# GCSE MARKING SCHEME

**SUMMER 2024**

**GCSE**
**DESIGN AND TECHNOLOGY –**
**ENGINEERING DESIGN**
**3601U10-1**

**About this marking scheme**

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

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**WJEC GCSE DESIGN AND TECHNOLOGY – ENGINEERING DESIGN**

**SUMMER 2024 MARK SCHEME**

## Guidance for examiners

### Positive marking

It should be remembered that learners are writing under examination conditions and credit should be given for what the learner writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme. For questions that are objective or points-based the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

### Banded mark schemes

For band marked questions mark schemes are in two parts, the indicative content and the assessment grid. The indicative content suggests the range of points and issues which may be included in the learner's answers. It can be used to assess the quality of the learner's response. Indicative content is not intended to be exhaustive and learners do not have to include all the indicative content to reach the highest level of the mark scheme. In order to reach the highest level of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is, it contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded. In Design and Technology, each question addresses one assessment objective: either AO3 or AO4. The assessment grid sub-divides the total mark to allocate for a question. These are shown in bands in the mark scheme. For each question, descriptors will indicate the different skills and qualities at the appropriate level. Examiners should first read and place a tick in the learner's answer/s to indicate the evidence that is being assessed in that question; the mark scheme can then be applied. This is done as a two stage process.

### Stage 1 – Deciding on the band

Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptors for that band. If the descriptors at the lowest band are satisfied, examiners should move up to the next band and repeat this process for each band until the descriptors match the answer. If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance, if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content. Examiners should not seek to mark learners down as a result of small omissions in minor areas of an answer.

### Stage 2 – Deciding on the mark

During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner.

Examiners should mark the examples and compare their marks with those of the Principal Examiner. When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

| **Question 1** | | | | |
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| The image below shows a circuit board, manufactured using CNC (Computer Numeric Control). | | **AO3** | **AO4** | **Marks** |
| (a) | Describe **one** disadvantage of using CNC to manufacture a circuit board. | | ✓ | [2] |
| | Answers relating to one disadvantage of CNC circuit board manufacture should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• CNC machines have expensive set up costs.<br>• User requires training to use the software and hardware.<br>• Can be time consuming due to the number of passes needed to remove copper.<br>• The whole of the board is copper- waste issue.<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. The CNC machine needs to pass over the copper several times.<br><br>More detailed description e.g. The CNC machine would pass over the copper several times in order to remove the unwanted materials. Depending on the circuit this could be a slower process than using an etching tank to make a PCB. | | | 0<br><br>1<br><br>2 |
| (b) | Name the **four** CAM (Computer Aided Manufacture machines) shown below. | | ✓ | [4] |
| | Answers relating to naming CAM machines should be awarded up to 4 marks.<br><br>**Guidance for marking:**<br><br>Incorrect/no answer<br><br>3D Printer<br><br>CAMM1 / CNC Vinyl cutter/ Vinyl cutter / Vinyl printer<br><br>CNC Milling machine / PCB engraver<br><br>Laser cutter<br><br>One mark each correct answer. | | | 0<br><br>1<br><br>1<br><br>1<br><br>1 |

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| (c) | Explain **two** advantages of additive CAM manufacture. | | ✓ | [4] |
| | Answers relating to two advantages of additive CAM should be awarded up to 4 marks.<br><br>*Accept other similar answer from below:*<br><br>• Less wastage as the component is built not cut.<br>• Additive manufacture can build complex 3D shapes.<br>• Additive manufacture can build with different densities depending of the level of accuracy required when making parts/model.<br>• Can be used with a range of materials depending on the CAM machine. i.e. plastics, metals.<br>• Parts can be uploaded to build with ease.<br>• Relatively low-level skill needed to use the CAM machine<br>• Parts can be re-built several times over.<br>• Low cost of reels of material<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. Additive manufacture builds parts with less waste.<br><br>More detailed description e.g. Additive manufacture builds parts with less waste as it adds material generally from a reel instead of subtractive manufacture that cuts into already formed materials.<br><br>*Up to two marks for each advantage* | | | 0<br><br>1<br><br>2<br><br>x2 |
| | | | **Total** | **10** |

