RECOGNISING ACHIEVEMENT

GCSE

Design and Technology

General Certificate of Secondary Education

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

Mark Scheme for June 2012

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Question			Answer	Mark	Guidance
1	(a)	(i)	Worm and (worm) wheel or gear,	1	Allow pinion.
		(ii)	Large reduction in a single stage, cannot be reverse driven, stays where you leave it, good mechanical advantage, good accuracy, tends to stay where you put it, drives through 90 degrees.	2	**2x1** Any 2, accept 'makes it easy to steer' for 1 mark high level of friction due to sliding contact patch means that it is NOT an efficient mechanism.
		(iii)	To lock worm wheel to shaft, provide positive drive to shaft, locate wheel / gear on shaft.	1	Allow 'holding the …. on the shaft', 'stop ….falling off the shaft'.
	(b)	(i)	Any of lubrication, cooling, corrosion prevention, reduce friction, prevent metal to metal contact.	2	Watch for vague, repetitive answers, i.e. same thing said differently or hopeful guesses.
		(ii)	So the flow is controlled (as oil is runny and would quickly run away), one drip at a time, ensuring a continuous but limited/small supply.	1	Fed in a controlled manner.
	(c)	(i)	Pipe work (A) Copper, steel. Makers Name Plate (B) Brass, aluminium Cast Body (C) Cast iron, iron, steel, mild steel Display Base (D) Any hardwood, oak, pine.	4	**4x1** Allow aluminium for Cast body Allow any named wood variety incl. soft/hard but not 'wood' alone. Not MDF
		(ii)	Connecting rod, con rod, crank rod.	1	Allow crank arm.
			Question 1 Total	**12**	
2	(a)	(i)	Rack and pinion.	2	1 mark each word, allow miss-spellings
		(ii)	Changes OSCILLATING (or Reciprocating) motion into ROTARY motion (or rotates).	2	**2x1** Accept LINEAR into ROTARY, award 1 mark if Osc. and Rotary or Rotary into Linear. 'backwards and forwards' into 'round and round' scores 1 as it lacks technical clarity. No mark if single word describing part of mechanism movement.

Question			Answer	Mark	Guidance
		(iii)	Part A moves up and down, part B rotates (direction not relevant, Part C rotates in opposite direction to arrows drawn on Part B. Double ended arrows fine so long as movements correct. Rack may have DE arrow with single direction on gears.	3	**3x1** For the third mark part C MUST be the reverse of what is drawn on part B. Some candidates may draw four motions e.g. small and co-mounted large gear. Work backwards from C looking for correct motion up to 3 marks.
	b	(i)	Ratchet, ratchet and pawl, freewheel, one way clutch.	1	Must be a ratchet mechanism.
		(ii)	When rotated in anti-clockwise direction, fingers (pawls) fly out and engage with ratchet ramps on inside, transferring motion or locking the drive. When inner motion stops, fingers are retracted/knocked back and the flywheel unit freewheels.	2	2 marks only if an engage/disengage action is adequately described. Accept one way nature of the mechanism correctly described. Ratchet only drives in one direction.
		(iii)	A flywheel stores/saves (rotational) energy (for use later).	2	Needs "stores" or "saves" (or equivalent) AND "energy" (or equivalent, e.g. momentum) to gain 2 marks.
			Total Question 2	**12**	
3					
	(a)	(i)	ROTARY motion into RECIPROCATING (or reversed).	2	Only, order does not matter for 2 marks.
		(ii)	Twice the radius shown, 2*45mm = 90 mm	1	Written or numerical, or both.
		(iii)	A double-ended arrow indicating up and down.	1	If only a single ended arrow has been drawn, allow an up arrow, but not a down arrow. **The part cannot move any further downwards.**
	(b)		200*10=270*x. (or equivalent) 2000/270=7.4	2	1 mark for spotting the correct numbers 1 mark for the correct answer (working not needed)

