Sample assessment task	
Year level	8
Learning area	Technologies
Subject	Design and Technologies: Engineering principles and systems
Title of task	Motion, force and energy, and circuit symbols
Task details	
Description of task	Students are required to develop knowledge and understanding of the language of engineering; definitions of motion, energy and force; identify electronic components and symbols used in electronic circuits. Students are required to develop a design solution while investigating simple IC control systems receiving input from sensing changes in light, or heat, motion or a simple switching device. Students design and construct a model electronic device, using equipment and materials available in a studio or workshop.
Type of assessment	Formative
Purpose of assessment	Develop students' understandings of the use of motion, force and energy to manipulate and control electromechanical and mechanical systems
Assessment strategy	Completed worksheets on the topics of motion, force and energy; students' developed skills in research into definitions of engineering fundamentals, and to complete the project, a design folio development, within a suitable time frame.
Evidence to be collected	• The design folio or series of worksheets • Completed product and evaluation sheet
Suggested time	One semester, approximately 18 weeks
Content description	
Content from the Western Australian Curriculum	***Knowledge and understanding*** **Technologies and society** Social, ethical and sustainability considerations, in the development of technologies and designed solutions, to meet community needs for economic, environmental and social sustainability Development of products, services and environments through the creativity, innovation and enterprise of individuals and groups **Engineering principles and systems** The design of simple solutions using motion, force and energy, to manipulate and control electromechanical and mechanical systems ***Processes and production skills*** **Investigating and defining** Investigate a given need or opportunity for a specific purpose Evaluate and apply a given brief Consider components/resources to develop solutions, identifying constraints **Designing** Design, develop, evaluate and communicate alternative solutions, using appropriate technical terms and technology Produce a simple plan designed to solve a problem, using a sequence of steps

	Producing and implementing Safely apply appropriate techniques to make solutions using a range of components and equipment **Evaluating** Develop contextual criteria independently to assess design processes and solutions **Collaborating and managing** Work independently, and collaboratively when required, to plan, develop and communicate ideas and information when managing projects
Task preparation	
Prior learning	Students will have an understanding of the principles of engineering and fundamental understanding of motion, energy and force, have ICT skills and a fundamental hand and tool skills for a production in electronics.
Assessment differentiation	Teachers should differentiate their teaching and assessment to meet the specific learning needs of their students, based on their level of readiness to learn and their need to be challenged. Where appropriate, teachers may either scaffold or extend the scope of the assessment tasks.
Assessment task	
Assessment conditions	Individually complete worksheets and a design folio and the construction of the product, accompanied by an evaluation sheet.
Resources	• Relevant theory explanations and skill demonstrations • Electrical and electronics theory notes and texts • Selection of available materials, components, tools and equipment theory worksheets • Design task template for folio

Online resources

Scootle

http://www.scootle.edu.au

Design and Technology; all contexts and years (UK sites)

http://www.design-technology.info/home.htm

http://www.design-technology.org/

http://www.notesandsketches.co.uk/Index.html

https://electronicsclub.info/

https://www.yenka.com/technology/

https://www.allaboutcircuits.com/

http://www.school-electronics.co.uk/

http://www.doctronics.co.uk/design.htm

http://www.rev-ed.co.uk/picaxe/

http://www.kpsec.freeuk.com/symbol.htm

Design and Technology; all contexts and years (USA sites)

http://www.electronics-tutorials.com/

Design and Technology; all contexts and years (AUS sites)

https://www.scorpiotechnology.com.au/

http://www.altronics.com.au/

http://www.rsaustralia.com/cgi-bin/bv/rswww/home.do?cacheID=auie&returningUser=N

http://www.wavecom.com.au/

http://www.wiltronics.com.au/

http://www1.curriculum.edu.au/sciencepd/index.htm

Instructions for teacher

Part one: knowledge worksheets

1. Introduction to the design of simple solutions, using motion, force and energy, to manipulate and control electromechanical and mechanical systems.

2. Below is a worksheet that requires students to research fundamental definitions of motion, force and energy, and the circuit symbols used to design electronic circuits.
   With teacher supervision and guidance, students can investigate given websites to find correct responses to the worksheet questions.

