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13/05/2022
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Automotive Materials
Sustainability

Section A

a biobutanol is a fuel that is cheaper to produce than gasoline. It also only produces carbon dioxide and ~~doesn't~~ doesn't produce SOX, NOX or carbon monoxide. Dimethyl or DME produces low NOx because its low combustion temperatures. The mpg was larger than gasoline.

b the impacts DME would have on the user would be that the fuel has poor lubricity properties meaning it would wear the engine faster. It also has a low energy content which ~~means~~ means the fuel tank size would be increased. biobutanol is an alcohol and can be corrosive to existing fuel delivery systems. It is also ~~likely~~ ~~likely~~ required to have forced induction to compete with conventional fuel making it more complicated.

c biobutanol can use the existing fuel delivery system but its introduction would be controversial as it's less corrosive than ethanol.

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Section B

Q2.
a. Ionic Bonding is when atoms transfer electrons between ~~each~~ each other. Atoms want to be balanced and have complete outer shells. It is required that a electron donor and receiver with metals being the donors and non metals being the receivers. Nearly complete outer shells want to receive. ~~covalent~~ covalent Bonding this is where atoms share electrons but don't permanently transfer them. This normally happens to atoms of the same element or close to each other on the periodic table mostly happens with non metals. Rare metals and metals and non metals can form a covalent Bond. Valency is the amount of Hydrogen atoms an atom can bond with.

b.

Copper has 4 atoms

$$a = 0.362 \text{ nm} = 3.62 \times 10^{-11}$$

$R =$

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

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

$$R = 1.279 \times 10^{-11} \text{ m}$$

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Section B

C.) there are 3 defects point, line and Area.
A point defect is when an atom is missing in the structure creating a distortion. It can also have a self interstitials defect where it has an atom positioned between the normal lattice structure.
A substitutional point defect is where an atom is replaced by a different type of atom. Line defects are ~~caused~~ caused by dislocations in the lattice structure this means that layers of the lattice to slip ~~the~~ then atoms can then reform once the slip has completed this would be a permanent plastic deformation. Area Defects are caused by Grain defects which are the boundaries between the crystals in the material this means the orientation of the crystals will be different and can help impede dislocations

d) Secondly stage of creep ^{is} ~~can be~~ controlled by the temperature and means that adding refractory metals help improve the thermal degradation properties, also helping the grain boundaries. also Silicon fibres help the thermal resistance, or to help ventilate the part to lower the temperature

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Section B
Q4

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a Aluminium 7xxx series this ~~means~~ means it can be heat treated to increase the strength this means it also becomes more brittle this is rarely used alone

ii the first number is to signify that the steel is carbon

and the 3rd and 4th number is the percentage of carbon in the steel

b composites have 3 groups 1 Particle Reinforced, 2 Fibre Reinforced and 3 Structural. Particle Reinforced composites are harder and stiffer than matrix material. this starts with the matrix in an atomic level or a molecular level. it restricts plastic deformation. Fibre reinforced composites main goal is a high strength to weight ratio this is because it uses low density fibre and matrices it also relies on the direction of the fibres with there being aligned fibres. Random and woven with woven being stronger in all directions and aligned in one direction and random not producing much strength in any but being cheaper to manufacture than others if used correctly aligned fibres can give the best strength to weight ratio. Structural composites use a mesh having a comb structure to add a reinforced structure this makes the composite thicker

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Q4 a
and help to resist deformation this add multiple layers to the process. aluminium is often used to reform this ~~can~~ is ~~often~~ often used in the aerospace companies.