OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY: ELECTRONICS AND CONTROL SYSTEMS **J301**

A515/03 Sustainability and technical aspects of designing and making_Mechanisms

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions in Section A **and** Section B.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.
- Do not write in Bar Codes.
- Show all working out for calculations.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with an asterisk (*).
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- Dimensions are in millimetres unless stated otherwise.
- The total number of marks for this paper is **80**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**1**	
2	**1**	
3	**1**	
4	**1**	
5	**1**	
6	**1**	
7	**1**	
8	**1**	
9	**1**	
10	**1**	
11	**1**	
12	**1**	
13	**1**	
14	**1**	
15	**1**	
16	**20**	
17	**15**	
18	**15**	
19	**15**	
TOTAL	**80**	

Section A

Answer **all** questions

On questions 1 – 5 circle your answer

1 If a product is said to have a large carbon footprint, does it:

(a) Leave large black marks on a carpet

(b) Need special care when transporting it

(c) Produce a significant amount of carbon dioxide during its manufacture or use

(d) Only fit into large recycling bins **[1]**

2 What information does this symbol tell the consumer about the product?

(a) Product won't tip over

(b) It is made of polystyrene

(c) It is repairable

(d) It is person safe **[1]**

3 Solar power devices are fitted to houses to:

(a) Save water

(b) Stop draughts

(c) Make houseplants grow

(d) Reduce energy costs **[1]**

4 A biomass boiler burns which of the following to produce energy:

(a) Plant and wood-derived pellets or shavings

(b) Coal

(c) Crude Oil

(d) Natural Gas **[1]**

5 When a re-chargeable battery is discharged, you should:

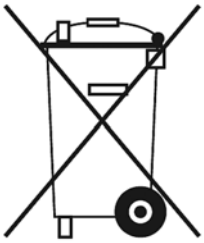
(a) Return it

(b) Reverse it

(c) Complain to the manufacturer

(d) Recharge it **[1]**

6 State what is meant by the symbol shown below:



.....**[1]**

7 State the name of one green source of energy.

.....**[1]**

8 State why the use of recycled paper is a good idea.

.....**[1]**

9 State why plumbers are required to use lead-free solder for connecting domestic water pipes.

.....**[1]**

10 State the term that describes the design of an electronic product to ensure the comfort of its user.

.....**[1]**

Decide whether each of the following statements is **true** or **false**.

Tick (✓) the box to show your answer.

		True	False	
11	An energy saving light bulb is easier to switch on than a filament bulb	☐	☐	**[1]**
12	A “sweatshop” is somewhere with poor working conditions	☐	☐	**[1]**
13	Recycling is an initiative to promote bicycle sharing	☐	☐	**[1]**
14	Car sharing decreases overall carbon emissions	☐	☐	**[1]**
15	The Forest Stewardship Council encourages using sustainable forest products	☐	☐	**[1]**

16 **Fig. 1** shows an assembled solar powered lamp**.**

Fig. 1

(a) The solar powered lamp is packaged in a box made of recycled cardboard.

(i) State why this is considered good environmental practice.

.....**[1]**

(ii) The manufacturer has printed assembly instructions showing how to assemble the lamp on the outside of the box.

State which of the 6Rs this illustrates.

.....**[1]**

(iii) State **one** benefit of printing the assembly instructions on the outside of the box.

.....**[1]**

(b) The solar powered lamp contains a Ni-Cad cell.

(i) State how a worn out Ni-Cad cell should be disposed of.

.....**[1]**

(ii) If the worn out cell was replaced, state which of the 6Rs would have been fulfilled.

.....**[1]**

(iii) Since 2008 an EU directive has banned all manufacturers/distributors from importing Ni-Cad batteries into Europe.

Give **one** reason why this legislation has been introduced.

.....**[1]**

(c) The WEEE Directive aims to both reduce the amount of electrical and electronic equipment being produced and to encourage everyone to reuse, recycle and repair it.

Look at Fig. 2a and 2b and explain how the designer has made the solar powered lamp WEEE compliant.

