



General Certificate of
Secondary
Education

Design and Technology:
Product Design 45551

Mark scheme

4555
June 2015

Version 1: Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

Question	Part	Sub Part	Marking Guidance	Mark	Comments
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1	a		Accept Art Nouveau only.	1 mark	
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1	b		<p>Target market</p> <ul style="list-style-type: none"> • Identification of the customer- may be different to end user. • Identification of the end user – may be different to the buyer. • Help generate a client profile to ensure product would be suitable. • Where the product would be sold and who it is aimed at- is it fit for target market. <p>Materials & component catalogues</p> <ul style="list-style-type: none"> • Look in appropriate supplier catalogues- INTERNET needs qualifying • Testing materials • Availability of materials e.g. standard forms, sizes, pack size • Price of materials e.g. multiple/pack costs <p>Impact on the environment</p> <ul style="list-style-type: none"> • Make sure materials sourced are from an environmentally friendly source. • Reference re-use, recycle, repair, reduce, rethink and refuse. • Select materials considering fair trade, product miles, carbon footprint and product disposal. <p><i>Any one of the above points related to designed product would gain 2 marks.</i></p>	3x2 marks	<p>2 marks max per response for each research type.</p> <p>Point with qualification =2</p> <p>Two simple points = 2</p> <p>One simple point = 1</p> <p>No marks for: Cheap/cheaper=0 Strength/strong = 0</p>
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<p>1</p>	<p>c</p>	<p>12 -15 marks Very creative design using natural form, pattern and structure.</p> <p>Detailed and appropriate use of materials considered for the design.</p> <p>Detailed constructional information indicated, appropriate for material(s) used and product to be made e.g. proportioned drawings with dimensions possibly added.</p> <p>Excellent use of colour and tone to clarify suitable finish and decoration as appropriate.</p> <p>8-11 marks Design generated with natural forms, patterns and structures used. Detail may be missing in places</p> <p>Some appropriate materials identified for use in the design</p> <p>Constructional information given appropriate for materials used and product to be made.</p> <p>Good use of colour and tone to clarify finish and decoration as appropriate.</p> <p>4-7 marks Response lacking significant detail. Natural forms, patterns or structures may have not been considered.</p> <p>Limited reference to materials, possible generic labels.</p> <p>Evidence of some constructional detail. Accuracy and proportion will be lacking.</p> <p>Simplistic use of colour and/or tone to clarify finish and decoration.</p> <p>1-3 marks Response lacking significant detail with respect to natural forms,</p>		
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			<p>patterns and structures.</p> <p>Very limited reference to materials. May not be appropriate for design.</p> <p>Little or no constructional detail.</p> <p>Little or no attempt to consider finish and decoration using colour or tone.</p> <p>No attempt/ question not answered= 0 marks</p>		
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1	d	i	<p>Aesthetically pleasing-HOW IT LOOKS</p> <ul style="list-style-type: none"> • Reference to: how the product looks, its appearance, use of colour, line, shape, form, texture sizes, proportions and finish. • Reference to colours for temperature to create warmth ok. • Responses may make reference to specific vocabulary e.g. golden section, symmetry, visual balance, asymmetrical, motif, tessellations and harmony. 		<p>Point made and explained = 2 marks</p> <p>Simple point made = 1 mark.</p> <p>4 marks</p>
		ii	<p>Functionally effective – WHAT IT DOES.</p> <ul style="list-style-type: none"> • What does the designed product do? • Is it fit for purpose? • Answers may draw on features you would find in a specification for the product. • Accept answers considering performance (how well it does its intended task). 		<p>Point made and explained = 2 marks</p> <p>Simple point made = 1 mark.</p> <p>4 marks</p> <p>Drink out of mug =1</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	a		<p>Cup & saucer <u>Mat/Comp/Ingr:</u> porcelain, earthenware, china clay. Clay =0</p> <p><u>Processes:</u> Spinning, slip casting, glazing, firing in a kiln.</p> <p>Chocolate box <u>Mat/Comp/Ingr:</u> Food grade cardboard, Foil lined cardboard, cardboard. Polymer (PET, HIPS) tray Corrugated paper/card for liner. Note: accept chocolate</p> <p><u>Processes:</u> Die - cutting, embossing, laminating, offset lithography printing, vac forming. Note: If chocolates considered allow moulding, enrobing, moulding & tempering.</p> <p>Pizza <u>Mat/Comp/Ingr:</u> Flour, and specific topping materials. Salt, water. NOT DOUGH</p> <p><u>Processes:</u> Baking, cooking, proving & kneading.</p> <p>Rocking horse <u>Mat/Comp/Ingr:</u> HDPE, MDF, Plywood, Beech, Ash, CSK screws. <u>Processes:</u> Rotational moulding, lamination, turning (handles), drilling (screw holes for assembly), cutting, sawing, sanding, varnish/painting.</p> <p>Step ladders <u>Mat/Comp/Ingr:</u> Aluminium, steel, pop rivets. <u>Processes:</u> Press forming, pop riveting. Extrusion, powder coating, anodising.</p> <p>Printed Circuit Board <u>Mat/Comp/Ingr:</u> any named electronic component e.g. resistor,</p>	6 marks	<p>One mark for a Correct main material, component or ingredient =1</p> <p>Process used during manufactured with explanation = 2</p> <p>Named process only = 1.</p> <p>Look for description about the process NOT the product or the user.</p> <p>Example or process description: STEP LADDERS- extrusion is used to produce the rectangular tube cross section needed for the step ladders legs.</p> <p>NB If candidate talks about chocolates we will accept.</p> <p>N.B. Do not accept generic material types e.g. wood, paper, metal, textiles, cloth.</p>

