IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

Design Technology
Higher level and standard level

Specimen paper 1s, 2s and 3s

For first examinations in 2009

CONTENTS

IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

SPEC/4/DESTE/HPM/ENG/TZ0/XX

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 1

SPECIMEN PAPER

1 hour

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

16 pages

1. What type of model is the IB design cycle model?

A. Physical

B. Mathematical

C. Graphical

D. Flow chart

2. Which ideas-generating technique involves analysing a range of products in relation to their main features and then considering different ways of improving them to generate new ideas?

A. Morphological synthesis

B. Attribute listing

C. Brainstorming

D. Analogy

3. Which type of graphical communication uses the technique of foreshortening?

A. Isometric

B. Exploded isometric

C. Perspective

D. Orthographic

4. Why is the iPod pictured in Figure 1 an example of dominant design?

Figure 1: iPod

A. It is the best-selling music player in the market place

B. Its features are recognized as essential

C. It is the longest-selling music player

D. It is the outcome of incremental changes

5. How is the design cycle related to the product cycle?

A. The product cycle precedes the design cycle

B. The product cycle is the same as the design cycle

C. The design cycle precedes the product cycle

D. The designer is in control of both cycles

6. Which technique for joining components facilitates design for disassembly?

A. Using a thermoset adhesive

B. Using a thermoplastic adhesive

C. Welding

D. Riveting

7. What is **not** an advantage of design for manufacture (DfM) ?

A. Reduced manufacturing times

B. Fewer parts

C. Reduced costs for stocks of raw materials

D. Lower design costs

8. Which combination of "market" and "environmental impact" is most likely to make a product category a target for life cycle analysis?

	Market	**Environmental impact**
A.	Global	High
B.	Global	Low
C.	Local	High
D.	Local	Low

9. What would be the most appropriate timber to use for an outdoor picnic table?

A. Veneered hardwood

B. Particle board

C. Plywood

D. Treated pine

10. What factors are important in considering timber as a renewable resource?

I. Growth rates

II. Durability

III. Markets

A. I only

B. II only

C. III only

D. I, II and III

11. What is **one** result of the plastic deformation of metal?

A. Increased grain size

B. The metal is work hardened

C. The metal becomes more malleable

D. The metal becomes an alloy

12. Why is glass increasingly used as a structural material?

A. It has high electrical conductivity

B. It can resist high compressive forces

C. It is easy to recycle

D. It is cheap

13. Why are thermoplastics easier to recycle than thermosets?

A. Thermosets are too hard to break down for recycling

B. Thermoplastics are easier to transport to recycling depots

C. Thermoplastics have weak secondary bonds between adjacent polymer chains

D. Thermosets have weak secondary bonds between adjacent polymer chains

14. What material would **not** be joined by fusing?

A. Food

B. Plastic

C. Timber

D. Composites

15. In which of the following products would variable costs be more significant than fixed costs in determining the final price?

A. Extruded thermoplastic pipe

B. CNC-produced clothing

C. Craft-produced furniture

D. Injection-moulded tap washer

16. How would the bodies of the metal cooking pots shown in Figure 2 be produced?

Figure 2: Cooking pots

A. Casting

B. Machining

C. Extruding

D. Sintering

17. Which manufacturing system would least likely have been used to produce a car?

A. Mechanized production

B. Assembly line production

C. Craft production

D. Mass customization

18. Which combination of "material obsolescence" and "technological obsolescence" encourages reuse?

	Material obsolescence	Technological obsolescence
A.	Obsolete	Obsolete
B.	Not Obsolete	Not Obsolete
C.	Obsolete	Not Obsolete
D.	Not Obsolete	Obsolete

19. What would be the most relevant test criterion to evaluate by crash testing a car?

A. Material durability

B. Ease of use

C. Performance

D. Safety

20. Where is a consumer most likely to find the most reliable information comparing product performance?

A. Manufacturers' specifications

B. Reports of user trials

C. Media advertising

D. Consumer associations

21. Which sources of power characterize the use of power before and after the Industrial Revolution?

	Before	After
A.	Muscle	Steam
B.	Steam	Steam
C.	Muscle	Muscle
D.	Steam	Muscle

22. What is currently an advantage of using fossil fuels to generate energy?

A. Efficient conversion rates

B. Widespread availability

C. Inexhaustible supplies

D. Renewability

23. What would be the main problem preventing the increased use of solar power in an area that had 360 days of sunshine per year?

A. Set up costs

B. Continuity of supply

C. Maintenance costs

D. Running costs

24. Why are people encouraged to use mass transport systems for travelling in cities?

A. Ease of carrying goods

B. Increased security

C. They are cheaper

D. They are more environmentally sustainable

25. What ratio defines stiffness?

A. $\frac{\text{Load}}{\text{Effort}}$

B. $\frac{\text{Force}}{\text{Area}}$

C. $\frac{\text{Load}}{\text{Deflection}}$

D. $\frac{\text{Stress}}{\text{Strain}}$

26. What would be the factor of safety if a seat belt was designed with a design load of 54 kN when the normal maximum load is 18 kN?

A. 72

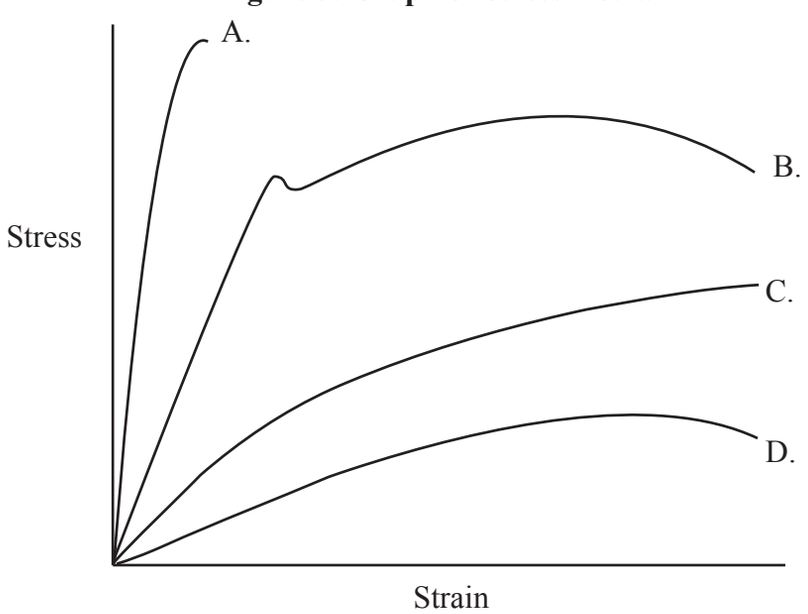
B. 36

C. 0.3

D. 3

27. Which line on the graph in Figure 3 best describes a brittle material?

Figure 3: Graph of Stress v Strain



28. Why is high tensile strength wire used in the fence in Figure 4?

Figure 4: High tensile strength wire

A. To reduce strain on the fence

B. So the wire doesn't break when force is applied

C. To maintain equilibrium with the compressive forces in the fence

D. Because the wire covers a large area

29. What is the velocity ratio for a wheelbarrow if it has to be lifted 300 mm for the load to rise 200 mm?

A. 1.5

B. 2/3

C. 0.5

D. 1:5

30. What is an advantage of a belt drive over a chain drive system?

A. There is less slippage

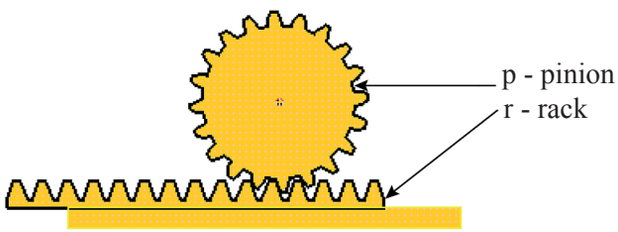
B. It adjusts readily to changes in load

C. It can carry a heavier load

D. It has a longer product life

31. What conversion of motion is done by the pinion-driven mechanism below?

Figure 5: Pinion driven mechanism



A. Linear to intermittent

B. Rotary to linear

C. Rotary to reciprocating

D. Linear to rotary

32. Which material can be joined by hot air welding?

A. Ceramics

B. Glass

C. Soft metal alloy

D. Plastic

33. What differentiates rotational moulding from blow moulding?

A. The use of heat

B. The use of air pressure

C. Quality of the surface finish on products

D. Hollow shapes are produced

34. What differentiates high pressure die casting from normal die casting?

A. Good surface finish

B. Metal moulds

C. High speed production

D. Use of a hydraulic press

35. Which product is most likely to be manufactured using a hand lay-up fibreglass process?

A. Canoe

B. Swimming pool

C. Fishing rod

D. A car body

Questions 36-40 relate to the following case study. Please read the case study carefully and answer the questions.

CASE STUDY

Passive solar design is widely used to reduce energy costs and make buildings more comfortable. In some countries heating is the primary concern, in others cooling is more of a problem. A designer working on a single-storey house located at 56°N has done an Internet search and found that the angle of the sun at midday in midsummer is 58° and in midwinter is 11°. She has drawn **Figure 6** to help calculate the width of the roof overhang required to shade the house in summer. In the winter the window should not be shaded by other buildings or trees from 9 am to 3 pm each day to allow the sun to shine into the house. Sunlight hits the floor and is absorbed as heat. The heat is stored by the thermal mass below the floor during the day and released as it cools in the evening. Thus the thermal mass moderates the effects of high daytime temperatures. Distribution of the solar heat through the building is by natural heat transfer (conduction, convection, and radiation). **Figure 7** shows a plan of the building in its grounds. The designer needs to select landscaping plants for locations P, Q, R and S.

	U value (W/m^2K)
Glazed wall	0.29
Brick wall	0.10

Figure 6: Cross-section through building to show south-facing window and roof overhang

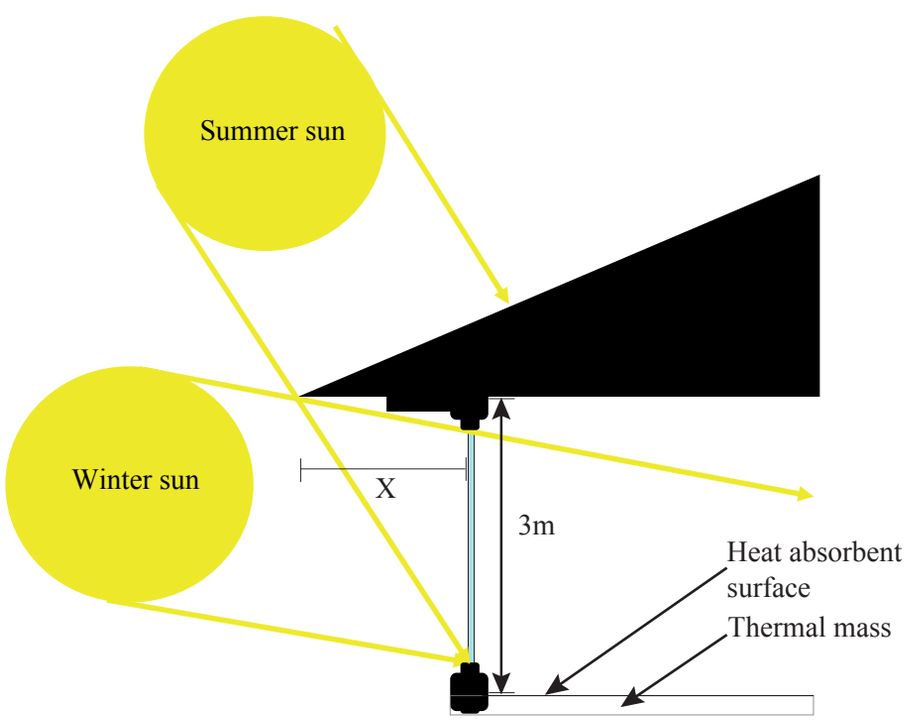
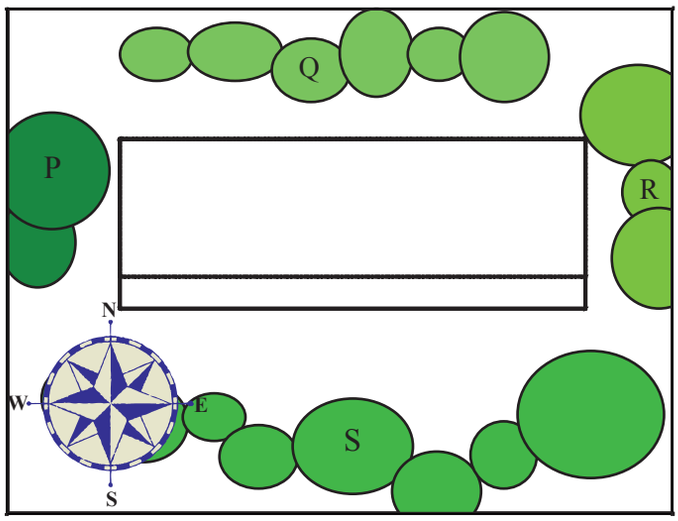


Figure 7: Plan of the building in its grounds



36. What contribution does the building envelope make to the house?

I. It balances requirements for ventilation and daylight.

II. It provides thermal protection appropriate to the prevailing climate.

III. It provides moisture protection.

A. I and II

B. II and III

C. I and III

D. I, II and III

37. Which equation represents dimension X of the roof overhang?

A. Tangent 32 = X/3 metres

B. Tangent 79 = X/3 metres

C. Tangent 58 = X/3 metres

D. Tangent 11 = 3/X metres

38. Which recommendations would enhance the passive solar design of the house?

I. Elongate the east-west axis of the house

II. Locate the bedrooms on the south-facing side of the house

III. Locate the lounge, kitchen and dining areas on the south-facing side of the house

A. I and III

B. II and III

C. I and II

D. I, II and III

39. Which combination of evergreen and deciduous trees would best contribute to the passive solar design of the house?

	P	**Q**	**R**	**S**
A.	Evergreen	Evergreen	Evergreen	Deciduous
B.	Evergreen	Evergreen	Deciduous	Deciduous
C.	Deciduous	Deciduous	Evergreen	Evergreen
D.	Deciduous	Deciduous	Deciduous	Evergreen

40. What is true if the south-facing wall of the house is partially glazed rather than fully glazed?

A. Reduced energy consumption for lighting

B. Reduced cooling required to counter waste heat produced by lighting

C. The need for electrical light sources during the day is removed

D. The heat flow through the south-facing wall is increased

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MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Higher Level

Paper 1

2 pages

1.	C	16.	A	31.	B	46.	–
2.	B	17.	C	32.	D	47.	–
3.	C	18.	D	33.	B	48.	–
4.	B	19.	D	34.	D	49.	–
5.	C	20.	B	35.	A	50.	–
6.	B	21.	A	36.	D	51.	–
7.	D	22.	B	37.	A	52.	–
8.	A	23.	A	38.	C	53.	–
9.	D	24.	D	39.	A	54.	–
10.	A	25.	C	40.	B	55.	–
11.	B	26.	D	41.	–	56.	–
12.	B	27.	A	42.	–	57.	–
13.	C	28.	B	43.	–	58.	–
14.	C	29.	A	44.	–	59.	–
15.	C	30.	B	45.	–	60.	–

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PROGRAMA DEL DIPLOMA DEL BI

SPEC/4/DESTE/HP2/ENG/TZ0/XX

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

SPECIMEN PAPER

1 hour 45 minutes

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

SECTION A

*Answer **all** the questions in the spaces provided.*

1. **Figure 1** shows the Playstation 3 games console manufactured by Sony and launched onto the market in the USA and Japan in November 2006. It will eventually be available in the global marketplace. The Playstation incorporates Blu-ray technology which allows the console to also be used to play high definition DVDs. **Figure 2** shows a table of suppliers of components for the Playstation by country. **Figure 3** shows a table of recommended retail prices (prices that the Playstation should be sold at) by geographical region.

Figure 1: Sony Playstation 3 games console and handset

Figure 2: % of component development by country

	Central Processing Unit	Graphics Processing Unit	Controller	Casing
Australia	0.5	0.5		
Canada	0.5	0.5		
Germany	0.5			
Great Britain		2.2		
Japan	46.9	69.3	50	73.4
Korea		0.5		
Mexico		0.9		
New Zealand	1.2	1.3		
USA	46.5	16.7	25	10
Patent Offices	3.9	8.1	25	16.6

(This question continues on the following page)

(Question 1 continued)

(a) (i) State the country with the largest percentage component development. *[1]*

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(ii) Outline **one** possible reason why the USA is the country with the second largest percentage component development. *[2]*

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(b) (i) State the product life cycle stage for the Playstation 3. *[1]*

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(ii) Explain **one** reason why there is pressure on manufacturing companies to extend a product's life cycle. *[3]*

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(c) (i) Outline why success in the USA and Japanese markets would **not** mean that the Playstation 3 has diffused into the marketplace. *[2]*

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(ii) Explain **one** reason why the Playstation 3 was launched first in the USA and Japan and not in other countries where the previous version sold well. *[3]*

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(Question 1 continued)

Figure 3: Table of recommended retail prices by region

RRP by region				
Region	**Expected Pricing at Release**			
	Basic		**Premium**	
	Local	**US $**	**Local**	**US $**
Japan	JP¥49,980	$420	JP¥59,980	$510
United States	US$499		US$599	
Canada	C$549	$480	C$659	$580
Hong Kong	HKD$3,180	$410	HKD$3,780	$490
Taiwan	NT$14,980	$450	NT$17,980	$540
United Kingdom	TBC		GB£425	$680
Eurozone (excluding Finland)	€499	$550	€599	$660
Denmark	4295 DKK	$720	5495 DKK	$930
Finland	€550	$710	€650	$840
Norway	TBC		5000 NOK	$750
Sweden	TBC		5999 SEK	$650
Switzerland	CHF 749	$550	CHF 899	$660

(d) Discuss the concept of value for money in relation to the data in Figure 3. *[3]*

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(This question continues on the following page)

(Question 1 continued)

(e) (i) Outline **one** reason why the cost of the Playstation 3 varies so much between countries. *[2]*

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(ii) Discuss market sector and market segmentation in relation to the data in Figure 3. *[3]*

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2. Describe electro-rheostatic material. *[2]*

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3. Discuss the influence of perception when collecting ergonomic data. *[3]*

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4. (a) List **two** renewable energy sources. *[2]*

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(b) Discuss **one** limitation of the use of renewable energy resources as alternatives to fossil fuels. *[3]*

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5. (a) Draw an isometric view of an I-shaped beam. *[2]*

(b) Explain how the shape of an I-shaped beam makes effective and economic use of materials. *[3]*

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6. (a) List **two** types of plastic weld. *[2]*

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(b) Explain how permanent joining techniques lead to planned obsolescence. *[3]*

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SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

7. **Figure 4** shows a reclining chair made from a metal frame with a polyurethane foam mattress covered in pieces of leather material which are stitched together. The reclining chair can be adjusted to full or semi-reclined position and the base frame can be reversed to form a rocking chair as shown in the inset picture. The chair is flat packed for home assembly.

Figure 4: Reversible reclining chair

(a) (i) Describe the structure and bonding of a thermoset plastic. *[2]*

(ii) Outline **one** property of polyurethane which makes it a suitable choice for the mattress. *[2]*

(b) Explain the importance of ductility to the manufacture of the metal frame. *[3]*

(c) State the type of mechanical motion employed when the chair is used as a rocker. *[1]*

(d) (i) State an alternative manufacturing technique which could be used to join the leather material together. *[1]*

(ii) Outline **one** advantage of using the technique stated in question 7 (d) (i). *[2]*

(e) Discuss the advantages of flat pack furniture from the point of view of the designer, manufacturer and consumer. *[9]*

8. **Figure 5** shows a CAD model of a concept design for a new passenger aircraft. By changing the body shape and using lightweight materials it is projected that the "blended wing plane" would consume 32% less fuel per passenger mile than conventional planes helping the European airline industry achieve its target of 50% reduction in emissions per passenger kilometer by the year 2020. Cleaner, more efficient engines should be able to produce 20% reduction in emissions by 2020.

