AQA A Level

Product Design

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SERIES A

Sample paper TWO

Mark Scheme

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A Level Design & Technology (Product Design)

Series A – Paper 2 mark scheme

This sample paper and mark scheme has been carefully compiled and checked to ensure parity with the AQA guidelines available. It is the normal process for the mark schemes of live papers to go through a standardisation process where students' responses are analysed and any answers not covered in the mark scheme are discussed and legislated for. As this is a sample paper only, this process has not been undertaken. Whilst this paper and mark scheme have been technically proofread, there may be additional responses that are worthy of marks. Teachers discretion should be applied in these circumstances.

Instructions for level of response marking

Descriptors are provided for different levels of response along with appropriate marks for each level. Read through a students' answer, annotating to show the qualities that have been achieved, before applying the level based mark scheme.

Determining a level

Start with the lowest level of response in the mark scheme and assess if the different qualities indicated have been met. If they have, move to the next level and check to see if these have been met. Continue the process until you can match the level with the answer. With repetition it becomes easier and quicker to work up through the levels of the mark scheme.

The principle of 'best fit' should be adopted and if small elements of a level are missing but the majority has been covered, then this is the appropriate level to award.

Determining a mark within a level

Having decided on the level, the mark within the level must be determined. Use the descriptors to help with this along with the indicative content. Where there is any doubt, it is advisable to read back through the answers again and reapply it to the indicative content. Students do not need to cover all of the indicative content to reach the top marks. Additionally the indicative content is not designed to be exhaustive and alternative appropriate answers may well be taken into consideration.

Student answers that do not contain any relevent content must be awarded zero marks.

SECTION A

1. **Award marks as shown.** **[8 marks]**

7-8 marks	A thorough and detailed comparison of both knives, referring in detail to the ways in which they have been designed and manufactured and meet specific needs to the end user.
5-6 marks	Good understanding of how both designs have been designed and manufactured to consider relevant needs of the end user.
3-4 marks	Basic understanding of both design and manufacturing features to meet the needs of the end user but points may not be explained in full.
1-2 marks	Limited number of points considering how knives have been designed and manufactured. Expect little consideration of the end user.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

Nylon and elastomer craft knife:

- Designed with ergonomics in mind e.g. finger grip on retraction lever
- Combination of polymers. Elastomer used for over-moulding on back edge palm and front edge finger grips to avoid slipping and discomfort from pressing into hand
- Designed from thermoplastics which can be readily recycled; waste polymer created during manufacture can be recycled in house
- Retracting blade designed for improved safety when not in use
- Blades need little handling and is easy to install safely (no specialist tools needed to replace blade)
- Portions of blade can be snapped off (safely using end cap) to ensure a sharp blade all the time; requires blade to be change less frequently
- Injection moulded body highly suited to mass production
- Polymers have improved characteristics e.g. colour coding for visibility, warmer to touch
- Polymers more likely to crack under pressure e.g. if stepped on

Stainless steel craft knife:

- Scalpel blade can be removed without any specialist tools
- Much harder to replace blade safely (care must be taken to avoid cutting hand and fingers), blade will need to be replaced frequently
- Body of knife die cast rapidly in one piece to speed up production
- No moving parts that could become faulty or fail
- A long product life due to no moving parts and durability of material
- Maintenance will be minimal
- Ergonomic textured area on shaft for additional grip
- Slim design easy to control fine movements
- Stainless steel will not corrode/rust
- Stainless steel body is easy to clean and sterilise

2. **Award marks as shown.** **[2 x 3 marks]**

(a) Marking and cutting aid for the locating the positions of the struts between the upper and lower wings:

Reference to jig (1); description of device which can locate holes repeatedly/consistently/accuracy (1); reference to securing jig to workpiece.

(b) Measuring and marking the shape of the plane body:

Reference to template/stencil (1); description of template/stencil which can replicate body shape (1); reference to locating template/stencil on blank (1).

Do not accept reference to tools.

