THE UNIVERSITY of York

EPSE Project 1: Sample Diagnostic Questions - Set 7

Matter and change
These questions, which might be used at Key Stage 2 level or early in KS3, are all probing pupils' ideas about matter and change (physical and chemical). They do not (apart from one small exception) use or depend on particle ideas.

Qs1-2 test whether pupils can distinguish between properties of an object and of the material from which it is made. Q3 then probes pupils' meaning of the term 'chemical': do they think all matter is made of 'chemicals' or that some is not? It may be useful to know this before using the idea of 'chemical' or 'chemical change' (or, indeed, that of 'new materials' being formed, as the National Curriculum at KS2 puts it).

Qs4-7 ask pupils to distinguish between examples of physical and chemical change, or where they think a new substance has been produced or not. The examples in each pair of questions here are the same – as it may be more useful to find out if a pupil sees these two ideas (a chemical change/new substance(s) formed) as equivalent. There is, of course, no reliable or infallible way to tell from observation if a change is physical or chemical – and chemists argue about some examples. So these questions should only be seen as giving a broad indication of the consistency (or otherwise) of pupils' thinking.

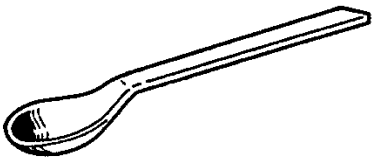
Qs8-9 are about separating by filtering – a topic that is included in the KS2 National Curriculum (Sc3). These questions probe understanding of the principles rather than recall of what happens. Q8(c) is the exception to the statement above that these questions do not require particle ideas.

Q10 tests pupils' recall of the correct terms for changes of state. This could be modified (to make it more difficult) by removing the box of words.

These questions are taken from a larger bank of diagnostic questions and tasks developed by the *Evidence-based Practice in Science Education (EPSE) Research Network*. The EPSE network was funded between 1999 and 2003 by the UK Economic and Social Research Council (ESRC) as part of the *Teaching and Learning Research Programme (TLRP).*

1

This spoon is made of polythene (a plastic).



Here are some facts about it:

- It does not rust.
- It gets softer, and bends more easily, if it is put into hot water.
- It weighs 10 grams.
- It is not attracted by a magnet.
- It is 10 centimetres long.

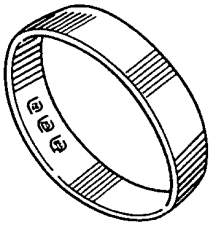
Which of these are **properties of polythene**?
And which are just **properties of this particular spoon**?

For each statement, show your answer by putting a tick (✓) in one column of the table below.

	A property of polythene	**A property of this particular spoon only**
It does not rust.		
It is 10 centimetres long.		
It gets softer, and bends more easily, if it is put into hot water.		
It is not attracted by a magnet.		
It weighs 10 grams.		

2

This ring is made of gold.



Here are some facts about it:

- It is fairly hard, though it can be scratched.
- It does not rust.
- It weighs 20 grams.
- It is a conductor of electricity.
- The hole in the middle is 2 centimetres across.

Which of these are **properties of gold**?
And which are just **properties of this particular ring**?

For each statement, show your answer by putting a tick (✓) in one column of the table below.

	A property of gold	**A property of this particular ring only**
It is fairly hard, though it can be scratched.		
It does not rust.		
It weighs 20 grams.		
It is a conductor of electricity.		
The hole in the middle is 2 centimetres across.		

3

For each of the things listed below, *tick ONE box (✓)* to show if you think it:

- is made entirely of one or more chemicals
- is made of one or more chemicals, plus some other things that are not chemicals
- is not made of chemicals.

		is made entirely of one or more chemicals	is made of one or more chemicals, plus some other things that are not chemicals	is not made of chemicals
a	**salt**			
b	**tap water**			
c	**pure orange juice**			
d	**a gold ring**			
e	**an aspirin tablet**			
f	**blood**			
g	**a cat**			
h	**an organic carrot**			

4

When a change involves a chemical reaction, we call it a **chemical change**.

In the table below, tick one box (✓) in each row to say if you think this is an example of a **chemical change**.

	Is this a chemical change?	**Yes**	**No**
a	when an ice-cube melts		
b	when a piece of wood burns		
c	when you stir sugar into your tea		
d	when you fry an egg		
e	when you boil water in a kettle		
f	when you crush a piece of chalk into powder		
g	when you put bicarbonate of soda into vinegar and it fizzes		
h	when an iron nail rusts		
i	in the filament of an electric light bulb when it is lit		
j	in the leaves of a plant as it grows		

List **three** things that can be signs that a chemical change has happened:

1 _____

2 _____

3 _____

5

In some changes, **new substances** are made.
In others, the same substances remain, but changed into a different form.

Think about each of the changes described below. For each, tick one box (✓) to show if you think **any new substance** is made in the change.