Figure 5: CAD model for the blended wing plane

(a) (i) State the most likely scale of production for the "blended wing plane". *[1]*

(ii) Explain why the scale of production stated in question 8 (a) (i) is suitable. *[3]*

(This question continues on the following page)

(Question 8 continued)

(b) (i) Describe the relevance of Young's Modulus to the selection of a suitable material for the body of the aircraft. *[2]*

(ii) Explain why the use of composites would be appropriate for the required lightweight materials for the body of the plane. *[3]*

(c) Outline **one** reason why the aircraft would be designed with a low factor of safety. *[2]*

(d) Explain the challenges facing the achievement of global action for more energy efficient air transport. *[9]*

9. **Figure 6** shows planks of laminated timber used to make a laminated floor. The laminated wood is available in different widths and thicknesses and also with a choice of surface veneers. **Figure 7** shows a room with a laminated wood floor.

Figure 6: Laminated planks of timber with different surface veneers

Figure 7: View of a room with a laminated floor

(a) (i) Describe the structure of laminated wood. *[2]*

(ii) Outline **one** reason why laminated wood is available with a choice of surface veneers. *[2]*

(b) Explain **one** potential safety problem with a laminated wooden floor in the home. *[3]*

(c) (i) Define *U value*. *[1]*

(ii) Explain how the range of laminated timbers available to the consumer affects the U value rating of the floor. *[3]*

(d) Evaluate laminated flooring laid on top of concrete in relation to tensile strength, toughness and hardness. *[9]*

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MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Higher Level

Paper 2

9 pages

SECTION A

1. (a) (i) *Award **[1]** for:*
Japan; ***[1 max]***

(ii) *Award **[1]** per distinct point for a suitable suggestion, **[2 max]** for one suggestion.*
USA has a large manufacturing base;
which means it has the capacity to easily manufacture new components and to distribute them efficiently;
USA produces its own electronic products;
so has the expertise and manufacturing capability to produce the components;
Japan and the USA may have a trade agreement in place;
which means that production of components in the USA is economically competitive with producing them elsewhere including in Japan;
the USA may be already producing the same or similar components;
which means that it is both economically viable and efficient/reliable to maintain the agreement; ***[2 max]***

(b) (i) *Award **[1]** for*:
early; ***[1 max]***

(ii) *Award **[1]** per distinct point in a satisfactory explanation **[3 max]** for the explanation.*
market pull;
as consumers become increasingly aware of green issues;
and demand more environmentally friendly products;
company policy;
as companies become aware of the effect of planned obsolescence on the environment;
and wish to minimise the effect;
legislation;
which may force companies to take responsibility for the impact of their products on the environment;
which will be more expensive for companies; ***[3 max]***

(c) (i) *Award **[2 max]** for*:
the product is intended for the global market;
it needs to sell world-wide to diffuse into the marketplace; ***[2 max]***

(ii) *Award **[1]** per distinct point in a suitable explanation up to **[3 max]** for one explanation.*
USA and Japan are both big markets for electronic products;
so it would be good to sell initially in such markets;
and would give a good indication of the potential success of the product for other markets;
it's cheaper to initially target fewer markets;
as advertising can be targeted;
and variable costs controlled; ***[3 max]***

(d) *Award **[1]** per distinct point in an explanation similar to*:
the price in Denmark is almost double the price in Hong Kong;
but consumers in Denmark may consider the Playstation 3 value for money;
in comparison to other products in their market; ***[3 max]***

(e) (i) *Award **[2 max]** for a suitable outline along the lines of*:
import duties;
which vary between different countries;

transportation costs;
which will vary depending on location of the markets; ***[2 max]***

(ii) *Award **[3 max]** for an explanation along the lines of*:
market sectors are large markets in different regions of the world;
such as North America (USA and Canada) or Asia (Japan, Hong Kong and Taiwan);
while market segments are relatively small markets in individual countries such as Switzerland; ***[3 max]***

2. *Award **[1]** per distinct point, **[2 max]**.*
a fluid which undergoes dramatic changes to its viscosity;
changes from a thick fluid to a solid in seconds when exposed to an electric field;
effect is reversed when the field is removed; ***[2 max]***

3. *Award **[1]** per distinct point in an explanation along the lines of*:
quantitative data can be gathered to measure people's reaction to psychological factors;
but individuals may vary in their reaction to the data;
for example a room temperature may be suitable for one person but uncomfortable for another person;
(any other suitable example allowed) ***[3 max]***

4. (a) *Award **[1]** each for any two of*:
solar;
wind;
biomass;
wave;
tidal;
hydro-electric;
geothermal; ***[2 max]***

(b) *Award **[1]** per distinct point in a suitable explanation **[3 max]** for one explanation*:
high cost;
of installation;
little economy of scale;

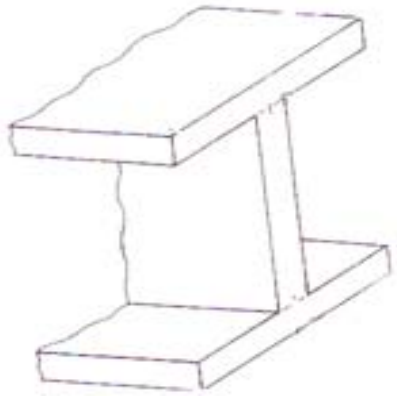
supply may be unreliable;
as energy source may be inconsistent;
depending on location;

low energy density;
as the amount of energy produced;
does not meet demand;

fossil fuel usually much cheaper;
as coal is an abundant resource;
and readily available;

tradition;
as fossil fuel has been used for centuries;
and the technology is well understood; ***[3 max]***

5. (a) *Award **[1]** for correct shape and **[1]** for isometric view.*



[2max]

(b) *Award **[1]** each for each distinct point in a suitable explanation along the lines of*:
the load is spread evenly;
minimum amount of material used;
the shape gives the same surface contact with the structure as a box beam which uses more material; ***[3 max]***

6. (a) *Award **[1]** each for*:
hot air;
friction welding; ***[2 max]***

(b) *Award **[1]** for each distinct point in an explanation along the lines of:*
do not allow for disassembly;
cannot easily be maintained/repaired;
so products are discarded after a shorter life cycle than necessary; ***[3 max]***

SECTION B

7. (a) (i) *Award **[2]** for*:
linear chain molecules with strong primary bonds;
cross linked to form a 3D structure; ***[2 max]***

(ii) *Award **[1]** per distinct point in a suitable outline*:
tough;
mattress needs to be durable;
low density;
so the mattress does not weigh too much;
stiffness;
so foam can be made stiff or pliable; ***[2 max]***

(b) *Award **[3]** for*:
ductility is the ability of a material to be stretched into a wire or tube;
the frame is extruded;
extruded metal materials need to be ductile; ***[3 max]***

(c) *Award **[1]** for*:
oscillating; ***[1 max]***

(d) (i) *Award **[1]** for any of*:
gluing;
riveting;
stapling; ***[1 max]***

(ii) *Award **[1]** per distinct point in a suitable outline based on a correct answer in (i).*
gluing:
cost-effective;
as glue is easy to apply;
riveting:
very strong;
as rivets fasten the material well;
good for thick material;
as rivets are available in different sizes;
stapling:
quick;
so very cost-effective; ***[2 max]***

(e) *Award **[1]** per distinct point in a suitable explanation **[3 max]** for each of the three aspects;*
designer:
need to decide what fixtures/fittings to use;
constraints of flat-pack on the type of design;
design cannot be too complicated;
needs to look like factory assembled when fitted together;
safety an issue;

manufacturer:
cheaper to make/distribute;
less storage space needed;
quicker to make;
good for volume production;
can use standardised parts on different products;
extra packaging required;

consumer:
immediate purchase usually available;
satisfaction of assembling the product;
cheaper than assembled furniture;
may be modular allowing for customisation;
range of surface finishes usually available; ***[9 max]***

8. (a) (i) *Award **[1]** for*:
batch; ***[1 max]***

(ii) *Award **[1]** for each distinct point in a suitable explanation along the lines of*:
no continuous flow market for such an expensive product;
different airlines may require modifications which batch would allow for;
it will take time for the new design to make existing products obsolete; ***[3 max]***

(b) (i) *Award **[1]** per distinct point in an explanation similar to*:
Young's Modulus refers to the relationship of stress and strain in a material;
this relates to strength and stiffness in a structure;
the aircraft body needs to be strong and stiff; ***[2 max]***

(ii) *Award **[1]** for each distinct point in a suitable explanation covering three of*:
good strength to weight ration;
resistant to changes in temperature;
resistant to moisture;
suitable to mould into complex curved shapes;
can be strengthened at stress points; ***[3 max]***

(c) *Award **[1]** for referring to maximum efficiency and **[1]** for outlining how this is achieved*:
loads acting on the structure are carefully calculated;
passengers/luggage etc carefully controlled;
structure must be as light as possible to be efficient; ***[2 max]***

(d) *Award **[1]** per distinct point in a suitable explanation*:
conflict between the need for growth in the industry and the effect of increased emissions;
the need for suitable strategy to cover different parts of the industry;
the need for airlines to remain competitive;
the difficulty of getting different governments/airlines to agree targets for controlling emissions;
persuading customers to pay more for better designed aircraft which reduce emissions;
politics involved with the introduction of green taxes;
problems of monitoring pollution globally;
many smaller airlines use old aircraft which pollute more;
influence of culture; ***[9 max]***

9. (a) (i) *Award **[2]** for*:
a composite;
composed of thin layers of wood glued together; ***[2 max]***

(ii) *Award **[1]** per distinct point in a suitable reason*.
consumers can choose which type of surface timber they prefer for colour / grain pattern / to match existing furniture;
greater choice for consumers;
increases sales for the manufacturer; ***[2 max]***

(b) *Award **[1]** per distinct point in a suitable explanation.*
thin layer of veneer used;
so can easily cause splinters when damaged;
which will harm bare skin;

polished floor;
causing a potential slip hazard;
if a non-slip polish is used;

fire hazard;
as wood burns easily;
if not treated; ***[3 max]***

(c) (i) *Award **[1]** for*:
a measure of the thermal conductance of a material; ***[1 max]***

(ii) *Award **[1]** per distinct point in a suitable explanation similar to*:
the range of materials will have different *U* values;
the timber is available in different thicknesses and the cross-section of the timber affects the calculation of the *U* value;
as does surface area; ***[3 max]***

(d) *Award **[1]** per distinct point in a suitable explanation **[3 max]** for each aspect:*
tensile strength:
the wooden floor is laid on top of concrete;
so does not have to take the load of people and objects;
but the floor will not break easily;
the structure of the laminate is very strong;
because of the grain pattern of each layer;
and the glue;

toughness:
wood is very tough;
the floor should not crack easily;
the grain pattern of each layer will help stop cracks propagating;

hardness:
timber is not very hard;
scratches will happen easily;
the surface veneer will wear away to reveal the core of the lamination;
which will be unsightly;
the surface needs a protective finish;
and should be maintained regularly; ***[9 max]***

IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

SPEC/4/DESTE/HP3/ENG/TZ0/XX

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 3

SPECIMEN PAPER

1 hour 15 minutes

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

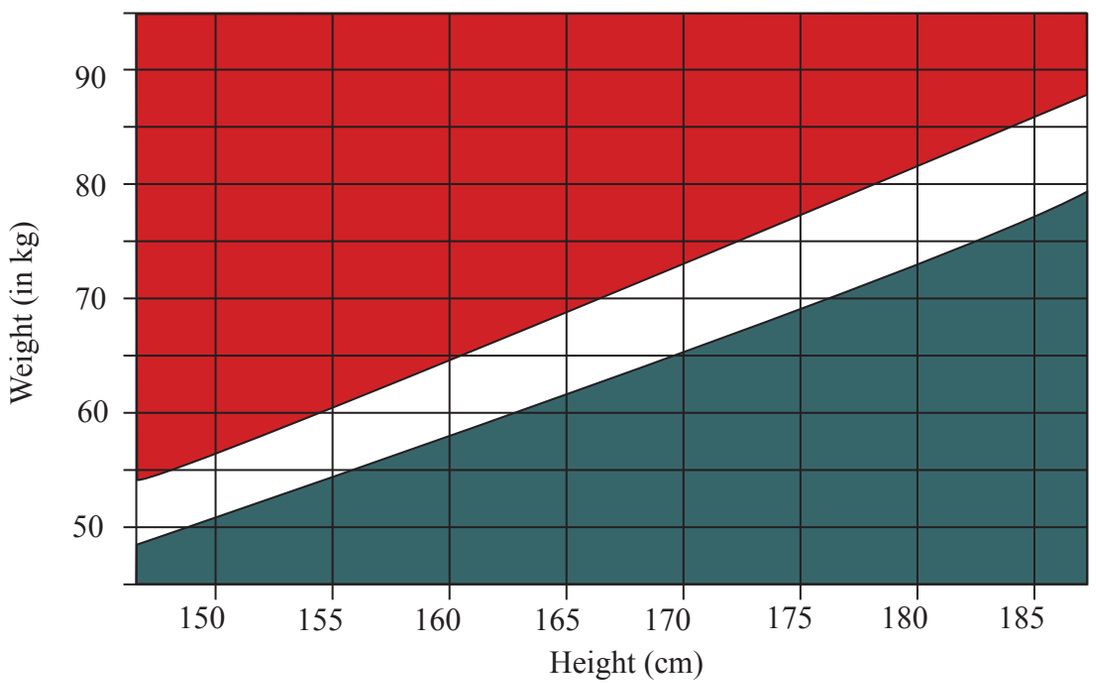
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from one of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

31 pages

Option A — Food science and technology

A1. Body mass index, BMI, is generated by dividing a person's weight in kilograms by height in metres squared. A BMI of 20-25 is considered normal, one of >25 is considered overweight bringing risk of increased mortality and one of >30 is considered obese bringing risk of significantly increased mortality through a range of conditions including diabetes, heart conditions, cancer and high blood pressure. **Figure A1** graphically illustrates underweight (BMI<20 in blue), normal (BMI 20-25 in white) and overweight (BMI >25 in red) weight for height data.

Figure A1: Graphic illustration of underweight, normal and overweight data



(a) Calculate the BMI of a man whose weight is 90 kg and height 1.70 m. *[1]*

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(b) Outline **one** disadvantage of using Figure A1 rather than calculating BMI for the man described in A1(a). *[2]*

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(Question A1 continued)

(c) Explain how overweight and obesity are caused. *[3]*

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A2. (a) Define *poverty*. *[1]*

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(b) List **two** factors that are incorporated into the human development index which is used as a holistic measure of poverty at a country level. *[2]*

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A3. Figure A2: Macronutrient information from a potato crisps (chips) packet

Nutrition Facts	
Serving Size 1 package 28.3 g	
Servings per container 1	
Amount per serving	
Calories 160	Calories from fat 90
	% Daily value*
Total Fat 10g	16%
Saturated fat 3g	15%
Trans fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 14g	5%
Dietary Fibre 1g	4%
Sugars 0g	
Protein 2g	

* Percent Daily Values are based on a 2000 Calorie/day diet.

(a) Calculate the amount of unsaturated fat per 100g of potato crisps (chips). *[2]*

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(b) Outline **one** reason why the amounts of saturated fat, trans fat and cholesterol are identified amongst the Nutrition Facts on the packet of potato crisps (chips). *[2]*

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A4. Discuss how health awareness affects food choice with reference to **two** nutritional issues. *[6]*

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A5. (a) List **two** factors underpinning the genetic modification of foods. *[2]*

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(b) Outline **one** advantage of FlavrSavr™ tomatoes over traditionally grown tomatoes. *[2]*

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(c) Outline **one** reason why it is important that the general public considers new food products acceptable. *[2]*

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A6. (a) Explain how **one** lifestyle factor may contribute to an increased incidence of food poisoning. *[3]*

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(b) Explain the role of cooking in controlling bacterial growth and preventing food poisoning. *[3]*

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A7. Explain how **three** different types of rancidity are important in the shelf life of food products containing fats and oils. *[9]*

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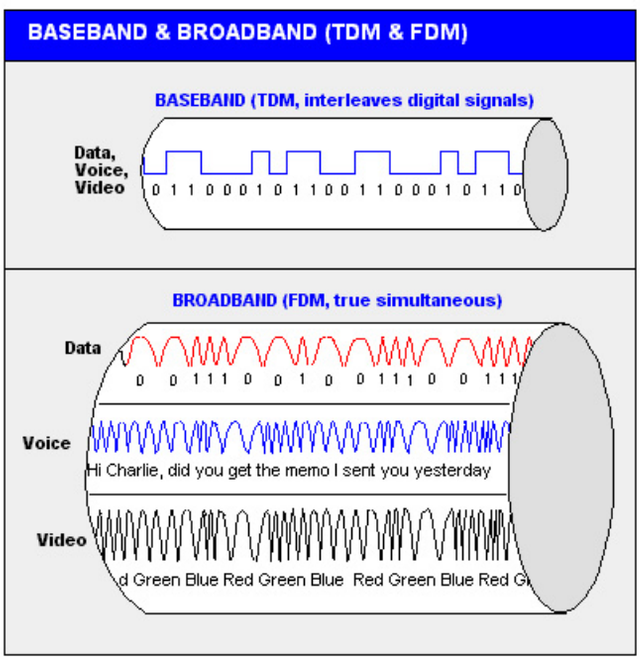
Option B — Electronic product design

B1. Frequency division multiplexing (see **Figure B1**) is widely used in modern communications systems. Consider a communication link with a bandwidth of 100 MHz. The link provider divides the available bandwidth into smaller bandwidths and allocates them to individual users who can then simultaneously use the communication link. The size of the bandwidth needed depends on the application - typical bandwidths for various applications are shown in **Table B1**.

Figure B1: Multiplexing



[Source: http://img.tfd.com/cde/BASEBAND.GIF]

Table B1: Typical signal bandwidths

Signal	Bandwidth
Voice	3 kHz
Analogue Television Broadcast	6 MHz
Standard Telphone	56 kHz
Broadband Internet	0.5 MHz

(a) State an alternative to frequency division multplexing. *[1]*

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(b) Calculate the number of broadband internet connections that could simultaneously use a communication link with a bandwidth of 100 MHz. *[2]*

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(This question continues on the following page)

(Question B1 continued)

(c) Explain the considerations a commercial communication link provider might identify when developing a pricing policy. *[3]*

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B2. (a) Define *product stewardship*. *[1]*

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(b) Outline **one** implication for manufacturers of adopting the concept of product stewardship. *[2]*

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B3. Safety is a key aspect for public transport systems, *e.g.* it is critically important that doors on a train are only allowed to open under clearly prescribed conditions. Three conditions are required for a door to open on any particular carriage of the train, as follows:

A. The train is stopped in the station;
B. The driver has signalled the "all clear";
C. A passenger in the carriage has pressed a door release button.

