Contents

Published by CGP

ISBN: 978 1 78294 754 7

www.cgpbooks.co.uk
Printed by Elanders Ltd, Newcastle upon Tyne.
Clipart from Corel®

Section One

Section One — Key Ideas in Design and Technology

Page 4 — Technology in Manufacturing

1 D ***[1 mark]***
2 a) Any two from: e.g. robots can increase the speed of production as they can work faster than humans and don't need to rest. / Robots work faster than humans so they can be cheaper to use than human workers. / Robots can increase the quality of manufacture as they work with high accuracy, whereas humans can make mistakes. / Robots can reduce costs as they work with high accuracy, whereas humans can make mistakes (which have costs, e.g. time and materials). / Robots can be used in dangerous situations where it would be unsafe for humans ***[2 marks]***.
b) E.g. they can't carry out tasks that require human judgement / can be very expensive to buy ***[1 mark]***.
3 B ***[1 mark]***
4 E.g. it reduces the amount of space needed for the storage of materials/finished products ***[1 mark]***. It means there's less money tied up in materials that aren't being used ***[1 mark]***.

Pages 5-6 — Production Systems — CAD/CAM

1 C ***[1 mark]***
2 B ***[1 mark]***
3 B ***[1 mark]***
4 C ***[1 mark]***
5 D ***[1 mark]***
6 E.g. layers of material are built up to create the shape of the product ***[1 mark]***.
7 a) E.g. it can be used to cut out shapes from a solid block of material ***[1 mark]***. It can be used to engrave objects ***[1 mark]***.
b) 2-axis machines only use x and y coordinates so they can only cut out 2D shapes ***[1 mark]***, whereas 3-axis machines use x, y and z coordinates so they can cut out 3D shapes ***[1 mark]***.
8 E.g. labour costs may be lower in Brazil ***[1 mark]***.

Pages 7-8 — Product Sustainability

Warm-up
non-finite, finite

1 Any two from: e.g. the materials the product is made from. / The processes used to make the product. / The design of the product ***[2 marks]***.
2 When products are designed to become obsolete/useless quickly ***[1 mark]***.
3 a) E.g. generally fossil fuels are burned to provide the energy for this transport ***[1 mark]*** and this releases carbon dioxide, which contributes to the product's carbon footprint ***[1 mark]***.
b) Any two from: e.g. when the raw materials the product is made from are transported to the factory. / When the product is distributed/transported to shops. / When the product is transported to the user. / When the product is taken to its final disposal location ***[2 marks]***.
4 a) E.g. if the power the product uses is generated by a method that causes carbon dioxide to be released, this contributes to the product's carbon footprint ***[1 mark]***.
b) The bigger a product's carbon footprint is, the larger its contribution to global warming ***[1 mark]***.
5 a) E.g. it means they can be reused rather than being disposed of, which might cause pollution ***[1 mark]***.
b) E.g. the envelopes will rot away naturally when disposed of but the bubble wrap will not ***[1 mark]***. This means that the bubble wrap will permanently take up space in landfill ***[1 mark]***.
c) E.g. the padded envelope can't be recycled as a whole ***[1 mark]***. The bubble wrap and paper need to be separated first, which can be difficult ***[1 mark]***.
6 E.g. making a new product durable ***[1 mark]*** and designing it so that parts can be maintained and repaired or replaced ***[1 mark]***.

Pages 9-10 — Product Sustainability and Social Issues

Warm-up
repair, re-use, recycle, rethink, reduce, refuse
1 B ***[1 mark]***
2 C ***[1 mark]***
3 a) Any two from: e.g. it can encourage consumers to replace their existing power tools with new ones, which can lead to older models being disposed of, which can cause pollution. / New, replacement power tools that are made have a carbon footprint. / New power tools being manufactured, packaged, transported and eventually disposed of can result in the increased usage of finite resources/environmental damage linked to the collection of resources ***[2 marks]***.
b) E.g. newer power tools are likely to have more efficient components than older power tools ***[1 mark]***. This means they may have lower carbon footprints ***[1 mark]***.
4 a) Re-use:
Disposable plastic razor: e.g. the design could be changed so the main body is reused and just the head with the blades is thrown away ***[1 mark]***. This would reduce the amount of energy and plastic being used ***[1 mark]***.
Stuffed toy: e.g. the stuffing could be made of material left-over from making other products ***[1 mark]***. Less new material would be used making it ***[1 mark]***.
b) Refuse:
Disposable plastic razor: e.g. the customer could refuse to buy a disposable product and buy a razor where just the blades change ***[1 mark]***. Fewer razors would be thrown away so it would reduce the amount of waste ***[1 mark]***.
Stuffed toy: e.g. the customer could refuse to buy a toy not made from non-finite resources, e.g. cotton ***[1 mark]***. Fewer finite resources would be used making the toy ***[1 mark]***.
c) Reduce:
Disposable plastic razor: e.g. the razor should be redesigned to use less material ***[1 mark]***. This would save resources and energy ***[1 mark]***.
Stuffed toy: e.g. less stuffing could be used in each toy ***[1 mark]***. Less material would be used, saving resources and energy ***[1 mark]***.
5 E.g. when plant materials are used to make the bioplastic more can be planted to replace them/plant material is a non-finite resource ***[1 mark]*** whereas, oil-based plastic is made from a finite resource ***[1 mark]***. / When the bioplastic toothbrush is disposed of at the end of its life it can breakdown fully ***[1 mark]*** rather than taking up space in landfill like an oil-based plastic toothbrush ***[1 mark]***.

Remember that finite resources can also be called non-renewable resources and non-finite resources can be called renewable resources. It's easy to confuse them, so double check you've written the one you meant to if you mention them in an answer to an exam question.

