



MARKSCHEME

May 2014

DESIGN TECHNOLOGY

Higher Level

Paper 3

27 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

1. (a) *Award [1] for stating one health benefit of the 5 A DAY shopping list and menu planner for families with young children.*
codifies nutritional best practice;
makes it easier for consumers to develop better eating habits;
convenience;
easy access to advice 24/7;
appealing to different age groups;
creates interest in menu planning/nutritional value of food;
gets children involved in the design and preparation of healthy meals;
skills development;
helps families develop better menus based on seasonal produce;
promotes a healthy/balanced diet; **[1 max]**
- (b) *Award [1] for each of two nutritional benefits of eating more fruit and vegetables [2 max].*
higher fibre intake;
higher intake of water-soluble vitamins/vitamin C/B vitamins;
lower energy density/reduced energy intake;
slow-release carbohydrate;
provides minerals/sodium/potassium for diet; **[2 max]**
- (c) *Award [1] for each of three distinct correct points in an explanation of why some governments provide public health advice and tools, such as the 5 A DAY shopping list and menu planner [3 max].*
many people do not understand the health implications of diet;
governmental public health advice can promote healthier lifestyles;
this can reduce the incidence of avoidable illness associated with poor lifestyles;

governments have a moral/ethical responsibility for their citizens;
providing public health advice is one way to evidence these responsibilities;
this can reduce the economic burden of health care; **[3 max]**
- Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.*
2. (a) *Award [1] for a definition of undernourishment.*
chronic food insecurity in which food intake is insufficient to meet basic energy requirements on a continuing basis; **[1]**
- (b) *Award [1] for one reason why local strategies are critically important for food security and [1] for a brief explanation [2 max].*
more sustainable;
take account of local conditions/problems;

local control/empowerment of local communities;
prevent need for international intervention/minimizes the development of dependency culture; **[2 max]**

3. (a) *Award [1] for each of two distinct correct points in a description of how an apple browns within a few minutes of being cut open [2 max].*
enzymic browning/apples contain an enzyme called polyphenol oxidase;
when an apple cut its cells are damaged and oxygen in the air allows enzymic reaction/polyphenols to react with the enzyme and other chemicals; [2]
- (b) *Award [1] for each of two distinct correct points in a description of how the browning of the toasted bread in Figure A3 occurs [2 max].*
Maillard reaction/non-enzymic browning/chemical reaction between an amino acid and a reducing sugar;
occurs as a result of heating; [2]
4. *Award [1] for each distinct point in an explanation of each of two ways in which the packaging of food products contributes to the development of brands [3 max] per type, [6 max] total.*
the shape of the packaging/the colour of the packaging, eg the Coca-Cola® red packaging;
promotes brand recognition;
promotes consumer loyalty/promotes sales;

the packaging can display the manufacturer's logo;
the logo/brand may be associated with quality/perceived status;
promotes consumer confidence; [6]
- Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.*
5. (a) *Award [1] for an implication for European food manufacturers associated with the lack of a labelling requirement for US foods when purchasing ingredients from the US and [1] for a brief explanation [2 max].*
traceability;
European food manufacturers will not know if they have purchased genetically modified crops/may find themselves in breach of EU legislation;

they may not buy US ingredients;
lack of confidence in quality of food/sourcing; [2 max]
- (b) *Award [1] for an implication of not labelling genetically modified foods for US consumers and [1] for a brief explanation [2 max].*
they will not know if their foods are genetically modified or not;
they will not be able to exercise choice about whether they eat genetically modified products; [2]

- (c) *Award [1] for an ethical benefit of genetic modification of foods for consumers and [1] for a brief explanation [2 max].*

genetic modification overcomes issues associated with a particular product;
eg susceptibility to pests or mildew/low nutritional value;

genetic modification can result in higher yields/less waste;
this may mean cheaper food for consumers;

[2 max]

6. (a) *Award [1] for each of three distinct correct points in an explanation of one way in which food contamination can be minimized in a self-service restaurant [3 max].*

good personal hygiene involves washing of hands before handling food especially after using the toilet or handling rubbish, tying back long hair, etc;
it ensures that food poisoning bacteria are not introduced into foods;
if there are no food poisoning bacteria in food then it cannot cause food poisoning;

the food should be protected whilst on display;
serving implemented, tongs, etc., need to be provided
to ensure that customers cannot sneeze/cough onto food/ handle it before purchase;

