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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology: Product Design 3544/H

Higher Tier

Mark Scheme

Standardising

2008 examination - June series

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Question 1

(a)

Material	Source
Earthenware clay	Clay pits Out of the ground, earth, soil
Scots Pine	Trees
Woollen yarn	Sheep, animal hair (but not fur)
Copper sheet	Copper ore Out of the ground (mining)
Paper	Trees, timber, wood pulp, recycled paper
Cheese	Milk Cows, goats etc.
Polyester	Oil

(3 × 1mark)

(b)

Material	Renewable	Non-renewable
Earthenware clay		✓
Scots pine	✓	
Woollen yarn	✓	
Copper sheet		✓
Paper	✓	
Cheese	✓	
Polyester		✓

(2 × 1mark)

Any two correct answers where more than two attempted.
Where both boxes ticked for one material, mark as incorrect (0)

(c) Product named with explanation of why materials have been combined. *(3 marks)*
Named product which relates to the explanation *(2 marks)*
Named product *(1 mark)*
Do not accept a material for product
Do not accept assembly of separate components

A wide range of answers acceptable e.g.

Product	Explanation
Brass ornament	Brass is combined from copper and zinc and is a golden colour when polished. Doesn't tarnish quickly so useful for decorative products.
Stretch jeans	Elastane (Lycra) is very stretchy and when mixed with denim gives a fabric which looks like denim but clings to the legs.
Drinks carton	Cardboard laminated with aluminium or plastic sheet to produce a waterproof container
Dining room chair	Laminated plywood is used to provide a curved back which is very strong
Roux sauce	Flour is added to the sauce to thicken the mixture
Cup	Glaze is coated onto the fired clay to make it waterproof and hygienic to drink out of
Boat hull	Made from glass reinforced polyester (GRP) as it is light and very strong
Racing cycle	Made from carbon fibre composite to increase strength and reduce weight

(d) (i) Product and named component which could be found on such a product. *(1 mark)*
Component must be appropriate to product.

A wide range of answers acceptable e.g.

Product	Components
Jeans	Zip, buttons, rivets
Cake	Iced lettering, "happy birthday" plastic sign
Car	Nuts, bolts, washers, spark plugs, bulbs etc.
Bicycle	Brake blocks, handlebar grips, chain, ball bearings etc.
Mobile phone	Battery, screen, mains adapter etc.
Furniture	KD fittings, screws, hinges, handles etc.
USB stick	Split ring, lanyard
Fountain pen	Nib, ink cartridge
Spectacles	Screws, nose pads
MP3 player	Batteries, ear phones
Shoes	Laces, buckles, pres-studs, eyelets, heel tips, insoles etc.
Skateboards	Wheels, trucks, grip-tape etc.

(ii) Detailed, well reasoned answer *(3 marks)*

e.g. Components are made in large quantities by specialist manufacturers to reduce costs and to make product maintenance easier; Components are often made from different materials to the main product and require very different manufacturing systems so it would not be appropriate for one manufacturer to make everything; Many different products with different functions require the same components which makes the components a product themselves which other manufacturers want to buy. Standard components – sustainability (easier to repair/maintain)

Detailed answer which might not be fully explained *(2 marks)*

e.g. Components are made in separate factories to reduce costs; Components need different manufacturing processes; Components are products themselves and are made for other manufacturers to buy.

Superficial answer *(1 mark)*

e.g. Saves time; Saves money;

Question 2

(a) (i) Sustainable products are those products providing environmental, social and economic benefits while protecting public health, welfare, and environment over their full commercial cycle, from the extraction of raw materials to final disposition.

Do not accept 3Rs unless qualified
Accept marketing (increased consumer appeal)

Any three points for one mark each *(3 marks)*

(ii) One mark awarded for each correct term given *(3 marks)*
Reduce, Reuse, Recycle, Restore, Refill, Respect, Recover, Repair, Refuse, Rethink

(b) (i) Any named 'throw away' product such as disposable cameras, disposable razors, pens, light bulbs etc. *(1 mark)*

(ii) Planned obsolescence is the conscious decision on the part of a manufacturer to produce a consumer product that will become obsolete and/or non-functional in a defined time frame. Planned obsolescence has great benefits for a producer in that it means a consumer will buy their product repeatedly, as their old one is no longer functional or desirable. Planned obsolescence has an obvious detrimental effect on the environment as it is a planned waste of resources, particularly as typical products might use high levels of non-renewable or difficult to recycle materials.
Not economical to repair

