

# **Design and Technology**

General Certificate of Secondary Education

Unit **A514/03** Technical aspects of designing and making Mechanisms

## **Mark Scheme for June 2013**

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

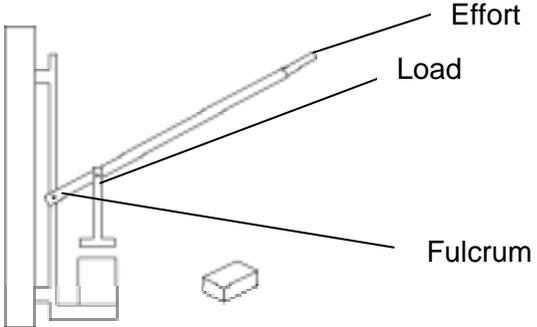
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1. For answers marked by levels of response:
2.
  - a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
  - b. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

Question			Answer	Marks	Guidance
1	(a)	(i)	Marked as indicated 	3	General area indicated so long as correct class of lever shown (Class 2) Do not credit the pressure pad. It's the connection with the lever arm we want.
	(b)	(i)	Any of: <ul style="list-style-type: none"> <li>• steel</li> <li>• mild steel</li> <li>• low carbon steel</li> <li>• high carbon steel/high tensile steel.</li> </ul>	1	Not Stainless steel unless qualified as 'stronger than mild steel' or 'looks smarter than painted steel'. Not Iron alone. Not aluminium unless stated as substantial section.
		(ii)	Any of: <ul style="list-style-type: none"> <li>• harder</li> <li>• tougher</li> <li>• less could be used</li> <li>• can be thinner as stronger (than steel)</li> <li>• does not corrode</li> <li>• looks good</li> <li>• won't need painting.</li> </ul>	2	Allow 'strong' or 'stronger', Durable but not 'cheap'.
	(c)	(i)	$1200 \times 10 = 12000$ substitution $12000 / 200 = 60$ calculation (method allow ECF) Ans = 60Nm answer	3	1 mark for each step or 3 marks for correct answer, units not required. Look carefully for method mark if applicable.

Question		Answer	Marks	Guidance
	(ii)	Any three valid improvements: <ul style="list-style-type: none"><li>• nice grip on handle</li><li>• longer handle</li><li>• move load closer to fulcrum</li><li>• bearings/bushes at point of load</li><li>• bearings/bushes at point of fulcrum</li><li>• more drainage holes.</li></ul>	3	Any three points well explained by sketches and/or notes Do not credit 'increase pad/log' size
<b>Total</b>			<b>12</b>	

Question			Answer	Marks	Guidance
2	(a)	(i)	Chain (duplex chain) and Sprocket	2	Only 'chain' or 'sprocket' 1 mark 'Duplex' not needed for 2 marks
		(ii)	<ul style="list-style-type: none"> <li>capable of transmitting large forces/power/high strength</li> <li>resists shock loads/won't snap</li> <li>does not slip</li> <li>wears at half the rate of a simplex chain</li> <li>long-lasting</li> <li>maintains timing.</li> </ul>	2	Any two Not 'won't slip' off' not 'easy maintenance'
		(iii)	<ul style="list-style-type: none"> <li>requires lubrication/maintenance</li> <li>sprockets must be in line</li> <li>expensive compared to belt systems</li> <li>unguarded – major risks.</li> <li>noisy</li> </ul>	2	Any two
		(iv)	The first nut (B) locks the sprocket onto the shaft, the second nut (A) locks the first (B) i.e. prevents it coming undone in service.	2	'locknuts' alone 1 mark Not 'Adds extra strength'. Must relate correctly to nuts A&B Allow nut B locks/secures sprocket, nut A lock nut B, prevents Nut B from moving
		(v)	Nyloc, (nylon locking nut)	1	or other self-locking nut, e.g. castellated nut and split-pin
	(b)	(i)	Vee belt and Vee pulley	2	Only 'Vee belt' or 'vee pulley' 1 mark. Allow V belt/pulley Allow one mark for 'belt and pulley'
		(ii)	Jockey wheel, idler pulley, belt idler, tensioning pulley	1	Must relate to its actual function, ie pulley/bearing alone will not gain a mark. Not 'spring loaded tensioner'.
<b>Total</b>				<b>12</b>	

Question		Answer	Marks	Guidance
3	(a)	The <b>rotary</b> motion of the motor is transferred into <b>reciprocating</b> motion of the jigsaw blade	2	1 mark per word,, allow misspelling so long as meaning is clear
	(b)	Dust is: <ul style="list-style-type: none"> <li>• potentially harmful to humans</li> <li>• obscures work in progress.</li> </ul> So removing it: <ul style="list-style-type: none"> <li>• makes for a safe working environment</li> <li>• allows work to proceed unhindered/un-obscured</li> <li>• greater safety as you can see what is being cut.</li> </ul>	2	Problem and solution for two marks Allow references to 'blocking/clogging up the motor' 'prevents wear' and 'cost of replacing parts', 'reduces efficiency', 'causes breakdowns'. Two different reasons or cause and effect
	(c)	A ratchet (toothed wheel) and pawl	2	1 mark per word, allow miss-spelling so long as meaning is clear, including 'Paul'.

