H

Design and Manufacture

Revision Pack

This pack includes a list of all the areas of knowledge that you should know and understand for Higher Design and Manufacture as they may come up in the final exam.

There are also some sample past paper questions to work through that have been amended for the new Higher course. There are also many other past papers from the old Higher and Intermediate Product Design course available on the department website which are still good to use for revision.

http://www.edubuzz.org/rhscdt/

Further mandatory information on Course coverage

The following gives details of mandatory skills, knowledge and understanding for the Higher Design and Manufacture Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of the Units of the Course.

The Course assessment (assignment and question paper) will require learners to draw on and apply knowledge of any of the concepts listed below. This table should be read in conjunction with the descriptions of the question paper and assignment.

Component 1 — assignment

The purpose of the assignment is to assess the learner's ability to apply skills, knowledge and understanding to solve a design task in a given context. It assesses the learner's ability to generate, explore and refine ideas, apply graphic and modelling techniques and to apply their knowledge and understanding of materials, processes and design issues to generate a design proposal.

The assignment Component of Course assessment will require learners to draw on and apply skills, knowledge and understanding as required, from the topic areas listed in the table below.

Design topic areas (assignment) — as required, or limited by a given design task.		
Design process	**Identification of a problem**	Situation analysis.
	Brief	Purpose, statement of problem, target market. Open brief, closed brief. Design brief analysis.
	Research	Sources of recorded and non-recorded information, methods of gathering information. Analysis, application and presentation of researched material.
	Specification	Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification.
	Idea generation	Morphological analysis, thought showers, technology transfer, analogy, and lateral thinking. Application of idea generation techniques. Mood and lifestyle boards.

	Development and refinement of ideas	Synthesis of ideas. Justification and recording of decisions taken. Presentation techniques. Modelling techniques.
	Evaluation	Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, and comparison to specification. Application of evaluation techniques, presentation of results.
Design factors	**Function**	Primary and secondary functions, fitness for purpose, safety in use.
	Performance	Design for re-use, for recycling, planned obsolescence, value for money, ease of maintenance, environmental aspects.
	Market	Consumer demands, end user, social expectations, niche marketing, branding, introduction of new products, economics, product life cycle, needs, wants, technology push, market pull.
	Aesthetics	Factors influencing aesthetics (line, shape, form, colour, proportion, contrast, pattern, texture, harmony, balance), influences of fashion, market trends, style.
	Ergonomics	Anthropometrics, psychology, physiology.
Communication and modelling	**Graphic techniques**	The use of graphic techniques, as required, in communicating design ideas, information and detail effectively eg the use of annotated sketches, orthographic drawings, isometric, oblique, one point and two point perspective, exploded views, dimensioned views, illustration techniques, CAD, use of scale. Use of graphic techniques to: develop, communicate and resolve ideas.
	Range of modelling techniques and materials	The use of modelling, as required, as it supports designing eg the use of scale models, mock-ups, fully crafted

		prototypes, test models, computer generated models, part product models, simulations and rapid prototyping. Use of appropriate modelling materials, as required, such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, modelling compound, balsa wood, expanded foam, sheet plastic, construction kits, smart materials. The application of modelling techniques, as required, to: develop, communicate, evaluate and resolve ideas.

Materials and manufacturing topic areas (assignment) — as required, or limited by given design task.

Learners should be able to demonstrate knowledge of materials and processes used in the commercial manufacture of products. They should be able to demonstrate knowledge of the characteristics of materials which make them suitable for producing particular products. They should be able to identify materials used in existing products and apply their knowledge of materials to the design of new products. It should be noted that learners may refer to materials outside of the list given providing the material has appropriate characteristics for the intended use.

For the assignment, learners should draw upon these applying knowledge and understanding of, as required, or limited by the given design task.

Planning for manufacture	**Production and planning systems**	One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining (automation) and rapid prototyping.
Materials and processes	**Plastics (including composites)**	Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers including, where appropriate, labelling and symbols.
	Metals	Mild steel, carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, aluminium and aluminium alloys, copper, tin, lead, zinc.