An in-depth answer explaining the main aspects of the disadvantages of planned obsolescence. *(3 marks)*

A limited range of knowledge of disadvantages of planned obsolescence, although an informed response on a single aspect. *(2 marks)*

One single aspect referred to with no or limited explanation. *(1 mark)*

Question 3

(a) (i) A full answer similar to examples below *(2 marks)*
Superficial or partial answer *(1 mark)*

A – Must be easy enough for thumb to press and slide without slipping off

B- Handle shaped to prevent slipping when cutting in a pulling action. Grooves have been provided to make grip easier.

C- Knurled locking screw must be easy to turn and easy to secure the blade in place by hand. Must not interfere with the comfort of the handle
*Answers that relate to the overall shape and size of the handle/body and deal with anthropometric data and ergonomics can be given full credit.

(ii) A full answer similar to examples below *(2 marks)*
Superficial or partial answer *(1 mark)*

Contrasting colours easier to see when left in toolbox/bag etc. These colours are often associated with danger (striped tape around machines in workshop); Hi-vis yellow standard colour linked to Health & Safety – road signs, notices. Accept marketing / aesthetics if well qualified e.g. brand image.

(b) 2 different features and explanations of improvements provided. *(2 × 3 marks)*

Feature identified. *(1 mark)*

Reasoned explanation of improvement *(2 marks)*
e.g. Handle is easier to grip; knife is easier to see due to colour; blade is retractable therefore potentially safer; snap off blade means always got a sharp blade available; no tools required to get a new blade out.

Superficial explanation of improvement. *(1 mark)*
e.g. better grip; easier to see; safer; easier to use.

(c) Quality of communication *(3 marks)*

A precise drawing with a clear layout showing high level skills *(3 marks)*
Some parts of the drawing not easy to understand *(2 marks)*
A weak or scrappy drawing which is difficult to identify the details *(1 mark)*

- how the packaging will be hung *(2 marks)*
  Simple hole indicated 1 mark, euroslot or other commercial hanging system 2 marks.

- where the name and company logo will be printed *(1 mark)*
- where the instructions will be printed *(1 mark)*
  Marks awarded for appropriate graphic layout. No marks for inappropriate locations.

- how the separate parts will be assembled *(2 marks)*
  Full explanation 2 marks, superficial explanation 1 mark.
  Appropriate method of joining plastic to card e.g. plastic sandwiched between two layers of card and glued; stapled; plastic folded around edges of card; plastic heat sealed / fused around edges.

  * Fully reward alternative packaging arrangements.

(d) Die-cutting *(2 marks)*
Stamping, laser cutter *(1 mark)*

(e) Lithography *(2 marks)*
Screen printing, gravure, letterpress/flexography *(1 mark)*
No marks for computer printing or digital printing

(f)

Barcode used to identify product as part of a stock control system *(1 mark)*

Polyethylene terephthalate. Method of identifying plastics to aid recycling *(1 mark)*

Naming of specific material not required to obtain mark
Do not accept 'recyclable' or 'plastic'
Both aspects identified for mark

Question 4

(a) User and typical use identified for 2 lights. *(2 × 3 marks)*

Detailed description which identifies the user and the typical use of light *(3 marks)*
Description which indicates user and superficially indicates use *(2 marks)*
Either user or use identified only *(1 mark)*

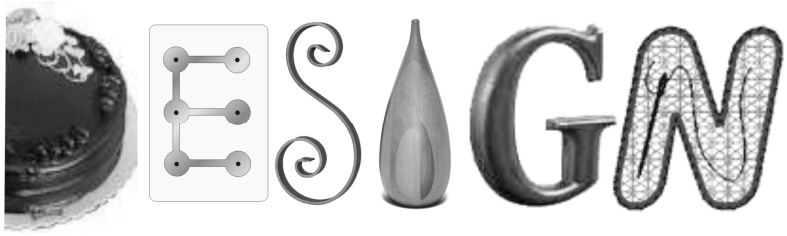
A- Heavy duty light suitable for construction worker, maintenance engineer, back of car etc. Suitable for supplying directional light. Handle makes it easy to carry. Large battery for prolonged use.
B- Attached to key fob makes it particularly suitable for carrying in pocket or handbag. Close-up light suitable for seeing lock, reading map or similar short term use over small area. Male or female, most likely a driver.
C- Cycle light. Easily attached and removed for safe keeping. Likely to be used by a serious cyclist (obviously for night time use) who commutes to and from work.
D- Portable desk light suitable for flexible use as a reading light. Does not need to be connected to mains supply. Easily folds away and can fit into briefcase so suitable for business person on the move. Could be safely used in child's bedroom or as make-up, shaving mirror. Safe for use in bathroom.

