Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Design technology

Higher level and standard level

Paper 2

16 pages

Section A

Question			Answers	Notes	Total
1.	a	i	6 % ✓	*Award [1] for stating the percentage of oil used in plastic production in 2014.*	**1**
		ii	106.5 x 365 million = 38,872.5 million (or 38,872,500,000) 38,872.5 million x 0.06 = 2332.35 million barrels (or 2,332,350,000 barrels) ✓ or 6% of 106.5= 6.39 ✓ 6.39 x 365= 2332.35 million barrels ✓	*Award [1] for the correct answer.* *Award [1] showing the working out.* *Final answer must be indicated in millions but does not need to include the term 'barrels'*	**2 max**
	b	i	renewable resources will not run out/can be replenished within a reasonable timeframe/are infinite✓ non-renewable resources will run out/cannot be replenished as they do not re-form at a rate that makes its use sustainable/are finite✓	*Award [1] for identifying each difference between renewable and non-renewable energy up to [2].*	**2**
		ii	dematerialization is a process that encourages the reduction of total material and energy utilisation ✓ which can be beneficial from an economic/environmental standpoint/promote the company as environmentally conscious/reduce the overall demand on oil/enhance green credentials ✓	*Award [1] for identifying a reason why manufacturers would use a strategy of dematerialization of plastic products and [1] for a brief explanation* *Do not award any marks for responses which simply state: 'dematerialization reduces amount of material used' or 'less waste'*	**2**

	c	**i**	volume/continuous flow/mass production✓ provides simple/consistent/rapid/precise production method✓ volume/continuous flow/mass production✓ for manufacture in large quantities/benefits economies of scale✓	*Award [1] for identifying a scale of production that would be appropriate for the manufacture of plastic products using injection moulding and [1] for a brief explanation*	**2 max**
		ii	thermoplastics can be heated and reformed/have a linear chain structure/weak polymer bond✓ thermosetting plastics can usually only be heated and formed once/have cross linking polymers that form a strong bond✓ this means that thermoplastics can be repurposed/makes them more appropriate or viable for recycling✓	*Award [1] for each of three distinct points in a comparison of the ease pf recovery and disposal of thermoplastics and thermosetting plastics.* *Do not accept answers that simply state that thermoset plastics cannot be reheated/reformed.* *Accept an appropriate example for the third mark i.e. recycled drink bottles used for clothing.*	**3**

	d	**i**	the total energy required to produce a product✓	*Award [1] for a correct definition of embodied energy*	**1**
		ii	cost effective✓ as it is a high volume/automated/mechanised production system✓ repeatability/consistency✓ as the exact same mould is utilised to produce all components/parts✓ high precision/accuracy✓ allows detailed features/complex shapes/textures/surface finishes✓ efficient use of material✓ waste is minimised/excess plastic can easily be recycled✓	*Award [1] for identifying an advantage of injection moulded plastic and [1] for a brief explanation* *Do not award a mark for "rapid production method"* *Do not award marks across different clusters*	**2 max**
	e	**i**	promoting positive impact✓ ensuring neutral impact✓ minimising negative impacts through conserving natural resources✓ reducing pollution and use of energy✓ reducing wastage of energy and resources✓ legislation✓ incentives✓ consumer/pressure groups/media✓	*Award [1] for listing each driver for employing clean technology in the production of the Dish Doctor.* *Do not accept answers such as "reduce environmental impact" or "environmentally friendly"*	**2 max**

		ii	solid models provide accurate data/a detailed impression of the product with dimensions and tolerances✓ which the designer uses to communicate/get feedback from client/manufacturers✓ making it easy to make necessary improvements/modifications✓ solid models can measure the volume✓ to calculate the material quantity/cost✓ optimising manufacturing capability✓ solid models can test the structure of the materials✓ to calculate the load (FEA) ✓ optimising the performance of product✓	*Award [1] for each of three distinct points in an explanation of why solid modelling is advantageous in the development of the Dish Doctor.* *Do not award marks across different clusters*	**3 max**