Fig. 2a

Fig. 2b

.....

.....

.....

..... **[3]**

(d) (i) Fig. 3 shows a solar torch built using the components from a solar powered lamp.

Fig. 3

State which of the 6Rs the designer of this product has applied.

..... **[1]**

(ii) Although fully functional, the solar torch in Fig. 3 lacks user appeal.

Use sketches and notes to show an improved version of the torch below.

[4]

(e)* Fig. 4 shows a wind farm that contains over a hundred wind turbines.

Fig. 4

Discuss the impact a large on-shore or off-shore wind farm could have on our needs for power and how it might affect the environment.

Marks will be awarded for the quality of written communication in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....**[6]**

Section B

Answer **all** questions

17 Fig. 5a shows a cam demonstration unit designed for use in a school workshop.

The three cam shapes used in the model are shown in Fig. 5b.

The demonstration unit is hand operated by turning handle **X**.

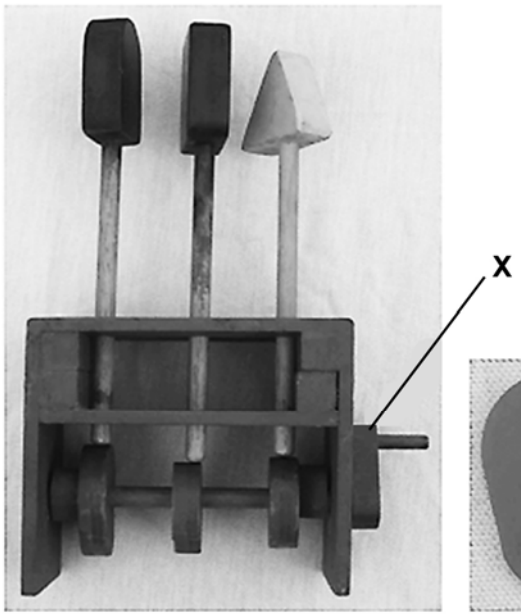


Fig. 5a

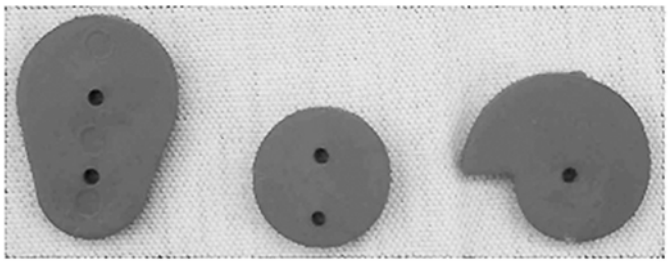


Fig. 5b

(a) (i) Name the conversion of motion that takes place when handle X is turned.

.....motion to .....motion. **[2]**

(ii) Name the mechanism used to operate the demonstration unit.

..... **[1]**

(b) State the technical name of the vertical rods that rest on each cam.

..... **[1]**

(c) The operator finds that the unit will only turn in one direction. State the reason why.

.....

..... **[1]**

(d) **(i)** The cam demonstration unit uses three different cam profiles as listed below.

Match the name of the cam to the type of motion they produce.

pear-shaped cam **eccentric cam** **snail cam**

The ..... cam produces a sudden rise and fall.

The ..... cam produces a steady rise and fall.

The ..... cam produces a slow rise and a sudden fall. **[3]**

(ii) On Fig. 5b mark the direction of rotation of the cam that produces a sudden rise and fall. **[1]**

(e) Fig. 6 shows a toy made by a pupil. When the handle is turned the bird rotates.

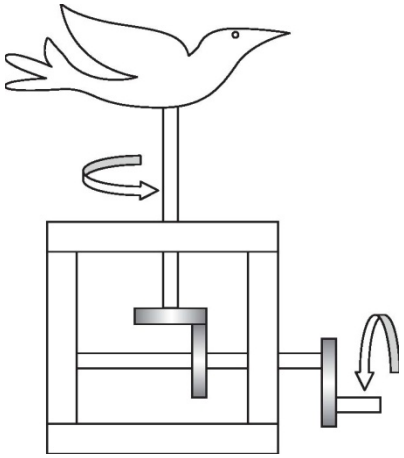


Fig. 6

In the space below draw a modification to the toy that would cause the bird to move up and down in addition to the rotary motion it currently performs.

