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Mark Scheme (Results)
Summer 2007

GCSE

GCSE Design and Technology: Systems & Control (Mechanisms) Higher Tier (1974)

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Marking Guidance

Give / State / Name
Normally a one or two word answer, at the very most a short sentence.

Describe
Normally, one or two sentences which form a description, making reference to more than one point. All points must be linked for a complete answer.

Explain
Normally, one or two sentences which form an explanation. This requires a clear or detailed account of something and includes a relevant justification, reason or example.

Evaluate
Normally one or two sentences where the quality, suitability or value of something is judged. This can include both positive and negative points, with each point normally requiring a relevant justification.

The mark scheme contains a range of possible answers for all questions. For some questions it is possible to provide a finite number of acceptable answers. However, in some instances it is not possible to provide every conceivable answer. In these instances objective guidance is provided.

For all answers candidates are not expected to give the exact wording contained in this mark scheme. However, to gain credit their answer must demonstrate the same meaning as detailed in the mark scheme.

It is the examiner's responsibility to apply their professional judgement in determining if what the candidate has written has the same meaning as the answer detailed in the mark scheme. For all answers the *'Key words'* have been written in bold text.

For describe and explain questions, candidates may give a different combination of the marking points listed in the mark scheme. In such instances candidates can be rewarded for the marking points provided that they are suitably linked. However, candidates cannot be rewarded for the same point repeated in two different combinations.

Examiners must mark in red pen using ticks and crosses in the body of the script.

Design & Technology: Systems & Control (Mechanisms) (1974/3H)
Full Course Higher Tier Mark Scheme

Question Number	Question		
1974_3H_Q01a	**The drawing below shows a folding bicycle and its carrying bag. It is used by people who need to take a bicycle on trains and buses.** **Two specification points for the folding bicycle are that it must** • **stop efficiently** • **reduce in size to fit in a carrying bag** **Under each of the following headings, give <u>one</u> more point which should be included in the specification for the folding bicycle. For each point, give <u>one</u> reason why it should be included.**		
	Answer	Part Mark	Total Mark
	Three specification points given: **Three** reasons given: **It is essential that the points and reasons both fully relate to market, environment and quality.** *(Do not accept repetition of the specification points given)* **<u>Market</u>** **Point**: appropriate ergonomics **Reason**: to suit 95 percentile **Point**: hold bag/box/case **Reason**: consumer convenience and expectation **Point**: modern/high tech. aesthetic **Reason**: to be attractive to consumers **Point**: needs to be cost effective (cheap) **Reason**: so more people will buy them	**3x1** **3x1**	**(6)**

Point: needs to be light
Reason: so they can be carried onto a train/bus/in work

Environment
Point: a 'green' product – manual power
Reason: no emissions

Point: recyclable materials
Reason: reduce use of raw materials and energy in conversion

Point: reduced road congestion
Reason: alternative mode of transport

Quality
Point: folding frame
Reason: takes up little space on mass transport

Point: welded alloy structure
Reason: strong and durable structure

Point: no sharp edges
Reason: safety in use

Point: needs to be durable
Reason: reliable to get to work

Point: must have a weatherproof finish
Reason: to prevent rust

Point: bag must be strong
Reason: does not break open whilst carrying

Point: hinges need tot be robust/strong/reliable
Reason: so bike does not fold when it is used

Some flexibility should be given as some points may cross over descriptions.

