Kafrelsheikh University
Faculty of Engineering
Mechanical Engineering Department
1st year –bylaw: 2007
Final Exam

Materials Engineering & Testing
June 5, 2015, 10: 00 AM
Time :3 Hrs
Maximum mark: 120

على كل طالب التأكد من ان الامتحان مكون من تسعة اسئلة فى عشرة صفحات

Question No. 1 (25 Marks):

Put ($\sqrt{}$) or (×) in the front of each of the following sentence:

| 1	The engineering stress strain relation in plastic zone is $\sigma = [k/(1+\varepsilon)] [\ln(1+\varepsilon)]^n$	( )
2	The units for toughness are the same as for resilience.	( )
3	Ductility may be expressed quantitatively in percent of area reduction as $\%AR = 100(l_f-l_o)/l_o$	( )
4	Lattice parameter can be measured within $0.5 - 50$ nm.	( )
5	All metals in elevated temperature are viscoelastic materials	( )
6	Atomic packing factor (APF) for simple cubic structure is 0.25 .	( )
7	The coordination number for simple cubic structure is 6.	( )
8	Close-packed planes are planes with the highest possible linear density.	( )
9	Viscoelastic behavior is nonlinear elastic behavior	( )
10	Diffusion coefficient is dependent on material and temperature only.	( )
11	Nonlinear elastic deformations are permanent deformations.	( )
12	In creep test strain rate is equal zero.	( )
13	Maxwell model can be used to evaluate material properties in tensile test	( )
14	Dashpots have instantaneous response with respect to load.	( )
15	Kelven and Voiget models are different viscoelastic models.	( )
16	Generally, the HB and the tensile strength are related according to $TS(MPa) = 3.45 \times HB$	( )
17	X-ray diffraction method can be used to measure the inter atomic distance of polymers	( )
18	Conversations between hardness results of different scales is possible	( )
19	For isotropic materials mechanical properties from tensile and compression tests are different	( )
20	For most of metals values of yields stress in shear is twice it value in tension	( )
21	Strain hardening exponent is equal to true yield strength at ultimate points	( )
22	Viscoelastic properties of material can be determine from relaxation test using Kelven model	( )
23	FGM can be used in manufacturing of fuel cell	( )
24	Resilience can be defined as the require energy per unit volume of material to induce failure.	( )
25	Recently polymers are used in electric power transportations	( )

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26	Elastic modulus of ceramics are higher than that of metals	( )
27	Fracture toughness of ceramics are higher than that of metals	( )
28	Corrective stress strain curve is lower that true stress strain curve.	( )
29	Colombia space shuttle was lost due to using FGM	( )
30	Most of metals are crystalline in the simple hexagonal structure due to its poor APF	( )
31	FGM are used in bone replacement	( )
32	FGM are used in electric power transportations	( )
33	Ashby charts are not used in metal forming process	( )
34	X-ray diffraction technique can measure lattice dimensions for all materials	( )
35	ASTM is a material properties	( )
36	Toughness of brittle materials are higher than that of ductile materials	( )
37	RCC composites strength increases with increasing temperature	( )
38	Mechanical properties can be determine from tensile or compression test usually	( )
39	Bucking is a precaution that should be considered in compression test	( )
40	Fraction effect is an important parameter during tensile test	( )
41	Design of machine elements depends on plastic properties	( )
42	Spinning is a metal forming process that depends on plastic properties	( )
43	Deep drawing process can be used in stainless steel pans	( )
44	Most of metals are crystalline materials	( )
45	Some of polymers are crystalline materials	( )
46	Gold electric resistivity is zero	( )
47	Materials engineering is a recent approach	( )
48	FGM are conventional composite materials	( )
49	Elastic deformation is a reversible process	( )
50	All metals are ductile in elevated temperature	( )

Question No. 2(17 Marks):

Using creep test find the mechanical properties of the given visoelastic model

Solution
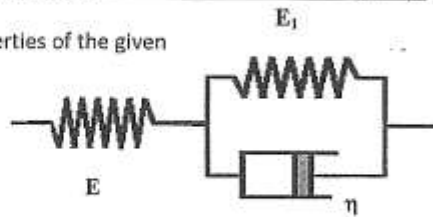
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Best wishes
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Question No. 3(8 Marks):

What are the precautions that should be taken into consideration during preparing tensile test specimens.

SOLUTION:

1)...

2)...

3)...

4)...