[3]

- (b) *Award [1] for each of three distinct points in an explanation of one issue of storage relating to the food on the counter in a self-service restaurant over a two-hour period [3 max].*

the temperature at which the food is stored needs careful consideration;
food must be kept hot or cold but not warm /microbial growth is fastest between 10 and 63°C/the temperature danger zone;
if food contaminated with food poisoning bacteria is kept in the temperature danger zone for an extended period the bacteria will multiply and could cause food poisoning;

[3]

7. *Award [1] for each distinct correct point in each of three ways in which the food industry in developed countries operates as of a tightly-controlled just-in-time system [3 max] per way, [9 max] total.*

food is delivered to store in line with customer requirements;
so there is no storage of stock;
reduced wastage;

strong information and communication technologies underpin the system;
so that supply is matched to demand;
ensures that the right amount of product is in the right place at the right time;

strong supply chain;
the food retailer must have a good understanding of lead times for supplies;
to get the product to the retail outlet/store at the right time;

lean;
no inventory/no wastage;
cost benefits for customer;

requires strong market research capability;
to understand customer needs (which can vary across different parts of a country);
loyalty cards can provide detailed data on customer needs;

[9 max]

Option B — Electronic product design

8. (a) *Award [1] for one piece of input data that is needed for the climate control unit to control the air temperature in a car.*
required air temperature / actual air temperature; **[1]**
- (b) *Award [1] for one other variable that will impact on the effectiveness of the closed loop control system and [1] for a brief explanation [2 max].*
the number of people in the car;
the more people the less effective will be the system in maintaining a steady temperature;
- people's temperature preferences;
the greater the difference between the preferred temperature and the ambient temperature the harder the climate control unit will have to work;
- if the windows are open;
the system will be trying to control the temperature beyond the car; **[2 max]**
- (c) *Award [1] for each of three distinct correct comments in an explanation of why the closed loop climate control system for a car uses negative feedback [3 max].*
negative feedback will stabilize the system;
so when the input changes in a manner which affects the performance of the system;
the type of feedback will create an appropriate response (output); **[3]**
9. (a) *Award [1] for a definition of virtual reality.*
the ability to simulate a real situation on the screen and interact with it in a near-natural way; **[1]**
- (b) *Award [1] for a design consideration in the development of a wearable human-computer interface for the implementation of virtual reality and [1] for a brief explanation [2 max].*
ergonomics/usability;
user interface and interaction;
- power;
supply and storage in conflict with size and weight;
- safety/physical danger;
distraction of mobile devices when in potentially dangerous environments, eg roads;
- behavioural targeting/profiling/targeted advertising based on real world behaviour;
seamless integration of online and offline lives; **[2 max]**

10. (a) Award [1] for an advantage for a consumer using a generic digital music system and [1] for a brief explanation [2 max].
compatibility between devices/systems;
familiarity/usability of systems/consumers will not have to learn how to master another system;

the generic digital music system will allow access to support services;
eg an app store and movie rentals;

[2 max]

- (b) Award [1] for an advantage for a manufacturer of developing its own digital music system and [1] for a brief explanation [2 max].
protected content using digital rights management (DRM);
ties content to specific devices/promote brand loyalty/promotion/control;

[2]

11. Award [1] for each of three distinct correct points in a discussion of each of two reasons why electronic products are designed to operate at dual voltages, for example, US 120 V UK 240 V [3 max] per reason, [6 max] total.

convenience/global standards;
product can be used in any country context/increase size of market;
consumer only needs to take one product when s/he travels;

