Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2019

Design technology

Higher level and standard level

Paper 2

17 pages

General Marking Instructions

Subject Details: Design Technology HL and SL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A (total ***[30 marks]***) ONE question in Section B ***[20 marks]***. Maximum total = ***[50 marks]***.

Markscheme format example:

Question			Answers	Notes	Total
4.	**b**	**ii**	the displacement and acceleration ✓ are in opposite directions ✓	*Accept* ***force*** *for* ***acceleration****.*	**2**

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a tick (✓) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative wording is indicated in the "Answers" column by a slash (/). Either wording can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***" on the line between the alternatives. Either answer can be accepted.

7. Words in angled brackets ❮ ❯ in the "Answers" column are not necessary to gain the mark.

8. Words that are <u>underlined</u> are essential for the mark.

9. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

10. 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 "Answers" column 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).

11. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

12. 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. "ECF acceptable" will be displayed in the "Notes" column.

13. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Section A

Question			Answers	Notes	Total
1.	a	i	(the application of scientific information concerning) the relationship between human beings/users to the design of products/systems/environments ✓	*Award **[1]** for a correct definition of ergonomics up to **[1 max]**.* *Answer in brackets is not required to award the mark*	1
1.	a	ii	biomechanics considers human mechanics/movement ✓ taking into account strength of the user/type of force required/the operations of the controls of a car ✓	*Award **[1]** for identifying a reason why biomechanics used in car design and **[1]** for a brief explanation up to **[2 max]**.*	2
1.	b	i	percentile ranges account for people that come in different shapes and sizes/5th-95th percentile ✓ for safety/comfort/adjustability ✓	*Award **[1]** for identifying a reason why different percentile ranges are used in car design and **[1]** for a brief explanation up to **[2 max]**.*	2
1.	b	ii	dynamic data considers the user in motion in the car ✓ operating a car must consider clearance/reach of the controls ✓	*Award **[1]** for identifying a reason why dynamic data is used in car design and **[1]** for a brief explanation up to **[2 max]**.*	2
1.	c	i	psychological factor data relates to texture/sound/light/temperature/smell ✓ which are used to consider the design of the car's materials/noise/lighting/windows/ventilation ✓	*Award **[1]** for identifying one way in which the psychological factor data can influence the design of the car and **[1]** for a brief explanation up to **[2 max]**.* *Answer in brackets is not required to award the mark* *Do not accept 'colour'*	2

Question			Answers	Notes	Total
1.	c	ii	legislation forces manufacturers to meet environmental standards/sustainability principles ✓ so that cars are required to reduce emissions/introduce cleaner technologies ✓ manufacturers will need to modify existing designs to meet these standards ✓ legislation can provide incentives/economic relief for manufacturers to produce green design cars ✓ which encourages investment in further research and development ✓ resulting in continuous improvement over time/leading to new versions and generations ✓	*Award **[1]** for each of three distinct points in an explanation of how legislation can be used to enable incremental green design in car design up to **[3 max]**.* *Do not award marks across clusters*	**3 max**
1.	d	i	cost effective ✓ easy to shape/manipulate ✓ easy to modify ✓ tactile material ✓ readily available (abundant) material ✓ helps communicate the form ✓ can be scanned/used for further digital development ✓ suitable for large scale modeling ✓	*Award **[1]** for listing a reason why clay modelling is still used to make prototype models such as in car design up to **[1 max]**.*	**1 max**

Question			Answers	Notes	Total
1.	d	ii	surface modelling is a realistic/aesthetic representation of the final model/offers some machining data/contains no data about the interior of the part ✓ whereas solid modelling is a comprehensive (internal and external) representation of the final part/provides a complete set of data for the product to be realized ✓	*Award **[1]** for each description of the difference between solid and surface modelling up to **[2 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters*	**2 max**
1.	e	i	isometric drawings provide a 3D view of the car ✓ that helps communicate the idea between designers and client/gives a clear representation what the product will look like ✓ exploded isometric drawings can be used to show how the parts need to be assembled ✓ which helps in the manufacturing of different parts of the car ✓	*Award **[1]** for identifying why isometric drawings are often used in car design and **[1]** for a brief explanation up to **[2 max]**.* *Do not award marks for 'shows all dimensions/angles of the car'* *Do not award marks across clusters*	**2 max**

