Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

DESIGN AND TECHNOLOGY **0445/42**

Paper 4 Systems and Control **May/June 2017**

MARK SCHEME

Maximum Mark: 50

Published

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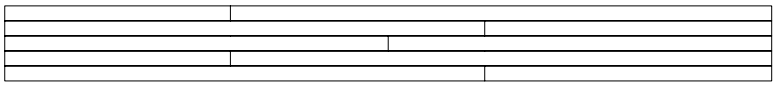
Section A

Question	Answer	Marks	Guidance
1(a)	Advantages of plastics could be: • Rigid PVC will not rot and is resistant to insect attack • Lightweight using hollow sections • Can be easily joined by welding • Long lasting • Does not warp • No natural defects	**2**	Allow other suitable advantages, comparisons must be against wood. Allow water resistance. Allow higher strength / weight ratio
1(b)	Advantages of wood could be: • Renewable resource • Easily obtainable • Can be joined with temporary or permanent joints • Higher tensile strength than rigid PVC • Different types available in different dimensions • Higher compressive strength	**2**	Allow other suitable advantages, comparisons can be against any plastics Allow stronger joints possible and aesthetic reasons Allow bio-degradable Allow ‘resists heat’

Question	Answer	Marks	Guidance
2(a)	Reasons for using hollow section steel will include: • Lighter than concrete • More precise dimensions • More of the beam can be hidden from view • Longer lengths easier to handle • Stronger in tension • Higher strength / weight ratio	**2**	Allow other valid reasons for use of hollow sections in beams Allow resistant to shearing
2(b)	Sketches to show beam made from three or more horizontal layers [1] Notes indicating gluing together [1] 	**2**	Beam may be curved or a shape other than straight If there is an indication that the beam is short enough to be made from single lengths of lamination allow second mark Allow other valid reasons
2(c)	Laminated beams can be produced in much greater lengths Easier to produce curves	**1**	Allow aesthetic and other valid reasons Allow 'renewable resource'

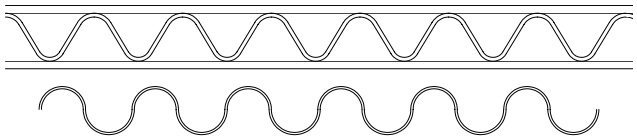
Question	Answer	Marks	Guidance
3	Clear explanation using relevant example – gear, levers, pulleys [1] Understanding of output force being greater than input force [1] normally being stated as a ratio [1]	**3**	Explanation with two clear points made, 2 marks, allow 2 marks for one well explained point

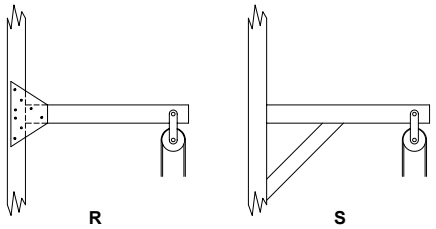
Question	Answer	Marks	Guidance
4(a)	Reasons will include reducing friction, reducing wear To provide support, prevent axial and radial movement To reduce energy usage in a mechanism	**1**	Accept wording that implies axial or radial movement
4(b)	Lubrication for a car crankshaft will be oil Lubrication for ball bearings will be grease	**2**	
4(c)	Properties of nylon will include: • It does not require any additional lubrication • Low coefficient of friction • Can be injection moulded into different shapes • Does not corrode / is resistant to chemicals / hard wearing • Lower cost than other materials 2 × 1 marks, 1 for each valid property	**2**	Allow 'wears away more easily than shaft'

Question	Answer	Marks	Guidance
5	Chemical hazards can be controlled by: • Storing in locked cupboards • Clear labelling on containers • Only having small amounts available at one time • Reading COSHH notes or other safety notes • Having precautions nearby when using them	**2**	Accept reference to relevant PPE for 1 mark Allow use of a ventilation system Allow 'use supervision / technician' Allow reference to correct disposal