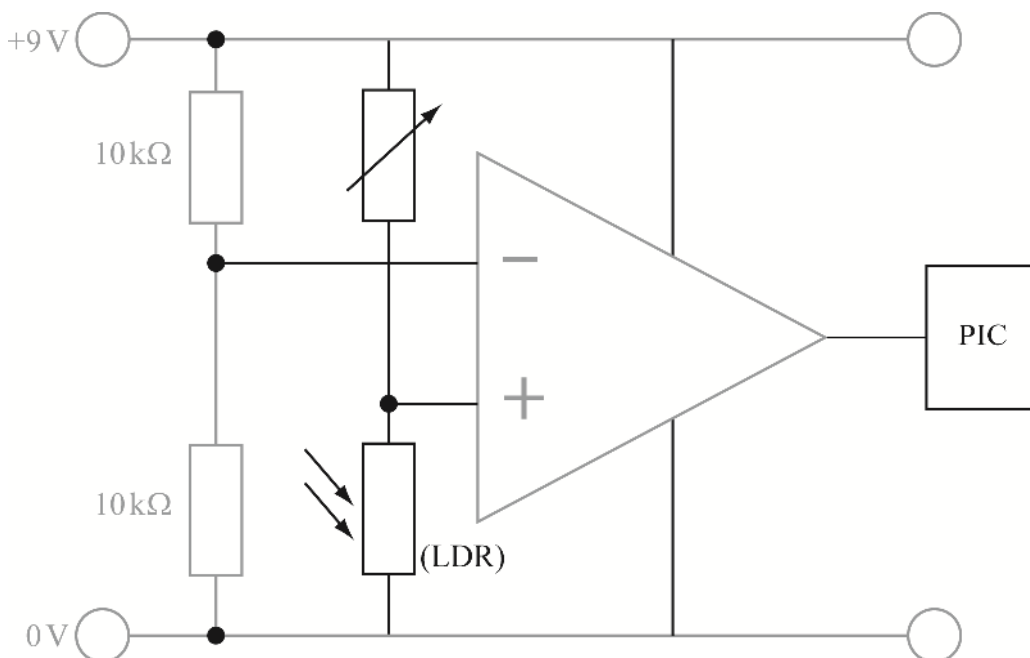
safety;

if a 240 V product were to be used on a 120 V supply it will underperform/not perform at all;

if a 120 V product were to be used on a 240 V supply it will malfunction/fuse/be unsafe;

[6]

12. (a) Award [1] for showing an LDR and a variable resistor and [1] for appropriately connected to the terminals of the operational amplifier [2 max].



Note to markers: some candidates may reverse the positions of the LDR and variable resistor. This is acceptable.

[2 max]

(b) *Award [1] for each of two characteristics of PICs that make them suitable for implementing the automated blind system [2 max].*
PICs can be programmed by the designer using simple language;
PICs can handle a number of inputs and outputs;
they are cheap/cost-effective;
they have a low power requirement so they can be used for battery operated systems however battery power not enough to open/shut blinds;
complex circuits can be implemented by software with no extra component costs; *[2 max]*

(c) *Award [1] for each of two distinct correct points in a description of a suitable output device for the automated blind system [2 max].*
motor;
to open or close the blind; *[2]*

13. (a) *Award [1] for each of three distinct correct points in an explanation of one advantage of upgradeability of electronic products for consumers [3 max].*
saves money;
overcomes product obsolescence/enhances product life;
the consumer can add additional memory/faster processor/additional peripherals; *[3]*

(b) *Award [1] for each of three distinct correct points in an explanation of one way in which the design of electronic products has contributed to the increased pace of innovation [3 max].*
most electronic products are designed for planned obsolescence;
they are not easy to repair;
manufacturers need to provide new generations of products with additional functionality;

a manufacturer may rush to be first to market for a product;
a manufacturer will develop versions/generations of products;
the product will then be updated at intervals to stimulate the market and maintain sales;

manufacturers often develop based on modular design;
this has enabled them to develop families of products;
this can be achieved very quickly so increasing the pace of innovation;

new technologies are continuously becoming available;
they provide opportunities for product innovation;
as the new technology is incorporated into new versions of the product; *[3 max]*

14. Award [1] for each of three distinct correct points in an explanation of each of three advantages of using programmable interface controllers (PICs) when developing a hearing aid [9 max].

customization;

individual settings as all users are different;

the amplification required by different users at different wavelengths is different as shown by their audiograms;

miniaturization/digital processing power evolves exponentially;

hearing aids can get smaller meaning the hearing aid can be closer to the ear drum;

so requires less battery power thus enhancing battery life;

environmental considerations;

filtration of extraneous noise;

differentiation of speech and other environmental noises in real time;

reprogrammability;

programmable software for individual needs;

better programming means better sound processing in multiple sound environments – from a quiet library to a noisy restaurant;

[9 max]

Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.

