

Version 1.0



**General Certificate of Education
June 2010**

**Design and Technology:
Product Design (3D-Design)
1551**

**PROD1
Materials, Components and Application**

Final

Mark Scheme

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JUNE 2010 SERIES

COMPONENT NUMBER: PROD1

COMPONENT NAME: Materials, Components and Application

Question 1

(a)

Ferrous	Mild steel	Stainless steel	High carbon steel
Other Ferrous	Cast Iron	Medium Carbon Steel	
Non Ferrous	Aluminium	Copper	Silver
Other Non Ferrous	Gold Platinum	Lead Titanium	Tin Zinc

No to steel

Low carbon steel – same as mild steel

6 marks

(b) (i) Metal: e.g. silver
Use: e.g. Jewellery

1 mark

(ii) E.g. Silver can be soldered which is needed to make rings. When polished, silver has an attractive aesthetic appearance.

2 marks
0 = No metal named

TOTAL FOR QUESTION 1: 9 Marks

Question 2

- (a) Veneered MDF
Used in table tops.

Breakdown:

1 mark for material.

2 marks

1 mark for application. If material is missing but application is suitable for a man made board, give the mark.

- (b) Man- made boards are available in long wide boards which removes the need to join lots of smaller pieces together when making things like table tops, work surfaces, etc.

Man-made boards are stable. They do not warp or twist like natural timber can.

Environmentally friendly made from scrap woods.

Accept cheaper than solid timber.

Breakdown:

1 mark per advantage.

3 marks

- (c) This is the Forest Stewardship Council (F.S.C) logo. It indicates that the timber is sourced from sustainable forests.

NB. Do not need to say what F.S.C means

Breakdown:

1 mark for correctly stating Forest Stewardship Council. 1 mark for explanation or simply two marks for a reasonable explanation alone.

2 marks

TOTAL FOR QUESTION 2: 7 Marks

Question 3

Modelling –

Extruded polystyrene foam (Styrofoam)

1 mark

Design sketching –

Layout paper

Bleed proof paper

1 mark

Marker rendering -

Bleed proof paper Layout paper

1 mark

Retail packaging with a clear window for display –

Acetate

1 mark

Each answer can only be used once.

If the same answer is given in more than one box – only reward one of the answers.

TOTAL FOR QUESTION 3: 4 Marks

Question 4

- (a) **Carbon Fibre Reinforced Polymer (Tennis racquet)**
CFRP is very lightweight which makes it easier to hold and swing than traditional alternatives.
CFRP can be moulded into a variety of shapes to make ergonomic grips, etc.
CFRP can be strong.

Alternative answers:

CFRP looks stylish and can be painted or have applied graphics printed on.
CFRP can be reinforced with alloy mesh to increase tensile strength.

Breakdown:

1- 2 marks per relevant point. 2 marks where point is explained or further detail given. 4 marks

If a list of generic points – max 2 marks.
e.g. it is lightweight, scratch resistant, etc.

- (b) **Concrete (Garden ornament)**
Concrete can be cast into a re-usable mould which is much easier than carving stone.
Concrete can be coloured with pigments to increase aesthetic qualities.

Alternative answers:

Concrete or its constituent parts are more readily available than stone.
Concrete can have different aggregates added to give it the appearance of stone at a fraction of the cost.
Weather resistant

Breakdown:

1- 2 marks per relevant point. 2 marks where point is explained or further detail given. 4 marks

If a list of generic points – max 2 marks.
e.g. it is lightweight, scratch resistant, etc

- (c) **Liquid Silicon Rubber (Mobile phone cover/skin)**
LSR provides impact resistance so the phone might be protected if accidentally dropped.
LSR is flexible and so will stretch over the phone to allow the cover to be put on or removed.
Pigments can be added/ phosphorescent pigments (glow-in-the-dark)

Alternative answers:

LSR can be injection moulded over the top of other polymers to provide a textured grip.

LSR has a rubber like texture which is comfortable to hold.

Breakdown:

1- 2 marks per relevant point. 2 marks where point is explained or further detail given. 4 marks

If a list of generic points – max 2 marks.
e.g. it is lightweight, scratch resistant, etc

(d) **Beech (Chopping board)**

Beech is a close grained hardwood which is needed to help prevent food being absorbed into the chopping board.

Beech has good hardness which helps it to resist cutting from knives.

Aesthetic – suits modern kitchens

Alternative answers:

Beech is non toxic and therefore will not contaminate food.

Beech does not leave a taste.

Breakdown:

1- 2 marks per relevant point. 2 marks where point is explained or further detail given. 4 marks

If a list of generic points – max 2 marks.

e.g. it is lightweight, scratch resistant, etc

(e) **Titanium (Wrist watch strap and casing)**

Titanium is a very hard metal which withstands scratching which will maintain the aesthetic appearance of the watch.

