DTBase©

Design & Technology
Edexcel GCSE

Thermoforming and Thermosetting Polymers

Materials required for questions

- Pencil
- Rubber
- Calculator

Instructions

- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

Advice

- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don’t spend too much time on one question

Good luck!

Q1. Which one of the following is a thermosetting polymer?

A Acrylic

B High impact polystyrene (HIPS)

C Urea formaldehyde

Q2. What is Biopol?

A A biodegradable polymer

B A thermosetting polymer

C A type of acrylic

Q3. Which polymer is clear and is often used for shop signs and display stands?

A Acrylic

B Polyester resin

C Urea formaldehyde

Q4. Which property describes a material that does not let electricity pass through it?

A Toughness

B Insulator of electricity

C Insulator of heat

Q5. Which property describes a material that can absorb an impact without breaking?

A Hardness

B Insulator of heat

C Toughness

Q6. What happens when a thermoforming polymer is heated?

A It softens and can be reshaped

B It sets permanently

C It becomes an electrical conductor

Q7. For each of the products below, give a property of the material it is made from that makes the material suitable for the product.

Q7a. Acrylic soap tray. **(1 mark)**

Q7b. High impact polystyrene (HIPS) drinking cup. **(1 mark)**

Q7c. Polyester resin printed circuit board (PCB). **(1 mark)**

Q7d. Urea formaldehyde picnic plate. **(1 mark)**

Q8. A pair of safety glasses is made from a thermoforming polymer.

Explain the term thermoforming. **(2 marks)**

Q9. A 3-pin plug is made from urea formaldehyde.

Explain one disadvantage of using urea formaldehyde for the 3-pin plug. **(2 marks)**

Q10. Some garden plant pots are made from polyester resin, which is a thermosetting polymer.

Q10a. Give one reason why this material is suitable for use in garden plant pots. **(1 mark)**

Q10b. Give one other example of a thermosetting polymer. **(1 mark)**

Q11. The body of a saucepan is made from a metal and the handle is made from a thermosetting polymer.

Explain one reason why a thermosetting polymer is suitable for the saucepan handle. **(2 marks)**

Q12. An electric light switch is made from urea formaldehyde.

Give two different properties of urea formaldehyde that make it an appropriate choice of material for the electric light switch. For each property, explain one advantage of using urea formaldehyde for the electric light switch. **(6 marks)**

Property 1

Explanation

Property 2

Explanation

Q13. A small tub of ice cream has a polymer spoon that fits underneath the lid.

Explain two reasons why a biodegradable polymer, such as Biopol, should be used to make the spoon. **(4 marks)**

1

2

Q14. The case of a children's Sing Along Box is made from high impact polystyrene (HIPS). A voice recorder is fitted inside.

Explain two benefits of using HIPS for the case of the Sing Along Box. **(4 marks)**

1

2

Answers

Q1. C
Q2. A
Q3. A
Q4. B
Q5. C
Q6. A

Q7a.

Any one property (1 mark): waterproof/water resistant; durable/long lasting; plasticity/can be softened when heated; tough/impact resistant.

Q7b.

Any one property (1 mark): lightweight; tough; hygienic/inert; plasticity; waterproof. Do not accept "can be recycled" or "durable".

Q7c.

Any one property (1 mark): electrical insulator/does not conduct electricity; good heat resistance; good chemical resistance; hard; stiffness/rigidity. Do not accept "insulator" on its own.

Q7d.

Any one property (1 mark): stiff/rigid/hard; waterproof/stain resistant/non-absorbent; food safe/non-toxic; good heat resistance; good UV resistance; lightweight. Do not accept "can be recycled", "durable", "light" or "strong" on their own.

Q8.

Up to 2 marks for a clear understanding of the term, for example: a thermoforming polymer can be softened by heating (1) and reformed or shaped, such as into the safety glasses, and this can be done again and again (1).

Q9.

Any one disadvantage (1 mark) and a linked justification (1 mark):

- UF is brittle (1), therefore if it gets banged/knocked it can break/shatter/splinter (1)

- UF is a thermosetting polymer (1), therefore it cannot be recycled if it breaks/is not biodegradable (1)
- UF can burn at high temperatures (1), therefore it becomes a hazard/danger (1)

Q10a.

Any one reason related to garden plant pots (1 mark): available in different colours; weather resistant/waterproof; will not break easily if it falls over; non-biodegradable, so will not break down when full of soil; will not soften in hot weather. Do not accept "recyclable", or "strong"/"durable" unless qualified.

Q10b.

Any named thermosetting polymer (1 mark), e.g. urea formaldehyde (UF), melamine formaldehyde, epoxy resin. Do not accept thermoforming polymers, e.g. acrylic, HIPS, polypropylene.

Q11.

Up to 2 marks for an explanation:

- It does not conduct heat/is an insulator of heat, so it will not get hot when the metal saucepan is heated (1); the user can pick up the saucepan without burning their hand (1)
- The handle keeps its shape when used near heat (1), as once moulded it cannot be reheated and remoulded/softened (1)

Q12.

Any two explanations that include a property (1 mark), plus two linked justifications of that property (1 mark + 1 mark):

- It is an electrical insulator (1), which means it will not conduct electricity (1), therefore the user will not get an electric shock when they touch the switch (1)
- It has good heat resistance (1), which means it will not melt (1) and it will not catch fire (1)
- It is a hard material (1), which means it can withstand constant use (1), therefore it can be touched/moved lots without wearing away (1)

Q13.

Any two reasons (1 mark each) and a linked justification of each (1 mark each), up to 4 marks:

- The spoons can be composted (1), therefore it reduces the amount of waste going into landfill/incineration (1)
- Biodegradable polymers are made from sustainable/renewable resources (1), which means there will always be resources available to make them (1)
- It reduces the demand for oil (1), therefore current stock levels last longer (1)
- The spoons may be dropped as litter (1), therefore over time they would break down/decompose, reducing their environmental impact (1)

Q14.

Any two benefits (1 mark each) and a linked justification of each (1 mark each), up to 4 marks:

- HIPS is lightweight/has a low density (1), therefore it will be easier for young children to carry/move around/it is portable (1)
- HIPS has good impact resistance/is tough (1), therefore if the box is dropped the contents inside will be protected/the box is unlikely to break (1)
- HIPS does not absorb water/is waterproof (1), therefore it can be easily cleaned/wiped down without damaging the electronic circuit or working parts (1)
- As a thermoforming polymer, HIPS can be formed/moulded (1), therefore it can be used to form complex shapes/intricate details (1)