		<p>transistor IC (Integrated Circuit). Chips, wire or solder = 0 <u>Processes:</u> drilling (component holes), surface mount components, soldering, flow soldering</p> <p>Cushion <u>Mat/Comp/Ingr:</u> any specific named fabric e.g. denim, cotton, polyester-cotton. Wool (stuffing).Components – zip, press studs, <u>Processes:</u> patchwork, quilting, piping, plain seam stitching, sewing,batik, dye sublimation printing, screen printing</p> <p>Menu <u>Mat/Comp/Ingr:</u> laminated card, waxed card. <u>Processes:</u> offset lithography, digital printing, lamianation, die cutting, creasing, embossing, dye sublimation.</p>		<p>Copy /printer paper = 1 Card = 1 Cartridge paper = 0</p>
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2	b	<p>New materials: These are man-made materials developed recently. New materials have properties previously unavailable (not present in natural materials) allowing them to be used in new and innovative ways. <i>Examples are precious metal clays (PMC), corn starch polymers, glass fibre reinforced plastic (GRP),carbon fibre, kevlar, flexible plywood, necuron foam, maplex, medite (laser MDF),flexible MDF, hexaboard, micro fibres, gortex, sympatex, liquid crystals (LCDs).</i></p> <p>Smart materials: React and change with a physical change in their environment e.g. heat, light, electrical current. <i>Examples are thermochromic dyes, photochromic dyes, phosphorescent pigments, polymorph, D3O orange polymer,(polycaprolactone/PLC), shape memory alloys e.g. nitinol (titanium& nickel alloy),quantum tunnelling composites (QTC),</i></p>	4	<p>Valid point made = 1</p> <p>Valid point made with explanation =2</p> <p>Key word: Properties</p> <p>NB Response could be all about either New Materials or Smart Materials.</p> <p>No marks for list of products or materials</p>
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			<i>Piezoelectric materials (when squeezed they produce an electrical charge)</i>		
2	c	i	N.B. No mark for chosen product.		
			Any specific named new or smart material appropriate to chosen product.	1	Named material must be used in the chosen/selected product. N.B. Accept repeated materials identified in 2b.
2	c	ii	<p>Baby bottle Thermochromic pigments change colour with heat. The milk for a baby can be checked to make sure it is not too hot/cold. Colours can change from pink to yellow if food is too hot. Accept blue going to red? Avoid having to physically test food for correct temperature and eliminate contamination of any sort.</p> <p>Necklace Precious metal clays can be worked and shaped like clays, but when dried they take on the appearance of solid metal. Contain small quantities of metals like gold and silver. No need for specialist equipment e.g. casting facilities and reduce potential H&S issues. PMC can be used with children to create quality products quickly, in a classroom environment.</p> <p>Dental braces Shape memory alloys are heat treated to give the material a memory. The braces then try to return to their memory shape and pull teeth into a new position. Can be used in/with the human body without any adverse effect on health. Non-ferrous and does not react with saliva or moisture.</p> <p>Protective clothing Kevlar fibres can be woven into a cloth that can then be made clothing. The weave (a bit like a</p>	4	<p>Correctly named properties only = 2 marks max.</p> <p>Any 2 correctly named properties with qualification explaining why they are suitable for the chosen product = 4</p>

