GCE

Design and Technology

H006/01: Principles of product design

AS Level

Mark Scheme for June 2024

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Question			Answer	Mark	Guidance
1	(a)		Possible features may include: • A symmetrical (1) shape so that it can used by left and right-handed users (1) • Sloped and curved design (1) that can be used by a variety of different sized hands (1). • Intuitive design (1) so users of all ages can use the mouse with minimal training/ support (1). • Size takes into account anthropometric data (1) making it comfortable for 95% users' hands (1). • Arthritic users (1). • Neutral colour scheme (1) therefore does not exclude gender (1). • Contrast colour scheme (1) to aid those with visual impairment (1). • Any other valid suggestion.	4	In each case: Up to two marks for explaining a feature of the wireless computer mouse that has been designed for inclusivity. No marks for listing parts of mouse e.g. button. Must be linked to inclusivity. Specific reference to the context in the question is needed for marks to be awarded.
	(b)	(i)	Possible improvements may include: • More support for users with RSI (1) using a finer operated roller ball on the top of the design reducing the strain on the arm (1). • Brighter colours (1) for users with sight problems so it can be located more easily (1). • More support for users with arthritis (1) by changing the design so that the hand and wrist have greater support (1). • Adjustability (1) to allow wider range of users more comfortable access to mouse (1). • Any other valid suggestion	4	In each case: One mark for identifying a suitable improvement. One mark for justifying the response. Specific reference to the context in the question is needed for marks to be awarded. No marks for simple one-word responses e.g. 'support'.
		(ii)	Possible methods may include: • CAD could be used to design the roller ball (1). It could be used to program a 3D printer to prototype the parts and design (1).	4	In each case: Up to two marks for describing how the improvement in

			• MDF block modelled could be cut out and sanded to create a mould (1). This could then be vacuum formed to create the mouse shapes of different colours using HIPs/it could then be sealed and painted to show different colours (1). • The use of blue foam (1) could cut and shaped with a hot wire cutter to a design with a wrist support, this is a quick process so many iterations could be made and tested (1). • Polymorph/thermoform (1). • Cardboard modelling (1). • Aesthetic change (1) modelling could include different coloured paper/vinyl/card added (1). • Any other valid suggestion.		design could be physically modelled. It is expected that candidates will use examples of materials in their answer. This should receive appropriate credit. Specific reference to the context in the question is needed for marks to be awarded.
	(c)		**Indicative content:** Possible features that could be considered: <u>The connection evolution:</u> Wired mouse: The PS/2 port that was developed by IBM which is a 6-pin port was a small port that enabled another input to the computer. Disadvantages could include: • the pins could be bent • some systems needed re-starting if they were removed. • The wire meant that the user had to sit in close proximity to the hard drive and it could get tangled with other components. Advantages could include: • They were cheap and easier to design and manufacture and has quick response times. • No separate power source was needed from the mouse as it ran from the hard drive. A USB connection. Disadvantages could include: • More expensive to manufacture than the PS/2 port. Advantages could include:	**8**	**Level 3 [6-8 marks]** The candidate has a clear understanding of technological advancements. They produce a thorough evaluation in relation to the question, the influence of technological developments on the evolution of a computer mouse design. The explanation reasons are clear and well-developed and a number of examples are used to exemplify the points being made. **Level 2 [3-5 marks]** The candidate has a reasonable understanding of technological advancements. They produce a reasonable evaluation in relation to the question the influence of technological developments on the evolution of a computer mouse design. The explanation of influences is sufficient although

			• Port could be multi-purpose and interchangeable. • Slimmer design so could be integrated into laptops more efficiently. • Plug and play technology so no additional drivers required. Wireless mouse: Disadvantages could include: • Need a separate power source. • Needs to be paired to the computer. • Needs to be used in a range from the hard drive. Advantages could include: • No clutter on the work desk as wires removed. • Ability to use the mouse away from the hard drive. Other possible technologies that could be discussed could include: • Battery sizes. • Blue tooth. Candidates could also refer to the evolution of the: • Buttons and scroll button • Roller ball operation to infra-red • Laptop integrated Touch pads/ touch screens • Any other valid suggestion.		one or two opportunities are missed in referring to different examples. **Level 1 [1-2 marks]** The candidate has a basic knowledge of technological advancements. Any reference to this issue is descriptive in nature and has little appreciation of the influence of technological developments on the evolution of a computer mouse design. The response contains no analysis or evaluation. **0 marks** No answer or answer not worthy of credit.
2	**(a)**		Length of back of tank = 400 mm Length of front of tank = 280 mm Length of each angled side of tank = 84.85 x 2 = 169.68 mm [1] Length of one side of tank = 220 mm therefore 2 sides = 220 x 2 = 440 mm [1] Length of one upright of tank = 255 mm Total uprights = 6 therefore, 255 x 6 = 1530 mm [1]	**5**	Award five marks as follows: One mark for calculating total length of the two angled sides. One mark for calculating the total length of the two sides. One mark for calculating total length of uprights of tank (6 uprights).