Pages 11-12 — Products in Society

1 A ***[1 mark]***
2 B ***[1 mark]***
3 D ***[1 mark]***
4 C ***[1 mark]***
5 Any two from: e.g. they could promote the range on social media. / They could promote the range via email. / They could get the range moved nearer the top of the page in search engine results ***[2 marks]***.
6 a) E.g. when new products are designed, or existing ones are improved, as a result of new technology or manufacturing techniques ***[1 mark]***.
b) i) E.g. the new model has a larger screen ***[1 mark]*** because technology has improved so larger screens can be used ***[1 mark]***. / The new model is thinner ***[1 mark]*** because screen and other computer technology has decreased in size to allow this thinness ***[1 mark]***. / The new model has a touchscreen instead of a keyboard ***[1 mark]*** because of advances in screen technology ***[1 mark]***.
ii) E.g. the new model has a larger screen ***[1 mark]*** because people want to be able to comfortably watch videos etc. on their smartphone ***[1 mark]***. / The new model is thinner ***[1 mark]*** because people want phones that are less bulky to carry around ***[1 mark]***.

Some of the differences between the phones could have been caused by technology push or market pull, as manufacturers continually redesign products in response to both of these things. So as long as you explain your reasoning, these differences can be valid answer for either part i) or ii).

7 a) E.g. elderly people / people with a disability ***[1 mark]***.
b) Large buttons: e.g. large buttons are easier to use for elderly people with less mobile hands / people with physical disabilities ***[1 mark]***.
High ringing volume: e.g. high volume is suited to elderly people / people with a hearing impairment that need the phone to ring loudly so they can hear it ***[1 mark]***.
Ability to make the on-screen text larger: e.g. being able to increase the size of text is suited to elderly people / people with a vision impairment who will find it easier to read larger text ***[1 mark]***.

Pages 13-14 — Powering Systems

Warm-up
Renewable: solar, tidal, wind, biomass, hydroelectricity
Non-renewable: coal, oil, gas, nuclear fuel
1 E.g. a non-renewable energy resource will one day run out ***[1 mark]*** but a renewable energy resource can be renewed as it is used ***[1 mark]***.
2 D ***[1 mark]***
3 C ***[1 mark]***
4 a) E.g. wind turbines can be noisy ***[1 mark]*** / wind turbines can spoil the landscape/look ugly ***[1 mark]***.
b) E.g. solar panels only produce electricity in the daytime whereas wind turbines can produce electricity through the night ***[1 mark]***.
5 Any two from: e.g. they're finite so will eventually run out. / Their extraction has negative social and environmental impacts. / They release greenhouse gases when they are burned, which causes lots of environmental problems ***[2 marks]***.
6 a) i) E.g. from 1995 to 2015, the production of electricity from renewable resources increased, from 0.2 to 1.6 TWh ***[1 mark]***.
ii) E.g. extracting and burning fossil fuels damages the environment. / Many people think it's better to learn to get by without non-renewables before they run out. / Improved efficiency in renewable power production mean renewables are becoming a more attractive option. / Governments have begun to introduce targets for using more renewable resources, and for cutting down on carbon dioxide emissions ***[1 mark]***.
b) i) 2015: 3.0 + 1.6 = 4.6 TWh
1995: 3.8 + 0.2 = 4.0 TWh
4.6 – 4.0 = 0.6 TWh
[2 marks for a correct answer, otherwise 1 mark for correctly calculating the electricity produced each year.]

To get the right data from the graph to use in these calculations, you need to make sure you've worked out the scale of the y-axis (the vertical axis). In this question each square on the y-axis is equal to 0.1 TWh because there are 10 squares for every 1.0 TWh (1.0 ÷ 10 = 0.1). For example, this means that six squares up from 1.0 is equal to 1.6 TWh.

ii) E.g. the population may have increased / the number of electronic devices that people own/use may have increased ***[1 mark]***.

Section Two — An Introduction to Materials and Systems

Page 15 — Properties of Materials

Warm-up
Toughness — The ability of a material to change shape instead of breaking or snapping.
Hardness — The ability to withstand scratching, abrasion or denting.
Density — A measure of the mass per unit volume of a material.
1 C ***[1 mark]***
2 B ***[1 mark]***

Electrical wires need to be good electrical conductors, so electricity can flow through them easily.

3 a) E.g. it's the ability of a material to let heat travel through it ***[1 mark]***.
b) Any two from: e.g. they have high melting points/low fusibility / they are malleable ***[2 marks]***

Pages 16-17 — Paper, Board and Timber

Warm-up
Softwood — pine, larch, spruce
Hardwood — oak, mahogany, beech, balsa, ash

Section Two

Contents

Published by CGP

ISBN: 978 1 78294 754 7

www.cgpbooks.co.uk
Printed by Elanders Ltd, Newcastle upon Tyne.
Clipart from Corel®

Section One

Section One — Key Ideas in Design and Technology

Page 4 — Technology in Manufacturing

1 D *[1 mark]*
2 a) Any two from: e.g. robots can increase the speed of production as they can work faster than humans and don't need to rest. / Robots work faster than humans so they can be cheaper to use than human workers. / Robots can increase the quality of manufacture as they work with high accuracy, whereas humans can make mistakes. / Robots can reduce costs as they work with high accuracy, whereas humans can make mistakes (which have costs, e.g. time and materials). / Robots can be used in dangerous situations where it would be unsafe for humans *[2 marks]*.
b) E.g. they can't carry out tasks that require human judgement / can be very expensive to buy *[1 mark]*.
3 B *[1 mark]*
4 E.g. it reduces the amount of space needed for the storage of materials/finished products *[1 mark]*. It means there's less money tied up in materials that aren't being used *[1 mark]*.

Pages 5-6 — Production Systems — CAD/CAM

1 C *[1 mark]*
2 B *[1 mark]*
3 B *[1 mark]*
4 C *[1 mark]*
5 D *[1 mark]*
6 E.g. layers of material are built up to create the shape of the product *[1 mark]*.
7 a) E.g. it can be used to cut out shapes from a solid block of material *[1 mark]*. It can be used to engrave objects *[1 mark]*.
b) 2-axis machines only use x and y coordinates so they can only cut out 2D shapes *[1 mark]*, whereas 3-axis machines use x, y and z coordinates so they can cut out 3D shapes *[1 mark]*.
8 E.g. labour costs may be lower in Brazil *[1 mark]*.