(b) 2 advantages and 1 disadvantage identified *(3 × 2 marks)*

Detailed advantages/disadvantage identified *(2 marks)*
Superficial response such as "cost", "safety" *(1 mark)*

Lamp	Advantages	Disadvantages
12 volt halogen	Safer than 240v mains current Allows more creative applications such as current conducted along exposed parts Smaller bulbs Very bright light Easier to replace – push fitting	Needs transformer (bulky) Bulb gets very hot Expensive by comparison to filament bulbs Very hot
Energy saving light bulb	Last for a long time Use less electricity therefore cheaper to run / save money over time / kinder to environment Cooler Easier to replace – screw fitting	Expensive by comparison to filament bulbs Large Might not fit standard light fittings / shades Unattractive Not as bright (different quality of light) Contain mercury – environmental issues on disposal Take time to reach full brightness More sophisticated manufacturing techniques resulting in more expensive product.

Question 5

(a) 

One material correctly named *(1 mark)*

e.g.
Cake mixture – flour, eggs, sugar, butter/margarine, chocolate
Printed circuit board, copper clad board
Mild steel, wrought iron. Accept any named metal but not "metal"
Any named timber such as mahogany, walnut etc. Accept hardwood or softwood but not "wood"
Any named plastic or metal but not "plastic" or "metal"
Any named fabric but not "fabric" or "material" or any named thread. Accept embroidery thread

Explanation of manufacturing process *(4 marks)*

Every stage of production has been identified and fully explained. *(4 marks)*
Any four separate points fully explained for maximum marks if process is more complex.

Most of the stages of production have been identified and are adequately explained. *(3 marks)*

The most important stages identified with some explanation *(2 marks)*

Some stages of production identified with little explanation. *(1 mark)*

Quality of communication *(3 marks)*

Drawings clear and sequential and easy to follow. (3 marks)

Well drawn but not easy to follow or easy to follow but poorly drawn *(2 marks)*

At least one aspect is clearly drawn and easy to understand but overall sequence may be flawed *(1mark)*

Manufacturing processes:

D Cake – Mixing ingredients into paste, greasing cake tin, cooking at approx 190 degrees in oven, cooling, melting chocolate in Bain Marie or microwave oven and spreading on cake. Icing sugar mixed with water to make paste rolled out and shaped into flowers.

E PCB – mask printed onto acetate or tracing paper, exposed to UV light. Immersed in Ferric chloride (or similar), washed cleaned with wire wool drilled. Alternative manufacture using rub down masking stencils rather than printed mask.

S Metal scroll – cold forming or hot forming processes. Metal is hammered to create bent ends which grips the scrolling iron. Metal pulled around the scrolling iron, turned over and repeated

I Wood turned timber – block made up of glued pieces is prepared by planning/sawing edges to form octagonal shape. Centres drilled at each end. Placed in wood lathe and rotated against chisel/gouge. Sanded and polished on lathe.

G Cast/moulded or vacuum formed. Candidates might interpret this example very differently.
Casting – prepare mould in sand using wooden pattern or machine shape in reverse into MDF or Necuron foam (sometimes described as plastic wood). Heat metal (aluminium for sand casting, pewter for die casting) and pour into mould. When cool remove and cut off excess metal using hacksaw and file. Polish

Injection moulding – prepare mould by machining into metal block (aluminium most likely). Polish mould. Place in injection moulding machine and forcing in molten plastic. Candidates might describe a glue-gun version of this.
Vacuum forming - prepare former from MDF or similar. Place in base of Vac former (platen). Clamp thermoplastic (probably HIPS) and heat until soft. Lift platen and switch on vacuum pump. Allow to cool. Trim off excess plastic (slotting saw, Gerbil cutter etc.)

N Embroidery – hand or CNC method. Prepare threads in correct sequence in machine. Clamp fabric in embroidery frame and send file. Trim excess threads/link threads. Hand method may describe stitch patterns e.g. cross stitch.