			Total sealant = 400 + 280 +169.68* + 440* + 1530* = 2819.7* mm [1] Rounded to nearest cm = 2820*/10 = 282* cm [1]		One mark for calculating the total sealant (including front and back lengths). One mark for rounding answer to the nearest cm. If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.
2	**(b)**		SA front and back = (400x255) + 280x255) = 102000 + 71400 = 173400 mm^2 [1] SA of 2 sides = (220 x 255) x 2 = 112200 mm^2 [1] SA of triangle (x 2) = (84.85 x 255 x 2) = 43273.5 mm^2 [1] SA of one tank = 102000* + 71400* + 112200* + 43273.5* = 328873.5 mm^2 [1] Alternative method: Perimeter of the fish tank x vertical upright of tank = 1289.7 mm x 255 mm = 328873.5 mm^2	**4**	Award four marks as follows: One mark for calculating the external surface area of the front and back panels. One mark for calculating external surface area of two back side panels. One mark for calculating external surface area of two front side panels. One mark for calculating the external surface area of one tank.

					If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown. There is no requirement to round answer. If candidates does round answer do not penalise. If the candidate has carried forward the incorrect perimeter from part (a) and then used it to work out the surface area full marks can still be awarded.
2	**(c)**		Ratio of gravel to water = 0.5:4.5 = 1:9 [1] Amount of gravel = 22.5 / 9* = 2.5kgs [1]	**2**	Award two marks as follows: One mark for correct calculation of ratio. Oe mark for correct calculation of total amount of gravel required. If correct answer is given without working out shown award full marks.

					Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown. The candidate could express a ratio in a number of acceptable forms: 1:9 0.5:4.5 0.5 kg:4.5 l All of the above must be accepted.
2	**(d)**		P (Goldfish) = 10 / (10+35+45) = 10 / 90 = 1/9 [1] P (Neon Tetra) = 35 / (10+35+45) = 35/90 = 7/18 [1] P (Goldfish or Neon Tetra) = 1/9* + 7/18* = 2/18* + 7/18* = 9/18* = ½* or 0.5 [1] Alternative method: 10 Goldfish + 35 Neon Tetra = 45 45/90 = 0.5	**3**	Award three marks as follows: One mark for calculating probability for Goldfish One mark for calculating probability for Neon Tetra One mark for calculating overall probability. Accept 50% Accept ½ If correct answer is given without working out shown award full marks.

					Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.
3	**(a)**	**(i)**	Possible woods may include: • Ash (1). • Cedar (1). • Chestnut (1). • Elm (1). • Teak (1). • Oak (1). • Any other valid suggestion.	**1**	One mark for identifying a specific suitable wood. Specific reference to the context in the question is needed for marks to be awarded.
		(ii)	Possible properties may include: • It is buoyant (1) therefore it will float in the water (1). • Resistant to moisture (1) less susceptible to damage (1). • Natural chemicals (1) which prevent rot (if wood such as Teak selected) (1). • Sustainable material (1) as it can be responsibly sourced (FSC) (1). • Easily worked into the shapes needed (1). • Any other valid suggestion.	**2**	One mark for identifying a property of the selected material. One mark for justifying answer linked to suitability. Specific reference to the context in the question is needed for marks to be awarded.
	(b)		Possible reasons may include: • Internal frame (ribs) braces the hull (1) preventing it from bending/ warping out of shape (1). • Thwarts/ corner sections brace the frame (1) and help to prevent it warping or bending with pressure (1). • Rim around the top holds the shape and clamps the curved pieces in place (1)	**2**	Up to two marks for explaining how structural integrity is achieved in the boat hull. Specific reference to the context in the question is needed for marks to be awarded.

