m

   Time taken = $24 \times 60 \times 60$ = 86,400 s

   Speed = $\frac{\text{Distance}}{\text{Time taken}} = \frac{39{,}600{,}000}{86{,}400}$ = 458 m/s



2. Radio signals are similar to light. They also travel at 300,000,000 m/s. These signals can also be reflected off the surfaces of objects. We use these signals to find out how far away these objects are.

Geno has a radar that sends out or receives a very short and sharp radio signal. One day, he saw an unidentified flying object (UFO) in the distant sky over the horizon and quickly sent out his radio signal. Soon after, his radar received the reflected signal. The time interval between these signals was 1.8 ms.

a) Explain why there were two signals.

The first radio signal was the one sent out to the UFO. The second signal was the one reflected and travelled back to Geno.

b) Geno used the time interval between the two signals to tell how far away the UFO was. Show his calculations.

Let the UFO be at a distance D away. At the speed of light, the radio signal travelled 2D during the time interval between the two signals.

$$\frac{\text{Distance moved}}{\text{Time taken}} = \text{Speed}$$

$$\frac{2D}{0.0018\ \text{s}} = 300{,}000{,}000\ \text{m/s}$$

$$2D = 300{,}000{,}000 \times 0.0018 = 540{,}000\ \text{m}$$
$$D = 270\ \text{km}$$

Hence, the UFO was 270 km away from Geno.

3. Marie and Isaac were timekeepers on Sports Day. Marie sat by the finishing line, 200 m away from the starting line. Isaac stood by the starting line to time the 200 m race. As soon as Isaac and Marie heard the starter's gun, they each started their stopwatches. They stopped their stopwatches when the winner reached the finishing line. Isaac's stopwatch read 23.12 s while Marie's stopwatch read 22.54 s.

a) If we take Isaac's time to be correct, what was the average speed of the winner?

$$\frac{200\ \text{m}}{23.12\ \text{s}} = 8.65\ \text{m/s}$$

b) Marie realised that the sound of the gun took time to travel. By the time she heard the gun, it was too late, and the participants had already started running. How much time did the sound of the gun take to travel to Marie?

$23.12 - 22.54 = 0.58$ s

c) Using your answer in part (b), calculate the speed of sound.

$$\frac{200\ \text{m}}{0.58\ \text{s}} = 345\ \text{m/s}$$

Name: _____ Class: _____ Date: _____

Chapter 4 Classification of Matter

Worksheet 4.1	For Science Matters Textbook Volume A, sections: 4.1 What is Classification? 4.2 Types of Physical Properties

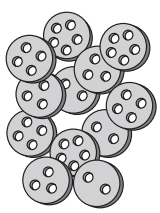
Secure Your Basics

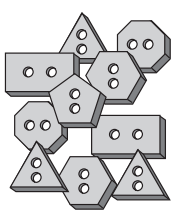
Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Which of the following **is not** an example of classification?

   A Arranging groceries in a shop according to their prices
   B Planning a menu according to food available in the refrigerator
   C Separating cutlery according to their sizes
   D Sorting books according to their subjects (B)

2. The diagram below shows how a group of buttons are classified.





   How are they classified?
   A They are classified according to the number of holes they have.
   B They are grouped according to the types of edges they have.
   C They are classified based on their colours.
   D They are grouped based on their functions. (B)

3. Which of the following **is not** a physical property of substances?

   A Electrical conductivity **B** Flexibility
   C Source of a substance **D** Strength (C)

4. What is classification? How is classification useful to us?

   Classification is the process of grouping things according to their similar properties.

   Classification allows us to group things more systematically. It is a useful and systematic way to help us study the world around us.

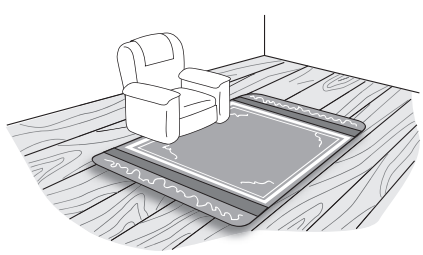
5. Match the following properties with their definitions.

Property	Definition
a) Strength	Measure of how readily electricity passes through a material
b) Hardness	Ability to support a heavy load without breaking
c) Density	Ratio of the mass of a substance to its volume
d) Flexibility	Constant temperature at which matter changes from liquid to gas
e) Electrical conductivity	Ability to bend without breaking and return to an object's original shape and size
f) Heat conductivity	Ability to withstand wear and scratches
g) Boiling point	Measure of how readily heat passes through a material
h) Melting point	Constant temperature at which matter changes from solid to liquid

6. List the properties of the materials that are important for the following objects.

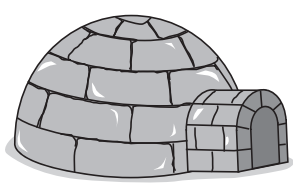
a) **Carpets** to layer wooden floors of houses in cold countries

Poor heat conductor, strong, flexible, soft, can be woven into different shapes and sizes.



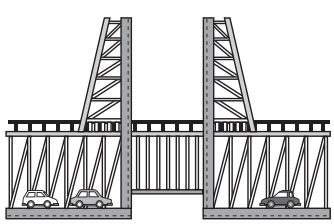
b) **Ice blocks** for walls of igloos

Poor heat conductor, strong, can be cut to different shapes and sizes.



c) **Steel** for structures of bridges

Hard and strong, malleable (can be bent and moulded into shapes).



Challenge Yourself • 20 min •

Attempt the following questions within the time allocated.

1. Use the information below to list the order of hardness of materials W, X, Y and Z, starting with the hardest substance.

- W is left with a mark when X is rubbed with it.
- Y is scratched by all the other three materials.
- When rubbed with Z, all three materials are left with a mark.

A W, X, Y, Z
B X, Y, Z, W
C Z, X, W, Y
D Z, Y, X, W (C)

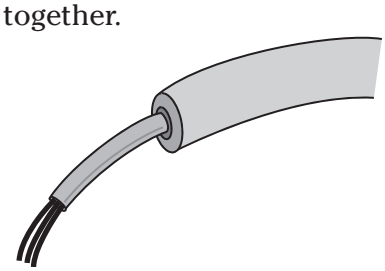
2. The table below shows the melting and boiling points of substances investigated by three students.

Student	Melting point (°C)	Boiling point (°C)
Tracy	–12	45
Sara	23	1,200
Ben	–12	45

Which of the following is **true**?

A They investigated three different substances.
B They investigated the same substance.
C Tracy and Ben investigated the same substance.
D The substance investigated by Sara is solid at 28 °C. (C)

3. The diagram below shows how good conductors of electricity and good insulators of electricity can be used together.



a) Explain how good electrical conductors and insulators complement each other in the object shown above.

The copper wire conducts electricity. The plastic insulation prevents leakage of electricity to flow to other objects that are in contact with the cable; it also prevents electric shock.

b) Give another example of an appliance that uses good electrical conductors and insulators in a similar way.

Power plug

4. You are a sales representative of a company manufacturing protective clothing for firemen. Sketch a short advertisement on the protective clothing. In your advertisement, state the properties of the materials that are used for your products.

Explain why the materials are important for their functions.

Poor heat conductivity (insulator – heat proof), fire resistant (fire proof), lightweight and flexible (helps fireman to move about quickly), high melting point (withstand high temperatures).

Name: _____ Class: _____ Date: _____

Worksheet 4.2	For Science Matters Textbook Volume A, section: 4.3 Types of Materials

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Silk is classified as a _____.

   A ceramic **B** fibre
   C metal **D** plastic (B)

2. Plastics are made from _____.

   A crude oil **B** fibres
   C minerals **D** plants (A)

3. Which of the following **is not** a property which makes iron widely used?

   A Corrodes easily **B** Good electrical conductivity
   C Malleability **D** Strength (A)

4. What type of material is polythene classified as?

   A Ceramics **B** Fibres
   C Glass **D** Plastics (D)

5. Which materials demonstrate the following properties?

   - conduct electricity well
   - ductile
   - hard and strong
   - malleable

   A Fibres **B** Glass
   C Metals **D** Plastics (C)

6. What is the source of each of the following materials?

   a) Glass: Made of silica, soda ash, and lime.

   b) Ceramics: Produced using clay and other minerals from the earth.

   c) Metals: Found in the earth's crust.

   d) Plastics: Made from crude oil.

   e) Fibres: Made from natural (e.g. plants, crude oil) or artificial substances (e.g. chemicals).

Challenge Yourself • 10 min •

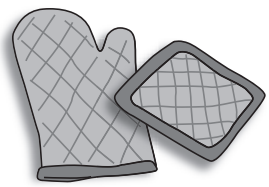
Attempt the following questions within the time allocated.

1. The properties of a material are given below.

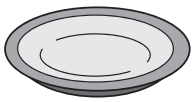
- conducts heat well
- does not rust
- has a high melting point

Which of the following objects is made of this material?