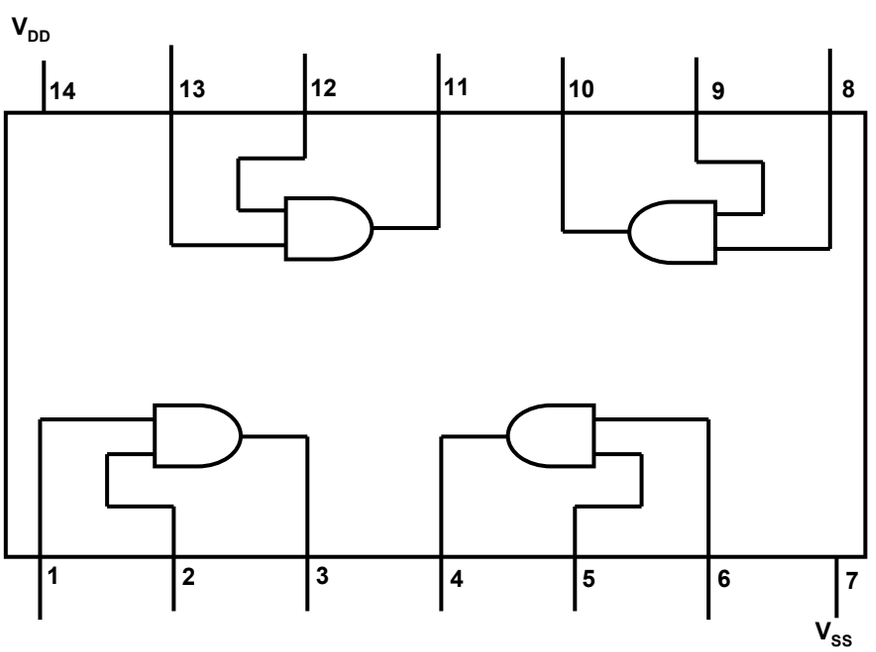
(a) Complete the truth table shown in Table B2 to show the behaviour of the logic gate required to ensure that the door opens appropriately. *[2]*

Table B2: Truth table

A	B	C	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

(b) Using the Quad 2-input **AND** gate shown in Figure B2, complete the circuit to achieve the truth table in Table B2. *[2]*

Figure B2: Quad 2 - input AND gate



B4. Discuss **two** factors that would need to be considered when specifying a real time video monitoring system for a department store explaining the implications of each factor for system performance and cost/bandwidth requirements. *[6]*

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B5. (a) Outline **one** aesthetic consideration relating to the design of a smart home lighting system. *[2]*

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(b) List **two** input devices for use in a smart home lighting system. *[2]*

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(c) Outline **one** way in which a smart home lighting system benefits the environment. *[2]*

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B6. (a) Explain how cognitive science will be used in the implementation of "*The Communicator*". *[3]*

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(b) Explain **one** potential advantage of "*The Communicator*" for global cooperation. *[3]*

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B7. Discuss **three** issues for a mobile phone manufacturer relating to the adoption of generic standards. *[9]*

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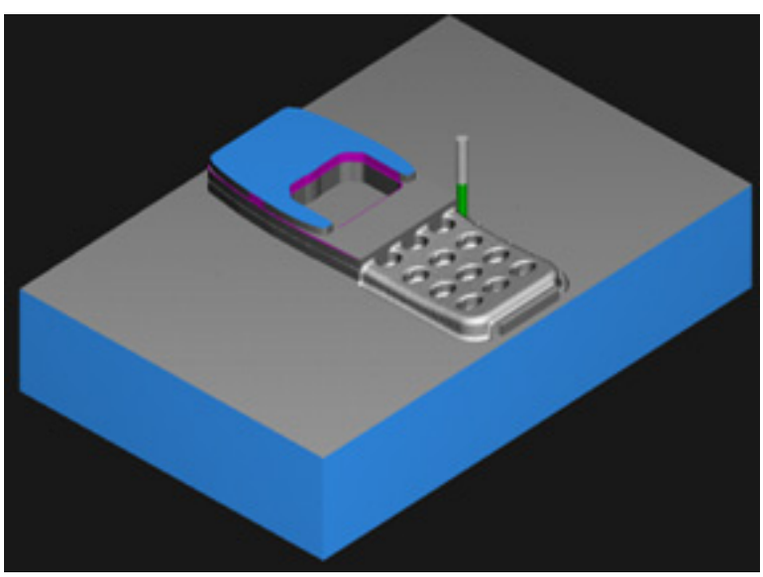
Option C — CAD / CAM

C1. CNC machinery uses a range of tooling, feed speeds and depth of cut in order to increase accuracy of detailing and reduce manufacturing time. **Table C1** shows a range of cutting tools and their cutting detail. Figures in blue refer to a roughing cut. Figures in red refer to a finishing cut. **Figure C1** shows a simulation of a CNC Router profile cutting a model mobile phone.

Table C1: CNC Router Post processing tool library

Tool Index	Description	Diameter (mm)	Length (mm)	Depth (mm)	Feed (mm/min)	Speed (rpm)	Stepover (%)
1	Ball End Cutter	3.00	15.00	4.00 (1.00)	300 (600)	3000 (3000)	95 (15)
2	Ball End Cutter	6.00	20.00	4.00 (1.00)	400 (600)	2500 (2500)	95 (10)
3	Slot Drill Cutter	6.00	7.5	4.00 (1.00)	300 (600)	2500 (2500)	95 (10)
4	Slot Drill Cutter	10.00	22.00	400 (1.00)	200 (600)	2000 (2000)	95 (7)
5	Engraving Cutter	3.00	5.00	0.2	500	5000	0
6	Engraving Cutter	6.00	10	0.2	500	3000	0

Figure C1: Graphic image of CNC manufacturing simulation



(This question continues on the following page)

(Question C1 continued)

(a) State the stepover percentage for a 3 mm ball end cutter on a finishing cut. *[1]*

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(b) Calculate the tool stepover dimension for a 6 mm slot drill cutter on a finishing cut. *[2]*

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(c) Explain why a 10 mm Slot Cutter and a 3 mm ball end tool would be used to manufacture the part in Figure C1. *[3]*

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C2. (a) State **one** characteristic of manufactured boards that make them appropriate for CAM. *[1]*

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(b) Outline a suitable material other than manufactured board that could be used in a CAM process. *[2]*

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C3. **Figure C2: 3D drawing of a wheel for a trolley**

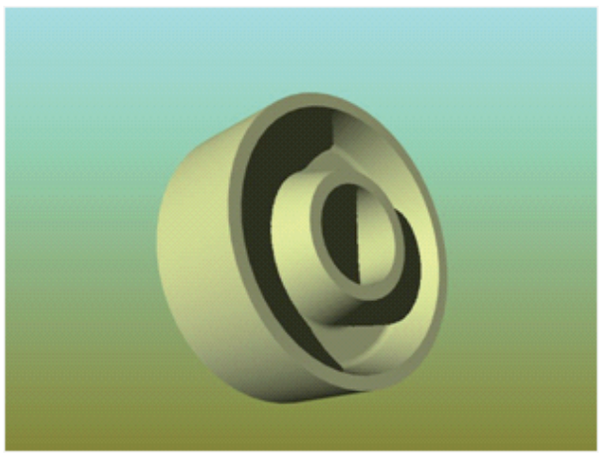
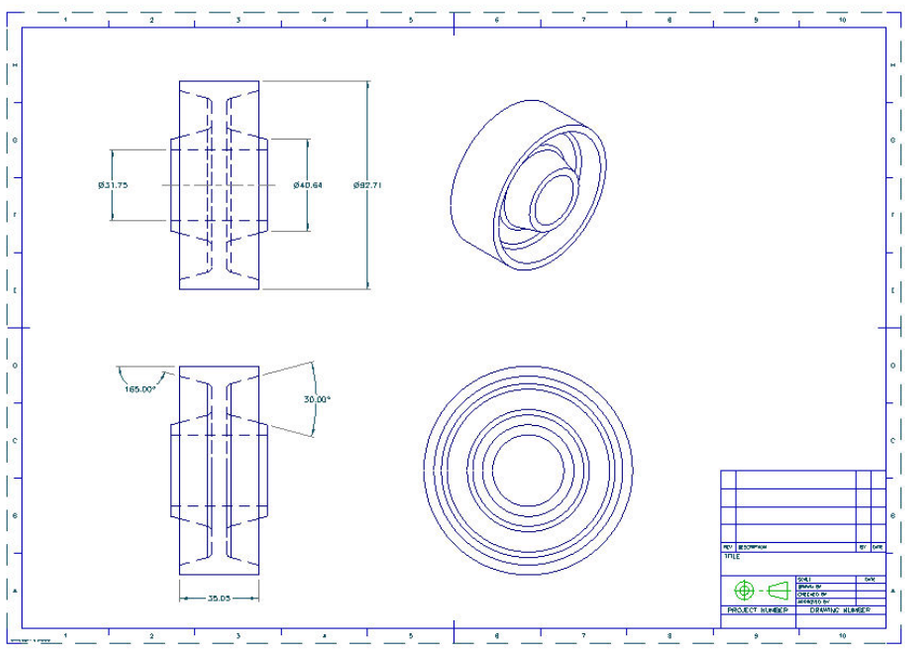


Figure C3: Orthographic Drawing of a wheel for a trolley



(a) Outline why the 3D drawing of the wheel in Figure C2 is most likely to have been created first. *[2]*

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(b) Outline a reason why a 2D drawing is generated. *[2]*

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C4. Discuss **two** issues relating to the use of CAM to produce furniture from manufactured boards. *[6]*

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C5. (a) Outline **one** way in which robots have contributed to the health and safety of employees in manufacturing environments. *[2]*

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(b) Describe **one** way in which robots can contribute to quality control in manufacturing environments. *[2]*

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(c) Identify **one** advantage of using robots for small-scale production. *[2]*

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C6. (a) Discuss **one** social issue for designers working in a CAD environment. *[3]*

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(b) Explain **one** way in which the CAM process may contribute to efficient use of materials. *[3]*

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C7. Discuss advantages of rapid prototyping for the designer, manufacturer and consumer. *[9]*

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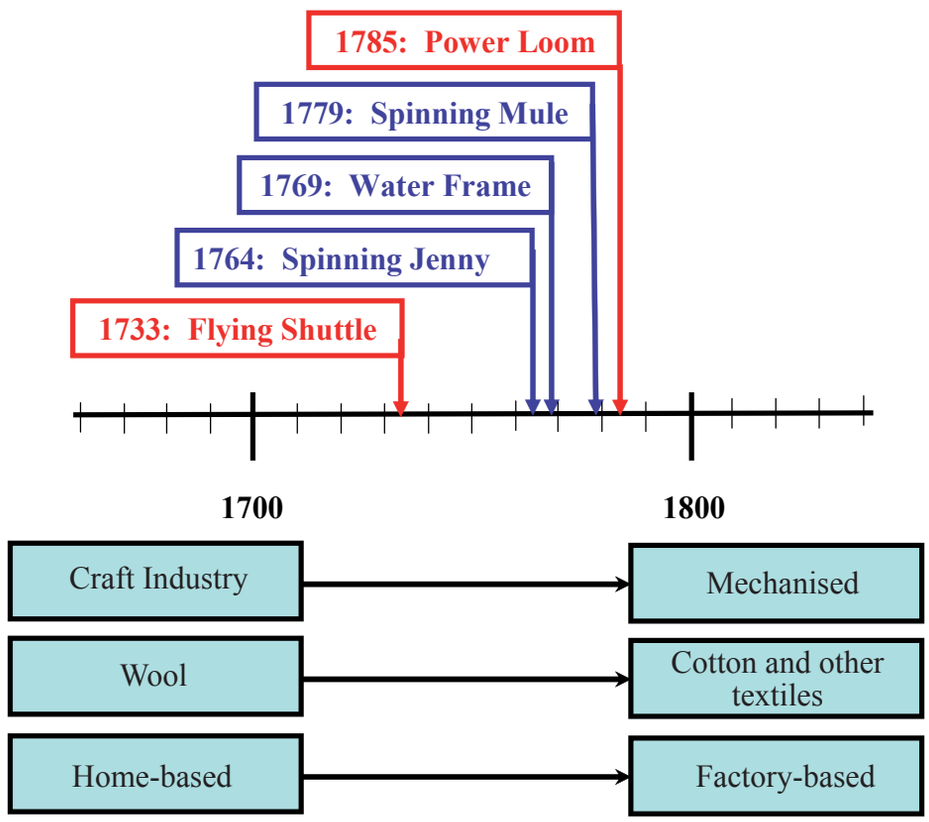
Option D — Textiles

D1. Prior to the middle of the 18th Century the British textile industry was a craft industry. Families worked together at home to clean, comb, spin, dye and weave wool into cloth – a very slow process. During the 18th Century demand for textile, especially cotton, products increased. A series of important inventions (see **Figure D1**) relating to various aspects of the spinning (shown in blue) and weaving (shown in red) processes transformed the British textile industry.

Figure D1: Key inventions in the development of the British textile industry



The Flying Shuttle allowed wider cloth to be produced more quickly. The Spinning Jenny allowed more threads of cotton to be spun simultaneously. Both the Flying Shuttle and the Spinning Jenny were small enough to be used in cottages. However, the Water Frame was powered by a watermill – it was too large for a cottage and too expensive for an individual family and forced spinning into factories. When the Power Loom was adopted weaving too shifted from cottages to factories.

(This question continues on the following page)

(Question D1 continued)

(a) State the source of power used by the textile industry in Britain prior to its mechanisation in the Industrial Revolution. *[1]*

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(b) Describe why the development of the textile industry resulted from a combination of market pull and technology push. *[2]*

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(c) Compare **one** impact on British textile workers of working in a factory rather than working at home. *[3]*

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D2. (a) State **one** key benefit of the EU Flower system for consumers. *[1]*

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(b) Outline **one** way in which the environmental impact resulting from the care and maintenance of textile products in the home could be reduced by careful design of the textile product. *[2]*

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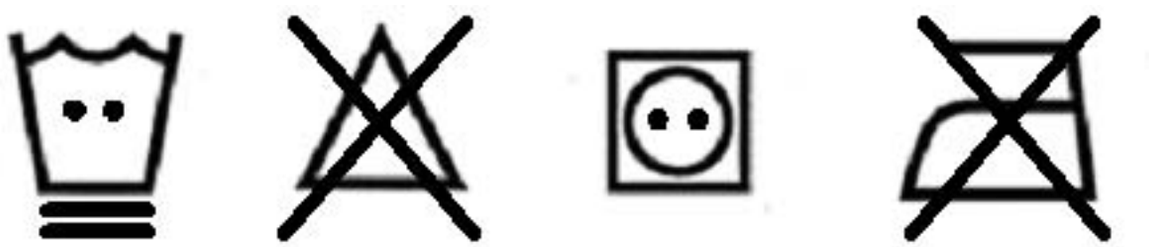
D3. Clothing labels use a simple system of internationally-recognisable symbols to communicate care instructions to consumers. These symbols relate to washing, bleaching, drying, ironing and dry cleaning (see **Figure D2**). These are combined with modifiers (dots and bars). Dots indicate the temperature – one dot means cool/low temperature, two dots means warm/medium temperature and three dots mean hot/high temperature. Bars indicate more gentle treatment requirements – one bar means permanent press cycle and two bars means gentle/delicate cycle. A cross over a symbol means "Do not", *e.g.* "Do not bleach" or "Do not iron" (see **Figure D3**).

Figure D2: Care instruction symbols

Figure D3: Instructions from a care label



(a) State the meaning of the **two** symbols on the care label shown in Figure D3, apart from the "Do not bleach" and "Do not iron symbols". *[2]*

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(b) Outline **one** reason why it is important that an internationally-recognisable system of care instructions is used by manufacturers on care labels. *[2]*

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D4. Discuss **one** advantage and **one** disadvantage of using biomimetrics in the design of sports clothing. *[6]*

Advantage:

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Disadvantage:

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D5. (a) Discuss **one** advantage for developing countries when large multinational companies establish textile manufacturing plants in their country *[3]*

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(b) Explain **one** way in which fair trade regulations contribute to the sustainability of the textile industry. *[3]*

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D6. (a) Explain **one** challenge for the development of wearable computing garments. *[3]*

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(b) Discuss **one** benefit of aligning the wearable computing market more closely with the fashion market. *[3]*

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D7. Discuss **three** aspects of the global impact of branded textile products. *[9]*

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Option E — Human factors design

E1. Stools without wheels are often provided with stand up workbenches to reduce fatigue during long tasks. When not in use they slide under the bench. **Figure E1** is a side view of a stool, the recommended dimensions for which are provided in **Table E1** below.

Figure E1: Stool and a stand up workbench

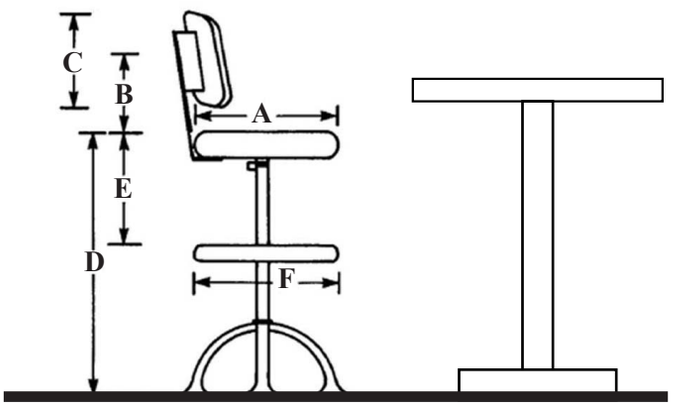

Table E1: Dimensions of Stool

Letter (Figure E1)	Dimensions
A - seat width	381 mm
C - backrest height	203 mm
D - seat height	500 to 762 mm max
E - seat/foot support distance	457 mm
F - foot support	457 mm

(a) If the vertical distance between the seat and the backrest is 50mm, state the overall maximum height of the chair. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Identify the percentile used to determine the height of the workbench if it was for a school classroom. *[2]*

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(c) Explain why it is recommended that wheels should not be used with workbench stools. *[3]*

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E2. (a) State **one** device used to capture human motion. *[1]*

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(b) Describe **one** advantage of using digital humans in product marketing. *[2]*

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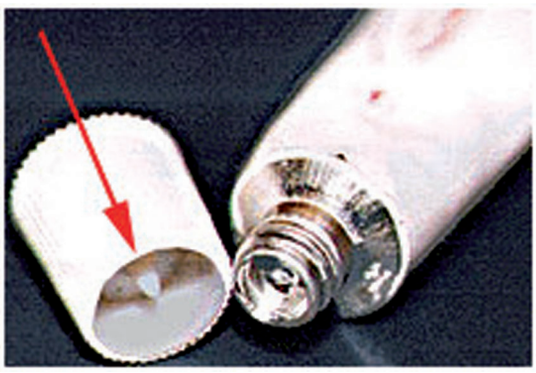
E3. **Figure E2** shows a small tube of toothpaste which is part of a kit given to long distance airline passengers. A number of passengers have complained that they can't pierce the seal in the tube. They have not noticed the pin in the top of the lid to be used for this purpose.

Figure E2: Toothpaste tube



[Source: www.cs.usm.maine/edu/~welty/cos368/topics//tube1.gif]

(a) Identify a data collection strategy designers of the toothpaste tube in Figure E2 could have used to become aware of the problem. *[2]*

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(b) Describe an alternative design solution to the problem outlined above. *[2]*

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E4. The picture in **Figure E3** shows the detail of the front panel of the music player pictured in **Figure E4**.