			• Any other valid suggestion.		Either two independent points or a point plus development. Credit either approach.
	(c)		Possible composites may include: • GRP (1). • Accept plywood composite construction (plywood panels with multiple layers of resin fibre glass or synthetic tape) (1). • Any other valid suggestion.	**1**	One mark for naming a specific suitable composite. Specific reference to the context in the question is needed for marks to be awarded.
	(d)		Possible disadvantages may include: • Composite can de-laminate over time in the water (1) and will not be easily repaired /repairs will not be aesthetically pleasing, if patched (1). • Composites are a less sustainable material (1) as it does not degrade easily and cannot be recycled/ raw materials are from finite sources and extraction causes pollution etc. (1). • The cost of manufacture is more expensive (1) as specialist moulds and equipment need to be used (1). • Less aesthetically pleasing in a natural environment (1) because it doesn't complement its surrounding area (1) • GRP more likely to fracture in collision (1) whereas wood is more impact resistant (1). • Any other valid suggestion.	**4**	In each case: Up to two marks for explaining a disadvantage to the user of a boat hull made from a composite material rather than a boat hull made from wood. Specific reference to the context in the question is needed for marks to be awarded. No marks for simple one word responses e.g. **'**cost'
	(e)		**Indicative content:** **The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.** Process:	**8** All processes demonstrated must relate to the manufacture of a boat hull.	**Level 3 [6-8 marks]** The candidate demonstrates a good level of detail of the process needed to manufacture the boat hull using technical terms and considering any relevant specialist tooling and quality control checks. Sketches, if used will be clear and supported with

			• Hull mould is created. • Highly polished two piece to allow removal and no imperfections. • Mould treated to ensure it is non-stick release agent. • Layers of gelcoat sprayed onto the mould. • Laid up with multiple layers of fibre glass, resin and other core materials. • Fixing points and fittings incorporated into the moulding where needed. • Each layer is cured. • Rollers used. • Process repeated until thickness achieved. • Use off PPE. • Removed from mould. Accept rotational moulding. Accept a one-off method or mass-produced method. Accept method which explains plywood composite manufacture. Any other valid suggestion.	Shape and quantity of production not specified to allow students to drawn on own knowledge. .	relevant notes. The process includes all relevant stages. **Level 2 [3-5 marks]** The candidate will demonstrate a sound level of detail of the process needed to manufacture the boat hull using some technical terms and there will be some consideration of any relevant specialist tooling and quality control checks. Sketches, if used, will for the most part be clear and supported with notes most of which are relevant. The process includes some relevant stages. **Level 1 [1-2 marks]** The candidate will demonstrate a limited level of detail of the process needed to manufacture the boat hull with a limited use of technical terms and there will be a basic consideration of any relevant specialist tooling and quality control checks. Sketches, if used, will be unclear with only basic notes to accompany them. Few relevant stages are included. **0 marks** No response or no response worthy of credit.
4	**(a)**	**(i)**	Possible thermoplastics may include: • ABS (1). • Polypropylene (1).	**1**	One mark for identifying a specific suitable thermoplastic.

			• HIPS (1). • Any other valid suggestion.		Specific reference to the context in the question is needed for marks to be awarded.
		(ii)	Possible reasons may include: • Chemical resistant (1) so it can be easily cleaned (1). • Flexible (1) so the button can be pressed with ease and return to shape. (1). • Impact resistance (1) therefore more durable less likely to break (1). • Can be injection moulded into the complex shape needed (1). • Any other valid suggestion.	**2**	One mark for identifying a property of the selected material. One mark for justifying answer linked to suitability. Specific reference to the context in the question is needed for marks to be awarded. Specific reference to the context in the question is needed for marks to be awarded. No marks for simple one-word responses e.g. 'flexible'
		(iii)	Injection moulding (1).	**1**	Specific reference to the context in the question is needed for marks to be awarded.
		(b)	Possible problems and solutions could include: • Problem: Soap dripping (1) could cause a mess/ waste (1). Solution: Design a tray to catch the soap (1) could be located underneath so hands could "hover" on top (1). • Problem: Difficult to operate one handed (1). Have to touch the dispenser to get the soap out/difficult to use with wet hands (1). Solution: Automatic dispenser that recognises a hand underneath (1) could operate with an infra-red sensor that identifies a hand underneath (1). • Problem: Difficult to re-fill (1) as wall mounted and is not clear how more soap can be filled (1).	**8**	In each case: Up to two marks for describing a potential problem. One mark for identifying a solution. One mark for justifying the solution given.

			Solution: Have a wall holder that allows the dispenser to slide in and out (1) This could be locked in place to prevent vandalism (1). • Problem: Not obvious to see where soap comes out (1) so may miss the hand and fall on feet (1) Solution: Have a graphic on the front to indicate where the soap will be dispensed (1) this could be integrated into the moulding of the design which would texture for multi-sensory communication (1). • Any other valid suggestion.		Specific reference to the context in the question is needed for marks to be awarded.
		(c)	**Indicative content:** **The candidate is expected to demonstrate their understanding of the process involved through annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of how a soap dispenser could be designed to mount to the wall.** Possible solutions could include sketches and notes detailing the use of fixtures or fixings that could include: • Slotted brackets - angled / dovetail locking. • KD fittings. • Mirror plates with slotted key-holes. • Picture hook. • Concealed fittings with sliding plates. • Brackets. • Any other valid suggestion.	**6**	**Level 3 [5-6 marks]** The candidate demonstrates a good level of detail of the process needed to mount a dispenser to a wall. Sketches, if used will be clear and supported with relevant notes. The method includes all relevant parts to be feasible. **Level 2 [3-4 marks]** The candidate will demonstrate a sound level of detail of the process needed to mount a dispenser to a wall. Sketches, if used, will for the most part be clear and supported with notes most of which are relevant. The methods include some relevant parts to be feasible. **Level 1 [1-2 marks]** The candidate will demonstrate a limited level of detail of the process needed to mount a dispenser to a wall. Sketches, if used, will be unclear with only basic notes to accompany them.