| Question 2 | | | | |
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| The image below shows a basic Styrofoam concept model of a wireless computer mouse. | | AO3 | AO4 | Marks |
| (a) | Describe **one** advantage of using Styrofoam when making prototype models. | | ✓ | [2] |
| | Answers relating to one advantage of Styrofoam should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Inexpensive material for modelling<br>• Easy to shape and work with hand tools<br>• Melts with ease with hot wire cutter to shape<br>• Enables good quality 3D models<br>• Can be joined together<br>• Good dimensional stability<br>• Can be recycled after use<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Brief description with little detail e.g. Styrofoam is a soft material that is easy to shape with hand tools.<br><br>More detailed description e.g. Styrofoam is a soft material which can be shaped with hand tools and hot wire. It can be made into complex shapes to test the suitability of the model's form, shape and size. | | | 0<br><br>1<br><br>2 |
| (b) | Explain **two** ergonomic considerations when modelling the computer mouse. | | ✓ | [4] |
| | Answers relating to two important ergonomic considerations should be awarded up to 4 marks.<br><br>Accept other similar answer from below:<br><br>• Size of the hand to fit the mouse comfortably<br>• Shape formed by the hand when arched<br>• Length of finger to access front buttons<br>• Access to the scroll wheel<br>• Position of the wrist (does not require support)<br>• Textured scroll wheel<br><br>**Guidance for marking:**<br><br>Incorrect / no answer<br><br>Brief explanation with little detail e.g. The designer must consider the size of the user's hand.<br><br>More detailed explanation e.g. The designer must consider the size of the user's hand. This will enable them to judge whether it fits correctly and with comfort ensuring that no stress or strain to the wrist.<br><br>*Up to two marks for each correct answer* | | | 0<br><br>1<br><br>2<br><br>x2 |

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| (c) | Styrofoam carries the symbol below.<br><br>(i) State which of the 6Rs this symbol represents. | | ✓ | [1] |
| | Answers relating to the 6R's and should be awarded up to 1 mark.<br>**Guidance for marking**<br>Incorrect/no answer<br>Recycling / Recycle | | | <br><br>0<br>1 |
| | (ii) Polymers are often produced using crude oil. Circle the word below that best describes crude oil. | | ✓ | [1] |
| | Answers relating to crude oil should be awarded 1 mark.<br>**Guidance for marking**<br>Incorrect/no answer<br>Non-renewable | | | <br><br>0<br>1 |
| | (iii) Manufacturers are moving away from oil rich polymers and developing plant-based polymers. Explain **one** environmental advantage for this technological advancement. | | ✓ | [2] |
| | Answers relating to **one advantage plant-based plastics** should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Oil is a non-renewable raw material and cannot be replaced after use.<br>• Plants can be harvested.<br>• Plant-based plastic is biodegradable in three to six months.<br>• Biodegradable plastics are easier to recycle than oil-based plastics.<br>• Less energy is needed in the manufacturing of biodegradable plastics compared to ordinary plastics. Often around 65% less energy compared to a similar polymer made from petroleum.<br>• As biodegradable plastics decompose faster the impact on wildlife is reduced as animals are less likely to become entangled or trapped.<br>• Less $CO^2$ produced.<br>**Guidance for marking**<br>Incorrect/no answer<br>Brief explanation with little detail e.g. Plant based plastics are biodegradable and no non-renewable oil is used to manufacture them.<br>More detailed description e.g. Plant based plastics are harvested from crops that are renewable. They are biodegradable and take around three to six months to decompose unlike non-renewable oil-based plastics which can take hundreds of years to decompose fully. | | | <br><br><br><br><br><br><br><br><br><br><br><br><br><br>0<br>1<br><br><br>2 |
| | | | **Total** | **10** |

| **Question 3** | | | | |
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| The images below show a Bluetooth wireless shower speaker. | | **AO3** | **AO4** | **Marks** |
| (a) | State **two** important factors that would need to be considered when designing the Bluetooth wireless shower speaker. | | ✓ | 2x[1] |
| | Answers relating to two considerations should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Size and/or of components e.g. PCB, Speaker...<br>• Ergonomic data to ensure ease of user interface and interaction.<br>• Suitability of materials; physical characteristics and working properties.<br>• Waterproofing case to protect electronic inners.<br>• Manufacturing considerations; production methods and assembly of parts of components.<br>• Scale of production.<br>• Aesthetics<br>• Functionality of circuit.<br>• Sustainability.<br>• User interface.<br>• Cost.<br>• Connectivity.<br>• Power supply.<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. The designer would consider what materials are suitable to make the product waterproof<br><br>*Up to one mark for each correct answer* | | | 0<br><br>1<br><br>x1 |

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| (b) | Explain the advantages of using aluminium for the mesh on the Bluetooth wireless shower speaker. | | ✓ | [4] |

Answers relating to two advantages of aluminium should be awarded up to 4 marks.