Figure E3: Music player detail

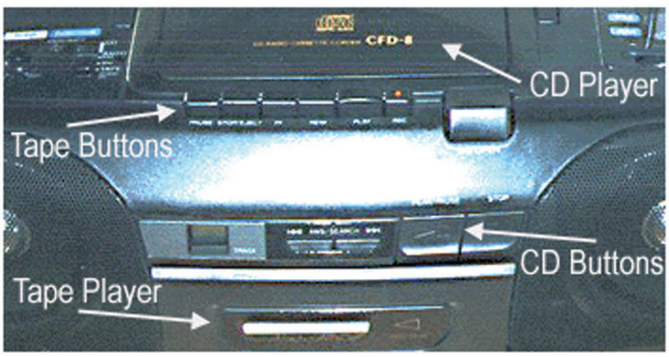
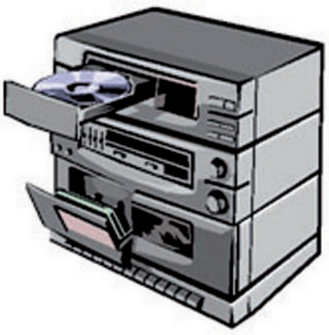


Figure E4: Music player



Discuss **two** characteristics of user product interfaces related to the product pictured in Figure E3. *[6]*

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E5. (a) List **two** forces involved in unscrewing the lid of a jar. *[2]*

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(b) Outline **one** method designers would use to research human factors for people with limited hand movement. *[2]*

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(c) Identify **one** variable that might affect the design of an appliance to unscrew the lid of a jar. *[2]*

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E6. (a) Explain how **one** area of the "four pleasure framework" has been considered in the development of the iPod MP3 music player. *[3]*

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(b) Explain how the "four pleasure framework" promotes a holistic view of product design. *[3]*

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E7. Explain how **three** psychological human factors considered in kitchen design may conflict with other design aims. *[9]*

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IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

SPEC/4/DESTE/HP3/ENG/TZ0/XX/M

MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Higher Level

Paper 3

22 pages

Option A — Food science and technology

A1. (a) *Award **[1]** for the correct calculation and answer.*
***Note**: no units are required as the answer is a ratio, so do not subtract **[1]** for missing units.*
BMI = weight in kg/(height in m^2) = $90/1.70 \times 1.70 = 31.14$; ***[1 max]***

(b) *Award **[1]** for stating that the man does not know if he's obese from Figure 1 (a).*
calculating BMI gives the answer 31.14 which makes the man obese;
using Figure 1 (a) he is overweight and so loses the additional information that he is at significant increased risk of mortality, *i.e.* in a more serious condition; ***[2 max]***

(c) *Award **[1]** for each distinct point in an explanation of how overweight and obesity are caused.*
overweight and obesity have a strong familial component;
however energy intake and levels of physical activity are important;
low levels of physical activity coupled with high levels of energy intake are likely to lead to an increased BMI;
the issue of obesity and overweight can be addressed by increasing physical activity and/or reducing energy intake; ***[3 max]***

A2. (a) *Award **[1]** for a definition of poverty to the effect of:*
deprivation of essential goods and services *e.g.* food, clothing, shelter, education and a lack of sufficient income and wealth; ***[1 max]***

(b) *Award **[1]** for each of two factors that are incorporated into the human development, which is used as a holistic measure of poverty at a country level.*
life expectancy;
knowledge/education;
a decent standard of living; ***[2 marks]***

A3. (a) *Award **[1]** for correct method of calculation plus **[1]** for the correct answer including units.*
10 g (total fat) – 3 g (saturated fat) = 7 g (unsaturated fat);
$(7 \times 100)/28.3 = 24.7$ g/100 g; ***[2 max]***

(b) *Award **[1]** for each distinct point in a brief explanation of why the amounts of saturated and trans fats and cholesterol are identified amongst the Nutrition Facts on a packet of potato crisps (chips).*
saturated fats, trans fats and cholesterol are considered bad for health;
people who are being careful about their diet would want to know how much of each component is present so that they can decide whether to purchase/eat the product; ***[2 max]***

A4. *Award **[1]** for identifying a particular nutritional issue and **[1]** for each additional point in an explanation of how health awareness affects food choice with reference to that issue, **[3 max]** for each issue.*

fat quality and quantity;
choose a diet low in fat;
fat provides twice as many calories as the equivalent amount of carbohydrate or protein;
high fat intake can lead to overweight and obesity;

choose a diet low in saturated fat/trans fat/dietary cholesterol;
consumption of saturated fat, trans fat, and dietary cholesterol raises low-density lipoprotein (LDL) or "bad cholesterol," levels, which increases the risk of coronary heart disease (CHD);

saturated fat (from meat, milk and milk products) raises blood cholesterol more than other forms of fat;

reducing saturated fat to less than 10 % of calories will help lower blood cholesterol levels;

replace total/saturated fat by eating more unsaturated/polyunsaturated fat;
unsaturated fats reduce blood cholesterol when they replace saturated fats in the diet;

choose a diet low in trans fats;
partially hydrogenated vegetable oils, such as those used in many margarines and shortenings, contain a form of unsaturated fat known as trans-fatty acids that may raise blood cholesterol levels, although not as much as saturated fat;

choose a diet low in cholesterol;
the body makes all the cholesterol it needs;
dietary cholesterol comes from animal sources such as egg yolks, meat (especially organ meats such as liver), poultry, fish, and higher fat milk products;
eat more grain products, vegetables and fruits and by limiting intake of high cholesterol foods;

Fibre intake;
fibre is good for the health of the gut;
eating a high fibre diet appears to reduce the risk of developing various conditions, including heart disease, diabetes, diverticular disease, and constipation;
low fibre content foods, *e.g.* refined foods such as white bread, white rice, refined cereals (corn flakes, Cheerios), white spaghetti and sugar should be replaced with higher fibre alternatives;

Sugar intake;
medical experts agree that people should get no more than 10 % of their calories from sugar;
higher intakes of sugar can lead to overweight, obesity and a range of obesity-linked diseases;

Salt intake;
high salt consumption can contribute to high blood pressure for people who have been diagnosed with hypertension, high blood pressure can lead to heart disease and stroke;
recommended salt intake in UK is 6 g, a salt intake of about 6 g is considered sensible medical advice; ***[6 max]***

A5. (a) *Award **[1]** for each of two factors underpinning the genetic modification of foods.*
enhanced yield;
improved resistance to attack by pathogens;
enhances storage characteristics;
enhanced eating quality;
production/removal of particular biochemicals from a food product; ***[2 max]***

(b) *Award **[1]** for identifying an advantage of FlavrSavr™ tomatoes over traditionally grown tomatoes and **[1]** for a brief explanation.*
traditional tomatoes have to be harvested green so they stay firm on trip to supermarket;
FlavrSavr™ tomatoes have a firmer skin and so can be left to ripen on the vine so producing a fuller-flavoured tomato; ***[2 max]***

(c) *Award **[1]** for identifying why it is important that new food products are considered acceptable by the general public and **[1]** for a brief explanation.*
products must have a market to remain viable;
food choice is determined by habit and culture and people are wary of new food products especially ones where scientists have interfered with nature;
it takes time to establish a product in the market place and growth in the market must be rapid enough to maintain commercial viability; ***[2 max]***

A6. (a) *Award **[1]** for each distinct point in an explanation of how one lifestyle factor may contribute to an increased incidence of food poisoning.*
increased incidence of eating out/increased consumption of ready meals;
not all restaurants have high standards of food hygiene which may result in someone eating food that is more likely to cause food poisoning;
poor food hygiene may mean that food poisoning bacteria are introduced into a food or allowed to grow in that food;
foods which are not stored or reheated correctly can contribute to food poisoning; ***[3 max]***

(b) *Award **[1]** for each distinct point in an explanation of the role of cooking in controlling bacterial growth and preventing food poisoning.*
cooking can kill food poisoning bacteria;
food must be cooked at a sufficiently high temperature and for a sufficient time;
the temperature/time depends on the size of the food item and its initial temperature (frozen or at room temperature); ***[3 max]***

A7. *Award **[1]** for each distinct point in an explanation of how each type of rancidity is important in the shelf life of food products containing fats and oils, **[3 max]** per type of rancidity.*

Oxidative rancidity;
important when food products containing unsaturated fatty acids are stored in too hot/light conditions and produce off flavours;
involves three phase process – initiation, propagation and termination. (Initiation – molecular oxygen combines with unsaturated fatty acids in the presence of chemical oxidizers or enzymes to produce hydroperoxides and free radicals which are very reactive. Propagation – further oxidation by lipid oxidation products gives rise to the term "auto-oxidation" that is often used to refer to this process. Termination phase results in relatively unreactive compounds, *e.g.* hydrocarbons, aldehydes and ketones);

Hydrolytic rancidity;
occurs in food products containing fats and oils due to reaction of lipid and water in the presence of a catalyst or by the action of lipase enzymes;
results in the formation of free fatty acids and soaps (salts of free fatty acids);
although low levels of free 16-18°C atom fatty acids as in soybeans, corn or animal fat are not necessarily objectionable, low levels of shorter carbon chain fatty acids, as in coconut oil or butter fat, can be quite objectionable;
oil/fat develops a soapy taste/texture;

Absorption rancidity;
important when oils and fats are stored next to products (such as paint, detergents or disinfectants) which have a strong smell;
smell absorbed by fat/oil making it unpleasant to eat;
food should be stored in dry cool place away from strong smelling items; ***[9 max]***

Option B — Electronic product design

B1. (a) *Award **[1]** for stating an alternative to frequency division multiplexing.*
time division multiplexing; ***[1 max]***

(b) *Award **[1]** for identifying the correct data and **[1]** for the correct answer.*
100/0.5;
200 broadband Internet connections; ***[2 max]***

(c) *Award **[1]** for three distinct correct points in an explanation of how a commercial communication link provider might develop a pricing policy.*
set up costs;
maintenance costs;
the capacity of the network;
the amount of bandwidth required by particular users (voice, TV, broadband);
peak/off peak use of the system; ***[3 max]***

B2. (a) *Award **[1]** for stating one implication of product stewardship for manufacturers.*
everyone involved in making selling, buying or handling electronic equipment takes responsibility for minimizing environmental impact of the equipment at all stages of the life cycle; ***[1 max]***

(b) *Award **[1]** for identifying one implication for manufacturers of adopting the concept of product stewardship and **[1]** for a brief explanation.*
manufacturing products in a way that makes them more easily disassembled for reuse and recycling;
using temporary joining techniques (*e.g.* thermoplastic adhesives or screws) rather than permanent joining (*e.g.* rivets);

manufacturing products in a way that makes them easier to repair/maintain;
use of standard components (so easier to source) / components subject to wear and tear are easy to get at;

using materials that minimize negative environmental impacts of disposal;
using less toxic materials/using more recycled and recyclable materials;

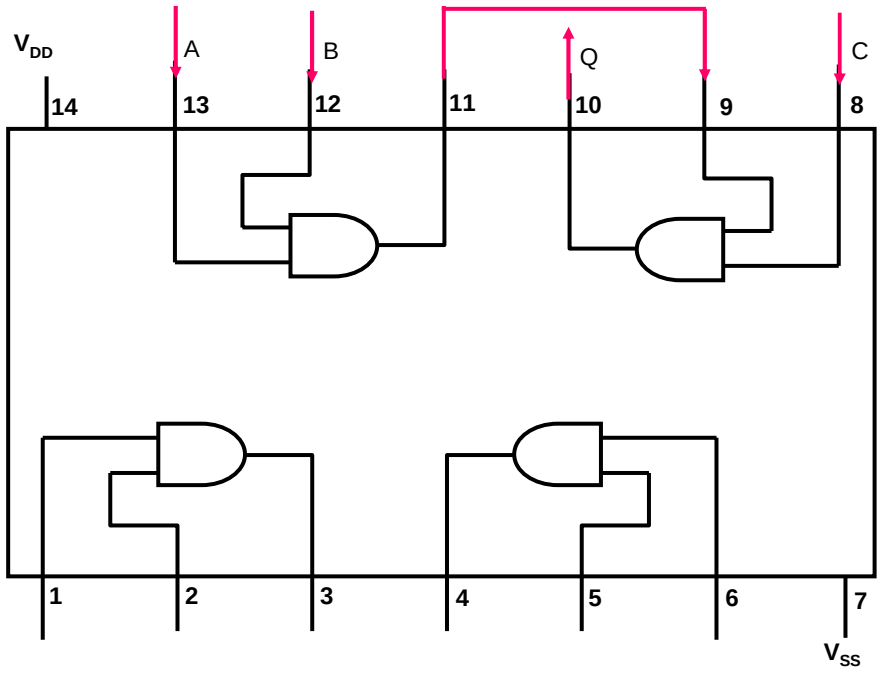
taking back used products for rebuilding or recycling;
developing an environmentally sound collection and recycling infrastructure / incorporating the costs for collection and recycling into the product price so they are paid by consumers at the point of sale not tax payers at the point of disposal; ***[2 max]***

B3. (a) *Award **[1]** for putting 0s for all lines except 1, 1, 1 and **[1]** for putting 1 for 1, 1, 1, as show below:* ***[2 max]***

A	B	C	Q
0	0	0	**0**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**0**
1	0	1	**0**
1	1	0	**0**
1	1	1	**1**;

;

(b) *Award **[1]** for inputting A and B to one logic gate (inputs 12 and 13 OR 8 and 9 OR 5 and 6 OR 1 and 2). Award **[1]** for connecting the output from that gate (11, 10, 3 OR 4) as the input to a second gate with C and for marking the output as Q.*



[2 max]

B4. *Award **[1]** for identifying each of two factors that would need to be considered in specifying a real time video monitoring system for a department store **[1]** for a brief explanation of the implications of each factor for system performance and **[1]** for the implications for cost/bandwidth requirements.*

lots of cameras;
to be able to monitor all sections of department store;
increases cost and bandwidth requirements;

control room of dedicated monitors;
can continuously monitor all sections of department store;
increases cost and bandwidth requirements;

high definition pictures;
makes it easier to identify people and to see clearly what they are doing;
increases cost and bandwidth requirements;

colour;
makes it easier to identify people and to see clearly what they are doing;
increases cost and bandwidth requirements;

fast refresh rate;
the faster the refresh rate the smoother will be the movements of the people being observed, with a slow refresh rate things, *e.g.* a customer slipping something into their bag, might be missed;
increases cost and bandwidth requirements;

recording capacity;
can record for later replay if something specific needs investigations, *e.g.* by police;
increases cost but not bandwidth requirements; ***[6 max]***

B5. (a) *Award **[1]** for identifying one aesthetic consideration relating to the design of a smart home lighting system and **[1]** for a brief explanation.*
colour of light produced;
daylight balanced lighting may be more appropriate in studies, work rooms or kitchen;

amount of light provided;
need to provide more light in certain areas;

ability to increase/decrease light through use of dimming switch;
can create different moods;

may want to programme lighting for different times of days or different levels of ambient light;
saves user turning light on in evening / can help in home security if person's home is unoccupied;

may want lighting to turn on or off automatically if someone enters a room or if noone is in a room;
save energy if lighting not required; ***[2 max]***

(b) *Award **[1]** for each of two input devices for use in a smart home lighting system.*
ambient light sensor;
movement sensor;
pressure sensor;
manual on/off switch; ***[2 max]***

(c) *Award **[1]** for identifying a way in which a smart home lighting system benefits the environment and **[1]** for a brief explanation.*
saves energy;
turning off light if no-one in room or if ambient light levels high; ***[2 max]***

B6. (a) *Award **[1]** for each distinct correct point in an explanation of how cognitive science will be used in the implementation of "**The Communicator**".*

it will promote understanding of the way that humans make decisions and interpret the world around them;
this will lead to an understanding of the most effective learning styles for individuals;
this will in turn provide the best method of training for individuals;
it will help identify and eliminate bias in the decision making process;
it will provide ways of understanding how common values to promote social cooperation can be achieved;
it will provide understanding of how people relate to the world and people around them;
it will identify the best method of communication; ***[3 max]***

(b) *Award **[1]** for each distinct correct point in an explanation of one potential advantage of "**The Communicator**" for global cooperation.*

it will enable people to interact globally without travelling;
it would facilitate networking and enhance the effectiveness of communication between individuals in geographically-disparate locations;
it would promote cooperation between schools, businesses and government agencies globally;
it would enable people to develop collaborative solutions and to achieve consensus on issues; ***[3 max]***

B7. *Award **[1]** for identifying each of three issues for a mobile phone manufacturer relating to the adoption of generic standards and **[1]** for each of two points of explanation for each aspect, **[3 max]** per aspect.*

product loyalty and opportunities to access a wider market;
use of generic standards mean that more customers are likely to adopt the product as it uses standard technology;
use of generic standards provides access to a world-wide market;

interoperability;
the generic standard will make the product compatible with other products;
this means that files can be transferred from one device to another, especially important in relation to interfacing with computers;

investment in research and development;
manufacturers can piggyback onto other people's R&D;
development costs are much lower making the development much more cost-effective;

to develop a company-specific standard is a pioneering strategy;
a pioneering strategy is much more risky and requires huge investment;
adopting an imitative strategy offsets risk; ***[9 max]***

Option C — CAD / CAM

C1. (a) *Award **[1]** for stating:*
15 %; ***[1 max]***

(b) *Award **[1]** for working and **[1]** for correct answer, including units.*
6 mm × 10% =;
0.6 mm; ***[2 max]***

(c) *Award **[1]** for each distinct point in an explanation of how the tools would be used.*
10 mm tool used to rough cut material;
10 mm wastes large amounts of material and reduces manufacturing time;
3 mm tool used to complete final finishing cut to allow intricate machining in pockets; ***[3 max]***

C2. (a) *Award **[1]** for stating:*
no warping, which allows material to be held flat;
stable;
uniform grain structure, no knots; ***[1 max]***

(b) *Award **[1]** for stating and **[1]** for an appropriate reason.*

modelling wax;
good lubrication properties, allows a smooth finish;
finished product lends itself to lost wax casting;

high-density foam;
cheap light weight material that can be painted to resemble the proposed final outcome;

card;
can be used for LOM and packaging models; ***[2 max]***

C3. (a) *Award **[1]** for stating a reason why the 3D drawing of the wheel is not likely to have been created first and **[1]** for a brief explanation.*

animation;
animation allows product to be simulated and assembled to other parts;

show to clients;
virtual product can be shown to clients before attempting to make 3D models;

can then create 2D orthographic drawing;
orthographic drawings can be created from a 3D image, which will allow for calculation of material and provide views for manufacture;

reduction in prototypes;
client does not need to see a physical model, material and time is not wasted; ***[2 max]***

(b) *Award **[1]** for stating why a 2D drawing is generated and **[1]** for a brief explanation.*

part dimensions;
dimensions can be added to the drawing to view constraints;

scale;
drawing can be scaled for ease of reading;

calculating amount of material;
material volume can be calculated in order to estimate costs involved in manufacture;

can be manufactured from drawing;
different views and detailed dimensioning allow for the part to be manufactured;

detailed views of different elevations;
sectional views and elevations give more detail to the manufacturer; ***[2 max]***

C4. *Award **[1]** for identifying a particular issue **[1]** for each additional point in an explanation. **[3 max]** for each issue.*

structure of material;
- grain direction;
- hardness;

safety;
- adhesive used within material could cause illness if exposure is high;
- dust levels are high and extraction units are required;

range of materials available;
- MDF;
- chipboard;
- plywood;

surface finish;
- painting;
- varnish;
- laminated;
- veneers;

efficiency;
- waste material reduced by nesting;
- tools wear;

[6 max]

C5. (a) *Award **[1]** for stating and **[1]** for an appropriate reason.*
robots used in hostile environments;
handling toxic waste;
spot-welding and paint spraying environments;

robots can perform repetition;
uncomfortable, heavy, tiring tasks; ***[2 max]***

(b) *Award **[1]** for identifying reason and **[1]** for a description.*
reliability;
reduction in tolerances;
less error in assembly;
no fatigue – no lack in concentration;
responsible for measuring parts and rejecting failures;
24/7 working;
no training;
laser dimensioning;
automatic feedback; ***[2 max]***

(c) *Award **[1]** for stating and **[1]** for an appropriate reason.*

flexibility;
robots can be used to carry out other procedures by changing tool heads;

reprogramming;
robots can be reprogrammed to perform other functions;

cost effective;
old robots from precision assembly lines can be reprogrammed and reused in different environments;
speed or noise of robot may not be an issue to manufacturer; ***[2 max]***

C6. (a) *Award **[1]** for identifying a particular social issue for designers working in a CAD environment and **[1]** for each additional point in an explanation. **[3 max]**.*

working hours;

can be more flexible as people can work from home;
communication between manufacturer and designer could be at unsocial hours;
training – willingness of employees to adopt more flexible approaches to work and the recognition that they will need to retrain or update their skills as systems develop;

communication;

less communication in office environment due to possibility of reduced work force;
better communication with global workplace;
alienated;
lacks social interaction;
conferencing;
teamwork, designers can work as part of a team to create a number of parts for which they may be individually responsible / parts will be virtually assembled before manufacturing tooling; ***[3 max]***

(b) *Award **[1]** for identifying a particular way that CAM may contribute to efficient use of materials and **[1]** for each additional point in an explanation **[3 max]**.*

reduction in materials;

addiditive manufacturing techniques such as RP eliminate the wastage of materials;
RP uses less energy than conventional methods of manufacture / pollution levels reduced;
CAM can allow designers to investigate the redesign of products to reduce material, reduce energy consumption in manufacture and reduce transports cost;
nesting of parts when cutting from sheet material; ***[3 max]***

C7. *Award **[1]** for identifying a particular issue and **[1]** for each distinct correct point in an explanation. **[3 max]** for each issue.*

designer;
speed;
3D outcome shown to client;
performance Testing;
reduced R&D costs;
minimal waste;
intricate internal structures possible;

manufacturer;
short lead times for one-off products;
reduction in tooling costs;
flexibility;
3D outcome shown to client;

consumer;
reduced costs due to reduced R&D time;
customisation;
wider range of product available;
value for money; ***[9 max]***

Option D — Textiles

D1. (a) *Award **[1]** for stating the source of power used by the textile industry in Britain prior to its mechanisation in the Industrial Revolution.*
human muscle power; ***[1 max]***

(b) *Award **[1]** for each distinct point in a description of why the development of the textile industry resulted from a combination of market pull and technology push.*
demand was increasing for textile products hence market pull;
the textile industry benefited from other technological developments; ***[2 max]***