					Few relevant methods are included. **0 marks** No response or no response worthy of credit.
		(d) *	**Indicative content:** Areas that could be considered: • Planned obsolescence of consumable products means regular waste from packaging. • Packaging waste is often plastic wrapping on soap, or bottles and pumps from liquid dispensers. • Rely on users to recycle, this process adds to the carbon footprint of the product as this waste is collected, sorted and recycled or transported to landfill. • Waste from the end of the bottle/ soap bars getting wet on sinks and degrading. • Refillable soap dispensers hold larger quantities, so need refilling less often, larger containers can be used to purchase refills and contain large volumes. This can be made from squashable, pouches that use less material. • They create less waste as soap is contained and old soap filters down as new soap put in. • Problem if allergy occurs and soap not suitable as wasted. • Public spaces can be vandalised, and large quantities could be wasted. • Any other valid suggestion.	**8**	**Level 3 [6-8 marks]** The candidate has a clear understanding of the environmental impact of using refillable soap dispensers as a means of providing soap for handwashing. They produce a thorough discussion in relation to the question. The explanation reasons are clear and well-developed and a number of examples are used to exemplify the points being made. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples.* **Level 2 [3-5 marks]** The candidate has a reasonable understanding of the environmental impact of using refillable soap dispensers as a means of providing soap for handwashing. They produce a reasonable discussion in relation to the question. The explanation

					of influences is sufficient although one or two opportunities are missed in referring to different examples. *There is a line of reasoning presented with some structure. The information presented is for the most part relevant and supported by some evidence.* **Level 1 [1-2 marks]** The candidate has a basic knowledge of the environmental impact of using refillable soap dispensers as a means of providing soap for handwashing. Any reference to this issue is descriptive in nature. The response contains no analysis or evaluation. *The information has some relevance and is presented with limited structure or detail. The information is supported by limited evidence.* **0 marks** No answer or answer not worthy of credit.
5	**a**		Possible responses may include: • Designers need to select a suitable material they will refer to websites such as TRADA or BPF (1) They are selected as they provide	**4**	In each case: Up to two marks for describing how designers select and

			independent unbiased technical information that can used to weigh up options (1). • When considering safety BSI (1) can be purchased and this data can then be accessed and used to calculate correct sizes and restrictions that need to be applied to a design (1). • When considering ergonomics EBSCO (1) can be referred to and data can be taken and applied to products to ensure fit and comfort of the user (1). • When considering IP the IPO (1) can be accessed to review existing patents, this can also be used to look at lapsed patents and give designers new ideas (1). • Any other valid suggestion.		interpret technical data and information. It is expected that one mark in each description will be awarded for the identification of a specific websites, publication or regulation.
	b*		**Indicative content:** A variety of responses will be expected here depending on the familiar product selected data should be linked to the product: Primary data could refer to: • Focus groups to collect lifestyle information. • Information about problems with existing designs. • Feedback from product testing. Secondary data could refer to: • Standardised components. • Material selection. • Environmental impacts. • Legislation. • IP. • Anthropometric data tables. • BS safety standards. Any other valid suggestion.	**8**	**Level 3 [6-8 marks]** The candidate has a clear understanding of how information from specialist websites and data gathered from primary and secondary sources is used to support the design development of a familiar product. They produce a thorough discussion in relation to the question. The explanation reasons are clear and well-developed and a number of examples are used to exemplify the points being made. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples.* **Level 2 [3-5 marks]**

					The candidate has a reasonable understanding of how information from specialist websites and data gathered from primary and secondary sources is used to support the design development of a familiar product. They produce a reasonable discussion in relation to the question. The explanation of influences is sufficient although one or two opportunities are missed in referring to different examples. *There is a line of reasoning presented with some structure. The information presented is for the most part relevant and supported by some evidence.* **Level 1 [1-2 marks]** The candidate has a basic knowledge of how information from specialist websites and/or data gathered from primary and secondary sources is used to support the design development of a familiar product. Any reference to this issue is descriptive in nature. The response contains no analysis or evaluation. *The information has some relevance and is presented with limited structure or detail. The*

					information is supported by limited evidence. **0 marks** No answer or answer not worthy of credit.

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