Question			Answers	Notes	Total
1.	e	ii	digital humans are virtual simulations of human beings with realistic movements of various parts of the body ✓ can be used to test/evaluate how people interact with the car interior/ controls ✓ to determine optimum clearance/reach/adjustability ✓ digital humans are virtual simulations of human beings with realistic mass/size/shape ✓ can be used to test/evaluate the result of a crash/accident ✓ to optimise the interior of the vehicle to enhance safety/minimise risk of injury ✓ digital human libraries contain models of varying sizes and shapes ✓ designers do not need to utilise a range of real people/physical models to test the interior of the car ✓ reducing labour costs/making modifications to the car interior design quick/cost effective ✓	*Award **[1]** for each of three distinct points in an explanation of why digital humans are used in car interior design up to **[3 max]**.*	**3 max**

Question			Answers	Notes	Total
2.	a		regarded as a dominant design ✓ as it contains features that are essential (to align sight and sound) ✓ is seen as iconic ✓ due to its cultural association to the film industry ✓ has become ubiquitous/omnipresent ✓ as it is often seen on screen/in media ✓ has a distinctive image ✓ with its instantly recognizable (aesthetic) features ✓ is seen as timeless ✓ and remains in use/serves as a standard of its time ✓	*Award **[1]** for identifying one way why the clapperboard can be defined as a Classic Design and **[1]** for a brief explanation up to **[2 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters*	**2 max**
2.	b		the clapperboard is still commonly/widely used ✓ but is not growing in demand ✓ sales have reached their peak ✓ but are beginning to decline ✓	*Award **[1]** for identifying why the clapperboard is in the maturity phase of its product cycle and **[1]** for a brief explanation up to **[2 max]**.* *Do not award marks across clusters*	**2 max**

Question			Answers	Notes	Total
3.			end-of pipe technologies only focus on reducing pollutants at the end of a process ✓ however pollutants may still be released during the production process ✓ strategies (system level solutions) that capture the pollutants earlier in the production process can result in less pollutants being emitted overall ✓ end-of pipe technologies only focus on reducing pollutants at the end of a process ✓ different types of pollutants can be released during the manufacturing process ✓ that may not be addressed/eliminated with one single solution ✓	*Award **[1]** for each of three distinct points in an explanation of why end-of-pipe technologies may not be the most effective strategy to reduce pollution of up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters*	**3 max**
4.			some products are designed with planned obsolescence (in mind) ✓ meaning products need to be replaced/consumers need to buy new products ✓ increasing sales/profits (for the company) ✓ some products are designed to prevent access to (internal) components/parts ✓ due to structural/mechanical/electrical/chemical risks ✓ to ensure safety/prevent possible injury ✓ consumers may attempt to repair/modify a product themselves ✓ using incorrect techniques/incompatible components ✓ which can impair the performance/function/quality of the product ✓	*Award **[1]** for each of three distinct points in an explanation of why products may be designed so that they cannot be easily disassembled up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters*	**3 max**

Section B

Question			Answers	Notes	Total
5.	a		recycling refers to reprocessing/using materials (from obsolete products) to create new/other products ✓ reusing is using a product more than once, in the same/a different context ✓	*Award **[1]** for each description of the difference between recycling and reuse up to **[2 max]**.* *Answer in brackets is not required to award the mark*	**2**
5.	b		adaptation is when a solution to a problem in one field is used to provide a new idea for a design problem in another ✓ the Anglepoise lamp adopts the principles of car suspension (levers and springs) ✓ to create the unique design of the movement/form of the lamp ✓	*Award **[1]** for each of three distinct points in an explanation of why the innovation strategy for the Anglepoise lamp is an example of adaptation up to **[3 max]**.* *Answer in brackets is not required to award the mark*	**3**
5.	c		screws/nuts and bolts ✓ are a temporary/non-permanent joining method ✓ that allows for assembly/disassembly for repair/replacement of parts ✓ fasteners/nuts and bolts ✓ allows for pivoting/movement of parts ✓ to adjust the angle of the lamp/light ✓ fuse/weld/rivet/hard solder ✓ is a permanent joining method ✓ that keeps together the parts that don't require any movement ✓	*Award **[1]** for each correct suggestion of two <u>different</u> joining techniques that could have been used to join the metals in the Anglepoise lamp and **[2]** for an explanation of why this joining technique is appropriate up to **[3 max]**.* *Do not award marks across clusters* *Mark as **[3]** + **[3]**.*	**6**

