



# **MARKSCHEME**

**May 2013**

**DESIGN TECHNOLOGY**

**Higher Level**

**Paper 3**

29 pages

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## Subject Details: Design Technology HL Paper 3 Markscheme

### Mark Allocation

Candidates are required to answer questions from **ONE** of the Options [**1 × 40 marks**].

Maximum total = [**40 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

**Option A — Food science and technology**

- A1.** (a) Award [1] for stating **one** reason why craft-produced breads are generally more expensive than mass-produced breads.  
craft production is a labour-intensive process / smaller batches more work/time input per loaf;  
more expensive raw materials / specialist ingredients; [1 max]
- (b) Award [1] for identifying how gluten in flour contributes to the final texture of dough and [1] for a brief explanation [2 max].  
gluten is the protein in flour which it hydrates to form an elastic matrix;  
this contributes to the elastic nature of the bread dough; [2]
- (c) Award [1] for each of three distinct points in an explanation of how the addition of yeast to bread dough contributes to the physical properties of bread [3 max].  
lowers the density of the dough/bread;  
yeast ferments sugar to carbon dioxide which aerates/produces small gas bubbles in the dough;  
the dough/gas expands during heating;  
cooking denatures the gluten so becomes inelastic/retains deformed shape/aerated/leavened bread; [3 max]
- A2.** (a) Award [1] for stating **one** advantage of the FlavrSavr™ tomato over traditionally grown tomatoes.  
can be ripened on the vine;  
are fuller flavoured;  
longer shelf-life / store/keep better;  
have firmer skins; [1 max]
- (b) Award [1] for a reason why the FlavrSavr™ tomato was withdrawn from the market and [1] for a brief explanation [2 max].  
public concerns over the safety of genetically-modified organisms / consumer scepticism about GMOs;  
some people think that genetic modification is playing God and is wrong;  
reduced market demand makes product unsustainable/unless people buy a product it is not commercially viable and therefore unsustainable; [2 max]

- A3.** (a) Award [1] for *one* reason why it is important that governments raise public awareness of food-related health issues and [1] for a brief explanation [2 max].  
eating the wrong balance of foods can result in a wide range of chronic/acute food-related issues, for example, obesity, diabetes, food poisoning;  
governments can reduce the incidence of these by providing educational materials to raise public awareness of health-related issues/reduce cost of healthcare provision;  
governments have a moral responsibility for public health;  
government policies educate public/advocate healthy eating; [2 max]
- (b) Award [1] for each of two distinct points in an identification of why “The eatwell plate” system would not be appropriate for children below the age of two years [2 max].  
babies and very young children have different nutritional requirements to older children/adults;  
babies and very young children need energy-dense foods/their digestive systems cannot cope with the wide range of foods on the eatwell plate some of which are difficult to digest; [2]
- A4.** Award [1] for each of three distinct points in an explanation of each of how travel and the media have promoted the development of an international cuisine [3 max] for travel and [3 max] for the media.  
*Travel:*  
through travelling and eating out more in restaurants people are exposed to different dishes;  
on their return home they want to recreate their holiday experiences;  
supermarkets/other food outlets now carry a wide range of authentic ingredients so they are able to do this;
- The media:*  
cookery books/programmes/commercials/articles in newspapers/magazines present dishes from other cultures;  
they show people how dishes from different cultures should be prepared/served;  
people are able to experiment for themselves; [6]