	Woods	Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, Parana pine, spruce.
	Timber derivatives	Manufactured boards — fibreboards, plywood, block-board, chip-board, hard-board, and veneer.
	Properties of materials	Justification of the selection of materials based upon their properties in the design, manufacturing and use of products.
	Plastic processes	Cutting, injection-moulding, extrusion, rotational moulding, vacuum-forming, blow-moulding, laminating, rapid prototyping, joining, compression moulding, calendering, casting, bending, fabrication, coating, forming, adhesive bonding, finishing.
	Metal processes	Cutting, turning, milling, die-casting, sand casting, lost wax casting, pressing, stamping, punching, extrusion, spot welding, arc welding, adhesive bonding, riveting , fitted joints, bolts, screws, piercing and blanking, drop forging, finishing.
	Wood processes	Cutting, drilling, turning, routering, laminating, spindle moulding, adhesive bonding, knock-down fittings, finishing.
	Identification of commercial processes	Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material, shear marks, cross-section over length, surface finish (texture/detail).
Society, environment and the world of work	**The impact of design and manufacturing technologies on society and the environment and the world of work**	Energy efficiency, sustainability, pollution, materials innovation, design for recyclability, design for re-use.

Component 2 — question paper

The purpose of the question paper is to assess the learner's ability to retain and integrate knowledge and understanding from across the Course.

The question paper Component of Course assessment will require learners to draw upon and apply knowledge and understanding of a sample from the topic areas listed below.

Design topic areas (question paper)		
Members of a design team		Designers, market researchers, accountants, engineers, manufacturers, lawyers, materials technologists, production specialists, marketing teams, ergonomists, consumers, retailers economists, sub-contractor. Relationships between team members and types of teams.
Design process	**Brief**	Purpose, statement of problem, target market. Open brief, closed brief. Design brief analysis.
	Research	Sources of recorded and non-recorded information, methods of gathering information. Analysis, application and presentation of researched material.
	Specification	Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification.
	Idea generation	Morphological analysis, thought showers, technology transfer, analogy, and lateral thinking. Application of idea generation techniques. Mood and lifestyle boards.

	Evaluation	Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, and comparison to specification. Application of evaluation techniques, presentation of results.
Design factors	**Function**	Primary and secondary functions, fitness for purpose, safety in use.
	Performance	Design for re-use, for recycling, planned obsolescence, value for money, ease of maintenance, environmental aspects.
	Market	Consumer demands, end user, social expectations, niche marketing, branding, introduction of new products, economics, product life cycle, needs, wants, technology push, market pull.
	Aesthetics	Factors influencing aesthetics (line, shape, form, colour, proportion, contrast, pattern, texture, harmony, balance), influences of fashion, market trends, style.
	Ergonomics	Anthropometrics, psychology, physiology.
Communication and modelling	**Graphic techniques**	The role of graphic techniques in communicating design ideas.
	Range of modelling techniques and materials	The role of modelling as it supports designing.

Materials and manufacturing: topic areas (question paper)

Learners should be able to demonstrate knowledge of materials and processes used in the commercial manufacture of products. They should be able to demonstrate knowledge of the characteristics of materials which make them suitable for producing particular products. They should be able to identify materials used in existing products and apply their knowledge of materials to the design of new products. It should be noted that learners may refer to materials outside of the list given providing the material has appropriate characteristics for the intended use.

Planning for manufacture	**Production and planning systems**	One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining (automation) and rapid prototyping.
Materials and processes	**Plastics(including composites)**	Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers including, where appropriate, labelling and symbols.
	Metals	Mild steel, carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, aluminium and aluminium alloys, copper, tin, lead, zinc.
	Woods	Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, Parana pine, spruce.
	Timber derivatives	Manufactured boards — fibreboards, plywood, block-board, chip-board, hard-board and veneer.
	Properties of materials	Justification of the selection of materials based upon their properties in the design, manufacturing and use of products.
	Plastic processes	Cutting, injection-moulding, extrusion, rotational moulding, vacuum-forming,

		blow-moulding, laminating, rapid prototyping. joining, compression moulding, calendering, casting, bending, fabrication, coating, forming, adhesive bonding, finishing.
	Metal processes	Cutting, turning, milling, die-casting, sand casting, lost wax casting, pressing, stamping, punching, extrusion, spot welding, arc welding, adhesive bonding, riveting, fitted joints, bolts, screws, piercing and blanking, drop forging, finishing.
	Wood processes	Cutting, drilling, turning, routering, laminating, spindle moulding, , adhesive bonding, knock-down fittings, finishing
	Identification of commercial processes	Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material, shear marks, cross-section over length, surface finish (texture/detail).
Society, environment and the world of work	**The impact of design and manufacturing technologies on society and the environment and the world of work**	Energy efficiency, sustainability, pollution, materials innovation, design for recyclability, design for re-use, employment patterns, consumer choices and new or different skills required.

