

Year 7

DESIGN AND TECHNOLOGY

TERM 3 LST / HOMEWORK

LST: Your teacher will tell you how many LST questions you will need to revise. You will be tested at the beginning of every lesson.

DUE DATES:

Task 1 _____

Task 2 _____

Task 3 _____

Task 4 _____

Task 5 _____

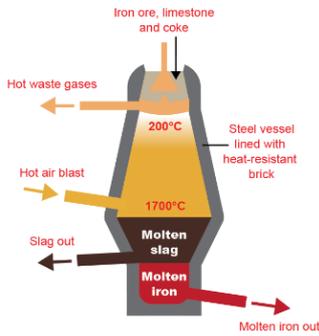
Task 6 _____

NAME:

GROUP:

TEACHER:

DESIGN AND TECHNOLOGY – LST UNIT 5C - Metals

	Question	Answer
1	<p>This question is about recycling. Which one of the following statements is true? [1]</p> <ul style="list-style-type: none"> • Metals can only be recycled a finite number of times • Metals must be separated from other materials to be recycled • Metal recycling is more expensive than mining and refining ore • Blast furnaces are used to recycle metals 	<p>Metals must be separated from other materials to be recycled</p>
2	<p>Which one of the following is a suitable finishing technique for use with metal? [1]</p> <ul style="list-style-type: none"> • Refining • Turning • Brazing • Galvanizing 	<p>Galvanizing</p>
3	<p>Metals are commonly extracted from the earth in the form of ore. (a) Iron ore is taken to a refinery where it is fed into a blast furnace. Explain the process by which the iron is separated from the ore. You may use diagrams in your answer. [6]</p>	<p>The ore is crushed and fed into a blast furnace; the furnace is hot enough (1,700°C) to melt the iron; which has a lower melting point (1,538°C); the molten iron sinks to the bottom of the furnace; and a molten waste product known as slag floats on top of it; the molten (pig) iron is tapped off from the bottom of the furnace; the molten slag is tapped off from above the level of the molten iron.</p> 
4	<p>(b) The iron from the furnace is very brittle when cooled. (i) State what causes the iron to be brittle? [1]</p>	<p>Very high carbon content.</p>
5	<p>(ii) Briefly explain how the iron is further refined in order produce steel? [1]</p>	<p>The carbon content is reduced (and further quantities of other metals are added).</p>
6	<p>Metals are available in a wide range of standardised stock forms. (a) (i) What are the four dimensions you must consider when ordering box section steel and what key requirements of the design must you consider? [1]</p>	<p>Length x Width x Thickness / Height x Wall thickness or gauge.</p>
7	<p>(ii) Suggest one key requirements of the design that you must consider?</p>	<p>Consideration must be given to the function, if the wall thickness is too thin, the box section may not be strong enough and if it is too thick it may be too heavy and be a waste of money as it costs more.</p>
8	<p>(b) Describe two advantages of using standardised sized materials.</p>	<ul style="list-style-type: none"> • A wide variety of materials, components, tools, fittings and fixtures use the same standardised measurements and so are compatible with one and other. • Designers, architects and engineers can design and plan knowing what sizes are available to them. • Manufacturers can ensure they use compatible machinery and components. • Makes ordering easier.

