**Design & Technology**

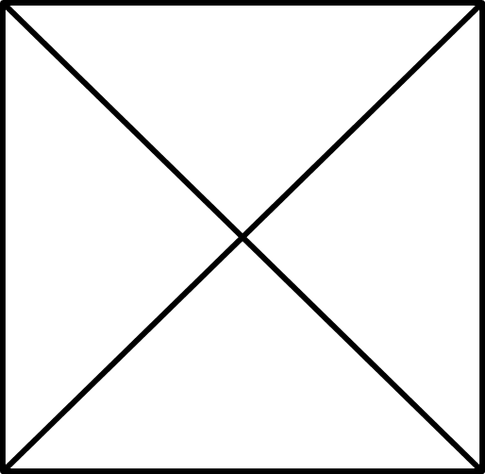
**A-Level**

**Polymer Processes**

**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
* Use a cross in the box to mark you 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.** What might vacuum forming be used to make?

Shape, square

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**A** Yoghurt pots

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**B** Cling film

Shape, square

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**C** Water bottles

**Q2.** What is the name given to the platform that the mould sits on in vacuum forming?

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**A** Plate

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**B** Platen

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**C** Staging

**Q3.** Why might someone use calendaring to make plastic bags?

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**A** Good at high volume

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**B** Long machinery lifespan

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**C** Low set-up costs

**Q4.** Line bending is commonly used in schools for what reason?

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**A** Easy to learn

Shape, square

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**B** Very safe

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**C** Can produce complex designs easily

**Q5.** What might line bending be used to make?

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**A** A food container

Shape, square

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**B** Car parts

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**C** A phone stand

**Q6.** What is an advantage of blow moulding?

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**A** Moulds are cheap to manufacture

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**B** Intricate shapes can be made

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**C** It’s a simple process

**Q7.** What is an advantage of rotational moulding?

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**A** No seams on product

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**B** Uses less labour than other processes

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**C** Can be used on a variety of materials

**Q8.** What might rotational moulding be used to make?

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**A** Yoghurt pots

Shape, square

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**B** Plastic footballs

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**C** Water bottles

**Q9a**. Using notes and/or sketches, describe the rotational moulding process. (7 marks)

**Q9b**. Outline the advantages of rotational moulding over injection moulding. (4 marks)

**Q10**. Continuous lengths of PVC tubing can be produced by extrusion

Describe, using notes and/or annotated sketches, the process of extruding continuous PVC tubing (8 marks)

**Q11**. Blow moulding is commonly used for the production of plastic bottles. Describe, using notes and/or sketches, the blow moulding process. (6 marks)

Q12a. Name three key features of a successful vacuum forming mould. (3 marks)

**Q12b**. Using notes and diagrams, describe how the process of vacuum forming (6 marks)

**Q13**. Figure 7 shows a parts drawing for both halves of the drill body.

A picture containing text, linedrawing, map

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Evaluate the decision to use injection moulding to create the drill body. (9 marks)

Answers

**Q1**. A

**Q2**. B

**Q3**. A

**Q4**. A

**Q5**. C

**Q6**. B

**Q7**. A

**Q8**. B

**Q9a**.

1. Release agent added
2. Powder/granules/pellets/liquid/loaded
3. Mould closed/mould
4. Mould heated/heater/melted plastic
5. Mould undergoes 2 axes of rotation/turns in many directions
6. Polymer sticks to all inside surfaces of mould/spreads evenly around the walls/hollow shape is formed
7. Mould cooled/cooling equipment/fans/water
8. Remove moulding from mould

Diagram

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**Q9b**.

* Generates a hollow / sealed one piece shape / no joints. (1)
* Moulds are cheaper / quicker / simpler to manufacture. (1)
* Viable for short / batch production runs. (1)
* Enables larger mouldings. (1)
* Less waste material / no sprues or runners needed. (1)
* Tougher mouldings / mouldings are stress free / less likely to split
* or crack. (1)
* Wall thickness can be changed without altering the mould. (1)
* No draw angle is needed. (1)
* Quicker to change polymer colour between mouldings. (1)

**Q10**.

* Hopper (1)
* Granules / granules fed in (1)
* Motor / motor turn screw (1)
* Screw / screw pushes material along (1)
* Heaters / granules is heated (1)
* Polymer melts (1)
* Die / mould /polymer squeezed through die (1)
* Cooling tanks / formed shape is cooled (1)
* Run-out support / tube is supported as it is fed out (1)

Max 7 marks from above points.

* Core/ pin creates hollow tube (1)
* Core supports/ plastic flows round core supports (1)

Diagram

Description automatically generated

**Q11**.

* Bottle die (1)
* Extruder heats parison/ forms parison / preform heated (1)
* Parison fed in / preform inserted (1)
* Die closed (1)
* Air blown in (1)
* Pressure maintained to fully fit moulding to die (1)
* Die cooled /water pipes cool die (1)
* Die opened to release bottle (1)

Diagram, engineering drawing

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**Q12a**.

Rounded corners  
• Draft or angle sides  
• Smooth surface  
• Lack of undercut  
• Vent holes in recesses

**Q12b**.

* Stage 1- The mould is placed on the machine bed.
* Stage 2- A sheet of plastic is clamped onto the machine.
* Stage 3- A heating element is moved over the sheet.
* Stage 4- the heat softens the sheet and it begins to sag.
* Stage 5- The mould is moved up into the soften sheet and the vacuum is switched on to draw the plastic around the mould. Stage 6- The plastic is left to cool slightly.
* Stage 7- The mould is removed from the plastic and the excess plastic is trimmed to size.

Diagram

Description automatically generated

**Q13**.

Candidates might refer to the following in their responses:

* the drill body has a thin wall section/complex shape
* and profile
* the body will be required in high volume
* the design requires cores/bushes/inserts/
* components/fastenings.
* a range of colours can be offered
* cost of mould/skilled labour required
* speed of production
* energy costs
* environmental influences.

Expansion that can be used to justify judgments relating to positive or negative points:

* the form can be achieved with a highly complex mould
* does not need any additional surface finishing
* injection moulding process is capable of delivering the
* product to consistent level of quality time after time/suitable for high volume/the body will need to fit other components so must be same every time
* cores/inserts/components/fastenings can easily be moulded into the drill body, which allows it to be produced in one process
* the initial cost of the mould is expensive, requiring high volume to recoup costs
* colour can be changed without need for additional moulds
* a fast process allowing rapid volume production
* the level of detail and craftsmanship/knowledge
* required to make the mould is expensive/limited
* number of people capable
* if the process is 24/7 then it is more efficient than a
* costly start-up period each day, but this has to be
* weighed against 24/7 labour costs
* ambient temperature/viscosity changes/mould
* temperature variations are all factors that can have an adverse effect on the moulding process and need careful monitoring/environmental control systems.