*Accept other similar answer from below:*

- Light weight metal compared to others.
- High strength-to-weight ratio.
- Corrosion resistant, does not rust.
- Aluminium is a ductile material, can be easily processed – punched/press moulded - malleable.
- It is easily coloured by anodization and holds paint extremely well.
- Can be widely recycled

**Guidance for marking:**

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| Incorrect/no answer | 0 |
| Brief explanation with little detail e.g. Aluminium is a ductile material that can be easily shaped. | 1 |
| More detailed explanation of one advantage e.g. Aluminium is a ductile material that can be easily processed into a meshed circle by a punching manufacturing process. | 2 |
| Explanation of two or more advantages e.g. Aluminium is a ductile material that can be easily processed into a meshed circle by a punching manufacturing process. Aluminium is corrosion resistant and does not rust. | 3 |
| Clear detailed explanation of two or more advantages e.g. Aluminium is a ductile material that can be easily processed into a meshed circle by a punching manufacturing process. Aluminium is corrosion resistant and does not rust therefore is suitable for use in the shower. | 4 |

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| (c) | The image below shows the PCB used in the Bluetooth wireless shower speaker.<br><br>(i) State what the term PCB stands for | | ✓ | [1] |
| | Answers relating to PCBs should be awarded up to 1 mark.<br>**Guidance for marking**<br>Incorrect/no answer<br>Printed Circuit Board | | | 0<br>1 |
| | (ii) The image shows holes drilled in the PCB. State the reason why the manufacturer has used these on the PCB. | | ✓ | [1] |
| | Answers relating the reason for PCB holes should be awarded up to 1 mark.<br>*Accept other similar answer from below:*<br>• To fix the circuit board to the casing.<br>• Secure the PCB to stop movement.<br>• Hold PCB in place.<br>• As a reference point for CNC to mount SMT components.<br>**Guidance for marking**<br>Incorrect/no answer<br>Brief explanation e.g. The holes are used to screw the PCB to the casing to prevent movement. | | | 0<br>1 |
| | (iii) Explain **one** reason for the use of SMT (Surface Mounted Technology) on the wireless shower speaker PCB. | | ✓ | [2] |
| | Answers relating to one reason for SMT on the PCB should be awarded up to 2 marks.<br>Accept other similar answer from below:<br>• Smaller components.<br>• Higher component density (components per unit area).<br>• Components can be placed on both sides of the circuit board.<br>• Small errors in component placement are corrected automatically as the surface tension of molten solder pulls components into alignment with solder pads.<br>• Better mechanical performance under shock and vibration conditions.<br>• Fewer holes are needed to be drilled which is less time-consuming and expensive.<br>• Lower initial cost and time of setting up for mass production, using automated equipment.<br>• Many SMT parts cost less than equivalent through-hole parts.<br>**Guidance for marking**<br>Incorrect/no answer<br>Brief explanation with little detail e.g. *Fewer holes are needed to be drilled than through hole components.*<br>More detailed description e.g. *Fewer holes are needed to be drilled this makes manufacturing less time-consuming and expensive.* | | | 0<br>1<br>2 |

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| (d) | The images below show developments of the Bluetooth speaker. Study the images and analyse how the developments have had an impact on sales. | ✓ | | [5] |
| | Answers relating to analysing product range should be awarded up to 5 marks.<br><br>*Accept other similar answer from below:*<br><br>• The wireless shower speaker is available in a range of colours to cater for a range of aesthetic opinions.<br>• Additional accessories have been developed to broaden the target market.<br>• Climbing carabiner is used to make the product more desirable for people interested in outdoor pursuits e.g. climbing, hiking etc.<br>• The use of 'C' clamp can be added enabling the devices suitability for use on products such as bicycles, scooters etc.<br>• The wireless shower speaker makes use of Bluetooth technology enabling other Bluetooth devices to link up to play and/or stream music.<br>• Suction pads are used on flat smooth surfaces e.g. shower tiles, car window etc.<br>• User can use their own memory card.<br>• Rechargeable.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Simplistic analysis but no reasoning limited understanding evident. e.g. A range of additional accessories have been developed.<br><br>Some analysis evident and limited reasoning. Some understanding evident. e.g. A range of additional accessories have been developed to broaden the target market by offering devices such as climbing carabiner, C shaped clamp, suction pads.<br><br>Clear analysis with detailed reasoning. Detailed understanding evident. e.g A range of additional accessories have been developed to broaden the target market. Accessories such as climbing carabiner that can be used when taking part in outdoor pursuits such as climbing, hiking. This feature would make the speaker more desirable to a wider audience. | | | 0<br><br>1<br><br>2-3<br><br>4-5 |
| | | | **Total** | **15** |