A



B



C

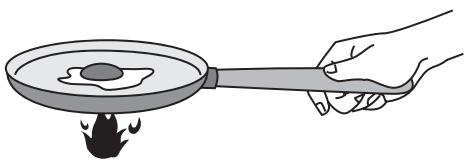
D

(D)

2. Why are we strongly encouraged to reuse, recycle or reduce the use of plastics?

Plastics are non-biodegradable and do not corrode easily. They are made from crude oil, which will eventually run out.

3. The diagram below shows a frying pan, being used to cook an egg.



a) What are the two different materials used to make various parts of this pan?

The pan is metallic and the handle is plastic.

b) Why are those materials used?

Metal is used because it conducts heat well. Food can be heated easily. Plastic is used because it does not conduct heat. It prevents heat from flowing to the hand.

Name: _____ Class: _____ Date: _____

Worksheet 4.3	For Science Matters Textbook Volume A, section: 4.4 Choosing the Right Material

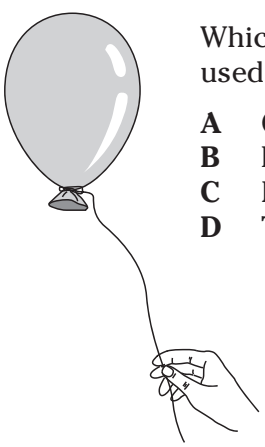
Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. To select a material to make a water bottle, which of the following properties are important?

   I Does not corrode
   II Waterproof
   III Transparent

   A I **B** II
   C III **D** I and II (D)

2. 

   Which property would you need to consider when choosing a gas used to fill the gas balloons?

   A Colourlessness
   B Density
   C Melting point
   D Transparency (B)

   Note to Teacher:
   Ask the students, "Which gas, helium or carbon dioxide, will sink or float in air?" Provide them with the densities of helium (0.00018 g/cm^3), carbon dioxide (0.001977 g/cm^3) and air (0.00128 g/cm^3).

3. Why are drinking mugs made from ceramics?

   A They are easily coloured.
   B They are poor conductors of heat.
   C They do not corrode.
   D They do not melt easily. (B)

4. Write down at least two uses for each of the materials below.

   a) Ceramics: Floor and wall tiles/ Kitchenware / Decorative vases / Space shuttle tiles / Engine components / Catalytic converters / Artificial bones and teeth / Electronic components.

   b) Fibres: Kitchen gloves / Clothing / Curtain material / Ropes / Carpets / Rugs.

5. Study the following table and answer the questions that follow.

	Transparency	Strength	Heat conductivity	Melting point
Material A	Transparent	Moderate	Good	High
Material B	Transparent	Moderate	Poor	Low
Material C	Opaque	High	Good	High

a) Which material (A, B or C) is most suitable for making the containers used in the science laboratory? Explain.

Material A.

Transparent — allows us to observe what is happening in the apparatus.

Good heat conductivity & high melting point — allows heating of substances/chemicals without melting.

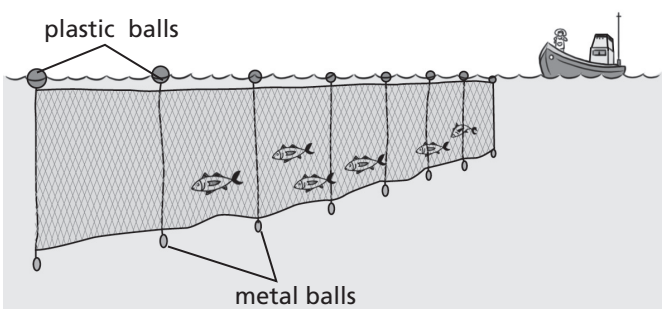
b) State another property that is important before you decide on the choice of a material for making the containers used in the science laboratory. Explain.

Resistance to chemicals — the material used to make apparatus should not react with chemicals used in the laboratory.

c) Suggest possible identities of materials A and B.

Substance A – Glass; Substance B – Plastics.

6. Look at the trawling net used to catch fish below.



Explain why plastic balls and metal balls are used.

Plastic balls are less dense than water. Therefore, they can float. This helps the fisherman to identify the position of the net. Metal balls are denser than water. Therefore, they sink. This helps spreading out the net.

Map It Out

Complete the graphic organiser that follows the question below.

What are the different non-metallic materials? Give two examples of objects made up of each material.

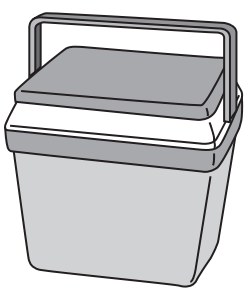
Non-metals

- Ceramics
  - Vase
  - Plate
- Glass
  - Window
  - Spectacles
- Plastics
  - Water bottle
  - Pail
- Fibre
  - Clothes
  - Bed sheet

Challenge Yourself • 25 min •

Attempt the following questions within the time allocated.

1. Which is the most important reason for the use of plastics in the making of cooler boxes?



A Plastics are lightweight.
B Plastics are poor heat conductors; hence, they do not allow heat to be transferred into the boxes easily.
C They are durable and can last for a long time.
D They can be coloured brightly. (B)

2. From the table below, which material would be most suitable for making overhead electric cables?

Material	Relative electrical conductivity (measured against copper – value of 100)	Density
A	59	2.7
B	100	8.9
C	17.7	7.85
D	1.66	13.6

(A)

3. Isaac heated a piece of iron on a Bunsen flame and placed the hot metal immediately into a container. To his horror, the container started to melt.

a) Suggest why the container melted. Name a possible material for this container.

The melting point is too low, lower than the temperature of the hot iron. A possible material for this container is plastic.

b) Suggest another material for the container so that it will not melt if the same process is carried out. Why did you choose it?

Ceramic or glass. It has a very high melting point.

c) Suggest the materials which made up the equipment that Isaac had used to hold the hot piece of iron in the flame of the Bunsen burner.

Handle — made of wood or plastic (insulator).

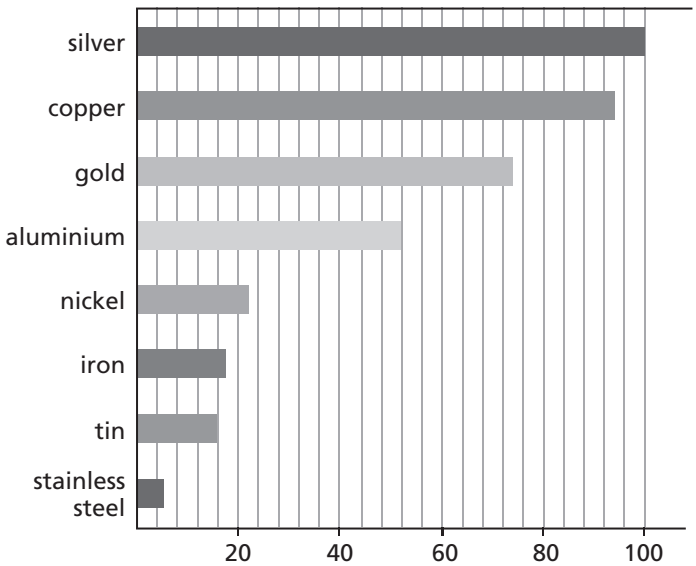
The part holding the iron — made of metal or ceramic (high melting point).

4. One of the first synthetic (man-made) substance, Bakelite, was discovered in 1907, by Leo Baekeland, a New York chemist. Bakelite is a material that retains its shape and form, does not conduct electricity, is resistant to chemicals, heat insulating and shatter-proof. Suggest possible uses for this material.

Handles of kitchen utensils / Electrical plugs / War weapons / Lightweight war machinery.

(Accept any other reasonable answers.)

5. The bar chart below shows the thermal conductivity of various metals, given the scale 100 for the thermal conductivity of silver.



a) In general, a material that has a high thermal conductivity also has a high electrical conductivity.

i) Based on this statement, which metal is the best electrical conductor?

Silver.

ii) Why then instead of using this metal (in (i)), copper is used in wires? Suggest a possible answer.

Silver is more expensive than copper./ Silver is more difficult to obtain.

b) Metals are commonly used to make cookware and bakeware. Among the most common metals used for this purpose are iron, aluminium and copper. Which of these cookware — an iron pan, an aluminium pan or a copper pan — will cook food most quickly? Why?

Copper. It is the best conductor of heat of the three; therefore, food can be heated more evenly.

Note to Teacher:
Expect students to ask why good electrical conductors are, in general, good heat conductors. Free-moving electrons in the conductors may move when there is a voltage difference between two points along the conductors; this causes an electric current. Temperature difference between two points along the conductors causes the transfer of heat.

Get It Right

Observe the design of the playground nearby your block.

a) Identify the material that makes the chin-up bar. Why do you think the chin-up bar is made of this material?