Question	Answer	Marks	Guidance
6(a)	Resistance will change	**1**	
6(b)	Light can be absorbed and reacted to faster than heat Heat takes longer to be conducted through the body of the thermistor Reference to light [1], Reference to heat [1]	**2**	

Question	Answer	Marks	Guidance
7(a)	In a rotary switch a number of terminals [1] are joined in turn to a common terminal [1] as the switch shaft is rotated	**2**	
7(b)	The flat is to allow a control knob to be attached without rotating on the spindle	**1**	
	Total:	**25**	

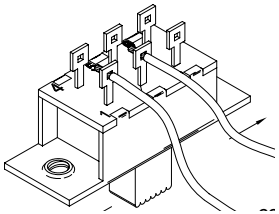
Question	Answer	Marks	Guidance
8(a)(i)	Strain gauge	**1**	
8(a)(ii)	Very small changes in resistance will be registered by the gauge when it is stretched	**1**	Allow mark for Resistance without reference to the level of change
8(a)(iii)	The steel strip will register tension on the top face and compression on the bottom face	**2**	Both points must be mentioned in the explanation for 2 marks
8(a)(iv)	The non-electronic method must use a dial gauge to register movement when the steel strip is loaded Dial gauge [1] in a suitable position [1] fastening method to the test rig indicated [1]	**3**	
8(b)(i)	Reasons for strength of packaging will include: • Folds on long edges, double triple thickness • Locking tabs used with cut outs for edges to fit • Flat sides are supported by strengthened edges • One piece of card used, no extra joints • Folded edges on lids • Inner package is moulded, curves giving strength to the shape • Ribs used on the moulded inner packaging • Absorb shock / impact	**2**	Allow other valid reasons 1 mark for each valid reason 2 × 1 marks
8(b)(ii)	Regular shape / uniform pitch [1] and height [1] of corrugation Accept either with outer sheets or without, corrugations can be square 	**2**	Accept triangular corrugations
8(b)(iii)	Corrugations running from wall to edge [1] overlap visible [1]	**2**	

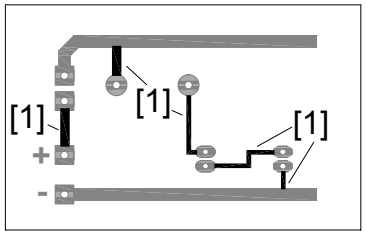
Question	Answer	Marks	Guidance
8(c)(i)	Gusset plate principle [1] Brace principle [1] Functional proportions on both methods [1]  	**3**	
8(c)(ii)	Scaled line to represent 200 N [1] Triangle completed [1] Force in chain taken from drawing – 400 N [1]	**3**	Allow 1 mark for force calculated rather than using diagram
8(d)	Structure stable in three dimensions [1] Height of structure 1.5 m or greater [1] Materials noted [1] Joints described or clearly drawn [1]	**4**	
8(e)	Explanation to include the term 'twisting' or similar term [1] Valid example given [1]	**2**	
	Total:	**25**	

Question	Answer	Marks	Guidance
9(a)(i)	Second order / second class lever	**1**	
9(a)(ii)	Benefits of a cable could include: • Able to bend / be routed around tubes • High tensile strength • Easily replaced / adjusted • Low cost to replace • Can work over a long distance • Lighter than solid linkage 2 × 1 marks for valid benefits	**2**	Allow any other valid benefits Allow ‘ instant movement’
9(a)(iii)	Drawback could include: • Cables can stretch • Cables can corrode • Single wire in the cable can break causing friction in the casing 1 mark for valid drawback	**1**	Allow – cable can break Allow ‘maintenance needed’, cannot transmit compressive force’
9(a)(iv)	Increased force at brake lever 90 × 5 = 35 × load [1] Load = 12.86 N [1] Force at mechanism 110 × 12.857 = 30 × load [1] Final load = **47.14 N**[1]	**4**	Allow ecf from first part of calculation Allow 47 N 4 for correct answer with no working