| **Question 4** | | | | |
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| The image below shows a typical design and technology soldering iron station set up. | | **AO3** | **AO4** | **Marks** |
| (a) | Analyse the safety of the soldering iron station set up | ✓ | | [5] |
| | Answers relating to analysing safety should be awarded up to 5 marks.<br><br>*Accept other similar answer from below:*<br><br>• Work area appears clear and well positioned on the desk<br>• Soldering irons all have soldering iron stands.<br>• Soldering iron stands are all in use.<br>• Safety goggles are available next to all soldering irons.<br>• A PCB holder (crocodile clip stand) is available next to each soldering iron.<br>• All soldering iron stands include sponges.<br>• Closest soldering iron cable has a label (PAT tested).<br>• Work surfaces are worktops. Thermoset plastic used: Melamine Formaldehyde – will not melt if solder or soldering iron touch it.<br>• Soldering irons can be plugged and unplugged.<br>• Soldering iron handles are made from insulated material.<br>• Isolation switches (plug switches or other).<br><br>• Soldering irons are not low voltage.<br>• No signage for goggles to be used.<br>• No fume extraction.<br>• Soldering irons do not have voltage regulators.<br>• Soldering iron wires are loose/could be untidy.<br>• Plugs can be plugged in by anyone (no method of limiting use).<br>• Heat-proof mat could be used for extra protection of table.<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Simplistic analysis but no reasoning limited understanding evident. e.g. Soldering irons all have soldering iron stands.<br><br>Some analysis evident and limited reasoning. Some understanding evident. e.g. Soldering irons all have soldering iron stands with sponges. This makes the storage of the soldering irons safe as they will not be left loose on the work-surface. The sponge will enable the soldering iron to stay clean therefore there will be less fumes given off.<br><br>Clear analysis with detailed reasoning. Detailed understanding evident. e.g. Soldering irons all have soldering iron stands with sponges. This makes the storage of the soldering irons safe as they will not be left loose on the work-surface. The sponge will enable the soldering iron to stay clean therefore there will be less fumes given off which is beneficial as there is no fume extraction present. The set up does require some form of fume extraction because even if the soldering irons are clean there will still be a percentage of fumes that will emit when soldering. | | | 0<br><br>1<br><br>2-3<br><br>4-5 |

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| (b) | The images below are of a typical soldering iron found in Engineering Design lessons.<br><br>(i) Describe the benefit, to the consumer, of using a soldering iron that carries the **CE** mark. | | ✓ | [2] |
| | Answers relating to one advantage of the CE mark should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Meets requirements set by the single Market in the European Economic Area.<br>• Ensures that the product has met high safety requirements.<br>• Ensures that the product meets health requirements therefore will not be harmful.<br>• Ensures that the product meets environmental protection requirements.<br>• To show the product has been tested to appropriate standard.<br><br>**Guidance for marking:**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. The CE Mark ensures that the soldering iron has met high safety requirements.<br><br>More detailed description e.g. The CE Mark ensures that the soldering iron has met high safety, health and environmental requirements in the single market in the European economic area. | | | 0<br><br>1<br><br>2 |
| | (ii) Explain **two** tests that would have been carried out to enable the soldering iron to gain a CE mark. | | ✓ | 2 x [2] |
| | Answers relating to two CE mark tests should be awarded up to 4 marks.<br><br>*Accept other similar answer from below:*<br><br>**<u>Low Voltage Directive</u>**<br>• Plug/Power supply unit testing.<br>• Cable testing.<br>• Grounding quality test.<br>• Fuse test.<br>• Flammability test.<br>• Material property test – compression, impact, tension.<br>• Generation of heat related to accessible parts test.<br>• Leakage current to operator test.<br>• Single fault testing.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. The cable of the soldering iron would be tested for faults.<br><br>More detailed description e.g. The cable of the soldering iron would be tested for faults like the ground quality and current leakage.<br><br>*Up to two marks for each test explained.* | | | 0<br><br>1<br><br>2<br><br>x2 |

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| (c) | The image below shows a PCB precision drill and stand.<br><br>(i) The PCB precision drill stand makes use of a lever to operate it. Explain **one** benefit for this mechanical part. | | ✓ | [2] |
| | Answers relating to one benefit of a lever should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• A lever arm assists with mechanical advantage.<br>• The lever arm will make it easier to lower the drill platform.<br>• It enables the user to move the drill up and down with ease.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. It enables the user to move the drill up and down with ease.<br><br>More detailed description e.g. It enables the user to move the drill up and down with ease as the mechanical advantage is increased. This is because the longer the lever arm is the easier it is to move the drill in the stand. | | | 0<br><br>1<br><br>2 |
| | (ii) Describe the impact of reducing the length of the lever arm when drilling. | | ✓ | [2] |
| | Answers relating to the length of a lever should be awarded up to 1 mark.<br><br>*Accept other similar answer from below:*<br><br>• The mechanical advantage will be reduced.<br>• It will be more difficult to move the drill.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. The mechanical advantage reduces.<br><br>More detailed description e.g. The mechanical advantage reduces this means that it would be more difficult to move the drill and move force would be needed to move the lever arm. | | | 0<br><br>1<br><br>2 |