[3]

(f) In use, the drive that makes the bird rotate slips.

Describe how this could be prevented.

.....

..... **[1]**

(g) In the space below draw a cam profile that will cause a slow rise and fall three times per revolution.

[2]

18 Fig. 7 shows a mechanism used to join two shafts together.

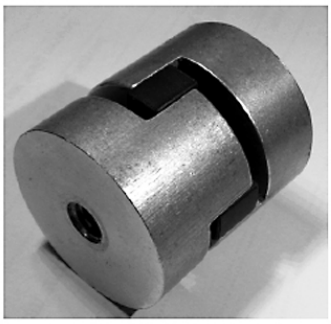


Fig. 7

(a) (i) Describe the purpose of the mechanism shown in Fig. 7.

.....

.....

..... **[2]**

(ii) Use sketches and notes to show an alternative mechanism for joining two shafts together.

[3]

(b) Fig. 8 shows a drum, motor and drive belt assembly in a tumble dryer.

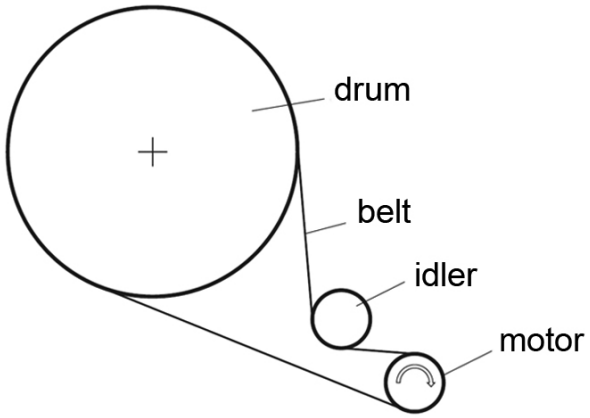


Fig. 8

In use the belt would wear and require a tensioning device.

Draw on Fig. 8 the best position for a belt tensioning device. **[1]**

(c) Belt tensioning systems are often spring-loaded and fully automatic.

Give **two** benefits of automatic belt tensioning systems.

1.....

2..... **[2]**

(d) State the purpose of the idler pulley shown in Fig. 8.

..... **[1]**

(e) Fig. 9 shows the section of a poly-vee belt.

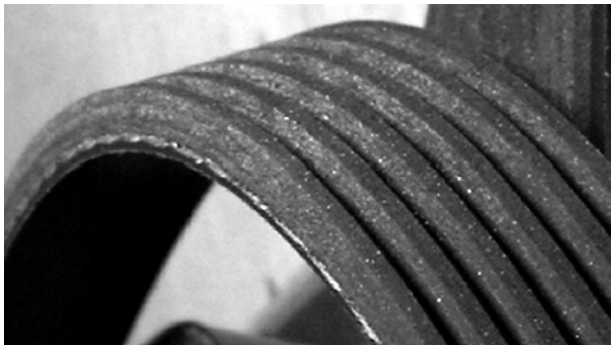


Fig. 9

Poly-vee belts are often used in preference to vee-belts.

Give **two** reasons, other than cost, why poly-vee belts are used.

1.....

2..... **[2]**

(f) Fig. 10 shows a clutch plate used in a car.

Fig. 10

Label the clutch plate friction material on Fig. 10. **[1]**

(g) Fig. 11 shows an enlarged view of part of the clutch plate shown in Fig. 10.

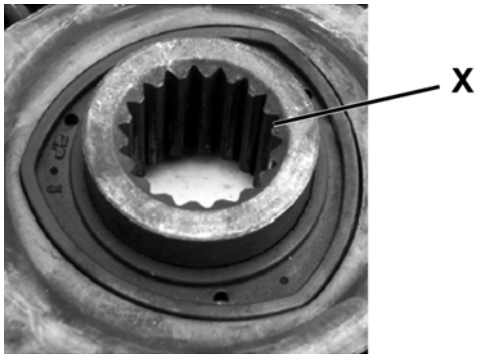


Fig. 11

(i) Name the engineering feature **X** shown in Fig. 11.

