DTBase©

Design & Technology
Eduqas GCSE

Polymers: factors influencing selection

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 of these is an aesthetic property of polymers?

A Good electrical insulator

B Can be any colour, with a glossy, matt or textured finish

C Waterproof

Q2. Why are plastic products often described as "self finishing"?

A The colour and surface finish come from the mould, so no painting is needed

B They repair themselves when scratched

C They do not need to be moulded

Q3. What should be included when estimating the true cost of a product?

A Only the cost of the materials

B Materials, labour, energy, overheads, finishes, packaging and transport

C Only the cost of the labour

Q4. What does "compostable" mean?

A Made from crude oil

B Can be recycled many times

C Breaks down fully in composting conditions into compost with no toxic residue

Q5. What is a bio-based polymer?

A A polymer made from plants instead of oil

B A polymer that always biodegrades in the sea

C A thermosetting polymer

Q6. Which of these is a disadvantage of biodegradable and compostable polymers?

A They reduce long term plastic pollution

B They are often made from renewable crops

C They can contaminate normal plastic recycling

Q7. A set of kitchen knives has handles made from a sustainable polymer.

Q7a. Explain two advantages of manufacturing the kitchen knife handles from a sustainable polymer. **(4 marks)**

Q7b. Explain one reason for using coloured polymers for the knife handles. **(2 marks)**

Q8. A window frame is manufactured from polyvinyl chloride (PVC).

Q8a. Explain one reason for introducing additives into the PVC. **(2 marks)**

Q8b. Explain one working property of PVC that makes it suitable for the window frame. **(3 marks)**

Q8c. Explain two negative effects on the global environment of using PVC for the window frame. **(4 marks)**

Q9. The body of a child's puzzle piece is made from High Impact Polystyrene (HIPS). Explain two working properties of HIPS that make it an appropriate choice of material for the body of the puzzle piece. **(6 marks)**

Q10. This question is about plastic carrier bags.

Q10a. Explain what the word "biodegradable" means in relation to environmental and sustainability issues. **(2 marks)**

Q10b. In 2014, 7.6 billion plastic bags were given away in England. In 2015, 5.4 billion were given away. Calculate the percentage reduction in the number of plastic bags given away between 2014 and 2015. Give your answer to the nearest whole number. **(2 marks)**

Q10c. In 2015, charging for carrier bags was introduced, resulting in a reduction in the number of bags being manufactured. Explain one negative effect of this reduction for the manufacturer. **(2 marks)**

Q11. Explain why each factor below would need to be considered by a manufacturer when sourcing materials or components.

Q11a. Bulk buying **(2 marks)**

Q11b. Ethical factors **(2 marks)**

Q12. A small lightweight drone is to be manufactured for recreational use. The electronic components cost £2.35 and the plastics cost £3.15 per unit. Assembly and manufacture cost a further £4.08 per unit.

Q12a. Calculate how much it would cost the manufacturer to make 12,000 drones. Show all workings. **(1 mark)**

Q12b. The manufacturer sells a drone to a retailer for £58.00. Calculate how much money the manufacturer would receive if they sold 80% of the 12,000 units. Show all workings. **(2 marks)**

Q12c. Calculate how much profit the manufacturer would make from your answer to Q12b. Show all workings. **(2 marks)**

Q13. A set of bowls is injection moulded. The polymer granules cost £1.80 per kilogram and each bowl needs 0.10 kilograms to mould.

Q13a. Calculate the cost of the granules to manufacture a batch of 750 bowls. Show all workings. **(2 marks)**

Q13b. The bowl is to be made using a different polymer, which reduces the cost of the granules by one third. Calculate the new cost of the granules needed for one bowl, to 2 decimal places. Show all workings. **(2 marks)**

Q14. A plastic puzzle toy is manufactured in an economically developing country. Analyse how a designer can ensure the puzzle is produced in an ethical and environmentally friendly way. **(5 marks)**

Answers

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

Q7a.

Any two advantages: an explanation (1) and a linked justification (1). For example:

- The product can be marketed as made from a sustainable material (1), which might increase sales or widen its appeal (1)
- The knife parts can be recycled or the materials separated (1), so they will not go to landfill and take many years to break down (1)
- Crude oil will not be used (1), so oil resources will last longer due to reduced demand (1)
- Less chance of environmental pollution or accidents (1), because oil does not need to be transported to processing plants (1)

Q7b.

A reason (1) and a linked justification (1). For example:

- Different colours can be used for aesthetic or style purposes (1), letting users choose colours to suit their taste or kitchen (1)
- Different colours can be used for different foods (1), so there is no cross contamination, e.g. blue for fish, red for meat (1)

Q8a.

A reason (1) and a linked justification (1). For example:

- Light stabilisers reduce UV degradation and colour fading (1), so the frame keeps its colour for longer (1)
- Reinforcing fibres can be added (1), making the polymer stiffer and stronger (1)
- Pigments can be added (1), so the frames can be made in different colours (1)

- Plasticisers can be added (1), making the polymer more flexible and easier to extrude (1)

Q8b.