Question 6

(a) Idea drawn for one gift from list.

Feasibility of idea *(2 marks)*

The idea is completely feasible and well described *(2 marks)*
The idea is not fully detailed and/or some areas may not be feasible *(1 marks)*

Quality of notes and sketches *(4 marks)*

Clear detailed drawing, easy to see all details, detailed annotation *(4 marks)*
Clear drawing which may lack some details, clear annotation *(3 marks)*
Drawing may not be clear or may be lacking in detail, some annotation *(2 marks)*
Drawing not clear, difficult to distinguish features, little or no annotation *(1mark)*

Use of colour and/or tone enhances drawing and skilfully applied *(2 marks)*
Colour and/or tone has been applied but lacks skill *(1 mark)*

(b) (i) Any named material which would be suitable for the idea shown. *(1 mark)*
No marks for generic names – wood, metal, plastic, fabric etc.

(ii) Clear justifications linked to properties, manufacturing techniques, costs, aesthetics, availability etc. *(2 marks)*
Superficial/single word answers e.g. "cheap" *(1 mark)*
Must relate to product and material previously specified

(c) See appendix for further guidance

- An accurate description of each stage of the process, sequence is clear with no major omissions. Suitable for producing 200. *(4marks)*
A generally correct sequence of manufacturing detailed but maybe some omissions. Suitable for producing 200 *(3 marks)*
Some significant omissions in the sequence of manufacturing or processes may be incorrectly detailed. Suitable for producing 200 *(2 marks)*
Only part of the process superficially detailed or unsuitable for producing 200 *(1 mark)*

- References made to manufacturing aids, CAM, ongoing checks, final inspections. *(2 marks)*
Reference to one with full explanation or reference to two with superficial explanation *(2 marks)*
Reference to one *(1 mark)*

- Correctly named tools and equipment for major stages of manufacture *(2marks)*
Some tools and equipment are correctly named *(1 mark)*
Look for evidence in body of process

- Quality of communication is good. Clear drawings and notes. *(2 marks)*
Quality of communication is sound. Drawings may lack some annotation but are generally easy to understand *(1 mark)*

Question 7

(a)

Smell	Hearing	Touch	Taste	Vision
Acrid	Beat	Texture	Salty	Movement
Pungent	Pitch	Temperature	Sourness	Colour
Fragrant	Loudness	Weight	Sweetness	Pattern

9 - 12 correct answers *(3 marks)*
5 – 8 correct answers *(2 marks)*
1 – 4 correct answers *(1 mark)*

(b) **Sectional/curved** workstations – easier to package and transport as split into smaller more manageable pieces.

1 **Flat** workstation is one large piece (requires 2 people) – difficult to handle – too large to transport in car - stackable

2 **Sectional** workstation – easiest to assemble – manageable for one person

3 **Curved** workstation – difficult shape to package/transport – centre section may be too large for car

A detailed well reasoned answer *(3 marks)*

A detailed answer which might not be fully explained *(2 marks)*

A superficial answer *(1 mark)*

(c) Two different adjustments chosen and explanations provided for each. *(2 × 3 marks)*

No marks for adjustment.

A detailed response showing a very good understanding of the implication and issues of the adjustment required, dealing with specific benefit as well as the broader benefits of comfort, safety, reach etc. *(3 marks)*

A description of the adjustment and explanation of the benefit to the driver. Response may be lacking in detail or lacking in understanding. (*2 marks)*

A basic description of the adjustment. *(1 mark)*

The more adjustable features within the car (e.g. steering wheel adjustment in/out, up/down and tilt), the greater the likelihood of the driver achieving good and comfortable posture.

- Good visibility of the road should be possible, together with a good view of all the instruments.
- The driver should be able to reach all of the controls (pedals and hand controls) without stretching.
- The body should be supported and muscular effort minimised to allowing the driver to concentrate on the driving task.

Specific comments to each adjustment may include:

A Prevent whiplash

B Prevent back strain/increase comfort

C Relationship to pedals and other controls

Question 8

(a) (i) Two different processes named. *(2 × 1 mark)*

Casting/moulding:
Injection moulding, sand casting, die-casting, food moulding, slip casting etc.

Forming:
Felt blocking, vacuum forming, drape moulding, folding, bending, compression moulding, forging etc.