- A5.** (a) Award [1] for describing **one** measure used to estimate the number of hungry people in a country and [1] for a brief explanation [2 max].  
 global hunger index;  
 a composite measure/multidimensional statistical tool that reflects the number of hungry people in a country;
- undernourishment;  
 a state in which food intake is insufficient to meet basic energy requirements on a continuing basis;
- undernutrition;  
 wasting/stunting/underweight results from prolonged low levels of food intake/poor absorption of food consumed; [2 max]
- (b) Award [1] for listing **two** criteria for food security [2 max].  
 sufficient food is available;  
 supplies of food are relatively stable;  
 people in need of food can obtain it; [2 max]
- (c) Award [1] for identifying **one** reason why international strategies for maintaining food security are important and [1] for a brief explanation [2 max].  
 when a country is unable to respond to food insecurity resulting from warfare, drought/other natural disasters, etc;  
 it is critical that the international community (usually through the auspices of the United Nations) intervenes/reacts to deal with the potential ensuing disaster/famine; [2]
- A6.** (a) Award [1] for each of three distinct points in an explanation of **one** way in which proper cooking of food can help control food poisoning [3 max].  
 cooking raises the temperature of food about 78 degrees Celsius;  
 this kills bacteria;  
 it is the growth/proliferation of food poisoning bacteria on food which causes food poisoning; [3]
- (b) Award [1] for each of three distinct points in an explanation of **one** way in which good personal hygiene can help to prevent food poisoning [3 max].  
 coughing/spitting/touching of food can contaminate food with food poisoning bacteria;  
 if food is not kept out of the temperature danger zone then the bacteria will multiply in food;  
 consumption of the food will then cause food poisoning;  
 hand washing (and other aspects of good personal hygiene) reduces bacterial load on hands/reduces potential for contamination of food when touching it; [3 max]

**A7.** Award [1] for each of three distinct points in an explanation of each of **three** implications of urbanization for the food industry in developed countries. [3 max] for each factor.

high population density / lots of people live in a small area;  
urban dwellers often totally reliant on the food industry for the provision of their dietary needs;  
they no longer have access to land for growing of food;

food is a highly-perishable commodity;  
food processing (freezing, canning, etc) extends shelf-life of foods;  
this can facilitate distribution from rural areas where food produced to urban areas where food consumed;

food manufacturers operate just-in-time (JIT) systems to deliver food to the point of sale;  
CIM/logistics enable this;  
they ensure the right amounts of food products are available as and when required by consumers;

more food shops;  
provide access to food in urban areas;  
encourage/promote the development of new food products;

better law enforcement;  
easier access for law enforcement officials;  
forces higher standards;

[9 max]

**Option B — Electronic product design**

**B1.** (a) Award [1] for stating the type of circuit.  
comparator; [1]

(b) Award [1] for substituting appropriately into the formula  $T = CR$  and [1] for a calculation showing units [2 max].  
 $T = CR$ ;  
 $T = 470 \times 50000 = 23500000$  microseconds ;  
 $T = 0.000470 \times 50000 = 23.5$  seconds; [2 max]

(c) Award [1] for each of three distinct points in an explanation of how the circuit operates when the switch is opened [3 max].  
when the switch opens, the voltage on the capacitor rises;  
the timer starts;  
when the voltage on the capacitor meets/exceeds that of the R1 R2 divider the comparator switches low, so turning on/activating the relay;  
  
when switch opens, current from the resistor flows into the capacitor;  
capacitor charges / its voltage rises from 0V;  
after some time it goes above/exceeds the voltage at the +/non-inverting input and the output from the op amp switches over/becomes zero/low;  
turns on/activates relay; [3 max]

**B2.** (a) Award [1] for stating **one** service cost consideration for the consumer when purchasing a washing machine.  
call out charges for repair workers;  
cost/availability of spare parts;  
consumers may consider insurance/guarantee/ warranty to offset risk; [1 max]

(b) Award [1] for identifying **one** way that design for disassembly promotes the upgradeability of electronic products and [1] for an explanation.  
makes it easy to replace parts/reprogramme/incorporate new technology;  
having parts which can be easily replaced promotes reuse/increases functionality/extends product life; [2]



**B3.** (a) Award [1] for X and [1] for Y [2 max].

A	B	X	Y
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

[2]

(b) Award [1] for **one** reason why, in practice, digital logic functions would be implemented using NAND gates and [1] for a brief explanation [2 max].

NAND gates are universal gates;  
they can implement any (Boolean) logic gate function without the need to use any other gate type;

NAND gates are economical and easier to fabricate;  
they are used in digital logic families;

[2 max]

**B4.** Award [1] each for stating **three** different implications for the consumer for both TDM and FDM. [3 max] each.

FDM bandwidth supplied to the user in fixed allotments/amounts;  
supports a limited number of users at a set bandwidth;  
the higher the amount of bandwidth supplied by the ISP, the faster the connection will be for individual users;

TDM users have an individual signal digitally coded in short duration pulses/bursts;  
pulses for each user are sent in order along the link in “packets”;  
the receiver must be synchronized with the user so information bytes can be correctly reassembled to produce signals;

