Materials 2 Questions set 8
Durability and failure in materials – deformation, fracture & corrosion
Materials story: Challenger and Liberty ships – learning from mistakes

1. Watch the videos on Doitpoms of polymer balls bouncing at different temperatures, and silly putty being deformed at different rates:
http://www.doitpoms.ac.uk/tlplib/glass-transition/demos.php
(i) State carefully what you observe, and then explain the behaviour of the balls, and silly putty, use annotated sketches in your answer.
(ii) In what applications in engineering is this behaviour important?
(iii) How does this link to the Challenger disaster, and was it a purely materials issue?

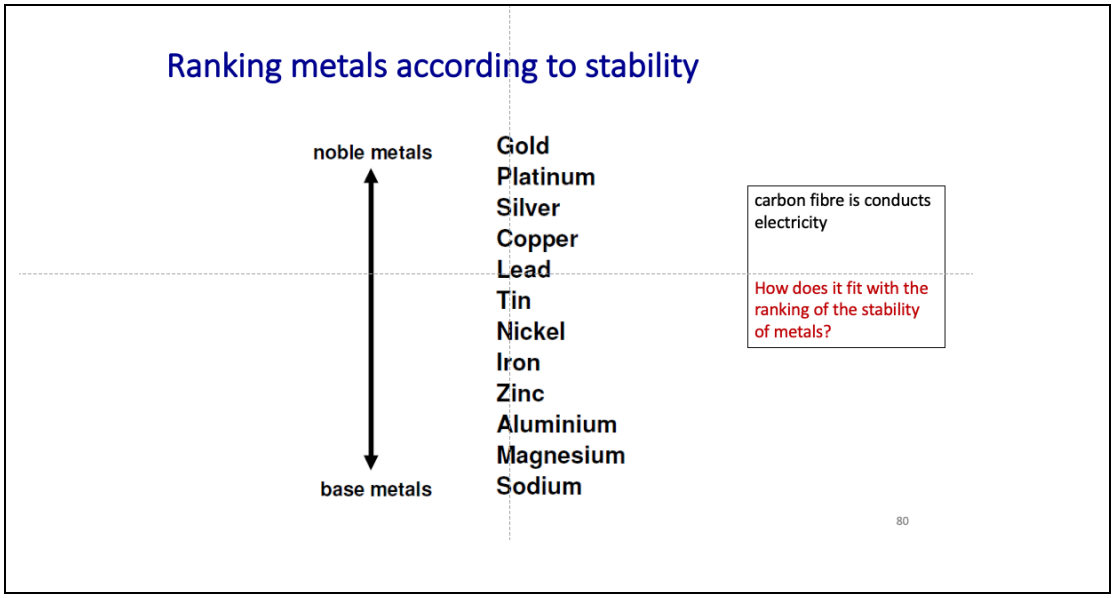
2. Elastic bands and car tyres are both made from elastomeric materials. However, these two materials have different properties.
(i) State three key property requirements for rubber used in car tyres.
(ii) Use sketches, and a few words, to explain the difference in the structures and constitution of the elastomers used for elastic bands and car tyres.
(iii) Explain why the concept of glass transition temperature is important for tyres used in cold climates. Is a lower or higher glass transition temperature desirable for use in cold conditions, and explain why?
To answer part (ii) of this question, and perhaps other parts, you will need to use **Resources** beyond what has been given on Learn to answer this question – recommendation start with Google.

3. (i) Give two examples of fatigue failures in engineering.
(ii) What are the typical features of the fracture surfaces?
(iii) Dye penetrant testing can be used to examine a material / component for cracks. Draw a series of annotated sketches to explain the procedure.
You will need to use **Resources** beyond what has been given on Learn to answer this question – recommendation start with Google.
(iv) Consider, and state, the locations in engineering structures and components where fatigue fractures may begin, with this in mind, what steps can be taken in engineering design to decrease the possibility of fatigue failures?

4. What is stainless steel? Why does it have good corrosion resistance (under most conditions)? Under what conditions does it have poor corrosion resistance?

5. Draw annotated sketches to describe the formation of the oxide layer in: elevated temperature oxidation of a nickel superalloy (highly resistant to oxidation) and steel (which oxidises readily).

6. See slide below: What corrosion issues can you envisage when carbon fibre composites are used in contact with metals and alloys? How can you mitigate these issues?



7. See slide below:
make an annotated sketch of what you would be able to see on the surface of the bolt.