SECTION 1 - 25 Marks

Attempt all questions.

1.

Chair A

Chair A—Ergolife Stol

Made from solid birch and fabric.

Rolled up length: 400mm

Diameter: 100mm

Weight approx 1 kg

Retail price £29·99

Chair B

Chair B—Messenger Bag

Director's Chair

Less than 100 mm thick when folded.

Comes with telescoping legs and folding backrest.

Made from aluminium, plastic and nylon mesh seat.

Integrated cup holder and two pockets in the armrests.

Retail price £95

[Turn over]

1. (continued)

(*a*) Outline a product specification for the design of **one** of the chairs. **6**

(*b*) *Explain why the materials chosen for each of these products are suitable. You should make six valid points. You do not need to cover all materials but should cover both products in your answer.* *6*

(*c*) Name three appropriate mass manufacturing processes used in the production of these chairs and explain why they are suitable. You should cover both products in your answer. 6

(*d*) For both chairs describe the quality assurance issues that would affect: 4

(i) the manufacture;

(ii) the consumer.

(e) Describe the ergonomic issues associated with the use of **each** of these chairs. 3

Total for Section A (25)

[Turn over]

2. The teeth in the blade of the cheese grater shown have been manufactured using the process of piercing and blanking.

(a) **Explain** why piercing and blanking is a suitable process for this type of product. 2

(*b*) **State** the name of a suitable metal for the manufacture of this product **and** justify why it is appropriate. **3**

(5)

3. Modelling is an important part of the design process.

For each of the modelling types below, describe the information that would be gathered from their use.

The three modelling types are:

- **Scale models** **2**
- **Test models** **2**
- **Prototypes**. 2

(6)

[Turn over]

4. A designer has been asked to produce concepts for a new style of domestic kettle.

Specification

Stainless steel body

Programmable timers

Protective thermal security system stops over-heating

Save up to 25% more energy

Display integrated in the handle

Electronic temperature control

Bugatti Vera Electric Kettle—£189·95

The kettle shown above has been designed for a niche market.

(*a*) With reference to the kettle explain the term "**niche market**". 2

Another selling point is that the kettle could be recycled easily.

(*b*) Describe the steps the designer could take to make the kettle easier to recycle at the end of its working life. 2

The kettle could be manufactured using batch production techniques.

(*c*) Describe the considerations the manufacturer would need to make before deciding upon this production system. 2

(6)

[Turn over]

5. The carcass of the kitchen cabinet shown below has been constructed using manufactured boards and knock down fittings.

(*a*) Explain the benefits to the **manufacturer** of using knock down fittings instead of traditional joining methods. 2

The door of the kitchen cabinet is manufactured using solid timber.

(*b*) Explain the benefits to the **consumer** of using solid timber for the cabinet doors. 2

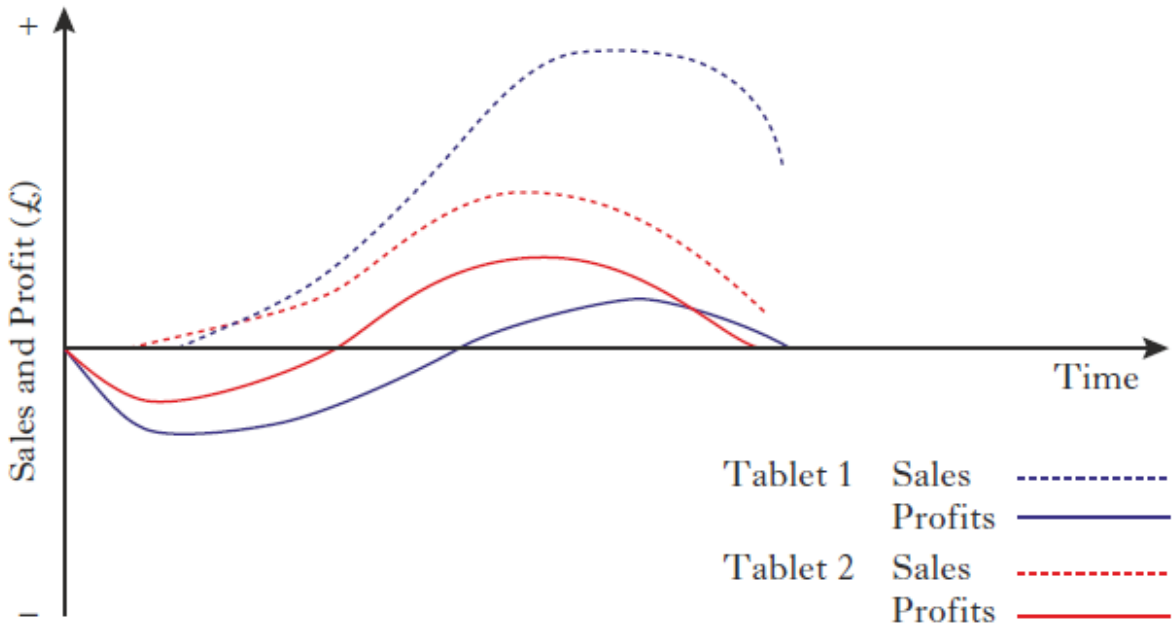
(*c*) Describe the obsolescence issues associated with modern fitted kitchens. 2