	New substance made?	**Yes**	**No**
a	when an ice-cube melts		
b	when a piece of wood burns		
c	when you stir sugar into your tea		
d	when you fry an egg		
e	when you boil water in a kettle		
f	when you crush a piece of chalk into powder		
g	when you put bicarbonate of soda into vinegar and it fizzes		
h	when an iron nail rusts		
i	in the filament of an electric light bulb when it is lit		
j	in the leaves of a plant as it grows		

List **three** signs that tell you that a new substance may have been made:

1 _____

2 _____

3 _____

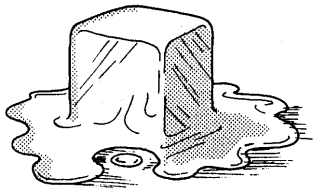
6

When a change involves a chemical reaction, we call it a **chemical change**.

Think about each of the changes described below. For each, tick one box *(✓)* to show if you think this is an example of a **chemical change**.

a ***when an ice-cube melts***

Tick one box (✓)



A chemical change ❑

Not a chemical change ❑

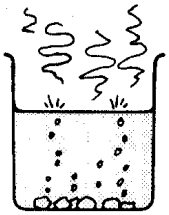
Explain why you think so: _____

_____

_____

b ***when you put bicarbonate of soda into vinegar and it fizzes***

Tick one box (✓)



A chemical change. ❑

Not a chemical change ❑

Explain why you think so: _____

_____

_____

c ***when you stir sugar into your tea***

Tick one box (✓)

A chemical change. ❑

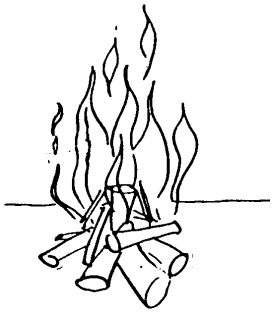
Not a chemical change. ❑

Explain why you think so: _____

_____

_____

d ***when a piece of wood burns*** *Tick one box (✓)*



A chemical change. ❑

Not a chemical change. ❑

Explain why you think so: _____

_____

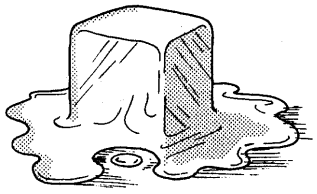
_____

7

In some changes, new substances are made.
In others, the same substances remain, but changed into a different form.

Think about each of the changes described below. For each, tick one box *(✓)* to show if you think **a new substance** is made in the change.

a ***when an ice-cube melts*** *Tick one box (✓)*



A new substance is made. ❑

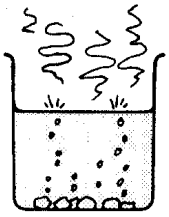
No new substance is made. ❑

Explain why you think so: _____

_____

_____

b ***when you put bicarbonate of soda into vinegar and it fizzes*** *Tick one box (✓)*



New substances are made. ❑

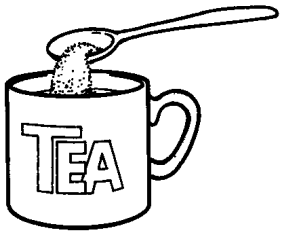
No new substances are made. ❑

Explain why you think so: _____

_____

_____

c ***when you stir sugar into your tea*** *Tick one box (✓)*



New substances are made. ❑

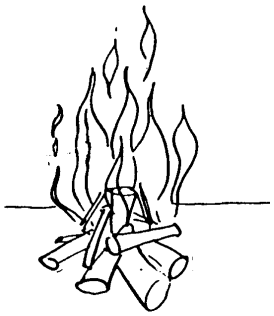
No new substances are made. ❑

Explain why you think so: _____

_____

_____

d ***when a piece of wood burns*** *Tick one box (✓)*



New substances are made. ❑

No new substances are made. ❑

Explain why you think so: _____

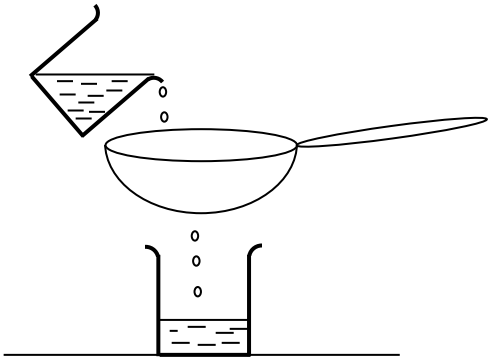
_____

_____

8

Sam takes a beaker of water, and adds a spoonful of garden soil to it. She stirs it all up together. The water looks brown and cloudy.

(a) She pours half of it through a kitchen sieve. The water which comes through is still brown and cloudy.

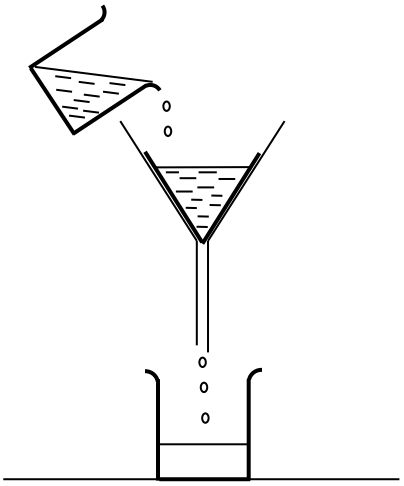


What is the best explanation for this?