Question			Answers	Notes	Total
5.	d		**Omnipresence:** the lamp has existed/been in circulation a long time ✓ it was designed/created in 1932 ✓ and is still widely available today ✓ **Image:** the lamp has a distinctive shape ✓ making it instantly recognizable ✓ which can create/evoke/trigger an emotional response/nostalgia ✓ **Dominant design:** the lamp contains features that are recognized as essential/becomes a standard of its time ✓ and becomes embedded in our life/dominates the marketplace/is imitated by other companies ✓ so demand for the product continues even when new products enter the market ✓	*Award **[1]** for each of three distinct points in an explanation of why omnipresence makes the Anglepoise lamp a classic design up to **[3 max]**.* *Award **[1]** for each of three distinct points in an explanation of why image makes the Anglepoise lamp a classic design of up to **[3 max]**.* *Award **[1]** for each of three distinct points in an explanation of why dominant design makes the Anglepoise lamp a classic design of up to **[3 max]**.* *Do not award marks across clusters* *Mark as **[3]** + **[3]** + **[3]**.*	**9 max**

Question			Answers	Notes	Total
6.	a		a patent is a legal agreement that gives someone the right to make or sell an invention (for a certain number of years) ✓ and protects the inventor from having their idea copied/imitated ✓	*Award **[1]** for identifying why designers would register a patent and **[1]** for a brief explanation up to **[2 max]**.* *Do not award marks for answers referring to 'copyright' or 'ownership'* *Answer in brackets is not required to award the mark*	**2**
6.	b		steel-reinforced concrete is made up of two materials (steel and concrete) ✓ which are difficult/require a large amount of energy to separate ✓ the concrete must be crushed to allow the steel to be melted down/recycled ✓ steel-reinforced concrete is a composite material ✓ made from a variety of different materials (sand/gravel/water/cement with steel bars) ✓ which cannot be separated easily into each material category for recycling ✓	*Award **[1]** for each of three distinct points in an explanation of why why the recycling of the steel reinforced concrete is problematic up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters*	**3 max**

Question			Answers	Notes	Total
6	c		**Form:** relates to the shape and the aesthetic qualities of the bridge ✓ some bridges are designed to be recognisable/iconic ✓ should be in harmony with the surrounding environment ✓ the form of the bridge may be influenced by the intended load ✓ optimum materials/structure for the function may not compliment the form ✓ **Function:** a bridge needs to function as a safe crossing between two land masses ✓ it is required to withstand forces/have tensile/compressive strength to fulfil its purpose ✓ needs to function under a specific/intended load (consider factor of safety) ✓ should withstand adverse environmental conditions (earthquakes/high winds etc.) ✓ form follows function/function is more important than form (in a safety-critical structure such as a bridge) ✓	*Award **[1]** for each of six distinct points in a discussion of the conflict between **form** and **function** when designing a new bridge.* ***[3 max for each]*** *Answer in brackets is not required to award the mark* *Do not award marks across clusters* *Mark as **[3]** + **[3]**.*	**6 max**