3. Instruct students to research using available research tools, and present detailed statements that define each of these three Engineering fundamentals:
   - motion
   - force
   - energy,

   including references in an appropriately set out reference list.

4. Research and present a definition of the different forms of energy.
   - kinetic
   - potential
   - thermal
   - chemical
   - electrical
   - electrochemical
   - electromagnetic,

   including references in an appropriately set out reference list.

5. Research and present a definition for Mechanical Advantage (MA) and Velocity ratio.

6. Research sources of information about batteries and how they work, and provide energy. Provide a description of two common examples; the two examples should require approximately 100 words.
   Images may be included and referred to in the description of the battery and energy.
   Include all references in an appropriately set out reference list.

7. Using the worksheets provided, correctly label the symbols representing the electronic components on the circuit diagram with the correct name from the tabled list.

This knowledge will be applied to designing and producing an electronic device in the later part of the task.

Student worksheet

Name: _____ Group: _____

Task description:

1. Investigate these three Engineering fundamentals and produce detailed statements that define each.

Motion

_____

_____

_____

_____

_____

Force

_____

_____

_____

_____

_____

Energy

_____

_____

_____

_____

_____

Produce a reference list.

2. Research and present a definition of the different forms of energy.

Kinetic

_____

_____

Thermal

_____

_____

Chemical

_____

_____

Electrical

_____

_____

Electrochemical

_____

_____

Electromagnetic

_____

_____

3. Research and present a definition for:

Mechanical Advantage (MA)

_____

_____

Velocity ratio

_____

_____

4. Research sources of information about batteries and how they work, store and deliver energy. Provide a description of two common examples; the two examples should require approximately 100 words. Images may be included and referred to in the description of the battery and energy. Include all references in an appropriately set out reference list.

5. Engineering uses standard mathematical units of measure; listed in the table below.

Prefix	Symbol	Factor
pico	p	10^{-12}
nano	n	10^{-9}
micro	µ	10^{-6}
milli	m	10^{-3}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Complete this table by filling in each box with the correct prefix, symbol, factor or numeric value.

Prefix	**Symbol**	**Factor**	**Numeric value**
tera		10^{12}	
	G		1,000,000,000
mega		10^{6}	
milli	m		
	µ	10^{-6}	0.000 001
pico			0.000 000 000 001
	n	10^{-9}	
	k	10^{3}	

Complete the following by writing in the prefix needed, then write in the numerical values.

