

# Markscheme

November 2017

Design technology

Higher level and standard level

Paper 2

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**Section A**

Question			Answers	Notes	Total
1.	a	i	6 % ✓	<i>Award [1] for stating the percentage of oil used in plastic production in 2014.</i>	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 ✓	<i>Award [1] for the correct answer.</i>  <i>Award [1] showing the working out.</i>  <i>Final answer must be indicated in millions but does not need to include the term 'barrels'</i>	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✓	<i>Award [1] for identifying each difference between renewable and non-renewable energy up to [2].</i>	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 ✓	<i>Award [1] for identifying a reason why manufacturers would use a strategy of dematerialization of plastic products and [1] for a brief explanation</i>  <i>Do not award any marks for responses which simply state: 'dematerialization reduces amount of material used' or 'less waste'</i>	2

	<b>c</b>	<b>i</b>	<p>volume/continuous flow/mass production✓          provides simple/consistent/rapid/precise production method✓</p> <p>volume/continuous flow/mass production✓          for manufacture in large quantities/benefits economies of scale✓</p>	<p><i>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</i></p>	<b>2 max</b>
		<b>ii</b>	<p>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✓</p>	<p><i>Award [1] for each of three distinct points in a comparison of the ease of recovery and disposal of thermoplastics and thermosetting plastics.</i></p> <p><i>Do not accept answers that simply state that thermoset plastics cannot be reheated/reformed.</i></p> <p><i>Accept an appropriate example for the third mark i.e. recycled drink bottles used for clothing.</i></p>	<b>3</b>

	<b>d</b>	<b>i</b>	the total energy required to produce a product✓	<i>Award [1] for a correct definition of embodied energy</i>	<b>1</b>
		<b>ii</b>	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✓	<i>Award [1] for identifying an advantage of injection moulded plastic and [1] for a brief explanation</i>  <i>Do not award a mark for “rapid production method”</i>  <i>Do not award marks across different clusters</i>	<b>2 max</b>
	<b>e</b>	<b>i</b>	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✓	<i>Award [1] for listing each driver for employing clean technology in the production of the Dish Doctor.</i>  <i>Do not accept answers such as “reduce environmental impact” or “environmentally friendly”</i>	<b>2 max</b>

		<p><b>ii</b> 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✓</p> <p>solid models can measure the volume✓          to calculate the material quantity/cost✓          optimising manufacturing capability✓</p> <p>solid models can test the structure of the materials✓          to calculate the load (FEA) ✓          optimising the performance of product✓</p>	<p><i>Award [1] for each of three distinct points in an explanation of why solid modelling is advantageous in the development of the Dish Doctor.</i></p> <p><i>Do not award marks across different clusters</i></p>	<p><b>3 max</b></p>
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Question			Answers	Notes	Total
2.	a	i	form✓ texture✓ size/proportions✓ shape✓ colour scheme✓ placements of dials✓ placement of logo/branding✓	<i>Award [1] for listing each aesthetic characteristic that the retro styled Nikon DF shares with the original production Nikon EL2.</i>	2 max
		ii	finger/thumb dimensions✓ palm/hand size✓ viewing angle✓ size and dimensions of eye socket✓	<i>Award [1] for each two distinct pieces of anthropometric data that would be used in the design of a camera.</i>	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✓	<i>Award [1] for each of three distinct points in an explanation issues that designers need to address when using retro styling.</i>  <i>Do not award marks across different clusters</i>	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✓	<i>Award [1] for each of three distinct points in an explanation of how classic design of a product such as a car transcends obsolescence.</i>  <i>Do not award marks across different clusters</i>	3

			<p>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✓</p>		
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**Section B**

