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Question one

- a) Two fuels that could help meet the regulations are bio-ethanol and ~~Dimethyl ether (DME)~~ ~~bio~~ ethanol helps reduce emissions by carbon offsetting. When ~~it~~ produced as it comes from plants such as corn, corn and algae so the carbon footprint has been reduced ~~by~~ before it has been combusted. DME would help as it has low NOx emissions as the combustion happens at a lower temperature and will burn fit as can use existing LPG infrastructure.
- b) The practicalities of using alternative fuels has ~~not~~ always fallen short of the ~~case~~ of being regular petroleum or diesel. Using bio-fuels such as ethanol can leave the consumer with less mpg than regular Automotive fuels along with already being harder to source in today's climate. If these fuels such as DME and bio-ethanol were used regularly a flex fuel system would need to be installed as the scarcity of finding them could leave a motorist stranded if they could not source the fuel. In countries such as Brazil bioethanol is a main fuel in fitting situations as there is enough land to farm for fuel without imposing on land needed for agriculture along with a climate that is suited for growing cane.

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Question 1 (c)

for fuels such as DME and bioethanol to be successful in a country like the UK would need an ~~inf~~ infrastructure change to accommodate the new fuels. The DME could use existing technology that LPG uses but would need to be scaled up to allow for a more economically successful product unless if the fuels were supplied in low volumes the end cost to the user would not warrant using the fuel. As DME has a low calorific value more fuel would need to be used to get the same mileage as petrol or diesel, this would then cause more shipping and truck delivery costs to get it to the vehicles to ~~refuel~~ refuel. Ethanol although could use the same filling station currently would require a lot of land mass to grow the fuel something the UK ~~to~~ does not have. Bioethanol grown in Brazil can produce 60 tonnes of sugar cane per hectare which alone can produce environmental problems such as vassé which is a corrosive by product and can ruin ecosystems if not disposed of correctly. The average fuel sales in the UK is roughly £17,000 litres a day if we were to run on pure ethanol we would need around 29 Acres per Day of ethanol, ~~to~~ which ~~is~~ is not sustainable in the UK.

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Question 2 (a)

Valency of an atom is a calculation of the number of ^{electrons} ~~atoms~~ in the outer shell. If they are between 1 and 4, if ~~the number~~ in the outer shell then the valency is classed as positive, for a compound with 4, 5, 6, 7 Valency is determined by subtracting the electron from 8.

Ionic bonding occurs when the transfer of electrons takes place. One atom or molecule donates one or more electrons to another. The ions then attract each other through electrostatic forces of attraction as they are oppositely charged. Metallic bonding is bonding that occurs in metal. This leads to giant structures of metals atoms arranged in a regular pattern. The outer shell of electrons of metals are delocalised and so a metallic structure is a regular arrangement of positive ~~charge~~ charged ions with negative electrons in between, held together by electrostatic forces of attraction. Covalent bonding is when the atoms share electrons but don't permanently transfer them. Normally happens with atoms of the same element or elements close on the periodic table.

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Question 2 (B)

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$$a = 0.362$$

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

$$R = \frac{2\sqrt{2}}{a} = \frac{2\sqrt{2}}{0.362} = 7.81 \text{ nm}$$

Question 2 (c)

Point Defects can be present in the form of missing atoms when the lattice structure forms. It can leave vacancies in the atom structure, allowing for the distortion of surrounding atoms. Point Defects can also be present in the ~~off~~ interstitials where the defect occurs when an atom has become positioned between the normal lattice structure atoms. The final point defect is substitutional this occurs when a crystalline solid is replaced by a different type of atom - unlike interstitial defect, foreign atoms should occupy the lattice site only and not the interstitial position. Line Defects are caused by dislocations in the lattice, where the defect in the structure. Dislocations allow layers of the lattice to slip relative to adjacent layers. As the areas move, bonds between atoms break, with new bonds forming once the slip motion is complete. Area Defects are when the grain boundaries create area defects in the crystalline structure. grain boundaries between the crystal in a material bonding structure changes - orientation of crystals will be different.

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Question 2 D

~~growing a grain structure as used on~~
~~Jet engine blades as~~

The Dislocation movement is classed as the Secondary creep. The Dislocations are generated and move when the Stress is applied to help drive the material from creep and fatigue.

Question 4

a) The main alloying element in 7xxx Aluminium is Zinc and Magnesium base on the Al-Zn-Mg-Cu, benefits to this alloy are relatively lightweight, good corrosion resistance and weldability, limitations of this alloy is it is not as strong as a steel equivalent

ii) ~~B~~ 1st Number indicates that the steel is Carbon steel the last two numbers indicate that the steel has a Carbon percentage of 0.45%

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Question 4 (b)

~~with~~ The 3 types of composite classifications are particle-reinforced, fibre reinforced and structural. The particle reinforced are harder and stiffer than the matrix material as the particles are part of a macro, micro or nanoscopic scale along with an improvement of mechanical behavior depends on the interface bonding. The fibre reinforced composites will have a continuous aligned fibres and create a high strength to weight ratio whilst utilizing a ~~low~~ relatively low density ~~and~~ fibre and matrix material. fibres are often brittle and will fail with minimal deformation whereas the matrix are often ductile acting in a plastic manner but when combined fibre reinforced will have characteristics of both. These can be used for automotive applications such as body panels and ducting where a ~~to~~ big load would not be seen. Structural composites are usually laminates or sandwich panels these are made up of both a composite and homogeneous materials combined, these create a material with properties in both. Examples include Aluminium honey comb and laminated ply carbon which can be used in automotive chassis structures. They can be used for this application as the grains are run oppositely like panel in ply wood.

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4(b) continued

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The cone panels are made from very
dense materials often from or mixed to
save weight as they can resist
deformation. Honey comb is a good choice
as it is naturally a very strong shape and
again resists deformation well.

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Question 4 (c)

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Volume = 0.45
Ef = 65 GPa
Em = 3.2 GPa
If =
Im =

≠ 2

$$f_t/f_m = \frac{(65 \times 0.45)}{(3.2 \times 0.55)} = 16.62$$

$$F_c = 30 \text{ mPa} \times 0.103 = 3.09 \text{ N}$$

$$F_c = f_t + F_m = 9 \text{ N}$$

$$F_m = 8.62 = 9 \text{ N}$$

$$7.62 = 9 \text{ N}$$

$$F_m = 1.957$$

$$\text{So } F_m = 9 - 1.957 = 7.042 \text{ N}$$