Question Number	Question		
1974_3H_Q01b	**The folding bicycle frame is made from an aluminium alloy.** **One reason for the use of aluminium alloy is its good strength to weight ratio.** **Give <u>two</u> other reasons why aluminium alloy is a suitable material for the frame.**		
	Answer	Part Mark	Total Mark
	Two reasons **given** from: • low levels of corrosion • easy to machine/cut/join • needs no finishing • attractive appearance when polished / aesthetic • can be easily plated/sprayed/polishes • lightweight	**2x1**	**(2)**
Question Number	Question		
1974_3H_Q01c	**A bearing is used on the wheel axle.** **Give <u>two</u> reasons for using a bearing on the wheel axle.**		
	Answer	Part Mark	Total Mark
	Two reasons **given** from: • reduces friction / allows wheels to turn / easier to move • gives a smoother ride • increases efficiency • reduces wear/prolongs life	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q01d	**The mudguards of the folding bicycle are made of a thermoplastic.** **Give <u>two</u> properties of a thermoplastic that make it a suitable material for the mudguards.** **For each property give <u>one</u> reason why it makes a thermoplastic suitable.**		
	Answer	Part Mark	Total Mark
	Two properties with reasons **given** from: **Property**: self coloured **Reason**: range of colours can be achieved **Property**: durable/tough/elastic/flexible **Reason**: long chain molecule structured plastic **Property**: plasticity **Reason**: easily moulded **Property**: low melting point **Reason**: chemical/molecular structure **Property**: self finishing **Reason**: chemical/molecular structure	**2x1** **2x1**	**(4)**
Question Number	Question		
1974_3H_Q01e	**The reflector on the rear mudguard is made from red coloured plastic.** **Explain <u>one</u> reason why the reflector is coloured red.**		
	Answer	Part Mark	Total Mark
	One reason **explained** from: • red is **internationally** recognised as the colour for **warning** signage • red reflective covers are **used on all road going vehicles to indicate that it is the rear of the vehicle** so that you can **show caution as you approach**	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q01f	**A chain and sprocket system is used to transfer motion from the pedals to the rear wheel. The chain must be kept lubricated.** **Explain <u>one</u> reason why the chain must be kept lubricated.**		
	Answer	Part Mark	Total Mark
	One reason **explained** from: • to **make the bicycle efficient** because lubrication **reduces friction** • to **make the chain last longer** because lubrication **reduces wear / stops rusting**	**2x1**	**(2)**
Question Number	Question		
1974_3H_Q01g	**Two purposes of the folding bike are that it must:** • **stop efficiently** • **reduce in size to fit in a carrying bag** **Explain under the following headings, how the folding bike achieves these purposes.**		
	Answer	Part Mark	Total Mark
	One reason explained from: **Stop efficiently** • a **small input force from the lever** results in a **large force being applied to the wheel** • the **friction between the rubber block and the wheel is high** therefore the **bicycle slows quickly**	**2x1**	**(2)**
	One reason explained from: **Reduce in size to fit in a carrying bag** • **small diameter wheels** reduces the overall size of the product once folded down **allowing it to fold away into the bag** • **frame folds down into a smaller section** which means it is **more compact** • **saddle post drops down through the column** which **allows it to fold away into the bag** • **handle bars and steering tube collapse/fold** which makes it **easier/smaller to fit into the bag**	**2x1**	**(2)**
			Total 22 marks

Question Number	Question		
1974_3H_Q02ai	**The drawing below shows a rowing exercise machine.** **The casing is made from sheet steel.** **Name <u>two</u> finishing processes that can be applied to sheet steel.**		
	Answer	Part Mark	Total Mark
	Two finishes **named** from: • painting/hammeriting • dipping • coating • plating • galvanizing • lacquering • epoxy	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q02aii	**The sheet steel casing is joined together using rivets.** **Give <u>two</u> advantages of using rivets to join the sheet steel.**		
	Answer	Part Mark	Total Mark
	Two advantages **given** from: • simple and effective permanent fixing • lends itself to automated construction • strong • cost effective	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q02b	**The casing can also be made from a carbon fibre composite.** **Give <u>one</u> reason for suing a carbon fibre composite.**		
	Answer	Part Mark	Total Mark
	One reason **given** from: • improved tensile strength • improved strength when subject to bending • improved strength to weight ratio • improved impact resistance • durable • does not corrode	**1**	**(1)**
Question Number	Question		
1974_3H_Q02c	**The individual components of the exercise machine must be made to a tolerance.** **Explain what is meant by the term <u>tolerance</u>.**		
	Answer	Part Mark	Total Mark
	One explanation **given** from: • the **amount of dimensional allowance/variation** of a specific part to **within a predetermined size** • the **amount of imperfection that can be allowed** of a dimensioned part that **makes it acceptable or not**	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q02d	**The manufacturer is developing a prototype for a new exercise machine.** **Describe <u>two</u> ways in which the manufacturer could use ICT to help develop a prototype.**		
	Answer	Part Mark	Total Mark
	Two ways **described** from: • **internet research** into **materials/components** • **internet research** into competitors **comparative products** • sourcing **clipart/design images** and **to use as stimulus material** • **searching databases** to gain **information about new materials** • **CAD modelling** to see what the **prototype will look like** • **CAD modelling** to simulate **stress/strain on various parts** • **rapid prototyping** to produce **very quick 3D representations**	**2x1** **2x1**	**(4)**
Question Number	Question		
1974_3H_Q02e	**Computer integrated manufacturing (CIM) is used in the manufacture of the exercise machine.** **Give <u>three</u> advantages to the manufacturer of using CIM.**		
	Answer	Part Mark	Total Mark
	Three advantages **given** from: • flexibility of manufacture (FMS) • speed of response to market demands/changes • manufactured component accuracy • speed of manufacture • lower labour costs • repeatability of quality • ease of quality assurance • global manufacturing	**3x1**	**(3)**