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| | (iii) Explain why cast iron is a suitable material for the base of the drill stand. | | ✓ | [2] |
| | Answers relating to one reason for using cast iron should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Good casting properties.<br>• Can be shaped into complex shapes.<br>• Is very strong when it is in compression.<br>• Heavy material<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. Cast iron is a heavy metal that can be cast.<br><br>More detailed description e.g. Cast iron is a dense metal that can be cast with ease. This makes the stand stable as it is heavy and has a wide and flat base. | | | 0<br><br>1<br><br>2 |
| | (iv) Explain the basic process of casting. | | ✓ | [3] |
| | Answers relating metal die casting should be awarded up to 3 marks.<br><br>*Accept other similar answer from below:*<br><br>• Metal is heated to melt until molten metal.<br>• The molten metal is then poured/ forced (injected) into the die/mould/shape.<br>• It must have time to solidify and cool. Once the metal has completely cooled it takes on its final shape of the casting.<br>• Once the cooling process has finished the metal is taken out of the die/mould. The extra material is trimmed off of from the final cast piece.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>One of the above steps with some basic detail.<br><br>Two of the above steps with some basic detail.<br><br>Three or more of the above steps with some basic detail. | | | 0<br><br>1<br><br>2<br><br>3 |
| | | | **Total** | **20** |

| Question 5 | | | | |
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| The image below shows a bike tyre. | | AO3 | AO4 | Marks |
| (a) | Evaluate the use of Kevlar in bike tyres, compared to traditional rubber. | ✓ | | [5] |
| | Answers relating to evaluating Kevlar should be awarded up to 5 marks.<br><br>*Accept other similar answer from below:*<br><br>• Kevlar is flexible in normal conditions and becomes rigid under extreme force/impact.<br>• Kevlar has a high tensile strength at low weight.<br>• It can handle a great deal of tension without tearing apart.<br>• Kevlar has a high modulus, meaning it does not flex or bend easily under applied force.<br>• Kevlar has a high tensile strength; five times stronger per weight than steel.<br>• Kevlar has a high modulus of elasticity.<br>• Kevlar has a very low elongation up to breaking point.<br>• Kevlar has a high Fracture Toughness (impact resistance).<br>• Kevlar has a high cut resistance.<br>• Kevlar is airtight.<br>• Kevlar wears away more slowly than rubber.<br>• Kevlar has good grip in all weather conditions.<br><br>• Rubber absorbs shock loads very well.<br>• Rubber is airtight.<br>• Rubber is tear resistant.<br>• Rubber has a high elongation.<br>• Rubber has a good tensile strength.<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Brief analysis with little detail of the **use of Kevlar in bike tyres**. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.<br>e.g. One point from the above list conveyed in a very simple fashion. See list above.<br><br>Brief analysis with little detail of the **uses of Kevlar in bike tyres and rubber bike tyres**. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.<br>e.g. One or two points from the above list conveyed in a simple fashion. See list above.<br><br>More detailed analysis, with some explanation and detail of the **uses of Kevlar in bike tyres compared to traditional rubber**. Quality of Written Communication is basic, presenting occasionally appropriate material with some coherence, some errors of grammar, punctuation and spelling.<br>e.g. Several (3 points) conveyed in a simple fashion. See list above. | | | 0<br><br>1<br><br>2<br><br>3 |

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| | Detailed analysis and explanation of the **uses of Kevlar in bike tyres compared to traditional rubber**. Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.<br>e.g. A good range of points (4 points) conveyed clearly and well. See list above.<br><br>Clear and detailed analysis and explanation of the **uses of Kevlar in bike tyres compared to traditional rubber**. Quality of Written Communication is excellent, presenting wholly appropriate material in a coherent and logical manner, hardly any errors of grammar, punctuation and spelling.<br>e.g. Many points conveyed articulately (5 or more) See list above. | | | 4<br><br>5 |
| (b) | The image below shows a bike hoist storage system.<br><br>(i) Explain **one** advantage of using nylon for the pulley wheels. | | ✓ | [2] |
| | Answers relating to one advantage polyamide should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br>• Corrosion resistant<br>• Self-lubrication qualities<br>• Lightweight<br>• Can easily be injection moulded to shape.<br>• Tough and durable.<br><br>**Guidance for marking:**<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. Nylon is a plastic with self-lubricating qualities.<br><br>More detailed description e.g. Nylon is a plastic with self-lubricating qualities this makes it suitable for the pulleys because they are less likely to clog up or jam when the pulley is rotating around the other components. | | | <br><br><br><br><br><br><br><br><br><br>0<br><br>1<br><br>2 |