.....**[1]**

(ii) Explain what the engineering feature shown in Fig. 11 allows the clutch plate to do.

.....

.....

.....**[2]**

19 Fig. 12 shows the basis of a water pumping system.

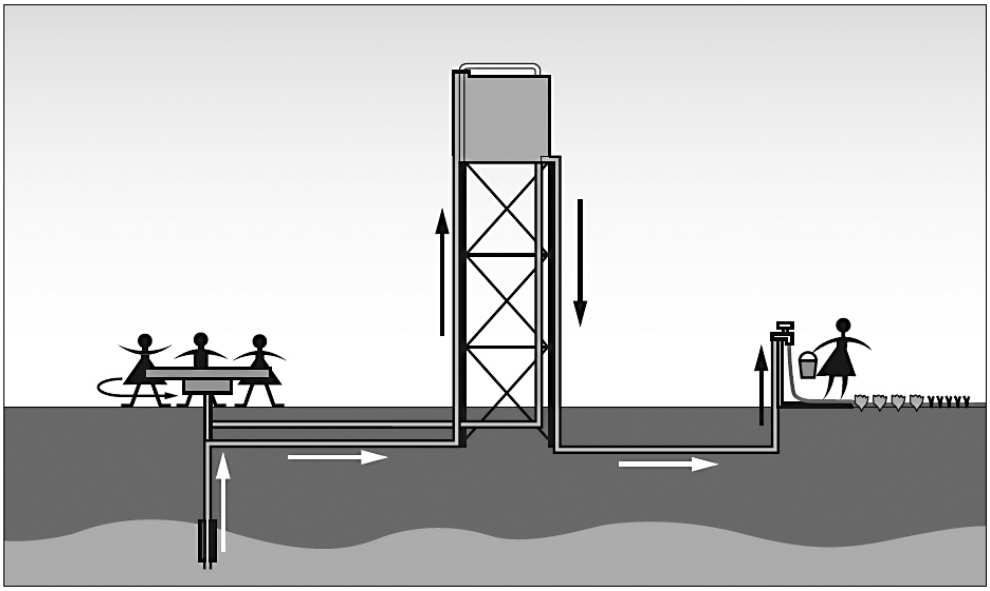


Fig. 12

PlayPumps International is an organisation that has funded and donated more than 1,200 PlayPump ®™ systems in Africa. It provides the benefits of clean drinking water to millions.

While children have fun spinning on the PlayPump ®™ merry-go-round, clean water is pumped from underground into a tank. A tap is used to fill buckets with water.

(a) The whole product is shipped partly assembled. When the steel tower arrives it requires several different parts to be joined together without access to welding processes.

(i) Name a suitable temporary fixing for use in assembling the steel tower.

..... **[1]**

(ii) State a suitable process that would help prevent corrosion of the steel tower.

..... **[1]**

(b) **(i)** Name a suitable material for a plain bearing that could be used on the vertical axle of the merry-go-round.

..... **[1]**

(ii) Give **two** reasons why a sealed ball bearing system would be more suitable than a plain bearing.

1 .....

2 ..... **[2]**

(c) Waterwheels are often used in areas of high rainfall. They are powerful but turn slowly.

Show on Fig. 13 below, a mechanism that will change rotary motion from the waterwheel shaft into reciprocating motion to operate the bellows that blow air for the blacksmiths forge.

The bellows require a maximum stroke of 300 mm.

Name and dimension key parts of your design.