3. Award marks as shown. **[8 marks]**

7-8 marks	Excellent understanding of the principles of the Bauhaus movement and knowledge of the work of Marianne Brandt. Clear working knowledge of relevant works with correct and highly appropriate examples to support response.
5-6 marks	Good understanding of the principles of the Bauhaus movement and knowledge of the work of Marianne Brandt. Some correct understanding and examples of relevant works referenced to support answer.
3-4 marks	Basic understanding of the principles of the Bauhaus movement and at least one example of the type of work of Marianne Brandt designed.
1-2 marks	Little or no understanding of Bauhaus/Marianne Brandt and relevant works. Simple statements referencing Bauhaus principles.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

- Brandt was a designer famous for her design of household objects e.g. tea sets, metal ashtrays, tea and coffee services, lamps
- Brandt was a multi-disciplinary artist: painter, sculptor, photographer and designer
- Brandt's work/Bauhaus is characterised by geometric forms with references to the Art Deco style
- Brandt/Bauhaus is classified as a modernist designer/movement
- She specialised in metalwork
- Form follows function, aesthetics references manufacturing process and materials and were not littered with superfluous ornamentation
- Embraced the industrial aesthetic and materials e.g. chrome plating, tubular steel
- The machine age, focus on the beauty of machined processes, aesthetics and finishes
- Everyday products for the masses, a reaction to the hardships of WWI, the Bauhaus movement sought to make everyday products more affordable, mass production

4. Award marks as shown. **[8 marks]**

7-8 marks	A through and detailed discussion of several relevant technological changes that have shaped both the design and manufacture of kettles. Clear reference to specific features of the kettles featured to support response. Detailed justification.
5-6 marks	Balanced discussion, showing a good understanding how technological changes have shaped both the design and manufacture of kettles. Some reference to the kettles featured to support response. Most points are justified.
3-4 marks	Basic points made considering how technology has shaped the design and manufacture of kettles. Response is descriptive rather than evaluative. Some justification.
1-2 marks	Limited understanding of technological developments. Points have little/no justification.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

- Use of electricity rather than direct conduction of heat means kettles can be placed anywhere where there is a plug socket, not just on a hob
- More efficient way of heating water; less heat lost in surrounding environment
- Figure 4 kettle will conduct less heat to surrounding area compared to Figure 3, makes Figure 4 is more efficient and safer to use
- Ability to measure and heat a specific amount of water with viewing window
- Figure 4 has a docking station, meaning cable does not have to be attached/detached (earlier electronic kettles did not have a docking station)
- Use of polymers that are both water and heat resistant built into Figure 4 kettle e.g. viewing window is transparent, so users can see contents
- Reduction in metals used has reduced weight of kettles, easier and safer to use
- Shape and size of handle in Figure 4 affords better grip; reference to anthropometric data
- More ergonomic handle in Figure 4; safer to use / reduced risk of burning
- Use of thermoset polymers used in some features of Figure 4 to ensure safety and reliability e.g. polymers are poor conductors so risk of burns through handling can be minimised - Figure 3 has early thermoset handle on lid probably Bakelite
- Figure 4 uses micro-electronics in the design to operate the thermostatically controlled shut-off and LED
- Automatic shut off on Figure 4 kettle increases ease of use and safety
- CAD and CAM will have been used in the design stage of Figure 4 and for making moulds and circuit board production

SECTION B

5. **Award 1 mark for a suitable point and a further 1 mark for a simple explanation or 2 marks for a detailed explanation.** **[3 marks]**

Use to check a tolerance range (1) for quality control (1) e.g. lengths of steel rods to make axles for a toy car (1).

'Go no go' gauges the maximum and minimum acceptable size (1) e.g. +/- 2mm before they are rejected (1).

Parts that are not within tolerance are rejected (1).

The part being tested needs to past one test (go) and fail another (no go) to be within the tolerance (1) e.g. a drilled hole may allow gauge to pass through in one orientation and not pass through in another (1).

6. **Award marks as shown.** **[6 marks]**

5-6 marks	Specific electronic product(s) named with excellent consideration of how it conserves energy, material and components. Explanation is well-structured with a wide range of points justified in detail.
3-4 marks	Generic electronic product(s) named and there is good consideration of how it conserves at least two out of three areas of energy, material and components. Explanation covers a range of points which are justified.
1-2 marks	Generic electronic product(s) is named and there is evidence of basic consideration of how it conserves energy, materials or components. Limited/no justification.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

Energy points:

- Ability to auto shut off / go to low power mode / screen save
- Ability turn off / disable features / software e.g. data roaming / flight mode / reduce screen brightness / cooler settings / low power mode
- Advances in battery technology makes them more efficient / recharge faster
- Portable/built-in solar chargers to harness renewable energy
- Indicators to show when fully charged or when charging is needed

Materials:

- Reduced packaging size
- Miniaturisation of electronic components / microelectronics, products have become smaller, saving materials in housing & reducing weight for more efficient transport
- Use of premium materials such as glass, stainless steel, aluminium which give added longevity and can be recycled
- Design for disassembly and or repair
- Interchangeable components e.g. personal toothbrush heads, different cleaning attachments
- One product that does the jobs of many, reference to convergent technologies e.g. a smart phone is a camera, computer, music library, torch etc.