(c) *Award **[1]** for identifying a relevant factor and then **[1]** for each of two appropriate points relating to this factor – one for home working and one for factory working.*
noise;
factory working: generally much noisier environment than the home – employees would be likely to have to wear ear protection;
home working: likely to be much quieter environments – employees may have to wear ear protection when conducting particular noisy processes; ***[3 max]***

D2. (a) *Award **[1]** for stating one benefit of the EU Flower system for consumers.*
legal compliance;
opening new markets;
reducing costs;
EU Flower bearing products are often the preferred suppliers with certain sectors, especially the government sector; ***[1 max]***

(b) *Award **[1]** for identifying one way in which the environmental impact resulting from the care and maintenance of textile products in the home could be reduced by careful design of the textile product, and **[1]** for a brief explanation.*
finishing the fabric so it resists dirt;
washed less often / washed at lower temperatures;

finishing the fabric so that it is easy to iron or does not require ironing;
reduced energy consumption from not ironing the fabric; ***[2 max]***

D3. (a) *Award **[1]** for stating the meaning of each of the two symbols on the care label shown in Figure D3 apart from the Do not bleach and Do not iron symbols.*
wash using a gentle/delicate cycle;
tumble dry using a warm/medium temperature; ***[2 max]***

(b) *Award **[1]** for identifying a reason why it is important that an internationally-recognizable system of care instructions is used by manufacturers on care labels and **[1]** for a brief explanation.*
clothing products are global products and used in countries all over the world;
internationally-recognizable symbols without words can be readily understood without linguistic issues wherever the garments are used; ***[2 max]***

D4. *Award **[1]** for each of three distinct correct points in a discussion of one advantage and one disadvantage of using biometrics in the design of sports clothing, **[3 max]** for each issue.*

advantage:

biomimetic fabrics adapt ideas from natural animal and plant systems, *e.g.* shark skin;
imitating high performance natural systems can promote innovation in the development of new textile products;
can enhance human performance and provide advantages for users;

disadvantage:

sports clothing using biomimetic fabrics need to fit perfectly;
therefore there are special made-to-measure requirements;
this pushes up the price and may mean that those users who cannot afford to purchase them are disadvantaged; ***[6 max]***

D5. (a) *Award **[1]** for identifying one advantage for developing countries when large multinational companies establish textile manufacturing companies in their country and **[1]** for each of two distinct additional points of explanation.*

creates employment;
development of skills and competences;
contribution to economic development and poverty alleviation; ***[3 max]***

(b) *Award **[1]** for each of three distinct points in an explanation of one way in which fair trade regulations contribute to the sustainability of the textile industry.*

ensures that people in developing countries are not exploited;
under the fair trade regulations they should get a fair rate of pay for the work they do;
this makes the textile industry a good employment sector for individuals in developing countries; ***[3 max]***

D6. (a) *Award **[1]** for each distinct point in an explanation of one challenge for the development of wearable computing garments.*

interaction of devices with body is complex;
comfort is affected by weight distribution;
designers need to promote comfort to create a market for wearable computing garments;

price;
stretch is limited;
this means that wearable computing garments have to be made for a wider range of sizes;

wearable computing garments are produced for standard sized (homogenized) humans;
craft production is an option;
this has worked for the luxury markets;

care/maintenance is a key issue;
wearable computing garments are not necessarily easy to launder;
maintenance of connections between wires and devices are an issue; ***[3 max]***

(b) *Award **[1]** for each distinct point in a discussion of one benefit of aligning the wearable computing market more closely with the fashion market.*
fashion market tends to be high cost with bigger profit margins or high volume;
alignment of the wearable computing market with the fashion market would increase the volume of sales;
this would reduce the cost-effectiveness of production and would push the price down making them more accessible; ***[3 max]***

D7. *Award **[1]** for identifying each of three aspects of the global impact of branded textile products and **[1]** for each of two points of explanation for each aspect, **[3 max]** per aspect.*

erosion of traditional cultural values and development of a youth culture;
branded products are "cool" and are much sought after by young (and older) people;
this contributes to the development of a generation whose allegiances are not rooted in traditional values;

price;
the branded products command high prices in the market place;
coupled with manufacture often in developing countries this results in high profit margins;

many (not all) branded textile products are produced in sweatshops where people are exploited;
they challenge the concept of ethical consumerism where fair trade and appropriate employment practices would be required;
corporate social responsibility has become a way in which brands manage negative publicity around these issues; ***[9 max]***

Option E — Human factors design

E1. (a) *Award **[1]** for the correct answer.*
1015 mm or 1.015 m; ***[1 max]***

(b) *Award **[1]** for the percentile and **[1]** for identifying it as male.*
50th percentile;
male; ***[2 max]***

(c) *Award **[1]** each for three points in an outline **[3 max]**.*
provide stability for intricate tasks;
stool cannot be easily moved away from the workbench;
stool is available when required; ***[3 max]***

E2. (a) *Award **[1]** for a correct statement.*
video;
magnetic device;
electromechanical device; ***[1 max]***

(b) *Award **[1]** for identifying an advantage and **[1]** for a description.*
customer viewing;
customer can see what clothes would look like on an electronic model of themselves;

remote purchasing;
customer can see clothes digitally and make purchase decisions without being at the location; ***[2 max]***

E3. (a) *Award **[1]** for identifying the method and **[1]** for stating how it would help identify the problem **[2 max]**.*
prototype testing / user trial;
users would highlight the problem; ***[2 max]***

(b) *Award **[1]** for the solution and **[1]** for a description **[2 max]***

automatic seal;
when the cap is unscrewed, the seal is broken;

directions;
provide a small label with directions;

alternative seal;
provide a tab for a pull-off seal;

discard toothpaste;
pre impregnate toothbrush with paste; ***[2 max]***

E4. *Award **[1]** for the identification of each characteristic **[2 max]** and **[2]** for each distinct point in a discussion of the characteristics **[4 max]**.*
***[6 max]** in total.*

intuitive logic and organization;
expect control buttons to be close to function;
not logical placement of controls;
not the case in Figure E3;

memory burden;
high memory burden/need to memorize controls;
may misfunction if controls not learnt; ***[6 max]***

E5. (a) *Award **[1]** for each force listed **[2 max]**.*
torque;
friction; ***[2 max]***

(b) *Award **[1]** for naming a method and **[1]** for a point in an outline of the method **[2 max]**.*

user trial;
trial prototypes with the target population;
motion capture;
analyse how limited hand movements operate;
prototyping;
trial prototypes with the target population;
collect anthropometric data;
use relevant data in the product design; ***[2 max]***

(c) *Award **[1]** for a variable and **[1]** for a point in an elaboration of the variable. **[2 max]**.*
materials used;
plastic/metal;
texture;
rough/smooth;
size;
large/smooth; ***[2 max]***

E6. (a) *Award **[1]** for naming one of the four pleasure areas and **[2]** for explaining how it relates to the iPod design **[3 max]**.*

physio-pleasure;
smooth feel of the plastic surface;
subtle click of the wheel;

psycho-pleasure;
easy download of music;
ease of organizing music into groups;

socio-pleasure;
certain status conveyed by owning an iPod;
others jealous of ownership;

ideo-pleasure;
"cool" design;
minimalist design by hiding features; ***[3 max]***

(b) *Award **[1]** for each point in an explanation **[3 max]**.*
the framework provides a structured approach;
the framework can act as a practical tool;
the framework helps ensure a consideration of all relevant variables;
the framework can be the basis of a methodical approach;
the framework can help ensure a thorough analysis of all variables; ***[3 max]***

E7. *Award **[1]** for naming each of three factors **[3 max]** and **[2]** for each point in an explanation of the conflict between the factor and a design aim **[6 max]**.*
***[9 max]** in total.*

temperature;
some food must be kept cool/warm;
people may want a warm/cool working temperature;

light;
bright light needed for work areas;
may be more expensive to run more lights;

ventilation;
odors need to be ventilated out;
increased cost of ventilation systems;

colour;
cool colours may be most appropriate in a busy kitchen;
may conflict with house colour scheme; ***[9 max]***

IB DIPLOMA PROGRAMME
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SPEC/4/DESTE/SPM/ENG/TZ0/XX

DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 1

SPECIMEN PAPER

45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

11 pages

1. What type of model is the IB design cycle model?

A. Physical

B. Mathematical

C. Graphical

D. Flow chart

2. The design specification is relevant to which stage of the design process?

I. Identifying needs

II. Developing solutions

III. Evaluating

A. I, II and III

B. I and II

C. I and III

D. II and III

3. Which ideas-generating technique involves analysing a range of products in relation to their main features and then considering different ways of improving them to generate new ideas?

A. Morphological synthesis

B. Attribute listing

C. Brainstorming

D. Analogy

4. What is **not** true of a clay model?

A. It can be used to test forces

B. It requires skill to develop

C. It looks like the intended outcome

D. It can be used to communicate design ideas to clients

5. Which type of graphical communication uses the technique of foreshortening?

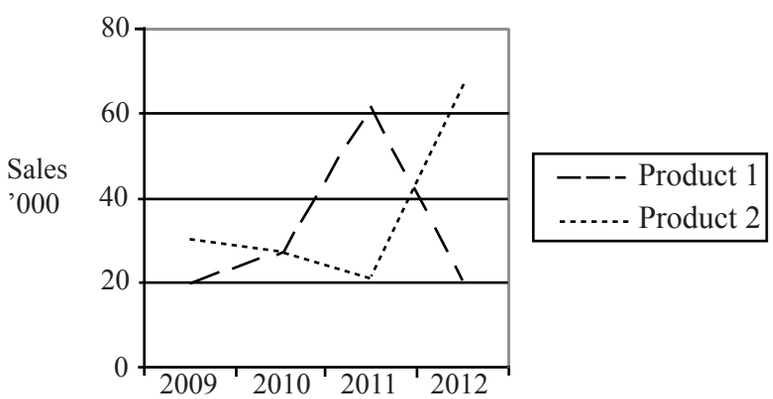
A. Isometric

B. Exploded isometric

C. Perspective

D. Orthographic

6. In 2012, at what stage of their life cycle are the products shown in the graph below?



	Product 1	Product 2
A.	Mature	Early
B.	Late	Mature
C.	Late	Early
D.	Early	Mature

7. Why is the iPod pictured in Figure 1 an example of dominant design?

Figure 1: iPod

A. It is the best-selling music player in the market place

B. Its features are recognized as essential

C. It is the longest-selling music player

D. It is the outcome of incremental changes

8. What is an advantage to a company of adopting a pioneering corporate strategy?

A. It is a costly strategy

B. It requires a strong research and development capacity

C. It provides access to market research

D. It has the potential for high profits

9. Which technique for joining components facilitates design for disassembly?

A. Using a thermoset adhesive

B. Using a thermoplastic adhesive

C. Welding

D. Riveting

10. Which combination of "market" and "environmental impact" is most likely to make a product category a target for life cycle analysis?

	Market	Environmental impact
A.	Global	High
B.	Global	Low
C.	Local	High
D.	Local	Low

11. What would be the most appropriate timber to use for an outdoor picnic table?

A. Veneered hardwood

B. Particle board

C. Plywood

D. Treated pine

12. What factors are important in considering timber as a renewable resource?

I. Growth rates

II. Durability

III. Markets

A. I only

B. II only

C. III only

D. I, II and III

13. What is **one** result of the plastic deformation of metal?

A. Increased grain size

B. The metal is work hardened

C. The metal becomes more malleable

D. The metal becomes an alloy

14. Why are superalloys used in rocket engines?

A. Their strength decreases as temperature increases

B. They do not resist oxidation

C. They are easy to produce

D. They do not creep

15. Why is glass increasingly used as a structural material?

A. It has high electrical conductivity

B. It can resist high compressive forces

C. It is easy to recycle

D. It is cheap

16. What is the term given to a material that gives off a small electrical charge when deformed?

A. Smart material

B. Composite alloy

C. Piezoelectric

D. Electro-rheostatic

17. What material would **not** be joined by fusing?

A. Food

B. Plastic

C. Timber

D. Composites

18. What is the most likely scale of production for the user trial of plastic drink containers?

A. Craft

B. Batch

C. One-off

D. Volume

19. In which of the following products would variable costs be more significant than fixed costs in determining the final price?

A. Extruded thermoplastic pipe

B. A CNC-produced clothing

C. Craft-produced furniture

D. An injection-moulded tap washer

20. What would be the cost factors associated with producing plastic furniture by injection moulding?

	Labour costs	**Capital Costs**
A.	Low	Low
B.	High	High
C.	Low	High
D.	High	Low

21. How would the bodies of the metal cooking pots shown in Figure 2 be produced?

Figure 2: Cooking pots

A. Casting

B. Machining

C. Extruding

D. Sintering

22. Which percentile range needs to be considered in determining the range of adjustability of the driver's seat in a car?

A. 5th – 95th

B. 5th

C. 50th

D. 95th – 100th

23. Which combination of "material obsolescence" and "technological obsolescence" encourages reuse?

	Material obsolescence	Technological obsolescence
A.	Obsolete	Obsolete
B.	Not obsolete	Not Obsolete
C.	Obsolete	Not obsolete
D.	Not Obsolete	Obsolete

24. What would be the best method to evaluate the durability of a new fabric?

A. User trial

B. Expert appraisal

C. Performance test

D. User research

25. What would be the most relevant test criterion to evaluate by crash testing a car?

A. Material durability

B. Ease of use

C. Performance

D. Safety

26. Which criterion would consumers apply to evaluate long-term use of a product?

A. Ease of maintenance

B. Aesthetics

C. Purchase price

D. Advertising

Questions 27–30 relate to the following case study. Please read the case study carefully and answer the questions.

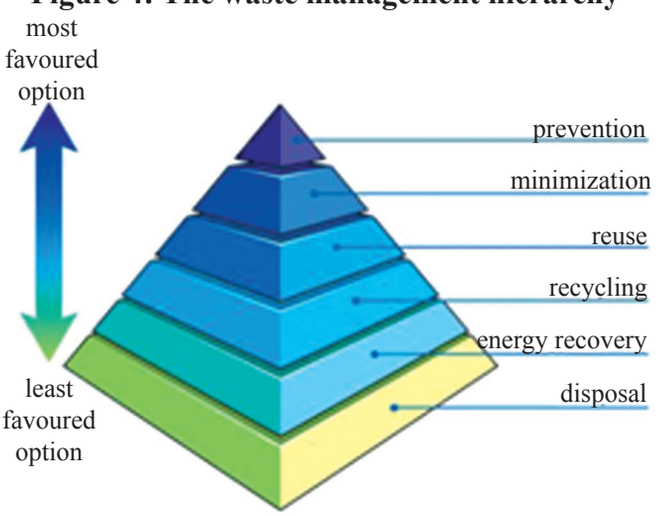
CASE STUDY

"Dead cars" or "End-of-life Vehicles" (ELVs) have until recently been crushed for disposal in landfill sites. This is unsightly (**Figure 3**) and dangerous. It is the least favoured option in the waste management hierarchy (**Figure 4**). European take back legislation adopts the key principle that the "polluter pays". It will force better design of cars for disassembly. An ELV's last owner should be able to take it to an authorised facility for treatment and recovery at no cost. By 2015 the legislation requires 95 % reuse and recovery from ELVs. ELVs comprise a range of components and the cost of disassembly is high unless considered at the design stage. A range of design for disassembly (DfD) strategies can facilitate material recovery, for example:

- use the minimum number of different materials
- colour code materials to facilitate separation
- avoid adhesives
- do not mix materials in producing components and sub-assemblies
- avoid coatings
- use thermoplastics not thermosetting plastics

Figure 3: Disposal of cars in landfill sites

Figure 4: The waste management hierarchy



27. What is **not** an advantage of DfD for manufacturers?

A. Reduced manufacturing times

B. Fewer parts

C. Reduced costs for stocks of raw materials and components for production

D. Lower design costs

28. If there was a conflict of design considerations, which one must be prioritized over DfD?

A. Safety

B. Aesthetics

C. Ease of use

D. Construction

29. Which material for use in car manufacturing meets the DfD guidelines listed above?

A. Varnished timber

B. Polyurethane

C. Laminated glass

D. Polypropene

30. Which category of smart materials can be used to design screws that retract their threads when heated above a trigger temperature so they fall out of their holes facilitating the separation of components from ELVs?

A. Shape memory alloys

B. Magneto-rheostatic materials

C. Electro-rheostatic materials

D. Piezoelectric materials

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MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Standard Level

Paper 1

2 pages

1.	C	16.	C	31.	–	46.	–
2.	D	17.	C	32.	–	47.	–
3.	B	18.	B	33.	–	48.	–
4.	A	19.	C	34.	–	49.	–
5.	C	20.	C	35.	–	50.	–
6.	B	21.	A	36.	–	51.	–
7.	B	22.	A	37.	–	52.	–
8.	D	23.	D	38.	–	53.	–
9.	B	24.	C	39.	–	54.	–
10.	A	25.	D	40.	–	55.	–
11.	D	26.	A	41.	–	56.	–
12.	A	27.	D	42.	–	57.	–
13.	B	28.	A	43.	–	58.	–
14.	D	29.	D	44.	–	59.	–
15.	B	30.	A	45.	–	60.	–

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DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 2

SPECIMEN PAPER

1 hour

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

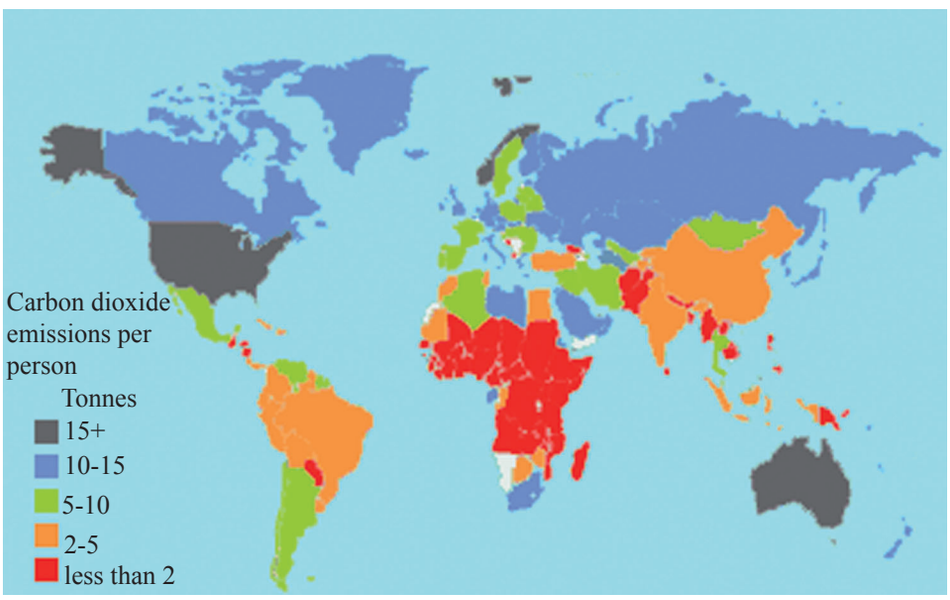
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

SECTION A

*Answer **all** the questions in the spaces provided.*

1. **Figure 1** shows the carbon footprint for different countries. **Figure 2** shows global concentration of CO^2 from 1870 - 2000 and **Figure 3** shows variations in global land temperature from 1870 - 2000.