			<p>goal net) can stop penetration by bullets, knives and sharp objects. High cut resistance. Low electrical conductivity, high chemical resistance. Flame resistant and self-extinguishing. Tough and hard wearing. Kevlar is lightweight, comfortable to wear and allows user to move easily. Used by armed forces and police for bullet proof vests.</p> <p>Food packaging Corn starch polymers are biodegradable unlike polythene which makes it better for the environment. The break down into carbon dioxide and water after a few months. The base material (corn) is preferred by manufactures as it is available from sustainable sources.</p> <p>Prosthetic limbs Made from carbon fibre, Kevlar and titanium. These materials are lightweight, flexible and can be fabricated into complex shape (CF and Kevlar), ergonomically suited to the user. Allow the owner to compete with able bodied users in sports, the workplace and social situations. Increase the opportunities for inclusive design.</p>		<p>Polypropelene(PP) & polystyrene(PS) not to be accepted as new materials</p>
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2	d	i	Any specific named pre manufactured component e.g. screw, hinge, zip, press stud, bifurcated pin, resistor, capacitor, cake decorations (sugar strands).	1	Correctly named pre-manufactured component = 1 mark
2	d	ii	<p>Acceptable answers include:</p> <ul style="list-style-type: none"> • Improve the effectiveness and efficiency of the manufacturing process. • Manufacture does not have to make all parts for a product. • Allow for manufacturer to gain benefits from buying in bulk, economies of scale etc. 	2x2	<p>Question not about stock forms e.g. steel tube, bags of flour.</p> <p>Any valid advantage qualified =2 Advantage only = 1.</p> <p>NB Does not have to be about part in 2d(i)</p>