Example 42 µ A = 42 micro amps = 0.000 042A

30mV = 30 _____ volts = _____V

200Tb = 200 _____ bites =_____b

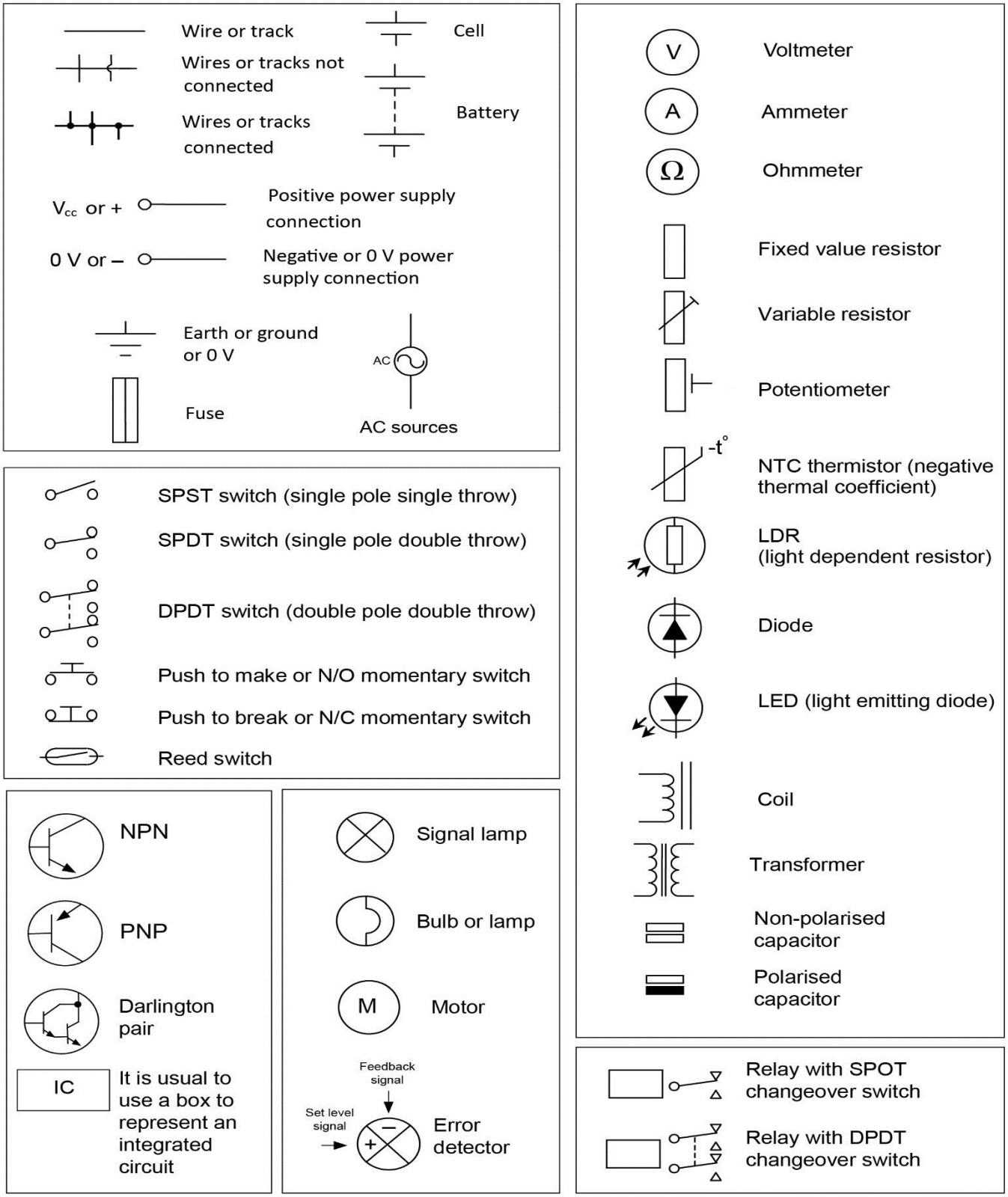
100MV = 100 _____ volts =_____V

1kN = 1 _____ newton = _____N

47kRPM = 47 _____revolutions per minute = _____RPM

6. Using the chart provided below, and the circuit diagram shown on the next page, correctly label the symbols representing the electronic components with their correct name from the tabled list.

