

1804234
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1. a) Hydrogen is a fuel that has had a lot of development. This fuel has proved it ~~is~~ can be 30% more efficient ~~that~~ than the gasoline equivalent. This fuel also has the capabilities to become zero emission.

SunHower-E (ethanol) was introduced in 2009, a fuel that is based off the growth a plants and W rays from the sun

- b) In terms to get these fuels more user friendly, more stations would be needed for the users to re-fuel as well as having more upgraded parts in the engine. For hydrogen, this would be needed due to hydrogen burning faster and at a higher temperature than gasoline. A normal engine would not be able to cope.

As for SunHower-E, as it is a new source, availability is also bad. ~~So~~ Stations for this fuel would have to be put in place for owners of vehicles to access this fuel easily. Engines would have to be adapted to ensure this fuel runs well in the vehicle

- c) Having these fuels being mass-produced would mean many a need in increase of labs to create these fuels. Ensuring a constant chain of ingredients is shipped to the labs to keep the production line turning, ensuring there would be no shortages of fuel.

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2.a) Ionic bonding is when atoms transfer electrons between each other. Ionic bonding wants atoms to be balanced and have a complete outer shell.

Covalent bonding differs as the electrons are not permanently shared. Covalent bonding happens with atoms that are close together on the periodic table as well as being non-metals.

Metalllic bonding is different due to it directly sharing electrons across shells with metal atoms shielding electrons from the outer shell freely. This therefore creates a positive charge in the ions and a sea of free electrons. This is also called Delocalised electrons.

The valency of an atom is measured by how many hydrogen atoms it can bond with. Group numbers are related to the amount of valency there is in an atom.

~~For examples~~

~~b) Body centered cubic Dimensions = $a = \frac{4R}{\sqrt{3}}$~~

$$a = \frac{4R}{\sqrt{3}}$$

$$a \times \sqrt{3} = 4R$$

$$\frac{a \times \sqrt{3}}{4} = R$$

$$\frac{a^2 \times 3}{4} = \frac{4R^2}{3}$$

$$\frac{a^2 \times 3}{4} = \frac{4R^2}{3}$$

$$\frac{0.362 \times \sqrt{3}}{4} = R$$

$$R = 0.157 \text{ nm}$$

$$\frac{a^2 \times 3}{4} = R$$

$$R = \frac{0.362 \times \sqrt{3}}{4} = 0.157$$

2.b) continued on page 8

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2.C) Point defect is when there are missing atoms in the structure. When the lattice forms, it leaves vacancies in the structure, allowing the surrounding atoms to become distort. Vacancies appear depending on temperature. ~~Line defects are caused dislocations in the lattice which are a defect~~

There are three different types of point defect with point defect: vacancies, self-interstitials and substitutional. Substitutional occurs when the original atom in the lattice site of crystalline solid is replaced by a different type of atom.

Line defects are caused by dislocations in the lattice, which are a defect in the structure. This allows the lattice to slip relative to their adjacent layers. Bonds break when the atoms move with new bonds forming once slip motion is activated.

Area defects - Grain boundaries create area defects in a crystalline structure. Grain boundaries are the boundaries between the crystals in a material and the bonding structure changes as well as the orientation of crystals will be different. Grain boundaries can help impede dislocations.

2.D) ~~The three stages of secondary stage of creep include:~~

- Grain rotation
- ~~Dislocation movement~~
- Cavitation

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2. D) The secondary stage of creep is dislocation movement. In this, defects and ~~say~~ dislocations within the crystalline structures will move towards the grain boundaries under load. The stress applied to the structure causes the dislocations as the crystalline structures move. At the grain boundaries, there are triple points which are the intersection of 3 grain boundaries. Dislocations will find their way to the triple points as they are the weakest link in the structure.

4. a) i) 7XXX has a main alloy element of Zinc. This alloy element is very strong when treated by heat, however it becomes brittle and is rarely used alone.

~~4. a) i)~~

4. a) ii) The first number tells the user the steel type is carbon. The ~~third~~ number tells the user the steel is re-sulfurized. The fourth number tells the user the steel is 0.44% carbon content.

4. b) The classification groups of composites include:

- Particle-reinforced
- Fibre-Reinforced
- Structural

Particle-reinforced are harder and stiffer than the matrix material. They are of macro, micro and nanoscopic scale. Improvement of mechanical behaviour depends on the interface bonding. Interaction with the matrix is not on the atomic level. Particle size is 0.01-0.1 microns.

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4. b) Fibre reinforced composites are heavily used in the automotive industry with materials such as carbon fibre. Low-density fibre and matrix materials are utilised to get a stronger material. Although strong, they are brittle.

Structural composites are made up of both composite and homogeneous materials. Combined, these create material with properties from both. The geometric construction of the composite plays a large part in the construction as well as being dependant on the material properties of the component materials. Common examples are Gullix ply - carbon fibre and aluminium honeycomb. Faces and cores create the composite in a sandwich like form.

$$4.c) E_c A_c = E_m A_m + E_f A_f$$

$$\frac{F_f}{F_m} = \frac{E_f V_f}{E_m V_m}$$

$$F_c = F_f + F_m$$

$$\sigma \times A$$

$$V_f = 0.45$$

$$E_f = 65 \text{ GPa}$$

$$E_m = 3.26 \text{ GPa}$$

$$A = 300 \text{ mm}^2$$

$$\sigma = 30 \text{ MPa}$$

$$E_c = \frac{E_m A_m + E_f A_f}{A_c}$$

$$E_c = \frac{(3.2 \times 10^9 \times 0.3) + (65 \times 10^9 \times 0.3)}{0.3}$$

$$E_c = 6.18 \times 10^{10}$$

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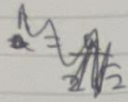
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2.0) face centered cubic dimensions = $a = 2\sqrt{2}R$



$$a = 2\sqrt{2}R$$

$$\frac{a}{2} = \sqrt{2}R$$

$$\frac{a}{2\sqrt{2}} = R$$

$$R = \frac{0.362 \text{ nm}}{2 \times \sqrt{2}} = 0.128 \text{ nm}$$