

Year 9

DESIGN AND TECHNOLOGY

TERM 2 LST / HOMEWORK

NAME:

TEACHER:

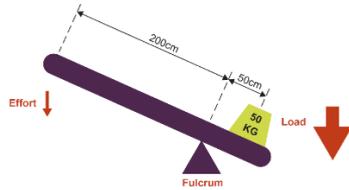
LST year 9 Unit 2 - Energy, materials, systems and devices

This will be your starter activity in every lesson. You must revise the below as you will be tested.

questions	answers
1. Which one of the following is a type of potential energy?	Mechanical
2. In a home security intruder alarm, which one of the following is the output device?	Audible alarm
3. What is the definition of a composite material?	A material made from two or more different materials to improve its properties
4. Look at the cam pictured below. Which one of the following	It has an even rise and fall
	
5. Which of the following is not a coated metal?	Stainless steel

<p>6. Discuss why developed and developing countries are moving away from fossil fuels to provide their supply of electricity?</p>	<p>Fossil fuels are a finite resources and supply will eventually run out [1] which will increase prices and raise household bills [1]. They produce pollution in the form of greenhouse gasses [1] which can cause local health issues as well as contributing to global warming [1]. Renewable energy can be developed in the country of origin [1] which saves importing fossil fuel and the associated import/transportation costs [1] and it means countries that do not have their own supply of fossil fuels become less reliant on other countries and markets [1].</p>								
<p>7. Explain two positive environmental impacts of using rechargeable batteries over single use batteries?</p>	<p>Batteries are replaced less frequently so fewer finite resources are used to make them [1]. Less waste is produced [1] which means less room used in landfill sites [1]. Fewer toxic chemical and heavy metals leach into the soil [1] and potentially reach the water table [1] meaning that less harm to animals, wildlife and the natural environment [1].</p>								
<p>8. Identify the type(s) of mechanical energy stored in the following examples:</p> <table border="1" data-bbox="193 1608 914 1872"> <tr> <td data-bbox="193 1608 371 1767">  </td> <td data-bbox="371 1608 533 1767">  </td> <td data-bbox="533 1608 699 1767">  </td> <td data-bbox="699 1608 914 1767">  </td> </tr> <tr> <td data-bbox="193 1767 371 1872"> <p>(a) Crossbow</p> </td> <td data-bbox="371 1767 533 1872"> <p>(b) Spring</p> </td> <td data-bbox="533 1767 699 1872"> <p>(c) Aerosol can</p> </td> <td data-bbox="699 1767 914 1872"> <p>(d) Newtons' cradle</p> </td> </tr> </table>					<p>(a) Crossbow</p>	<p>(b) Spring</p>	<p>(c) Aerosol can</p>	<p>(d) Newtons' cradle</p>	<p>(a) Tension in the cable, tension and compression in the bow.</p> <p>(b) Compression in the spring.</p> <p>(c) Compression in the spray can, motion in the paint particles once released.</p> <p>(d) Motion / momentum in the steel ball bearing(s) attached to the Newton's cradle. Potential energy would be stored in the ball/s that are held up right at the start.</p>
									
<p>(a) Crossbow</p>	<p>(b) Spring</p>	<p>(c) Aerosol can</p>	<p>(d) Newtons' cradle</p>						

9. Study the lever in the diagram below.



- (a) State the correct class of lever?
First order lever, class 1
- (b) Clearly label the **effort, load** and **fulcrum**.
- (c) If the lever is pressed down by 100cm, how far up will the weight move? **25cm**
- (d) How much effort is needed to lift the weight?
12.5kg

10. Explain why the use of battery farms and flywheel storage facilities are becoming more common as part of a mixed energy supply in many countries?

Renewable energy produced via solar and wind is less predictable [1] and therefore can cause fluctuations in supply [1]. Battery farms and flywheel storage facilities are used to balance/smooth supply [1] by storing surplus energy when available [1] and supplying it back to the National Grid when demand is high [1].

11. Name **two** smart materials and state the stimuli that trigger reactions

	Smart material	Stimuli
1		
2		

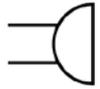
Answers include:

Thermochromic ink/pigment [1] heat [1], photochromic ink/pigment/particles [1] UV light [1], SMA nitinol [1] heat / electricity [1], self-healing polymer [1] stress / fracture [1], self-healing concrete [1] stress / fracture / water ingress, QTC [1] pressure [1], piezoelectric material [1] pressure / electricity [1], litmus paper [1] PH levels [1].