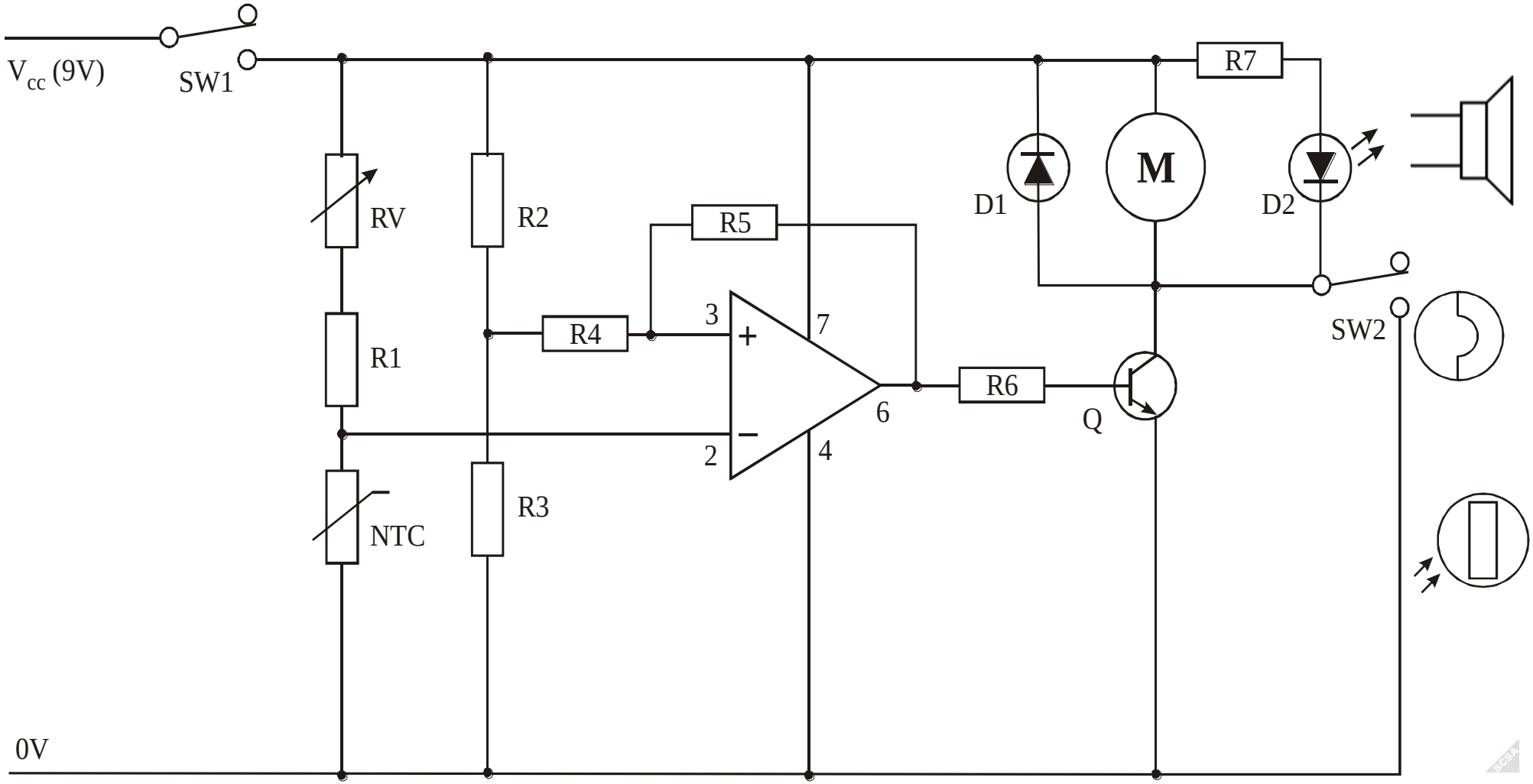
Standard symbols chart



Test: circuit symbols **Name: _____ Class: _____** **Total: _____/ 14**

Identify the component symbols and use the following names to label 14 components:

bulb	SPDT switch	ground (negative)	light dependent resistor	speaker	fixed resistor	motor
diode	thermistor	supply voltage (positive)	light emitting diode	transistor	variable resistor	Integrated circuit chip



Part two: design and produce an electronic device

Students will construct, test and house a printed circuit board (PCB) that incorporates an integrated circuit, configured as a comparator. This type of circuit can sense changes to the environment.

Students will use this project to understand *the design of simple solutions using motion, force and energy, to manipulate and control electromechanical and mechanical systems.* The principle is using an input to control an output to manipulate and control electromechanical systems.

1. Prepare a design folio; start with writing a design brief. Consider:
   - *Social, ethical and sustainability considerations, in the development of technologies and designed solutions, to meet community needs for economic, environmental and social sustainability*
   - *Development of products, services and environments through the creativity, innovation and enterprise of individuals and groups.*

2. Below is a page for a mind map. Brainstorming or mind mapping are simply methods for the collection and sorting out of ideas and thoughts.

Teach students to create their own mind map about sensing devices, group them by input actions and output results, using computer software or pencil and paper.

3. Design limitations
   Investigate the available input and output components.

Input components, choose from:

- light dependent resistor (LDR)
- thermistor (NCT)
- moisture sensor
- tilt switch
- reed switch

Output components, choose from:

- light bulb
- light emitting diode (LED)
- buzzer
- fan motor
- low voltage DC motor

Power supply; 9 volt battery

Technical knowledge and understanding

Specialist tools, materials and equipment available

Teacher will direct and demonstrate:

- identifying components parts, and construction/assembly of PCB and electronic device
- general and specialist workshop tools

Design and make an acrylic housing

- marking, cutting and shaping, edge finishing, polishing and bending acrylic plastic
- plastics bandsaw, drill, buffing machine, heat strip bender

An acrylic housing or stand will be shaped and formed from:

- one piece of 4mm clear or coloured acrylic plastic, size 150 x 210mm
- other materials can be used for small parts of the model
  - the housing may be painted, or decorated with signage or logos

4. Write out a statement of Intent.

5. Teacher-directed topics of theory:
    - understanding electricity
    - energy, electromotive force (emf)
    - resistance
    - current
    - electronic circuits
    - electronic components
    - comparator circuits
    - safety

Teacher to direct students to:

6. List the steps required to build the device (make notes during the teacher's skill demonstrations).

7. Draw working drawings for the acrylic housing, and a paper template to the piece of acrylic.

8. Finalise the list of colours, additional materials and printed logos to add to the housing.

9. Carefully follow a planned set of production steps to collaboratively and safely use tools and equipment in the workshop to produce and test the completed device.

10. Complete the assembly and testing of the device within the acrylic housing.

11. Students photograph their finished solution.

12. Evaluation: students write a 50 word reflection about how the device worked out and satisfied the design problem. Focus on the finished, working product. Explain how it works, and discuss its success as well as the areas that could be improved or changed (teacher may provide focus questions on a worksheet).

Name: _____ Group: _____

Design Brief:
In this section, write down your design statement.

_____

_____

_____

_____

_____

_____

Mind Mapping

Statement of intent

Write a clear description of the project you are going to design and make.

- Justify the application for the comparator circuit device that you have identified by considering each of the following:
  - why – situation
  - what – is it expected to do
  - where – location
  - who – you, family or other
  - and when – time of day, or occasion.
- Make statements that are clear, with full sentences and are detailed in their meaning
- Include the likely components you think are needed for input and output of this device to function
- Include additional notes and images and/or innovative ideas

Drawing space for ideas and concepts

Additional notes on ideas, colours and logos for device

Drawing template for developing ideas and concepts

Notes from Teacher Production skills demonstration

Take notes on components, printed circuit board, assembly components on PCB, soldering, testing, inputs/outputs, powering up.

Planning production

List the tools and equipment, and the steps of the process you need to follow to produce your design.

Tools/equipment	Process

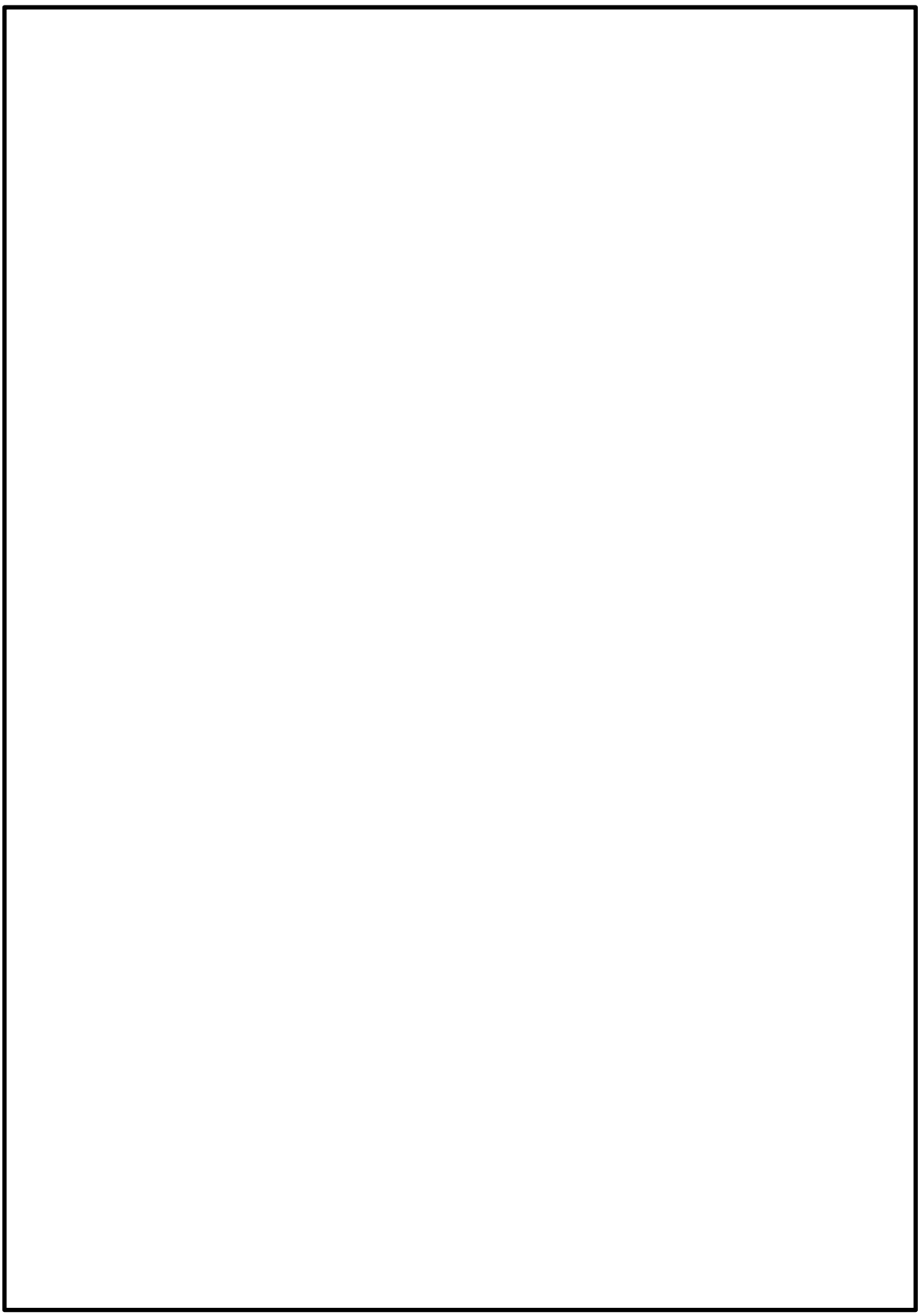
Drawing template for ideas and concepts for the housing

