Part V: Material and grading

Question V:1

A) Brinell, Vicker } ⇒ measure surface area

(2 Point)

Rockwell } ⇒ measure depth of indentation

B) (5 Point)
- Martensitic stainless steel
- Ferritic "
- Austemitic "
- duplex "
- Precipitation-hardened "

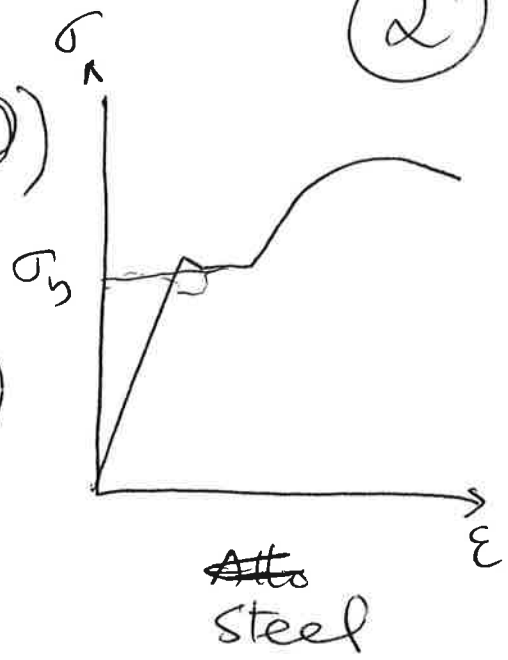
(C) PREN → Pitting Resistance Equivalent Number

(2P)

- Typical min value is 40.

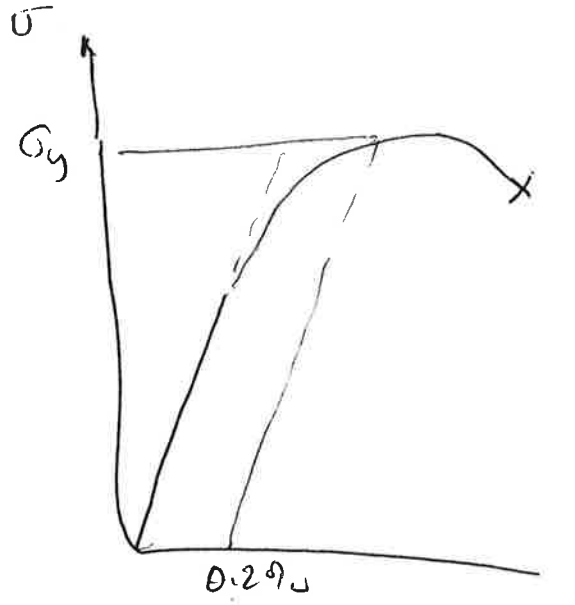
(2)

(D)



2P

Steel



Alloy

E) Resiliance

1P

X-80, $\sigma_y = 80$ ksi, $E = 125$ ksi $\Rightarrow R_x = \frac{\sigma_y^2}{2E} = \frac{80^2}{2\times125}$

$= \underline{25.6}$ ksi

Y-85, $\sigma_y = 85$ ksi, $E = 120$ ksi $\Rightarrow R_y = \frac{\sigma^2}{2E} = \frac{85^2}{2\times120}$

