31.5/40

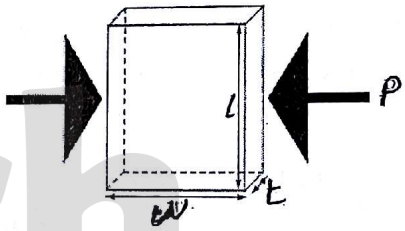
UNIVERSITY OF JORDAN
ENGINEERING SCHOOL
INDUSTRIAL ENGINEERING DEPARTMENT
Material science

Student Name: [redacted] Student Number: [redacted]

-Time duration:**50minutes**
-closed book & closed notes exam….
- **All constants you need are shown in the last paper**
solve Q1 and 2 on the paper, and the other questions on the answer sheet

Q 1 Fill in the blanks and multiple choice (20 marks)

1- The compressive stress induced in the volume element shown below is defined by the expression σ
=..E.ϵ..... / $\frac{P}{Lt}$



2- An example of a directional bond is ..Covalent bond (HF).

3- The van der Walls bond is a:

a) primary bond in polymeric materials.
b) dipole-dipole interaction.
c) charge-transfer fluctuation.
d) A +b
e) All of the above

15/20

4- Figure out the odd statement about ceramics in the following

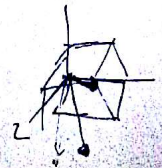
a) Good insulators of heat and electricity
b) Have high stiffness and strength
c) Ductile in nature
d) Contains both metallic and nonmetallic elements
e) B and C

5- The main difference between face –centered-cubic and the hexagonal-closed-packed crystal structure are in terms of ..geometry..... and ...number of atoms per unit cell.

stacking sequence.

6- The First material known to be used by man is ...metals...../.....stones.

7- In cubic crystal, the angle (in degrees) between the directions [111] and the directions [11$\bar{2}$] is :
...90°.....



8- The directionality of the physical properties of metals is called .Anistropy.

9- Two nitrogen atoms form an N_2 molecule by sharing (1/ 2/ (3)) electrons

10- The electronegativities of Ti and O are 1.5 and 3.5 respectively. The percent ionic character of the interatomic bond for the TiO_2 compound is ..63.12.....

11- There are several crystal systems that could be found in materials such as cubic system, hexagonal, and ...tetragonal....., and ..orthometic.

12- Fiber glass is considered to be a popular example on ..Composite.. materials.

13- The method that is used to calculate the grain size includes ..ASTM...and intercept.

14- The primary type of bonding that exist in AlP (aluminum phosphide) is ...Covalent.....

15- write down a name of a microscope that could be used to observe the grains of metals..optical..microscope

16- Polymer materials have (low/(high)) modulus of elasticity.

17- Twin boundaries result from .Shear.stress and .annealing..heat treatment.

Q 2 comparison: (3 marks) 3/3

	Ceramics	polymers	Smart materials
Objects made of / application	Glass vase	Bottles, Balls	Sensors (optical Fibers), Actuators (piezoelectric ceramics)

	Ionic	covalent	Van der waals
Bond energy	Hard, brittle, large bond energy	strong or weak	weak.

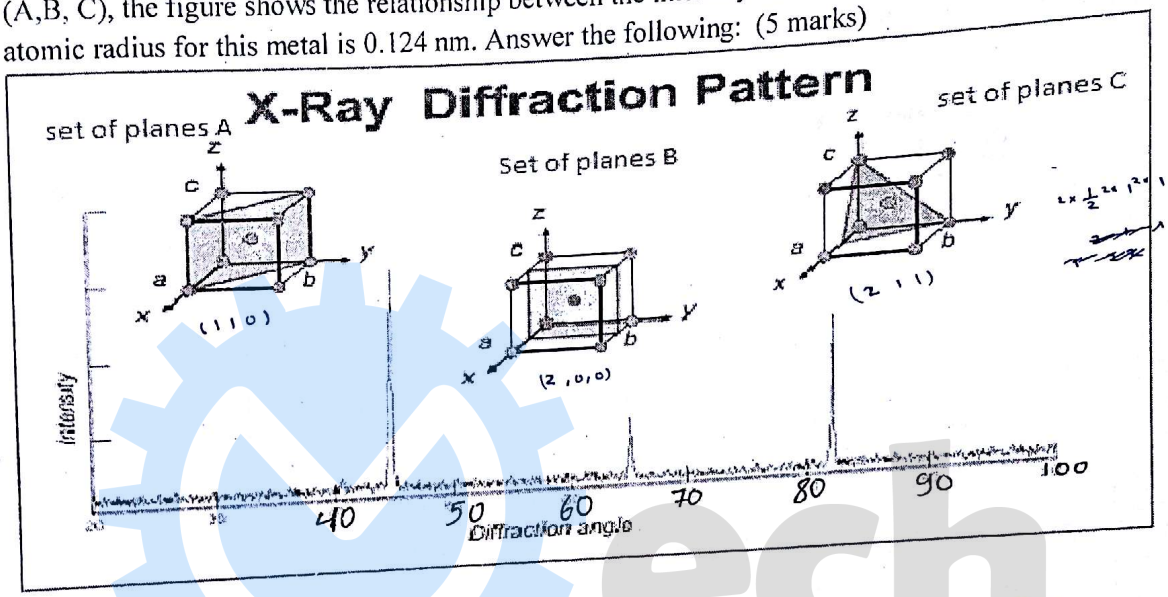
Q 3 Complete the four components of the discipline of material science? (1 marks)

Q 4 In a tensile test experiment, the following data was recorded: Find the change in diameter of a cylindrical specimen having an original diameter of 12.8 mm that is subjected to a tensile stress of 150 MPa if Poisson's ratio is 0.3 (3 marks)

Stress (MPa)	strain
100	0.001
150	0.002
250	0.004
390	0.1
450	0.25
fracture	0.38

6y

Q 5 The following figure shows the x- ray diffraction pattern for a certain metal at different set of planes (A,B, C), the figure shows the relationship between the intensity and the diffraction angle. Knowing that the atomic radius for this metal is 0.124 nm. Answer the following: (5 marks)

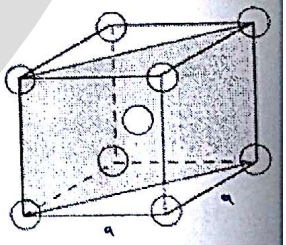


a) the crystal structure for this metal is ..... and the APF is.....

b) Determine the wave length of the used X- ray at a diffraction angle of 45 degrees? Assuming that diffraction order = 1

c) Name a plane (miller indices) where diffraction will not occur? (Justify your answer)

Q 6 Calculate the planner density in terms of R (atomic radius) for the plane below if the number of atoms centered on it is 2 atoms. (2 marks)



Q 7 Aluminum–lithium alloys have been developed by the aircraft industry to reduce the weight andimprove the performance of its aircraft. A commercial aircraft skin material having a density of2.50 g/cm3 is desired. Compute the concentration of Li (in wt%) that is required. knowing that densities of Li and Al are 0.534 and 2.71 g/cm3(3 marks)

Q 8 Draw 2 diagrams that clearly indicates the edge and screw dislocations (2marks)