Additional notes on ideas, colours and logos for device

Drawing template for consolidating ideas for the acrylic housing

Selected colour: _____

Maximum area of acrylic plastic: 210mm by 150mm



Notes from Teacher Production skills demonstration

Making ideas. Take notes on template marking out, cutting tools, forming, bending and shaping tools, assembly and finishing procedures.

Planning production

List the tools and equipment, and the steps of the process you need to follow to produce your design.

Tools/equipment	Process

My completed working device (photographs) and evaluation

Evaluation: Write a 50 word reflection about how you think your device worked out. Focus on the finished, working product. Explain how it works, and discuss its success as well as the areas that could be improved or changed.

Trigger questions

1. Did your design satisfy the design brief and statement of intent? If not, what changes did you make and why?
2. Did your design turn out as you planned it would? Explain why or why not? (Consider your sketch and comment on the size, shape, colour, added materials etc.)
3. Did your production process use the tools and equipment listed? If not, what changes did you make and why?

Sample marking key

Description	Marks
Part one of task: Engineering principles and specialisations	
Expresses a clear understanding of motion, force and energy, and with correct definitions of all of the different forms of energy, as well as MA and VR. Clearly describes how two different, common batteries work, and correctly labels more than ten of the components of the circuit diagram.	17–20
Provides accurate definitions for motion, force and energy, and presents correct definitions of the majority of the different forms of energy. Describes how two common batteries work, and correctly labels more than eight of the components of the circuit diagram.	13–16
Provides satisfactory definitions for motion, force and energy, and presents correct definitions of more than half of the different forms of energy. Describes how common batteries work, and correctly labels more than eight of the components of the circuit diagram.	9–12
Provides brief definitions for motion, force and energy, and presents satisfactory definitions of more than half of the different forms of energy. Describes how common batteries work, and satisfactorily labels more than eight of the components of the circuit diagram.	5–8
Provides some, but not all definitions of motion, force and energy and the different forms of energy. Describes in general, brief terms how common batteries work, and labels less than eight of the components of the circuit diagram.	1–4
Subtotal	**20**
Description	**Marks**
Part two of task: Technologies and Society	
Demonstrates an extensively broad understanding of the different social, ethical and sustainability considerations in the development of technologies and designed solutions by providing; a detailed design brief, well-organised mind map, clear detailed statement of intent; may include a variety of notes and images.	5
Demonstrates a high level of understanding of the different social, ethical and sustainability considerations in the development of technologies and designed solutions by providing clear comments in a design brief, clear arrangement of a mind map, satisfactorily detailed statement of intent; may include relevant notes and images.	4
Demonstrates a satisfactory level of understanding of the different social, ethical and sustainability considerations in the development of technologies and designed solutions by providing relevant comments design brief, suitable images or phrases in the mind map, satisfactory phrases in the statement of intent, some notes and images	3
Demonstrates an understanding of some social, ethical and sustainability considerations in the development of technologies and designed solutions by providing suitable comments design brief, an arrangement of ideas in the mind map, and some brief satisfactory phrases in the statement of intent	2
Difficulty providing relevant comments in design brief; requires assistance to select ideas and images to complete the mind map. Attempted phrases to complete a statement of intent	1
Subtotal	**5**

