

Andrew Chick

22nd Jan 2021

Student 1909134

Module ACMA 4000 - Materials + Introduction to Processing.

Question 1.

Properties required.

1. Water tight - needs to protect the snack
2. Air tight - needs to protect the snack.
3. Printable - Design of product important.
4. Recyclable - The target market care about environment.
5. Inexpensive - Competitive market
6. Strong - Used outdoors, needs to be strong.
7. Ductile - Packaging purposes
8. Light weight - less packaging/cost/environmental impact.

The first material I'd like to discuss is cardboard.

Cardboard is very cheap to source and manufacture, along with this, the benefits of recycling would be a great advantage. The printability of cardboard is very good, you only have to look in your local supermarket to see many products with eye catching designs. While cardboard is not waterproof a polyurethane coating can be applied easily and at little cost. As the target market would be people who are passionate about the environment this type of material is a great choice because its biodegradable.

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Question 1 continued.

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The second material I'd like to discuss is plastic. Plastic is great for moulding and printing on, there's thousands of products that already use plastic material. If using plastic, it would be water tight without the need to add to it.

Food ~~used~~ that is packed in plastic is easy to open and lightweight.

Based on the comparison, I'd recommend a cardboard packing because of these points

- Biodegradable
- Cheap
- Recyclable
- Easily printable
- While it's not airtight - coating can be added
- Would be a popular choice to target market
- Light weight
- Very versatile for packing
- Very strong
- Low energy consumption

So when considering all aspects cardboard is my choice.

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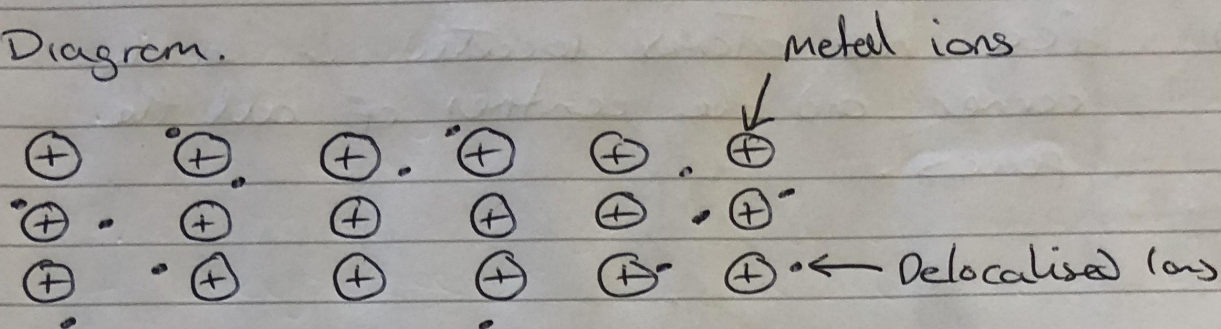
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Question 2 (a)

Diagram.



Metallic bonding is the type of bond between metal atoms. So when metal bonds to metal you can see the structure above. There is electrostatic attraction between the metal ions and the Delocalised ions, it's that attraction that we call metallic bonding.

(b) A valence electron is in the outer shell.

Metals would be stronger with 2 of these, rather than just one as ions will become more positive causing greater density

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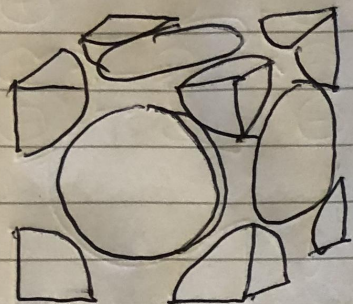
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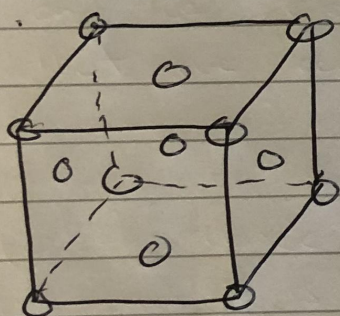
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Question 2 (b)

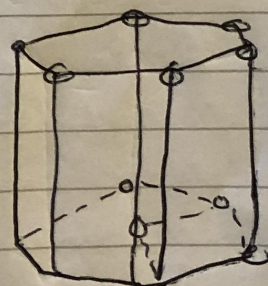
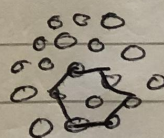
Body Centred cubic



Face centred cubic



Hexagonal close packed



BCC - this has atoms at each 4 corners of the cube plus one in the centre, they are shared with.

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Question 2 continued

- (b) fcc. has atoms located in each corner and the centres of all the faces.