Pages 7-8 — Product Sustainability

Warm-up
non-finite, finite
1 Any two from: e.g. the materials the product is made from. / The processes used to make the product. / The design of the product *[2 marks]*.
2 When products are designed to become obsolete/useless quickly *[1 mark]*.
3 a) E.g. generally fossil fuels are burned to provide the energy for this transport *[1 mark]* and this releases carbon dioxide, which contributes to the product's carbon footprint *[1 mark]*.
b) Any two from: e.g. when the raw materials the product is made from are transported to the factory. / When the product is distributed/transported to shops. / When the product is transported to the user. / When the product is taken to its final disposal location *[2 marks]*.
4 a) E.g. if the power the product uses is generated by a method that causes carbon dioxide to be released, this contributes to the product's carbon footprint *[1 mark]*.
b) The bigger a product's carbon footprint is, the larger its contribution to global warming *[1 mark]*.
5 a) E.g. it means they can be reused rather than being disposed of, which might cause pollution *[1 mark]*.
b) E.g. the envelopes will rot away naturally when disposed of but the bubble wrap will not *[1 mark]*. This means that the bubble wrap will permanently take up space in landfill *[1 mark]*.
c) E.g. the padded envelope can't be recycled as a whole *[1 mark]*. The bubble wrap and paper need to be separated first, which can be difficult *[1 mark]*.
6 E.g. making a new product durable *[1 mark]* and designing it so that parts can be maintained and repaired or replaced *[1 mark]*.

Pages 9-10 — Product Sustainability and Social Issues

Warm-up
repair, re-use, recycle, rethink, reduce, refuse
1 B *[1 mark]*
2 C *[1 mark]*
3 a) Any two from: e.g. it can encourage consumers to replace their existing power tools with new ones, which can lead to older models being disposed of, which can cause pollution. / New, replacement power tools that are made have a carbon footprint. / New power tools being manufactured, packaged, transported and eventually disposed of can result in the increased usage of finite resources/environmental damage linked to the collection of resources *[2 marks]*.
b) E.g. newer power tools are likely to have more efficient components than older power tools *[1 mark]*. This means they may have lower carbon footprints *[1 mark]*.
4 a) Re-use:
Disposable plastic razor: e.g. the design could be changed so the main body is reused and just the head with the blades is thrown away *[1 mark]*. This would reduce the amount of energy and plastic being used *[1 mark]*.
Stuffed toy: e.g. the stuffing could be made of material left-over from making other products *[1 mark]*. Less new material would be used making it *[1 mark]*.
b) Refuse:
Disposable plastic razor: e.g. the customer could refuse to buy a disposable product and buy a razor where just the blades change *[1 mark]*. Fewer razors would be thrown away so it would reduce the amount of waste *[1 mark]*.
Stuffed toy: e.g. the customer could refuse to buy a toy not made from non-finite resources, e.g. cotton *[1 mark]*. Fewer finite resources would be used making the toy *[1 mark]*.
c) Reduce:
Disposable plastic razor: e.g. the razor should be redesigned to use less material *[1 mark]*. This would save resources and energy *[1 mark]*.
Stuffed toy: e.g. less stuffing could be used in each toy *[1 mark]*. Less material would be used, saving resources and energy *[1 mark]*.
5 E.g. when plant materials are used to make the bioplastic more can be planted to replace them/plant material is a non-finite resource *[1 mark]* whereas, oil-based plastic is made from a finite resource *[1 mark]*. / When the bioplastic toothbrush is disposed of at the end of its life it can breakdown fully *[1 mark]* rather than taking up space in landfill like an oil-based plastic toothbrush *[1 mark]*.

Remember that finite resources can also be called non-renewable resources and non-finite resources can be called renewable resources. It's easy to confuse them, so double check you've written the one you meant to if you mention them in an answer to an exam question.

Pages 11-12 — Products in Society

1 A *[1 mark]*
2 B *[1 mark]*
3 D *[1 mark]*
4 C *[1 mark]*
5 Any two from: e.g. they could promote the range on social media. / They could promote the range via email. / They could get the range moved nearer the top of the page in search engine results *[2 marks]*.
6 a) E.g. when new products are designed, or existing ones are improved, as a result of new technology or manufacturing techniques *[1 mark]*.
b) i) E.g. the new model has a larger screen *[1 mark]* because technology has improved so larger screens can be used *[1 mark]*. / The new model is thinner *[1 mark]* because screen and other computer technology has decreased in size to allow this thinness *[1 mark]*. / The new model has a touchscreen instead of a keyboard *[1 mark]* because of advances in screen technology *[1 mark]*.
ii) E.g. the new model has a larger screen *[1 mark]* because people want to be able to comfortably watch videos etc. on their smartphone *[1 mark]*. / The new model is thinner *[1 mark]* because people want phones that are less bulky to carry around *[1 mark]*.

Some of the differences between the phones could have been caused by technology push or market pull, as manufacturers continually redesign products in response to both of these things. So as long as you explain your reasoning, these differences can be valid answer for either part i) or ii).

7 a) E.g. elderly people / people with a disability *[1 mark]*.
b) Large buttons: e.g. large buttons are easier to use for elderly people with less mobile hands / people with physical disabilities *[1 mark]*.
High ringing volume: e.g. high volume is suited to elderly people / people with a hearing impairment that need the phone to ring loudly so they can hear it *[1 mark]*.
Ability to make the on-screen text larger: e.g. being able to increase the size of text is suited to elderly people / people with a vision impairment who will find it easier to read larger text *[1 mark]*.