[6]

- B5.** (a) *Award [1] for describing **one** benefit of converging technology to national security and [1] for an explanation [2 max].*  
unmanned combat vehicles;  
can save human lives during war;
- high security/invulnerable data systems;  
ensures secure information cannot be intercepted;
- enhanced national security;  
for example, early warning systems;
- intelligence gathering systems;  
can pre-empt terrorist attacks; [2 max]
- (b) *Award [1] for a distinct point and [1] for a brief explanation of the point in an outline of how nanotechnology could be utilized in the implementation of “The Communicator”.*  
small size/high power;  
high speed interactive computational ability;  
through the use of wearable components sensors; [2 max]
- (c) *Award [1] for identifying **one** way in which “The Communicator” promotes global cooperation and [1] for a brief explanation.*  
enhances effective communication;  
promoting cooperation between different types of organizations/people who speak different languages;
- enhances group creativity/productivity;  
ideas/information can be shared/utilized in a connected society; [2 max]
- B6.** (a) *Award [1] for each distinct point in an explanation of how solar panels could be used in a smart home to generate electrical energy [3 max].*  
the solar panel is an active device that can track the sun’s path;  
voltage is generated when sunlight reaches its surface;  
can be used as a power supply for heating/lighting;
- in a smart home, controls can be used to turn/tilt the panel to track the sun;  
maximizes its effectiveness in collecting energy;  
electricity produced can be stored or input to the national grid; [3 max]
- (b) *Award [1] for each distinct point in a discussion of the benefit of a PIC’s data storing capability.*  
PICs can make decisions based on pre-programmed protocols to maintain or change environmental conditions;  
this information/decisions can be stored/reprogrammed;  
according to an individual’s personal preferences; [3]

**B7.** Award [1] for each distinct issue and [2] for a detailed explanation of each issue in a discussion of *three* issues a designer may need to consider in the design of a laptop computer for different global markets. [3 max] each.

company-specific standards may differ in different regions;  
patents may not be internationally recognized;  
software and applications may not be available/acceptable in different markets;

local environmental regulations may affect material specifications required of a laptop computer;

including the use of toxic/hazardous materials/power sources;  
“take back” legislation in some countries controls how electronic products are disposed;

differences in electrical voltage supply and plug/socket design in various global regions;  
require alternate designs for power or battery charging units;  
120V/60Hz / 240V/50Hz;

maintenance/after sales provision;  
availability of spares/accessories;  
advice/expertise;

aesthetics;  
colour availability/shape/styles;  
value systems, such as those attributed to colours, may differ from country to country;

different keyboard designs to support different languages;  
different markets may be different sizes;  
cost implications;

[9 max]

**Option C — CAD/CAM**

- C1.** (a) *Award [1] for stating the type of CNC machine used to manufacture the part in Figure C1.*  
CNC Lathe; [1]
- (b) *Award [1] for each of the distinct points in a description of how a CNC machine would need to be reprogrammed if the part in Figure C1 would be made from metal instead of plastic [2 max].*  
reduced/slower feed rate;  
shallower depth of cut per pass;  
different cutting tools; [2 max]
- (c) *Award [1] for each of three distinct points in an explanation of why the product in Figure C1 would require more than one tool for manufacture [3 max].*  
each tool does a different job/produces different finishes;  
one will be used for cutting the shape;  
another will be used for cutting the thread; [3]
- C2.** (a) *Award [1] for stating **one** way in which the use of robots in a manufacturing system has helped to reduce material waste.*  
better quality control;  
more accurate/lower tolerance;  
they have replaced humans, therefore more consistency;  
fewer errors made in production; [1 max]
- (b) *Award [1] for each distinct point in an outline of how the use of robots allows for flexibility in a manufacturing system in relation to scale of production.*  
ease of reprogrammability;  
they can be programmed to produce on a small-scale or large-scale volume production or batch production; [2]

**C3.** (a) *Award [1] for each distinct point in a description of the purpose of the CAD mould flow simulation.*

the colours show cooling of material as injected into the mould;  
the blue area indicates the point of injection/ensures material will not harden before it gets to all parts of the mould;

[2]