Question	Answer	Marks	Guidance
9(b)(i)	An electrical battery will convert stored **chemical** energy into **electrical** energy which is converted by a motor into **mechanical** energy 3 × 1 marks	**3**	
9(b)(ii)	Storage systems include: • air receiver tank (pneumatics) • spring • raised weight • stored water (hydroelectric / tidal) • diverted water (water mill) • flywheel 2 × 1 marks	**2**	Allow other valid examples of stored energy Allow 'GPE' and 'EPE' Allow 'steam in boiler'
9(b)(iii)	Examples could include engine design, car, aircraft, boat, white goods, washing machine, tumble dryer, fridge, freezer Factors in reducing energy demand could include: Reduced weight, improved aerodynamics, more rigid materials, and better insulation, reduction of friction, switch mechanism off, use alternative energy source 1 mark for suitable example, 2 marks for explanation with two valid points or one point explained in detail	**3**	
9(c)(i)	Ratchet drawing / notes [1] Pawl drawing / notes [1] spring or gravity drop for pawl [1]	**3**	
9(c)(ii)	One way mechanism is **snail cam** [1]	**1**	Allow **worm and wheel**
9(d)(i)	Greater lift on the cam [1] Change fulcrum position on the rocker – reduce distance from rocker shaft to push rod [1]	**2**	
9(d)(ii)	The rocker movement is **oscillation**	**1**	

Question	Answer	Marks	Guidance
9(e)(i)	The difference in the threads could be **pitch** or thread **profile** [1]	**1**	Allow mark for understanding shown
9(e)(ii)	The effect when using thread **B** would be that it must be turned more times to provide the same linear movement as thread **A** It can also be tightened more effectively and will not work loose as easily 1 mark for valid effect	**1**	Allow – easier to turn
	Total:	**25**	

Question	Answer	Marks	Guidance
10(a)(i)	**A** reed switch, **B** is a microswitch, **C** rocker switch, **D** push switch (PTM or PTB) 1 mark each	**4**	
10(a)(ii)	A **magnet** is used to operate a reed switch	**1**	
10(a)(iii)	Connections made to either 1 and 2, 2 and 3, 4 and 5 or 5 and 6. 2 × 1 marks 	**2**	Allow marks if connections go through terminals 1–4, 2–5 etc. No marks for joining all contacts together or for both contacts to one terminal One terminal connected correctly e.g. 1 and 3, 1 mark
10(a)(iv)	Common terminals are **2** and **5**, 2 × 1 marks	**2**	
10(b)(i)	Reasons for a relay could be: • To allow different voltages on motor and control circuit • To allow higher current in motor circuit • To isolate control and motor circuit 2 × 1 marks for valid reasons	**2**	
10(b)(ii)	Explanation to include, prevention of back emf, to protect the transistor	**2**	Both points required for 2 marks
10(b)(iii)	Explanation to include: Voltage in base / emitter circuit is used to switch the transistor on [1] The collector / emitter circuit will then start to conduct [1] Current in collector / emitter circuit is depends on the gain of the transistor [1]	**3**	All three points to be included for 3 marks. Two points – 2 marks One point – 1 mark
10(b)(iv)	Current = 100/12 [1] = **8.3A** [1]. 2 × 1 marks	**2**	
10(b)(v)	Suitable relay is **SPDT 10A 6V coil** [1]	**1**	
10(b)(vi)	Component **Y** is a fuse [1]	**1**	

Question	Answer	Marks	Guidance
10(c)(i)	1 mark for each correct  	**3**	Allow different arrangement of tracks if correct and functional
10(c)(ii)	Reasons for using a terminal block will include: • Ease of connecting / disconnecting • Less strain on the battery wires, no breaks at soldered joint • Larger wired can be used • No heat involved in changing wires / switch	**2**	Explanation with two clear points made, 2 marks, allow 2 marks for one well explained point One point made, 1 mark
	Total:	**25**	