

Design and Technology

General Certificate of Secondary Education **A514/03**

Technical aspects of designing and making Mechanisms

Mark Scheme for June 2010

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Question			Expected Answer	Mark	Additional Guidance												
1	(a)	(i)	1 mark for each correct, 4 x 1	[4]	Ignore shape of screw head, not “nut” or “bolt”, accept cross head screw												
			<table border="1"> <thead> <tr> <th>name</th> <th>fastener</th> <th>tool used to fasten</th> </tr> </thead> <tbody> <tr> <td>cap head screw</td> <td></td> <td>hexagon key allen key</td> </tr> <tr> <td>pozidrive screw accept philips</td> <td></td> <td>pozidrive screwdriver</td> </tr> <tr> <td>hexagon head bolt accept set screw</td> <td></td> <td>spanner</td> </tr> </tbody> </table>			name	fastener	tool used to fasten	cap head screw		hexagon key allen key	pozidrive screw accept philips		pozidrive screwdriver	hexagon head bolt accept set screw		spanner
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(ii)	Washers are used for following reasons: <ul style="list-style-type: none"> To spread load across a larger surface area; Reduce friction between turning and static surfaces; Act as a spacer; to reduce wear Spring washers will prevent fastener working loose. 1 mark for valid reason.	[1]	Not “allow for some movement”, lateral														
(iii)	From rotary to linear motion. 1 mark for each must be in correct order.	[2]															
	(b)	(i)	Worm gear. Accept worm	[1]	Ignore additional words after worm												
		(ii)	Explanation could include: <ul style="list-style-type: none"> One way action, can’t slip back; Can be operated with one finger/hand/no tool(s) needed; Fine adjustment because of low gear ratio. 2 marks for a clear explanation, justified point. 1 mark each for two valid points mentioned.	[2]													

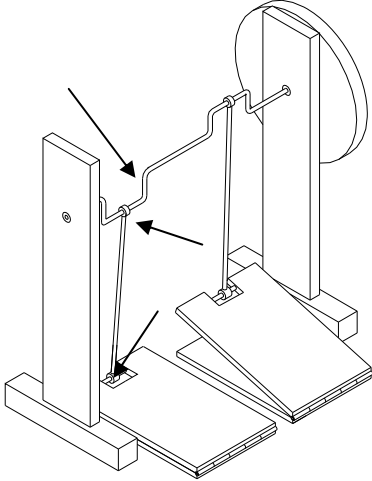
Question		Expected Answer	Mark	Additional Guidance
	(c)	<p>Safety checks for drill chuck:</p> <ul style="list-style-type: none"> • Drill accurately placed in centre of jaws; plastic guard used • Drill tight in chuck/ tightly fastened; • Chuck key removed. <p>1 mark for valid check.</p> <p>Safety checks for work being drilled:</p> <ul style="list-style-type: none"> • Work must be securely fixing to drill table; • Work fixed in machine vice/block of wood (underneath). <p>1 mark for valid check.</p>	[2]	
		TOTAL	[12]	

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	Effort correctly marked, 1 mark. Load correctly marked, 1 mark. Effort and load in correct relative positions but not placed to give maximum benefit, 1 mark.	[2]	
		(ii)	First order lever, class one, Class A	[1]	Not class B or C
	(b)	(i)	Description should include: <ul style="list-style-type: none"> • Double lever action allows blade/handle angle to be adjusted by loosening wing nut on shears; • Blade is turned 90 relative to handle; easier to use, • More natural movement in use; increased mechanical advantage, easier to cut through bigger stuff • Ergonomic improvement. Two relevant points included in description, 1 mark each.	[2]	Not allow 'No need to bend down' or "safer"
		(ii)	Ergonomic aspects of design could include: <ul style="list-style-type: none"> • Length of handle/lever; (variable length) • Size of handgrip; material used for handles, comfortable grips, allow handles • Amount of effort needed to close blades; • Method of use does not require complex instructions. 2 x 1 marks	[2]	Not length of blades
		(iii)	Properties required of blade include: <ul style="list-style-type: none"> • Hardness; tough;(properties of the material specific) • Ability to retain sharp cutting edge; • Corrosion resistance. Durable Allow reference to ease of cleaning.	[1]	Not rigid, strong
	(c)	(i)	Torque is rotational power/twisting/turning force.	[1]	