Figure 1: Carbon footprint by country



[Source: www.nef.org.uk/images/co2tonne.gif]

Figure 2: Global concentration of CO^2 1870-2000

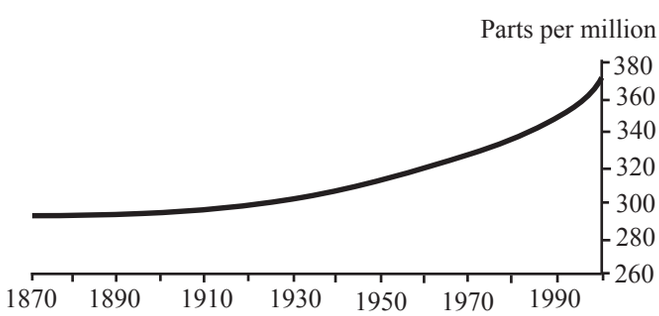
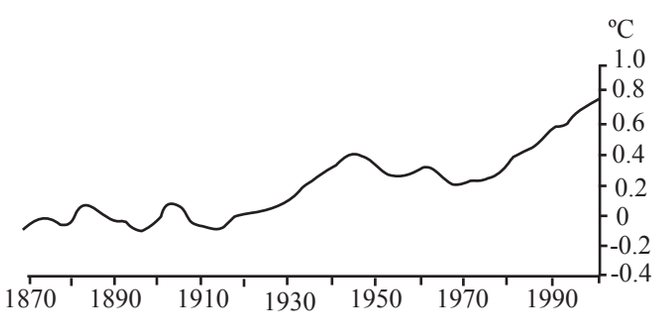


Figure 3: Variations in global land temperature 1870-2000



(This question continues on the following page)

(Question 1 continued)

(a) (i) State the general relationship between the northern and southern hemisphere countries in relation to carbon emissions per person. *[1]*

. . . . . .

. . . . . .

(ii) Outline **one** reason for the answer to question (a) (i). *[2]*

. . . . . .

. . . . . .

. . . . . .

(iii) Compare the graphs in Figure 2 and Figure 3 for the period 1910-1950. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(b) (i) State the global concentration of carbon dioxide in the atmosphere for the year 2000. *[1]*

. . . . . .

. . . . . .

(ii) Calculate the percentage increase in global concentration of carbon dioxide in the atmosphere from 1940 to 2000. *[2]*

. . . . . .

. . . . . .

. . . . . .

(c) Suggest **one** influence of the product life cycle on carbon dioxide concentrations in the atmosphere shown by the data in Figure 2. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

2. (a) State **one** characteristic of glass which make it popular for use as a packaging material. *[1]*

. . . . . .

. . . . . .

(b) Outline **one** reason why plastic has replaced glass for many types of packaging. *[2]*

. . . . . .

. . . . . .

. . . . . .

3. (a) Outline the pre-production stage of life cycle analysis. *[2]*

. . . . . .

. . . . . .

. . . . . .

(b) Explain the use of an environmental assessment matrix from a designer's point of view. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

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SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

4. **Figure 4** shows a product called the Driron which dries and irons clothes. It is made in Spain by the Fagor company, costs 1600 Euros (2000US$) and took 3 years of research and development to get it to market. Clothes are hung inside the machine and weighed down with clip-on attachments. The heat dries the clothes and also creates the steam used to eliminate wrinkles. Small objects such as socks or underwear are placed in the rack at the top. After two hours in the Driron clothes are dry and wrinkle free.

Figure 4: The Driron by Fagor

[Source: www.mcc.es/imgnews/F_Fagor_Dririnl.jpg]

(This question continues on the following page)

(Question 4 continued)

(a) (i) State the most likely scale of production for the Driron. *[1]*

(ii) Outline **one** reason why the company would adopt the scale of production stated in (a) (i). *[2]*

(b) Outline **one** disadvantage of the Driron in relation to green design. *[2]*

(c) (i) Explain **one** performance test which may have been used in the design cycle of the Driron. *[3]*

(ii) Compare the likely design costs and research and development costs of the Driron as proportions of the final cost of the product. *[3]*

(d) Discuss **three** strategies the company could use to market the Driron. *[9]*

5. **Figure 5** shows a pencil case made from a recycled car tyre. Its produced by the Remarkable Stationary company which manufactures a range of products made from recycled materials. Each product advertises boldly what it has been recycled from *e.g.* "I used to be a car tyre". Manufacturing the pencil case from a recycled tyre is more expensive than manufacturing it from virgin materials.

Figure 5: The remarkable pencil case

(a) List **two** mechanical properties important to the choice of a material for manufacturing the pencil case. *[2]*

(b) Explain how the structure and bonding of the thermoplastic material used to make the car tyre contributes to its ease of recycling. *[3]*

(c) (i) Define *value-for-money*. *[1]*

(ii) Outline **one** reason why consumers may consider the pencil case value-for-money. *[2]*

(iii) Suggest **one** reason why the use of a recycled car tyre makes the pencil case more expensive to manufacture than a conventional approach. *[3]*

(d) Suggest **three** possible aspects of the Remarkable Stationary company corporate strategy for green design. *[9]*

6. **Figure 6** shows the EVT 168 scooter made in Taiwan. Its top speed is 56 km/h and it has a range of 50 km before the battery needs a recharge. It is marketed as a very quiet machine and costs US$ 3900.

Figure 6: The EVT 168 scooter

[Source: www.electricbikesales.co.uk/shop/images/uploads/EVT_168_frontside_500.jpg]

(a) (i) State the percentile range used to design the adjustable seat. *[1]*

(ii) Outline **one** ergonomic consideration for the design of the handlebars. *[2]*

(b) Outline **one** disadvantage of the scooter operating very quietly. *[2]*

(c) Evaluate the use of a composite material for the body of the scooter. *[3]*

(d) Explain **one** influence of fashion on the design of the scooter. *[3]*

(e) Discuss the concepts of repair, re-use and reconditioning in relation to the design of the scooter. *[9]*

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MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Standard Level

Paper 2

7 pages

SECTION A

1. (a) (i) *Award **[1]** for:*
much higher in the north; ***[1 max]***

(ii) *Award **[1]** for identifying the reason referring to consumerism and **[1]** for each point relating it to increase in CO^2 emissions:*
much greater prosperity in the northern hemisphere which leads to increased consumerism;

incinerated waste;
more vehicles;
more manufacturing plants;
more use of non-renewable energy; ***[2 max]***

(iii) *Award **[1]** per distinct point:*
figure 2 shows a gradual increase for the period;
figure 3 shows a sharp increase to 1940;
then a decline to 1950; ***[3 max]***

(b) (i) *Award **[1]** for:*
370 parts per million ***[1 max]***

(ii) *Award **[1]** for identifying the correct data and **[1]** for calculating the right answer*:
370–300=70;
= 23.3 %;
(accept 23 %) ***[2 max]***

(c) *Award **[1]** for referring to the fact that product life cycles for most products have shortened since the introduction of mass production and **[2]** for two distinct points concerning the effects of the shortened life cycle.*
more materials used*;*
more fossil fuels used*;*
more energy used; ***[3 max]***

2. (a) *Award **[1]** for any of:*
transparency;
resistance to chemicals / moisture;
easy to clean;
easy to mould into shape;
cheap; ***[1 max]***

(b) *Award **[1]** per reason and **[1]** for a brief outline.*
safer;
if damaged;
density;
lighter to carry;
durability;
as does not break easily*;*
cheaper;
easier to manufacture;
choice of materials;
as many different types of plastic to choose from; ***[2 max]***

3. (a) *Award **[1]** for each distinct point:*
decisions taken at stages of the design cycle;
which impact on the environmental aspect of the matrix; ***[2 max]***

(b) *Award **[1]** per distinct point in a suitable explanation similar to*:
designers can use the matrix to assess the impact of decisions taken at stages of the design cycle;
on the subsequent product cycle;
and the environment; ***[3 max]***

SECTION B

4. (a) (i) *Award **[1]** for:*
batch; ***[1 max]***

(ii) *Award **[1]** for identifying a reason and **[1]** for relating it to the scale of production in (a) (i).*
new product;
so no volume market yet*;*
if it sells well;
the company would want to produce different versions; ***[2 max]***

(b) *Award **[2]** for:*
uses two hours of energy to dry the clothes;
which is not good for the environment; ***[2 max]***

(c) (i) *Award **[1]** for identifying a suitable test and **[2]** for showing its relevance to the design*
materials test;
to see the effect of heat on different textiles*;*
and when applied at regular intervals;
heat test;
to see how much heat is required to dry and iron the clothes;
and for how long; ***[3 max]***

(ii) *Award **[3]** for:*
took 3 years to develop so high R&D costs*;*
design costs not so high;
as effectively it's a cabinet with racking; ***[3 max]***

(d) *Award **[3 max]** for each strategy **[max 3 strategies]**:*
market penetration;
target existing customers of the company's products to persuade them to buy the new product;
or target existing customers of similar products by competitors*;*
market segmentation;
target specific customers;
by age; lifestyle; culture etc.;
market sector;
target consumers in relatively wealthy countries;
as the Driron is an expensive product;
market development;
develop the existing market for clothes driers;
and consumers who pay for their clothes to be ironed; ***[9 max]***

5. (a) *Award **[1]** each for any two*:
tensile strength;
stiffness;
toughness; ***[2 max]***

(b) *Award **[3]** for*:
linear chain molecules;
with weak secondary bonds between the chains;
which means that the bonds can be broken down easily for recycling; ***[3 max]***

(c) (i) *Award **[1]** for*:
the relationship between what something is worth and what it costs; ***[1 max]***

(ii) *Award **[2]** for*:
the pencil case costs more than others;
but consumers may perceive its green credentials as worth paying for; ***[2 max]***

(iii) *Award **[1]** per distinct point*:
car tyres need to be collected and taken to a recycling plant;
to volume produce pencils many car tyres are needed;
these tyres will be collected from various locations which will add to the cost of recycling the tyres;
car tyres are made from more than one material; ***[3 max]***

(d) *Award **[3 max]** for each strategy **[max 3 strategies]***:
increasing market for green products;
the company wants to capitalize on this market;
so it spends money on R&D to develop green products;

company image;
the company wants to be seen to be promoting green design;
so it promotes its strategy boldly on its products;

economics;
in some countries there may be tax or trade concessions for using recycled materials;
which makes the extra manufacturing cost feasible;

legislation;
legislation relating to sustainability is in place in some countries;
and the company may be anticipating more such legislation in the future;

moral and social values;
the company may have an ethos of ethical design;
and be taking a longer term view of sustainability; ***[9 max]***

6. (a) (i) *Award **[1]** for*:
5^{th} – 95^{th} adult (accept 2.5^{th} – 97.5^{th}); ***[1 max]***

(ii) *Award **[1]** per consideration and **[1]** for a suitable outline.*
anthropometric data;
relating to 50^{th} percentile adult handsize;
texture of the material;
in relation to grip;
shape of handlebars;
in relation to grip; ***[2 max]***

(b) *Award **[1]** for referring to safety and **[1]** for relating safety to noise made by scooter*:
scooters often weave in and out of traffic;
and other road users rely on hearing them approach;

pedestrians often hear a scooter approaching;
before seeing them; ***[2 max]***

(c) *Award **[1]** for each distinct point in a suitable explanation*:
good for moulding into curved / subtle shapes;
resistance to moisture;
little maintenance required;
able to build in extra strengthening in parts affected by stress concentrations;
low density so helps conserve resources;
expensive; ***[3 max]***

(d) *Award **[1]** for each distinct point up to **[3 max]** for an explanation of one issue*:
colour;
uses colours fashionable at the time;
and which are appealing to young people;
style;
retro which has appeal to a young market;
and to older market (nostalgia);
materials;
uses lots of chrome fittings;
which creates a traditional image; ***[3 max]***

(e) *Award **[1]** for each distinct point in a discussion referring to repair, re-use and reconditioning **[3 max]** for reference to each aspect:*
repair:
availability of parts;
ease of replacement of parts;
DIY possibility;
accessibility of parts;
cost of parts;
repair of body (scratches, dents, *etc*.);

re-use:
use of standardised parts;
ease of disassembly;
second hand sales;
extending life cycle;

reconditioning:
recondition the engine to lengthen its life;
respray the body to change its colour or style;
recondition other parts which are affected by wear before they become faulty; ***[9 max]***

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SPEC/4/DESTE/SP3/ENG/TZ0/XX

DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 3

SPECIMEN PAPER

1 hour

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

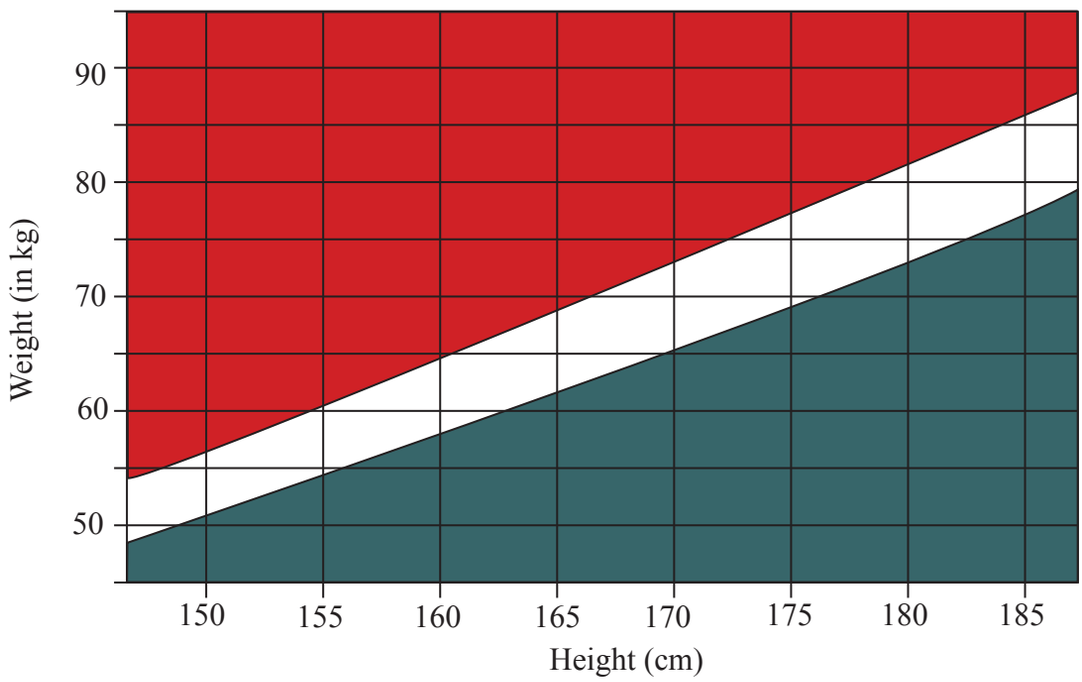
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from one of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

28 pages

Option A — Food science and technology

A1. Body mass index, BMI, is generated by dividing a person's weight in kilograms by height in metres squared. A BMI of 20-25 is considered normal, one of >25 is considered overweight bringing risk of increased mortality and one of >30 is considered obese bringing risk of significantly increased mortality through a range of conditions including diabetes, heart conditions, cancer and high blood pressure. **Figure A1** graphically illustrates underweight (BMI <20 in blue), normal (BMI 20-25 in white) and overweight (BMI >25 in red) weight for height data.

Figure A1: Graphic illustration of underweight, normal and overweight data



(a) Calculate the BMI of a man whose weight is 90 kg and height 1.70 m. *[1]*

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(b) Outline **one** disadvantage of using Figure A1 rather than calculating BMI for the man described in A1(a). *[2]*

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(This question continues on the following page)

(Question A1 continued)

(c) Explain how overweight and obesity are caused. *[3]*

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A2. (a) State the name of **one** commonly used emulsifying agent. *[1]*

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(b) Describe the role of an emulsifier in stabilizing a food emulsion. *[2]*

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A3. List **two** drivers for the development of new food products. *[2]*

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A4. Figure A2: Macronutrient information from a potato crisps (chips) packet

Nutrition Facts	
Serving Size 1 package 28.3 g	
Servings per container 1	
Amount per serving	
Calories 160	Calories from fat 90
	% Daily value*
Total Fat 10 g	16 %
Saturated fat 3 g	15 %
Trans fat 0 g	
Cholesterol 0 mg	0 %
Sodium 160 mg	7 %
Total Carbohydrate 14 g	5 %
Dietary Fibre 1 g	4 %
Sugars 0 g	
Protein 2 g	

* Percent Daily Values are based on a 2000 Calorie/day diet.

(a) Calculate the amount of unsaturated fat per 100 g of potato crisps (chips). *[2]*

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(b) Outline **one** reason why the amounts of saturated fat, trans fat and cholesterol are identified amongst the Nutrition Facts on the packet of potato crisps (chips). *[2]*

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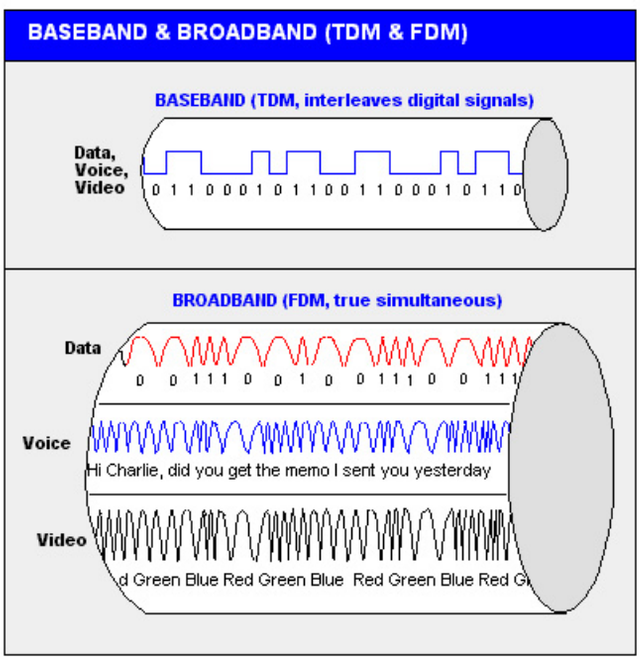
A5. Discuss how health awareness affects food choice with reference to **two** nutritional issues. *[6]*

A6. Explain how **three** different types of rancidity are important in the shelf life of food products containing fats and oils. *[9]*

Option B — Electronic product design

B1. Frequency division multiplexing (see **Figure B1**) is widely used in modern communications systems. Consider a communication link with a bandwidth of 100 MHz. The link provider divides the available bandwidth into smaller bandwidths and allocates them to individual users who can then simultaneously use the communication link. The size of the bandwidth needed depends on the application – typical bandwidths for various applications are shown in **Table B1**.

Figure B1: Multiplexing



[Source: http://img.tfd.com/cde/BASEBAND.GIF]

Table B1: Typical signal bandwidths

Signal	Bandwidth
Voice	3 kHz
Analogue Television Broadcast	6 MHz
Standard Telphone	56 kHz
Broadband Internet	0.5 MHz

(a) State an alternative to frequency division multplexing. *[1]*

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(b) Calculate the number of broadband internet connections that could simultaneously use a communication link with a bandwidth of 100 MHz. *[2]*

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(This question continues on the following page)

(Question B1 continued)

(c) Explain the considerations a commercial communication link provider might identify when developing a pricing policy. *[3]*

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B2. (a) Define *time constant.* *[1]*

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(b) Outline how an understanding of time constant helps in circuit design. *[2]*

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B3. Safety is a key aspect for public transport systems, *e.g.* it is critically important that doors on a train are only allowed to open under clearly prescribed conditions. Three conditions are required for a door to open on any particular carriage of the train, as follows:

A. The train is stopped in the station;
B. The driver has signalled the "all clear";
C. A passenger in the carriage has pressed a door release button.