Wastage:
Any machining process such as drilling, milling, turning etc.
Die-cutting, stamping, shearing, sawing, slicing etc.

Mixing
Combining materials/ingredients together before use, rubbing in flour and butter.

Fabrication.
Metal joining and assembly of components.

Assembly:
Any permanent or non permanent assembly method - nuts, bolts, screws, rivets, nails, Velcro, zips, press-studs, buttons, welding, brazing, bonding, KD fittings etc.

Finishing:
Printing, varnishing, embossing, foil blocking, painting, powder-coating, plating, polishing, l aminating etc.

(ii) A detailed diagram with detailed annotation showing very good understanding of the process *(4 marks)*
A good clear annotated diagram which clearly indicates the process *(3 marks)*
A reasonable diagram/notes where the process appears to be ok but is lacking in detail *(2 marks)*
A poor quality diagram / notes lacking in sufficient detail to adequately describe the process. *(1 mark)*

(b) (i) CAD, rapid prototyping, virtual modelling, stress analysis, report writing, costings, materials databases, giving presentations, digital photography, measuring, CAM etc.

A clear explanation which uses correct terminology and fully explains the operation/application within a commercial manufacturing context. *(3 marks)*
Explanation is simplistic or the application is more relevant to school use *(2 marks)*
Superficial answer such as "CAD *(1 mark)*

(ii) Two different benefits given. *(2 × 1 mark)*

Benefits might include accuracy, repeatability, reduced labour costs, flexibility, easier data storage/retrieval, quick-change set-ups, capability for full automation, monitoring etc.

(c) (i) A detail response which shows a clear working knowledge of the term selected and the implications on manufacturing. *(2 marks)*

A limited explanation with no wider understanding displayed. *(1 mark)*

Batch production - is used to produce or process any product in groups that are called batches. The products, for example bread, are made in batches of however many will fit in the baker's oven at a time. When that batch is made, the baker will start the process again with a new batch. Batch production techniques are used in the manufacture of specialty chemicals such as active pharmaceutical ingredients, inks, paints and adhesives. Batch production is useful for a factory that makes seasonal items or products for which it is difficult to forecast demand

One-off production is used to produce a single product either as a prototype or as a bespoke item to specific order, for example a wedding dress or hand crafted furniture. Prototypes are made to test a product's viability and suitability of production processes prior to production in quantity. Bespoke items are often hand crafted to a client's specific requirements and therefore more expensive than a similar batch or mass produced product.

Continuous production is a method used to manufacture, produce, or process any product without interruption. There is no discrete rate at which goods are produced, as opposed to a batch production process. Examples of continuous production are those used to make pens, paper, cars, light bulbs and computers. Continuous production presents possibilities for enhancing automation. By employing Programmable logic controllers (PLCs) and other automated controls, we can reduce chances of error (thereby delays and downtime) due to human intervention.

(ii) Product and appropriate scale of production named with reasons for choice. *(4 marks)*

Named product which is correct for scale of production *(1 mark)*

Detailed reasons which might link to any of the areas mentioned above, might also link to levels of demand, costs etc. *(3 marks)*

A reasonable response which shows a sound understanding of one of the areas above. *(2 marks)*

Superficial reasons or which link to school application. *(1 mark)*

Question 9

(a) Possible answers: *(2 marks)*

Innovative design styling
Innovative use of technology
Unique concept
New materials
New manufacturing methods
Indicative of a period in time or a particular culture

A very complete answer dealing with one or more issues *(2 marks)*
A superficial response. *(1 mark)*

(b) No definite answer. Mark for the quality of reasoning. *(6 marks)*

A detailed and well reasoned statement which argues for one or both of these categories and includes appropriate examples of other products. *(5 - 6 marks)*
(5 for less appropriate examples)

A detailed response which picks up on one aspect in detail and/or uses examples. *(3 - 4 marks)*

A superficial response which lacks understanding linked to one of the categories. *(1 - 2 marks)*

e.g.
Market pull
Market research suggesting the desire for a retro design to compete with the new VW Beetle. Designed to meet a niche market

Technology push
Advances in new technology makes it possible to manufacture a car with these features to a market price. New developments have been incorporated into the design

Appendix

Question 6 Higher Tier

Some suggestions to aid markers with processes

Laser cutting - Draw in suitable software (Corel, 2D Design Tools, ProDESKTOP), nominate different colours for cutting and engraving (typically red for cut, black for engrave but do vary), place material in laser and adjust setting. Send single design to print so that quality can be checked. If ok, copy and paste ensuring maximum use of material (nesting). Send to print, replace material until required number achieved. Unlikely any edge finishing is required in most materials.

