مدونة المناهج السعودية

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الموقع التعليمي لجميع المراحل الدراسية

في المملكة العربية السعودية

33.5

**ANSWER THE FOLLOWING**

**Q 1: Choose the correct answer:** *(5 marks)*

a. Which material has an exact melting point
   i. Crystalline
   ii. Amorphous
   iii. Super-cooled liquid

b. Screw dislocation is a-
   i. Point defect
   ii. Line defect
   iii. Surface defect

c. What is the coordination number in FCC lattice structure
   i. 10
   ii. 14
   iii. 12

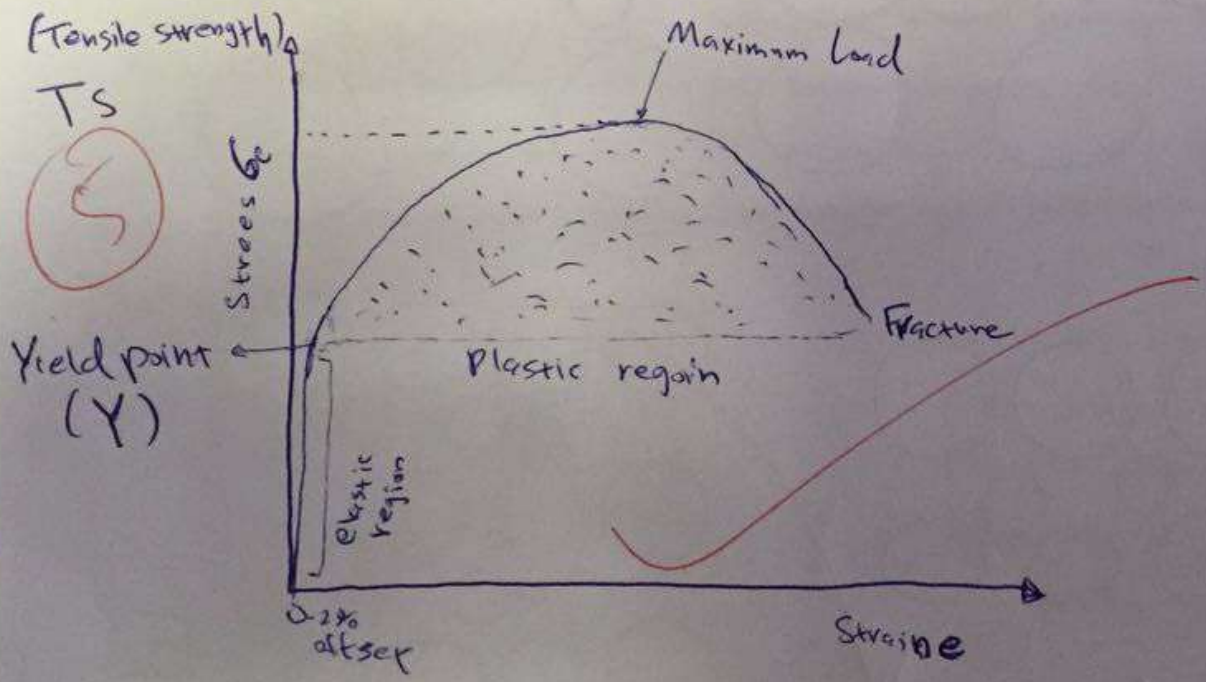
d. Which is the strongest bonding between atoms
   i. Ionic
   ii. Metallic
   iii. Covalent

e. Hooke's Law is applicable in which region
   i. Necking
   ii. Elastic
   iii. Plastic

4



**Q 2:** Draw a typical engineering stress-strain curve. Indicate important points and regions on the curve. *(5 marks)*



**Q 3:** Select which properties are important for the design of a plier from the list: Economic, Mechanical, Hardness, Physical, Chemical, Optical reflectivity, Thermal expansion, Emission, Electrical, Magnetic, Manufacturing, Aesthetics. *(2 marks)*

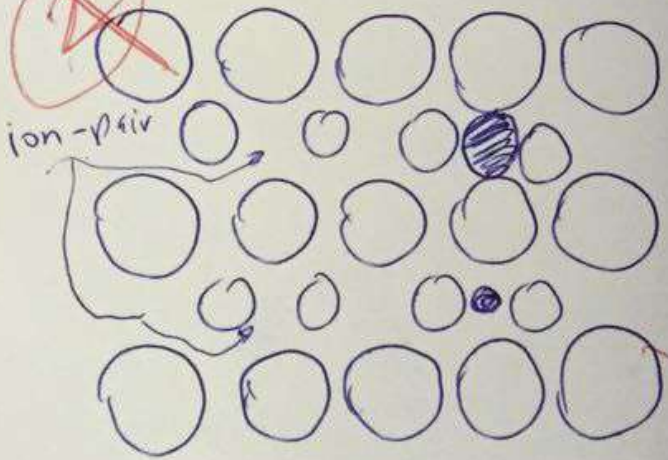


**Q 4:** Write down the advantages and disadvantages of "Substitution" and "Recycling" in manufacturing of products. *(4 marks)*