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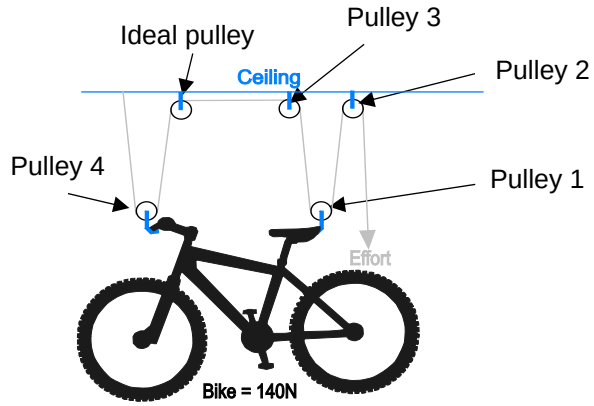
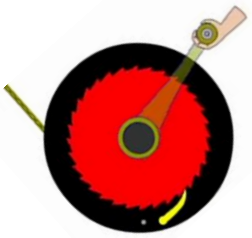
|---|---|---|---|---|
| | (ii) The bike hoist system below has a mechanical advantage of 4:1.<br>Calculate the force required to lift the bike. | | ✓ | [3] |
| | Answers relating to calculating the forces should be awarded up to 3 marks.<br>  <br><br>*Accept other similar answer from below*<br>**Load/effort**<br>**140 / 4**<br>**35N**<br>**Guidance for marking**<br>Incorrect/no answer<br>Correct formula – Load/Effort<br>Correct answer with no calculations.<br>OR<br>All of working out present. Incorrect answer.<br>All calculations correct and show with correct answer. | | | 0<br>1<br>2<br>3 |
| | (iii) If the rope is pulled 5 metres how high has the bike been hoisted? | | ✓ | [1] |
| | Answers relating to increasing MA should be awarded up to 1 mark.<br>*Accept other similar answer from below:*<br>5 metres / 4 = 1.25 metres<br>**Guidance for marking**<br>Incorrect/no answer<br>Correct answer | | | 0<br>1 |

| | | | | |
|---|---|---|---|---|
| | (iv) In the space below, use notes and sketches to design a safe mechanical method to enable the user to wind the cord in, rather than pulling it. | | ✓ | [4] |

Answers relating to ratchet and pawl should be awarded up to 4 marks.

*Accept other similar answer from below:*

**A representation of a ratchet and pawl with a lever handle that winds the polyamide cord.**



*Accept other logical mechanical designs that would safely wind the cord without releasing cord unsafely.*

**Guidance for marking**

| | |
|---|---|
| Incorrect/no answer | 0 |
| Shows detail of a winding mechanism with basic annotations | 1 |
| Shows detail of a winding mechanism with detailed annotations | 2 |
| Shows detail of a winding mechanism with a locking device with some annotations explaining the design. | 3 |
| Shows detail of a winding mechanism with a locking device with detailed annotations explaining the design. | 4 |

| | | | | |
|---|---|---|---|---|
| (c) | The image below shows a ceiling bracket and pulley for the hoist. Evaluate the benefits of stamp pressing this component. | ✓ | | [5] |

Answers relating to evaluating stamp pressing mild steel should be awarded up to 5 marks.

*Accept other similar answer from below:*

- Stamp pressing sheet metals adds structural strength to the component.
- Stamp pressing can cut away holes in the material.
- The stamp produces uniform components.
- The stamp produces highly accurate shape/forms.
- The pulley component can be moved to different positions along the pressed mild steel.
- The holes for the pulley mechanism/component ensure no twisting of the pulley as the square central hole adds support.
- Multiple holes to make it easier to fix to the ceiling.
- It is an accurate and fast mass production method.