Titanium is a very lightweight metal which makes it very comfortable to wear.

Alternative answers:

Titanium has an attractive patina or colour which makes it appealing.

Titanium still has a ‘prestige’ which makes it desirable as a piece of jewellery.

- Recyclable

- Strength – weight ratio good.

Breakdown:

1- 2 marks per relevant point. 2 marks where point is explained or further detail given. 4 marks

If a list of generic points – max 2 marks.

e.g. it is lightweight, scratch resistant, etc

TOTAL FOR QUESTION 4: 20 Marks

Question 5

- (a) LDPE is a thermoplastic which is needed for the blow moulding process which does not work with thermosets.
LDPE is recyclable which is desirable in a short lifecycle packaging product like this.
LDPE is flexible which allows the bottle to be squeezed to push the liquid out.

Alternative answers:

LDPE can have a pigment added which gives the product good aesthetic qualities.
LDPE is not affected by the contents of the bottle, it is completely waterproof and so will hold the liquid.

LDPE is durable and will last for as long as needed by the consumer. It will withstand usual wear and tear of being used in a kitchen.

- Lightweight
- Looks good
- Good strength – weight ratio
- Does not affect contents

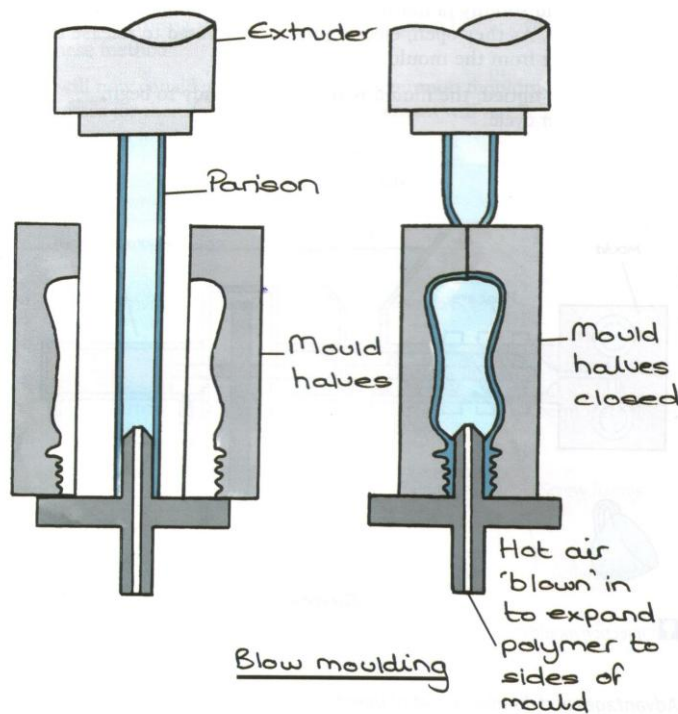
Breakdown:

1 – 2 marks per relevant point. 2 marks where point is explained or further detail given. 6 marks

If a list of generic points – max 3 marks.

e.g. chemical resistant, lightweight, can be blowmoulded.

- (b) **Answer:** (Note diagram for illustration only) mould design may differ to reflect product shape. Do not expect same level of line accuracy.



LDPE granules are heated and made into a molten state.
The polymer is extruded in a tube form known as a 'Parison'.
The mould halves close on the 'Parison' and trap the base together.
Air is blown into the Parison which is forced out to the sides of the mould where it cools. The moulds open, releasing the product.
Flash is removed.

Breakdown

- Basic diagram of a suitable manufacturing process with a few points labeled
E.g. simple diagram of mould. May not resemble product. Little detail. Labels such as 'mould', 'balloon'. Major points missing. Some confusion with injection moulding or main focus maybe the extrusion process. 0 – 3 marks
 - Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes.
E.g. mould resembles product, some specific parts correctly labelled. Step by step process in note form but may have some steps missing or lacks clarity. 4 – 6 marks
 - Detailed diagram with all points labelled and a good explanation of the process
E.g. mould clearly resembles the product. Step by step process is correct with few if any details missing for the top mark. 7 – 10 marks
- 7 marks max for no diagram

- (c) Blow moulding is used because the process produces a thin-walled item. 4 marks
Alternative answers might be:
Blow moulding is a fast process and an automated process which is necessary for high volumes of production. Blow moulding produces a standardised product which is necessary to meet quality standards,
Blow moulding is the recognised/established way of making such products.

Breakdown:

- Simple obvious statement without reference to volume or quality of production
e.g. blow moulding is fast
1 mark per statement
- Better use of appropriate terminology
2 marks per statement

TOTAL FOR QUESTION 5: 20 Marks

Question 6

- (a) (i) Stainless steel/ Aluminum/ Aluminum alloy only. 1 mark
- (ii) Stainless steel is a tough metal, therefore it withstands impact from being dropped accidentally. 6 marks

Stainless steel does not corrode. This makes it aesthetically pleasing and pleasant to drink from. Consumers would be put off if the cup was rusty.