Components:

- Washable filters that can be reused e.g. vacuum cleaners, washing machines
- PIC/microcontroller-based electronics where software/firmware can be upgraded removing need for wholesale disposal / obsolescence
- Use of PIC/microcontroller replacing many ICs in one small convenient package reduces consumption of raw materials and energy for additional manufacture and assembly – component redundancy
- Software taking place of hardware e.g. music software emulating synthesisers and drum machines
- New features via software/firmware upgrade to increase the lifespan of the product reducing need for additional components

7. **Award marks as shown.** **[8 marks]**

7-8 marks	Excellent evaluation of several national and international standards applied to the design/manufacture of the given product. Several specific examples of standards to support response.
5-6 marks	Good evaluation of some national and international standards. Relevant named standards identified and related to the given product.
3-4 marks	Basic evaluation of at least two national and/or international standards and how they can be used in product manufacture. Identification of at least two specific standards. Do not expect to see detailed evaluation for this band.
1-2 marks	Limited evaluation with general statements saying how standards can be applied to modern products to ensure they are fit for use. Specific examples unlikely to be identified.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

- Garden light may display the British Standards Institute (BSI) Kitemark™ to indicate independent/third party quality and safety testing has been carried out
- Packaging/product may display the Conformité Européenne (CE mark) to show that the manufacture of the light meets a minimum agreed standard, although not independently tested; a lower standard than BSI
- Reference to International Organisation for Standardisation (ISO) – national standard agencies agree and put international standards in place e.g. B EN ISO 9001
- As an electronic product, the light must adhere to Restriction of Hazardous Substances directive (RoHS) regulations - a European directive that restricts the use of hazardous materials e.g. mercury and lead. All products sold in the EU have had to be compliant with this directive since 2006.
- Rechargeable batteries in the product should be disposed of property and in accordance with the Battery directive (2006/66/EC) - this deals with the safe disposal of batteries and limits metals such as mercury in battery constructions
- Polymer casing should display codes – the 8 different versions of the Mobius loop for polymers e.g. ABS code 9, polypropylene code 5, polycarbonate code 7 allows for easier identification for recycling

- Packaging directives
- Product must display crossed wheelie bin symbol in accordance with the Waste from Electrical and Electronic Equipment (WEEE) directives which seeks to recycle materials and components from electrical products
- Packaging for garden light may display energy ratings – the bar symbol showing energy efficiency of electrical and electronic products, informs consumer of efficiency rating
- Eco labelling e.g. Mobius loop, EC symbol, FSC, EPA energy star etc.

8. **Award 1 mark for a suitable point and a further 1 mark for a simple explanation or 2 marks for a detailed explanation. Maximum of three marks per section. Candidates must address all three areas to gain full marks. [3 x 3 marks]**

Indicative content: accept alternative responses worthy of credit

(a) Raw materials extraction

- Limiting use of virgin materials to reduce deforestation and demand for non-renewables (e.g. materials needed for battery, PCB, printing inks etc.)
- Use of renewable energy/fuel to power machinery used for extraction e.g. biodiesel for harvesting trees
- Extraction sites for renewable materials are managed to ensure a sustainable supply e.g. managed forests (FSC)

(b) Manufacturing

- Limiting use of raw materials requiring primary processing
- Increased use of recycled materials or combining new extracted raw materials with recycled materials e.g. recycled paper/board, recycled metals and plastics for PCB
- Use of energy from renewable sources to power factories e.g. printers, paper mills, calendaring machines for laminate
- Use of vegetable inks for printing – renewable source and fewer pollutants
- Reduce water consumption required to process paper
- Use of CAD and to make best use of materials e.g. tessellating/nesting pages
- Use of CNC and CAM to accurately minimise waste through inaccurate and defective component parts e.g. digital printing, offset, flexographic printing
- Use of smart technology e.g. programmable chips to reduce number of process blocks in PCB production
- Use energy efficient machinery
- Switch off and save – energy walks – heat reclamation – energy from waste
- Complete LCA and LCI
- Use of carbon credits – carbon offsetting methods

(c) Ease of recycling

- No ability to replace battery
- Battery and electronics must be removed before recycling can take place
- Paper and board is easy to recycle but adding laminate makes the process more complex and costly

- Electronic components could be recycled but this would be difficult as they are built into the book cover

9. **Award marks as shown.** **[3 marks]**

Application	Modelling material
Architectural scale model	Foam board
Ergonomic handle for a product	Polymorph
3D printed model	Polylactic acid PLA