(b) *Award [1] for each distinct point in an outline of **one** way in which CAD simulations can aid cost analysis in the manufacture of the plastic product.*

number of parts needed can be calculated;  
aiding the planning of assembly;

material properties can be simulated using FEA;  
so a cheaper material could be used as an alternative;

cost;  
can calculate how much material is required to fill the mould;

wall thickness can be tested;  
reduction in wall thickness will reduce cost of product;

the amount of material required to fill the mould can be calculated;  
enabling the design to be altered to enhance cost-effectiveness;

the amount of time needed for the material to cool in the mould can be calculated;  
enabling the manufacturer to calculate the number of items per hour;

better quality control;  
identify potential stress areas/problems;

can test time taken for material to fill the mould;  
can calculate efficiency/rate of production;

[2 max]

**C4.** Award [1] for each distinct point in a discussion of **two** benefits of using rapid prototyping in the design development of the perfume bottle prototype. [3 max] for each benefit.

physical/performance testing;  
for a range of attributes/needs/purposes;  
for example, size/ergonomics/weight/performance/capacity;

design can be quickly altered;  
more iterations per unit time/reduces design development time;  
reduced time to bring a product to market;

additive process;  
reduced waste;  
reduced material usage in prototype production;

visualization/market testing / discussions with clients/consumers;  
user feedback can be gained;  
to inform ongoing design development;

expert appraisal;  
manufacturers/engineers can provide feedback;  
to advise on cost-effectiveness/feasibility/production;

cost-effective method of prototyping;  
cheap process/resources;  
easy to use/carry out;

[6 max]

C5. (a) Award [1] for outlining **one** disadvantage of CAD for the designer and [1] for a brief explanation.

training;  
time/cost of training;

the designer needs to be trained in using the CAD software;  
in order to be able to use software effectively to design products;

CAD software/hardware can be expensive;  
and requires updating on a regular basis;

software/hardware failure;  
can result in lost design work/can delay design development/can be costly to fix;

security issues;  
designs can be stolen/hacked;

can stifle creativity;  
the designer is limited to what the software is capable of;

[2 max]

(b) Award [1] for outlining **one** way in which CAM has impacted on the role of the manufacturer in a small-scale furniture business and [1] for a brief explanation [2 max].

less administration/less overhead;  
because fewer employees/more time to spend on marketing/meeting clients;

more emphasis on maintenance/training/development;  
to ensure efficiency/reliability of production/to keep up to date;

increased flexibility in relation to scale of production –  
one-off/bespoke/batch/volume;  
due to CAM equipment becoming cheaper to buy;

[2 max]

(c) Award [1] for identifying **one** advantage of exploded view CAD drawings for consumers when deciding whether to purchase flat-pack furniture and [1] for a brief explanation [2 max].

consumers can see how the various parts/components fit together/ how it would be assembled;  
and whether they feel capable of undertaking the self-assembly;

consumers can identify tools/equipment required to assemble/repair the product;  
and whether they have the tools/equipment or need to purchase them;

[2 max]

**C6.** (a) *Award [1] for each of three distinct points in a suggestion of **one** reason why the Morgan Motor Company continues to use traditional methods to make the car rather than use CAM [3 max].*

brand image;

reputation for “hand-made” cars has been built over a long period of time;

a change to CAM processes would risk the image/reputation;

consumer confidence;

in the craft skills of workers/employees;

implies quality of the product;

scale of production;

low volume/ small target market;;

lends itself to craft production rather than CAM;

processes suitable for materials/frame;

CAM would require all processes to be redeveloped;

skills of workforce allow for flexibility in the manufacture;

investment costs;

factory is set up for traditional/craft production;

switching to CAM production may not provide a good return on investment;

**[3 max]**

(b) *Award [1] for each of three distinct points in an explanation of **one** social implication of maintaining traditional manufacturing techniques in the Morgan Motor Company [3 max].*

maintain skilled workforce;

good for local employment/communities/inward investment;

enables skills to be passed to future generations, rather than be lost;

staff morale;

employees feel secure in the knowledge that their skills are required;

ensuring a content/stable workforce;

**[3 max]**



**C7.** Award [1] for each distinct point in a discussion of **three** benefits for consumers of purchasing classroom furniture produced by CAD/CAM. [3 max] per benefit.

