

1903844 B. Conway

Section B Q2

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Brian Conway

9) Ionic Bonding - (Metals Bond to non metals)
this is where atoms transfer electrons between each other. It requires an electron donor and an electron receiver. Mostly metals are donors and non metals are receivers which is generally determined by the valences. If an outer shell is near completion then it will want to receive, if not then it wants to donate.

Covalent Bonding - (non metals - non metals)
the atoms share electrons but it is not a permanent transfer. Typical of atoms close to each other on the periodic table. Eg. 2 Hydrogen atoms join to form the molecule H_2

Metallic Bonding - (metals - metals)
In pure metals this is a giant structure of atoms. Free electrons are able to move about known as delocalised. The atoms become $+ve$ ions as the electrons in the outer shell are given up. A strong electrostatic charge/attraction contributes to the metals high strength + high boiling point. This structure is also more malleable as layers of atoms can slide over each other.

With Alloys there are 2 or more elements. Different size elements disrupts the regular structure making it harder for layers to slide over each other, thus - harder material. Elements like carbon, chromium, manganese are popular to mix.

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combine) a) valency is associated with the free space for electrons in the outer shell.
Also denotes the combining power (How well it can bond).

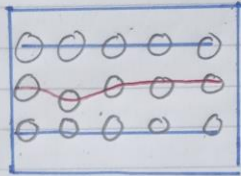
Full shells are chemically inert.

~~energy must be added to excite the system~~
~~allowing~~

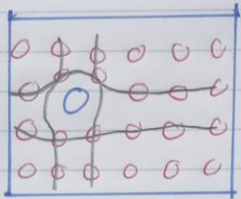
b.)

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c) Point defect - Vacancies



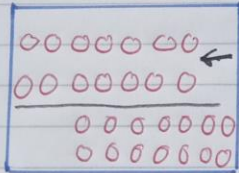
The structure of the lattice is distorted by a missing atom causing a vacancy (non uniform)



The atom is positioned between the normal lattice structure.
Self-interstitials

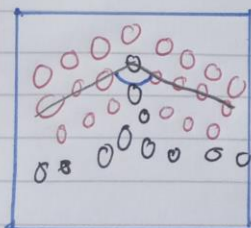
A perfect crystal can be disturbed also by a substitutional atom. The foreign atom ~~occupies~~ occupies the lattice site only.

Line defect



dislocations occur in the lattice structure. The layer slips, bonds break and new bonds form after slip is complete. Permanent plastic deformation.

Area



grain boundary

Formed @ grain boundaries there is a misalignment of crystal atoms (~~blue line~~). So the bonding structure changes. The defect forms when the two crystalline structures meet.

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d1

Q3 Section B.

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D. Lang

continue)

Forging Pistons can be Forged.

Aluminium is heated and placed in a mould (female side). The male side strikes the blank with tonnes of force and forces the aluminium into every crevice.

This method creates a scarred structure in the molecules creating very strong bonds.

Plastic injection moulding is suitable for a wide range of materials. Mostly thermoplastics as the runners and sprues can be recycled back into the hopper. However in some cases metal and even food can be produced with this method.

Blow moulding is limited by materials which can form a uniform paraffin. All thermoplastics or thermoset plastics are fine.

Forging is an energy intensive process commonly used with most metals or alloys. The material would define if heat treatment is necessary after forging happens.

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B. Cruz

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- (b) Generally risk assessment is carried out ranking Failure on a scale of 1-10
1 - very unlikely 10 - unavoidable.

$$RPN = D \times S \times P$$

The higher RPN should receive most attention in the action plan.

Process Name	(S) Severity (S) 1-10	(P) Probability of occurrence 1-10	(D) Probability of Detection 1-10	RPN No
Bolt-Torque Incorrect	Rating 1-10	Multiply each one out.	Make action Plan.	$S \times D \times P$ 50 75 <u>100</u>
Bolt Failure. etc.				

Priority

p8

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Bending.

ci)

$$k_G = C_1 + C_2 \left(\frac{2h}{D} \right) + C_3 \left(\frac{2h}{D} \right)^2 + C_4 \left(\frac{2h}{D} \right)^3$$

$$\frac{h}{r} = \frac{h=1.8}{r=.5} = 3.6 \quad \sqrt{h/r} = 1.897$$

$$C_1 = 0.935 + 1.922 \sqrt{\frac{h}{r}} + 0.004 h/r = 4.596 \quad 4.6$$

$$C_2 = -0.852 - 5.327 \sqrt{h/r} + 0.86 h/r = -10.35$$

$$C_3 = 0.754 + 6.281 \sqrt{h/r} - 0.121 h/r = 12.235$$

$$C_4 = -0.138 - 2.876 \sqrt{h/r} + 0.031 h/r = -5.48$$

$$k_G = 4.6 + (-10.35) \left(\frac{2(1.8)}{10} \right) + 12.235 \left(\frac{2(1.8)}{10} \right)^2 + (-5.48) \left(\frac{2(1.8)}{10} \right)^3$$

$$\frac{2(1.8)}{10} = .36$$

$$4.6 - 10.35(.36) + 12.235(.36)^2 - 5.48(.36)^3$$

$$k_G = .907$$

$$(ii) \sigma_{max} = k_G \frac{32 M}{\pi (D-2h)^3} = .907 \frac{32(55)}{\pi (10-2(1.8))^3}$$

$$= .907 \frac{1760}{823.55}$$

$$= 1.94 \text{ pa}$$

~~Section B.~~ Section A1903849
B.C

Q1 (a) Ultra low NOx and soot emissions are the focus of OMEX poly-oxyethylene - dimethyl ether, is a promising alternative to diesel when combined with gasoline.

Another fuel is hydrogen. if burned correctly should have low NOx + less harmful byproducts.

OMEX ^{Hydrogen} will reduce soot particles and NOx

(b) The End user may experience initial confusion as there will be more than just a choice of petrol and diesel available at the pump. Initially these fuels won't be in abundance so there could be a higher price at pump until infrastructure becomes more mainstream. Also with that said there could be shortages as popularity exceeds infrastructure.

(c) Availability at every gas station is needed. Hydrogen carries problem of storage which must be overcome. also it has different combustion characteristics and calorific value with lighter density. essentially the fuels cannot be simply added to any old engine. it would be great to deviate from oil (crude) to mitigate fracking and oil spills etc. less carbon in the atmosphere. the challenge is delivering the technology to the people reliably so it fits with their every day life.

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Section B Q2

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combining) a) valency is associated with the free space for electrons in the outer shell.
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$$b.) \text{ BCC } a = \frac{4R}{\sqrt{3}} \quad .362 = .00362 \text{ m}$$

$$.362 = \frac{4R}{\sqrt{3}}$$

$\sqrt{3}$

$$.362 = \frac{4R}{1.732}$$

$$1.732 \times .362 = 4R$$

$$\frac{1.732 \times .362}{4} = R$$

$$\frac{1.732 \times .00362}{4} = .1567$$

$$= .00156746 \text{ m}$$