9	<p>Scientific instruments like the microscope below require fine adjustment.</p> <p>The table or 'stage' on a microscope can be moved up and down using a fine adjustment knob. This uses a mechanism inside the body of the microscope called a 'screw jack' which raises or lowers a threaded rod connected to the stage.</p> <p>(a) What term is given to describe the coarseness of the thread on a screw, bolt or threaded rod? [1]</p>	Pitch
10	<p>(b) Specify the material and type of thread required for the 'screw jack' in the microscope. Justify your answer? [2]</p>	<p>A stainless steel rod with a very fine pitch would be most appropriate. Stainless steel is corrosion resistant when subject to chemicals, bodily fluids, acids etc. It is hygienic, easy to clean and resistant to wear. A fine pitch would enable the table or 'stage' to be raised accurately and by very minute amounts.</p>
11	<p>What method of commercial manufacture may have been used to create the metal lens casings? [1]</p>	Turned on a commercial lathe / CNC lathe; cast.
12	<p>Rivets are commonly used to join metals where a semi-permanent join is required or where welding or brazing the metal could warp or deform the metal.</p> <p>In what situation would you need to use a pop rivet instead of a cold-formed or snap rivet? [1]</p>	<p>When only one side of the work piece is accessible, snap rivets require access from both sides; for speed; and where excessive strength is not vital or required.</p>
13	<p>Pillar drills are used to drill metal in the workshop and in industry.</p> <p>(a) Name one key item of PPE you would need to wear when using a pillar drill. [1]</p>	<p>Ideally goggles, safety glasses or visor, protective/appropriate footwear. Can accept workshop coat, apron.</p>
14	<p>(b) Name one method of securing a work piece when using a pillar drill. [1]</p>	Vice, drill vice, clamp, G-clamp.
15	<p>(c) Explain two quality control measure you could take when drilling a 12mm diameter stopped hole to a depth of 15mm in 20mm thick steel. [4]</p>	<p>Set the depth stop to ensure the depth of the hole is correct and the drill doesn't go all the way through the piece into the vice or table.</p> <p>Control the speed of the drill bit to ensure the bit and the work piece do not get too hot.</p> <p>Control the speed at which you lower the bit into the work (feed rate), do not apply too much pressure or the bit may break.</p> <p>Use cutting fluid to act as a lubricant and coolant preventing too much heat and friction.</p>

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Pure aluminium is produced from aluminium ore or bauxite.

Discuss the use of energy and the environmental impact of mining and processing aluminium. [6]

Marks awarded as follows

5 – 6 marks	A high level response with a full and comprehensive explanation of the energy required for the production and transport of raw and processed materials. Points will also address the environmental issues. Response well-structured with good use of appropriate design and technology terminology and showing a good grasp of grammar.
3 – 4 marks	A medium level response with a good explanation of some aspects of energy use and environmental impact. Response is fairly well structured with some use of design and technology terminology with a small number of errors in grammar.
1 – 2 marks	An attempt at a response, with one or two useful points covering either energy use or the environmental impact.
0 marks	Nothing worthy of credit.

Answers may include:

Aluminium ore is extracted from large open cast mines which can scar the land. All wildlife and vegetation is removed from the area. Bauxite waste / “red sludge” contains high levels of contaminants and must be disposed of in designated areas.

The Bauxite is washed to remove the clay minerals and other impurities; the resulting aluminium oxide is then extracted using electrolysis; Processing the ore into aluminium using electrolysis requires huge amounts of electricity;

A vast amount of energy and water is required to extract the ore; energy comes from oil / coal / nuclear power; to fuel petrol / diesel powered vehicles; produce electrical energy in power stations. Power stations are frequently built next to mines in order to supply the required power.

Transporting the ore to be processed / once processed uses more energy.

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For the main body of each of the products below, state a suitable method of manufacture. [3]

		
Pepper mill	Spatula	Meat grinder

		
Pepper mill	Spatula	Meat grinder
Turning	Pressing / punching / blanking	Casting

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Look at the two metal joints below.

(a) For each image, state the method that has been used to create the joint and explain why that joining method has been used. [4]

	
Nuts, bolts and washers A non-permanent joining method. Used because access might be needed to the joint.	Welding A permanent joining method. Strong joint. Suitable for a thick-walled tube / pipe.

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(b) Brazing is a permanent joining method. Give **one** reason why brazing would be preferable to other joining methods? [1]

Suitable where heating to melting point could deform metal parts or where dissimilar metals are being joined.