Pages 13-14 — Powering Systems

Warm-up
Renewable: solar, tidal, wind, biomass, hydroelectricity
Non-renewable: coal, oil, gas, nuclear fuel
1 E.g. a non-renewable energy resource will one day run out *[1 mark]* but a renewable energy resource can be renewed as it is used *[1 mark]*.
2 D *[1 mark]*
3 C *[1 mark]*
4 a) E.g. wind turbines can be noisy *[1 mark]* / wind turbines can spoil the landscape/look ugly *[1 mark]*.
b) E.g. solar panels only produce electricity in the daytime whereas wind turbines can produce electricity through the night *[1 mark]*.
5 Any two from: e.g. they're finite so will eventually run out. / Their extraction has negative social and environmental impacts. / They release greenhouse gases when they are burned, which causes lots of environmental problems *[2 marks]*.
6 a) i) E.g. from 1995 to 2015, the production of electricity from renewable resources increased, from 0.2 to 1.6 TWh *[1 mark]*.
ii) E.g. extracting and burning fossil fuels damages the environment. / Many people think it's better to learn to get by without non-renewables before they run out. / Improved efficiency in renewable power production mean renewables are becoming a more attractive option. / Governments have begun to introduce targets for using more renewable resources, and for cutting down on carbon dioxide emissions *[1 mark]*.
b) i) 2015: 3.0 + 1.6 = 4.6 TWh
1995: 3.8 + 0.2 = 4.0 TWh
4.6 – 4.0 = 0.6 TWh
[2 marks for a correct answer, otherwise 1 mark for correctly calculating the electricity produced each year.]

To get the right data from the graph to use in these calculations, you need to make sure you've worked out the scale of the y-axis (the vertical axis). In this question each square on the y-axis is equal to 0.1 TWh because there are 10 squares for every 1.0 TWh (1.0 ÷ 10 = 0.1). For example, this means that six squares up from 1.0 is equal to 1.6 TWh.

ii) E.g. the population may have increased / the number of electronic devices that people own/use may have increased *[1 mark]*.

Section Two — An Introduction to Materials and Systems

Page 15 — Properties of Materials

Warm-up
Toughness — The ability of a material to change shape instead of breaking or snapping.
Hardness — The ability to withstand scratching, abrasion or denting.
Density — A measure of the mass per unit volume of a material.
1 C *[1 mark]*
2 B *[1 mark]*

Electrical wires need to be good electrical conductors, so electricity can flow through them easily.

3 a) E.g. it's the ability of a material to let heat travel through it *[1 mark]*.
b) Any two from: e.g. they have high melting points/low fusibility / they are malleable *[2 marks]*

Pages 16-17 — Paper, Board and Timber

Warm-up
Softwood — pine, larch, spruce
Hardwood — oak, mahogany, beech, balsa, ash

Section Two

Section Two

1 D ***[1 mark]***
2 D ***[1 mark]***
3 Property: e.g. high strength-to-weight ratio / low density / soft ***[1 mark]***
Use: e.g. modelling ***[1 mark]***
4 Any two from: e.g. it has attractive grain markings / it finishes well / it is durable / it is tough / it is very strong ***[2 marks]***.
5 E.g. hardwood tends to be denser than softwood ***[1 mark]*** and hardwood tends to be harder than softwood ***[1 mark]***.
6 Use: e.g. decking / fence posts ***[1 mark]***
Property: e.g. hard / tough / durable / resistant to rot ***[1 mark]***
Resistance to rot is a useful property for wood that is used outside because it will be exposed to moisture.
7 B ***[1 mark]***
8 a) e.g. duplex board ***[1 mark]***
b) E.g. duplex board can have a different colour on each side (as shown in Figure 1) / has a smooth surface on one side, which allows the packaging to be printed on (as shown in Figure 1) ***[1 mark]***.

Pages 18-19 — Metals, Alloys and Polymers

1 B ***[1 mark]***
2 A ***[1 mark]***
3 E.g. it's ductile ***[1 mark]*** and a good electrical conductor ***[1 mark]***.
4 Any two from: e.g. strong / corrosion-resistant / malleable / looks good (has a nice colour) ***[2 marks]***
5 E.g. drilling materials at high speed generates heat ***[1 mark]***. High speed steel keeps its hardness when heated to high temperatures ***[1 mark]***.
If cutting implements such as drill bits are not as hard as the material that is being cut, the bit will be cut away instead.
6 B ***[1 mark]***
7 C ***[1 mark]***
6 B ***[1 mark]***
7 C ***[1 mark]***
Phenol-formaldehyde is very easily moulded into bottle caps, snooker balls, etc.
8 a) Plastic — e.g. high-density polyethylene / HDPE ***[1 mark]***.
Reason — e.g. it's stiff so will keep its shape / it's strong so it can carry things without breaking / it's lightweight so it is easy to carry things ***[1 mark]***.
b) Plastic — e.g. polyvinyl chloride / PVC ***[1 mark]***.
Reason — e.g. it's cheap so it can be used in mass production / it's durable so offers long-lasting protective packaging ***[1 mark]***.
c) Plastic — e.g. polyethylene terephthalate / PET ***[1 mark]***
Reason — e.g. it's light so is good for being carried around / it's strong so will withstand being knocked or squashed without breaking / it's tough so will bend a little rather than breaking ***[1 mark]***.