virtual images help consumers decide if furniture is suitable;  
furniture can be virtually inserted into a 3D CAD model of the room;  
the consumer decides if this gives adequate space for pupils/range of activities;

flexibility of CAD;  
bespoke furniture can be designed to fit the space;  
and manufactured using CAM;

the furniture can be flat-pack;  
reducing the cost of distribution/assembly/storage;  
the consumer can assemble/disassemble the furniture easily onsite to move it;

furniture can be modular;  
the design can be adjusted for different needs/additional pieces can be added at a later date;  
to address ever-changing usage of the class environment;

maintenance/ease of repair;  
parts can be purchased and replaced easily on site;  
due to the use of fasteners/exploded views;

cost-effectiveness;  
can reduce price;  
so perceived as better value for money by consumers;

designs can be modified through discussion between the designer and the consumer;  
this can result in customization of the design;  
so supports mass-customization;

[9 max]

**Option D — Textiles**

- D1.** (a) Award [1] for stating **one** characteristic of polyester that makes it suitable for the graft apart from biocompatibility.  
it stretches;  
good chemical resistance;  
it is durable;  
lightweight;  
low moisture absorption; [1 max]
- (b) Award [1] for stating **one** benefit of using a woven fabric for the graft and [1] for a brief explanation [2 max].  
dimensional stability;  
will fit more closely to the artery;  
  
can be closely woven;  
less likely to leak;  
  
flexibility/ease of use/handling;  
can be shaped as required; [2 max]
- (c) Award [1] for each distinct point in an explanation of **one** reason why biocompatibility is important in the development of textile vascular grafts [3 max].  
compatible with body tissues / does not induce immune response / does not provoke inflammation;  
no rejection;  
no need to have repeat surgery/take (immuno-suppressive) drugs;  
enhances success of surgical procedures; [3 max]
- D2.** (a) Award [1] for stating **one** disadvantage of wearable computing for consumers.  
high cost of products;  
difficult to maintain/repair;  
technological changes;  
short product life;  
laundry/cleaning issues;  
technological obsolescence; [1 max]
- (b) Award [1] for stating **one** benefit of aligning wearable computing with the fashion market and [1] for a brief explanation [2 max].  
fashion is a fast-moving business;  
therefore products are brought to market quickly;  
  
the products would be more desirable;  
as they would be styled to suit different markets;  
  
mass-market fashion is a high-volume business so more would be sold;  
cost would reduce as economies of scale achieved; [2 max]

**D3.** (a) *Award [1] for each distinct point in an outline of **one** benefit of the introduction of circular knitting machines for manufacturers.*

no/few seams;  
therefore less processing/finishing;  
reduces costs/more cost-effective;

flexibility;  
different scales of production;

greater scope for the design of knitted items;  
broadens the market;

*[2 max]*

(b) *Award [1] for stating **one** benefit of circular knitting machines for consumers and [1] for a brief explanation [2 max].*

no/few seams;  
more comfortable/aesthetically pleasing product;

patterns can be knitted in;  
so more choice;

a single process;  
more confidence in quality;

*[2 max]*

**D4.** Award [1] for each of three distinct points in a discussion of each of **two** issues relating to the branding of textile products for adolescents [6 max].

peer pressure to buy particular brand of clothes;  
adolescents might not be able to afford branded textile products;  
so have low self-esteem/get depressed;

models are used to promote branded textile products;  
stereotype/perfect people become role models for adolescents;  
(stereotype) may be unachievable for many adolescents;

temptation to buy the latest item from brand;  
buying more than is needed;  
spending more money or wasting resources;

image associations with a brand;  
adolescents will portray this image;  
it might not be positive, for example, violence/antisocial tendencies;

reduced security / promotes crime;  
counterfeiting of branded products;  
increased risk of mugging/theft;

persuade parents to buy brands;  
pressure on parents / pester power;  
buying things they can't afford/can lead to debt;

branded products are generally more expensive than non-branded products;  
parents/adolescents can't necessarily afford them;  
low self-esteem or buying beyond their means;

belong to a group of people;  
feel important;  
better self-esteem/status;

unbranded products may be seen as inferior/lesser quality;  
impacts on sales;

[6 max]