there're a lot of advantages ~~on~~ such as: reduce the cost and reduce the working ~~hours~~ houre ~~for~~ and time for any factory and the work time become shorter and some materials when we recycling or substitution don't become bad or low qusilaty

and the disadvatages are: ~~some~~ Some matirel ~~because~~ not from safe to recycling or substitution and maybe became dangerous that before it Recycling and maybe ~~some~~ sometimes the ~~re~~ recycling cost is very expensive to us.

**Q 5:** Discuss and draw "Interstitialcy" and "Ion-pair vacancy" point defects. *(4 marks)*




ion-pair Vacancy:
~~the~~ mean ~~what~~ we remove two atoms diffrent ~~from~~ in signal and it balance the ~~another~~ ~~is~~ Schottky

**Q 6(b):** Chromium has an atomic radius of 0.130 x $10^{-3}$ mm, a BCC crystal structure, and an atomic weight of 51.99 g/mol. Compute the theoretical density of chromium. [Avogadro's number = 6.023 x $10^{23}$ atoms/mol] *(4 marks)*

$$\rho = \frac{nA}{V_c N_A} = \frac{2 \cdot (51.99)}{a^3 \cdot (6.023 \times 10^{23})}$$

$$= \frac{2 \times (51.99)}{(2.706 \times 10^{-11})(6.02 \times 10^{23})}$$

$$= 6.383 \times 10^{-12} \text{ g/mm}^3$$

$$4R = \sqrt{3}\, a$$

$$a = \frac{4(0.130 \times 10^{-3})}{\sqrt{3}}$$

$$a = 3.002 \times 10^{-4}$$

$$a^3 = 2.706 \times 10^{-11}$$

**Q 7:** A tensile test uses a test specimen that has a gage length of 60 mm and an area = 300 mm$^2$. During the test the specimen yields under a load of 98,000 N and the corresponding gage length = 60.4 mm. The maximum load of 168,000 N is reached at a gage length = 64.2 mm. Determine

(a) yield strength,
(b) modulus of elasticity
(c) tensile strength.
(d) If fracture occurs at a gage length of 68.1 mm, determine the percent elongation.
(e) If the specimen necked to an area = 95 mm$^2$, determine the percent reduction in area.

*(10 marks)*

(a) Yield strength: $\sigma_e = \frac{F}{A_o} = \frac{98,000}{300} = 326.66 \text{ N/mm}^2$

(b) $e = \frac{l - l_o}{l_o} = \frac{60.4 - 60}{60} = 6.66 \times 10^{-3}$

$\sigma_e = E e$ $\quad E = \frac{\sigma_e}{e} = \frac{326.66}{6.66 \times 10^{-3}} = 49048.04 \text{ N/mm}^2$

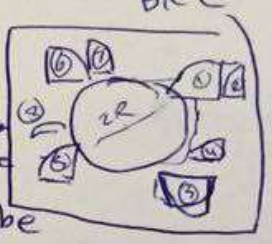
(c) $TS = \frac{F_{max}}{A_o} = \frac{168,000}{300} = 560 \text{ N}$

Q 6(a): Calculate the atomic packing factor (APF) for body centered cubic (BCC) lattice structure. Please show all the necessary steps for derivation. *(6 marks)*

(b) $APF = \dfrac{\text{number of atoms/unit cell} \cdot \frac{4}{3}\pi(R)^3}{V_c}$ — volume / volume cube

radius

BCC



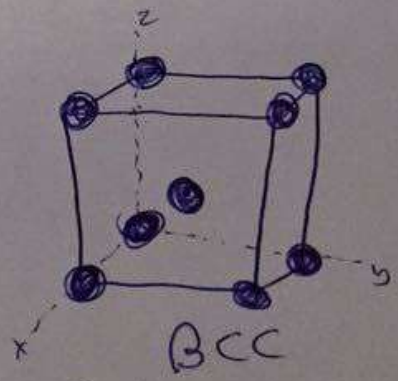

$4R = \sqrt{3}\,a$

$APF = \dfrac{2\,\frac{4}{3}\pi\left(\sqrt{3}\,\frac{a}{4}\right)^3}{a^3}$

$APF = \dfrac{2 \cdot 4\pi(\sqrt{3})^3 a^3}{3 \cdot 4^3 \cdot a^3}$

$APF = \dfrac{2\pi(\sqrt{3})^3}{3 \cdot 4^2} = 0.680$

number of atoms/unit cell = $1 + 8\frac{1}{8} \times 8\text{corners} = 2$




BCC

Body Centered Cube