12. Describe **two** different ways that the functionality of textiles can be improved.

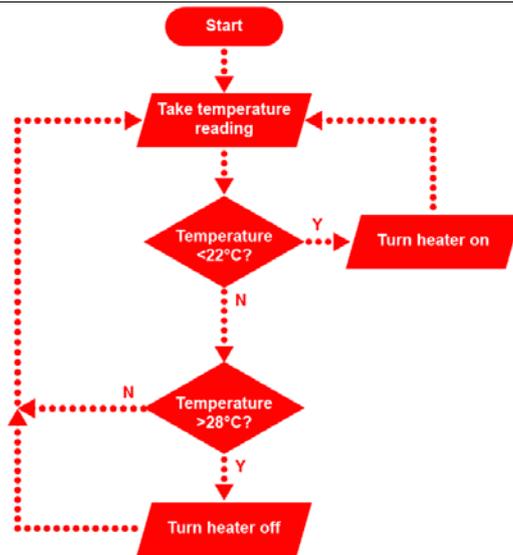
Flame retardancy [1] chemicals are added/coated to reduce the chance of combustion and to improve safety [1]. Conductive threads [1] can be sewn into garments to allow for electronic components to be controlled [1]. Microencapsulation [1] can allow for various chemicals to be added to provide antimicrobial coatings, insect repellent, slow release medicine etc. [1]. Accept other suitable response.

13. Name the components that relate to the following circuit symbols and state whether they are an input or output component.

Symbol	Component name	Input or output
	Buzzer	Output
	Push to break switch (PTB)	Input

14. Tropical fish are kept in a temperature controlled environment in a marine aquatic tank. Explain how a circuit could be designed to maintain the temperature between 22°C and 28°C. You may use block diagrams, flowcharts or notes and sketches to help explain how any inputs, processes and outputs work together to create a working proposal.

Clear use of block diagram, notes, sketches or flowchart to explain the following: Thermistor is used as the input sensor [1] which produces and analogue input signal [1]. The process compares the current temperature against a pre-set minimum level which is set to 22°C [1]. If no then loop back to start / decision box [1], if yes then switch water heater on [1]. 2nd decision box comparing current temperature against pre-set maximum level of



28°C [1]. If no, then loop back to turn heater on or back to start [1] if yes then turn heater off [1]. Loop back to start to ensure process repeats [1]

15. Using notes and sketches, explain the characteristics of the following timing processes.

Monostable process	Astable process
<p>A monostable is a single-shot timer, meaning that when triggered it will emit a single pulse for a given length of time and then turn off.</p>	<p>An astable device constantly oscillates between high and low. The length of the pulses can be varied. Their frequency is measured in hertz (Hz).</p>

One mark for each correctly drawn graph and up to **two** marks for each appropriate explanation.

Homework 1: Energy generation

1. Which of the following statements about fossil fuels is **false**? [1]
- Fossil fuels are burned to create heat, which fires steam-driven turbines
 - Fossil fuels include gas, oil and coal
 - Fossil fuels produce no CO₂ when burned
 - Fossil fuels cannot be replaced as fast as they are being used

2. Name **three** different renewable energy sources. [3]
-
-

3. The National Grid is the network of power cables that connect power sources to supply electricity to businesses and homes in the UK. [5]
- Discuss how the National Grid ensures a consistent supply of power on a cold and still winter's evening and justify why demand might be high at this point?

4. Explain how fossil fuels are used to produce electricity. [3]
-
-
-

5. Explain how shale gas is produced by fracking (hydraulic fracturing). [3]
-
-
-

Homework 2: Energy storage

1. Which **one** of the following is a type of kinetic energy? [1]

- Mechanical
- Sound
- Chemical
- Nuclear

2. Name **three** simple methods of storing energy that can be found in most homes or in a design and technology workshop? [3]

3. Explain the difference between **potential** and **kinetic** energy, giving **one** example for each. [4]

4. Describe how flywheels can be used to store surplus energy and smooth erratic energy generation from some renewable sources. [6]

5. Describe the use of energy storage systems, including kinetic pumped storage systems, to use surplus energy to help smooth peak supply and balance the demand on the National Grid.

You may use a diagram to aid your answer.

[4]

6. Standard alkaline battery cells are 1.5V.

(a) State the voltage of a rechargeable cell.

[1]

(b) How many rechargeable cells would be required in a 12V battery?

[1]

Total 20 marks

Homework 3: Modern materials

1. Which **one** of the following statements is **false**? [1]

- Nanomaterials are between 1 and 1000 nanometres in size
- Graphene is a carbon lattice structure one atom thick
- Biodegradable polymers are made from petrochemical resources
- Information is transmitted down fibre optic cables using pulses of light

2. Name **three** different modern materials and describe **one** use for each. [6]

3. Explain why LCD screens are appropriate for use in a battery powered metronome? [3]



4. Explain why biodegradable polymers are considered to be CO₂ neutral. [3]

5. How might metal foams be beneficial to patients receiving orthopaedic implants? [2]

Total 15 marks

Homework 4: Smart materials

1. Which **one** of the following smart materials **does not** react to electricity? [1]

- Shape memory alloy
- Quantum tunnelling compound
- Thermochromic pigment
- Piezoelectric material

2. Which smart material can be both a conductor and an insulator? [1]

3. Explain **one** disadvantage of using photochromic particles with self-darkening glasses. [2]



4. Describe how self-healing polymers could be useful in the construction of plastic frames for glasses and sunglasses. [2]

5. Use the following key words to create a short paragraph that explains the process that self-healing concrete undergoes when activated. [3]

Water – bacteria – stress – calcium carbonate – spheres – food – cracks

6. The following question is about the shape memory alloy, nitinol.

(a) Nitinol is an alloy of nickel and which other metal? [1]

(b) How is a shape 'set' in to the memory of nitinol? [2]

(c) A piece of Nitinol has a shape 'set' in its memory.