10. **Award marks as shown.** **[8 marks]**

7-8 marks	Excellent understanding of a wide range of advantages and disadvantages. Detailed consideration of several features required and the suitability of HDMF for modelling featured hairdryer prototype. Possible consideration of other materials is acceptable, but not necessary in response.
5-6 marks	Good understanding with consideration of both advantages and disadvantages in the use of HDMF for the featured hairdryer prototype. One or two specific properties/features considered.
3-4 marks	A developing discussion considering more than just how HDMF is used in general. Candidate considers either strengths or weaknesses in its use in modelling the featured hairdryer prototype.
1-2 marks	A basic description of how HDMF could be used to model a product. Little/no justification or reference to featured hairdryer prototype.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

Advantages:

- Easy to work and manipulate material into organic, fluid shape/form of hairdryer
- Readily forms an ergonomic shape needed for prototype
- Shaped using basic readily available workshop tools e.g. cut with bandsaw or hot wire, shaped with surform/files, drilled
- Can be primed and painted to create a finish which mimics other materials
- Abrasive paper can be used to obtain a good quality surface finish ready for priming
- Can be laminated to form large section e.g. hair dryer body and handle
- Lightweight making it easier to carry a model
- Can be formed from a CAD file using CNC devices e.g. hot air outlet, cavities for buttons and contours of body
- Can be combined with/bonded to dummy switches/buttons/vents/components to create a realistic effect

Disadvantages:

- Difficult to shape in small pieces
- Noxious fumes if heated/melted requiring ventilation
- Not as durable as harder materials e.g. MDF
- Easily crushed and deformed, not a very durable material e.g. thin walls around hot air outlet may be flimsy
- Creates dust when sanded and statically clings making it hard to clear up
- Material is easily damaged by use of solvent based adhesives, paints etc.
- Expensive compared to other modelling materials

11. **Award marks as stated**

(a) Mathematical calculations **[2 marks]**

1 mark	**Workings:** 35 × 30 × 120
1 mark	**Answer:** 126,000cm^3

(b) Mathematical calculations **[2 marks]**

1 mark	**Workings:** 0.35 of 120 = 120 / 100 × 65
1 mark	**Answer:** 78cm

(c) Mathematical calculations **[3 marks]**

1 mark	**Height:** 120cm (1.2 m) = 1.2 × 50 = 60m
1 mark	**Width:** 35cm (0.3 m) = 0.3 × 50 = 15m
1 mark	**Length:** 30mm (0.35m) = 0.35 × 50 = 17.5m

12. **Award marks as shown.** **[6 marks]**

5-6 marks	A thorough and detailed description how companies refine and develop consumer goods during the product life cycle. Clear reference to smart watches.
3-4 marks	A good description of how companies refine and develop consumer goods with reference to some parts of the product life cycle. Some reference to smart watches.
1-2 marks	Basic description considering how companies refine and develop consumer goods during the product life cycle. Little/no reference to smart watches. Reference to at least one parts of the product life cycle.
0 marks	Nothing worthy of credit.

Indicative content: accept alternative responses worthy of credit

Introduction / Youth:

- Company will market the smart watch to target audience, developing a strategy highlighting how it improves on a previous version and/or the competition e.g. smart phones, MP3 players, digital watches, wearable technology, step counters etc.
- As sales generate revenue, marketing strategies will be refined to ensure maximum exposure for capital invested to maximise profits
- Company also responds to market demand and to fill gaps in the market
- On-going research and development (R&D) likely e.g. software, new applications etc.
- Raising demand through pre-orders, teasers, announcements
- Aggressive marketing of smart phone

Growth:

- Increased advertisement including product placement on social media, TV, events e.g. smart phone endorsed by celebrity, targeted marketing based on browser history
- Focus on technical features and benefits they bring to the user e.g. miniaturisation of product, smart phone offers an alternative to the bulkier smart phone
- Positive feedback and reviews from happy customers publicised
- Any unforeseen product faults or glitches will need to be addressed at this stage e.g. software glitches
- Products within warranty are replaced with new versions

Maturity:

- Smart phone sold at discounted rate, as part of a promotion, with free gift to sustain market share
- Free accessories or hardware/software upgrades at same (or reduced) price
- Improved technical features for a similar price
- Development of related and supporting products e.g. smart phone, tablets
- Life of product extended through upgrades, add-ons, updates etc.

Decline & replacement:

- Technical support, spares and repairs while financially viable – upgrades encouraged - parts withdrawn
- Promotion and support shifts to the next generation product
- Product may have inbuilt 'planned obsolescence' e.g. with smart phone, software and apps are not supported on older hardware/operating systems
- Discounts on old stock
- Development of trade in/scrappage and recycling schemes

END OF MARK SCHEME