Pages 20-21 — Textiles

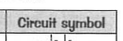
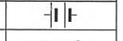
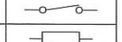
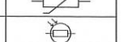
1 B ***[1 mark]***
2 A ***[1 mark]***
Sportswear is commonly made from synthetic fibres such as elastane, polyester and polyamide.
3 A ***[1 mark]***
4 E.g. natural fibres are easier to dye/more absorbent than synthetic fibres ***[1 mark]***. Natural fibres have less resistance to biological damage than synthetic fibres ***[1 mark]***.
5 D ***[1 mark]***
A 2-ply yarn is made up of two yarns twisted together.
6 Fibre: polyamide ***[1 mark]***
Property: e.g. strong / hard-wearing / warm / good elasticity / crease-resistant / resists biological damage / fairly cheap ***[1 mark]***
7 a) elastane ***[1 mark]***
b) Any three from: e.g. it's soft / extremely elastic / strong / hard-wearing / lightweight / keeps its shape well / resists sun / resists biological damage / non-absorbent / highly flammable / not biodegradable ***[3 marks]***.
c) E.g. sportswear / underwear ***[1 mark]***.
8 a) Any two from: e.g. warm / crease-resistant / can be lightweight / good elasticity ***[2 marks]***.
b) Any two from: e.g. it can shrink when washed / it can feel itchy / it can be fairly expensive / it dries slowly ***[2 marks]***.

Pages 22-23 — Textiles and Manufactured Boards

Warm-up
A: woven, B: non-woven, C: knitted
1 B ***[1 mark]***
2 E.g. webs of synthetic fibres ***[1 mark]*** that are either glued, needle-punched, stitched or melted together ***[1 mark]***.
3 Any two from: e.g. strong / hard-wearing / not very absorbent / soft / resistant to creasing / doesn't shrink easily / highly flammable ***[2 marks]***.
4 C ***[1 mark]***
The weft yarn travels from right to left across the weave, and the warp yarn travels up and down the weave.
5 B ***[1 mark]***
The layers of wood are arranged so that the grain directions are at 90° to the layers above and below.
6 A blended fabric is made from a yarn that is a combination of two or more different types of fibre ***[1 mark]***. A mixed fabric is made from two or more different types of yarn ***[1 mark]***.
7 a) chipboard ***[1 mark]***
b) e.g. self-assembly furniture ***[1 mark]***
8 E.g. it's cheap ***[1 mark]***, so it will save money for the charity ***[1 mark]***. / It has a smooth finish ***[1 mark]***, which is good for printing the logo on ***[1 mark]***.
9 Name: e.g. MDF ***[1 mark]***
Reasoning: E.g. it's a cheap material, so it's suitable for flat-pack furniture, which is generally sold cheaply ***[1 mark]***. It has a smooth uniform surface, so it can take paint well ***[1 mark]***.

Pages 24-26 — Electronic Systems

Warm-up

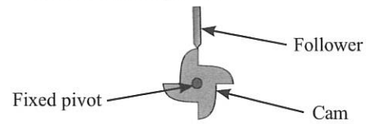
Component	Circuit symbol
Battery	
Switch	
Resistor	
Thermistor	
Light-dependent resistor (LDR)	
Buzzer	
Bulb	

1 A ***[1 mark]***
2 a) a buzzer ***[1 mark]***
b) e.g. a light-emitting diode / LED ***[1 mark]***
3 25 °C ***[1 mark]***
Reading off the graph, this is the temperature at which the resistance of the thermistor is 10 000 ohms.
4 B ***[1 mark]***
A voltage pushes an electrical current around a circuit.
5 C ***[1 mark]***
6 a) E.g. a microcontroller programmed as a timer could be used ***[1 mark]***. This device could be used to add a set time delay to the system, for example, from when the light is turned on until it is due to be turned off ***[1 mark]***.
b) Input device: e.g. light-dependent resistor (LDR) ***[1 mark]***
Reason: e.g. it senses changes in light levels, so could switch the circuit on when it gets dark enough ***[1 mark]***.
7 Any two from: e.g. using ICs simplifies the electronic system / systems with ICs are cheaper to make / systems with ICs are smaller / systems with ICs use much less power ***[2 marks]***.
8 C ***[1 mark]***
In NOT logic gates, if the input is on, the output will be off and if the input is off, the output is on.
9 a) an OR logic gate ***[1 mark]***
b) E.g. if one input or the other (or both) is on then the output is also on ***[1 mark]***.
10 B ***[1 mark]***
11 a) i) sensor ***[1 mark]***
ii) LCD display ***[1 mark]***
b) It counts pulses of voltage produced by an input device ***[1 mark]***.

Section Three

Pages 27-29 — Mechanical Systems

Warm-up



1 C ***[1 mark]***
The gear ratio can be written as "no. of teeth on driven gear : no. of teeth on driver gear" — 45 : 15 here. The ratio can be simplified to 3 : 1 by dividing both sides by 15.
2 a) bell crank ***[1 mark]***
b) It changes the direction of a force through 90° ***[1 mark]***.
3 a) first order lever ***[1 mark]***
b) E.g. it gives a mechanical advantage meaning the nail can be removed with a small effort ***[1 mark]***.
4 D ***[1 mark]***
5 D ***[1 mark]***
6 E.g. changing the size of the cam ***[1 mark]***. Changing the shape of the cam ***[1 mark]***.
7 a) idler gear ***[1 mark]***
b) Clockwise ***[1 mark]*** because the idler gear/gear A is turned anticlockwise ***[1 mark]***.
c) Slower ***[1 mark]*** because gear B is larger with more teeth than the driver gear ***[1 mark]***.
8 B ***[1 mark]***
9 C ***[1 mark]***
10 velocity ratio = 105 ÷ 35 = 3/1 / 3:1 / 3 ***[1 mark]***

Pages 30-31 — Development in New Materials

1 C ***[1 mark]***
2 A ***[1 mark]***
3 D ***[1 mark]***
4 a) Materials made of tiny particles/nanoparticles ***[1 mark]***.
b) E.g.
Carbon nanotubes ***[1 mark]*** are used in tennis racquets / electronics ***[1 mark]***.
Antibacterial fabrics ***[1 mark]*** are used in face masks / dressings / toys / odour-free socks ***[1 mark]***.
5 a) E.g. shape memory alloy/nitinol / photochromic pigments ***[1 mark]***.
b) E.g.
Shape memory alloy/nitinol:
If you deform products made from this, they can be returned to their original shape by heating ***[1 mark]***, so frames made from this can be easily fixed if they get accidentally bent out of shape ***[1 mark]***.
Photochromic pigment:
It can change colour when exposed to different levels of light ***[1 mark]***, so sunglasses with photochromic lenses can be designed to get darker in bright light, and clearer in low light ***[1 mark]***.
6 D ***[1 mark]***
7 a) A material formed by bonding two or more different materials together ***[1 mark]***.
b) Any two from: e.g. it is light / it is tough / it is strong ***[2 marks]***.
8 E.g. thermochromic pigments ***[1 mark]*** as these change colour in response to heat ***[1 mark]***.

