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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology: Product Design 3544/F

Foundation Tier

Mark Scheme

Standardising

2008 examination - June series

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Question 1

(a) An appropriate method with explanation. *(3 × 1 mark)*

No marks for responses which do not attempt to explain the next stage of re-use or recycle after collection e.g. "bottle banks"

Product	How it could be recycled or reused
 Wine bottle	Can be washed and refilled Can be taken to a bottle bank where it will be crushed and melted down to manufacture new products Crushed and bonded with resin – used for decorative building surfaces
 Inkjet Cartridge	Can be posted/taken to recycling centre to be refilled with ink Can be refilled using kits
 Car tyre	Reused for remoulds Used for sports playing surfaces and playgrounds Lorry tyres recut
 Aluminium drinks can	Recycled in can banks or through local authority schemes, melted down to recover metal
 Mobile Telephone	Reused by replacing worn parts batteries etc and exported to third world countries where the technology is still current. Second hand market.
 Woollen jumper	Clothing banks/charity shops to wash and re-use Recycled by breaking down into individual fibres

(b) Reasons why consumers should recycle *(2 × 2 marks)*
e.g. to minimise use of finite resources; conserve energy; reduce emissions; reduce landfill sites needed, saves money, legal/local council requirements, 'weee' regulations.

Reason fully explained. *(2 marks)*
A reason stated. *(1 mark)*

(c) (i) A full answer mentioning two or more materials *(2 marks)*
Basic answer such as "laminated" or "composite" *(1 mark)*

e.g. Main carton made of laminated materials which are very difficult to separate for recycling. Pouring spout made from another plastic which needs to be separated.

(ii) Appropriate alternative named and explanation of why it is more environmentally friendly. *(2 marks)*
Appropriate alternative named without explanation. *(1 mark)*

e.g. Glass bottle which can be reused by washing; plastic bottle (PET) which can be reused by washing or recycled; simple laminated card tetra pak without plastic spout/seal as easier to process. Can as recyclable, plastic pouch, i.e. any appropriate recyclable container.

Question 2

(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.

(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 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.
Where candidates have used Figure 2 as the improved knife, marks can be awarded for justified improvements.

(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 blister 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 methods.

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

(e) Lithography *(2 marks)*
Screen printing, gavure, letterpress *(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)*

Named/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 lamp. 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 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 50. *(4marks)*
A generally correct sequence of manufacturing detailed but maybe some omissions. Suitable for producing 50 *(3 marks)*
Some significant omissions in the sequence of manufacturing or processes may be incorrectly detailed. Suitable for producing 50 *(2 marks)*
Only part of the process superficially detailed or unsuitable for producing 50 *(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 either written or drawn

- 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)*

(d) (i) Appropriate risk identified, relevant to manufacturing process in (c). *(1 mark)*

(ii) Full explanation of how risk can be minimised detailing appropriate safety rules or interventions relevant to manufacturing process in (c). *(2 marks)*
Superficial response but relevant to manufacturing process in (c). *(1 mark)*

Safety rules / risk intervention should relate to process described earlier so answers such as using protective clothing whilst using the laser are not valid. See appendix for further guidance. Any sensible answer regarding general housekeeping, behaviour, supervision, protective clothing etc.

Question 7

(a) Colour or tone has been applied with skill. *(3 marks)*
Clear understanding of light and shadow

Colour or tone has been applied but with some skill or tonal contrast *(2 marks)*

Colour **or** tone has been applied. Limited understanding of tonal contrast and/or limited skill *(1 mark)*

(b) A wide range of acceptable answers related to the designing, prototyping and manufacturing stages *(3 × 2 marks)*

e.g. CAD; rapid prototyping; virtual modelling; stress analysis; report writing; costings; materials databases; giving presentations; digital photography; scanning; CAM etc.

Detailed answer, fully explained with example of use. *(2 marks)*
Answer lacking in detail or no example of use. *(1 mark)*

(c) Two terms selected and explanations given. ***(2 × 3 marks)***

No marks for term.
Detailed answer, fully explaining term, use of technical language where appropriate and example of when might be used. *(3 marks)*
Term well explained, some use of technical language, example of when might be used. *(2 marks)*
Superficial explanation, lacking in detail or example of when might be used. *(1 mark)*

Design specification

A list of criteria/feature the product should meet/have to be successful. This might make reference to performance criteria, key dimensions, style, human factors, materials etc. Used throughout the process to evaluate proposals.

Product Analysis

Detailed investigation of a product to compile a list of attributes/features for future reference/comparisons. This might make reference to performance criteria, key dimensions, style, human factors, materials etc.