(6)

[Turn over]

6. The graph shown below has been used to predict and compare how well **two** new graphics tablets will sell.

Product Life Cycle
(Sales and Profit)



(*a*) Describe what steps a manufacturer could take to reduce the time required to introduce a product onto the market. 2

(*b*) From the graph above state which of the two graphics tablets would be commercially viable and explain your reasons for this choice. 3

(*c*) Describe how a company could extend the sales life of a product. 2

(7)

[Turn over]

7. An in-house designer has been asked by Bosch to produce a new product concept for their lawnmower range.

(*a*) **Explain** why the designer may prefer an " **open brief**" rather than a " **closed brief**" . 2

(*b*) **Describe** the information a designer would gain from an initial meeting with the client. 2

A designer leaves the company during the design of the product.

(*c*) **Describe** the " intellectual property rights" issues relating to the design of the product in this situation. 3

(*d*) **Describe two** methods that companies can use to protect intellectual property. 2

The rapid prototype model shown in Figure 1 has been produced for testing purposes.

(*e*) **State** the name of a suitable rapid prototyping process to address the key features to be tested for the product in Figure 1. 1

(10)

Figure 1

Key Features to be tested:

Form and fit testing

Durability and functional material testing

Environmental testing

High stress, heat and chemical resistance

8. The body of the adjustable spanner shown below is made by the process of drop forging.

(*a*) Explain why drop forging is a suitable process for producing the body of this adjustable spanner. 1

(*b*) Describe two visual features that would indicate that the product was made by drop forging. 2

(*c*) Identify a suitable material for the body of the spanner and give a reason for your choice. 2

(5)

[End of Question Paper]

SECTION 1 — 25 marks

Attempt ALL questions

1. Two cooling fans are shown below. Both have been designed for use in an office or domestic environment.

Bladeless Cooling Fan (remote controlled)

• Body Material—ABS
• Remote Material—ABS
• Variable speeds and oscillating operation
• Power—65 Watts (mains operated)
• Height—1 Metre
• Weight—3·2 kg
• Air Multiplier™ technology—amplifies surrounding air 16 times to generate an uninterrupted flow of smooth air
• Dimmer-switch airflow control—precisely adjusts airflow power, without the limited settings of conventional fans
• Remote airflow control—changes airflow power and oscillation mode

Retail price £299·99

Pedestal Cooling Fan

• Blades—Stainless Steel Sheet
• Blade Guard—Plastic Coated Mild Steel Mesh
• Body/Stem and Base—Chromed Mild Steel
• Gears/Fasteners—Nylon
• 3 speed settings and oscillating operation.
• Power—50 Watts (mains operated)
• Height—0·7 to 1·1 metre
• Weight—3·5 kg

Retail price £60·00

Question 1 (continued)

(a) Explain why the materials chosen for each of these products are suitable. You should make six valid points. You do not need to cover all materials but should cover both products in your answer. **6**

(b) Name three appropriate mass manufacturing processes used in the production of these cooling fans and explain why they are suitable. You should cover both products in your answer but may refer to different processes for each. **6**

(c) Describe the aesthetic appeal of each cooling fan. Your answer should cover four different aesthetic aspects. **4**