			<ul style="list-style-type: none"> • Cost savings can be passed on to the customer allow for a lower product cost. • Pre manufactured components can often be easily replaced when lost or at the end of their useful life. 		<p>Cheap = 0 Easy to assemble = 0 Cheap +qualified = 1</p>
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3	a		<p>Reasons:</p> <ul style="list-style-type: none"> • Legal requirements can be identified e.g. age restriction, allergies, daily allowance, traffic light system(healthy eating) • Compliance with standards • Customer care information • User information – could be a picture of the product. • Know what they are buying • Safety • Storage information • Correct use information • Tamper label • Stock control e.g. bar code • QR reader • Product price • Disposal of materials e.g. recycling <p>Explanation: Responses need to focus on how product labelling is used by the manufacturer or consumer and/or why it is important /of value.</p>		<p>Each valid reason = 1.</p> <p>Any one valid point in qualified or 2 valid points in brief for each reason = 2.</p> <p>Repeats =0</p> <p>Example: some people have a specific dietary need e.g. nut allergy = 2</p>
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3	b		<p>A – given example</p> <p>B <u>Meaning:</u> Conformance European.or European standards</p> <p><u>Importance:</u></p>	12 marks	1 mark CE mark = 0
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		<p>Tells consumer that product has met the minimum requirements to be put on sale in the EU. Manufacturer's self declaration that its product meets basic EU requirements. Not independently tested. A lower standard than the BSI standard (identified by the kitemark). Manufacturer has checked product against EU standards for safety, health and environmental requirements.</p> <p>C <u>Meaning:</u> Recycling symbol/logo.</p> <p><u>Importance:</u> Tells the consumers that the materials used can be recycled in part or as a whole where facilities exist. Reference to number to ID polymer type.</p> <p>D <u>Meaning:</u> Age label/ limitation to user group/age restricted goods.</p> <p><u>Importance:</u> Indicates that the product is unsuitable for children under 3 years e.g. because it might contain small parts that could be swallowed.</p> <p>E <u>Meaning:</u> Bar code</p> <p><u>Importance:</u> Allow a manufacture to monitor price, stock control, record consumer loyalty, promotion data i.e. 3 for 2. Automate check out services.</p>	<p>Any valid point = 1</p> <p>Any point + qualification = 2.</p> <p>Not tests/tested =0 Not quality=0 Not safe /safe to use=0</p> <p>1mark Recyclable/recycle = 1</p> <p>Any valid point = 1</p> <p>Any point + qualification = 2</p> <p>1mark</p> <p>Any valid point = 1</p> <p>Any point + qualification =2</p>
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4	a	i	<p>Anthropometrics:</p> <ul style="list-style-type: none"> • Study of peoples or human size. • Anthropometric data makes use of the 5th to 95th percentile. • Involves measuring people. • Anthropometric data is measurements. 	2	Any 2 valid points or one point + clarification.
4	a	ii	<p>Ergonomics:</p> <ul style="list-style-type: none"> • A study of the relationship between people and their environments. • The application/use of anthropometric data in real situations. • The design of efficient layouts and workspaces. 	2	<p>Any 2 valid points or one point + clarification.</p> <p>Relationship between product and the user = 1</p>

4	b	i	<p>Looking for reference to measurement and size of a human user e.g.</p> <ul style="list-style-type: none"> • Size/ width of hands to work out handle/draw pull size. • Length of human reach (shoulder to fingertips) to decide on depth of cupboard and shelves. • Work top heights to waist. <p>FOCUS ON HUMAN USER</p>	3	<p>One simple point of how anthropometrics used = 1</p> <p>General understanding with at least one example considered = 2</p> <p>Full understanding of ergonomics and two or more specific examples of use = 3</p>
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4	b	ii	<p>Looking for reference to design of objects to fit the user/ more effective for the user e.g.</p> <ul style="list-style-type: none"> • Comfortable handles to hold e.g. shaped, textured, colour coded. • Rotating chamber in corner kitchen units making it easier to reach • Illuminated displays giving warning when hot/turned on. • Shelves not too high for most to reach • Minimising movements to complete a task – working triangle <p>Safety- non-conductive materials</p>	3	<p>One simple point of how ergonomics is used = 1 General understanding with at least one example considered = 2 Full understanding of ergonomics and two or more specific examples of use = 3</p>
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4	c	i	<p>Red <u>Location or use:</u> Switches, alarms, temperature indications, colour coded chopping board – meat etc. A SPECIFIC LOCATION <u>Reasons:</u> Red means danger e.g. hot or sharp. Red is a warning colour in nature e.g. flight v fright. Used to differentiate hot tap from cold. Red spot on frying pan. Indicator light on central heating or immersion system – know when they are on. Universally recognised as a warning colour.</p>	3	<p>1 mark for an appropriate location or use. 2 marks for reasons appropriate to the location or use. Accept any 2 valid points in brief or 1 in detail. N.B. No marks for ref. to aesthetic use of colour e.g. walls, wall tiles</p>
4	c	ii	<p>Green <u>Location or use:</u> Appliance instrumentation/indicators Reference to the environment e.g. environmentally friendly, recycling, reuse etc. Colour coded chopping board –veg. A SPECIFIC LOCATION <u>Reasons:</u> A natural colour / occurring in nature/associated with identification of environmental issues e.g. recycle,</p>	3	<p>1 mark for an appropriate location or use. 2 marks for reasons appropriate to the location or use. Accept any 2 valid points in brief or 1 in detail. N.B. No marks for ref. to aesthetic use</p>