Question Number	Question		
1974_3H_Q02f	**Stock control of products can reduce the manufacturer's costs.** **Describe <u>one</u> way in which ICT can be used in stock control to reduce the manufacturer's costs.**		
	Answer	Part Mark	Total Mark
	One description from: • **sales are automatically recorded** on a central system which means a **stock count is kept up to date** • once a certain stock level is reached **replacement orders can be automatically sent** to the manufacturers which means that **stock levels can be easily maintained**	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q02g	**ICT can be used to simulate the production and assembly lines used to make products such as the exercise machine.** **Describe <u>one</u> way in which computers can be used to simulate a production or assembly line.**		
	Answer	Part Mark	Total Mark
	One description from: • **virtual** production lines with **programmable variables** allowing events to be changed • **computer controlled scale models** of assembly modules allows the **manufacture to see how the production line/space should be optimised**	**2x1**	**(2)**

Question Number	Question		
1974_3H_Q02h	**3D 'virtual' products are often created on screen before new products are made.** **Explain <u>two</u> advantages to a manufacturer of creating 3D 'virtual' products on screen before new products are made.**		
	Answer	Part Mark	Total Mark
	Two advantages **explained**: • **cost effective** when compared to **making prototypes** • designs can be **interrogated** without actually **making a prototype** • **rapid changes** to the design can be achieved compared to **conventional methods**; colour schemes, sizes and finishes being easily viewed and amended. • virtual designs can be **sent instantly electronically** compared to manufactured prototypes which would need sending by **transport systems**	**2x1** **2x1**	**(4)**
			Total 22 marks

Question Number	Question			
1974_3H_Q03a	**A company is designing a transport system to move a television (TV) within a school or college.** **The specification for the swimmers' training system is that it must:** • **provide a platform for the TV which is adjustable in height** • **hold the TV securely** • **have wheels that are held securely on the axle and allow steering** • **be made from materials and processes that are suitable for high volume production** **In the spaces opposite, use sketches and, where necessary, brief notes to show <u>two different</u> designs idea for the swimmers' training system that meet this specification.**			
	Answer		Part Mark	Total Mark
	Design idea 1 Each point of the specification has two marking points. 1 mark should be awarded for evidence of each point of the specification resolved in the design. Where an answer does not viably answer a specification point	0 marks		
	For each specification point with only one element viably satisfied	1 mark		
	For each specification point with both elements viably satisfied	2 marks		
	Candidates may answer any specification point in either graphical form or by annotation. **No marks are awarded for the quality of communication.** Each specification resolved in design: Must provide a platform for the TV which is adjustable in height • **Evidence given** of a platform for the TV; Large flat area / frame		**1**	
	• **Evidence given** of adjustable in height; Hydraulic system/screw thread/holes to slip pins through		**1**	

Hold the TV securely

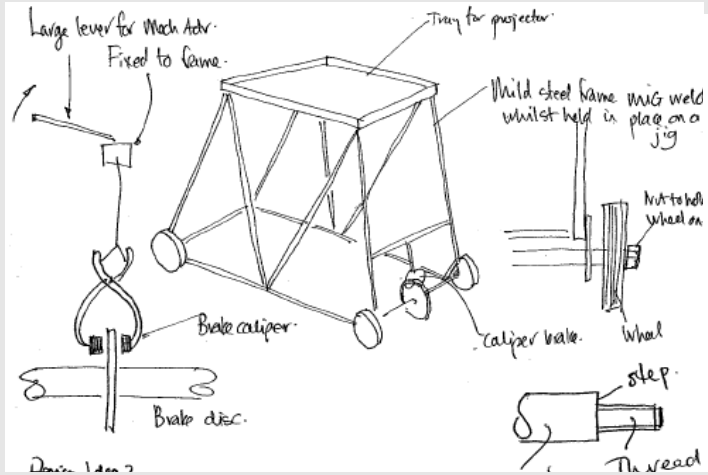
- **Evidence given** of holding the TV; **1**
  Flat area
- **Evidence given** of securely; **1**
  Rim/lip/straps/hinged flap

