Polymers

1. The table shows some of the properties of four polymers.

	Polymer	Properties
A	Polystyrene	brittle, cheap
B	PTFE	withstands high temperatures, non-stick
C	Perspex	rigid, transparent
D	Acrilan	strong, can be stretched into fibres

Match polymers, **A, B, C** and **D**, with the numbers **1 – 4** in the table below.

	How the polymer could be used
1	It could be used as a substitute for glass.
2	It could be used as a substitute for wool.
3	It could be used to make throw-away packaging.
4	It could be used as a coating on cooking pans.

2. Alkenes that have one or more hydrogen atoms replaced by fluorine can be polymerised to make thermosoftening polymers. Replacing hydrogen atoms with fluorine is a very expensive process.

Increasing the number of fluorine atoms in the polymers makes them very unreactive. Polymers with more fluorine atoms in their molecules are more resistant to heat damage. However, if they are subjected to intense heat, they can burn and release some very toxic fumes.

(a) Which one of the following monomers would result in the least reactive polymer?

    1 $CHF=CH_2$

    2 $CHF=CHF$

    3 $CH_2=CF_2$

    4 $CF_2=CF_2$

(b) The monomer $CHF=CHF$ . . .

    1   is saturated.

    2   does **not** react with bromine.

    3   reacts with hydrogen in the presence of a catalyst.

    4   can be produced by cracking alkanes.

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(c)   Which polymer would result from polymerisation of CHF=CHF?

(d)   Which statement would **not** apply to objects made from polymers containing a lot of fluorine?

1   They can be disposed of safely in an incinerator.

2   They are resistant to breakdown by microorganisms.

3   They are expensive to manufacture.

4   They can be used to make kitchen utensils.

3.   In each part choose only **one** answer.

Plastic waste in the United Kingdom has reached 3 million tonnes per year. About 56% of this waste is from packaging. 60% of the litter on United Kingdom beaches is plastic. Under European law, at least 55% of packaging must be recycled by 2008.

Most plastic waste does not break down at all.
Three improved types of plastic used for bags and packaging are:

• degradable: breaks down over a long period of time, but only into smaller pieces
• biodegradable: undergoes decomposition by microorganisms; produces some solid waste which may be toxic
• compostable: biodegrades and disintegrates in a compost-making system at home; produces no toxic waste

A   One reason that plastics are often used for bags and packaging is that they are cheap to produce.

Which of these properties of plastics is the **least** important when they are used for making waste-bin liners?

1   lightweight

2   resist wear and tear

3   resist chemicals and water

4   transparent

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B   Which of these is **not** an advantage of recycling plastics?

   1   conservation of non-renewable fuels

   2   reduced energy consumption

   3   less waste to landfill

   4   reduced use of plastic bags

C   A supermarket chain has introduced compostable food containers. Which of the following may **not** happen because of the increased use of compost-making systems at home?

   1   It will save council transport and labour costs.

   2   It will save space in landfill sites.

   3   It will reduce costs to supermarkets.

   4   It will help to conserve non-renewable fuels.

D   Some supermarkets are using more environmentally-friendly packaging.

   The most likely commercial reason for this is that the supermarkets are concerned about . . .

   1   decreasing the amount of litter.

   2   the damaging effects of acid rain.

   3   the increasing cost of plastics.

   4   attracting more customers.

4.   Some students made a slime by mixing a solution of PVA with a solution of borax.
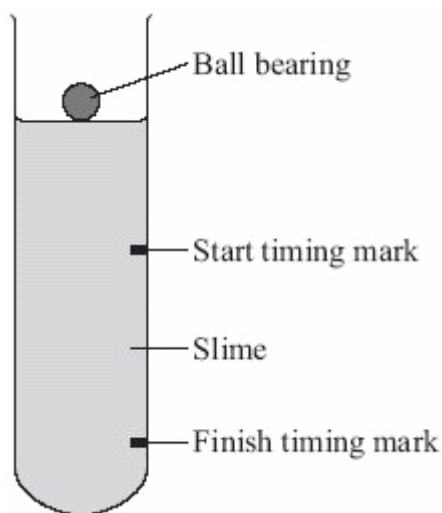
They decided to investigate how the viscosity (thickness) of the slime depended on the amount of borax solution added to the PVA solution. They used various mixtures and timed how long a ball bearing took to fall between two timing marks, as shown in the diagram.
The same person took the time readings throughout the experiment. The temperature of the room did not change.

Page **3** of **4**
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The students' results are shown in the table.

Volume of PVA solution in cm^3	Volume of borax solution in cm^3	Volume of water in cm^3	Time 1 in seconds	Time 2 in seconds	Time 3 in seconds	Average time in seconds
40	1	9	1.6	1.6	1.6	1.6
40	2	8	3.6	4.0	–	3.8
40	3	7	4.8	5.2	5.6	5.2
40	4	6	7.2	7.4	7.4	7.3
40	5	5	10.0	10.2	9.8	10.0
40	6	4	10.2	10.4	10.0	10.2
40	7	3	11.0	9.0	10.6	10.2
40	8	2	10.0	9.8	9.6	9.8
40	9	1	9.0	9.2	8.8	9.0
40	10	0	8.8	8.8	–	8.8

(a)   Which row in the table shows the correct independent and dependent variables in this experiment?

	Independent variable	**Dependent variable**
1	Volume of PVA solution	Time for ball to drop between the marks
2	Time for ball to drop between the marks	Volume of borax solution
3	Volume of borax solution	Volume of PVA solution
4	Volume of borax solution	Time for ball to drop between the marks

(b)   Which of the following actions will **not** improve the reliability of the results?

1   Measuring the time taken three times instead of two for the tests with 2 cm^3 and 10 cm^3 of borax solution.

2   Using a timer able to read to 0.1 seconds instead of 0.2 seconds.

3   Repeating the set of readings for 7 cm^3 of borax solution.

4   Repeating the whole experiment on another day.

(c)   What is the **best** conclusion that can be made from the results?

1   There is a consistent error in the method of timing.

2   The viscosity of slime depends directly on the volume of borax solution.

3   There is **not** enough evidence to relate the volume of borax solution to the viscosity of slime.

4   There is a clear relationship between the volume of borax solution and the viscosity of slime.

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