$= \underline{30.1}$ ksi

Y absorbe more energy than X

(F) API grading has one alphabet

2P

Non-API grading has two alphabet

Example API = L-80

Non-API XT-125

(G) $\sigma_y(275) = \sigma_y(75)\left[1 - x\%\cdot(275-75)\right]$

1P

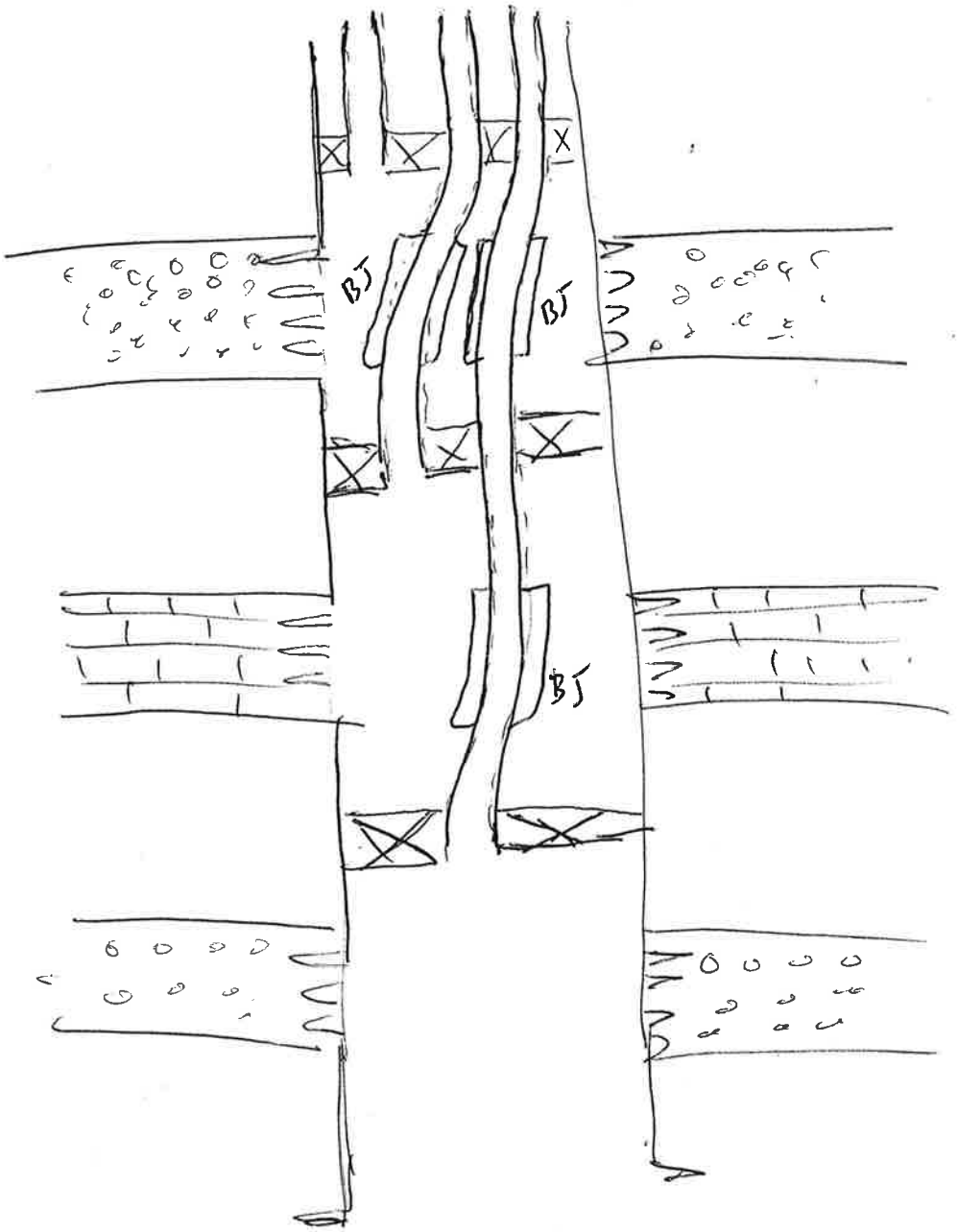
$x\% = \frac{1 - \sigma_y(275)/\sigma_y(75)}{275-75} = \frac{1 - \frac{100}{105}}{200} = \underline{0.001}$

Part VI Completion and tubing

Question VI.1

3P

a)



b) 1P

- Blast joint is a thick walled Subs.
  It is used to protect the tube string from abrasive due to the flowing oil/gas
- It is placed infront of the perforations

Question V1.2

(a) It is thick walled cylinder because $t > \frac{1}{10} \cdot r$ (1P)

(b)
- Equilibrium Condition
- Compatibility condition
- Hooke's law
- Boundary condition

(3P)

(c) Since $\sigma_\theta > \sigma_a > \sigma_r$ (4P)

According Tresca, at $r = a$

$$\sigma_\theta - \sigma_r = \sigma_y$$

$$\frac{P_a \cdot a^2}{b^2 - a^2}\left(1 + \frac{b^2}{r^2}\right) - \frac{P_a a^2}{b^2 - a^2}\left(1 - \frac{b^2}{r^2}\right) = \sigma_y$$

$$\frac{2 P_a a^2}{b^2 - a^2} \cdot \frac{b^2}{a^2} = \sigma_y$$

$$P_a = P_y = \frac{\sigma_y}{2}\left(\frac{b^2 - a^2}{b^2}\right)$$

$$= 0.5\sigma_y\left(1 - \frac{a^2}{b^2}\right)$$

(d) For $b/a = \sqrt{2}$

$$P_y = \frac{1}{4} \cdot \sigma_y$$

(1P)

Question V1.3

(5)

Burst. eqn

(1P)

$$P_y = 2\sigma_y \cdot \frac{t}{D}$$

$P_y = 21500$ psi

σ_y for C-90 = 90,000 psi

$$t = \frac{D \cdot P_y}{2\sigma_y} =$$

$$= \frac{5.5 \times 21500}{2 \times 90,000}$$

$$= \underline{0.6569 \text{ inch}}$$

Question V1.4

(1P)

$$\Delta l = l_o \alpha \Delta T$$

$$l_f = l_o (1 + \alpha \Delta T)$$

$$1000 \left(1 + 10^{-5} \times 200\right)$$

$$= \underline{1002 \text{ ft}}$$

(6)

Part VII 3D design and API - Collapse design

Question VII.2

(a) $SF = \dfrac{1}{\sqrt{x^2 - xy + y^2}}$

$x = -0.60$
$y = 0.55$

(2P)

$= \dfrac{1}{\sqrt{0.55^2 - (0.55)(-0.6) + (-0.6)^2}}$

$= \underline{1.0087}$

(1P) (b) Failure $\Rightarrow$ because (x, y) is outside the envelop.