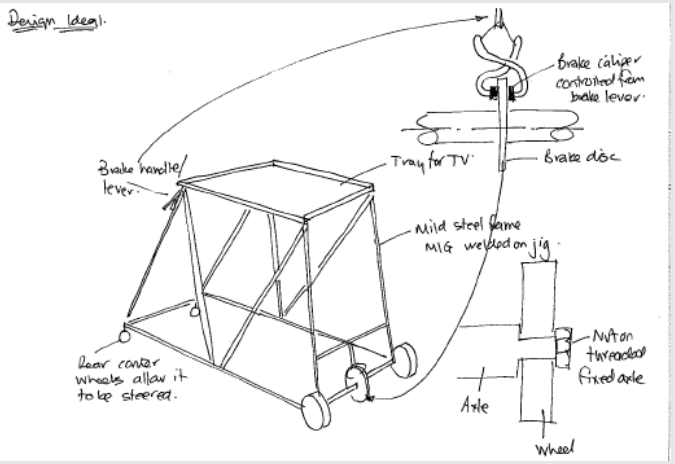
Have wheels that are held securely on the axle and allow steering

- **Evidence given** wheels that are held securely on the axle; **1**
  Nuts/split pins/grub screws/key & keyway
- **Evidence given** allow steering; **1**
  Castors/steering rack

Be made from materials and processes that are suitable for high volume production.

- **Evidence given that** materials are suitable for high volume production **1**
  Specific material named
- **Evidence given that** processes are suitable for high volume production; **1** **(8)**
  Specific process named

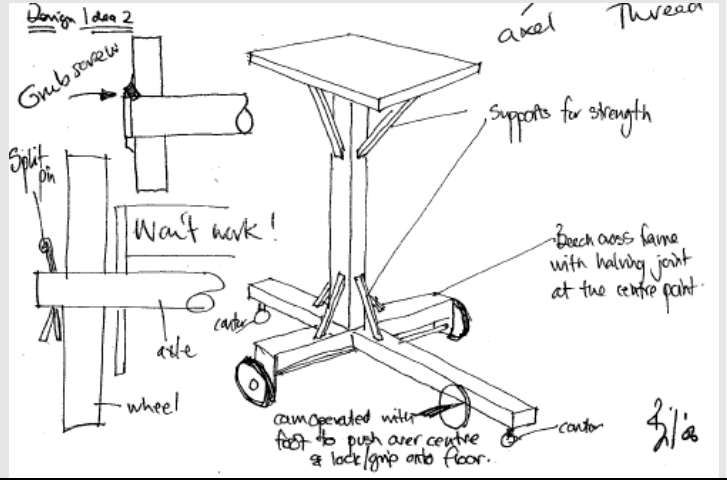


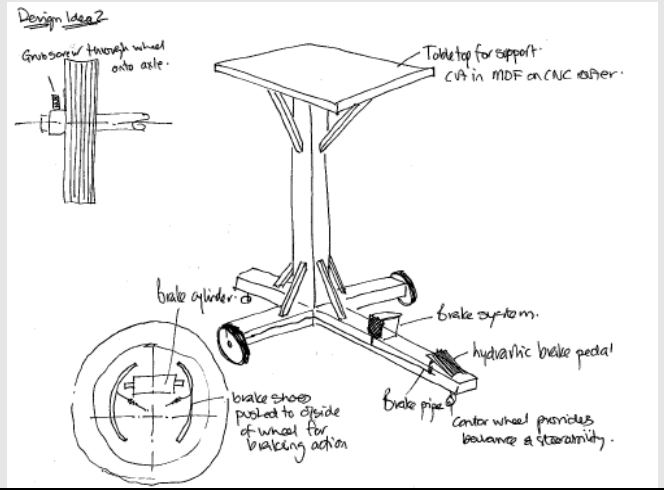


Design idea 2

To score a mark for Design Idea 2, each specification point must be resolved again in the second design idea but the second design **must be technically/conceptually different in design and construction** from the first to score a mark.
Use exactly the same criteria as design idea1 to mark design idea 2.

A different method of a platform	**1**	
A different method of adjustable in height	**1**	
A different method of holding the TV	**1**	
A different method of holding the TV securely	**1**	
A different method of wheels that are held securely on the axle	**1**	
A different method of allow steering	**1**	
A different material	**1**	
A different process	**1**	**(8)**





Question Number	Question		
1974_3H_Q03b	**Three of the original specification points are repeated below.** **Evaluate how <u>one</u> of your design ideas succeeds or fails to meet each of these specification points.** **(i) The transport system must provide a platform for the TV which is adjustable in height.** **(ii) The transport system must have wheels that are held securely on the axle and allow steering.** **(iii) The transport system must use materials and processes that are suitable for high volume production.**		
	Answer	Part Mark	Total Mark
	Each point clearly **evaluated**: If a candidate has indicated design Idea 1 and then evaluates design idea 2 for all or part of (i), (ii), & (iii) then the idea in greater evidence should be marked. The evaluation of the design must contain reference to either positive or negative aspects not simply a description of the design. Award 1 mark for a correct evaluation / justification relating to each design feature and how it succeeds or fails. Repetition of original spec scores 0. (i) Evaluation of: a **platform** for the TV which is **adjustable in height** Positive or negative statements relating to: • platform • height adjustment (ii) Evidence of: **hold** the TV **securely** Positive or negative statements relating to: • holding the TV • holding securely (iii) Evidence of: **materials** and **processes** that are suitable for high volume production. Positive or negative statements relating to: • Reference to named material • Reference to named process	**1** **1** **1** **1** **1** **1**	**(6)**
		Total 22 marks	