20	State two disadvantages of CNC milling or turning over hand producing parts. [2]	High initial set up costs. Loss of jobs and skills. Skilled labourers have to retrain to be operatives. Loss of wages. Machinery may become redundant when new technology comes along.
21	A metal work piece may become 'work-hardened' and brittle as it becomes stressed. Explain the process by which this change in properties of a work piece can be reversed. [2]	Annealing; metal is heated until at a critical temperature; and allowed to cool again; to make it more ductile.
22	Powder coating is used to finish metal parts. Briefly explain the process of powder coating. [2] 	Dry power paint; is electrostatically applied to metal parts; (the paint is positive and the work piece is negative); which are then heated to cure the paint; and bond it on to the surface.



Worksheet 1: Sources, origins and properties

Task 1

Aluminium is the third most abundant element. Those mining the aluminium ore, or bauxite, have environmental and social responsibilities to consider.



When a mining company plans to open a new bauxite mine it first has to make an assessment of risks and repercussions. Complete the table below.

Potential hazard	Risks	Who / what is at risk	Preventative measures
Choosing the site			
Noise			
Dust			
Road surface maintenance			

Task 2

In the table below, chart the sustainable life cycle of an aluminium can.

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
				

Stage 6	Stage 7	Stage 8	Stage 9	Stage 10
				



Task 3

Recycling metals still uses a huge amount of energy however there are many advantages of recycling over producing from scratch.

Give **three** advantages of recycling metal products and explain your answers:

Advantage:

Explanation:

Advantage:

Explanation:

Advantage:

Explanation:



Homework 1: Sources, origins and properties

1. Metal naturally occurs in the crust of earth. In its natural state, it is often combined with rock like substances. What is this material called? [1]

- ◇ Iron
- ◇ Coke
- ◇ Slag
- ◇ Ore

2. Complete the sentence: Aluminium comes from a raw material called: [1]

- ◇ Electrolysis
- ◇ Bauxite
- ◇ Carbon
- ◇ Duralumin

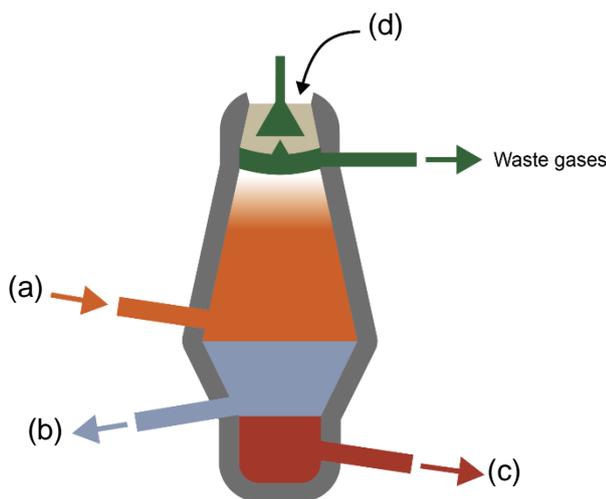
3. Below is a diagram of a blast furnace used in refining.
Complete the diagram by filling in labels a, b, c and d.

(a) _____ [1]

(b) _____ [1]

(c) _____ [1]

(d) _____ [1]



(e) Briefly explain **one** further process that happens to 'pig iron' to make steel. [1]



4. Metals can be recycled indefinitely without changing their properties.
(a) Describe how you might separate ferrous metal containers (for example steel) from non-ferrous containers (for example aluminium) at a recycling plant. [2]

- (b) Explain how designers and manufacturers can assist in the recycling of metal-based products at the end of their life. [2]

5. Discuss the environmental implication of surface mining as a method of obtaining metal ores. [4]

Total 15 marks

Worksheet 2: Working with metal based materials

Task 1

The first roller coasters were made predominantly from wood with steel rails. Unfortunately, the physical limits of wood restricted the complexity of roller-coaster design. Nowadays they tend to be made entirely from steel like the one below.



(a) Why is steel a suitable material for the roller coaster?

(b) Why is steel tube an ideal material for the upright supports?