Explain what stimulus is required to return the material to its 'set' shape, once deformed. [1]

(d) Name and briefly describe **one** commercial use of nitinol. [2]

Total 15 marks

Homework 5: Composite materials

1. Which **one** of the following is a type of Aramid fibre? [1]

- Cotton
- Stainless steel thread
- Gore-Tex®
- Kevlar®

2. What is meant by a 'composite' material? [2]

3. Put the following steps, for forming a single layer glass reinforced plastic component, in the correct order. Draw lines between the steps. [8]

Step 1	Apply resin and work evenly into matting
Step 2	Clamp in position and leave to cure
Step 3	Apply GRP matting
Step 4	Trim and finish workpiece
Step 5	Prepare mould
Step 6	Apply gel coat
Step 7	Apply release agent
Step 8	Release the workpiece from the mould

4. Explain how a Gore-Tex® membrane works. [3]

5. Gases, liquids and solids can be microencapsulated in a fabric.
Give **two** applications of microencapsulation within a technical textile

[2]

6. Discuss the environmental concerns regarding microfibre products such as the cleaning glove shown below.

[4]



Total 20 marks

Homework 6: Systems approach

1. Which **one** of the following components is used to detect light levels? [1]

- LED
- Thermistor
- LDR
- Resistor

2. Which **one** of the following is an output component? [1]

- Speaker
- PTM switch
- Pressure pad
- Microphone

3. Explain the functional difference between a closed loop system and an open loop system. [2]

4. This question is about connecting components together in a circuit.

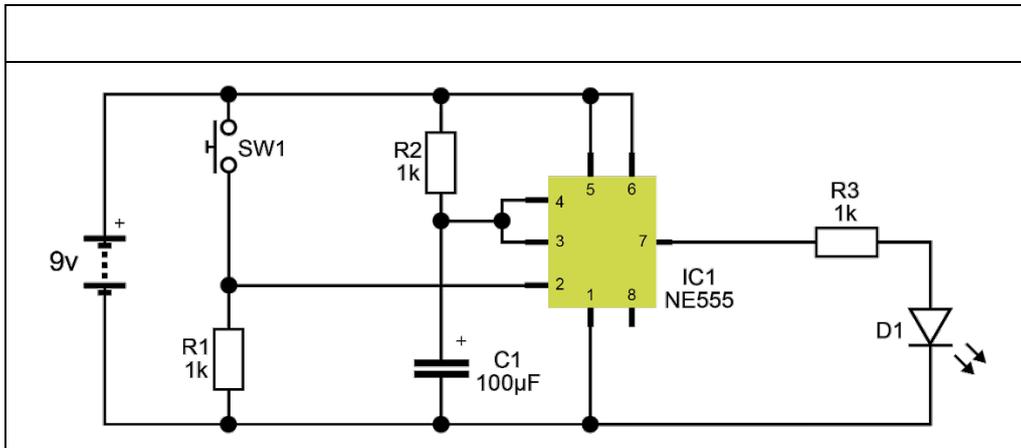
(a) What is the name for the style of circuit drawn below? [1]

(b) Which electronic component is labelled **SW1**? [1]

(c) Which electronic component is labelled **D1**? [1]

(d) Explain the function of resistor **R1**. [2]

- (e) Split the timing circuit below into **three** blocks by drawing two vertical lines across it. Label each of the blocks, stating whether it is the **input**, **output** or **process**. [3]



Total 12 marks

Homework 7: Electronic systems processing

1. Which **one** of the following components will give a digital signal? [1]
- Microphone
 - Light dependent resistor
 - Toggle switch
 - Thermistor
2. Using notes **and** sketches, explain the characteristics of the following types of signal. [4]

Analogue:	Digital:

3. Explain how a microcontroller can be programmed. [2]

4. A digital egg timer uses an input, process and output. [1]
- (a) Suggest an appropriate input component.

- (b) Suggest an appropriate output component. [1]

- (c) Circle the most appropriate device below to be used for the timing process. [1]

Monostable

Astable

Total 10 marks

Homework 8: Mechanical devices

1. Which **one** of the following motions describes travel along a straight path? [1]

- Reciprocating motion
- Linear motion
- Rotary motion
- Oscillating motion

2. Which type of motion best describes the movement of a washing machine drum? [1]

3. Which class of lever best describes the action of lifting a wheeled suitcase? [1]



4. What is meant by the term equilibrium when applied to levers? [1]

5. Give **two** functions of a linkage. [2]

6. A crank and slider converts one motion into another. State **both** motions. [2]

7. For each of the following statements, state the type of cam described.

(a) A round cam with a hole for the camshaft positioned off centre. [1]

(b) A cam with a long dwell, a slow rise and a sudden drop. [1]

(c) A cam designed to have no dwell period. [1]

(d) A cam with a long dwell and a rapid rise and fall. [1]

8. Which type of follower is the most accurate but most prone to wear? [1]

9. Explain the use of an idler gear? [2]

Total 15 marks