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(d)*	<p>Explanations embodying the benefits offered by (more) gears and (better) brakes:</p> <ul style="list-style-type: none"> <li>• easier to ride faster</li> <li>• easier to ride up hills</li> <li>• gear can be chosen to suit fitness level</li> <li>• improved range by controlling rate of work</li> <li>• improved stopping power of brakes</li> <li>• ergonomic brake levers make it easier to apply the brakes</li> <li>• hydraulic (or cable) disc brakes offer improved stopping power.</li> </ul>	6	<p>Watch for repetition, Additional gears make for improved ride-ability, additional leverage improves braking capability, wider handlebars improved steering (e.g. off-road compared to on road). Include relevant reference to hydraulic systems.</p>	<p>Simple lists score 2 marks maximum</p> <p><b>Level 3 (5–6 marks)</b> Thorough explanation, showing clear understanding of gearing and levers and their applications. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate will demonstrate the accurate use of spelling, punctuation and grammar</p> <p><b>Level 2 (3–4 marks)</b> Adequate explanation, showing an understanding of gearing and levers and their applications. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, grammar and punctuation</p> <p><b>Level 1 (0–2 marks)</b> Basic explanation, showing some understanding of gearing and levers and their applications. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive.</p>
		<b>Total</b>	<b>12</b>		
		<b>Section A Total</b>	<b>36</b>		

## SECTION B

Question		Answer	Marks	Guidance
4	(a)	<p>Sketches and notes that show how:</p> <ul style="list-style-type: none"> <li>• cams</li> <li>• followers</li> <li>• fulcrums (pivots)</li> <li>• cranks</li> <li>• wheels</li> <li>• linkage.</li> </ul> <p>arranged as required between the front jaw and rear tail provide the desired movement</p>	6	<p>6x1 valid parts of mechanisms that could combine to make a model that would work in principle. Correct proportions not required for full marks but ability to function and provide the desired movement is. Repetition of the front mechanism in an identical form should not earn more than 4 marks unless there are functional differences or additions that achieve the desired outcome.</p> <p>Sundry sketches that just show a bare mechanism with no relationship to parts of the toy in some way don't score. E.g. Jaw or tail should be labelled even if the drawing is not particularly clear.</p> <p>Pivot for tail or jaw needed for full marks, 3 for each jaw/tail. If top jaw animated, 2 marks maximum. If same shape cam used for both and movement feasible, allow mark.</p>

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(b)*	<p>Discussion around how ergonomics and anthropometrics can be applied to something like a child's pull-along-toy. Expects discussion around:</p> <ul style="list-style-type: none"> <li>• meanings of the two words</li> <li>• grip sizes</li> <li>• danger of entrapment (in mechanism)</li> <li>• materials safety</li> <li>• finish (paints) safety</li> <li>• choke hazard and related testing</li> <li>• ce mark</li> <li>• bsi kitemark.</li> <li>• comfortable to hold</li> <li>• designed to suit the age of child</li> </ul>	6	Simple lists score 2 marks maximum. Watch for repetition.	<p><b>Level 3 (5–6 marks)</b> Thorough discussion, showing clear understanding of the application of ergonomics and anthropometrics. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate will demonstrate the accurate use of spelling, punctuation and grammar</p> <p><b>Level 2 (3–4 marks)</b> Adequate discussion, showing an understanding of the application of ergonomics and anthropometrics. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, grammar and punctuation</p> <p><b>Level 1 (0–2 marks)</b> Basic discussion, showing some understanding of the application of ergonomics and anthropometrics. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive.</p>
<b>Total</b>			<b>12</b>		

Question			Answer	Marks	Guidance
5	(a)	(i)	<p>Explanation that embodies the following points:</p> <ul style="list-style-type: none"> <li>• positive location for arm</li> <li>• in a range of discreet steps</li> <li>• that allow for some minor adjustments</li> <li>• unlike a simple flat or hexagonal shaft</li> <li>• that greatly increases the torque transmission capability</li> <li>• of the joint between the gearbox and the linkage arm.</li> </ul>	3	<p>Correct list-like answers can score 3</p> <p>Not 'easy/quick to take off'</p> <p>Check for repetition.</p>
		(ii)	<p>To allow adjustment of:</p> <ul style="list-style-type: none"> <li>• the amount of movement of the control surface</li> <li>• to increase or decrease the torque (allow force) delivered to the control surface</li> <li>• alter the speed a control surface operates at.</li> </ul>	2	<p>Allow 'Movement goes up/down and the torque goes down/up as you move towards the outer holes', converse applies, or equivalent comment allowed</p> <p>Force/distance can be changed depending on application.</p>
		(iii)	A turning force	1	Allow a 'twisting force', 'rotational force', not energy, not driving force
		(iv)	Newton/metres (Nm).	1	Only as SI units asked for
	(b)	(i)	Compound	1	Only
		(ii)	Brass	1	Allow phosphor bronze, aluminium, titanium, only 1 metal, allow named alloy
	(c)	(i)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>• greater accuracy in shaft location</li> <li>• more precision location of output shaft</li> <li>• harder wearing</li> <li>• less friction</li> <li>• longer lasting/less maintenance/lubrication built in</li> </ul>	1	

Question		Answer	Marks	Guidance
	(ii)	It will: <ul style="list-style-type: none"> <li>• move less</li> <li>• give it lesser travel.</li> </ul> But with <ul style="list-style-type: none"> <li>• improved/increased resolution</li> <li>• lower speed</li> <li>• greater/more force.</li> </ul>	2	Effect and consequence for 2 marks. Must relate to movement. No credit for any comments relating to energy used  If only 1 correct, award 1 mark for which ever.
		<b>Total</b>	<b>12</b>	
		<b>Section B Total</b>	<b>24</b>	
		<b>Paper Total</b>	<b>60</b>	

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