

Question 1

The packaging must have the following requirements:

Water and Air Tight: The product will need to be protected from moisture also this will improve expiry and reduce microorganisms and bugs.

Toughness: The packaging will need to withstand transportation for instance an Snack will be put into a Consumers bag.

Non-Toxic - The packaging can not cause any reaction with the product or consumer.

Printable: The packaging will need to have images or text for Marketing and Consumer information.

Re-Cyclable - The packaging will need to be re-cyclable but also reduce food waste.
(expiry)

Low-Cost: Material must be low cost and cheap to manufacture.

Question 1 Cont...

These are the following materials I would consider:

Cardboard box and plastic bag

If the product was to be packaged into a plastic bag and then into a cardboard box (Compound Solution).

The plastic bag can be heat sealed to ensure it is air and water tight and with the cardboard outer packaging this will offer extra protection but will also be easier to pack during transportation. Both materials are re-cyclable and low cost to make but it 2 materials that will require processing and recycling by the consumer. It is also printable.

Laminate with metallised film (Aluminium)

less expensive to manufacture.

The film will enable the packaging to have good barrier to moisture, air. With it's reflective surface it can be printed and be attractive to consumers.

The packaging is light and will be compact so easy to transport and pack.

If too much pressure is placed on the packaging though it could burst.

Also some of these metallic laminates are not re-cyclable as it difficult to sort.

Question 1 Cont ...

Glass Jar

Glass is impermeable to gases and vapors, so it will maintain freshness for long period of time. glass can be sterilised to contain low or high acid foods.

glass is rigid, has good insulation and can be made into different shapes.

it is transparent so you can see the product.

but can also have colour to protect against light.

glass is re-cyclable and re-usable.

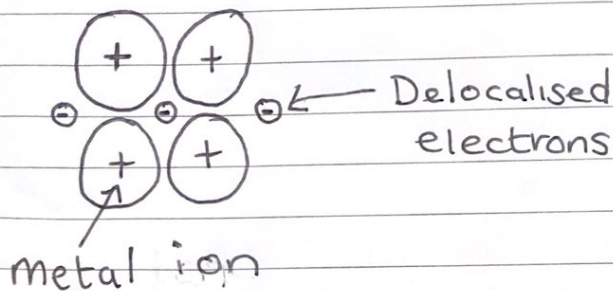
glass can be heavy so will cost more to transport, it can break with impact or thermal shock. Even though glass can be etched it is expensive so it will require an additional label (paper, glue).

it will also require a lid made with either plastic or metal so an additional material cost and process.

Even though the glass can be manufactured with recycled broken glass it is still a complex process using molds.

Question 2

a) metallic Bonding

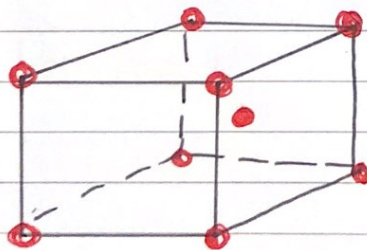


A metal with higher Valency is harder to dissolve hence has a higher melting and boiling point.

Metals have large Structures, the electrons on the outer shell of the metal atoms move freely. The bond is the force of the attraction between the free moving delocalised electrons and the positive ions.

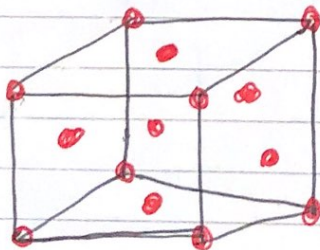
b)

BCC



Bcc has atoms located at all 8 corners and a single atom at the Centre.

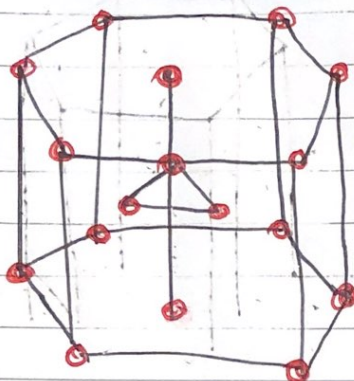
FCC



FCC has atoms located at all corners and cube faces.

b) cont . . .

HCP



HCP atoms are located at the top and bottom faces at the bottom of the unit cell and another 6 atoms form hexagons that surround a unit cell. Another plane holds 3 atoms between top and bottom plane.

c)

$$\text{HCP} = 0.74$$

$$\text{BCC} = 0.68$$

$$\text{FCC} = 0.74$$

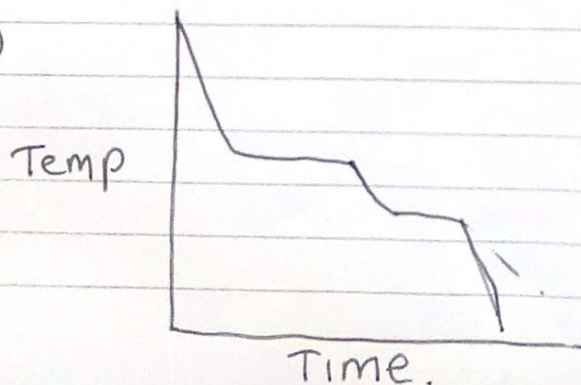
d) 97.3 at 1800°C - Liquid

1650°C - β + Liquid Titanium and liquid

800°C - β Titanium

600°C - α Titanium

e)



Question 3

a) Composites - Carbon Fibre

Ceramics -

natural materials - wood, Bamboo

metals - Magnesium Alloy

All classes are high on the phase diagram for stiffness and density.

Carbon Fibre has high stiffness, high tensile strength, low weight, high temperature tolerance and low thermal expansion.

Magnesium Alloy

light weight, low density, good high temperature mechanical properties,

corrosion resistance it has HCP lattice, with higher strength to weight ratio.

b) I would not consider natural materials like wood or Bamboo because it is flammable. I would also not consider ceramics as it can be brittle or shatter.

Question 3 Cont . . .

c) Carbon Fibre

The fibres are extremely stiff, strong and light. Carbon properties are similar to steel and weight close to plastic.

Strength to weight ratio is much higher than steel or plastic. It has high tensile strength, high stiffness, low weight, high chemical resistance, high temperature tolerance, and low thermal expansion. Steel is

cheaper than carbon fibre to manufacture. Carbon fibre can be bonded together thus saving on weight.

D) Strength can be altered drastically by welding if not enough heat is used then little penetration will occur, if too much heat is used it can destroy the chemistry of the base metal. Selecting the correct welding process is important. If a weld rapidly cools off it can cause the material to lose its ductility, welding reduces the fatigue life of steel parts. Peening technique is a cold working process which impacts the surface with a tool creating plastic deformations this will

improve fatigue strength, allowing higher steel strength.

Brazing has a lower melting point than the base metal so distortion will be reduced, it can join different metal together. even joining non metals the properties of the base metal will not change. It does not require final finishing after completing the join.

E) Adhesive bonding allows even distribution of stress loads, this reducing stress on the joint.

The properties of the glue means they can form an adhesive and sealant the same time while resisting vibration and flexing stress. The ability to act as a steel allows the adhesive to protect the joint from corrosion.

Bonding can join irregularly shaped surfaces with no change to dimensions.

Riveting

Very durable against shear forces, the process deforms the material to make it denser.

The zero clearance characteristics of rivets installation means they are less prone to wearing out due to vibrations.

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Question 4

a) The cylinder must be air tight, with stand high pressure, non-corrosive, light weight, water tight,

b) 6062 T6 Aluminium because it is cheaper and light weight and help buoyancy.

run out of time to
complete.