Question		Expected Answer	Mark	Additional Guidance
	(ii)	Notes/sketches to show driven plate, clutch plate, method of applying pressure (allow arrows). Could be spring pressure, dog clutch, friction drive. Components mentioned/drawn, 1 mark. Correct principle of clutch action applied, 1 mark. Clear sketch or notes, 1 mark.	[3]	
		TOTAL	[12]	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	Velocity ratio = $52/13 = 4$, 1 mark.	[1]	Allow numerically correct even if ratio is later stated incorrectly.
		(ii)	Speed in rpm = $60 \times 4 = 240$ rpm, allow just 240 1 mark for using VR and speed of driver, 1 mark for correct answer.	[2]	
		(iii)	Allow mark for: <ul style="list-style-type: none"> • Nylon is a good bearing material; • Requires no lubrication; • Low friction between mating surfaces, cause less friction 1 mark for suitable benefit.	[1]	
	(b)		Crossed belt to reverse direction only, 1 mark. Use of idler gear to reverse direction, teeth need not be shown, if 2 idlers used allow 1 mark. If alternative system function as required, give credit, e.g. Toothed belt, multiple idlers, transposition of solutions	[2]	
	(c)		Discussion could include elements of the following: <ul style="list-style-type: none"> • Replaceable bearings, split , shell, bush etc; • Ease of removal for maintenance and replacement; • Common bearings for a number of designs; • Porous metals, eg phosphor bronze; • Adjustable/non-adjustable types; • New materials, eg ceramics; • Self aligning to cut down wear on shaft. <p>Level 1 (0-2) marks Basic comments discussing some of the benefits of bearings that can be replaced or easily maintained. At least one of the above points mentioned.</p> <p>Level 2 (3-4) marks Discussion, showing understanding of the implications of matching the bearing type to the intended use. At least two specific types of bearing mentioned.</p>		

Question	Expected Answer	Mark	Additional Guidance
	Level 3 (5-6) Clear discussion comparing different types of bearing and commenting on their use in a sustainable product. Mention of ease of replacement and maintenance needs. Two different examples given with justification against sustainable life.	[6]	
	TOTAL	[12]	

Question		Expected Answer	Mark	Additional Guidance	
4	(a)	(i)	Vertical distance moved = 2 x throw of crank = 100mm. Units not required	[1]	
		(ii)	Flywheel must have enough mass to carry crank through the non-powered part of action. Flywheel must be balanced so that it does not cause movement/vibration in the frame. 1 mark for a reference to mass, weight, momentum or balance.	[1]	
	(b)	(i)	Crank must have extra throw opposite to the one given in Fig. 9.  Throw on crank, 1 mark. Connection to second connecting rod, 1 mark. Connection rod to treadle, 1 mark.	[3]	Ignore any reference to changes of throw

Question	Expected Answer	Mark	Additional Guidance
(ii)	<p>The operator must be sitting down to operate a two treadle machine or there has to be a second operator just to work treadles. 1 mark for understanding shown.</p>	[1]	Not both feet
(c)	<p>Explanation could include:</p> <ul style="list-style-type: none"> • Readily available materials for manufacture and maintenance; • Can be taken apart easily for maintenance (wing nuts); • Can be transported easily; • Human power so low energy costs; cost to build/cheap if justified • No complex production methods needed, needs no machine tools; • Simple, proven technology with minimum that can go wrong. • Servicing may be a problem in remote/poor area <p>Level 1 (0-2) marks Basic comments mentioning availability of materials, simplicity of design. At least one of the above points mentioned.</p> <p>Level 2 (3-4) Some thought given to maintenance and availability of spare parts. At least two of the above points mentioned.</p> <p>Level 3 (5-6) Clear explanation considering sustainability both in production and in use. And referring to the design as well as manufacture of the pump. Two different points explained with reference to facilities that may be available.</p>	[6]	Not just “cheap”
	TOTAL	[12]	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	When the toy is pushed along: <ul style="list-style-type: none"> The cam will rotate; Follower will pull string as it rises, lifting head; Follower will fall as weight of head drops head down pulling follower against cam. Any two points mentioned 1 mark each, 2 x 1.	[2]	1 mark only for weak, vague or confused answers
		(ii)	Benefit could relate to speed of production, accuracy or reduced number of processes, no finishing needed, self colouring, suitable for mass production, light weight and cheaper to transport or qualified 1 mark for valid benefit.	[1]	No reference to cheap or cheap to buy or cheaply
		(iii)	No expensive mould/tool required if manufacturing from wood. Renewable/sustainable resource, could appeal to high end of market, suitable for small batches, village manufacture 1 mark for valid reason.	[1]	Not cheap, not recycled (after use), not durable
	(b)		A more complicated cam profile would take longer to cut and require more processes. Circular cam can be turned on lathe. Circular cam (eccentric) will do the job just as well. 1 mark for clear reason.	[1]	Too vague "easy to make"
	(c)	(i)	Safety features will include: <ul style="list-style-type: none"> No small parts; 36 months choking hazard test, No sharp edges, allow rounded edges; no finger traps, cover mechanism. Non-toxic materials/paints/finishes used; Non-splintering timber used. 2 x 1 marks.	[2]	
		(ii)	Anthropometric measurements for the toy will include: <ul style="list-style-type: none"> Height of children from target range; Height of hands/toy from floor; Size of hands/grip. 	[2]	Not just "size" or "strength"

			1 mark for each measurement, allow marks for other valid measurements. 2 x 1 marks.		
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Question		Expected Answer	Mark	Additional Guidance
	(d)	Suitable bearing material used, tube or similar for axle to run in, make either head or side plate holes larger 1 mark. Axle to fit, side movement restricted on both sides, eg bolt with nyloc nut, 1 mark. Clarity of notes/sketches in explaining method, 1 mark.	[3]	
		TOTAL	[12]	

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