**Guidance for marking**

| | |
|---|---|
| Incorrect/no answer | 0 |
| Brief analysis with little detail of the benefits of stamp pressing. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.<br>e.g. One point from the above list conveyed in a very simple fashion. See list above. | 1 |
| Brief analysis with little detail of the benefits of stamp pressing. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.<br>e.g. Two points from the above list conveyed in a simple fashion. See list above. | 2 |
| More detailed analysis, with some explanation and detail of the benefits of stamp pressing. Quality of Written Communication is basic, presenting occasionally appropriate material with some coherence, some errors of grammar, punctuation and spelling.<br>e.g. Several (3 points) conveyed in a clear fashion. See list above. | 3 |
| Detailed analysis and explanation of the benefits of stamp pressing. Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.<br>e.g. A good range (4 points) conveyed clearly and well. See list above. | 4 |
| Clear and detailed analysis and explanation of the benefits of stamp pressing. Quality of Written Communication is excellent, presenting wholly appropriate material in a coherent and logical manner, hardly any errors of grammar, punctuation and spelling.<br>e.g. Many points conveyed articulately (5 or more) See list above. | 5 |

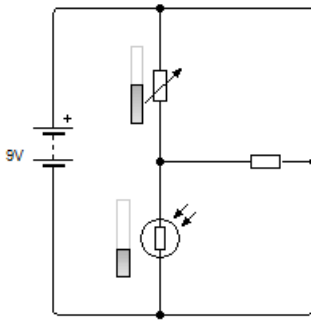
| | | |
|---|---|---|
| | **Total** | **20** |

| Question 6 | | | | |
|---|---|---|---|---|
| The image below is of a traffic safety cone with a light activated warning lamp. | | AO3 | AO4 | Marks |
| (a) | The warning lamp casing is made from polyvinyl chloride (PVC). Explain **one** reason why PVC is a suitable material for the warning lamp casing. | | ✓ | [2] |
| | Answers relating to the use of PVC should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br><br>• Easy to injection mould.<br>• High toughness and good resistance to wear.<br>• Resistant to grease and oil.<br>• UV resistant.<br>• Transparent/translucent to allow light through.<br>• Can come a range of colours (bright) so that they are visible to drivers.<br>• Water resistant to protect the electrical circuit.<br><br>**Guidance for marking**:<br><br>Incorrect/no answer<br><br>Brief explanation with little detail e.g. PVC is a grease and oil resistant plastic.<br><br>More detailed description e.g. PVC is a grease and oil resistant plastic therefore it is easy to maintain with the dirt produced by car fumes. | | | <br><br><br><br><br><br><br><br><br><br>0<br><br>1<br><br>2 |
| (b) | Analyse the circuit diagram below used in the warning lamp.<br><br>(i) Name the input component. | | ✓ | [1] |
| | Answers relating to **naming a component** should be awarded up to 1 mark.<br><br>**Guidance for marking**<br><br>• Incorrect/no answer<br>• LDR / Light Dependant Resistor / Photoresistor | | | <br><br><br><br>0<br>1 |
| | (ii) Name the output component. | | ✓ | [1] |
| | Answers relating to **naming a component** should be awarded up to 1 mark.<br><br>**Guidance for marking**<br><br>• Incorrect/no answer<br>• Bulb / Signal lamp / Lamp | | | <br><br><br><br>0<br>1 |

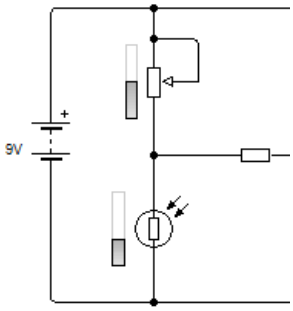
| | | | | |
|---|---|---|---|---|
| | (iii) Describe the purpose for the transistor in the warning lamp circuit. | | ✓ | [2] |
| | Answers relating to **one reason for the use of a transistor** should be awarded up to 2 marks.<br><br>*Accept other similar answer from below:*<br>• Works as a switch<br>• Works as an amplifier<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Brief description with little detail e.g. The transistor works as a switch in the circuit.<br><br>More detailed description e.g. The transistor works as an automatic switch in the circuit. When activated with a small amount of current to the base leg it enables current to travel through the transistor to turn on the output. | | | <br><br><br><br><br><br>0<br><br>1<br><br>2 |
| (c) | In the space below, show details of how the cone could be re-designed to make the lamp and cone one complete design. | | ✓ | [6] |
| | Answers relating to **re-designing with annotative notes** should be awarded up to 6 marks.<br><br>**Guidance for marking**<br><br>Incorrect/no answer<br><br>Limited information showing how to combine the two products. Few labelled design ideas with little consideration to suitable output light(s) .<br><br>Some clear sketching of a suitable combination of the two products. Some labelled design ideas with some details about suitable output light.<br><br>Clear sketching of a suitable combination of the two products. Labelled design ideas with some details about suitable output light and other suitable components would be positioned and how the product would function.<br><br>Clear sketching of a suitable combination of the two products. Detailed labelling of design ideas with some comprehensive details of a bulb(s)/other suitable output light and other suitable components would be positioned and how the product would function.<br><br>Accurate and clear sketching of the innovative combination of the two products. Detailed labelled design ideas with comprehensive details of a bulb(s)/other suitable output light and LDR would be positioned and how the product would function fully.<br><br>Accurate and clear sketching of the innovative combination of the two products. Fully labelled design ideas with comprehensive detailing of a bulb(s)/other suitable output light and LDR would be positioned and how the product would function fully. Includes details for materials and manufacturing methods. | | | <br><br><br><br>0<br><br>1<br><br>2<br><br>3<br><br>4<br><br>5<br><br>6 |