Stainless steel can be formed by compressive forces because it is malleable. The processes of spinning or press forming need this property.

- Strength
- Lightweight
- Hard/ not scratch easily

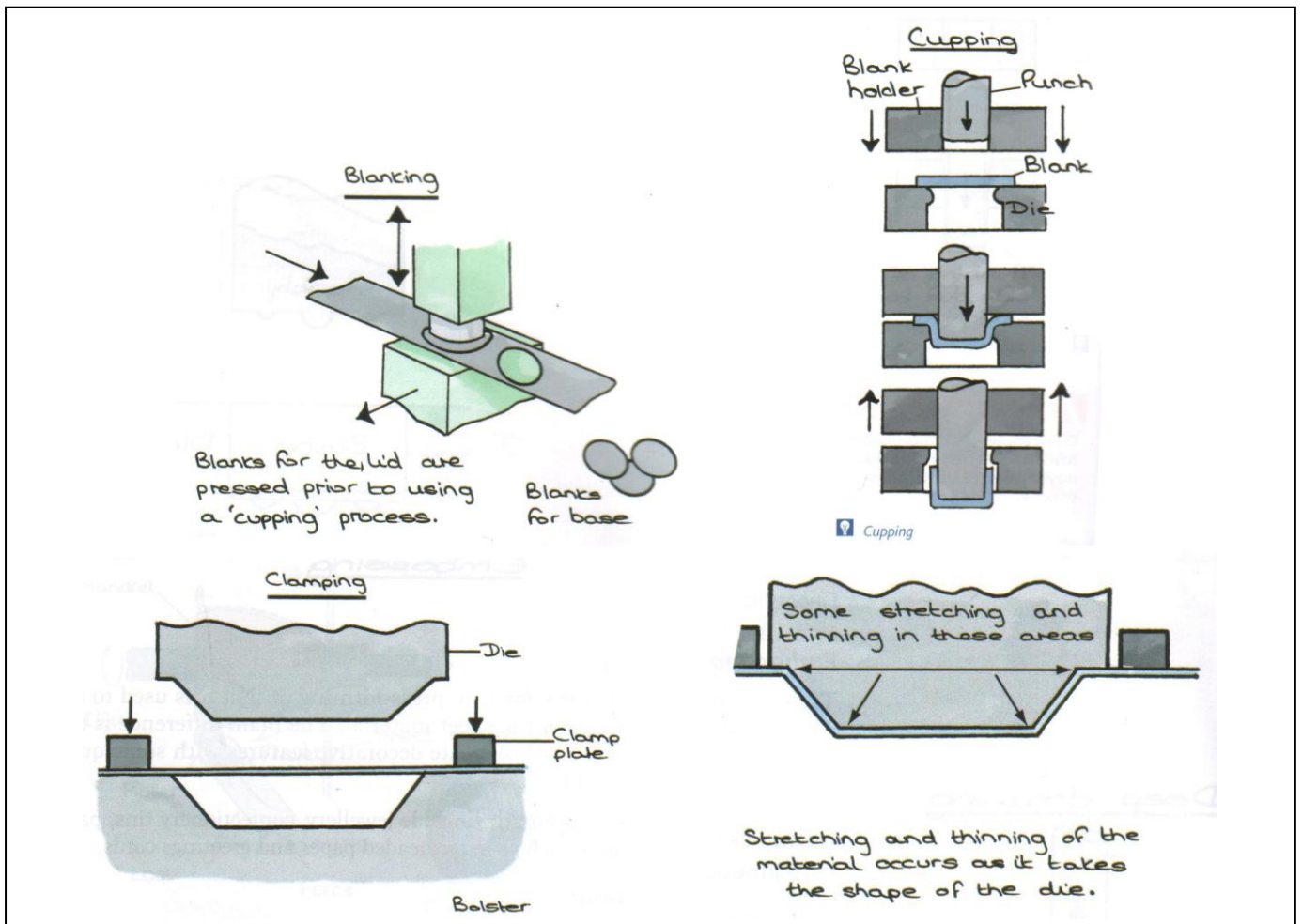
Breakdown:

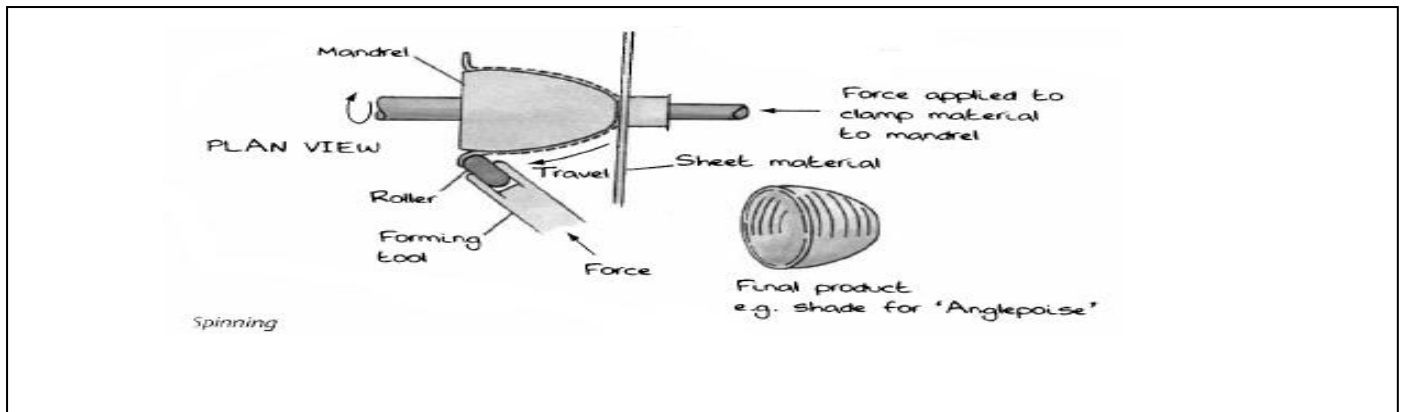
1 – 2 marks per relevant point. 2 marks where point is explained or further detail given.

A list of points – max 3 marks.

- (iii) Accept either spinning or press forming/cupping/deep drawing.
Accept details of Blanking.

Note: Diagrams for illustration only. Dies may differ according to product shape. Do not expect same level of line accuracy.





Stages:

Sheet steel is unrolled from stock material

Material may be annealed to increase ductility
Material is punched to make a blank.

Material clamped onto press former

Die moves down using hydraulic pressure and pushes into the material.
Material takes the shape of the dies.

Product removed for de-burring and cleaning.

Breakdown

- Basic diagram of a suitable manufacturing process with a few points labelled
(1 mark for stating 'spinning')
E.g. simple diagram of press forming dies. Generic die (doesn't resemble product) with little detail. Labels missing. Major points missing. 0 – 3 marks
 - Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes.
E.g. die resembles product, some specific parts correctly labelled such as die, clamp, etc. Step by step process in note form but may have some steps missing or lacks clarity. 4 – 6 marks
 - Detailed diagram with all points labelled and a good explanation of the process
E.g. Die clearly resembles the product. Details of die/punch, bolster, clamping ring, etc. Step by step process is correct with few if any details missing for the top mark. 7 – 10 marks
- 7 marks max if no diagram
- (iv) Polypropylene or LDPE/ HDPE/ ABS /HIPS. 1 mark
Do not accept acrylic or polycarbonate
- (v) PP is a food grade polymer which will not contaminate the drink/ non toxic.
PP is an insulator which helps to keep the drink warm and keeps the outer of the cup cool to touch.
PP is a thermoplastic and therefore can be injection moulded.
- Durable
 - Good chemical resistance

Breakdown:

1 – 2 marks per relevant point. 2 marks where point is explained or where additional detail is given.

If polymer given in part (iv) is incorrect still award credit for appropriate points in part (v).

If no polymer written in part (iv) award zero marks in part (v)
 If generic list of points – max 3 marks.

6 marks

(b)

- Finger grips shaped into handle.
- Use has the option of holding the handle or grasping the cup.
- Tapered shape of the cup is good for grip as it accommodates different hand sizes.
- Slide opening on the top to reveal small aperture for drinking on the move.
- Wide and deep rim to allow for ease of raising cup to lips and prevent spillage.
- Groove on twist off top to improve grip.
- Multi-start thread on top for ease of putting top on
- Air gap between polymer insert and stainless steel outer keeps the outer cool.
- Polymer insulates user from hot contents.
- Handle could be longer to accommodate wider palm line.
- Gap between cup and handle could be bigger to accommodate larger fingers.
- Slide opening is a possible place for dirt and germs to collect
- Sensible improvements
- Use of SMART materials
 e.g. pigments to show hot/cold,
 phosphorescent pigments for night use.

16 marks

- Polymorph for handle

Basic evaluation of ergonomic and safety features with limited 1 / 2 improvements 0 – 5 marks

Better evaluation of ergonomic and safety features with 2 – 3 improvements and supporting diagram 6 – 10 marks

Detailed evaluation of ergonomic and safety features with well explained improvements 11 – 16 marks

Do not award more than 1 mark for basic descriptions (e.g. has handle so it is easier to hold = 1 mark) Max 12 marks for no diagrams

TOTAL FOR QUESTION 6: 40 Marks