The chin-up bar is made of steel. This is because steel is strong; it can support heavy load repeatedly without breaking or tearing.

Study how a chin-up bar is used and refer to the Science Matters Textbook Volume A, section 4.3 on Types of Materials.

b) The floor of the playground is layered with a soft, flexible, rubbery material. Suggest two advantages of using this material.

The material is soft; hence, a kid will not get injured when falls onto it. The material is also flexible; it will return to its original shape.

Recall the behaviour of a material that is soft and a material that is flexible. Refer to the Science Matters Textbook Volume A, section 4.2 on Types of Physical Properties.

d) The slide is made of plastics. Suggest why it is not made of metal.

Metals conduct heat well. When the sun is shining, the slide will easily get heated up. No one will be able to play on the slide.

Study how slides are used and recall the properties of metals from the Science Matters Textbook Volume A, section 4.3 on Types of Materials.

Name: _____ Class: _____ Date: _____

Chapter 5 Elements, Compounds and Mixtures

Worksheet 5.1	For Science Matters Textbook Volume A, sections: 5.1 What is Matter Made Up of? 5.3 Periodic Table 5.2 Classifying Elements

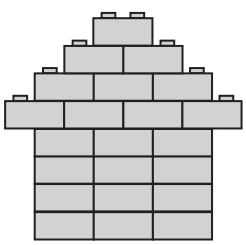
Secure Your Basics

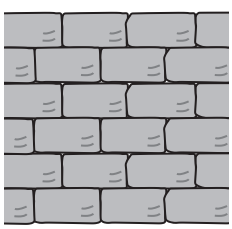
Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. The following are matter except _____.

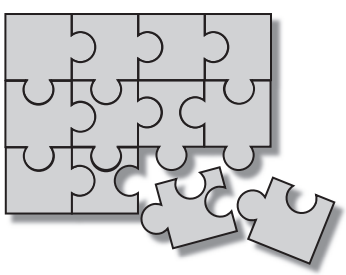
   A sound **B** hydrogen
   C cloud **D** air (A)

2. Which of the following **does not** give the correct analogy of elements as building blocks of matter?

   A
   

   B
   

   C
   

   D
   

   (C)

3. Which of the following **is not** a pair of an element and its chemical symbol? (You can refer to the Periodic Table.)

   A Calcium — Ca **B** Carbon — C
   C Chlorine — Cl **D** Copper — Co (D)

4. In a Periodic Table,

a) are there more metals or non-metals? Metals

b) what do we call the elements found in the same vertical column? A group

c) describe one property that can help you differentiate between a metal and a non-metal. Give an example using one metallic and one non-metallic elements.

Copper — malleable (can be bent and moulded into shapes); sulphur — brittle (breaks into pieces).

5. Graphite and diamond are two forms of the element carbon. What is the property of these two substances that makes graphite suitable for use in pencil lead and diamond in cutting tools?

Graphite — soft and flakes off easily against surface.

Diamond — very hard substance.

5. The following elements are given.

sodium	mercury	phosphorus	copper	helium
chlorine	tin	cadmium	fluorine	tungsten

a) Briefly describe, by completing the graphic organiser below, how you can identify whether an element is a metal or a non-metal using the Periodic Table.

Is the element located on the left of the zigzag staircase line?

Yes → A metal

No → A non-metal

b) Using the steps in (a), classify the elements given into metals and non-metals.

Metals	Non-metals
sodium mercury copper tin cadmium tungsten	phosphorus helium chlorine fluorine

Challenge Yourself • 20 min •

Attempt the following questions within the time allocated.

1. Marie read from a science book a statement that says "the melting point of pure ice is 0 °C whereas ice containing dissolved common salt (sodium chloride) melts at –2 °C". What can we deduce from this statement?

   A Pure ice is separated from sodium chloride at –2 °C.
   B Sodium chloride in ice forms a compound as it has a different melting point from pure ice.
   C Sodium chloride melts at –2 °C.
   D The melting point of impure ice is lower than that of pure ice. (D)

The following table shows the properties of three unknown substances. Use the information given in this table to answer questions 2 – 3.

Unknown substance	Appearance	Effects of passing electricity through the unknown substance in a circuit with a light bulb	Effects of heating the unknown substance
I	Colourless liquid	The bulb lights up; a colourless gas and a brown gas are produced.	Boils and produces a colourless gas; a white precipitate is formed.
II	Silvery solid	The bulb lights up.	Turns into silvery liquid at high temperature.
III	Yellow solid	The bulb does not light up.	Turns into sticky, yellowish orange liquid, then produces a pungent gas.

2. Which substances are likely to be elements?

   A I and II **B** I and III
   C II and III **D** I, II and III (C)

3. Which substance(s) could be used for making alloys?

   A I **B** II
   C III **D** I and II (B)

4. Explain the following:

a) Alloys of aluminium are used to make aircraft bodies instead of pure aluminium.

Alloys are harder than pure elements of metals such as aluminium.

b) Objects made of iron are usually coated with paint or a layer of protective metal.

Iron can rust and corrode away if it comes into contact with oxygen. Paint and other protective metals help to prevent rusting.

c) Electrical wires are usually made of copper.

Copper conducts electricity and is ductile (can be pulled into long wires without breaking).

5. The table below shows the properties of four elements, K, L, M and N.

Element	Electrical conductivity	Thermal conductivity	Melting point	Strength
K	High	Low	Low	Brittle
L	High	High	High	Strong
M	Low	Low	Low	Brittle
N	High	High	Low	Strong

a) Which element is definitely a metal? Give your reason.

Element L. It has all the properties that metals in general have: high electrical and thermal conductivity, high melting point and strong.

b) Element N is also a metal.

i) How is element N different from the element in (a) at room temperature?

Element N is liquid at room temperature while element L is solid at room temperature.

ii) Suggest the identity of element N.

Mercury

iii) Give an example of the uses of element N in everyday life.

Liquid in thermometers

Name: _____ Class: _____ Date: _____

Worksheet 5.2	For Science Matters Textbook Volume A, section: 5.4 What are Componds?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Which of the following substances is a compound?

   A Bronze **B** Gold
   C Steel **D** Water (D)

2. When a compound such as sugar is heated strongly, it _____.

   A combines with oxygen in air **B** decomposes
   C melts **D** undergoes combustion (B)

3. Which of the following substances cannot be separated into two elements by electricity?

   A Aluminium oxide **B** Calcium chloride
   C Sodium bromide **D** Titanium (D)

4. Listed below are some of the ingredients shown on a carton of chocolate milk.

   milk powder, sugar, cocoa powder, stabilisers, emulsifiers, flavourings, calcium, vitamin C, vitamin E, vitamin B6, vitamin B1, vitamin A, vitamin K and vitamin D3

   a) Name the ingredient that is an element.

   Calcium

   b) How do you think the element in (a) is different from cocoa powder? Explain.

   The element calcium cannot be broken down into any simpler substances. Cocoa powder, on the other hand, can most likely be broken down into simpler substances. Cocoa powder is not found in the Periodic Table. Those that are not in the Periodic Table may be compounds or mixtures.

Challenge Yourself • 10 min •

Attempt the following questions within the time allocated.

1. When substances such as copper carbonate and sugar are heated, they are broken down into simpler substances.

   a) Write down the name of this process. Decomposition

   b) What does this tell you about these two substances? They are not elements.

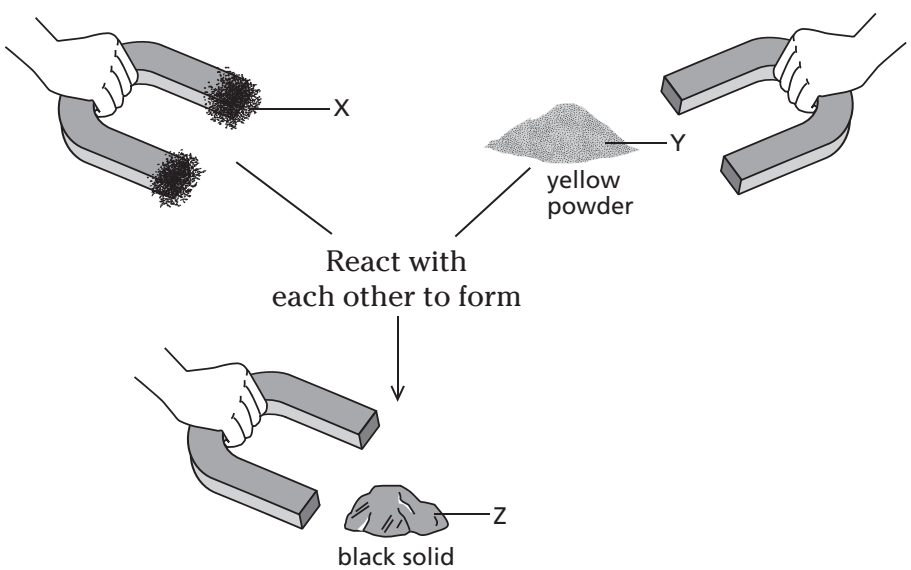
2. a) Write a word equation to describe what happens when sugar is burnt.