Hexagonal close packed structure has layers that sit in each other each one surrounded.

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Question 2

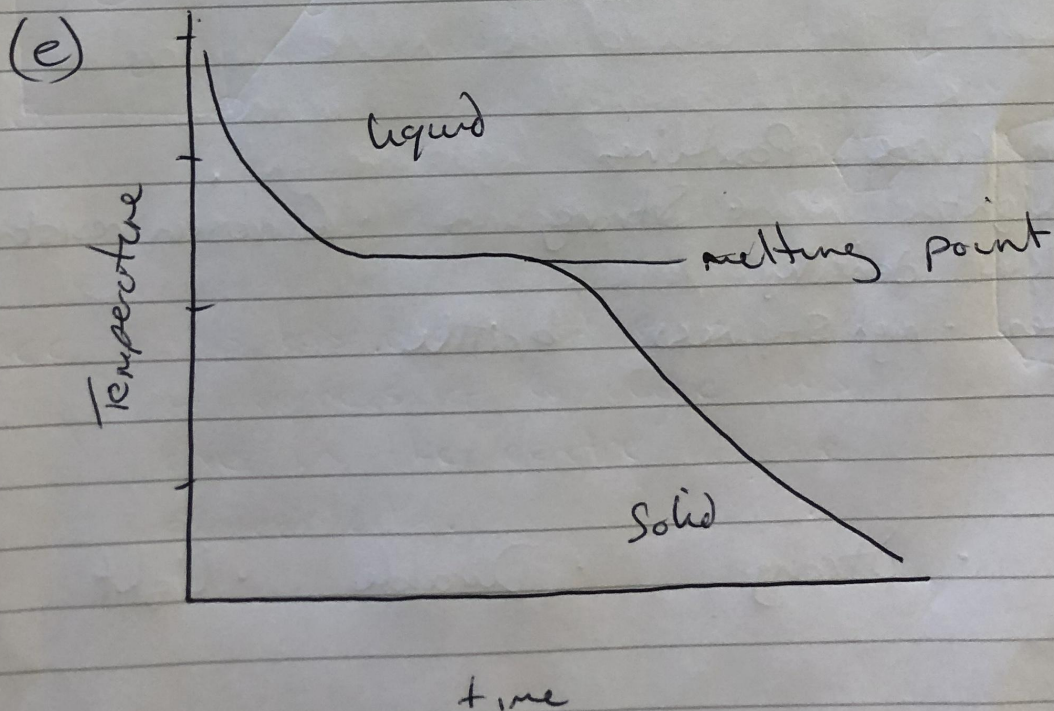
(c) HCP - 0.74
BCC - 0.68

(d) 1800 liquid with a 97:3.

1650 - part liquid part starting to solidifying
because of the different structures

800 - mostly solid

600 - Solid



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Question 3

(a) b4c would be my choice. It gives the best YM - Density and minimum mass which would be required for a chassis

(b) foams, Natural materials, Polymers, Elastomers

All of these I wouldn't consider based on the lower YM. Stress would be placed on the chassis and would yield with these materials

(c) Carbon fibre Positives

- light

- Strong

- Corrosion resistant

- low density

negatives - high stiffness brittle

Steel.

- Strong

- Durable

- light

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(d) Question 3

Brazing is higher quality because the material properties are not affected. You can also join many different materials. By brazing the strength, hardness, yield strength are not compromised.

By welding, the temperature you put into the material affects the properties. If the hardness is affected for example the material may fracture when absorbing energy.

(e) TIG welding - this uses electrical energy to heat at a point where you need to join material.

Electron beam welding - this is where a high velocity of electrons is applied to the point of joining. This allows repeatability and accuracy to your joining as well as the advantage of joining different materials.

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Question 4

~~14~~

(a) The cylinder would need to be as light as it can be while having a high yield strength. It would need to be non corrosive both internally and externally.

(b) Steel - high yield strength, density is ok.

Aluminium - This would be more favorable to me. The yield strength is acceptable, its non corrosive and it lightweight. It would be more expensive but a better fit for purpose.

(c)

$$(d) \quad t = \frac{2 P d}{2 y \omega}$$

$$P = 20 \times 10^6 \text{ Pa}$$

$$d = 100 \text{ mm} \times 10^{-6} \text{ m}$$

$$y = 241 \times 10^6 \text{ Pa}$$

$$= \frac{2 \times 20 \times 10^6 \times 100 \times 10^{-6}}{241 \times 10^6}$$

$$= \frac{2 \times 2000}{241 \times 10^{-6}} = \frac{2 \times 2000}{241 \times 10^6}$$

$$= 16.6 \times 10^{-6}$$

$$16.6 \text{ mm}$$