(d) Describe five functional issues that will have influenced the design of each of these products. **5**

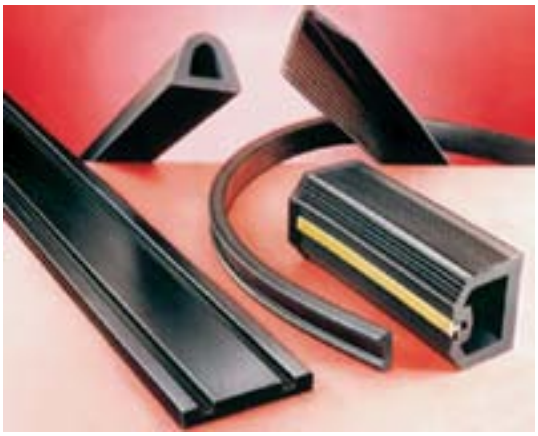
(e) Explain how any four production and planning systems can be used to improve production efficiency. **4**

(25)

SECTION 2 — 45 marks

Attempt ALL questions

2. A rubber composite material has been used in the production of the car park ramp shown below.



(a) Identify and justify the manufacturing process for products such as these. **2**

(b) Describe three advantages of using composite materials. **3**

(5)

3. The aluminium ladder shown below has been developed through technology transfer.

(a) Describe what is meant by technology transfer. **1**

(b) Explain why aluminium is a suitable material for the manufacture of this product. **2**

(c) Explain how safety has influenced the design of this product. **3**

(6)

4. The Airbus A380 passenger jet shown below was comprehensively tested and evaluated using scale models, computer simulations and prototypes before being allowed to carry passengers.

(a) Explain why scale models and computer simulations are used in the pre-production stages of design. **2**

(b) Some parts of the A380 can only be tested using a prototype.

(i) Explain what a prototype is. **1**

(ii) Explain **three** aspects of the A380 that could **only** be tested using prototypes. **3**

(iii) Describe how each of these aspects could be tested. **3**

(9)

5. Product design teams have a shared responsibility to design for sustainable development in order to protect the environment.

Explain how consideration for the environment has impacted on the design and manufacture of products with which you are familiar. **8**

6. Many home owners install decking in their gardens.

A softwood has been used in the manufacture of the spindles.

(a) Describe two issues related to the use of softwoods for this product. **2**

The spindles have been produced using a CNC lathe.

(b) Explain two benefits of using this process to produce the spindles. **2**

The spindles are manufactured in batches.

(c) Describe two issues for the manufacturer of using batch production for these components. **2**

(6)

6. The Baby Jogger City Mini Stroller shown below is an award winning buggy.

Ergonomics is a key issue that would be considered by the designer.

(a) With specific reference to physiological issues describe four aspects that would have been considered in the design of the buggy. **4**

The buggy is also produced in a twin version.

(b) Explain two ways that this version will benefit the consumer. **2**

(6)

7. The products shown below are protected by Intellectual Property Rights (IPR).

Describe how companies could use aspects of IPR to protect their products. **5**

SECTION 1 - 25 Marks
Attempt all questions.

1. Each of the lawnmowers shown below have been designed for a well known high street DIY retailer.

Electric Hover Mower

Blade— Mild Steel
Handle— Plastic coated Mild Steel
Body— Polypropylene
Gears/Fasteners— Nylon
Cable Length— 20 Metres

Weight— 4·2 kg

Retail price £29·99

Cylinder Mower (Manually Operated)

Blade— HSS (Tool Steel)
Handle— Foam Rubber coated Aluminium
Body— Mild Steel
Gears/Fasteners— Nylon
Wheels— Metal Alloy
Grass Catcher— Nylon with Polypropylene base

Weight— 7·3 kg

Retail price £119·50

Marks

1. (continued)

(*a*) Explain why the materials chosen for each of these products are suitable. You should make **six** valid points. You do not need to cover all materials but should cover both products in your answer. 6

(*b*) Name **three** appropriate mass manufacturing processes used in the production of these lawn mowers and explain why they are suitable. You should cover both products in your answer. 6

(*c*) Describe **five** ergonomic issues associated with **both** lawnmowers. 5

(*d*) Describe the appeal of **both** lawnmowers from the consumer's viewpoint. 4

(*e*) Describe how the design of **both** lawnmowers has been influenced by functional issues. 4