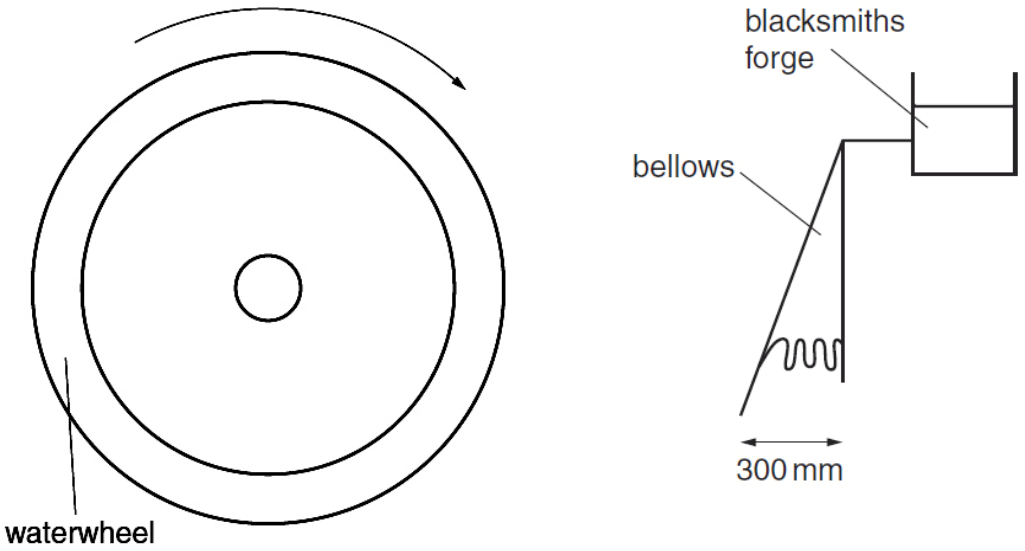


Fig.13

[4]

(d)* The PlayPump ®™ merry-go-round shown in Fig. 12 is a multi-purpose mechanism.

Discuss the factors that would have been considered in the design of the PlayPump ®™ merry-go-round.
Marks will be awarded for the quality of written communication in your answer.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... **[6]**

END OF QUESTION PAPER

OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Sample Assessment Material

DESIGN AND TECHNOLOGY: MECHANISMS

A515/03 Sustainability and technical aspects of designing and making_Mechanisms

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 80

DRAFT

This document consists of 12 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

TRADITIONAL

Before the Standardisation meeting you must mark at least 10 scripts from several centres. For this preliminary marking you should use **pencil** and follow the **mark scheme**. Bring these **marked scripts** to the meeting.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the scoris messaging system, or by email.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in anyway relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question

   Note: Award 0 marks - for an attempt that earns no credit (including copying out the question)

8. The scoris **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:
    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

Section A

Question			Answer	Marks	Guidance
1			(c) Produce a significant amount of carbon dioxide during its manufacture or use	1	
2			(b) It is made of polystyrene	1	
3			(d) Reduce energy costs	1	
4			(a) Plant and wood-derived pellets or shavings	1	
5			(d) Recharge it	1	
6			Item should not be placed in (domestic waste) bin, not intended for landfill,	1	Reason stated. Not ‘recycle’,
7			Wind, wave, hydro-electric, solar (voltaic or heat), geothermal, tidal,	1	Not water alone,
8			Means that trees are not used to produce new product,	1	
9			Lead is poisonous / harmful to humans / a cumulative poison /hazardous.	1	Do not accept ‘dangerous’.
10			Ergonomics or anthropometrics.	1	No variations.
11			False	1	
12			True	1	
13			False	1	
14			True	1	
15			True	1	
			Total	15	