   Sugar $\xrightarrow{\text{heat}}$ Water + Carbon

   b) Why does magnesium not behave in a similar manner when heated? What is formed instead when magnesium is burnt in air?

   Magnesium is an element, so it cannot be broken down into simpler substances. Magnesium oxide is formed.

3. Study the following diagram.



   a) Identify the following:

   i) X: Iron ii) Y: Sulphur

   b) How do you know that a new substance is formed from the reaction.

   The product, iron sulphide, does not have the physical properties of its constituent elements. For example, it does not have the magnetic property of iron.

Name: _____ Class: _____ Date: _____

Worksheet 5.3	For Science Matters Textbook Volume A, section: 5.5 What are Mixtures?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Which of the following lists of substances consists only of mixtures?

   A Dust, sea water, milk, petroleum
   B Ink, fizzy drinks, soil, distilled water
   C Smoke, steel, blood, sugar
   D Wine, paint, common salt, beer (A)

2. When a mixture is formed, _____.

   A a chemical change takes place
   B heat and light are produced
   C it has properties which are different from the properties of its components
   D the components are present in variable amounts (D)

3. Classify the following into elements, mixtures and compounds.

bronze	silver	mercury	wine
brass	oxygen	air	milk
alcohol	iodine	sugar	common salt
copper sulphate	soya sauce	carbon dioxide	nitrogen

Elements	Mixtures	Compounds
Silver, mercury, oxygen, iodine, nitrogen	Bronze, air, milk, soya sauce, brass, wine	Alcohol, sugar, common salt, copper sulphate, carbon dioxide

4.

wine	air	smoke	copper	brass	sulphur
milk	bronze	magnesium	zinc	steel	carbon

Select from the above list,

a) two mixtures which exist as gases at room temperature: Air, smoke

b) two liquid mixtures: Wine, milk

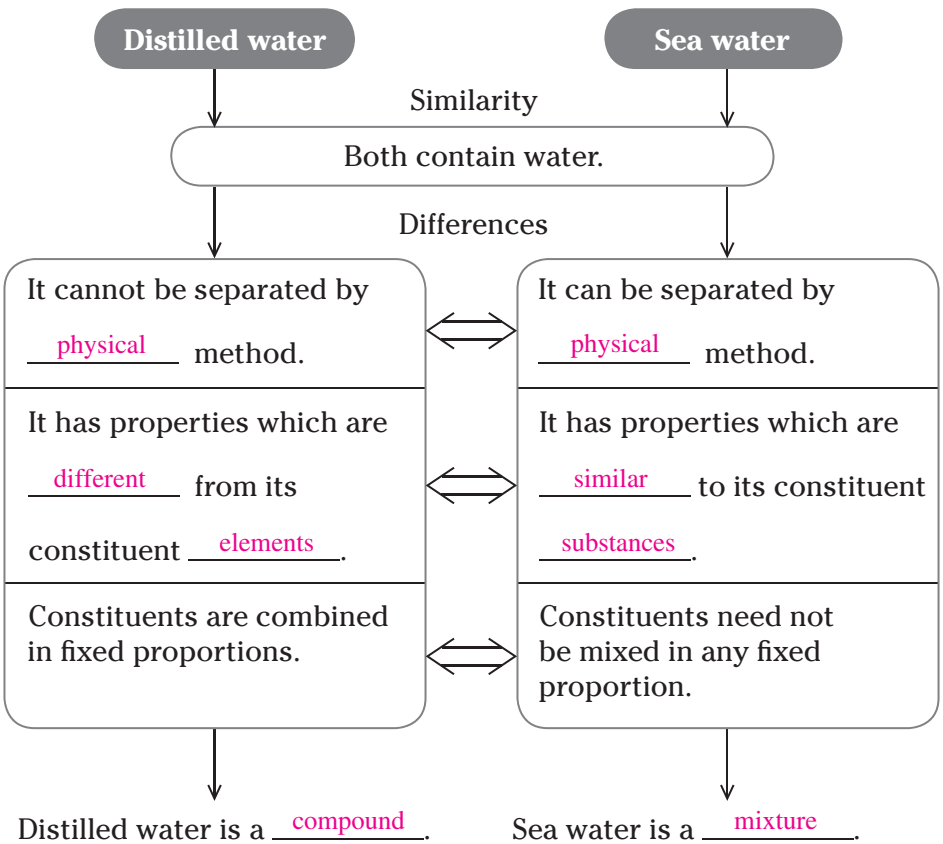
c) three solid mixtures: Brass, bronze, steel

d) two non-metals: Carbon, sulphur

Map It Out

Complete the graphic organiser that follows the question below.

Using what you know about elements, compounds and mixtures, compare distilled water and sea water.



Challenge Yourself • 10 min •

Attempt the following questions within the time allocated.

1. Marie adds a small piece of sodium to a beaker of water. The sodium moves about quickly on the surface of the water producing a hissing sound. It gets smaller and smaller until it disappears. The word equation for the reaction that occurs is:

   Sodium + Water → Sodium hydroxide + Hydrogen

   a) What can you say about the density of sodium? Explain your answer.

   Sodium is less dense than water. It floats on the water surface.

   b) Sodium is a metal. State one physical property of sodium.

   It is a good conductor of electricity.

   c) A solution of sodium hydroxide is left at the end of the reaction. State whether each of the following is an element, compoud or mixture.

   i) Sodium — Element

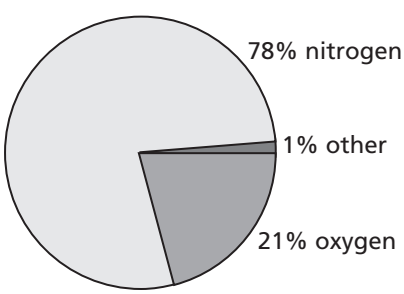
   ii) Water — Compound

   iii) Sodium hydroxide — Compound

   iv) Hydrogen — Element

   v) Solution of sodium hydroxide — Mixture

2. The pie chart below shows the composition of air.



The 1% of air is made up of carbon dioxide gas and other substances such as dust and microorganisms.

a) Is air a compound or a mixture?

Air is a mixture.

b) Name at least three constituents of air?

Nitrogen, oxygen, carbon dioxide

c) What is the minimum percentage of elements in the air ?

99% (78% nitrogen + 21% oxygen)

Get It Right

Observe the following illustration closely.

a) Why are light and shadow not considered matter?

Light and shadow do not have mass and do not occupy space.

Refer to the Science Matters Textbook Volume A, section 5.1 on What is Matter Made Up of?

b) The element carbon is found in the pieces of paper and in the pencil lead.

i) State the chemical symbol and the position of this element on the Periodic Table.

Chemical symbol: C, position: Period 2, group IV

Refer to the Science Matters Textbook Volume A, section 5.3 on Periodic Table.

ii) If each, paper and pencil lead, is connected to a light bulb circuit, which one will turn on the light bulb? Why?

When connected to the circuit, the pencil lead will turn on the light bulb. Carbon in the pencil lead is in the form of graphite. Graphite conducts electricity.

Refer to the Science Matters Textbook Volume A, section 5.2 on Classifying Elements.

c) The metallic chair is a mixture. Suggest why this is so.

The metallic chair is an alloy. An alloy is a solid-solid mixture.

Refer to the Science Matters Textbook Volume A, section 5.5 on What are Mixtures?

Name: _____ Class: _____ Date: _____

Chapter 6 Separation of Mixtures

Worksheet 6.1	For Science Matters Textbook Volume A, sections:	
	6.1 Separating Mixtures	6.3 Filtration
	6.2 Magnetic Attraction	6.4 Evaporation

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

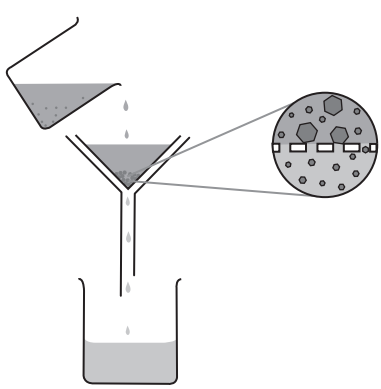
1. Which of the following shows the correct sequence to separate a mixture of salt and pepper, and obtain dry samples of each?

   I Adding water and stirring
   II Evaporating to dryness
   III Filtering the mixture

   A I ⟶ II ⟶ III
   B I ⟶ III ⟶ II
   C II ⟶ III ⟶ I
   D III ⟶ I ⟶ II (B)

2. Which of the following **cannot** be separated from a waste metal junkyard by use of magnetic attraction?

   A Iron gate grills
   B Scrap iron doors from cars
   C Steel utensils and cutlery
   D Zinc-plated roof tops (D)

3. 