$\Rightarrow$ Mode of Failure is Burst

Question VII.2

(0.5P) = (a) Four

(0.5P) (b) First compute D/t ratio

(4P) (c)
- Elastic
- Transition
- plastic
- Yield

Question VII.3

1P (a) It is burst pressure equation

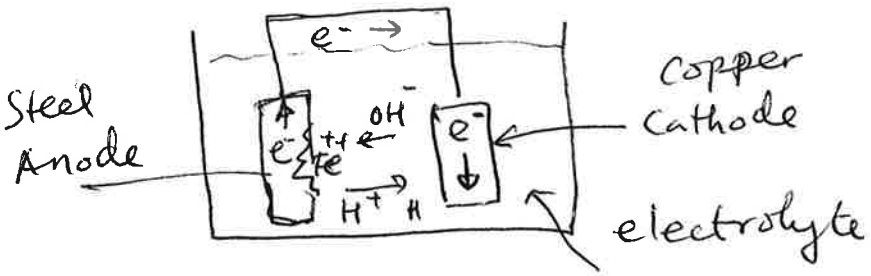
1P (b) bi-axial form, when $P_o = 0$

$$P_i = \frac{\beta \sigma_a - 2\sigma_a \pm \sqrt{-3\beta^2 \cdot \sigma_a^2 + 4(\beta^2 - \beta + 1)\sigma_y^2}}{2(\beta^2 - \beta + 1)}$$

Part VIII Corrosion

2.5P (a)

- Anode
- Cathode
- Electrolyte
- Electric current



2.5P (b) Cathode protection is an approach where the metal surface to be protected ~~Is made~~ by converting anodic (active) surface to cathodic (passive)

Continued for b

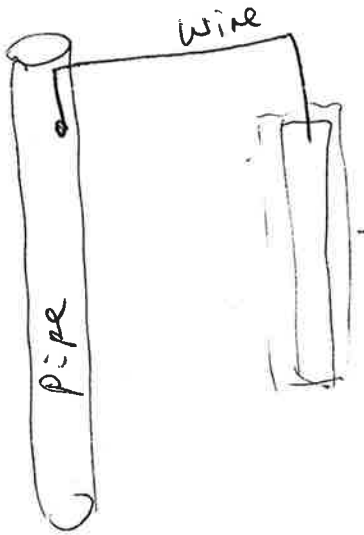
There are two types of Cathodic protections. These are

(I) Sacrificial anode

→ Sacrifical anode method utilizes galvanic corrosion

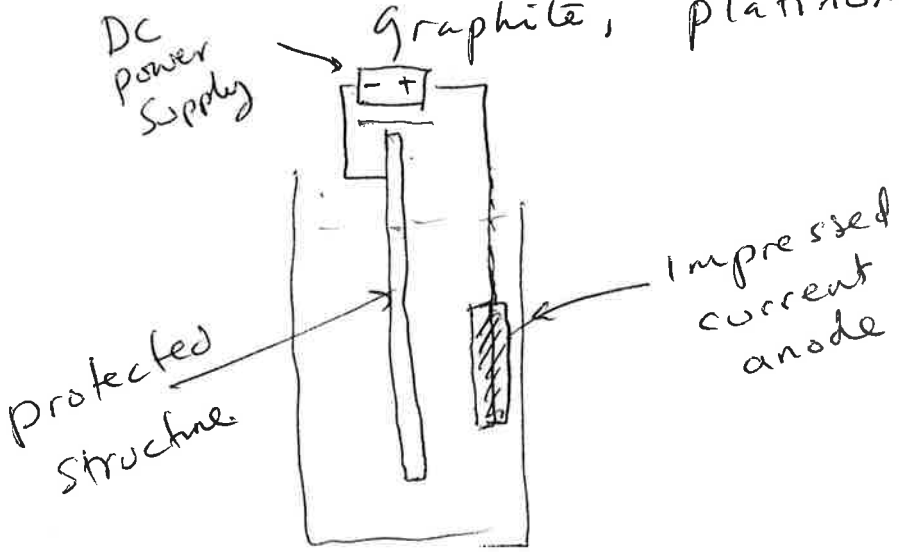
- Sacrifical anodes are pieces of metal usually electrically connected by wire ~~of steel~~ with the steel ~~metal~~ to be protected. The Sacrifical anode must be less noble than the steel such as magnesium, zinc, Al.

→ Sacrifical anodes corroded ~~and~~ protecting the steel from corrosion



(II) Impressed Current protection

— This method uses an external source to ~~protect~~ produce an electric current that is sent to the impressed-current anodes. These includes Graphite, platinum ...



(10) IO-Course

Part V.IIII Conoco – Halliburton Company

(1.25P) (a)
- Reduce risk level (HMS)
- Increase productivity
- reduce Non-productive time

(1.25P) (b)
- process
- Technology
  - People
  - Real time data

(1.25P) (c) RTO = Real Time Operation

ROT ~~E~~ngineer at offshore drilling Center is to support driller at offshore, ~~but not~~ to ~~disturb~~ pt, but not to disturb it

(1.25P) (D)
- Reliable data and
- data trasfer