			<p>reuse & reduce. Implies in harmony with nature e.g. neutral, not acid or alkali. Implies healthy, well being Main colour on the recycle symbol to indicate enviro/ more appropriate disposal. Indicate earth/ground terminal as part of colour combination with yellow on electrical wiring e.g. 13amp plug</p>		<p>of colour e.g. walls, wall tiles</p>
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4	d	<p>QWC question 'Working triangles' describes the range or number of movements required to do a task e.g. make a cup of tea.</p> <p>N.B. a good definition is credit worthy in the context of the question as a whole to explain how working triangles are used.</p> <p>Responses may consider:</p> <ul style="list-style-type: none"> • Effective organisation of available workspaces • Safety- minimise movement near hot surfaces or positioning electrical appliances too the sink. • Inclusive design – help differently enabled people move more efficiently round the kitchen. <p>Examples:</p> <ul style="list-style-type: none"> • Dishwasher near the tumble drier • Microwave near the cooker/oven • Tea, coffee and cups in a cupboard near the kettle • Bin close to the sink or alongside food preparation areas. <p>Simple points to look for: Movement(in kitchen) = 1 Organising(the kitchen) = 1 Safety (in the kitchen)= 1</p> <p>Watch for lots of reference to efficiency which is given in the question = 0</p> <p>MAXIMUM OF 4 MARKS FOR RESPONSES THAT DO NOT EXPLAIN WORKING TRIANGLES.</p>	8	<p>A fully detailed & comprehensive response that covers most of the points given. Use of 2 or more good examples to clarify understanding of issues given. The answer is well structured, with a good use of D&T terminology & showing a very good grasp of grammar, punctuation & spelling. 7-8 marks</p> <p>A detailed and comprehensive response with that makes use of several of the points above. Use of 1 or 2 examples to clarify understanding of question issues given. Response has structure with good use of D&T terminology and shows a good grasp of grammar, punctuation & spelling. 5-6 marks</p> <p>A fairly detailed response, which refers to some of the points above. A fairly well structured response, with some use of D&T terminology. Little or no use of examples to clarify understanding. Response does have a small number of errors in grammar, punctuation & spelling. 3-4 marks</p> <p>A very limited response with little if any reference to the points above. The answer is vague and poorly structured, with little use of D&T terminology. Many errors in grammar, punctuation & spelling. 1-2 marks</p>
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			<p>production runs and no need for expensive automation.</p> <ul style="list-style-type: none"> • Clean method of printing/ no mess with children – only accept for laser/ inkjet & dye sublimation printing. • No need for expensive investment in new equipment e.g. offset lithography printing machine. 		<p>Mark response. Don not penalise if 5b(i) is not worthy of credit</p>
5	c		<p>QA= Systems in place before, during and after production. Process orientated & defect protection</p> <ul style="list-style-type: none"> • Training to use equipment safely and to minimise waste • Machine/tool maintenance to ensure consistency • Activities completed to ensure a set standard is maintained. • Use of stencils, templates & jigs • Registration marks 	2	<p>Award maximum 2 marks for first statement.</p> <p>Point made and an example of QA in card manufacture = 2</p> <p>Brief simple statement about QA not clearly linked to card manufacture = 1.</p>
5	d	i	<p>Accept;</p> <ul style="list-style-type: none"> • Offset lithography • Digital printing • Gravure printing 	1	
5	d	ii	<p>Looking for reference to:</p> <ul style="list-style-type: none"> • Card is required in a large run, hence very expensive to have them hand made. • Large numbers of cards can be printed rapidly and of a consistent quality. • Printing can be automated to save on wages to pay workers. 	3	<p>Any valid point = 1 mark.</p> <p>Valid point with further clarification = 2 marks.</p>

