OCR Manufacture Gold Dust sheet 2019

Q1: Engineering Materials (pure metals)

Ferrous (contains iron): Iron, cast iron, carbon steel (low & high) stainless steel, High Speed Steel
Non-ferrous (no iron): zinc, copper, aluminium, lead, tin, titanium, brass, bronze, gold and silver
Alloys (combines 2 or more metals): brass (copper & zinc) Bronze (copper & tin), Stainless steel, steel, HSS, cast iron
Composite: (mix of man-made materials): glass reinforced plastic (GRP), carbon fibre, concrete.
Polymers: thermoplastics:- ABS, Polythene, HIPS, PVC, Nylon, Polycarbonate, Polypropylene.
Thermosetting:- polyester resin, urea-formaldehyde, epoxy resin, phenol-formaldehyde
Ceramic: Tungsten carbide, glass, ceramic bearing material
Smart materials: shape memory alloys, thermochromic materials, shape memory polymers, Quantum tunnelling composite (QTC)
Emerging materials: nanotechnology, advanced metal alloys (metal foams, Inconel)

Q2: Definitions

Ferrous metals contain iron. ***Non-ferrous*** does not contain iron. EG. of use - you may wish to select non-ferrous over ferrous in conditions where moisture is present so they won't rust.
Polymer categorise: **thermoplastic** – plastics that become soft when heating and harden on cooling, and are able to repeat these processes.
Thermosetting plastics – once heated and formed cannot be reshaped and difficult to recycle. Used for items that must not change shape when heated (pan handles & plugs)
Alloy is a combination of 2 or more metals to enhance the properties of the material to obtain a more desirable material.
Composite is a combination of 2 or more man made materials to enhance the properties of the material to obtain a more desirable material.
Smart materials:- are designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli- heat / moisture /magnetic fields etc.

Q2: Use of materials & properties

Stainless steel – sinks, cutlery **Cast Iron** – drain covers, machine bases **Cast steel** – vices, machines, engine parts
HSS- machine tools, drill bits, taps, **High carbon steels** – files, punches, chisels **Carbon fibre** – aircraft, lightweight parts
Tungsten carbide – machine tool inserts **Copper** – electric cables and pipes **Polycarbonate** – machine guards **Brass** – plugs, hinges **Bronze** – ship propellers **Polypropylene** - chairs, boxes, medical **QTC** – mobile phone screen **SMA** – glasses, fire alarms

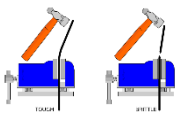
Q2: Material Properties

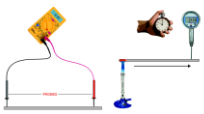
Property	Definition	Use
Ductility	Able to be deformed without losing toughness; pliable, not brittle.	Copper cables
Malleability	Able to deform under pressure without breaking	Riveting, lead/zinc roofing
Elasticity	Ability of a material to absorb force and flex in different directions, returning to its original position.	Bridges, springs
Hardness	The ability of a material to resist scratching, wear and tear and indentation	Bearings, surface plates
Tensile strength	The ability of a material to stretch without breaking or snapping	Steel cables
Conductivity	The ability of a material to conduct electricity.	Copper cables, brass plug

Forms of supply: what form do we get our materials in:- Sheet, rod, bar, angle, plate, powders and tubes.

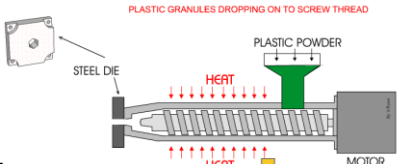
Characteristics of materials: cost, availability, machinability (how easy it can be machined), sustainability (resource and recycle)

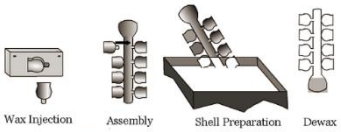
Testing: Destructive testing in a workshop (toughness, hardness, conductivity, tensile strength)

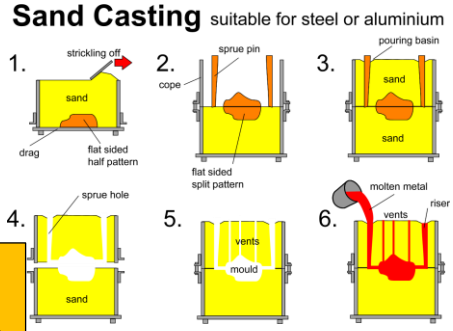


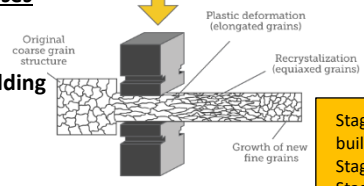



Non-destructive testing (NDT): Ultrasonic, X-ray, Dye penetrant and visual inspection









