Markscheme

May 2018

Design technology

Higher level and standard level

Paper 2

16 pages

Section A

Question			Answers	Notes	Total
1.	a	i	a simple mechanical arm that has the ability to carry out precise/repetitive motions/tasks (at high speed) ✓ a simple mechanical arm that requires constant supervision by a human operator ✓	*Award [1] for a definition of the term first generation robot* *Answer in brackets is not required to award the mark* *Allow a mark for answers across clusters*	**1**
		ii	the 3D/fixed space/area a robot can operate within ✓ considering clearance/reach ✓ the range of movement/degree of axis ✓ determined by the length/operation of the arm ✓	*Award [1] for each distinct point that describes the work envelope of a robot*	**2**
	b	i	efficiency/speed of production ✓ functions 24/7 leading to higher production/no need for breaks ✓ no need for salaries/benefits/sick leave ✓ reduces labour costs ✓ high accuracy/consistency of work ✓ reduced errors and waste ✓ higher quality/finish of final product ✓ can perform repetitive and dangerous tasks ✓ can work in confined spaces ✓ provides a long-term return on investment after initial setup costs ✓ better floor space utilisation ✓ flexible/versatile in being able to change tooling ✓	*Award [1] for each advantage listed of using robotics in mass production.*	**2 max**

		ii	CAM reduces the chance of errors ✓ more products can be made without the need for re-processing ✓ the variety of CAM operations ✓ allows products to be manufactured efficiently without the need for adjustment/re-tooling ✓ CAM is able to be operated automatically ✓ more products can be made due to continuous/(24/7) production ✓ CAM uses materials efficiently/with less waste ✓ more products can be made from stock/standard size materials ✓	*Award [1] for identifying how systems such as CAM can contribute to improving the rate of production and [1] for a brief explanation.* *Do not accept answers relating to speed.*	**2 max**
	c	**i**	design for disassembly is the ability to easily (and economically) take components apart ✓ meaning they can be recycled/reused/repurposed ✓ design for disassembly allows for repair/maintenance ✓ extends product life/minimises landfill ✓	*Award [1] for identifying how design for disassembly can minimise waste and [1] for a brief explanation* *Answer in brackets is not required to award the mark* *Do not award marks across different clusters*	**2**
		ii	automation can be used in volume production with machines controlled by computers ✓ the rise in automated production can create redundant workers/replace humans ✓ which can have detrimental economic effects on people/communities/lead to unemployment ✓ automation reduces labour costs/reliance on human labour ✓ therefore, manufacturers replace humans with machines ✓ leading to decreased social interaction in the workplace due to fewer employees ✓	*Award [1] for each of three distinct points in an explanation of the possible negative social effects of automation in a production system.* *Do not award marks across different clusters.*	**3 max**

Question			Answers	Notes	Total
	d	**i**	a (natural) resource that does not run out ✓ a (natural) resource that can replenish itself (over a period of time) ✓ a (natural) resource that can be used more than once/is infinite ✓	*Award [1] for a definition of renewable resource* *Answers in brackets are not required to award the mark*	**1 max**
		ii	made to break down naturally over a period of time ✓ meaning they cause less environmental damage as they do not contribute to landfill/pollute/create waste ✓ derived from natural/renewable sources ✓ which reduces the reliance on oil-based polymers/plastics ✓ non-toxic ✓ therefore do not harm ecosystems after disposal ✓ appeals to environmentally conscious consumers ✓ increases market potential ✓	*Award [1] for identifying an advantage of using biodegradable plastics in the Kuskoa Bi chair and [1] for a brief explanation*	**2 max**

Question			Answers	Notes	Total
	e	i	comfort/fatigue ✓ shape of the chair is designed to accommodate the user's body shape/posture/reduce stress on the body ✓	*Award [1] for identifying which type of physiological factor data would be used in the design of the Kuskoa Bi chair and [1] for a brief explanation*	**2 max**
		ii	***Materials:*** are sourced from abundant/renewable sources ✓ therefore do not rely on non-renewable fossil fuels/oil ✓ which minimises consumption of finite resources ✓ ***Energy:*** less energy is required to process and produce bioplastics ✓ therefore the resources required to produce these products will not be exhausted so rapidly ✓ which has positive environmental/economic effects/is more sustainable in the long term ✓ ***Pollution and Waste:*** the breakdown of bioplastics is less hazardous than oil-based plastics ✓ as they do not remain in the ecosystem/environment ✓ which minimises harm caused by water/air/soil pollution ✓	*Award [1] for each of three distinct points in an explanation of the possible effects of how the use of bioplastics in the Kuskoa Bi chair fits into either materials, energy or pollution and waste.* *Do not award marks across different clusters* *Students may be awarded marks for a cluster other than the one they have identified.*	**3 max**