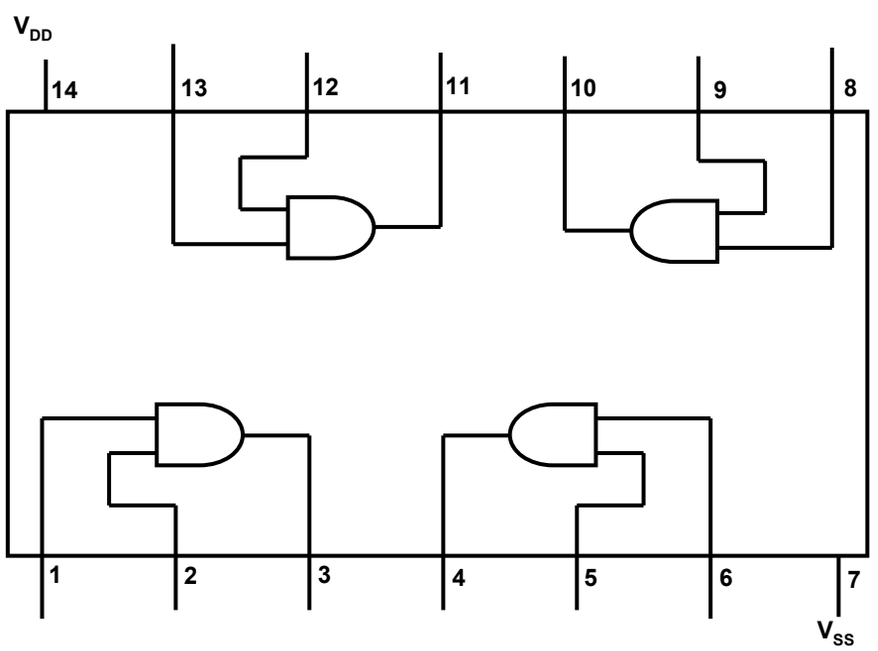
(a) Complete the truth table shown in Table B2 to show the behaviour of the logic gate required to ensure that the door opens appropriately. *[2]*

Table B2: Truth table

A	B	C	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

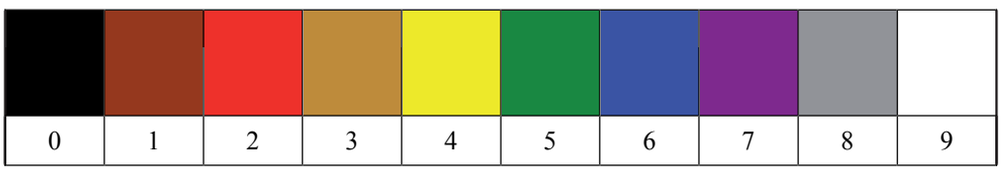
(b) Using the Quad 2-input **AND** gate shown in Figure B2, complete the circuit to achieve the truth table in Table B2. *[2]*

Figure B2: Quad 2 - input AND gate

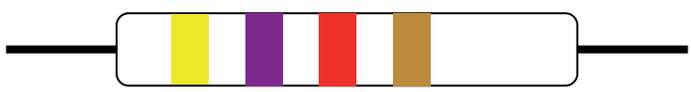


B4. Resistor values are normally shown using coloured bands. Each colour represents a number as in **Figure B3** for E12 series resistors. Most resistors have four bands: the first band indicates the first digit; the second band indicates the second digit; the third band indicates the number of zeros; the fourth band shows the tolerance (precision) of the resistor (gold represents + 5 % and silver + 10 %).

Figure B3: E12 colour series



Identify the value of the following resistor:



[2]

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B5. (a) Explain the advantage of using a PIC in the development of the electronic circuitry for a hearing aid. *[3]*

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(b) Explain how the use of PICs in the design of a hearing aid is consistent with the objectives of sustainable development. *[3]*

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B6. Discuss **three** issues for a mobile phone manufacturer relating to the adoption of generic standards. *[9]*

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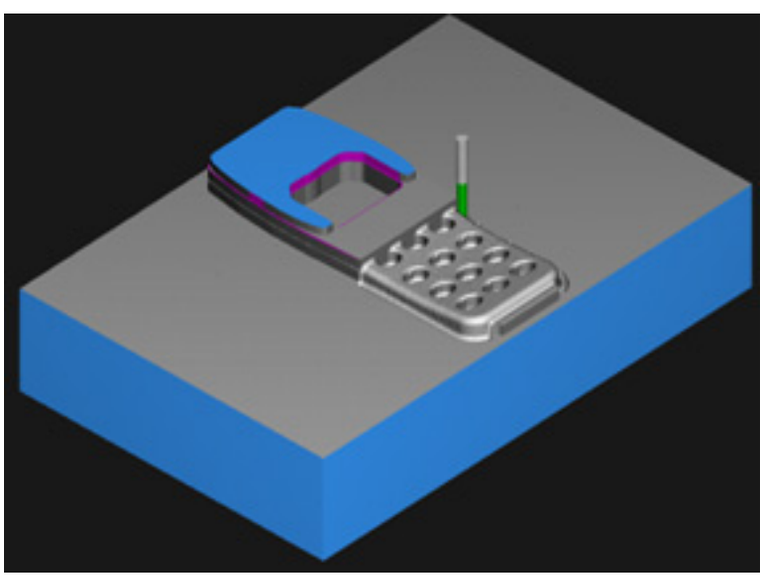
Option C — CAD / CAM

C1. CNC machinery uses a range of tooling, feed speeds and depth of cut in order to increase accuracy of detailing and reduce manufacturing time. **Table C1** shows a range of cutting tools and their cutting detail. Figures in blue refer to a roughing cut. Figures in red refer to a finishing cut. **Figure C1** shows a simulation of a CNC Router profile cutting a model mobile phone.

Table C1: CNC Router Post processing tool library

Tool Index	Description	Diameter (mm)	Length (mm)	Depth (mm)	Feed (mm/min)	Speed (rpm)	Stepover (%)
1	Ball End Cutter	3.00	15.00	4.00 (1.00)	300 (600)	3000 (3000)	95 (15)
2	Ball End Cutter	6.00	20.00	4.00 (1.00)	400 (600)	2500 (2500)	95 (10)
3	Slot Drill Cutter	6.00	7.5	4.00 (1.00)	300 (600)	2500 (2500)	95 (10)
4	Slot Drill Cutter	10.00	22.00	400 (1.00)	200 (600)	2000 (2000)	95 (7)
5	Engraving Cutter	3.00	5.00	0.2	500	5000	0
6	Engraving Cutter	6.00	10	0.2	500	3000	0

Figure C1: Graphic image of CNC manufacturing simulation



(This question continues on the following page)

(Question C1 continued)

(a) State the stepover percentage for a 3 mm ball end cutter on a finishing cut. *[1]*

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(b) Calculate the tool stepover dimension for a 6 mm slot drill cutter on a finishing cut. *[2]*

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(c) Explain why a 10 mm Slot Cutter and a 3 mm ball end tool would be used to manufacture the part in Figure C1. *[3]*

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C2. (a) State the term given to profile cutting in a circular path. *[1]*

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(b) List **two** pieces of information required to convert a 3D CAD drawing into a CNC file. *[2]*

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C3. **Figure C2: 3D drawing of a wheel for a trolley**

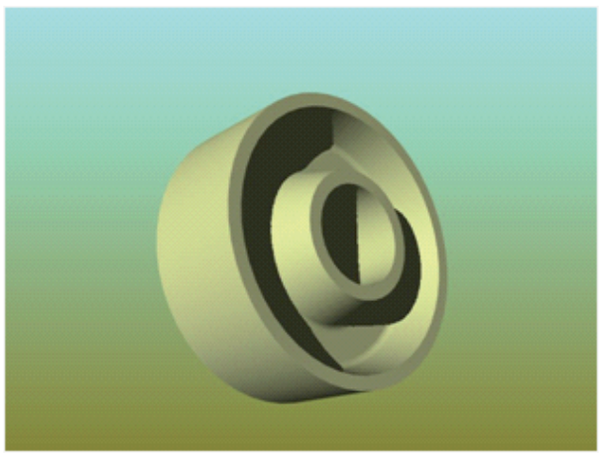
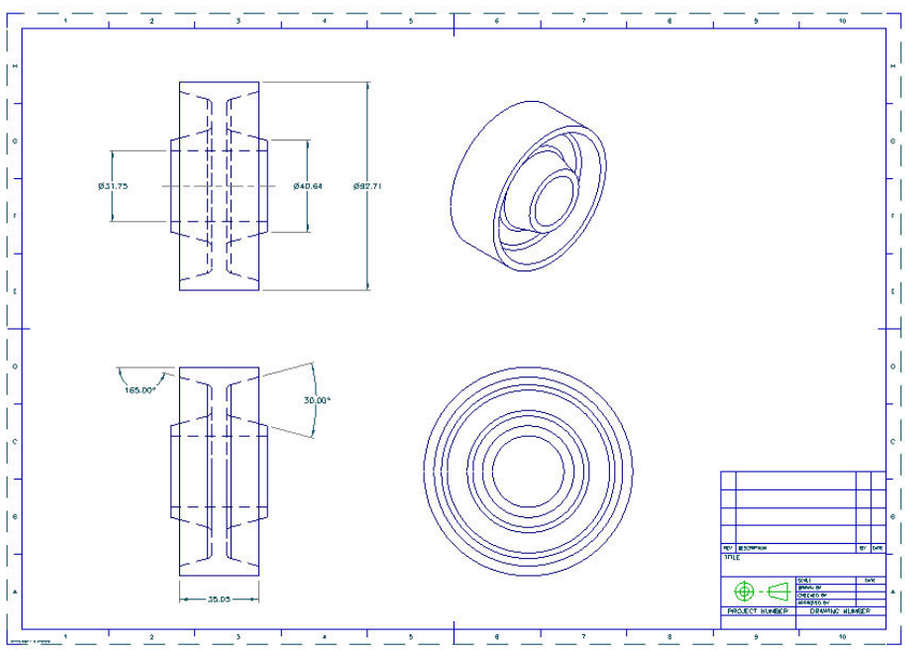


Figure C3: Orthographic Drawing of a wheel for a trolley



(a) Outline why the 3D drawing of the wheel in Figure C2 is most likely to have been created first. *[2]*

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(b) Outline a reason why a 2D drawing is generated. *[2]*

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C4. List **two** benefits of using lost wax casting for jewellery manufacture. *[2]*

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C5. Discuss **two** issues relating to the use of CAM to produce furniture from manufactured boards. *[6]*

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C6. Discuss advantages of rapid prototyping for the designer, manufacturer and consumer. *[9]*

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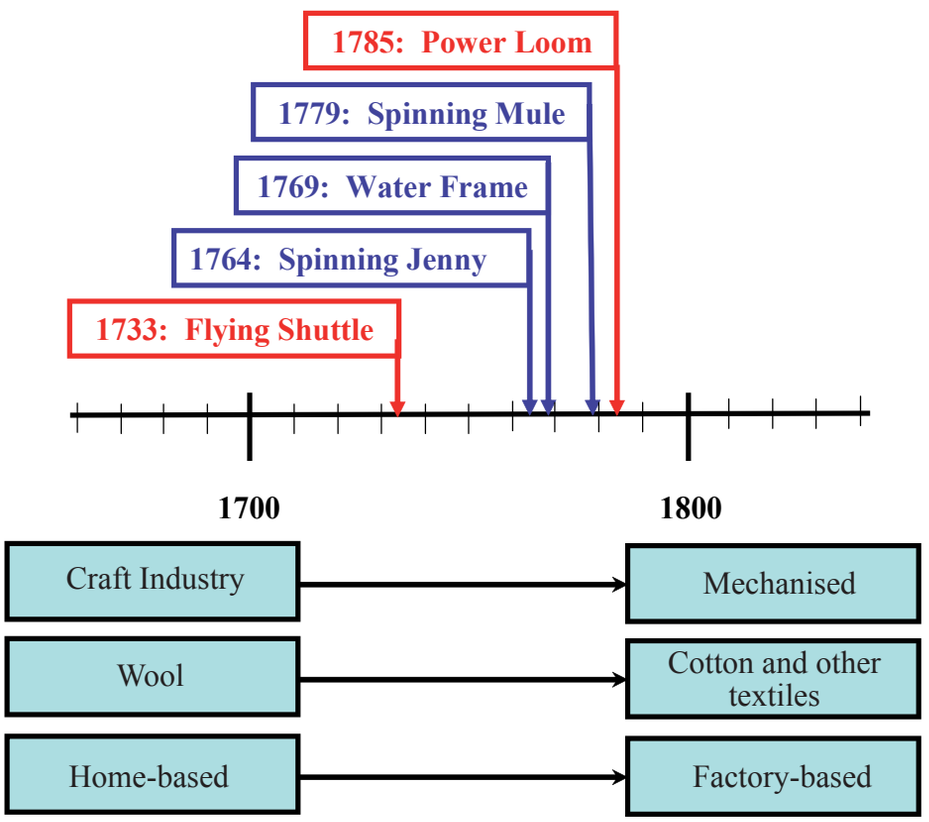
Option D — Textiles

D1. Prior to the middle of the 18th Century the British textile industry was a craft industry. Families worked together at home to clean, comb, spin, dye and weave wool into cloth – a very slow process. During the 18th Century demand for textile, especially cotton, products increased. A series of important inventions (see **Figure D1**) relating to various aspects of the spinning (shown in blue) and weaving (shown in red) processes transformed the British textile industry.

Figure D1: Key inventions in the development of the British textile industry



The Flying Shuttle allowed wider cloth to be produced more quickly. The Spinning Jenny allowed more threads of cotton to be spun simultaneously. Both the Flying Shuttle and the Spinning Jenny were small enough to be used in cottages. However, the Water Frame was powered by a watermill – it was too large for a cottage and too expensive for an individual family and forced spinning into factories. When the Power Loom was adopted weaving too shifted from cottages to factories.

(This question continues on the following page)

(Question D1 continued)

(a) State the source of power used by the textile industry in Britain prior to its mechanisation in the Industrial Revolution. *[1]*

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(b) Describe why the development of the textile industry resulted from a combination of market pull and technology push. *[2]*

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(c) Compare **one** impact on British textile workers of working in a factory rather than working at home. *[3]*

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D2. (a) State **one** source of wool. *[1]*

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(b) Describe how wool fibres are converted into yarn. *[2]*

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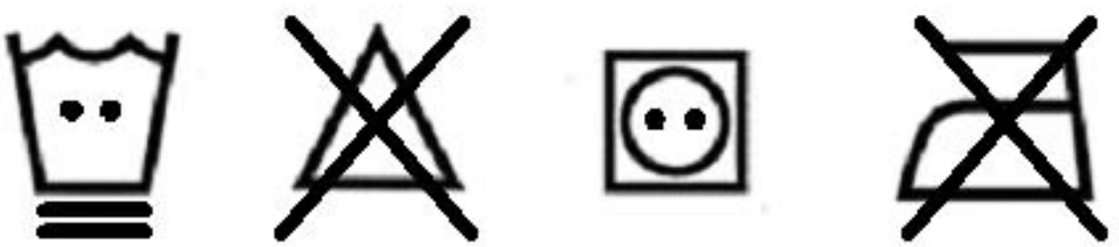
D3. Clothing labels use a simple system of internationally-recognisable symbols to communicate care instructions to consumers. These symbols relate to washing, bleaching, drying, ironing and dry cleaning (see **Figure D2**). These are combined with modifiers (dots and bars). Dots indicate the temperature – one dot means cool/low temperature, two dots means warm/medium temperature and three dots mean hot/high temperature. Bars indicate more gentle treatment requirements – one bar means permanent press cycle and two bars means gentle/delicate cycle. A cross over a symbol means "Do not", *e.g.* "Do not bleach" or "Do not iron" (see Figure D3).

Figure D2: Care instruction symbols

Figure D3: Instructions from a care label



(a) State the meaning of the **two** symbols on the care label shown in Figure D3, apart from the "Do not bleach" and "Do not iron symbols". *[2]*

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(b) Outline **one** reason why it is important that an internationally-recognisable system of care instructions is used by manufacturers on care labels. *[2]*

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D4. Discuss **one** advantage and **one** disadvantage of using biomimetrics in the design of sports clothing. *[6]*

Advantage:

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Disadvantage:

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D5. Carpets in motor vehicles can now be finished with a permanently-effective catalytic agent called Triple Fresh which oxidises and decomposes odour molecules, *e.g.* from cigarette smoking. List **two** advantages of finishing carpets with Triple Fresh during the manufacturing process rather than by the user after purchase. *[2]*

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D6. Discuss **three** aspects of the global impact of branded textile products. *[9]*

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Option E — Human factors design

E1. Stools without wheels are often provided with stand up workbenches to reduce fatigue during long tasks. When not in use they slide under the bench. **Figure E1** is a side view of a stool, the recommended dimensions for which are provided in **Table E1** below.

Figure E1: Stool and a stand up workbench

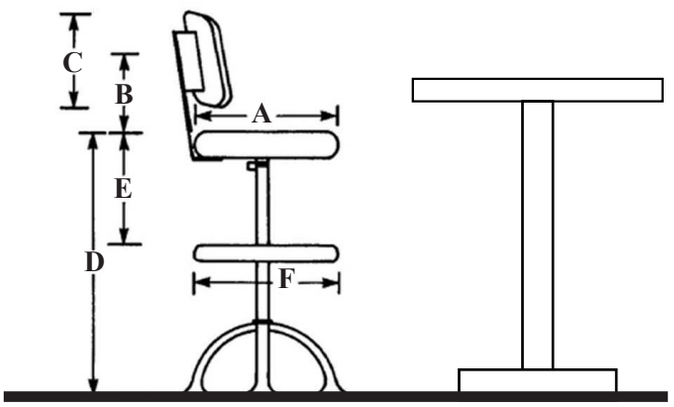

Table E1: Dimensions of Stool

Letter (Figure E1)	Dimensions
A - seat width	381 mm
C - backrest height	203 mm
D - seat height	500 to 762 mm max
E - seat/foot support distance	457 mm
F - foot support	457 mm

(a) If the vertical distance between the seat and the backrest is 50mm, state the overall maximum height of the chair. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Identify the percentile used to determine the height of the workbench if it was for a school classroom. *[2]*

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(c) Explain why it is recommended that wheels should not be used with workbench stools. *[3]*

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E2. (a) State the type of scale that would be used to collect comfort data. *[1]*

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(b) Outline **one** issue related to the application of comfort rating scales *[2]*

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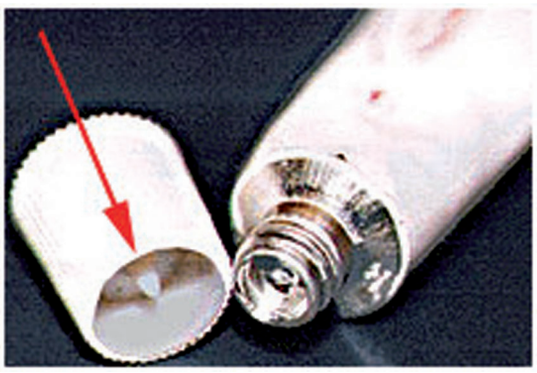
E3. **Figure E2** shows a small tube of toothpaste which is part of a kit given to long distance airline passengers. A number of passengers have complained that they can't pierce the seal in the tube. They have not noticed the pin in the top of the lid to be used for this purpose.

Figure E2: Toothpaste tube



[Source: www.cs.usm.maine/edu/~welty/cos368/topics//tube1.gif]

(a) Identify a data collection strategy designers of the toothpaste tube in Figure E2 could have used to become aware of the problem. *[2]*

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(b) Describe an alternative design solution to the problem outlined above. *[2]*

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E4. Describe the type of prototype most useful for collecting data about the aesthetics of a range of new mobile phones. *[2]*

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E5. The picture in **Figure E3** shows the detail of the front panel of the music player pictured in **Figure E4**.