			<ul style="list-style-type: none"> Manufactured with specialist equipment and highly trained operators to reduce wasted time and materials. 		
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5	e		<p>QC= Checks/testing on the product. Defect identification. Checks on the cards as they are made.</p> <p>NB IF YOU CAN MEASURE IT, THEN IT IS QC.</p> <ul style="list-style-type: none"> Sampling every 1000 card and check against proof/reference copy. Check for alignment (registration marks). Colour consistency. Physical/visual checks to see if card opens/closes etc correctly. Checked/ tested against a manufacturing specification. Product is tested to ensure it will do the job it is designed for when it reaches the market. Checking input materials e.g. weight of paper. 	2	<p>Award maximum 2 marks for first statement.</p> <p>Point made and an example of QC in card manufacture = 2</p> <p>Brief simple statement about QC not clearly linked to card manufacture = 1.</p> <p>Check = 1</p> <p>Where statement is vague and could be applied to both QA and QC – award 1 mark.</p>
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		<p>Oil camping light: <u>Feature:</u></p> <ul style="list-style-type: none"> • Carrying handle • Glass shade to stop light being blown out. • Self-contained fuel storage • Stable flat base <p><u>Explanation:</u></p> <ul style="list-style-type: none"> • Handle stops you from burning yourself on the hot lamp. Can also be used to hang it up. • Glass shade stops naked flame from been blown out if there is a draft. • Base stores fuel so that lamp will provide light for a long time before running out. • Base (combined with weight of fuel) will make lamp stable and stop it from falling over and causing a fire. <p>Battery Powered Torch: <u>Feature:</u></p> <ul style="list-style-type: none"> • Large reflective lens • On/off button • Colour coded on/off button • Tough and robust ABS plastic case • Ergonomically designed handle. • Battery power source – safety. <p><u>Explanation:</u></p> <ul style="list-style-type: none"> • The lens allows you to direct the light beam a long way in one direction e.g. to see where you are going on a walk. • The on/off button allows you to turn the light on or off with no fuss e.g. no need for matches. • Colour coded button may be 	6	<p>1 mark for any appropriate feature identified.</p> <p>Light = 0 Wick =1 Oil = 0 Oil powered = 1</p> <p>Any 2 simple points of explanation or one point qualified.</p> <p>Look for what makes it suitable.</p> <p>Light=0 Bulb=1 Battery = 0 Battery powered =1</p> <p>1 mark for any appropriate feature identified.</p> <p>NB Both lights can use handle as answer. Any 2 simple points of explanation or one point qualified.</p> <p>Look for what makes it suitable.</p>

			<p>luminous so it is easy to turn on in the dark.</p> <ul style="list-style-type: none"> • The tough and durable case will resist sudden knocks and impacts unlike the glass shade. • The handle is designed to fit the user as you may be carrying it along time. The shaped handle will stop the torch from slipping out of your hand. • The battery power source is easier to replace when the batteries go flat. It may use rechargeable batteries that can be recharged for future trips. • Batteries present less danger for the user (children on DofE?) than matches, flammable fuel and naked flames. 		
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6	b		<p><u>Feature:</u></p> <ul style="list-style-type: none"> • Replace oil and wick with a battery and bulb. <p><u>Explanation:</u></p> <ul style="list-style-type: none"> • Battery presents less of a H&S risk so the light could be used by children without adult supervision. • Requires good hand eye co-ordination to light lamp wick and refill the oil tank on the lamp. May not be possible if you have some form of visual impairment, paralysis, arthritis etc. • No chance of being knocked over and causing a fire. • Reduce chance of glass lens 	3	<p>1 mark for any appropriate feature identified.</p> <p>Any 2 simple points of explanation or one point qualified.</p>
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			breaking and cutting someone/allowing flame (light) to go out.		
6	c		<p><u>Feature:</u></p> <ul style="list-style-type: none"> • Change torch to a wind up one to generate electricity. • Include a solar cell on torch case to recharge batteries directly. • Superbright LEDs e.g. piranha LEDs. Accept LEDs <p><u>Explanation:</u></p> <ul style="list-style-type: none"> • There will be no need to buy batteries, the torch will be wound up when light is required. • The solar cell will recharge the batteries during the day when the torch is not in use. The solar cell could be mounted on the torch body or exist as a stand-alone charging unit. 	3	<p>1 mark for any appropriate feature identified.</p> <p>Battery, long lasting batteries, stronger batteries = 0</p> <p>Any 2 simple points of explanation or one point qualified.</p>