- D5.** (a) Award [1] for **one** each distinct point in an outline of the importance of salt (sodium chloride) in the process of dyeing cotton.  
salt (sodium chloride) forces the dye onto the fibre;  
the dye then bonds with the fibre; [2]
- (b) Award [1] for stating **one** environmental issue involved in the commercial dyeing of cotton products and [1] for a brief explanation [2 max].  
toxic discharge;  
may contaminate ecosystems;  
  
uses a lot of water/energy;  
natural resource depletion; [2 max]
- (c) Award [1] for stating **one** benefit of using Retayne on cotton fabrics to fix the dye during the dying process for the consumer and [1] for a brief explanation [2 max].  
stops dye bleeding/patterns remain on the fabric;  
other garments are not damaged when washed;  
  
keeps colour in fabric for longer/colourfast;  
fabrics don't fade quickly; [2 max]
- D6.** (a) Award [1] for each of three distinct points of discussion of **one** issue relating to the adoption of fair trade regulations for a company in a developed country [3 max].  
manufacture/products might be more expensive;  
therefore in paying a fair price;  
people may be less likely to buy products;  
  
brand image/corporate reputation;  
consumers may be impressed/to be associated with the company/ feel good doing something for developing countries;  
encouraged to buy/seek out their products; [3 max]
- (b) Award [1] for each of three distinct points of discussion of **one** issue relating to the adoption of fair trade regulations for a company in a developing country [3 max].  
improved wages/conditions for workers;  
more employment protection for workers;  
leading to a more secure/better standard of life;  
  
host country may promote them as a fair trade company;  
to raise the local economy;  
brings long-term benefits/tax breaks/other incentives; [3 max]

**D7.** Award [1] for each of three distinct points of explanation of each of **three** advantages of using nylon for an automobile (car) airbag. [3 max] per advantage.

very good strength to weight ratio;  
will resist the force of the rapid inflation/explosion of air into the bag;  
without tearing;

can be packed into a small space;  
it can be used in very thin sections;  
still function effectively;

interaction with the human body;  
will not damage body/skin;  
despite the dynamic interaction of the material with the person;

nylon is a man-made material;  
it is easy to manufacture nylon with different properties;  
the properties required for the airbag are very specific;

readily available material;  
relatively cheap to make/obtain;  
it is cost-effective/easy to manufacture;

non-toxic material;  
easier to dispose of;  
does not cause waste disposal issues after use;

[9 max]

**Option E — Human factors design**

- E1.** (a) Award [1] for stating the type of data scale represented by the general comfort rating scale in Figure E1.  
ordinal; [1]
- (b) Award [1] for stating **one** reason for using this type of data scale shown in Figure E1 and [1] for a brief explanation [2 max].  
it is based on a sequence of numbers;  
the positions on the scale represent some kind of order/progression / there are no fixed units for comfort; [2]
- (c) Award [1] for each of three distinct points of explanation of which point on the comfort rating scale would be appropriate for the design of public seating in a railway station as part of a policy of Design for Discomfort [3 max].  
3;  
the seating should be designed to be comfortable enough for rail users waiting for a train for a limited period of time;  
the designer does not want the seating to be too comfortable so that people use the railway station as a general meeting area/for refuge; [3]
- E2.** (a) Award [1] for a definition of work-space envelope.  
a 3D space within which physical activities can be undertaken at a fixed location / the immediate space around a person within which physical activities can be undertaken at a fixed location; [1]
- (b) Award [1] for stating **one** piece of anthropometric data required when considering the work-space envelope of a wheelchair user at a desk and [1] for a brief explanation [2 max].  
leg clearance;  
for the user when seated at the desk;  
  
reach;  
so the user can access all areas of the work-space;  
  
circulation space;  
so the user can manoeuvre the wheelchair within the envelope; [2 max]