Question			Answers	Notes	Total
2.	**a**		high thermal resistance ✓ jet engines operate at extremely high temperatures ✓ resistance to creep ✓ reduces the potential for failure over time ✓ high mechanical strength ✓ maintains shape/reducing potential for fatigue or deformation ✓ oxidisation/corrosion resistance ✓ makes it more durable/easy to maintain ✓	*Award [1] for identifying why a super alloy would be used to produce a turbine in an aircraft engine and [1] for a brief explanation*	**2 max**
	b		can make complex shapes ✓ can make parts to high accuracy ✓ can be done faster than traditional methods of manufacture ✓ minimises waste in production ✓ can be made as a single component ✓ reduces the number of processes required ✓ can increase number of variants/allows changes to the product ✓	*Award [1] for identifying each advantage of using 3D printing to create the turbine blade.* *Note to examiners - mark as a 'list' question.*	**2 max**

Question			Answers	Notes	Total
3.			a legal right that grants the creator (of an original literary and/or artistic work) sole ownership (for its use and distribution) ✓ copyright prohibits others from using the creator's intellectual property (IP)/allows the creator to receive compensation/enables copyright holders to sue ✓ for a limited time/within geographical boundaries ✓	*Award [1] for each of three distinct points in an explanation of how copyright can be used as a strategy for the protection of intellectual property (IP).* *Do not award marks for answers referring to patents, products, logos, brands or names.* *Answer in brackets is not required to award the mark*	**3**
4.			disruptive innovations challenge existing companies to diversify/embrace technical change ✓ mobile phones (smartphones) offer multiple functions (video/camera/games/internet/music/GPS) ✓ which replaced/led to the decline of previous/existing products/systems/technologies ✓ the development of mobile telephones/cellular technology ✓ led to improvements in portable communication/a new system of telecommunication ✓ technology push encouraged companies to exploit this new market ✓	*Award [1] for each of three distinct points in an explanation of how the mobile phone can be classified as disruptive innovation.* *Answer in brackets is not required to award the mark.* *Do not award mark for referring to obsolescence of previous/existing products/systems/technologies*	**3**

Section B

Question			Answers	Notes	Total
5.	**a**		anthropometric data utilised by the CAD software uses quantitative/structural/static body measurements ✓ to optimise the size/clearance of the interior of the cabin ✓ anthropometric data utilised by the CAD software uses functional/dynamic data ✓ to determine optimal distance to reach the controls ✓	*Award [1] for identifying anthropometric data can be used in the CAD ergonomic software and [1] for a brief explanation*	**2**
	b		virtual modeling allows models to be tested/altered quickly ✓ CAD can use FEA/surface/solid modeling/haptics ✓ to limit the possibility of errors before production/make modifications ✓ CAD allows designers to easily transfer files digitally ✓ to manufacturers in other locations ✓ which can increase manufacturing options/decrease cost of production ✓ CAD systems can be linked to CAM output ✓ which would increase efficiency in production ✓ saving time/money ✓ CAD takes advantage of design for manufacture ✓ to consider optimum use of existing manufacturing capability in the design phase ✓ which has an economic benefit for the manufacture ✓	*Award [1] for each of three distinct points in an explanation of the benefit for production when CAD is used in the design phase.* *Do not award marks across different clusters*	**3 max**

	c		a conceptual model begins in the imagination/mind ✓ conceptual models enable designers to communicate the big idea to the client/user ✓ and gauge people's reaction to the concept or idea ✓ designers can share/communicate the idea with the design team ✓ using graphical/physical/virtual methods ✓ which allow conceptual ideas to be understood/developed/moved from being intangible to tangible ✓	*Award [1] for each of three distinct points in an explanation of each of two advantages of using conceptual modelling prior to the development of a CAD model* *Do not award marks across different clusters*	**6**

Question			Answers	Notes	Total
	d		***Comfort:*** digital humans can be used to test the best position/range of adjustability of the chair ✓ allowing the designers to create the optimal layout of the control panel ✓ minimising fatigue and discomfort for the operator ✓ digital humans can help determine the shape and size of the chair ✓ based on the suitable percentile range/anthropometric data ✓ to maximise the user's comfort over a long duration of time ✓ ***Safety:*** digital humans can be used to test the position and size of the door ✓ to allow for easy/safe access for the operator ✓ which could minimise the risk of falling/tripping when opening the doors/entering or exiting the cabin ✓ digital humans can be used to test the position and size of windows ✓ to allow for optimal line of sight for the operator ✓ which could minimise risk of accidents when operating the crane ✓ digital humans can be used to simulate risky situations ✓ to determine the optimal position of emergency buttons/controls ✓ to ensure/test safe evacuation procedures ✓ ***Performance:*** digital humans can be used to ensure optimal reach of controls ✓ which allows efficiency/ease of operation ✓ to maximise productivity ✓ digital humans can be used to ensure there is a sufficient work envelope/area ✓ to perform maintenance tasks ✓ using required tools/equipment ✓	*Award [1] for each of three distinct points in an explanation of how the use of a digital human can help improve the design of the crane cabin with respect to comfort [3 max], safety [3 max] and performance [3 max].* *Do not award marks across different clusters*	**9 max**