Question			Answers	Notes	Total
6	d		**Physical properties:** thermal expansion/contraction ✓ timber does not expand/contract readily ✓ retaining the structural integrity of buildings in different climates ✓ thermal conductivity/resistance ✓ timber does not conduct heat readily ✓ helping to insulate (warm/cool) the building ✓ mass/weight ✓ timbers vary in their density ✓ some buildings need to have lightweight features/high density for stability ✓ different timbers vary in their hardness ✓ consideration needs to be given to the selection of timber to reduce wear/resist impact/scratches ✓ to ensure its durability/longevity ✓ **Aesthetic properties:** appearance/texture ✓ timber has a natural colour/grain ✓ and can be selected to suit various tastes/aesthetic/styles/environments ✓ smell ✓ certain species of timber have unique/distinctive smell ✓ that can enhance the user experience/create an emotional response/ evoke memories ✓ finishes ✓ timber can be treated in a variety of ways ✓ such as painting/varnishing/oiling/staining/waxing ✓	*Award **[1]** for each of three distinct points in an explanation of why timber as a building material is influenced by its physical properties up to **[3 max]**.* *Award **[1]** for each of three distinct points in an explanation of why timber as a building material is influenced by its aesthetic properties up to **[3 max]**.*	**9**

			Environmental impact: Renewability ✓ timber can be harvested and regrown from sustainable sources ✓ minimising the depletion of finite resources ✓ deforestation ✓ involves clearing a wide area of trees ✓ causing a destruction of natural habitat/decrease in biodiversity ✓ recovery and disposal ✓ timber can be reused ✓ or used as biomass/creation of composite material ✓ biodegradable ✓ timber is a natural material ✓ that will degrade/return to the earth ✓	*Award **[1]** for each of three distinct points in an explanation of why timber as a building material is influenced by its environmental impact up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters* *Mark as **[3]** + **[3]** + **[3]**.*	

Question			Answers	Notes	Total
7.	a		hardness/scratch resistance (screen) ✓ tough/impact resistant (screen) ✓	*Award **[1]** for listing each property of the materials in the smartwatch that enable its development up to **[2 max]**.* *Do not accept 'strong'* *Answer in brackets is not required to award the mark*	**2**
7.	b		converging technology is the merging of information/communication technologies ✓ the smartwatch combines the traditional wristwatch with modern digital applications/technologies ✓ in a single wearable device/reducing the need for multiple devices ✓	*Award **[1]** for each of three distinct points in an explanation of why the smartwatch is an example of a converging technology up to **[3 max]**.*	**3**
7.	c		robots used in manufacturing ensure high accuracy/speed/repeatability ✓ smartwatches have (numerous) complex/miniaturised components ✓ which ensures they are manufactured to a high quality/consistent standard/with reduced errors ✓ robots can operate 24/7 ✓ ensuring smartwatches can be produced in high volumes ✓ which increases profit for the company/ensures watches are produced with economy of scale ✓ robots can be programmed to perform more than one task ✓ to carry out various operations/be utilised in an assembly line/ be retooled ✓ increasing efficiency in manufacture ✓	*Award **[1]** for each of three distinct points in an explanation of how the use of robotic manufacturing systems can assist in the production of smartwatches up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters* *Mark as **[3]** + **[3]**.*	**6 max**

Question			Answers	Notes	Total
7.	d		**Sustaining innovation:** sustaining innovation is the development of new/improved products ✓ the smartwatch sustains time-keeping innovation by adding additional functionality ✓ which offers the user a range of features previously unavailable on a traditional watch ✓ sustaining innovation is minor improvements to new generations/versions of an existing product ✓ that can be constantly updated (hardware/software) ✓ sustaining market/consumer demand ✓ **Disruptive innovation:** disruptive innovation challenges existing companies through radical change ✓ incorporating technologies previously found in other devices (smartphones/tablets) ✓ which manufacturers ignore/embrace ✓ **Process innovation:** an improvement in the organization and/or method of manufacture ✓ new manufacturing processes are required to create and assemble miniaturised components ✓ which results in speed/efficiency of manufacture ✓	*Award **[1]** for each of three distinct points in an explanation of why sustaining innovation applies to the development of the smartwatch up to **[3 max]**.* *Award **[1]** for each of three distinct points in an explanation of why disruptive innovation applies to the development of the smartwatch up to **[3 max]**.* *Award **[1]** for each of three distinct points in an explanation of why process innovation applies to the development of the smart watch up to **[3 max]**.* *Answer in brackets is not required to award the mark* *Do not award marks across clusters* *Mark as **[3]** + **[3]** + **[3]**.*	**9 max**