- E3.** (a) Award [1] for stating **one** advantage of the door handle in relation to human factors and [1] for a brief explanation [2 max].  
length of handle enhances mechanical advantage;  
reduces force needed to open door;
- easy to use by a wide range of users;  
as it just requires the user to pull the handle down to open the door/no twisting required; [2 max]
- (b) Award [1] for stating **one** advantage of the door knob in relation to human factors and [1] for a brief explanation [2 max].  
smooth surface;  
no sharp edges;
- shape fits into hand;  
helps user to grasp the knob;
- round shape;  
limits the possibility of snagging on clothes;
- easy to use;  
as long as no twisting action required (if the door is held in place by a ball catch device); [2 max]
- E4.** Award [1] for each of three distinct points in a discussion of each of **two** human factors considerations in the design of *The Butterfly Stool* shown in Figure E4 [6 max].  
no back support;  
the user will need to adopt an upright posture;  
to prevent discomfort/potential back pain;
- no arm rests;  
the user will need to sit on the stool carefully;  
and use a lot of leg muscle/power to stand up after sitting;
- curved ends of the seat;  
stops the user slipping sideways off the stool;  
and gives more support than a conventional flat surface;  
could be a problem if too narrow for some users;
- hard surface;  
likely to be uncomfortable/number 3 on the comfort rating scale;  
when sitting for a lengthy period of time;
- gap in the middle of the seat;  
could pinch the skin;  
or snag on clothing; [6 max]



- E5.** (a) Award [1] for stating **one** reason why the background colour of road signs often corresponds to the colours used on maps and [1] for a brief explanation [2 max].  
navigation;  
map users can easily relate the sign to the colours used for roads on the map;
- memory burden;  
limited use of colours so users can easily recognize the type of road; [2 max]
- (b) Award [1] for stating **one** advantage of the use of LED signs for authorities responsible for motorways (highways) and [1] for a brief explanation [2 max].  
flexibility;  
signs can be used to provide a variety of information/easy to change message;
- visibility;  
a variety of types of LED are available so they can be chosen to suit the requirements of the context;
- LEDs can blink;  
more likely to attract motorists' attention;
- if one bulb goes out;  
sign still visible; [2 max]
- (c) Award [1] for stating **one** disadvantage of the use of LED signs on motorways (highways) for motorists and [1] for a brief explanation [2 max].  
changing messages;  
motorists may be distracted by the signs when the message is being changed;  
increased chance of accidents; [2 max]

- E6.** (a) *Award [1] for each of three distinct points of explanation of **one** reason why human factors research is often not considered a priority in developing countries [3 max].*

cost / companies may not be able to afford the research;  
specialists required to undertake research;  
training takes a long time;

culture;  
attitudes may not be developed in relation to the importance of human factors research;  
so are given low priority;

legislation;  
human factors legislation may not be in place;  
so human factors issues may be ignored;

**[3 max]**

- (b) *Award [1] for each of three distinct points in an explanation of how mass customization has improved the scope for designing for people with disability [3 max].*

it allows individuality of design / meets the needs of a wider range of people;  
designs can be adapted for specific disabilities requirements;  
without changing the overall concept/idea;

economies of scale/volume production can still be achieved;  
design for disability is often very expensive due to the limited market;  
mass customization/can provide a cost-effective solution/can deliver products at lower prices so they are better value for money for persons with disabilities;

**[3 max]**

**E7.** Award [1] for each of three distinct points in a discussion of each of **three** pieces of legislation which impact on human factors aspects of the design of an open-plan office [9 max].

temperature;

legislation states the minimum and maximum temperature range for offices;

employees can legally refuse to work in an office outside the range;

lighting levels;

must be appropriate to task being undertaken;

legislation states the minimum and maximum light levels in an office environment;

light spread evenly/no glare;

noise;

legislation states the maximum noise level in an office environment;

employees can legally refuse to work in an office with noise limits in excess of the maximum;

size of computer work stations;

legislation states the minimum dimensions for worktops to be used for computers;

and the distance between users;

seating;

legislation states that computer users must have chairs which are adjustable;

for height and posture;

eye strain;

legislation is in place to ensure users do not suffer eye strain from computer screen glare;

employers may offer to pay for an annual eye test for employees who constantly use computers;

back strain;

legislation states the maximum loads workers are allowed to carry;

on level floors/up and down stairs;

trip hazards;

legislation states that cables must be secured to surfaces;

carpets not worn/frayed at the edges, *etc*;

fire regulations;

clear access to fire exits required;

for maximum number of occupants/all areas;

mandatory health and safety considerations;

must not be compromised in the design of the open-plan office;

fire exits/extinguishers / smoke detectors, *etc*;

[9 max]