Section Three — More about Materials

Pages 32-33 — Selecting Materials

Warm-up
False, True, False
1 a) A duty to act in a way that benefits society and the environment ***[1 mark]***.
b) E.g. they are often cheaper than socially responsible design choices ***[1 mark]***.
2 a) Any two from: e.g. the material needs to be strong enough to support the weight of items that will be put on it / it needs to be lightweight so the table is portable / it must be able to withstand outdoor conditions ***[2 marks]***.
b) Any two from: e.g. colour / surface finishes / texture ***[2 marks]***.
c) E.g. materials that are widely available are usually less expensive / quicker and easier to source ***[1 mark]***.
d) E.g. buying the materials in bulk allows the company to negotiate a discount with the supplier ***[1 mark]***. This means the table can be made for less money, so can be sold for a cheaper price ***[1 mark]***.
3 a) A material that is produced in an environmentally sustainable way ***[1 mark]*** that is also fair to workers ***[1 mark]***.
b) E.g. it has come from responsibly managed forests and/or verified recycled sources ***[1 mark]***.
c) i) Re-used metals are used again for the same purpose as they were originally made for ***[1 mark]***. Recycled metals are used again for a different purpose ***[1 mark]***.
ii) E.g. they would help to limit the amount of metal on rubbish tips ***[1 mark]*** and the amount of metal ore that would need to be mined to make the bed frames ***[1 mark]***.

Pages 34-35 — Forces and Stresses

1 a) torsion ***[1 mark]***
b) shear ***[1 mark]***
2 a) Extra layers of fabric that are stuck/sewn onto the inside of textiles products ***[1 mark]***.
b) Any two from: e.g. they add strength to the collar / they add rigidity to the collar / they improve the functionality of the collar / they improve the aesthetics of the collar ***[2 marks]***.
c) e.g. cuffs / pockets / button holes ***[1 mark]***
3 a) Force A: tension ***[1 mark]***
Force B: bending ***[1 mark]***
b) i) E.g. a woven fabric ***[1 mark]*** with a high tensile strength ***[1 mark]***.
ii) E.g. webbing has a high tensile strength, so it won't break easily when the straps are under tension/when the hammock is in use ***[1 mark]***.
4 a) It is laminated/layered ***[1 mark]***. The middle layer is made up of a series of bends ***[1 mark]***.
b) E.g. strength is important as it means the packaging is less likely to break under the weight ***[1 mark]***. Rigidity is important, because it allows the packaging to hold its shape better ***[1 mark]***.
c) It is less rigid ***[1 mark]***.

Pages 36-37 — Scales of Production

1 a) E.g. products are made to exactly meet their requirements ***[1 mark]***.
b) E.g. they are labour-intensive/can take a long time to make ***[1 mark]*** and often require highly skilled labour ***[1 mark]***.
2 a) Production that goes for 24 hours a day without stopping at any point ***[1 mark]***.
b) E.g. the process can be made very efficient / the cost per item is low ***[1 mark]***.
c) e.g. aluminium foil / chemicals ***[1 mark]***
3 a) Products that are identical to each other ***[1 mark]*** and that are for the mass-market/bought by lots of people ***[1 mark]***.
b) Any two from: e.g. by replacing the silk with a cheaper fabric / by using artificial pearls / by stitching the pearls on using a machine / by simplifying the pearl design ***[2 marks]***.
c) E.g. it may use expensive specialised equipment ***[1 mark]***.
4 a) Type of production: one-off production ***[1 mark]***
Desk — any two from: e.g. the desk might be made from expensive materials (e.g. solid wood, oak, mahogany or steel) / be hand-made by a skilful worker / have intricate decoration / be custom-made to fit a room/user.
Formal shoes — any two from: e.g. the shoes might be designed to be made of expensive materials (e.g. leather uppers and soles) / be hand-made by a skilful worker / be hand-stitched / be designed to fit a customer perfectly.
Earrings — any two from: e.g. the design might use expensive materials (e.g. gold, silver, diamond) / be quite intricate / be hand-made by a skilled worker.
[2 marks]

Section Three

b) Type of production: batch production ***[1 mark]***
Desk — any two from: e.g. they might be designed to be made from slightly cheaper materials (e.g. a hardwood veneer glued to manufactured boards) / have a simpler, standard design / designed to be made using jigs/templates/moulds / be made in a range of standard sizes/veneers/colours / use standard components / use simple decoration.
Formal shoes — any two from: e.g. they might be designed to be made from slightly cheaper materials (lower quality leather or plastic) / have a simpler, standard design / designed to be made using jigs/templates/moulds / be made in a range of standard sizes / use standard components.
Earrings — any two from: e.g. the earrings might have a simpler/less intricate design / designed to be made using jigs/templates/moulds / be made using cheaper materials (e.g. steel, glass, or plastic) / use standard components.
[2 marks]

c) Type of production: mass production ***[1 mark]***
Desk — any two from: e.g. they might be made from cheap materials (e.g. plastic laminate glued to manufactured board) / have designs with little or no detail / only be made in one standard size / be flat-packed/self-assembled / use CAD/CAM.
Formal shoes — any two from: e.g. they might be made from cheaper materials (plastic) / have designs with little or no detail/decoration / they will be made in standard sizes / use CAD/CAM.
Earrings — any two from: e.g. they might have a very simple design / be made using only cheaper materials (e.g. steel, plastic) / use CAD/CAM.
[2 marks]

5 a) Batch production ***[1 mark]*** — e.g. because the machines can be easily altered to produce the different types of bed frame ***[1 mark]***.

b) Mass production ***[1 mark]*** — e.g. because thousands of identical cars will be made / the cars can be made on a production line ***[1 mark]***.