Question			Answers	Notes	Total
2.	**a**	**i**	form✓ texture✓ size/proportions✓ shape✓ colour scheme✓ placements of dials✓ placement of logo/branding✓	*Award [1] for listing each aesthetic characteristic that the retro styled Nikon DF shares with the original production Nikon EL2.*	**2 max**
		ii	finger/thumb dimensions✓ palm/hand size✓ viewing angle✓ size and dimensions of eye socket✓	*Award [1] for each two distinct pieces of anthropometric data that would be used in the design of a camera.*	**2 max**
3.			a design that uses the form/stylistic features/decoration from a particular period of time✓ but is updated with newer technology/materials/components/ functionality✓ to make it more appropriate/functional for a new market/user✓ a design that shares/respects the original designers intent✓ by employing nostalgia✓ which triggers an emotional response/re-attracts previous/old customers who may recognise/remember it from their childhood✓	*Award [1] for each of three distinct points in an explanation issues that designers need to address when using retro styling.* *Do not award marks across different clusters*	**3 max**
4.			classic cars are representative of a specific period of time✓ triggering feelings of nostalgia/attachment✓ and often increase in value long after they have ceased to be manufactured✓ classic cars are timeless through their form✓ which increases desirability due to their rarity✓ although newer cars are technologically advanced✓	*Award [1] for each of three distinct points in an explanation of how classic design of a product such as a car transcends obsolescence.* *Do not award marks across different clusters*	**3**

			obsolescence is when a product is no longer needed even though it may function as well as it did when first manufactured✓ it remains in style/attains iconic status/has a strong image✓ which transcends across cultures/makes it recognisable✓		

Section B

Question			Answers	Notes	Total
5.	a		hardness ✓ thermal conductivity / resistivity ✓ electrical conductivity / resistivity ✓ density ✓ weight ✓ mass ✓ volume ✓	*Award [1] for listing two distinct physical properties that could be improved by alloying a metal.*	**2 max**
	b		height of the seat✓ can be adjusted so that the pedals can be reached by people of different sizes✓ to allow people of different sizes to get maximum pedalling efficiency/comfort/minimize the risk of injuries✓ length between seat and handlebars✓ both can be adjusted so the handlebars/grips can be reached by people of different sizes✓ to get maximum steering control/reduce fatigue✓ width/tilt/angle of handlebars✓ so people of different sizes can adjust the bicycle to suit their shoulder width/wrists/hands✓ to allow people of different sizes to get maximum steering control /comfort/reduce fatigue/ increase target market✓ forks/frame dampening✓ some bikes have adjustable suspension✓ allowing the rider to customise the comfort according to terrain✓	*Award [1] for each of three distinct points in an explanation of how bicycles are adjustable.* *Do not award marks across different clusters*	**3 max**

	c		relative advantage✓ how improved an innovation is over the previous generation✓ consumers would see that the 3D printed bicycle has some advantages over previous bicycle designs✓ compatibility✓ the level of compatibility that an innovation has with an individual's life✓ the 3D printed bicycle functions in the same way as existing bicycles, making it easy to be assimilated into an individual's life✓ complexity✓ the innovation should not be perceived as complicated or difficult to use✓ the 3D printed bicycle is no more complex than existing bicycle so consumers would not be deterred✓ observability✓ the extent that an innovation is visible to others by seeing others riding the 3D printed bicycle or in a bicycle shop✓ visibility will drive communication among the individual's peers and personal networks/create more positive or negative reactions✓ trialability✓ the degree to which the innovation may be trialled/tested on a temporary basis/for a limited time✓ to give consumer a better understanding how the product performs/greater inclination to adopt the innovation ✓	*Award [1] for each of three distinct points in an explanation of how each of Rogers' characteristics are applicable to the Renishaw 3D printer bicycle.* *[3 max] for any two of Rogers' characteristics.* *Do not award marks across different clusters*	**6 max**

	d		cost effective✓ the time/skill required to assemble a traditional frame is high✓ therefore, the labour cost of assembling the frame is much lower✓ reduction of waste✓ instead of removing material, it 'adds' material layer by layer✓ therefore, it only uses the exact amount of material required to manufacture the bicycle frame✓ process efficiency✓ traditional frame manufacture includes cutting/shaping/welding of tubes✓ 3D printing enables the frame to be made as a single component in one process✓ flexibility✓ changes in frame design can be made without needing to change tooling/processes✓ this allows the manufacturer to quickly adapt to changes as required by the market✓ complexity of form✓ traditional frames have comparatively simple forms✓ additive manufacture allows more detailed/complex designs to be realised✓ reduction in labour✓ the manual tasks can now be done by a machine✓ although the setup cost of machine is high, this cost will be recovered over time✓ reduction of errors✓ reducing the need of reprocessing the frame/parts of the frame✓ due to mistakes made by human workers✓	*Award [1] for each of three distinct points in an explanation of the advantages of a manufacturer using additive manufacturing for a bicycle frame.* *[3 max] for any advantage.* *Do not award marks across different clusters*	**9 max**