Tick ONE box (✓)

- ☐ The particles of soil are **bigger** than the holes in the sieve.
- ☐ The particles of soil are **the same size** as the holes in the sieve.
- ☐ The particles of soil are **smaller** than the holes in the sieve.

(b) She then pours the other half of the cloudy brown water into a filter funnel with a folded filter paper in it. The soil collects in the filter paper.

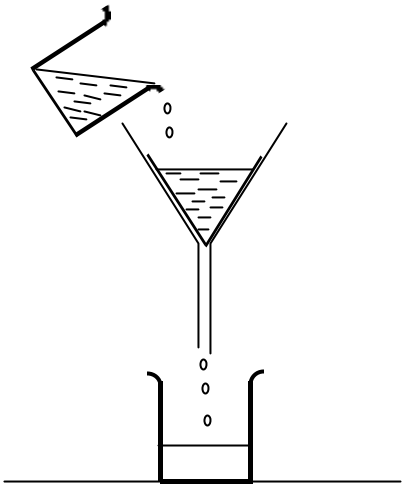


Why does the soil not go through the filter paper?
Which of these is **the best explanation**?

Tick ONE box (✓)

- ☐ The particles of soil are **bigger** than the gaps between the fibres of the filter paper.
- ☐ The particles of soil are **the same size** as the gaps between the fibres of the filter paper.
- ☐ The particles of soil are **smaller** than the gaps between the fibres of the filter paper.
- ☐ The paper has no gaps in it, so soil particles cannot get through it.

(c) The water that comes through the filter paper is clear.



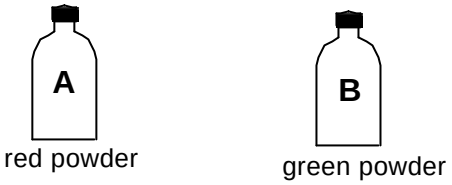
How does the water get through the filter paper?
Which of these is **the best explanation**?

Tick ONE box (✓)

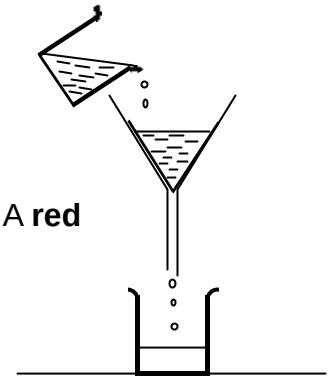
- ☐ Water is made of tiny particles that are **bigger** than the gaps between the fibres of the filter paper.
- ☐ Water is made of tiny particles that are **the same size** as the gaps between the fibres of the filter paper.
- ☐ Water is made of tiny particles that are **smaller** than the gaps between the fibres of the filter paper.
- ☐ Water is not made of tiny particles. It is a liquid, so it can soak through paper.

9

Bottle A contains a red powder.
Bottle B contains a green powder.



Peter takes a beaker of water and adds a spoonful of the red powder and a spoonful of the green powder. He stirs it all for several minutes. Then he pours the liquid into a filter funnel, with a folded filter paper inside it.



The liquid which comes out of the filter funnel is **green**. A **red** solid is left in the filter paper.

(a) What does this tell you about the red powder in bottle A?

Tick ONE box (✓)

- ☐ It is soluble in water.
- ☐ It is insoluble in water.
- ☐ You cannot tell from this information.

(b) What does it tell you about the green powder in bottle B?

Tick ONE box (✓)

- ☐ It is soluble in water.
- ☐ It is insoluble in water.
- ☐ You cannot tell from this information.

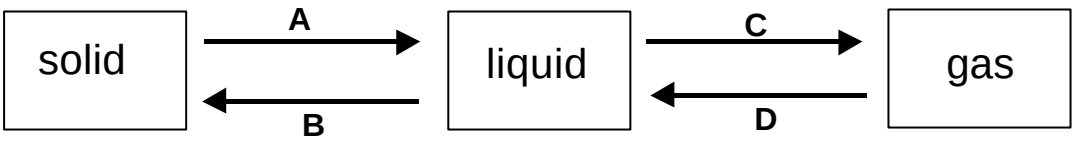
(c) Would you expect the green liquid that comes out of the filter paper to be …

Tick ONE box (✓)

- ☐ Cloudy
- ☐ Clear
- ☐ It is impossible to predict

10

A pupil draws a diagram in her notebook to summarise what she has learned about changes of state. Unfortunately, she has not completed the diagram. The labels are missing from the arrows.



Choose from the following words to complete the sentences below:

melting	**boiling**	**dissolving**	**evaporating**
softening	**solidifying**	**condensing**	**separating**

(a) The label on arrow A should be _____

(b) The label on arrow B should be _____

(c) The label on arrow C should be _____

(d) The label on arrow D should be _____