(c) A new roller-coaster has 12 upright supports, each support is made up of several steel tubes each of which is 2 meters (2,000mm) long.

2 supports are made up of 10 tubes.

4 supports are made up of 8 tubes.

6 supports are made of 6 tubes.

How many meters of steel tube will be used in total?

- (d) The calculations, designing, modelling and testing of new roller-coasters are done using a computer-aided design (CAD) program. Why is CAD used before any 3D prototypes are made?

Task 2

You are asked to make a hanging basket bracket like the one pictured out of mild steel strip.



- (a) State and explain the process used to make the steel more malleable for bending.

- (b) Repeatedly twisting the metal will affect its malleability and make it more brittle. What is this process called?

- (c) The bracket needs to be secured to the wall. How would you make two holes in the mild steel?



- (d) What method would you use to permanently join the components together to make the bracket?

- (e) In the box below draw a diagram and explain how pop rivets can be used to create a strong semi-permanent join.

Homework 2: Working with metal based materials

1. Name each of the following tools/components/equipment. Give details of a specific process where you would use each tool.

Item	Name	Process
		[2]
		[2]
		[2]
		[2]

2. Metal-based materials come in a range of stock forms, types and sizes.

Describe **one** advantage of using standard forms. [2]

3. What type of drill would you use to drill steel box section and why? [2]



When drilling metal, why is it important to select the right speed? [1]

Why would cutting fluid be used whilst drilling metal? [1]

4. The medal below has been cast. Explain using diagrams and annotations how a cross section of the mould would look. [6]



You should include the following key features:

Cope

Runner

Riser

Casting

Drag

Open riser

Pouring cup / sprue

Total 20 marks



Worksheet 3: Commercial manufacturing

Task 1

Cooking utensils and hand tools are commercially produced to a stringent set of requirements.

- (a) Give **three** reasons why stainless steel is commonly used in the manufacture of cooking utensils?

- (b) Copper is also commonly used in professional and domestic kitchens for cookware.

- (i) What properties of copper would be desirable in a saucepan?

- (ii) Explain one disadvantage of copper being used in this way.

- (c) Explain how hardening and tempering can improve the properties of the steel part of the handle (tang) and blade of a stainless steel kitchen knife.



- (d) State how the black plastic handle has been attached to the knife tang.



Task 2

You have been asked to restore the steel wheelbarrow shown below. The paint has worn and it has considerable rust damage.



Repainting could extend the life of the wheelbarrow.

- (a) Suggest **one** method of preparing the surface for a repaint? Explain your answer.

- (b) What method would you use to apply the paint to achieve an even, professional finish?

- (c) The total surface area of the wheelbarrow is 1500mm^2 . Each can of paint contains 400ml with a coverage of 0.4m^2 .

How many cans would you need to cover the wheelbarrow?

- (d) Other than painting, suggest **one** alternative method of extending the life of the wheelbarrow if kept outside.

- (e) What method of finishing could be used to create a smooth, comfortable grip on the handles of a wheelbarrow?



Homework 3: Commercial manufacturing

1. Suggest finishes that have been used on the products in the table below and explain why they are suitable.

	[2]
	[2]
	[2]
	[2]

2. Hardening and tempering are process used to make hand tools like the precision screwdriver shown below.



- (a) Explain the process of hardening the steel screw driver blade in the workshop. [5]
(i) Step 1 Preparation:



(ii) Step 2 Setting up:

(iii) Step 3 Heating:

(iv) Step 4 Quenching:

(v) What are the properties of the screwdriver blade at this stage?

(b) Now explain the process of tempering the tip of the steel blade. [4]

(i) Step 1 Cleaning:

(ii) Step 2 Heating:

(iii) Step 3 Cooling:

(iv) How does tempering affect the properties of a hardened blade?



- (c) Suggest an appropriate surface treatment or finish for the handle of the screwdriver shown? [1]

3. Give **two** advantages of milling using an automated Computer Numerical Controlled (CNC) machine. [2]

Total 20 marks