Question			Answers	Notes	Total
6.	a		constructive discontent ✓ analysing a situation that could benefit from a re-design, and then working out a strategy to improve it ✓	*Award [1] for identifying the driver for invention used by Brebner and [1] for a brief explanation*	**2**
	b		lone inventors have creative freedom/complete ownership✓ but work in isolation/are self-funded/need skills from design to marketing/lack the opportunity for interaction with others/take on risk as they have to do everything✓ however if the product is successful they gain recognition/attain financial success✓	*Award [1] for each of three distinct points in a discussion of the advantages and disadvantages of being a lone inventor.*	**3**
	c		stiffness✓ the resistance of an elastic body to deflection by an applied force✓ the handle of the umbrella needs to be stiff to resist becoming permanently bent, if the handle bends the umbrella will no longer function✓ toughness✓ the ability of a material to absorb energy and plastically deform without fracturing/cracking✓ if the handle or ribs of the umbrella were to fracture/crack it would no longer be usable/function✓ tensile strength✓ the ability of a material to withstand pulling forces✓ when the wind blows over the umbrella the canopy material will be placed in tension, it must withstand this tension or it will tear✓ elasticity✓ the ability of a material to return to its original shape✓ If the umbrella is blown inside out it will return to its original shape/shape will not have stretched✓	*Award [1] for each of three distinct points in an explanation of two mechanical properties of the materials used to manufacture the Brebner umbrella.* *Do not award marks across different clusters*	**6 max**

	d		aesthetic models✓ look like the final model and are used for evaluating aesthetic appeal✓ the designer could have used aesthetic models to consider the different colour combinations to offer the umbrella in✓ mock-ups✓ is a scaled or full sized replica✓ which helps communicate form/proportions of the design/gain feedback from users✓ prototypes✓ to test the mechanisms and validate the design/test for functionality✓ and make necessary changes to improve the performance✓ instrumented model✓ measured testing of wind force could be carried out✓ to determine the strength of the internal structure if the umbrella/its resistance to folding under strong wind pressure✓ scale models✓ scale models are a larger or smaller physical copy of an object✓ the designer could have used scale models to work out the detail of the folding mechanisms – which would be too small to model at full size✓	*Award [1] for each of three distinct points in an explanation of the different types of physical models the designer could have used in the development of the Brebner umbrella.* *Do not award marks across different clusters*	**9 max**

Question			Answers	Notes	Total
7.	a		analogy✓ an idea from one context is used to stimulate ideas for solving a problem in another context✓	*Award [1] for identifying the strategy for innovation used in the development of the Coral Pendant Light and [1] for a brief explanation*	**2**
	b		accuracy/consistency✓ the CNC router cuts the pieces identically✓ which allows all components to fit together precisely/with no error✓ reduced waste✓ the pieces can be nested together to achieve least possible wastage of material/bamboo plywood✓ which saves material costs/reduces waste that would need to be disposed of✓ speed of manufacture/reduced manufacturing time✓ with no need for additional finishing/sanding✓ which saves manufacturing time✓ reduced labour✓ mechanising the production reduces the amount/skill of labour required✓ which reduces the overall production cost**;**✓	*Award [1] for each of three distinct points in an explanation of the benefit of using a CNC router in the development of the Coral Pendant Light* *Do not award marks across different clusters*	**3 max**

	c		transportation✓ an assembled lamp would take up more space, by using a kitset the environmental impact/energy cost is reduced✓ when transporting the product from factory to retailers✓ distribution✓ size of packaging✓ an assembled lamp would require a larger package, by using a kitset the quantity of packaging materials is reduced✓ disposal✓ disassembly of Pendant Light✓ the kitset can be disassembled which allows for easy collection/disposal at the end of its life**;**✓	*Award [1] for each of three distinct points in an explanation of the benefit of using LCA in the selling of the Coral Pendant Light.* *Do not award marks across different clusters.*	**6 max**
	d		design for materials✓ the product would be designed considering locally available materials✓ the bamboo used may be grown in renewable forests which is more sustainable than other timber species✓ design for process✓ using a specific manufacturing process such as CNC, enables the parts to be closely nested/cut more accurately✓ which minimises waste/defects/errors✓ design for assembly✓ designing taking account of assembly at various levels (component to component, components into sub-assemblies, sub-assemblies to complete products) ✓ the lamp is sold as a kitset which reduces the environmental impact of distribution of a larger pre-assembled product✓	*Award [1] for each of three distinct points in an explanation of the manufacture strategies that have been made to make the Coral Pendant Light a green design.* *Candidates should include the full name of the strategy. i.e. "design for materials", "design for process" etc.* *Do not award marks across different clusters.*	**9 max**

			design for disassembly✓ designing a product so when it becomes obsolete it can easily/economically be taken apart✓ enabling components to be reused or repaired and materials recycled✓		