Question			Answer	Marks	Guidance
16	(a)	(i)	Does not use any trees or new material or saves energy in making, no need to make new cardboard.	1	Not 'can be recycled'.
		(ii)	Reduce or Rethink.	1	
		(iii)	Any two of: uses less materials/paper in making product, potential purchaser can see if it is within their capabilities, less space needed in box, so transport costs are reduced, will user be able to assemble, less likely to lose instructions.	1	
	(b)	(i)	Taken to a battery bank / "batteryback" container / battery container / back to shop where bought / council waste facility for 'recycling'.	1	Not 'recycling' alone.
		(ii)	Repair, do not allow reuse.	1	
		(iii)	To help stop cadmium from non-recycled cells entering landfill sites, cadmium is poison/harmful to life.	1	Needs to focus on poison, toxic to Environment /human.
	(c)		Max three marks for an accurate explanation: Points relating to how the object can be reduced to its component parts (1) quickly and easily without recourse to tools (1) so that they can be re-used or recycled (1) especially removal of circuitry and/or cell (1) and separation of plastic parts from each other/circuitry (1). No tools required in this case to repair circuit or replace cell (1)	3	Repair, reuse and recycle ONLY if justified or explained.
	(d)	(i)	Reuse, do not allow repair.	1	
		(ii)	Sketches and notes, ergonomic shape and/or grip/switch placement/type or modification e.g. slide switch, slimmer / longer / rounder shape to suit the human hand, carrying strap, more aesthetically pleasing . Features or features and justification, internal circuitry or additional functions. 4x1 or 2x2.	4	Must IMPROVE aspects of the existing boxy design / red / white only. Watch for duplicate sketch and description.

Question			Answer	Marks	Guidance	
					Content	**Levels of response**
	(e)*		Answers should have information showing some relevant knowledge of likely impact wind farms could have on the UK: • realistic figures for % contribution (1-20%), • possible locations, not just 'hilly' or 'windy' places" • Impact on environment should mention visual, wildlife hazard, migrating birds, noise of blades, visual disturbance strobe effect, loss of visual amenity for residents • NIMBYism / NOMFDS, • benefits of offshore/onshore, • large amounts of concrete needed, • capital cost, • offset consumption of fossil fuel, • less CO2 emission.	**6**	Relevant points need justification.	**Level 3 (5-6 marks)** Thorough discussion, showing a clear understanding of the likely impact wind farms could have on the UK. There will be three or 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. **Level 2 (3-4 marks)** Adequate discussion, showing an understanding of the likely impact wind farms could have on the UK. 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 1 (1-2 marks)** Basic discussion, showing some understanding of the likely impact wind farms could have on the UK. 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. 0 marks = no response or no response worthy of credit
			Total	**20**		

Section B

Question			Answer	Marks	Guidance
17	(a)	(i)	**Rotary** motion to **reciprocating** motion, 1 mark for each term correct.	2	
		(ii)	Crank or crank handle.	1	NOT 'handle' or 'winder'.
	(b)		Cam Followers, Follower,	1	Allow pushrod(s).
	(c)		Snail cam will only rotate in one direction.	1	
	(d)	(i)	Pear shaped – sudden rise and fall. Circular cam – steady rise and fall. Snail cam – slow rise and sudden fall.	3	
		(ii)	Clockwise arrow on snail cam, 1 mark.	1	
	(e)		Drawing, sketches and notes that explain and show either a eccentric or pear shaped cam on axle or an angled swash plate on the bottom of the bird pole follower.	3	(1) for cam shape, (1) suitable location, (1) could action work (all as described and/or drawn).
	(f)		By adding a rubber or similar high-grip covering, or sand/glass/abrasive material/paper that improves grip/friction between the two surfaces.	1	
	(g)		2 marks for a tri-lobed cam with a centre marked, 1 mark for just triangular or tri-lobed equivalent that could function.	2	
			Total	15	

Question			Answer	Marks	Guidance
18	(a)	(i)	Allows rotation/rotary motion to be transmitted at a slight angle, (1) allows for errors in axial alignment.(1)	2	Enables/allows drive to be engaged /disengaged, (1) if it is a dog clutch. (1)
		(ii)	Recognised method of coupling used. (1) Detail shown on both parts of coupling. (1) Method of fastening parts together shown. (1)	3	
	(b)		A pulley/arrow/indication drawn touching the free bottom section of belt between motor and drum.	1	
	(c)		Any two benefits, one mark each: self adjusting, increases maintenance intervals, maintenance free (no checks required), takes up wear for you, always at the correct tension, should not slip, less worry, lower running/maintenance costs.	2	
	(d)		To increase the belt contact area / improve belt warp-around / improve grip / more grip of belt.	1	
	(e)		Any two reasons, one mark each: Improved service life, better power transmission / higher power transmission, 1 belt does all (drives more than one application - serpentine), compact solution (allowing a shorter engine), less energy wasted flexing belt / more efficient than v-belt.	2	Do not allow ‘does not stretch’ or similar.
	(f)		Arrow / line / indication pointing to any part of the outer ring of friction material.	1	
	(g)	(i)	Spline.	1	Name of part must be ‘spline’.
		(ii)	Transmit drive or similar (1) whilst being able to move along a shaft (to allow for wear or release of clutch pressure). (1)	2	Allow mark for correct functional description.
			Total	15	