Pages 38-39 — Quality Control

1 a) To check products have been made to a high enough standard ***[1 mark]*** and to make sure they meet the manufacturing specification ***[1 mark]***.

b) E.g. it would take too long to test every product/component that was manufactured ***[1 mark]***.

2 a) registration mark ***[1 mark]***

b) It's used to make sure the printing plates are aligned ***[1 mark]***.

3 a) Upper limit — 51 mm ***[1 mark]***
Lower limit — 49 mm ***[1 mark]***

b) go/no go fixture / limit gauge ***[1 mark]***

c) E.g. it is faster than having to measure the actual dimensions of a component ***[1 mark]***.

4 a) E.g. check the label has printed clearly / check that it has been cut to the right size / check that the colours have printed correctly ***[1 mark]***.

b) i) 27 mm ***[1 mark]***

25 mm plus the 2 mm of tolerance.

ii) E.g. that it is stuck on straight / that it is stuck on securely / that it is stuck on the right way up ***[1 mark]***.

c) The label is not within the required tolerance ***[1 mark]***, because the height should be between 47.5 mm and 52.5 mm (50 ± 2.5 mm) which it is not ***[1 mark]***.

5 a) E.g. a depth stop is a long rod that is clamped close to the drill bit ***[1 mark]***. Once the chosen depth has been reached, the depth stop comes into contact with the material and prevents the drill from going any deeper ***[1 mark]***.

b) E.g. the power settings ***[1 mark]*** and the feed rate ***[1 mark]***.

c) E.g. keeping the PCB exposure times to UV light/the developer solution/the etching solution constant ***[1 mark]***.

Pages 40-41 — Production Aids

1 a) A jig helps guide tools when working on a component / a jig makes sure that the workpiece is positioned in the right place ***[1 mark]***.

b) Any two from: e.g. it can reduce errors / it makes the pre-drilled holes consistent/identical for each different shelving unit / it saves time/effort ***[2 marks]***.

2 a) Sketch of a balloon or a candle shaped template ***[1 mark]***.

b) E.g. wood / plastic / metal ***[1 mark]*** because it is a strong and hard-wearing material ***[1 mark]***.

Paper or card would not be used to make the template because they would become worn or damaged if used repeatedly.

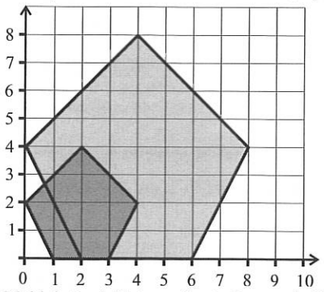
c) A template is drawn round with a pencil/cut round on a protective mat with a knife ***[1 mark]***.

3 a) The pattern is a template that is pinned to the fabric ***[1 mark]*** and cut round ***[1 mark]***. The cut pieces of fabric are then sewn together to make a textiles product ***[1 mark]***.

b) i) e.g. resin / wood / metal ***[1 mark]***

ii) E.g. casting patterns can be used many times ***[1 mark]*** and they make products that are a consistent shape ***[1 mark]***.

4



Multiply the initial coordinates by a scale factor of 2: (2,0), (6,0), (8,4), (4,8), (0,4).
[2 marks for correct drawing, otherwise 1 mark for correctly multiplying by a scale factor of 2]

You can check your answer using a ruler — each new coordinate should be twice as far from the datum as the corresponding old coordinate.

Pages 42-43 — Production of Materials

1 a) fractional distillation ***[1 mark]***

b) Some fractions need to be broken down into smaller molecules (cracked) before they can be polymerised ***[1 mark]***.

2 E.g. seasoned wood would be stronger than unseasoned wood ***[1 mark]***. Seasoned wood would be less likely to rot than unseasoned wood ***[1 mark]***.

3 a) A rock with enough metal locked up in it ***[1 mark]*** to make it profitable for the metal to be extracted from the rest of the ore ***[1 mark]***.

b) Process: heating the ore in a furnace ***[1 mark]***
Metal: e.g. iron / zinc / copper / tin ***[1 mark]***
Process: electrolysis ***[1 mark]***
Metal: e.g. aluminium / zinc ***[1 mark]***

c) To remove any remaining impurities ***[1 mark]***.

4 a) E.g. the wood chips are ground down ***[1 mark]*** to separate out the fibres ***[1 mark]*** / the wood chips are heated with chemicals ***[1 mark]***, which dissolves non-fibrous parts of the wood, leaving only the cellulose fibres behind ***[1 mark]***.

b) The pulp is washed and bleached to make it white ***[1 mark]***. Then it is pressed flat between rollers, dried and cut to size ***[1 mark]***.

c) other plants, e.g. grasses ***[1 mark]***

5 Name: plywood ***[1 mark]***
How to grade your answer:
[No marks] There is no relevant information.
[1 mark] There is a brief description of the process, but key stages are left out and the answer contains a number of errors. AND/OR there is a diagram but it lacks detail and clarity.
[2 marks] There is a description of the process, but some points are missing or there are some errors. AND/OR there is a diagram with some annotations, but it lacks detail or contains errors.
[3 marks] There is a detailed description of the process, with most stages in the correct order but the description may contain small errors or lack some clarity. AND/OR there is an annotated diagram, which is mainly correct but some points are missing.
[4 marks] There is a clear, accurate and detailed description of the process, including the key stages in the correct order. AND/OR there is an accurate and appropriately annotated diagram clearly showing the process.
Here are some points your answer may include:
The wood is softened through soaking it in hot water or steaming it.
A thin sheet is peeled from the softened wood.
The sheet is cut into a suitable size and dried.
The cut wood is arranged into stacks of three or more, with each layer having a grain direction 90° to the layers above and below.
Glue is added between each layer.
The sheets are heated and pressed.
(Relevant, labelled sketches with annotations showing these points should also be credited.)