Prototype

A one-off design which can be fully tested prior to full scale production taking place. This might be made using different materials and manufacturing processes or could be identical to the production model

Evaluating

Detailed testing of a product to ensure that it meets the design specification. Should take place throughout the designing stages as well as at the end of the process.

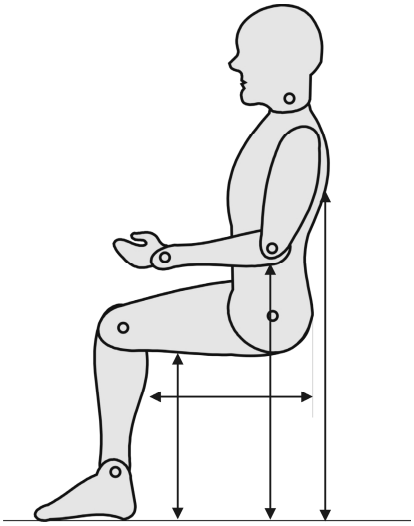
(d) (i) Retro Design *(1 mark)*

(ii) Three separate points identified. *(3 × 1 marks)*
e.g. digital screen easier to read; more lightweight; remote control allows user interface from a distance; more economical to produce; better sound quality; access to more radio stations; portable.

(iii) Two reasons given. *(2 × 2 marks)*
Reason fully explained. (*2 marks)*
Superficial statement *(1 mark)*

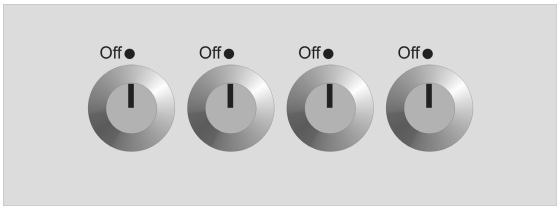
e.g. More lightweight; styling reasons; ease of production; cost savings; safety; incorporates modern technology.

Question 8



(a) Any three measurements clearly shown *(3 × 1 mark)*

(b) All four dials and off marks are positioned vertically. *(2 marks)*
Any logical positioning where dials and off mark are the same *(1 mark)*



(c) (i) Any logical alteration which increases grip or leverage *(3 marks)*
Alteration is an improvement but may be only partially effective *(2 marks)*
Attempt made at improvement but unlikely to be effective *(1 mark)*
Accept electronic solution / foot operation.

(ii) Detailed explanation of what alterations have been made and what benefit they will have to the user. *(2 marks)*
Explanation lacks detail, explains alteration without benefit or benefit without alteration. *(1 mark)*
Look for evidence in (i)

Appendix

Question 6 Foundation 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.

d Apart from good housekeeping rules the following additional safety issues are associated with the processes listed above:

Laser cutting – a fully guarded system. Fire and fume risk:
1 Supervise at all times,
2 ensure extraction is running

CNC milling/routing - a fully guarded system:
1 Sharp tools so care needed when placing/removing materials.
2 Dust risk, care needed when removing to avoid eye contact.

Pewter casting – burn risk:
1 Wear gloves and face mask when pouring.
2 Goggles and loose clothing/hair secured when drilling or polishing.

Die-cutting – sharp blades:
1 Handle with care.
2 Keep hands free when using press.

Dye sublimation/transfer printing – burn/fire risk:
1 Keep hands away from heated surfaces.
2 Watch fabric closely to avoid fire risk

Chocolate moulding - burn risk, hygiene risk:
1 Handle with care.
2 Ensure all surfaces which come in contact with chocolate are clean and sterilised

Pastry/biscuits. - burn risk, hygiene risk:
1 Handle with care. Oven gloves needed.
2 Ensure all surfaces which come in contact with food are clean and sterilised

Ceramics – burn and toxicity risk:
1 Severe burn risk when emptying kiln, adult supervision needed.
2 Toxic dusts/glazes, keep surfaces clean, was hands after use

Injection moulding - burn risk,
1 Handle with care/wear gloves when using hot glue-gun system.
2 Keep knife blade cutting away from you when trimming excess plastic

CNC turning - a fully guarded system.
1 Sharp tools so care needed when placing/removing materials.
2 Swarf risk, care needed when removing to avoid eye contact, metal swarf can be very sharp.

Printing – toxic materials. Fire/fume risk when using solvent based inks.
1 Use solvent based inks in well ventilated area free from naked flame
2 Wash hands after use

Machine embroidery – unguarded system. Danger from moving parts, especially needle:
1 Keep hands clear when machine is in use
2 Fasten all loose clothing /hair