Question No. 4(8 Marks):

An FGM plate that has continuous gradation of the material properties as

$$E = E_o e^{\beta x}, \qquad v = v_o e^{\beta x}, \qquad k = k_o e^{\delta x} \qquad \text{and} \qquad \alpha = \alpha_o e^{\gamma x}$$

Where E: Youngs modulus, n: Poissons ratio, a: coefficient of linear thermal expansion, k: heat conductivity and E_0, v_0, k_0, β, γ and δ are material constants. Find the values of these constants.

SOLUTION:

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Question No. 5(12 Marks):

State 12 different applications for FGM

SOLUTION:

1)...

2)...

3)...

4)...

6)...

6)...

7)...

8)...

9)...

10)...

11)...

12)...

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Question No. 6(12 Marks):

Prove that the strain hardening exponent is equal to the true strain at the ultimate tensile strength point.

SOLUTION:

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Question No. 7 (12 Marks):
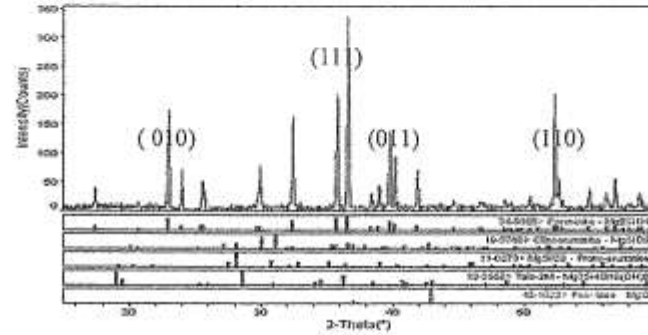
The following figure shows an x-ray diffraction pattern for sintered forsterite compacts with 1500°C for 1 hr at 10°C/min taken using a diffractometer and monochromatic x-radiation having a wavelength of 0.1542 nm; each diffraction peak on the pattern has been indexed. Compute the interplanar spacing for each set of planes indexed; also determine the lattice parameter of Fe for each of the peaks.
SOLUTION:

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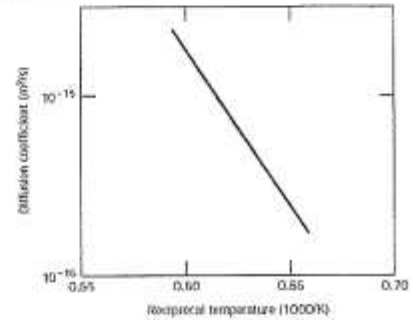على كل طالب التأكد من ان الامتحان مكون من تسعة اسئلة في عشرة صفحات

Question No. 8 (15 Marks)

Below is shown a plot of the logarithm (to the base 10) of the diffusion coefficient versus reciprocal of the absolute temperature for the diffusion of iron in chromium. Determine values for the activation energy and pre-exponential.
(R= 8.31 J/mol. K)
SOLUTION:

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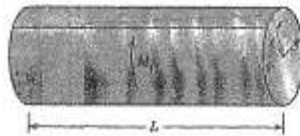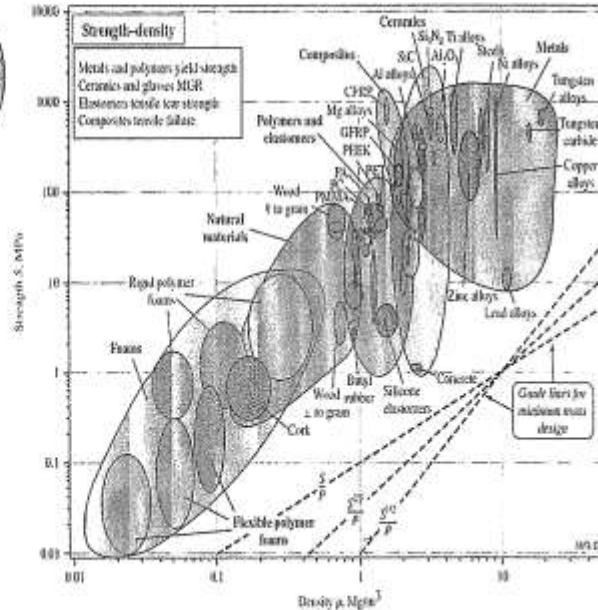على كل طالب التأكد من ان الامتحان مكون من تسعة اسئلة فى عشرة صفحات

Question No. 9 (20 Marks)

Design a light and strong cylindrical shaft of length L and radius r, as shown in the given figure. The shaft is subjected to twisting moment (or torque) M_t that produces an angle of twist ϕ Shear stress τ at radius r is defined by the equation $\tau = M_t r / J$. Where, J is the polar moment of inertia.

SOLUTION:

e

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