Pages 44-45 — More on the Production of Materials

Warm-up
Wool — Sheep's fleece, Silk — The cocoon of a worm,
Nylon — Crude oil

1 Natural fibres — e.g. wool / cotton / silk ***[1 mark]***
Regenerated fibres — e.g. viscose fibres ***[1 mark]***
Synthetic fibres — e.g. polyester / LYCRA® / nylon ***[1 mark]***

2 a) i) Cutting down large areas of forest without planting new trees to replace the old ones ***[1 mark]***.

ii) E.g. deforestation destroys forest habitats ***[1 mark]***, which has a negative impact on the plants and animals that live there ***[1 mark]***.

b) E.g. mining uses a lot of energy from fossil fuels, which can cause air pollution/contribute to global warming / large areas of land are cleared for mining, which leads to the destruction of habitats / chemicals and waste rock can pollute nearby water, and harm wildlife ***[1 mark]***.

3 a) Cotton — cotton plant ***[1 mark]***
Polyester — crude oil ***[1 mark]***

b) i) E.g. farming for cotton fibres often uses artificial fertilisers/pesticides, which can pollute rivers and harm wildlife ***[1 mark]***. Land may need to be cleared for farming, which could involve deforestation/clearing of habitats ***[1 mark]***.

ii) Any two from: e.g. drilling for crude oil can result in toxic chemicals being released into the atmosphere / can result in waste material/oil leaks, which pollute the surrounding habitats / may require land to be cleared to make room for the drill site, which can destroy habitats ***[2 marks]***.

c) How to grade your answer:
[No marks] There is no relevant information.
[1 mark] There is a brief description of the process, but key stages are left out and the answer contains a number of errors. AND/OR there is a diagram but it lacks detail and clarity.
[2 marks] There is a description of the process, but some points are missing or there are some errors. AND/OR there is a diagram with some annotations, but it lacks detail or contains errors.
[3 marks] There is a detailed description of the process, with most stages in the correct order but the description may contain small errors or lack some clarity. AND/OR there is an annotated diagram, which is mainly correct but some points are missing.
[4 marks] There is a clear, accurate and detailed description of the process, including the key stages in the correct order. AND/OR there is an accurate and appropriately annotated diagram clearly showing the process.
Here are some points your answer may include:
Cotton:
The plants are treated with chemicals to make the leaves fall off.
The cotton fibres are then harvested.
The cotton fibres are cleaned to remove dirt.
The seeds are removed from the pods.
The fibres are then combed using wire rollers (carding).
The fibres are then spun into yarn.
Polyester:
Crude oil is fractionally distilled.
Certain fractions are polymerised to make a polymer (polyester).
The polymer is then melted and forced through tiny holes to form long filaments.
The filaments are left to cool, before being spun into yarn.
(Relevant, labelled sketches with annotations showing these points should also be credited.)

Section Four

Section Four — Paper and Board

Pages 46-47 — Properties of Paper and Board

Warm-up
false, false, true

1 a) Flyers and leaflets don't need to last for a long time ***[1 mark]***.

b) e.g. low-weight / biodegradable / unbleached ***[1 mark]***

2 a) i) A6 paper ***[1 mark]***

ii) A2 paper ***[1 mark]***

b) area = 1 ÷ 8 = 0.125 m² ***[1 mark]***

A3 paper is 8 times smaller than A0 so that's why you divide the area of an A0 sheet by 8.

3 a) Type of paper/board: e.g. board laminated with aluminium ***[1 mark]***
Reasons: e.g. it's airtight, so it keeps flavour in and air out. Advertising and nutritional information can be printed onto the paper. ***[Maximum 2 marks, 1 for each correct reason]***.

b) Type of paper/board: e.g. corrugated cardboard ***[1 mark]***
Reasons: e.g. it's strong, so can withstand the force of other boxes being stacked on top of it without bending. It's good at retaining heat, so keeps the pizza warm.
[Maximum 2 marks, 1 for each correct reason].

4 a) E.g. kraft paper — food packaging / greaseproof paper — baking ***[1 mark for type of paper, 1 for correct application]***.

b) Any two from: e.g. strength / brightness / colour ***[2 marks]***

5 How to grade your answer:
[No marks] There is no relevant information.
[1-2 marks] Brief consideration of the positive and negative aspects of each property with regards to packaging. Limited or no conclusion drawn. Points discussed may be limited to only positive OR negative aspects.
[3-4 marks] Positive AND negative aspects of each property discussed and supported with sensible explanation. Conclusion drawn after considering positive and negatives aspects of each property.
Here are some points your answer may include:
Rigidity:
Packaging needs to be rigid so that it keeps its shape and gives effective protection to what is inside.
Rigid packaging is more difficult to form, as it is hard to bend/fold it into a 3D shape (e.g. a cardboard box).
Strength:
Packaging needs to be strong so it can withstand a fair amount of force before bending and/or breaking.
Strong packaging is usually heavier/bulkier, which can increase transport costs.

Page 48 — Standard Components

Warm-up
staples, plastic comb, tabs, treasury tags, Velcro® pads, drawing pins

1 a) E.g. self-seal envelopes/peel and seal envelopes ***[1 mark]***.
The seal is difficult to break without tearing the envelope, so it's obvious if the letter has been tampered with ***[1 mark]***.

b) e.g. a treasury tag ***[1 mark]***

2 Using standard components saves time during manufacture / is more efficient ***[1 mark]***. Using standard components means that specialist machinery and extra materials aren't needed, which saves money ***[1 mark]***.