Option C — CAD/CAM

15. (a) *Award [1] for stating one reason for using different feed speeds during the production of the scale model in Figure C2.*
different feed speeds are required for different tool sizes/surface finishes/depth of cut;
speed needs to be matched to the material/matched to the force the machine can withstand; **[1 max]**
- (b) *Award [1] for identifying one advantage of using a five-axis CNC machine to produce the scale model in Figure C2 and [1] for a brief explanation [2 max].*
platform and cutting tool movements reach all model sides/all sides of the machine with undercuts;
there is no need for repositioning/additional fixtures; **[2]**
- (c) *Award [1] for each of three distinct correct points in an explanation of one benefit of creating the CAD simulation in Figure C1 for the production of the scale model in Figure C2 [3 max].*
allows a realistic visualization of the product (for the client/non-technical audiences);
so problems can be detected before actual production commences;
manipulate surface finishes/colours/dimensions; **[3]**
16. (a) *Award [1] for stating one characteristic of modelling wax that makes it suitable for use with CAM.*
low hardness;
easy to cut;
low melting point;
recyclable;
reduced tool wear;
low cost/cost effective/cheap; **[1 max]**
- (b) *Award [1] for identifying one way modelling wax is used with CAM to produce jewellery and [1] for a brief explanation [2 max].*
CAM is used to produce a wax master/wax replicas from CAD files;
designer no longer required to carve wax master;
use as a mould for lost wax casting; **[2 max]**

17. (a) *Award [1] for identifying one advantage of using orientation A (Figure C3) with solid object printing and [1] for a brief explanation [2 max].*
orientation B requires support material;
orientation A does not;
- speed;
orientation A means nozzles only deposit build material on the platform;
- less post processing;
model will not require the removal of any support material; **[2 max]**
- (b) *Award [1] for identifying why either orientation A (Figure C3) or orientation B (Figure C4) is suitable for use with select laser sintering (SLS) and [1] for a brief explanation [2 max].*
no support material is required for SLS;
the prototypes would be supported on all sides by powder; **[2]**
18. *Award [1] for each of three distinct points in an explanation of each of two impacts of introducing CNC machines on the fixed and variable costs of a multinational company [3 max] per impact, [6 max] in total.*
Fixed costs:
the company will have to make a capital investment in CNC machines;
so fixed costs will rise;
the company will have to consider its return on investment/breakeven;
- Variable costs:*
labour costs should reduce;
following an initial period of redundancy and retraining;
fewer but probably better paid/more technical jobs;
- material costs should reduce;
increased accuracy;
fewer errors; **[6 max]**
- Note to markers: candidates may offer training as either a fixed (as a part of the purchase of the CNC machines) or variable costs (where additional costs may be incurred after the CNC machines have been installed) depending on the context, in this case either approach is acceptable and responses may be derived from more than one cluster.*

19. (a) *Award [1] for identifying one implication of the increased use of CAD on the infringement of copyright and [1] for a brief explanation [2 max].*
more potential for copyright infringement;
deliberate system intervention of designs due to increasing cyber crime;

accidental loss;
due to flexibility of use of laptops in a variety of locations; **[2 max]**
- (b) *Award [1] for identifying one impact of the use of CAM on the infringement of patents and [1] for a brief explanation [2 max].*
criminals use reverse engineering to analyse products and pirate designs;
create new/slightly different product without undertaking research and development/R&D; **[2]**
- (c) *Award [1] for identifying one reason why some companies decide not protect their innovative products with patents and [1] for a brief explanation [2 max].*
patent laws vary between countries;
settlements may require lengthy expensive lawsuits;

ease of modification;
CAD facilitates copying and changing designs so they are no longer subject to patent;

pioneering/first to market;
capture market segment;

costly/time consuming;
but not always effective in terms of protecting design;

cannot always guarantee product/idea is patentable;
not all designs are patentable

may decide to go open source, eg for software or sports/mountain biking products;
allows the product to be modified by the user;

to avoid industrial espionage;
by keeping sensitive information about the products out of the public domain; **[2 max]**

20. (a) *Award [1] for each of three distinct points in an explanation of one reason why traditional craft production techniques are still used in the manufacture of some cars [3 max].*

image;

people appreciate hand-made fine detail;

craft techniques associated with certain car brands;

aesthetics;

a skilled craftsman's feeling for aesthetics cannot be compensated when using CAM;

robots do not differentiate wood grains or colour gradients;

added value;

traditional techniques are labour-intensive and require skilled craftsmen;

creates market pull;

unique selling point for product;

as part for a niche market;

low demand may not warrant investment in CNC;

[3 max]

Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.