Question			Answer	Marks	Guidance
19	(a)	(i)	Nuts and bolts of some description.	1	Head shape not required nor mention of washer or self-locking capability, Do not allow welding or any permanent method.
		(ii)	Galvanising, plating (eg BZP bright zinc plating), painting.	1	Do not allow Cadmium plating.
	(b)	(i)	Suitable material for plain bearing is phosphor bronze, brass, white metal, nylon.	1	Do not allow steel.
		(ii)	Any two reasons, one mark each: • less maintenance • no lubrication required • better load carrying capacity • longer lasting.	2	
	(c)		Connecting rod attached to bottom left side of bellows. (1) Connecting rod linked to waterwheel with slight offset from centre. (1) Indication that connecting rod/crank offset is 150 mm from centre of wheel. (1) Bearing or flexible joint at one or both ends of connecting rod. (1)	4	Alternative mechanisms that could work (assumption of spring in bellows allowed for return) can score up to full marks, e.g. cam. Separate drawing of mechanisms score 0.

Question			Answer	Marks	Guidance	
					Content	**Levels of response**
	(d)*		Discussion based around design requirements – • size/gender of different children, • height from ground, • seating, • something to hold / grip size • smooth surfaces painted to Attract people / prevent corrosion • construction methods / rugged • long-lasting, • other system related design considerations on merit. • safety issues such as limb damage on or under the roundabout are valid.	**6**		**Level 3 (5-6 marks)** Thorough discussion, showing clear understanding of issues involved designing for human usage (ergonomics and anthropometrics) with consideration of manufacturing methods and protection from corrosion. There will be three or 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. **Level 2 (3-4 marks)** Adequate discussion, showing an understanding of the issues involved designing for human usage (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. **Level 1 (1-2 marks)** Basic discussion, showing some understanding of design requirements. 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. 0 marks = no response or no response worthy of credit
			Total	**15**		

	Assessment Objective Grid			
GCSE Design & Technology: Mechanisms				
		Recall, select and communicate	Apply knowledge, understanding and skills	Analyse and evaluate	
Question		A01	A02	A03	Mark
1		1			**1**
2		1			**1**
3		1			**1**
4		1			**1**
5		1			**1**
6		1			**1**
7		1			**1**
8		1			**1**
9		1			**1**
10		1			**1**
11		1			**1**
12		1			**1**
13		1			**1**
14		1			**1**
15		1			**1**
16ai			1		**1**
16aii			1		**1**
16 aiii				1	**1**
16 bi		1			**1**
16 bii			1		**1**
16 biii			1		**1**
16 c			1	2	**3**
16 di			1		**1**
16 dii			3	1	**4**
16 e*		2	3	1	**6**
17 ai		2			**2**
17 aii		1			**1**
17 b		1			**1**
17 c			1		**1**
17 di		3			**3**
17 dii		1			**1**
17 e		2		1	**3**
17f		1			**1**
17g		1		1	**2**
18 ai		2			**2**
18 aii		1		2	**3**
18 b		1			**1**
18 c		2			**2**
18 d		1			**1**
18 e		2			**2**

18 f		1			**1**
18 gi		1			**1**
18 gii		2			**2**
19 ai		1			**1**
19 aii		1			**1**
19 bi		1			**1**
19 bii		2			**2**
19 c		2		2	**4**
19 d		2	1	3	**6**
Total		**52**	**14**	**14**	**80**