Figure E3: Music player detail

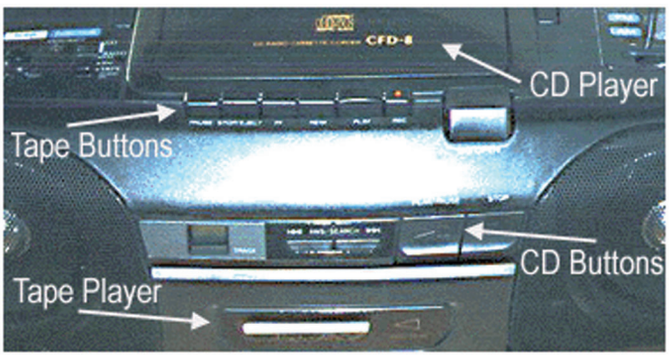
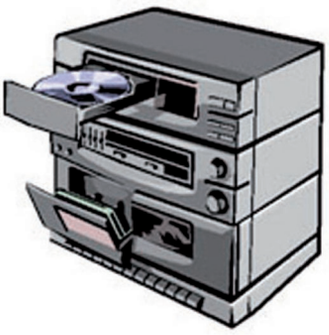


Figure E4: Music player



Discuss **two** characteristics of user product interfaces related to the product pictured in Figure E3. *[6]*

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E6. Explain how **three** psychological human factors considered in kitchen design may conflict with other design aims. *[9]*

IB DIPLOMA PROGRAMME
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SPEC/4/DESTE/SP3/ENG/TZ0/XX/M

MARKSCHEME

SPECIMEN

DESIGN TECHNOLOGY

Standard Level

Paper 3

16 pages

Option A — Food science and technology

A1. (a) *Award **[1]** for the correct calculation and answer.*
***Note**: no units are required as the answer is a ratio, so do not subtract **[1]** for missing units.*
BMI = weight in kg/(height in m^2) = $90/1.70 \times 1.70 = 31.14$; ***[1 max]***

(b) *Award **[1]** for stating that the man does not know if he's obese from Figure 1 (a).*
calculating BMI gives the answer 31.14 which makes the man obese;
using Figure 1 (a) he is overweight and so loses the additional information that he is at significant increased risk of mortality, *i.e.* in a more serious condition; ***[2 max]***

(c) *Award **[1]** for each distinct point in an explanation of how overweight and obesity are caused.*
overweight and obesity have a strong familial component;
however energy intake and levels of physical activity are important;
low levels of physical activity coupled with high levels of energy intake are likely to lead to an increased BMI;
the issue of obesity and overweight can be addressed by increasing physical activity and/or reducing energy intake; ***[3 max]***

A2. (a) *Award **[1]** for stating the name of a commonly used emulsifying agent.*
egg yolk proteins (stabilize mayonnaise and salad dressing);
hydrophilic colloids, such as gum arabic or gelatin (stabilize water-in-oil emulsions);
lecithins (E322) (mixtures of phospholipids, *e.g.* phosphatidylcholine and phosphatidylethanolamine, usually from soya);
mono-and di-glycerides of fatty acids (E471);
esters of monoglycerides of fatty acids (E472a-f);
phosphated monoglycerides; ***[1 max]***

(b) *Award **[1]** for each distinct point in a brief description of the role of an emulsifier in stabilizing an emulsion.*
an emulsion is a suspension of oil droplets in a water phase or water droplets in an oil phase in which the droplets remain separate;
emulsifier has a hydrophilic part and a hydrophobic part and aligns itself at the surface of the droplet appropriately preventing the coalescence of the droplets; ***[2 max]***

A3. *Award **[1]** for each correct driver for the development of new food products.*
lifestyle factors;
health issues;
environmental issues;
consumer demands (*e.g.* for convenience, quality, cost, availability);
technological developments (processing equipment or packaging materials);
increasing market share;
entering new/non-traditional markets (sports products, military/survival products); ***[2 max]***

A4. (a) *Award **[1]** for correct method of calculation plus **[1]** for the correct answer including units.*
10 g (total fat) – 3 g (saturated fat) = 7 g (unsaturated fat);
$(7 \times 100)/28.3 = 24.7$ g/100 g; ***[2 max]***

(b) *Award **[1]** for each distinct point in a brief explanation of why the amounts of saturated and trans fats and cholesterol are identified amongst the Nutrition Facts on a packet of potato crisps (chips).*
saturated fats, trans fats and cholesterol are considered bad for health;
people who are being careful about their diet would want to know how much of each component is present so that they can decide whether to purchase/eat the product; ***[2 max]***

A5. *Award **[1]** for identifying a particular nutritional issue and **[1]** for each additional point in an explanation of how health awareness affects food choice with reference to that issue, **[3 max]** for each issue.*

fat quality and quantity;
choose a diet low in fat;
fat provides twice as many calories as the equivalent amount of carbohydrate or protein;
high fat intake can lead to overweight and obesity;

choose a diet low in saturated fat/trans fat/dietary cholesterol;
consumption of saturated fat, trans fat, and dietary cholesterol raises low-density lipoprotein (LDL) or "bad cholesterol," levels, which increases the risk of coronary heart disease (CHD).

saturated fat (from meat, milk and milk products) raises blood cholesterol more than other forms of fat;

reducing saturated fat to less than 10 % of calories will help lower blood cholesterol levels;

replace total/saturated fat by eating more unsaturated/polyunsaturated fat;
unsaturated fats reduce blood cholesterol when they replace saturated fats in the diet;

choose a diet low in trans fats;
partially hydrogenated vegetable oils, such as those used in many margarines and shortenings, contain a form of unsaturated fat known as trans-fatty acids that may raise blood cholesterol levels, although not as much as saturated fat;

choose a diet low in cholesterol;
the body makes all the cholesterol it needs;
dietary cholesterol comes from animal sources such as egg yolks, meat (especially organ meats such as liver), poultry, fish, and higher fat milk products;
eat more grain products, vegetables and fruits and by limiting intake of high cholesterol foods;

fibre intake;
fibre is good for the health of the gut;
eating a high fibre diet appears to reduce the risk of developing various conditions, including heart disease, diabetes, diverticular disease, and constipation;
low fibre content foods, *e.g.* refined foods such as white bread, white rice, refined cereals (corn flakes, Cheerios), white spaghetti and sugar should be replaced with higher fibre alternatives;

sugar intake;
medical experts agree that people should get no more than 10 % of their calories from sugar;
higher intakes of sugar can lead to overweight, obesity and a range of obesity-linked diseases;

salt intake;
high salt consumption can contribute to high blood pressure for people who have been diagnosed with hypertension, high blood pressure can lead to heart disease and stroke;
recommended salt intake in UK is 6 g, a salt intake of about 6 g is considered sensible medical advice; ***[6 max]***

A6. *Award **[1]** for each distinct point in an explanation of how each type of rancidity is important in the shelf life of food products containing fats and oils, **[3 max]** per type of rancidity.*

oxidative rancidity;
important when food products containing unsaturated fatty acids are stored in too hot/light conditions and produce off flavours;
involves three phase process – initiation, propagation and termination. (Initiation – molecular oxygen combines with unsaturated fatty acids in the presence of chemical oxidizers or enzymes to produce hydroperoxides and free radicals which are very reactive. Propagation – further oxidation by lipid oxidation products gives rise to the term "auto-oxidation" that is often used to refer to this process. Termination phase results in relatively unreactive compounds, *e.g.* hydrocarbons, aldehydes and ketones);

hydrolytic rancidity;
occurs in food products containing fats and oils due to the reaction of lipid and water in the presence of a catalyst or by the action of lipase enzymes;
results in the formation of free fatty acids and soaps (salts of free fatty acids);
although low levels of free 16-18°C atom fatty acids as in soybeans, corn or animal fat are not necessarily objectionable, low levels of shorter carbon chain fatty acids, as in coconut oil or butter fat, can be quite objectionable;
oil/fat develops a soapy taste/texture;

absorption rancidity;
important when oils and fats are stored next to products (such as paint, detergents or disinfectants) which have a strong smell;
smell absorbed by fat/oil making it unpleasant to eat;
food should be stored in dry cool place away from strong smelling items; ***[9 max]***

Option B — Electronic product design

B1. (a) *Award **[1]** for stating an alternative to frequency division multiplexing.*
time division multiplexing; ***[1 max]***

(b) *Award **[1]** for identifying the correct data and **[1]** for the correct answer.*
100/0.5;
200 broadband Internet connections; ***[2 max]***

(c) *Award **[1]** for three distinct correct points in an explanation of how a commercial communication link provider might develop a pricing policy.*
set up costs;
maintenance costs;
the capacity of the network;
the amount of bandwidth required by particular users (voice, TV, broadband);
peak/off peak use of the system; ***[3 max]***

B2. (a) *Award **[1]** for a definition of time constant to the effect of:*
the time required for the current or voltage in a circuit to rise or fall exponentially through approximately 63 % of its amplitude; ***[1 max]***

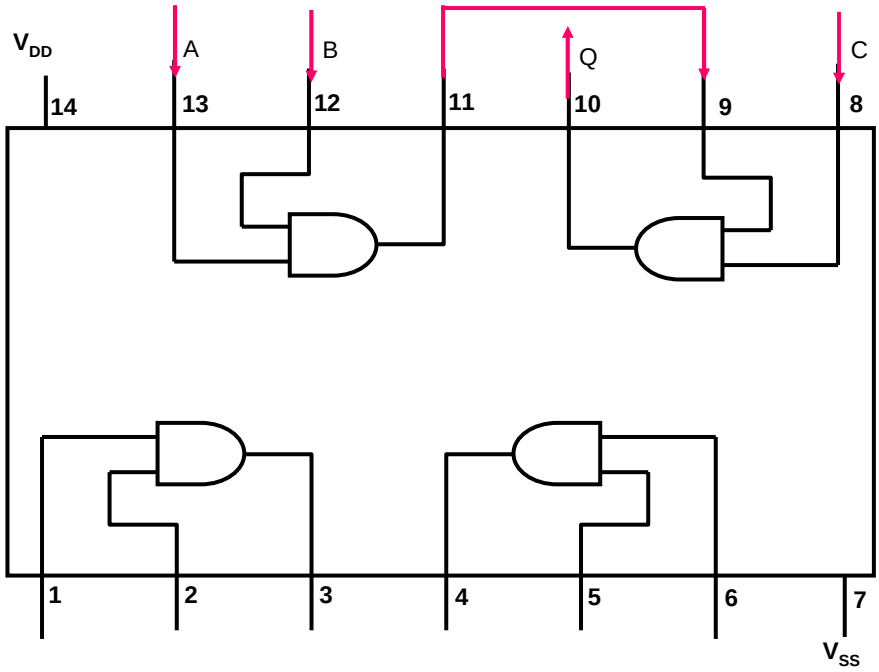
(b) *Award **[1]** for each of two distinct points in a description of how an understanding of time constant helps in circuit design.*
capacitors are used in a circuit to damp out rapid changes of voltage;
it takes time for charge to flow, especially when a large resistor opposes flow; ***[2 max]***

B3. (a) *Award **[1]** for putting 0s for all lines except 1, 1, 1 and **[1]** for putting 1 for 1, 1, 1, as show below:* ***[2 max]***

A	B	C	Q
0	0	0	**0**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**0**
1	0	1	**0**
1	1	0	**0**
1	1	1	**1**;

;

(b) *Award **[1]** for inputting A and B to one logic gate (inputs 12 and 13 OR 8 and 9 OR 5 and 6 OR 1 and 2). Award **[1]** for connecting the output from that gate (11, 10, 3 OR 4) as the input to a second gate with C and for marking the output as Q.*



[2 max]

B4. *Award **[1]** for identifying the value of the resistor and **[1]** for identifying the tolerance.*
47 00 *i.e.* 4.7K;
± 5%; ***[2 max]***

B5. (a) *Award **[1]** for each distinct correct point in an explanation of an advantage of using a PIC in the development of the electronic circuitry for a hearing aid **[3 max]**.*
the hard-wired circuit of the hearing aid is developed;
a PIC can then be programmed to replace the function of the hard-wired circuit;
ear prescriptions change over time and the PIC can be periodically reprogrammed to respond to this; ***[3 max]***

(b) *Award **[1]** for each distinct correct point in an explanation of how the use of PICs in the design of hearing aids is consistent with the objectives of sustainable development, **[3 max]**.*
software upgrades can be downloaded;
thus their product life is extended;
thus they can overcome issues of planned obsolescence;

small amounts of non-toxic readily available material are used in their production;
small amounts of energy are required to produce them;
small amounts of material are required to encase them and their battery supply; ***[3 max]***

B6. *Award **[1]** for identifying each of three issues for a mobile phone manufacturer relating to the adoption of generic standards and **[1]** for each of two points of explanation for each aspect, **[3 max]** per aspect.*

product loyalty and opportunities to access a wider market;
use of generic standards mean that more customers are likely to adopt the product as it uses standard technology;
use of generic standards provides access to a world wide market;

interoperability;
the generic standard will make the product compatible with other products;
this means that files can be transferred from one device to another, especially important in relation to interfacing with computers;

investment in research and development;
manufacturers can piggyback onto other people's R&D;
development costs are much lower making the development much more cost-effective;

to develop a company-specific standard is a pioneering strategy;
a pioneering strategy is much more risky and requires huge investment;
adopting an imitative strategy offsets risk; ***[9 max]***

Option C — CAD / CAM

C1. (a) *Award **[1]** for stating:*
15 %; ***[1 max]***

(b) *Award **[1]** for working and **[1]** for correct answer, including units.*
6 mm × 10 % =;
0.6 mm; ***[2 max]***

(c) *Award **[1]** for each distinct point in an explanation of how the tools would be used.*
10 mm tool used to rough cut material;
10 mm wastes large amounts of material and reduces manufacturing time;
3 mm tool used to complete final finishing cut to allow intricate machining in pockets; ***[3 max]***

C2. (a) *Award **[1]** for stating:*
spiral; ***[1 max]***

(b) *Award **[1]** for each piece of information from the list below:*
XYZ coordinates;
feed speeds;
spindle speeds; ***[2 max]***

C3. (a) *Award **[1]** for stating a reason why the 3D drawing of the wheel is most likely to have been created first and **[1]** for a brief explanation.*

animation;
animation allows product to be simulated and assembled to other parts;

show to clients;
virtual product can be shown to clients before attempting to make 3D models;

can then create 2D orthographic drawing;
orthographic drawings can be created from a 3D image, which will allow for calculation of material and provide views for manufacture;

reduction in prototypes;
client does not need to see a physical model, material and time is not wasted; ***[2 max]***

(b) *Award **[1]** for stating why a 2D drawing is generated and **[1]** for a brief explanation.*

part dimensions;
dimensions can be added to the drawing to view constraints;

scale;
drawing can be scaled for ease of reading;

calculating amount of material;
material volume can be calculated in order to estimate costs involved in manufacture;

can be manufactured from drawing;
different views and detailed dimensioning allow for the part to be manufactured;

detailed views of different elevations;
sectional views and elevations give more detail to the manufacturer; ***[2 max]***

C4. *Award **[1]** for each benefit of using lost wax casting from the list below:*
one master required;
mass customization;
reproduction;
tree allows for many parts to be made at any one time;
wax can be reused reducing wastage; ***[2 max]***

C5. *Award **[1]** for identifying a particular issue and **[1]** for each additional point in an explanation **[3 max]** for each issue.*

structure of material;
- grain direction;
- hardness;

safety;
- adhesive used within material could cause illness if exposure is high;
- dust levels are high and extraction units are required;

range of materials available;
- MDF;
- chipboard;
- plywood;

surface finish;
- painting;
- varnish;
- laminated;
- veneers;

efficiency;
- waste material reduced by nesting;
- tools wear;

[6 max]

C6. *Award **[1]** for identifying a particular issue and **[1]** for each distinct correct point in an explanation. **[3 max]** for each issue.*

designer;
- speed;
- 3D outcome shown to client;
- performance testing;
- reduced R&D costs;
- minimal waste;
- intricate internal structures possible;

manufacturer;
- short lead times for one-off products;
- reduction in tooling costs;
- flexibility;
- 3D outcome shown to client;

consumer;
- reduced costs due to reduced R&D time;
- customisation;
- wider range of product available;
- value for money;

[9 max]

Option D — Textiles

D1. (a) *Award **[1]** for stating the source of power used by the textile industry in Britain prior to its mechanisation in the Industrial Revolution.*
human muscle power; ***[1 max]***

(b) *Award **[1]** for each distinct point in a description of why the development of the textile industry resulted from a combination of market pull and technology push.*
demand was increasing for textile products hence market pull;
the textile industry benefited from other technological developments; ***[2 max]***

(c) *Award **[1]** for identifying a relevant factor and then **[1]** for each of two appropriate points relating to this factor – one for home working and one for factory working.*
noise;
factory working: generally much noisier environment than the home – employees would be likely to have to wear ear protection;
home working: likely to be much quieter environments – employees may have to wear ear protection when conducting particular noisy processes; ***[3 max]***

D2. (a) *Award **[1]** for stating one source of wool.*
sheep;
camel;
goats;
Angora rabbits; ***[1 max]***

(b) *Award **[1]** for each of two distinct points in a description of how wool is converted into yarn.*
the wool is spun into yarn on a spinning wheel;
the woollen fibres are twisted round each other to form a yarn of consistent cross-section; ***[2 max]***

D3. (a) *Award **[1]** for stating the meaning of each of the two symbols on the care label shown in Figure D3 apart from the "Do not bleach" and "Do not iron symbols".*
wash using a gentle/delicate cycle;
tumble dry using a warm/medium temperature; ***[2 max]***

(b) *Award **[1]** for identifying a reason why it is important that an internationally-recognizable system of care instructions is used by manufacturers on care labels and **[1]** for a brief explanation.*
clothing products are global products and used in countries all over the world;
internationally-recognizable symbols without words can be readily understood without linguistic issues wherever the garments are used; ***[2 max]***

D4. *Award **[1]** for each of three distinct correct points in a discussion of one advantage and one disadvantage of using biometrics in the design of sports clothing, **[3 max]** for each issue.*
advantage
biomimetic fabrics adapt ideas from natural animal and plant systems, *e.g.* shark skin;
imitating high performance natural systems can promote innovation in the development of new textile products;
can enhance human performance and provide advantages for users;

disadvantage
sports clothing using biomimetic fabrics need to fit perfectly;
therefore there are special made-to-measure requirements;
this pushes up the price and may mean that those users who cannot afford to purchase them are disadvantaged; ***[6 max]***

D5. *Award **[1]** for listing each of two advantages of finishing carpets with Triple Fresh during manufacture rather than by a user after purchase.*
more even application;
finish can work throughout the product life;
the user may not follow appropriate health and safety procedures; ***[2 max]***

D6. *Award **[1]** for identifying each of three aspects of the global impact of branded textile products and **[1]** for each of two points of explanation for each aspect, **[3 max]** per aspect.*

erosion of traditional cultural values and development of a youth culture;
branded products are "cool" and are much sought after by young (and older) people;
this contributes to the development of a generation whose allegiances are not rooted in traditional values;

price;
the branded products command high prices in the market place;
coupled with manufacture often in developing countries this results in high profit margins;

many (not all) branded textile products are produced in sweatshops where people are exploited;
they challenge the concept of ethical consumerism where fair trade and appropriate employment practices would be required;
corporate social responsibility has become a way in which brands manage negative publicity around these issues; ***[9 max]***

Option E — Human factors design

E1. (a) *Award **[1]** for the correct answer.*
1015 mm or 1.015 m; ***[1 max]***

(b) *Award **[1]** for the percentile and **[1]** for identifying it as male.*
50th percentile;
male; ***[2 max]***

(c) *Award **[1]** each for three points in an outline **[3 max]**.*
provide stability for intricate tasks;
stool cannot be easily moved away from the workbench;
stool is available when required; ***[3 max]***

E2. (a) *Award **[1]** for stating the scale.*
ordinal; ***[1 max]***

(b) *Award **[1]** for identifying an issue and **[1]** for an outline.*
subjectivity;
individuals have different tolerance levels;
time;
data may vary depending on the time of day collected;
anthropometric variations;
people have different postures; ***[2 max]***

E3. (a) *Award **[1]** for identifying the strategy and **[1]** for stating how it would help identify the problem **[2 max]**.*
prototype testing / user trial;
users would highlight the problem; ***[2 max]***

(b) *Award **[1]** for the solution and **[1]** for a description **[2 max]**.*

automatic seal;
when the cap is unscrewed, the seal is broken;

directions;
provide a small label with directions;

alternative seal;
provide a tab for a pull-off seal;

discard toothpaste;
pre impregnate toothbrush with paste; ***[2 max]***

E4. *Award **[1]** for naming the prototype and **[1]** for a description **[2 max]**.*
appearance prototype;
looks like the final product/does not function; ***[2 max]***

E5. *Award **[1]** for the identification of each characteristic **[2 max]** and **[2]** for each distinct point in a discussion of the characteristics **[4 max]**.*
***[6 max]** in total.*

intuitive logic and organization;
expect control buttons to be close to function;
not logical placement of controls;
not the case in Figure E3;

memory burden;
high memory burden/need to memorize controls;
may malfunction if controls not learnt; ***[6 max]***

E6. *Award **[1]** for naming each of three factors **[3 max]** and **[2]** for each point in an explanation of the conflict between the factor and a design aim **[6 max]**.*
***[9 max]** in total.*

temperature;
some food must be kept cool/warm;
people may want a warm/cool working temperature;

light;
bright light needed for work areas;
may be more expensive to run more lights;

ventilation;
odors need to be ventilated out;
increased cost of ventilation systems;

colour;
cool colours may be most appropriate in a busy kitchen;
may conflict with house colour scheme; ***[9 max]***