Question			Answers	Notes	Total
6.	**a**		tough/impact resistant ✓ hardness/scratch resistant ✓ easy to (injection) mould ✓ durable ✓ waterproof ✓ available in a variety of colours ✓ electrical resistivity ✓ thermal resistivity ✓	*Award [1] for each property of ABS listed that makes it suitable for use in the Wakati power unit.* *Answer in brackets is not required to award the mark.*	**2 max**
	b		consumers will be attracted to a product that relates to their experiences/values and needs ✓ the users of the Wakati One tent will have had experiences of unreliable energy and the need to preserve their produce ✓ which could increase the rate of adoption ✓	*Award [1] for each of three distinct points in an explanation of how compatibility will affect consumer adoption of an innovation such as the Wakati One tent.*	**3**

	c		***Cost:*** injection moulding is a mass production/continuous flow method of production ✓ meaning units costs can be kept low ✓ which benefits economy of scale ✓ injection moulding creates a smooth surface ✓ minimising the need for additional finishing ✓ saving costs in time and labour ✓ ***Waste:*** excess plastic produced during injection moulding ✓ can be easily reheated and reintroduced into the moulding process ✓ reducing the need for additional raw materials ✓ injection moulding can create accurate parts ✓ meaning higher tolerances/less mistakes ✓ resulting in less waste during production ✓	*Award [1] for each of three distinct points in an explanation of how injection moulding minimises costs [3 max] and waste [3 max] during production of the Wakati power unit.* *Do not award marks across different clusters*	**6 max**

Question			Answers	Notes	Total
	d		***Need*:** the inventor identified/saw a gap in the market ✓ to deal with issue of perishable fruit and vegetable due to high temperatures/lack of reliable energy supply ✓ which solves the problem of food perishing before it gets to market ✓ innovation is the business of putting an invention in the marketplace and making it a success ✓ the success of the product is based on market pull/an identified need ✓ and how well the product solves the initial/specific problem ✓ ***Price:*** as the initial target market are African farmers/farmers based in developing countries ✓ the price point will need to be carefully considered ✓ as the market may not have the economic means to purchase the tent ✓ the product needs to be manufactured cost effectively ✓ to make the Wakati One tent affordable ✓ which would increase the chances of successful diffusion into the market ✓ ***Marketing:*** the tent itself can be used to market the product ✓ as it is large and easily visible for the target audience ✓ and can promote product awareness/brand identity ✓ the inventor is aiming this product at a specific market ✓ therefore appropriate promotional strategies need to be chosen ✓ that can reach communities with unreliable energy supply ✓	*Award [1] for each of three distinct points in an explanation of how the inventor is addressing need [3 max], price [3 max] and marketing [3 max] so that the Wakati One tent can become a successful innovation.* *Do not award marks across different clusters*	**9**

Question			Answers	Notes	Total
7.	**a**		corrodes/rusts ✓ heavy ✓ added weight can make the car more expensive to run ✓	*Award [1] for each disadvantage of using steel for the body of cars.*	**2**
	b		laminated glass contains a layer of film between two pieces of glass ✓ which keeps the windscreen in one piece/prevents the glass from shattering/creating sharp shards on impact ✓ reducing the risk of injury to the driver/passengers ✓	*Award [1] for each of three distinct points in an explanation of why the Volkswagen (VW) Beetle uses laminated glass for its windscreen.*	**3**
	c		using incremental design/solutions ✓ small changes/additional features can be added over time ✓ leading to new variations/versions/generations ✓ continuing to market/advertise/promote the car ✓ allows VW to widen exposure of the brand ✓ to reach a greater range of potential consumers ✓ offering price reductions ✓ makes the car more competitive in the marketplace ✓ providing an incentive for potential consumers to purchase the product ✓ using retro styling ✓ allows VW to retain aspects of the original aesthetic/style ✓ that appeals to a new market ✓	*Award [1] for each of three distinct points in an explanation of two ways [3 max for each way] that VW can extend the maturity phase of the product life cycle.* *Do not award marks across different clusters*	**6 max**

Question			Answers	Notes	Total
	d		***Mass production:*** production of large numbers of the VW Beetle ✓ has made the car visible/observable on a global scale ✓ making it a ubiquitous product ✓ VW Beetle has been omnipresent in society ✓ as it has become available globally ✓ and is recognised as an iconic design ✓ ***Dominant design:*** the VW Beetle contains implicit features/elements which are easily recognised ✓ such as body shape/style/headlights ✓ to remain a desirable product/a standard of its time ✓ the form of the VW beetle is unique/distinctive ✓ and creates an emotional attachment/feelings of nostalgia ✓ which helps develop customer loyalty/brand recognition ✓ ***Cultural status:*** the VW Beetle has transcended cultures/reflected cultural influences ✓ through its association with sub-culture (such as youth movements, pop culture, film, TV, art) ✓ becoming an iconic classic design ✓ ownership of a VW Beetle can increase the status (social position) of an individual ✓ classic designs can increase in value ✓ as they become more rare/desirable ✓	*Award [1] for each of three distinct points in an explanation of how mass production [3 max], dominant design [3 max] and cultural status [3 max] have made the VW Beetle a classic design.* *Do not award marks across different clusters*	**9 max**