Question		Answers	Notes	Total
5.	a	hardness ✓ thermal conductivity / resistivity ✓ electrical conductivity / resistivity ✓ density ✓ weight ✓ mass ✓ volume ✓	<i>Award [1] for listing two distinct physical properties that could be improved by alloying a metal.</i>	<b>2 max</b>
	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 ✓	<i>Award [1] for each of three distinct points in an explanation of how bicycles are adjustable.</i>  <i>Do not award marks across different clusters</i>	<b>3 max</b>

<p><b>c</b></p>	<p>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✓</p> <p>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✓</p> <p>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✓</p> <p>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✓</p> <p>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 ✓</p>	<p><i>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.</i></p> <p><i>[3 max] for any two of Rogers' characteristics.</i></p> <p><i>Do not award marks across different clusters</i></p>	<p><b>6 max</b></p>
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<p><b>d</b></p>	<p>cost effective✓  the time/skill required to assemble a traditional frame is high✓  therefore, the labour cost of assembling the frame is much lower✓</p> <p>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✓</p> <p>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✓</p> <p>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✓</p> <p>complexity of form✓  traditional frames have comparatively simple forms✓  additive manufacture allows more detailed/complex designs to be realised✓</p> <p>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✓</p> <p>reduction of errors✓  reducing the need of reprocessing the frame/parts of the frame✓  due to mistakes made by human workers✓</p>	<p><i>Award [1] for each of three distinct points in an explanation of the advantages of a manufacturer using additive manufacturing for a bicycle frame.</i></p> <p><i>[3 max] for any advantage.</i></p> <p><i>Do not award marks across different clusters</i></p>	<p><b>9 max</b></p>
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Question		Answers	Notes	Total
6.	a	<p>constructive discontent ✓                      analysing a situation that could benefit from a re-design, and then working out a strategy to improve it ✓</p>	<p><i>Award [1] for identifying the driver for invention used by Brebner and [1] for a brief explanation</i></p>	2
	b	<p>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 ✓</p>	<p><i>Award [1] for each of three distinct points in a discussion of the advantages and disadvantages of being a lone inventor.</i></p>	3
	c	<p>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 ✓</p> <p>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 ✓</p> <p>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 ✓</p> <p>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 ✓</p>	<p><i>Award [1] for each of three distinct points in an explanation of two mechanical properties of the materials used to manufacture the Brebner umbrella.</i></p> <p><i>Do not award marks across different clusters</i></p>	6 max

	<b>d</b>	<p>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✓</p> <p>mock-ups✓ is a scaled or full sized replica✓ which helps communicate form/proportions of the design/gain feedback from users✓</p> <p>prototypes✓ to test the mechanisms and validate the design/test for functionality✓ and make necessary changes to improve the performance✓</p> <p>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✓</p> <p>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✓</p>	<p><i>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.</i></p> <p><i>Do not award marks across different clusters</i></p>	<p><b>9 max</b></p>
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Question		Answers	Notes	Total
7.	a	analogy✓ an idea from one context is used to stimulate ideas for solving a problem in another context✓	<i>Award [1] for identifying the strategy for innovation used in the development of the Coral Pendant Light and [1] for a brief explanation</i>	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;✓	<i>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</i>  <i>Do not award marks across different clusters</i>	3 max

<p><b>c</b></p>		<p>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✓</p> <p>distribution✓  size of packaging✓  an assembled lamp would require a larger package, by using a kitset the quantity of packaging materials is reduced✓</p> <p>disposal✓  disassembly of Pendant Light✓  the kitset can be disassembled which allows for easy collection/disposal at the end of its life;✓</p>	<p><i>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.</i></p> <p><i>Do not award marks across different clusters.</i></p>	<p><b>6 max</b></p>
<p><b>d</b></p>		<p>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✓</p> <p>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✓</p> <p>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✓</p>	<p><i>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.</i></p> <p><i>Candidates should include the full name of the strategy. i.e. “design for materials”, “design for process” etc.</i></p> <p><i>Do not award marks across different clusters.</i></p>	<p><b>9 max</b></p>

			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✓		
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