   Using the diagram on the left, explain why solid particles can be separated from a liquid by filtration.

   The large particles of the solid are trapped on the filter paper because they are too large to pass through the pores/small holes on the filter paper.

4. Why is filtration of sea water unable to yield a pure filtrate? What are the impurities found in the filtrate?

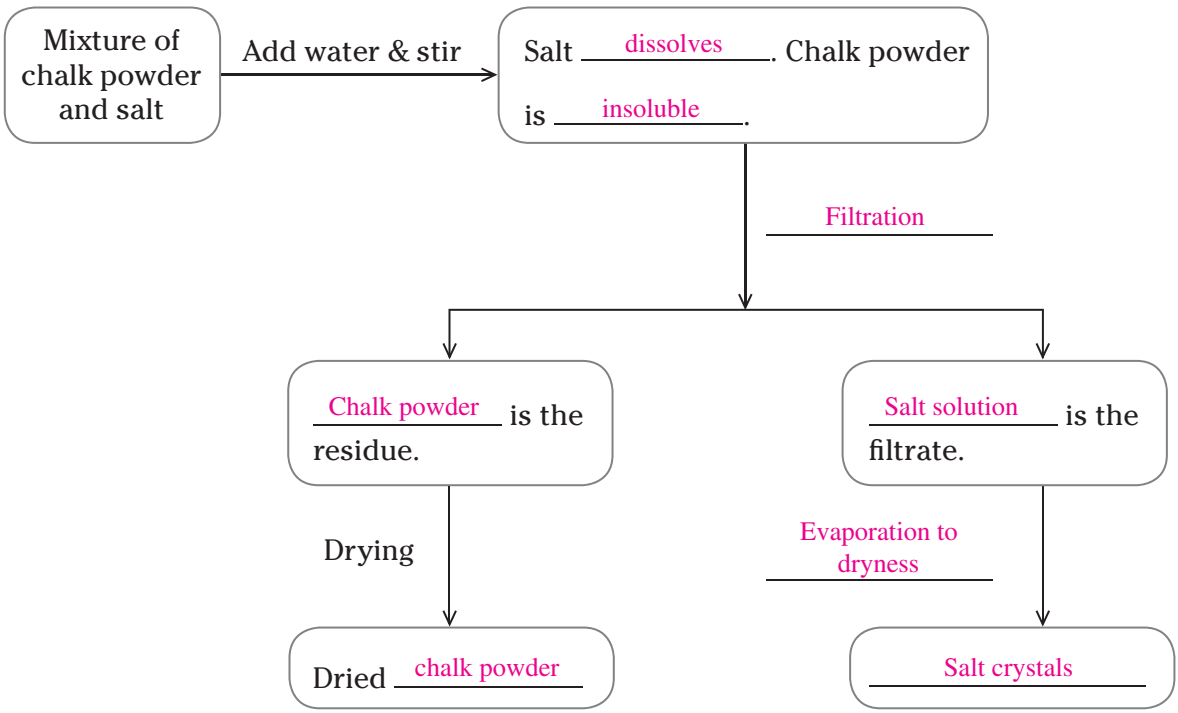
   The filtrate contains dissolved substances that are able to pass through the small pores in the filter paper.

   These substances include dissolved minerals, pollutants and dissolved gases.

Map It Out

Complete the graphic organiser that follows the question below.

Given a mixture of chalk powder and salt, describe how you can separate and obtain dry portions of each substance.



Challenge Yourself • 5 min •

Attempt the following questions within the time allocated.

1. Geno wants to obtain iodine from a solution of iodine in ethanol. What would be a suitable method?

   A Chromatography **B** Distillation
   C Evaporation to dryness **D** Filtration (C)

2. Marie accidentally mixed tea leaves with salt. Suggest how Marie should separate the mixture to obtain the tea leaves.

   Add water into the mixture and stir the mixture. Then filter the mixture to obtain the tea leaves on the filter paper. Air-dry the tea leaves.

Name: _____ Class: _____ Date: _____

Worksheet 6.2	For Science Matters Textbook Volume A, section: 6.5 Distillation

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. When we distill a mixture of salt water, the pure water is collected as the _____.

   A distillate **B** filtrate
   C pure substance **D** residue (A)

2. Which of the following substance(s) is/are obtained by distillation?

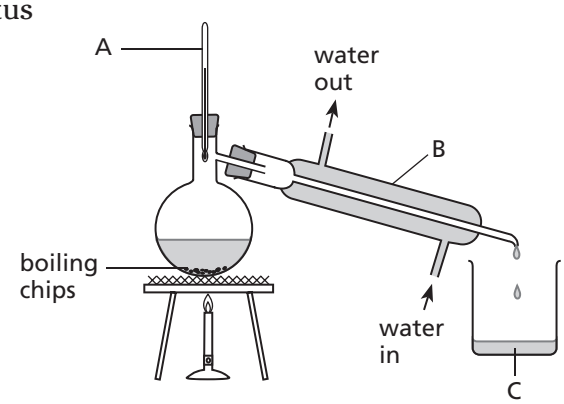
   I Wine from fermentation of grapes
   II Petrol from crude oil
   III Clean air

   A I only **B** I and II only
   C I and III only **D** All of the above (B)

3. The processes in distillation involve _____.

   A combustion then condensation **B** condensation then evaporation
   C evaporation then condensation **D** filtration then condensation (C)

4. The diagram on the left shows the apparatus for distillation.



   a) Label the following parts.

   A: Thermometer

   B: Condenser

   C: Distillate

   b) What is the function of part B?

   To turn a vapour into a liquid for collection.

   c) Why are boiling chips placed in the distilling flask?

   To ensure smooth boiling.

   d) Why is the direction of water into the condenser from the bottom?

   To ensure maximum condensation of vapour in the condenser.

Challenge Yourself • 15 min •

Attempt the following questions within the time allocated.

1. There is a change in the state of matter in the following separation methods except _____.

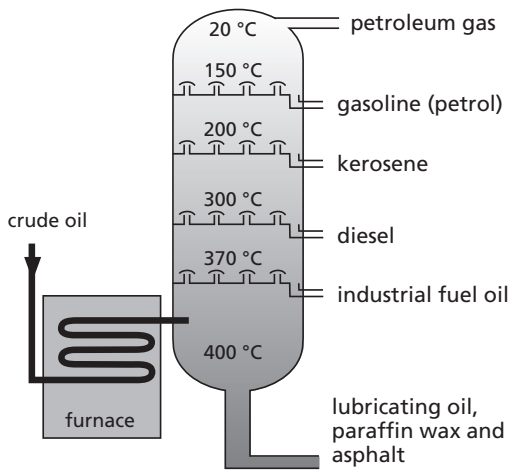
   A distillation
   B evaporation
   C filtration
   D fractional distillation (C)

2. Which of the following is the difference between filtrate and distillate?

   A Filtrate is obtained from physical separation, whereas distillate is obtained from chemical separation.
   B Distillate is a pure liquid, whereas filtrate may not be a pure liquid.
   C Filtrate is a liquid, whereas distillate is not a liquid.
   D Distillate is obtained from solid-solid mixture, whereas filtrate is obtained from solid-liquid mixture. (B)

3. The diagram below shows the fractionating column used to separate fractions of petroleum.

Note to Teacher:
Students may ask why crude oil (petroleum) needs to be separated. Crude oil is extracted from the earth as a toxic and smelly, black liquid. It is not useful for humans unless it is separated into its fractions.



   a) The fractions of petroleum are separated using a method known as fractional distillation. Which property of the fractions makes this method of separation works?

   Different boiling points of the fractions.

   b) Briefly explain how the process takes place.

   The fraction with the lowest boiling point boils first, hence it is obtained as the distillate first. After all this fraction distills, the fraction with the second lowest boiling point gets distilled and so on.

   c) Write down the order in which fractions are obtained in this process.

   Petroleum gas, gasoline (petrol), kerosene, diesel, industrial fuel oil and lubricating oil, paraffin wax and asphalt.

Name: _____ Class: _____ Date: _____

Worksheet 6.3	For Science Matters Textbook Volume A, sections: 6.6 Paper Chromatography 6.7 Reverse Osmosis

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. Which of the following processes allow you to obtain pure substances from the mixtures?