Question Number	Question		
1974_3H_Q04a	**The drawing below shows part of a drilling machine.** **Name Mechanism A used in the drilling machine to convert rotary motion into linear motion.**		
	Answer	Part Mark	Total Mark
	Rack and pinion *(Only answer, both parts named for 1 mark)*	**1**	**(1)**

Question Number	Question		
1974_3H_Q04bi	**A pulley and belt system is used to transfer the rotary motion from the motor shaft to the drill shaft.** **The type of belt used to do this is shown below.** **Name the type of belt shown above.**		
	Answer	Part Mark	Total Mark
	V belt *(only answer)*	**1**	**(1)**

Question Number	Question		
1974_3H_Q04bii	**Name <u>three</u> other types of belts used with pulleys.**		
	Answer	Part Mark	Total Mark
	Three other belts **named** from: • flat • toothed • linked • round	**3x1**	**(3)**

Question Number	Question		
1974_3H_Q04c	**Explain <u>two</u> advantages of using a pulley and belt system for the drilling machine rather than using a chain and sprocket system.**		
	Answer	Part Mark	Total Mark
	Two advantages **explained**: • **less maintenance** is required since the pulley **does not need any lubrication** • **belt would slip if drill jammed in work, which would be safer** • **easier to replace the belt if it breaks** because it can **simply be slipped over onto the pulleys** • **cheaper than chains and sprockets** because **less is involved in their manufacture** • **quieter in operation** therefore **operator friendly**	**2x1** **2x1**	**(4)**

Question Number	Question		
1974_3H_Q04di-ii	**Details of the pulley and belt system used in a drilling machine are shown below.** **Use the following formula to calculate the velocity ration of the system and the output speed.** **Velocity ratio = <u>driven pulley diameter</u> driver pulley diameter** **Output speed = <u>input speed</u> velocity ratio**		
	Answer	Part Mark	Total Mark
	(i) $^{150}/_{75}$ / 2:1 / Two to one / $^{2}/_{1}$ *(Do not accept 2 on its own)* (ii) $\frac{1200}{2:1}$ = 600 rpm *(If answer is incorrect in (i) apply ECF)*	**1** **1**	**(2)**

Question Number	Question		
1974_3H_Q04e	**Many of the mechanical systems of the drilling machine are produced using CAD/CAM.** **Describe <u>two</u> effects that replacing manual machines with CAD/CAM machines has on workers.**		
	Answer	Part Mark	Total Mark
	Two effects **described** from: • the workers would **become less skilled** resulting in a **lowering of job satisfaction** • the **amount of workers would be reduced** effecting **local employment prospects** • **pay** would be effected and lowered effecting **workers living standards** • manual workers could **lose their jobs** and may have to **move from their community** in order to find work**.** • the **'high tech'** workers needed may have to come from **outside the community** • **loss of jobs** would have a **'Knock on' effect** that could affect the **livelihood** of local traders	**2x1** **2x1**	**(4)**
Question Number	Question		
1974_3H_Q04f	**The manufacturing company wants to promote a more environmentally friendly image by improving its waste management.** **Give <u>three</u> ways in which the environment will benefit from the company improving its waste management.**		
	Answer	Part Mark	Total Mark
	Three ways **given** from: • reducing the need for landfill • reducing the demand of raw materials • reducing the amount of energy consumed in the production of new, raw materials • less noise/pollution from traffic taking waste to land fill sites	**3x1**	**(3)**

Question Number	Question		
1974_3H_Q04g	**Product reliability is important to consumers.** **Explain <u>two</u> benefits to the consumer of product reliability.**		
	Answer	Part Mark	Total Mark
	Two benefits **explained** from: • **greater value for money** because the product **will last and will not need to be replaced** • **increased confidence in the use of the product** because they know that **every time they use the product it will work** • **product will come with a guarantee** which means **any faulty products will be replaced**	**2x1** **2x1**	**(4)**
			Total 22 marks
			TOTAL FOR PAPER: 88 MARKS