Milling/routing – Draw in suitable software (Corel, 2D Design Tools, ProDESKTOP), nominate different colours for different size cutters or, place material in machine and adjust setting (typically referred to as offsets, may include feeds and speeds relative to material). Send single design to plot so that quality can be checked. If ok, copy and paste ensuring maximum use of material (nesting). Send to plot, replace material until required number achieved. Edges are likely to be rough so some form of sanding and polishing/painting/varnishing might be specified.

Pewter casting- Draw in suitable software (Corel, 2D Design Tools, ProDESKTOP), nominate different colours for different size cutters or, place material (typically MDF or Necuron) in milling machine/router and adjust setting (typically referred to as offsets, may include feeds and speeds relative to material). Send single design to plot so that quality can be checked. If ok, repeat to get a number of moulds. Heat pewter (variety of methods used) until molten and pour into moulds. Once cool, remove form mould and trim excess material. Polishing is likely, maybe application of colour.

Die-cutting – Make a cutter by fastening dieflex bade around MDF/plywood shape (double sided tape or screws). Use this in press to stamp out shapes. Likely to be linked to some form of printing eg. Laser printing is likely for card, sublimation printing/transfer printing for fabrics. Latter involves a heat transfer system – press or iron. Reference might be made to crop marks for alignment. Fabric parts might be sewn together and filled with wadding.

Chocolate moulding – First issue is to manufacture moulds in large quantity. Any system can be used for making formers although CAM system (laser/milling) is most likely. Vacuum form moulds (most likely from HIPS or PET – food quality needed) in trays. Trim and clean/disinfect. Heat chocolate in bain marie or microwave, pour into moulds, scape off surplus chocolate and put in fridge to set. A protective cover will be needed (foil, polythene).

Pastry/biscuit/salt-dough/clay cutting – a cutter will need to be made. A simple vacuum formed HIPS cutter can be made over any rigid former and trimmed to make an effective stamping tool. Alternatively, a strip of sheet metal could be shaped and joined to form a cutter. Material will need to be rolled out into even sheets and stamped. Excess material rolled out again and process repeated. Cooking or kiln firing should be noted. Decoration might include icing or edible printing onto rice paper, painting, glazing etc. Edible decorations likely to be covered (cellophane wrapping for example).

Injection moulding – could utilise an injection moulding machine or hot melt glue gun and coloured sticks. Mould could be made in acrylic layers (laser cutting most likely). Plastic injected into mould and allowed to cool (more than one mould would be needed). Once removed, excess plastic needs to be trimmed (fettling). No further work should be necessary.

CNC turning – as flat shape not specified this process might be suggested. Only suitable for forms made up cylinders, spheres, cones which are symmetrical around the length. Draw in suitable software (LatheCAM). Place material in lathe and ensure correct tools are in place. Length and diameter of material (billet) will need to be put into software. Send single design to ,machine so that quality can be checked. If ok, repeat until required number achieved. Unlikely any finishing is required in most materials (aluminium or brass most common) although polishing on buffing wheel is possible.

Screen printing/block printing – Might be suggested onto a range of materials such as card or fabric. Screen/printing block will need to be prepared. A wide variety of methods are possible. Ink applied to block and pressed onto material or pressed through screen using a squeegee. There will be a considerable amount of drying time needed. A suitable cutting out method will need to be specified but scissors used to cut a simple outline might be regarded as suitable. Additional work such as sewing fabric pieces together will gain extra credit.

Machine embroidery – this would be a very slow production method but might be suggested. Design to be drawn in suitable software (Corel Draw, Paint) and pasted into the embroidery software (PE Design). Fabric fastened into frame with backing fabric attached. Coloured threads threaded into machine in correct sequence. Design sent to machine. Excess threads need to be trimmed afterwards. A suitable cutting out method will need to be specified but scissors used to cut a simple outline might be regarded as suitable. It would not be feasible to cut out shape prior to embroidering in this instance as fabric needs to be held in frame. Additional work such as sewing fabric pieces together will gain extra credit.