   I Evaporation
   II Distillation
   III Chromatography

   A I and II **B** I and III
   C II and III **D** III only (C)

2. Which of the following methods is used to obtain desalinated water in Singapore?

   A Distillation **B** Evaporation to dryness
   C Filtration **D** Reverse osmosis (D)

3. Which separation process below **does not** correspond to its use?

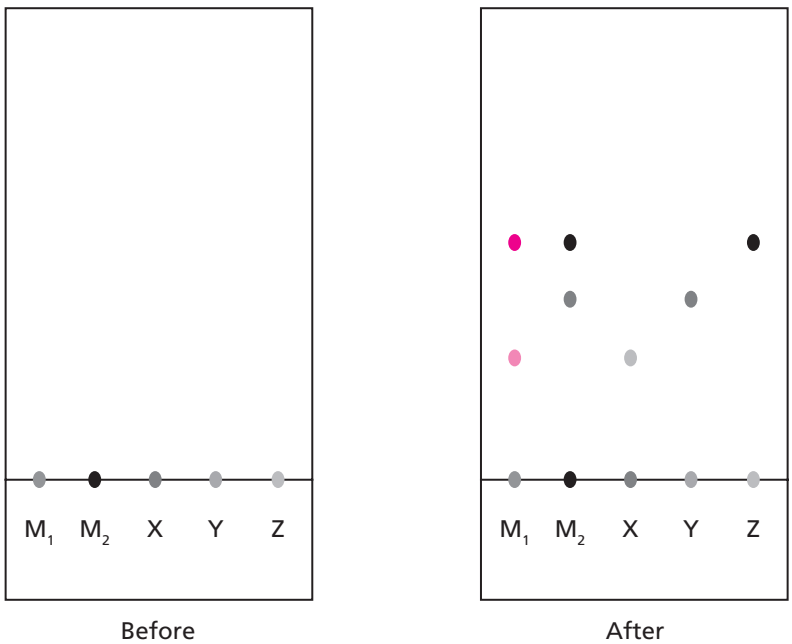
	Method	Use
A	Chromatography	Separate traces of dyes from ink samples
B	Distillation	Test trace levels of drugs in urine samples
C	Evaporation to dryness	Obtain sea salt
D	Filtration	Separate tea leaves from tea

(B)

4. Complete the following table with the suitable method used to obtain each substance from the mixture:

Substance to obtain	Separation Method
Sand from sea water	Filtration
Sodium chloride from salt water	Evaporation to dryness
Alcohol from beer	Distillation
Permitted food dyes in sweets	Chromatography
Water after boiling barley seeds	Filtration

5. A chromatography was carried out on unknown samples M_1 and M_2 and on three known dyes X, Y and Z. The results are shown in the chromatogram below.



a) What dyes are found in M_2?

Dyes Y and Z.

b) If M_1 is made up of dyes X and Z, draw the spots to show the results for M_1 after chromatography is completed.

6. Outline how NEWater is obtained by reverse osmosis.

Sea water is pre-treated to remove debris and contaminants such as oil, grease and suspended solids. In reverse osmosis, the pre-treated sea water is then pumped at high pressure through partially permeable membranes to remove undesirable contaminants such as bacteria, viruses, most chemicals and dissolved minerals.

7. How are the filter paper used in filtration and the partially permeable membrane used in reverse osmosis similar?

Both filter paper and partially permeable membrane prevent certain particles to pass through.

Challenge Yourself • 10 min •

Attempt the following questions within the time allocated.

1. An ink sample on a forged cheque is dissolved in ethanol. How do you obtain a concentrated sample of the ink to run a chromatogram?

   A Heat the ink-ethanol mixture to evaporate some of the ethanol away.
   B Evaporate the ink-ethanol mixture to dryness in an evaporating dish.
   C Filter the ink-ethanol mixture.
   D Shake the ink-ethanol mixture in a separating funnel. (A)

2. A small slip of paper stained with ink is found at the scene of a crime. Why is chromatography useful in analysing the ink?

   Only small amounts are needed; it can separate the ink components to determine the source/make-up of the ink sample.

3. Study the table below, which shows the properties of three substances.

Substance	Effect of heat	Adding water	Adding alcohol
X	Stable to heat	Insoluble	Dissolves
Y	Decomposes	Dissolves	Insoluble
Z	Sublimes	Dissolves	Insoluble

   Substances X, Y and Z are mixed. Starting from the mixture, briefly describe how you would obtain a dry sample of each of the following:

   a) substance X

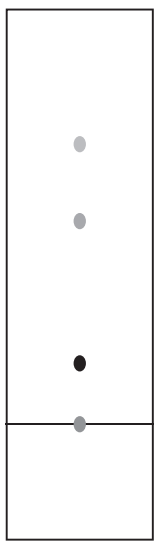
   Add water to the mixture and stir to dissolve the soluble substances. Filter the mixture and dry the residue.

   b) substance Z

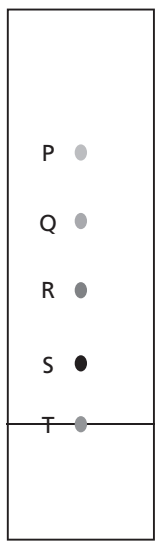
   Heat the mixture in an evaporating dish with an inverted filter funnel placed above the dish. Collect substance Z formed on the wall of the inverted filter funnel.

Get It Right

The Food and Drug Authority (FDA) examines various consumable products that are going to be released to the market. For a generic cough syrup, for example, an FDA chromatogram sets the standard for a safe-to-consume cough syrup.
Company X came with a new cough syrup product, Stop Cough. An FDA officer conducted paper chromatography on the new product.



chromatogram of the generic cough syrup



chromatogram of Stop Cough

a) A substance with high solubility travels quickly along a chromatogram. Which substance is most soluble on the chromatogram?

Substance at the highest position is most soluble.

b) Study the chromatogram of the product Stop Cough.

i) How is this chromatogram different from the chromatogram of the generic cough syrup? Identify the different spot.

Spot R does not appear in the chromatogram of the generic cough syrup.

ii) What could be inferred from this result?

The product Stop Cough could contain one more substance than the generic cough syrup.

iii) Is the product Stop Cough safe for consumption? Why?

It may not be safe for consumption as the substance R may be harmful for the body.

Remember that different substances have different solubilities; hence, they travel along the chromatography paper at different speeds.

Name: _____ Class: _____ Date: _____

Chapter 7 Solutions and Suspensions

Worksheet 7.1	For Science Matters Textbook Volume A, sections: 7.1 What are Solutions? 7.2 What are Suspensions?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

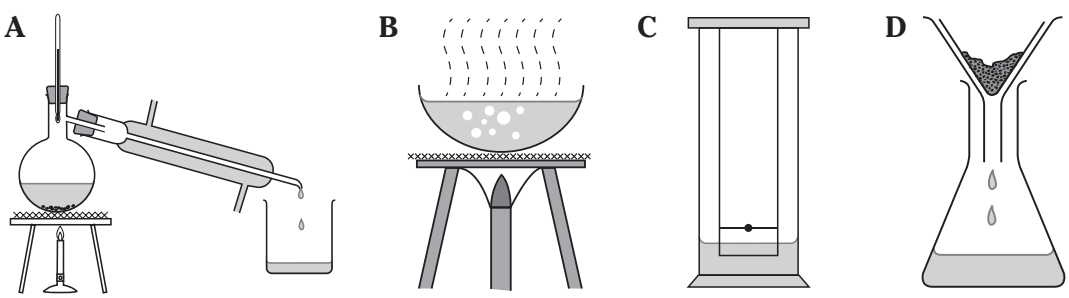
1. Which of the following **does not** describe a solution?

   A It contains the same amount of dissolved solute per cm^3 of the mixture.
   B It does not produce any residue when filtered.
   C It has an insoluble solute in a solvent.
   D No particles settle to the bottom when left to stand for a long time. (C)

2. Which of the following **is not** a solution?

   A Antiseptic iodine **B** Orange juice
   C Eye drops **D** Mineral water (B)

3. Which of the following set-ups is used to identify if a substance is a solution or a suspension?



(D)

4. Which of the these substances forms a solution when added to water?

   A Rock sugar **B** Chalk powder
   C Talcum powder **D** Oil (A)

Note to Teacher:
Talcum is a mineral used in baby powder. This mineral prevents rashes on the baby's skin.

5. Classify the following into solutions and suspensions.

muddy water	soya sauce	vinegar	wine
salad dressing	perfume	toothpaste	antiseptic mouthwash

Solutions	Suspensions
Soya sauce	Muddy water
Vinegar	Salad dressing
Wine	Toothpaste
Perfume	
Antiseptic mouthwash	

6. Complete the following table.

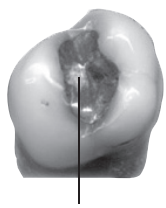
Type of solution	Examples of solution	Solute(s)	Solvent
Solid dissolves in liquid	Antiseptic iodine	Iodine	Alcohol
	Salt water	Salt	Water
Liquid dissolves in liquid	Beer, wine	Alcohol	Water
	Vinegar	Ethanoic acid	Water
Gas dissolves in liquid	Carbonated drinks	Carbon dioxide	Water
	Pond water	Oxygen, carbon dioxide	Water

7. Dental amalgam has been used by dentists for over a century. It is used in tooth filling and is a stable alloy containing silver, copper and tin dissolved in mercury. It has been researched on and is durable, easy to use, highly resistant to wear and tear and relatively inexpensive.