- (b) *Award [1] for each of three distinct points in an explanation of one social disadvantage associated with replacing traditional manufacturing techniques with robots other than unemployment [3 max].*

loss of tradition/skills;

some markets value craft production for their aesthetics/value for money;

many products in different markets will no longer be unique;

indirect effect on communities;

loss of work in related industries/supply chain;

other local businesses may close as a result;

[3 max]

21. Award **[1]** for each of three distinct points in a discussion of three issues when using natural timber to produce furniture with CNC equipment. **[3 max]** per issue, **[9 max]** total.

type of construction;

CNC machines cannot make intricate joints;

the product needs to be designed to take account of this;

structure of natural timber/natural irregularities;

natural wood does not have a uniform grain structure and includes knots;

cutting tools are affected/damaged/need regular maintenance;

stability;

changes in humidity and temperature may lead to shrinkage;

differences in dimensions must be accounted for when using CNC;

damage to natural timber in CNC machining eg burning;

can require further surface treatment;

leading to added cost;

[9 max]

*Note to markers: candidates may offer linked examples from more than one cluster. Award **[1]** for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.*

Option D — Textiles

22. (a) *Award [1] for stating one characteristic relating to ease of maintenance that makes polyester suitable for the Nike Flyknit shoe.*
resistant to most chemicals;
quick drying;
wrinkle resistant;
mildew resistant;
easily washed; **[1 max]**
- (b) *Award [1] for a characteristic of knitted fabrics that contributes to the tight fit of the finished Nike Flyknit shoe and [1] for a brief explanation [2 max].*
low dimensional stability;
the knitted upper can take on the shape of the athlete's foot; **[2]**
- (c) *Award [1] for each of three distinct correct points in an explanation of the advantage to Nike of launching the Flyknit shoe at the London 2012 Olympics [3 max].*
athletes are positive role models;
people, especially young people, want to emulate them;
this would promote sales of the shoe and other Nike products;
- the 2012 Olympics was a high profile event;
it would be watched by billions of people globally;
lots of people would want to have the same shoes as worn by the winning athletes/creates market pull; **[3 max]**
23. (a) *Award [1] for a definition of intelligent fabric.*
a fabric with technology-enhanced performance (widely used in smart clothing); **[1]**
- (b) *Award [1] for each of two distinct correct points in a description of how Elektex fabric would contribute to the performance of the fabric keyboard shown in Figure D2 [2 max].*
laminated with two conducting outer layers separated by a partially-conducting central layer;
acts as an insulator when not pressed and a conductor when pressed; **[2]**

24. (a) *Award [1] for a reason why Velcro is an example of biomimetics and [1] for a brief explanation [2 max].*
biomimetics is the application of methods and systems found in nature to the study and design of engineering systems and modern technology;
the burrs were the inspiration for Velcro; [2]
- (b) *Award [1] for a reason why nylon is suitable for the production of Velcro and [1] for a brief explanation [2 max].*
nylon can be produced in threads of various thickness;
thicker threads for the hooks/thinner threads for the loops;

nylon is durable;
it will have a long product life;

it does not rot/go mouldy;
often used on waterproof clothing;

cost-effective;
suitable for volume production/cheap material and manufacturing costs; [2 max]
25. *Award [1] for each of three distinct points in an explanation of each of two considerations in relation to the biocompatibility of textile vascular prostheses. [3 max] per consideration, [6 max] total.*
textile vascular prostheses are in contact with blood;
blood contains antibodies to reject foreign materials;
if the textile is not biocompatible it will be rejected;

cleaning/sterilization/packaging involves heat treatment/and interaction with other materials;
the quality of materials can deteriorate during production;
biocompatibility must be tested in their final state; [6]