Question			Answer	Mark	Guidance
	(c)*		Discussion of the benefits of CAD and subsequently CAM to the designer and manufacturer. All aspects relevant from ease of making changes through to worldwide communication of the design to remote manufacturing facility. Ability to simulate mechanisms action in software, prototype parts by Rapid Prototyping machines.	6	**6X1** **Level 1 (1-2 marks)** Basic explanation, showing some understanding of CAD/CAM and their advantages. 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. **Level 2 (3-4 marks)** Adequate explanation, showing an understanding of CAD/CAM and their advantages. 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. **Level 3 (5-6 marks)** Thorough explanation, showing clear understanding of CAD/CAM and their advantages. There will be **three** of more clearly identified and explained points. 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.
			Total Question 3	**12**	
			Section A Total	**36**	

Question			Answer	Mark	Guidance
			Section B		
4	(a)	(i)	Any of positive drive, low maintenance, long service life, no lubrication required, high power transmission capability, maintains timing, silent running.	2	2X1 Allow reference to 'efficiency' for 1 mark
		(ii)	Any two of toothed belts are often used as timing belts, if belt breaks damage can be caused by parts colliding (due to) miss-timing, belt materials decays, belt / teeth wear out, can strip a tooth/teeth.	2	2x1 Not 'stretching' but allow for wear induced slack issues.
		(iii)	Any of: Lower maintenance costs, (as) chains last longer / don't wear out, less likely to fail, are physically smaller than a belt. Takes shock loads well.	1	Allow stronger. Not 'more reliable'.
	(b)		Grease is easier to retain in the bearing, does not run out, does not leak away in use. More solid, last longer, greater viscosity.	1	
	(c)		Discussion around the closed shop/monopoly of being tied to the maker for servicing and repair, and/or the moral/environmental costs of a product that has failed and may be deemed BER or which has been deliberately made inaccessible to the end user. To be added to in light of candidate response.	6	**6x1** Allow 1 mark for a statement like 'buy a new one' (or similar). **Level 1 (1-2 marks)** Basic explanation, showing some understanding of the 'closed shop/monopoly' of being tied to the maker for servicing and repair, and/or the moral/environmental/financial costs of a product that has failed and may be deemed BER or has been deliberately made inaccessible to the end user. 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. **Level 2 (3-4 marks)** Adequate explanation, showing an understanding of the 'closed shop/monopoly' of being tied to the maker for servicing and repair, and/or the moral/environmental/financial costs of a product that has failed and may be deemed BER or has been deliberately made inaccessible to the end user.

Question			Answer	Mark	Guidance
					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 **Level 3 (5-6 marks)** Thorough explanation, showing clear understanding of the 'closed shop/monopoly' of being tied to the maker for servicing and repair, and/or the moral/environmental/financial costs of a product that has failed and may be deemed BER or has been deliberately made inaccessible to the end user. There will be **three** of more clearly identified and explained points. 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
			Question 4 Total	**12**	
5	(a)	(i)	Sketches and notes need to show: 2 drive systems one to each propeller, and two correct contra rotating propellers.	4	**4x1** If no pulleys shown, (just lines) then 3 marks maximum.
		(ii)	Quick way of researching a solution, does it work as planned, eliminate errors, wasted time/costs of something that turns out faulty.	2	Vague repetitive answers lacking depth or reason score 1 mark. 'Quick' alone scores 0 Look for an 'advantage' and then an 'explanation/reason'.
	(b)	(i)	A smart material is a material whose properties can be significantly changed in a controlled manner by the application of temperature, stress, magnetic field or by the passing of electricity (causing heat) through them.	2	Weak explanation with no reference to what causes the change only gains 1 mark. Reference to heat or electricity alone with no smart material mentioned scores zero.
		(ii)	Effect of heat. Polymorph: Softens when heated (at 62C) SMA: returns to previous shape	4	**4x1** Temperature NOT required for mark. **NOT 'melts' alone.** SMA also known as memory wire, muscle wire, Nitol

Question			Answer	Mark	Guidance
			Effect of Electricity. Polymorph – no effect (insulator), stays rigid SMA – (conducts electricity so heating), returns to previous shape		**NOT melts as this does not display knowledge of SMA.**
			Question 5 Total	**12**	
			Paper Total	**60**	

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