State which are the solutes and solvent in dental amalgam.

Solutes — silver, copper and tin

Solvent — mercury



dental amalgam

Note to Teacher:
Most metals are soluble in mercury. Iron, however, is not.

Map It Out

Complete the graphic organiser that follows the question below.

Given a salt solution and a calamine lotion, explain how you can conduct tests to observe the differences between the two substances.

Salt solution	Differences	Calamine lotion
Homogeneous	⟺	Non-homogeneous
When left to stand on its own, the solute does not separate from the solvent.	⟺	When left to stand on its own, solid particles settle to the bottom.
When filtered, no residue is obtained.	⟺	When filtered, a residue is obtained.

Challenge Yourself • 25 min •

Attempt the following questions within the time allocated.

1. Which of the following actions would be useful to remove a non-water-soluble ink stain from a shirt?

   A Rub the stain with another solvent for ink.
   B Soak the shirt for a longer time in water.
   C Stir the shirt in water.
   D Use hot water for washing the shirt. (A)

2. The label on a bottle of liquid medicine says "Shake before use."

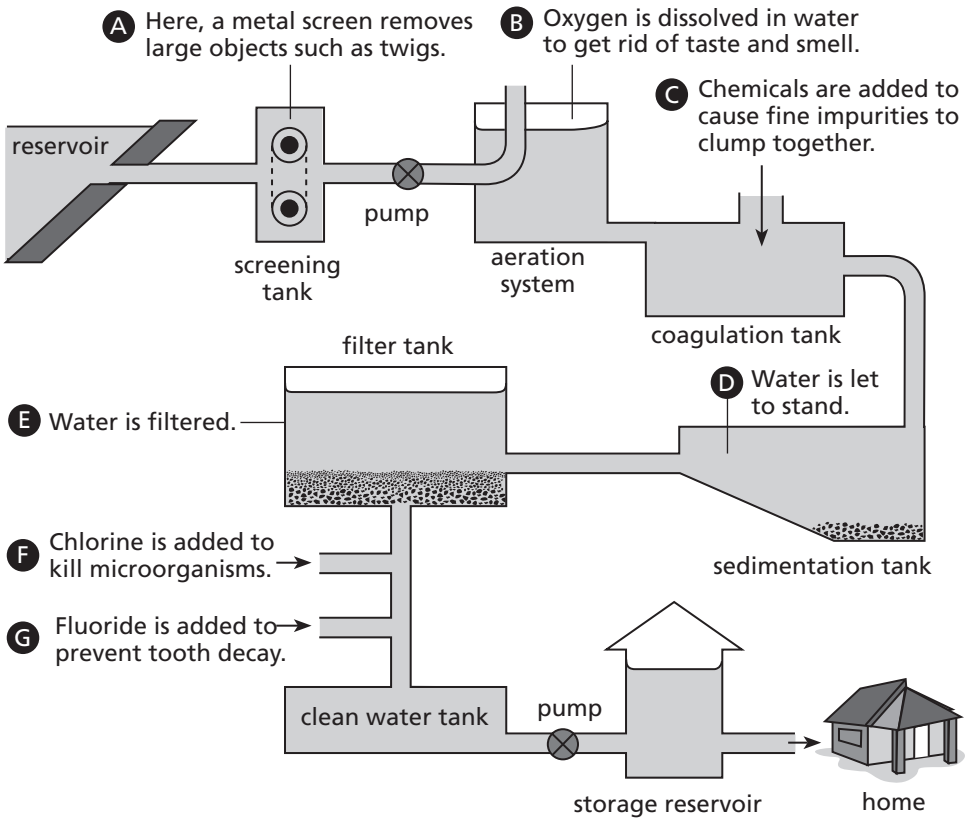
   a) Is the medicine a solution or a suspension? Explain.

   A suspension. The suspended particles settle to the bottom of the bottle after some time. Shaking allows the setting particles to disperse throughout the liquid.

   b) What is the disadvantage of not shaking the bottle of liquid medicine before taking it?

   The dosage of certain substances in the medicine taken will not be correct, either too little or too much. Medicine may work less effectively in the body.

3. The following diagram shows the stages (A to G) in water treatment.



a) i) List at least three stages that show that water from the reservoir is a suspension.

A, C, D and E.

ii) Explain your answer in (i).

In A, large objects such as twigs are suspended in water. / In C, fine impurities clumping together are suspended. / In D, lumps of impurities settle at the bottom of sedimentation tank. In E, insoluble solid impurities are retained on the filtration bed.

b) Which stages of the water treatment show that water is a solvent? Name the solute for each stage.

B, F and G. The solute in stage B is oxygen. The solute in stage F is chlorine and the solute in stage G is fluoride.

c) Is water from the tap pure? Why?

No. It contains dissolved substances such as chlorine, fluoride and dissolved gases.

Name: _____ Class: _____ Date: _____

Worksheet 7.2	For Science Matters Textbook Volume A, section: 7.3 What is Solubility? 7.4 What is Rate of Dissolving?

Secure Your Basics

Without referring to the textbook, try to answer these questions. If you cannot answer a question, look up the relevant section in your textbook.

1. In which of the following will the greatest amount of sugar dissolve in 100 g of water?

   A Stirring sugar to a beaker of water at 80 °C
   B Adding sugar to a beaker of water at room temperature
   C Stirring sugar in a beaker of water at 40 °C
   D Stirring sugar in a beaker of water at room temperature (A)

2. Marie needs to prepare a saturated solution of the salt copper sulphate for her experiment. What must she do before the solution becomes saturated?

   A Continuously heat the mixture
   B Grind copper sulphate before adding
   C Keep adding copper sulphate and stir
   D Keep adding water and stir (C)

3. Which of the following actions would enable you to dissolve sugar faster to make a syrup solution?

   A Add more sugar. **B** Add more water.
   C Heat up the water. **D** Use rock sugar. (C)

4. a) State whether each of the following statements is **true** or **false**.

   i) All substances are soluble in water. False
   ii) Solubility of sugar increases with stirring. False
   iii) Solubility is the amount of substance dissolved in 100 g of solvent. False
   iv) Powdered salt dissolves faster than rock salt in the same solvent. True
   v) Suspensions leave a residue after filtration. True
   vi) A saturated salt solution remains saturated after heating. False

b) Explain your answer for each of the false statements in (a).

ii) Some substances, such as sand, are not soluble in water.

iii) The rate of dissolving of sugar increases with stirring. The solubility depends on nature of solvent, nature of solute and the temperature.

iv) Solubility refers to the maximum amount of substance dissolved in 100 g of solvent at a given temperature. (The amount of substance that is dissolved in 100 g of solvent is known as concentration.)

vii) A saturated salt solution becomes unsaturated after heating. Saturation depends on temperature — most substances become more soluble at higher temperatures.

5. Use the terms below to describe the underlined words or phrases in the following statements.

solute	solvent	solution	solubility
saturated	rate of dissolving	suspension	

E.g. Sugar is added to water and stirred. — Solute

a) Iodine is stirred in a test tube containing alcohol. — Solvent

b) Calamine lotion contains insoluble solid particles in water. — Suspension

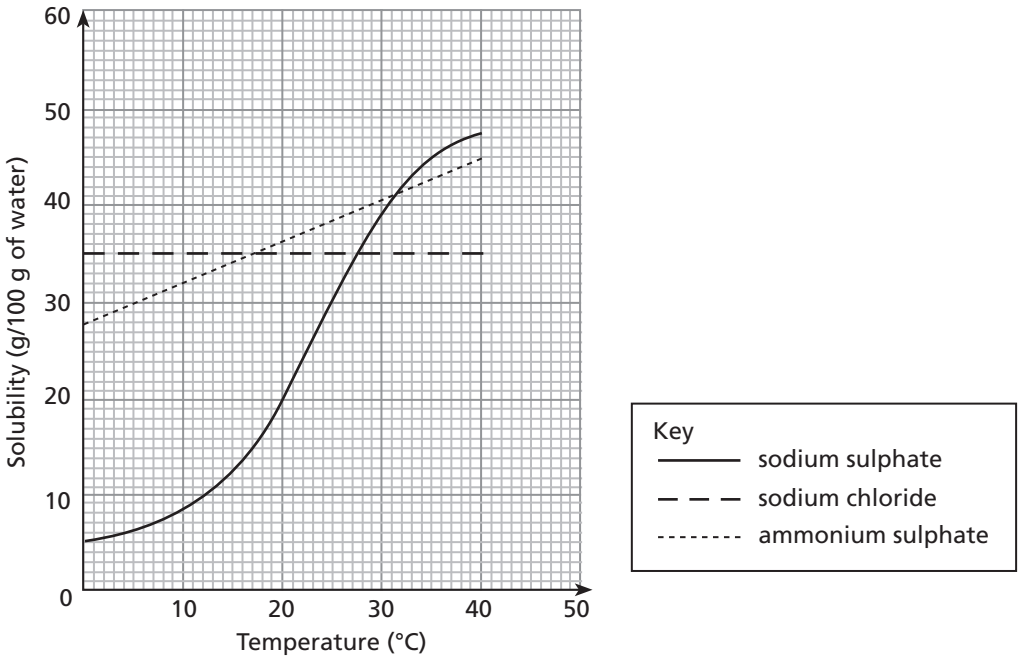
c) The dissolved substances in sea water are the mineral salts from rocks. — Solute

d) We can design an experiment to determine the maximum amount of sodium sulphate that can dissolve in 100 g of water at room temperature. — Solubility

e) Sally tries to find out how fast the sugar can dissolve in water using a stopwatch. — Rate of dissolving

f) Dissolved gas in water is known as a gas-liquid mixture. — Solution

6. The graphs below show the solubilities of some salts in 100 g of water against temperature.



a) Which substance is most soluble at 40 °C? Sodium sulphate

b) From the graph, infer the solubility of sodium sulphate at 35 °C.