Description	Marks
Investigating and defining	
Demonstrates thought and insight into the researching of components for an intended purpose. Understands the different uses of a range of components/resources to a developed solution, describing likely constraints.	5
Applies learned research skills to present relevant components for an intended purpose. Considers available components/resources and how they work to develop solutions, identifying constraints.	4
Demonstrates satisfactory understanding of the application of a range of components/resources to develop solutions.	3
Demonstrates a limited understanding of the use of common components/resources.	2
Requires assistance to select suitable component/resources.	1
Subtotal	**5**

Description	Marks
Designing	
Demonstrates a well-developed understanding of design process, using a range of appropriate technical terms to explain plans, drawings and design choices. Provides accurately drawn and labelled design for a device. Selects a variety of appropriate components and materials to make a device and justifies materials selected to match their use.	5
Applies understanding of the design process and demonstrated a high level of competence when choosing components and materials, which is reflected in the drawing of the device, while using suitable technical terms to explain choices. Drawings reflect accurate detail for the proposed design.	4
Demonstrates a developing understanding of the design process, through labelled, satisfactory drawings of the intended device. Uses some technical terms to explain their choices.	3
Demonstrates a limited level of understanding of the design process, with limited notes and few steps in the design process completed. Requires assistance to correct inaccuracies in the drawn design.	2
Shows little accuracy in the steps of the design process. Notes are incomplete and lack any detail. Demonstrates limited skills in drawing and does not communicate ideas clearly.	1
Subtotal	**5**

Description	Marks
Producing and implementing	
Selects materials appropriate to the construction of the device and accurately plans and follows the procedure. Explains safety considerations clearly. Confidently and safely uses a range of components, equipment and techniques to complete a product, explaining any alterations made.	5
Selects construction materials and tools for the making of the device and follows a planned procedure. Safely uses a range of components, equipment and techniques to complete a product, explaining any alterations made.	4
Demonstrats safe processes using a range of components, equipment and techniques to complete a product, explaining the processes. Identifies changes made.	3

Requires assistance to assemble the end product as per the design. Attempts to give basic reasons for changes.	2
Finishes with an end product that does not resemble the design and provides no relevant explanation as to why.	1
Subtotal	**5**
Description	**Marks**
Collaborating and managing	
Demonstrates consistent management skills and processes. Works independently and co-operatively to develop ideas and plan production. Works collaboratively when required to assist others to produce designed devices.	5
Demonstrates developing management skills. Works co-operatively to develop ideas and plan production. Works collaboratively when required to produce designed device.	4
Works co-operatively to develop ideas and plan production. Works collaboratively when required to produce designed device.	3
Works co-operatively to produce designed device.	2
Demonstrates little collaboration, and requires assistance to work towards an end product.	1
Subtotal	**5**
Description	**Marks**
Evaluating	
Comprehensively acknowledges that the initial design needs to match the end outcome and accurately explains any alterations made, justifying why they were made. Clear and detailed descriptions of how the devices work.	5
Understands that the device must match the design and can clarify changes made and give reasons for the changes. Clear description of how the device works.	4
Follows design accurately and understands the end program should match the initial design. Lists basic changes made. Provides a description of how the device should work.	3
End product may not match design. Attempts to give basic reasons for changes. Describes how the device should work.	2
End product does not match the design and no explanation is given for why, or the explanation is not relevant to the task. The device does not work as designed.	1
Subtotal	**5**
Total	**50**