Q3&4: Manufacture processes

Extrusion –

Investment casting-

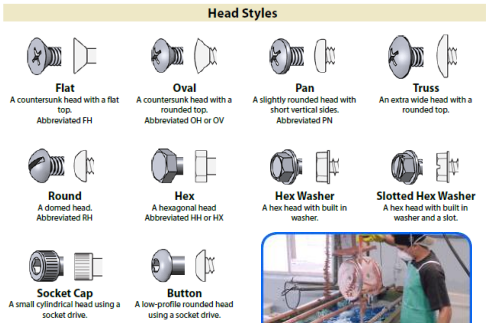
Die casting / injection moulding

Sand casting-

Forging-

Riveting – (pilot drill first)

Stage 2 coat wax pattern in refractory slurry to build-up mould
Stage 3 heat mould to melt out wax
Stage 4 pour molten metal into mould and leave to cool/solidify

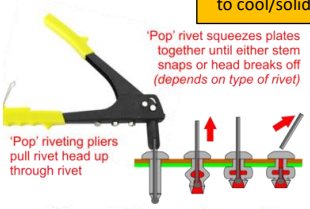


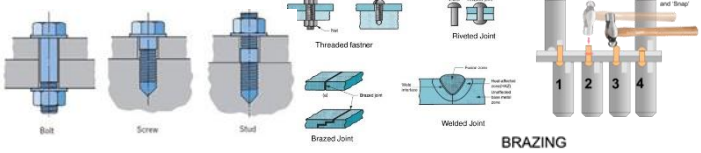
Surface finishes

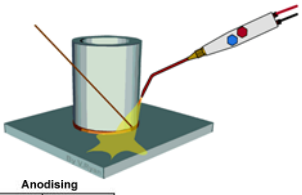
Electroplating

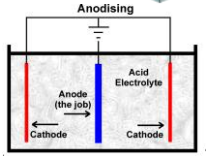
Powder coating

Galvanising









Heat treatments: There are five basic heat treating processes: **hardening**, **case hardening**, **annealing**, **normalizing**, and **tempering**. Although each of these processes bring about different results in metal, all of them involve three basic steps: heating, soaking, and cooling.

Scale of production: one off, prototype, batch, mass & continuious.

Moulding processes: vacuum forming, blow moulding, compression moulding, line bending, rotational moulding (bottles)

Risk assessment:- 5 stages – hazard, whom might be harmed, what you currently doing, how to improve and review.

Safety precaustions: guards in place, safety zone, no loose clothing, cleared area, clean floor,PPE, hair nets,

Turning operations: facing off (datum) turning diameters, knurling, undercutting, chamfering (45deg angle), taper turning (long angles) parting off, drilling from tail stock, centre drill, boring (making a larger hole)

Drilling processes: centre drill, through hole, blind hole, countersunk, counterbore, reaming.

Milling processes: end milling (grooves), Slot milling (slots within the work), face milling (flat surfaces), boring holes, drilling

Q5&6

Computer Numerical Control (CNC) – lathe, milling, routers, punching machines, press brakes (guilotine), water jet cutting, laser cutting, 3D printing (additive manufacturing) (DMLS, FDM,SLS)

Multi axis centre – combination of milling machine & lathe – 5 axis

Impact of modern technologies

Automation – output = faster to market, increased production rate, reduced makingn time

Quality =consistant / zero defects/ right first time

Workforce = smaller workforce, employee retraining, changes to job profiles, improved working conditions, less injuries, cleaner environment

Costs = high initial capital outlay and setting up, saving in workforce wages, reduce overall production costs (time, materials, wages)

Digital communication - research & development = internet research, CAD, electronic communication of drawings (email, video, VR), Video conferencing (skype)

Material supply & control = Just in time JIT – parts delivered when needed no long term stock kept less than 24hrs stock. (asda)

Inventory reduction = no need to keep large stocks, less space needed

Automatic ordering systems = bar code stock, as scanned, reordered.

Stock management = bar codes and tracking of products

Global manufacturing – global supply chain = close to skilled workers or raw materials to reduce transport cost (think cars (Ford))

Business benefits = changing global economies (funding lower economic country)

Standardisation of processes & proceedures = all factories doing same process, qulaity control, standards, ISO, EU.