| | | | | |
|---|---|---|---|---|
| (d) | (i) Complete the circuit diagram below, by adding the missing component, to allow the sensitivity to be adjusted and explain the reason for your choice of component. | | ✓ | [3] |

Answers relating to drawing a component should be awarded up to 1 mark.




or




**Guidance for marking**

| | |
|---|---|
| Incorrect/no answer | 0 |
| Correctly inserted variable resistor / potentiometer on circuit. | 1 |
| Brief explanation with little detail e.g. The variable resistor has been used as the level of resistance can be changed. | 2 |
| More detailed description e.g. The variable resistor has been used as the level of resistance can be changed. This would enable the transistor to activate at a different light level. | 3 |

| | | | | |
|---|---|---|---|---|
| | (ii) Use the diagram below. Calculate the voltage at Vout. | | ✓ | [2] |

Answers relating to potential divider calculations should be awarded up to 2 marks.

*Accept other similar answer from below:*

$$Vout = \frac{R_2}{R_1 + R_2} \times Vin$$

$$Vout = \frac{400}{600 + 400} \times 5$$

Vout = 2 Volts

$$Vout = \frac{Vin}{R_1 + R_2} \times R_2$$

$$Vout = \frac{5}{600 + 400} \times 400$$

Vout = 2 Volts

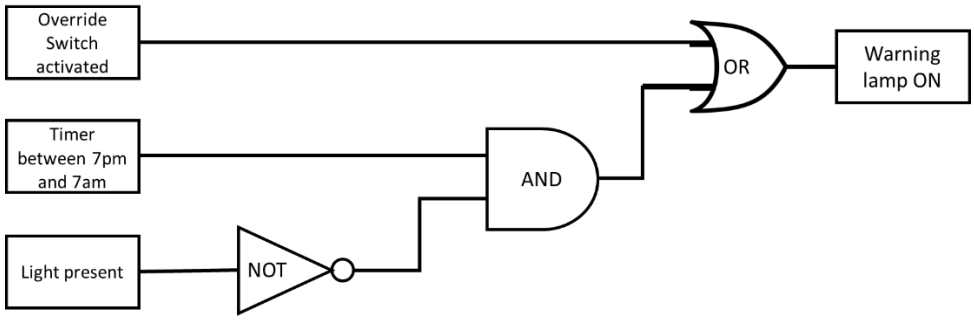
600/400 = 6/4 =3/2

3+2 = 5V

Vout = 2V

**Guidance for marking**

| | |
|---|---|
| Incorrect/no answer | 0 |
| Correct answer with no method of working out. | 1 |
| Correct answer with workings out. | 2 |

| | | | | |
|---|---|---|---|---|
| (e) | (i) Name the logic gate below. | | ✓ | [1] |
| | Answers relating to one logic gate name should be awarded up to 1 mark.<br>**Guidance for marking**<br>Incorrect/no answer<br>*OR Gate* | | | 0<br>1 |
| | (ii) Complete the truth table for an AND gate below. | | ✓ | [4] |
| | Answers relating to completing a truth table should be awarded up to 4 marks.<br>**Guidance for marking**<br>Incorrect/no answer | | | 0 |
| | **A** \| **B** \| **Y**<br>**0** \| **0** \| **0**<br>**1** \| **0** \| **0**<br>**0** \| **1** \| **0**<br>**1** \| **1** \| **1** | | | 1<br>1<br>1<br>1 |
| | One mark for each correct answer (answers in red) | | | |
| | (iii) Use the **three** logic gate symbols provided below. Complete the warming lamps logic diagram to meet its new specifications.<br><br>**Warning lamp Specifications:**<br>The warming lamp has been modified to operate when;<br>• The warning lamp sensor is in darkness,<br>• Between the hours of 7pm and 7am,<br>• If an override switch is activated. | | ✓ | [3] |
| | Answers relating to completing the logic gate diagram should be awarded up to 3 marks.<br>**Guidance for marking**<br>Incorrect/no answer | | | 0 |
| |  | | | 1<br>1<br>1 |
| | One mark for each correctly positioned logic gate. Names of logic gate not required. | | | |
| | | | **Total** | **25** |