A working property (1) and two linked justifications (1) + (1). For example:

- PVC is weatherproof and durable (1), so it can withstand rain as an outdoor component (1), therefore it lasts a long time and does not absorb water (1)
- PVC is chemical resistant (1), so it is not affected by cleaning products used on the windows (1), therefore it lasts a long time (1)
- PVC softens when heated (1), so it flows well (1), therefore it can be extruded through a profiled die (1)

Q8c.

Any two negative effects (1) with a linked justification (1). For example:

- PVC is made from oil (1), placing demand on a finite resource that will eventually run out (1)
- PVC is expensive and difficult to recycle (1), which encourages people to tip it or send it to landfill (1)
- PVC gives off poisonous fumes if burnt (1), polluting the atmosphere and damaging the environment (1)

Q9. (6 marks)

Any two explanations: a working property (1) and two linked justifications (1) + (1). Do not accept electrical conductor, heat safe or lightweight given the context and size of the part. For example:

- HIPS is tough with high impact strength (1), so it withstands knocks, being thrown or bitten during play (1), therefore it lasts a long time and does not break, dent or lose its appearance (1)
- HIPS is waterproof (1), so it can be put in a child's mouth (1), therefore it does not absorb moisture or bacteria and can be washed or sterilised (1)
- HIPS provides a good printing surface (1), so it is easily printed on (1), therefore no extra surface preparation is needed, saving time and money (1)
- HIPS can be moulded smooth (1), so it can be wiped clean and is hygienic (1), therefore it is safer for children and does not spread germs (1)

Q10a.

2 marks for two or more creditworthy points; 1 mark for a single correct point. For example: products or materials that break down (degrade) naturally when exposed to the environment, e.g. air, water, light, bacteria. Examples include corn starch polymers and potato starch products.

Q10b.

(7.6 − 5.4) ÷ 7.6 × 100 (1) = 29% (1). Award full marks for the correct answer without working.

Q10c.

A negative effect (1) and a linked justification (1). For example:

- A smaller workforce is needed (1), so there are job losses or redundancy costs (1)
- The company might downsize or close (1), resulting in lost jobs, profits or income in the area (1)
- Money is tied up in old bag making machinery (1), which cannot be used for anything else but still needs maintaining (1)

Q11a.

2 marks for two simple points or one point explained in detail; 1 mark for one simple point. For example:

- Economies of scale: buying in bulk reduces material and component costs, which can be passed on to the customer as a more competitive price
- Manufacturers secure discounts on standard components and stock forms
- Buying exactly the quantity of stock needed for a product range means it can be used without waste

Q11b.

2 marks for two simple points or one point explained in detail; 1 mark for one simple point. For example:

- Finite or renewable: avoid using up finite resources that will run out; use sustainable materials where possible
- Provenance: where do the materials come from? Are they from an ethical source, e.g. Fairtrade?
- Working conditions: support people in developing countries so they are not exploited, harming their education, health and well-being

Q12a.

£2.35 + £3.15 + £4.08 = £9.58 × 12,000 = £114,960 (1)

Q12b.

80% of 12,000 units = 9,600 (1). 9,600 × £58.00 = £556,800 (1)

Q12c.

£9.58 × 12,000 = £114,960 (1). £556,800 − £114,960 = £441,840 (1). Credit any appropriate method.

Q13a.

0.10 kg × £1.80 = £0.18 per bowl (1). 750 × £0.18 = £135 (1)

Q13b.

£0.18 ÷ 3 = £0.06 (1). £0.18 − £0.06 = £0.12 (1). Accept 12p. Allow carry forward of an incorrect answer from Q13a.

Q14. (5 marks)

To reach band 3, answers must cover both ethical and environmental considerations. Indicative content:

Environmental

- Use thermoforming polymers that can be recycled, or consider biodegradable polymers

- Dispose of manufacturing waste correctly and safely, and use a closed loop system to minimise waste
- Use factories powered by renewable energy such as solar power
- Source and process raw materials in the same country, or manufacture locally, to cut transport pollution
- Reduce packaging and make sure it is recyclable
- Make a quality product that lasts; carry out a life cycle analysis; design for a circular economy

Ethical

- Safeguard the health and well-being of employees
- Fair pay and acceptable hours, with breaks, in well ventilated, healthy workplaces
- Contracts that give workers a regular income
- No child labour or exploitation of workers; ethically sourced raw materials
- Respect local culture and practices

However:

- Toys can quickly go out of fashion and be thrown away, however much was paid for them

Band	Marks	Descriptor
3	4 to 5	A coherent answer with detailed, relevant knowledge and understanding of how a designer can ensure ethical and environmentally friendly production. Relevant examples and a well-developed, logical chain of reasoning, sustained throughout.
2	2 to 3	Some coherence, with partial knowledge and understanding. Mostly relevant examples and a logical chain of reasoning that may not be sustained throughout.
1	1	Basic knowledge and understanding. Limited relevant examples or logical chain of reasoning.
0	0	Incorrect or irrelevant answers.