26. (a) *Award [1] for an environmental issue associated with the cultivation of non-organic cotton and [1] for a brief explanation [2 max].*
use of pesticides/fertilizers;
can cause significant damage to ecosystems/kills off beneficial insects (such as bees) as well as pests;
- cotton growing requires large volumes of water;
reduces water available for other purposes, eg drinking water; [2 max]
- (b) *Award [1] for a benefit of the "EU flower system" for consumers and [1] for a brief explanation [2 max].*
promotes consumer confidence;
a producer's environmental claims are independently checked and verified by the EU; [2]
- (c) *Award [1] for an advantage of a Global Organic Textile Standard over the "EU flower system" and [1] for a brief explanation [2 max].*
EU recognized in EU only;
the Global Standard is recognized world-wide;
- many textile products are produced outside the EU/in developing countries;
the Global Standard is more appropriate for developing country producers to use for sale of their products in the global marketplace / the EU standard is expensive to achieve and may only represent part of the producer's market; [2 max]
27. (a) *Award [1] for each of three distinct correct points in a discussion of one issue in relation to human resource management issues for a large multinational company establishing a textile manufacturing plant in a developing country [3 max].*
staff training/expertise;
the company may have to invest considerable amounts of time and money;
to train local people in the developing country context;
- relocation of management;
management may be reluctant to relocate to developing country contexts;
therefore desired changes may not be possible; [3 max]
- (b) *Award [1] for each of three distinct correct points in a discussion of one disadvantage for a developing country of a large multinational company establishing a textile manufacturing plant there [3 max].*
potential for exploitation;
MNCs may offer poor working conditions and low wages;
low quality employment opportunities may entrap not empower employees;
- the MNC culture may be incompatible with local culture;
resulting in conflict;
communities may be reluctant to work in such plants; [3 max]

28. Award [1] for each distinct correct point in each of three ways in which branding of textile products contributes to a global marketing strategy [3 max] per way, [9 max] total.

brand loyalty;

consumers often develop allegiance with a particular brand;

they will buy that brand in preference to another brand;

brand recognition/awareness;

branding a product makes it easier to promote with potential consumers;

this makes it easier to launch new products;

co-creations of brands;

consumer websites/Facebook/Twitter allow consumers to have their say and to contribute to the development of a brand;

global brands have to develop mechanisms to support consumer involvement;

a brand may not fit the culture of a particular country context;

a brand may need to be adapted to meet particular requirements – glocalized;

this poses challenges for global brands since digital technologies are not limited by country borders;

[9 max]

Option E — Human factors design

29. (a) *Award [1] for stating one reason why the control buttons on the handset are not all the same size.*
 so they fit within the profile of the handset;
 larger sizes are used for the buttons that are used most/easier to press;
 differentiate between (major and minor) functions;
 visually easier to navigate;
 users more easily develop a memory of how to use the product;
 aid partially sighted users (to distinguish certain functions); **[1 max]**

(b) *Award [1] for stating one reason for the shape (profile) of the handset in Figure E1 and [1] for a brief explanation [2 max].*
 fits comfortably in the hand / allows for a good grip;
 leaves the thumb/fingers of the other hand free to press the buttons;

 the narrowing in the centre of the handset;
 makes it suitable for most sizes/children and adults/balances the weight of the handset; **[2 max]**

(c) *Award [1] for each of three distinct points in an explanation of one reason for using a colour scheme for the buttons on the handset shown in Figure E1 [3 max].*
 colour schemes are used to differentiate between different functions/groups of functions;
 to facilitate ease of use;
 the black buttons relate to common functions on the TV (eg channel selection) /
 the blue buttons relate to additional features / the red, green, blue and yellow buttons relate to special functions/easy to learn/low memory burden – colour code/no need for glasses to read small print /no need for labels;

 convention/stereotyping;
 coding system enables ease of recognition of control functions;
 global product/easy to use in different contexts; **[3 max]**

30. (a) *Award [1] for stating which aspect of the “four pleasure framework” is triggered by the aroma of freshly-baked bread.*
 physio-pleasure; **[1]**

(b) *Award [1] for one reason why technophiles would experience psycho-pleasure when using a newly-purchased mobile phone and [1] for a brief explanation [2 max].*
 technophiles welcome technological change and the challenges that go with it;
 they would derive great pleasure from working out how the phone operated in order to maximize its use/utilize all the available features/use it before it becomes commonplace; **[2]**

Do not award a mark if the candidate refers solely to fashion as technophiles are pioneers rather than followers of fashion