46 g/100 g of water.

c) At about what temperature does ammonium sulphate become more soluble than sodium chloride? 17 °C

d) Which substance shows the greatest change in solubility in response to the change in temperature? Sodium sulphate

e) What can you infer from the graph of the solubility of sodium chloride with respect to temperature?

The solubility of sodium chloride remains quite constant despite the change in temperature. / The solubility of sodium chloride does not change much with temperature.

f) What can you infer from the graphs the solubilities of ammonium sulphate and sodium chloride?

Solubility increases with temperature.

7. Marie wanted to make iced lemon tea. She added freshly squeezed lemon juice to ice water and added sugar crystals to sweeten the drink. However, the drink did not taste sweet as the sugar did not dissolve completely.

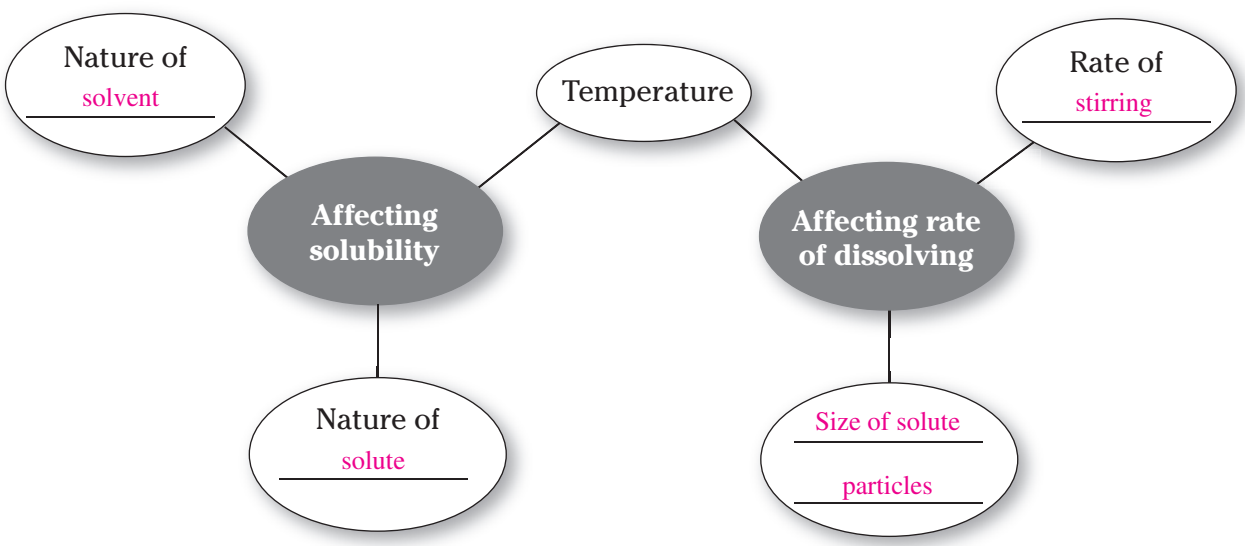
What would you have done to sweeten the drink? Why?

Ice water has a low temperature; solubility of sugar is lowered. Sugar does not dissolve quickly. Add the sugar to hot water and then add ice cubes to make the drink cold after that. We can also use sugar syrup instead of sugar crystals.

Map It Out

Complete the graphic organiser that follows the question below.

The solubility and rate of dissolving of a solute depend on several factors. List some of these factors.



Challenge Yourself • 20 min •

Attempt the following questions within the time allocated.

The table below shows the solubility of some salts. Use the information provided to answer questions 1– 2.

Salt	Solubility (g/100 g of water) at 20 °C
Sodium chloride	36
Potassium chloride	34
Copper chloride	73

1. At 20 °C, which of the following gives a saturated solution?

   A 40 g of copper chloride dissolved in 50 g of water
   B 20 g of potassium chloride dissolved in 100 g of water
   C 35 g of sodium chloride dissolved in 100 g of water
   D 72 g of sodium chloride dissolved in 250 g of water (A)

2. What would be observed when a mixture of 20 g of sodium chloride stirred in 50 g of water is filtered at 20 °C?

   A A colourless filtrate is obtained and no residue remains.
   B A colourless filtrate is obtained and white residue remains.
   C A purple liquid is obtained.
   D Only a white solid is obtained. (B)

3. Isaac added a lot of iodine crystals into a test tube of alcohol and stirred it. Which of the following **does not** help him conclude that he has a saturated solution?

   I The mixture appears to be homogeneous.
   II The mixture does not leave a residue after filtration.
   III When more iodine is added, it cannot dissolve anymore.

   A I and II **B** II and III
   C I, II and III **D** III only (A)

4. Most substances dissolve in greater amounts at higher temperatures. Which of the following becomes less soluble at higher temperatures?

   A Carbon dioxide **B** Iodine
   C Sugar **D** Water-soluble ink (A)

5. A packet of jelly powder reads, "Pour contents of sachet into hot water". Which statement explains the instruction?

A The jelly powder becomes an unsaturated solution.
B The jelly powder forms a saturated solution at low temperature.
C The jelly powder is insoluble in cold water.
D The jelly powder takes a longer time to dissolve in cold water. (D)

6. The label of a pack of coffee powder reads, "Pour hot water over coffee powder and stir." Based on your understanding of solubility and rate of dissolving, explain this instructions.

Hot water — At higher temperatures, more coffee can dissolve at a higher rate.

Stirring — Stirring increases the rate of dissolving, so the drink can be prepared faster. The drink also tastes better as more coffee has dissolved into the water, giving it a richer taste.

Note to Teacher:
Alert students that it is wrong to write, " Stirring increases the solubility of a substance."

Get It Right

The table below shows the solubility of some substances at 20 °C.

Substance	Solubility (g/100 g water)
Barium sulphate	0.00025
Sucrose	204.0
Baking soda	9.5
Sodium chloride	36.0
Calcium carbonate	0.0015

a) List the order of solubility of the substances in the table, starting with the least soluble substance.

Barium sulphate, calcium carbonate, baking soda, sodium chloride, sucrose.

b) Determine the maximum amount of sucrose that can dissolve in 150 g of water at 20 °C.

$$\frac{204 \text{ g}}{100 \text{ g of water}} \times 150 \text{ g of water} = 306 \text{ g of sucrose}$$

Ask yourself, "If a maximum of 204 g of sucrose can dissolve in 100 g of water (see table), how many grams of sucrose can dissolve in 150 g of water?" [Hint: Use proportion.]

c) What do you expect to happen to the solubility of sodium chloride when the temperature is increased to 40 °C?

The solubility should increase.

Refer to the Science Matters Textbook Volume A, section 7.3 on What is Solubility?

d) Marie stirred 6 g of baking soda in 50 g of water. What would she observe? Explain. What do you call the resulting solution?

Some white baking soda remained undissolved; they settled at the bottom. The maximum amount of baking soda that can dissolve in 50 g of water is 4.75 g. The resulting solution is called a saturated solution.

Ask yourself, "How many grams of baking soda can dissolve in 50 g water if 100 g of water can dissolve a maximum of 9.5 g of baking soda?" and "What will happen if there is more baking soda?"

e) State the possible ways by which Marie can get all the baking soda to dissolve Explain why you choose each method.

Heat the solution — solubility increases with temperature, hence more solute can dissolve at higher temperatures.

Add more water — more solute can dissolve in a greater amount of solvent.

Explore the various factors that affect solubility and rate dissolving of a substance. Refer to the Science Matters Textbook Volume A, section 7.3 on Solubility and section 7.4 on Rate of Dissolving.