Total for Section A 25

[Turn over]

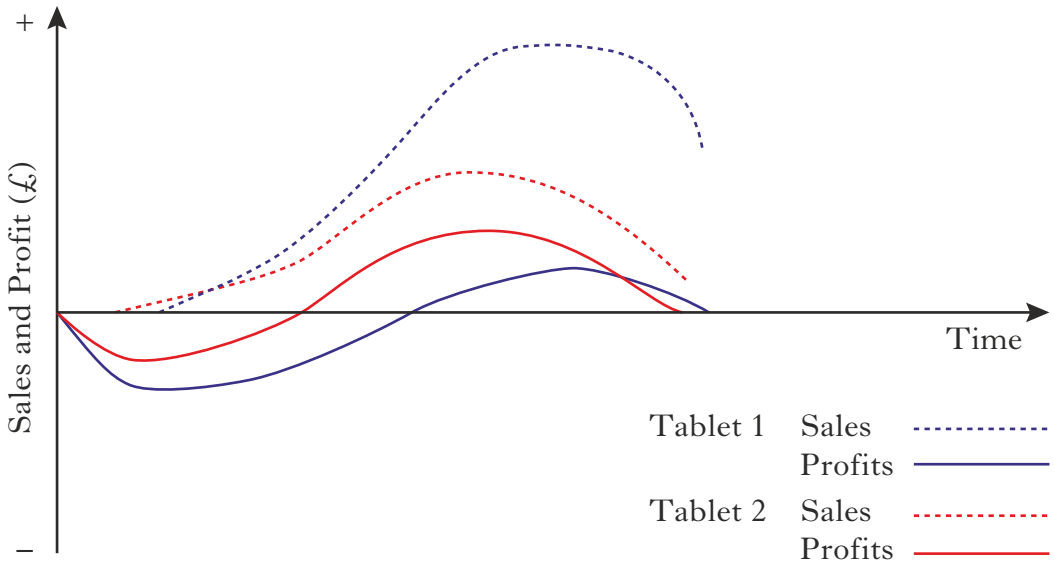
Section 2 - 45 marks

Attempt ALL questions

Marks

1. The graph shown below has been used to predict and compare how well **two** new graphics tablets will sell.

Product Life Cycle (Sales and Profit)



(*a*) Describe what steps a manufacturer could take to reduce the time required to introduce a product onto the market. **2**

(*b*) From the graph above state which of the two graphics tablets would be commercially viable and explain your reasons for this choice. **3**

(*c*) Describe how a company could extend the sales life of a product. **2**

(7)

[Turn over

MARKS

2. A bicycle is shown below.

Pinarello cycle

Detail of carbon-fibre seat post

A number of different prototypes were used during the development of the bicycle.

(a) Describe **three** ways in which prototypes could be used to gather specific information during the bicycle's development. **3**

Computer technologies were used during the development of the bicycle.

(b) Explain **two** benefits of using each of the following computer technologies in the development of the bicycle.

(i) CAD **2**

(ii) Rapid prototyping **2**

During the development of the bicycle the designer would have worked with a number of specialists within the design team.

(c) Describe **two** aspects of the role of each of the following specialists in the development of the bicycle.

(i) Market researcher **2**

(ii) Materials technologist **2**

Standard components were used in the manufacture of the bicycle.

(d) Describe **two** benefits of using standard components. **2**

The bicycle seat post was made from carbon-fibre which is a composite material.

(e) Describe **two** benefits of using composite materials. **2**

(15)

Marks

3. An in-house designer has been asked by Bosch to produce a new product concept for their lawnmower range.

(*a*) **Explain** why the designer may prefer an "**open brief**" rather than a "**closed brief**". **2**

(*b*) **Describe** the information a designer would gain from an initial meeting with the client. **2**

4. The Evac+Chair is used to transport a mobility impaired individual down stairs in a safe, smooth, and controlled way.

The consideration of ergonomic issues in the design of this product was vitally important.

With reference to the Evac+Chair, describe the ergonomic issues that may have been considered in terms of:

(*a*) Anthropometrics; **2**

(*b*) Physiology; **2**

(*c*) Psychology. **2**

5. Product design teams have a shared responsibility to design for sustainable development in order to protect the environment.

Explain how consideration for the environment has impacted on the design and manufacture of products with which you are familiar. **8**

End of Question Paper