31. (a) Award [1] for each of two distinct correct points in a description of the function of the sensory input when receiving a text message on a mobile phone and [1] for a brief explanation [2 max].
visual/audible/vibratory alert;
nerve impulse sent to central processes/brain from sensory organ/eyes/ears/skin; [2]
- (b) Award [1] for identifying a reason why the motor processing stage may lead to errors in writing a response to the received message and [1] for a brief explanation [2 max].
disability;
there may be a breakdown in the information flow from the brain to the muscles of the hand/the muscles may not be able to carry out the action;

dyslexia;
there may be a problem in the way the brain interprets written text;

speed;
the brain may process the information quickly but the muscles cannot respond as quickly and the wrong keys are pressed;

dexterity;
the physical interaction with the keys may not be accurate/controlled enough;
predictive text – not noticed when incorrect; [2 max]
32. Award [1] for each of three distinct correct points in a suggestion of each of two reasons why dimensions in anthropometric data tables are stated as estimates [3 max] per reason, [6 max] total.
sample size of users;
may not be representative of all the user population/people of different ethnicity;
so measurements taken may not be totally accurate;

date when the measurements were taken;
dimensions of the user population may have changed since that date;
due to diet/nutrition;

difficult to measure people/reliability of the measuring;
a tolerance is included to allow for a small amount of error;
measuring instruments may not have been very accurate;

dimensions are stated in whole numbers;
actual measurements taken may have included decimal figures;
numbers are rounded up for ease of use; [6 max]

33. (a) *Award [1] for identifying one way in which designers have improved the opportunities for disabled people to participate fully in sports activities and [1] for a brief explanation [2 max].*
products;
a wide range of products is now available for disabled people;
- prosthetics;
enhancing performance;
- user-centred approaches;
makes it easier to ensure products properly meet the needs of disabled persons; **[2 max]**
- (b) *Award [1] for identifying one method that designers could use to research human factors for the design of a wheelchair to be used by disabled athletes and [1] for a brief explanation [2 max].*
expert appraisal;
wheelchair competitors will be experts at what they require from a wheelchair in a competition and will be able to provide detailed information of requirements to designers;
- user trial/;
designers can observe wheelchair users in a basketball competition to note down special requirements of the wheelchair;
- user research;
designers can use motion capture to identify special requirements of the wheelchair athlete;
- literature search;
designers can access information already available on existing wheelchair designs for Paralympians/standards or legislation provided by the Olympic organization; **[2 max]**
- (c) *Award [1] for identifying one way in which the use of digital humans would increase the speed of the product development process for the new wheelchair design and [1] for a brief explanation [2 max].*
virtual modelling enables more design iterations in less time than in a user trial;
this means that a new product can be developed more quickly; **[2]**

34. (a) *Award [1] for each of three distinct correct points in a discussion of one way in which cultural differences can impact on a person's attitude to personal space when using an airport lounge [3 max].*

country of origin;

people from some countries welcome the opportunity to talk to strangers so enjoy a more intimate arrangement of seating;

while people from other countries prefer to be more isolated and not pressured to engage in conversation/distinct arm rests/separate seating;

gender/religion;

some religions have strict rules/guidelines on the nature of social gatherings/interaction between people;

eg between men and women;

socio-economic class divisions;

people who have paid for a particular class of ticket expect to be segregated from other people of lower classification tickets;

eg first class;

[3 max]

- (b) *Award [1] for each of three distinct correct points in an explanation of one way in which designers take into account different attitudes to personal space in the layout of the furniture in a café [3 max].*

flexibility of arrangement of furniture;

so that people may choose a space which suits their preference;

without compromising the space for other people with different preferences;

different sizes of furniture/fixtures/modular design of furniture;

to cater for individuals, small groups and larger groups;

and different needs of people at different times of the day eg people wanting to read the newspaper quietly at breakfast;

[3 max]

35. Award [1] for each of three distinct points in a discussion of human factor considerations in the design of a car seat belt for a volume-produced car in relation to anthropometrics, psychological and physiological factors [3 max] per factor, [9 max] total.

Anthropometrics:

data required for relevant aspects of body size (eg dimensions of the abdomen/chest/height);
dimensions to relate to all the user population;
range of adjustability within 5th–95th percentile;

Psychological:

users must feel safe/reassured by the 'click' with the seatbelt on;
the driver must also be satisfied about the safety of passengers;
and complying with legislation;

Physiological:

Comfort/feel of the material is important to users;
the range of adjustability of the belt must provide comfort for all users;
the tension of the belt must provide safety but also ease-of-use by a wide range of users;

[9]

Note to markers: If candidates have used the incorrect heading but the content is appropriate, mark positively and do not penalize the candidate for the incorrect use of a heading.
