國　立　清　華　大　學　命　題　紙

94 學年度_____材料系_____系（所）_____組碩士班入學考試

科目_____理工測驗三_____科目代碼___1303___共_16__頁第_1__頁 *請在試卷【答案卷】內作答

1. 以米勒(Miller)指標表示一個晶體平面時，(123)平面與 x, y, z 軸分別交於何處？
   (a) 1, 2, 3　(b) 3, 2, 1　(c) 2, 3, 6　(d) 6, 3, 2　(e)2, 1, 0

2. X-光繞射常用的粉末法，對 fcc 晶體產生的繞射線，其繞射角度最小的原子晶面是
   (a) {100}　(b){110}　(c) {111}　(d) {200}　(e) {210}

3. 理論上對一完美晶體而言，將兩個相鄰原子平面剪移所需的應力，大約是此晶體剪模數(shear modulus)的幾倍？ (a)5　(b)0.5　(c)0.01　(d)0.001　(e)0.0001

4. fcc 晶體($\bar{1}11$)平面上的 1/2[110]全差排(total dislocation)，可分解爲哪兩條部份(partial)差排？
   (a) 1/6[12$\bar{1}$], 1/6[21$\bar{1}$]　(b) 1/6[1$\bar{2}$1], 1/6[$\bar{2}$1$\bar{1}$]
   (c) 1/6[$\bar{1}$2$\bar{1}$], 1/6[2$\bar{1}$1]　(d) 1/6[121], 1/6[21$\bar{1}$]　(e) 1/6[12$\bar{1}$], 1/6[211]

5. 沿[100]方向對鋁單晶施以拉伸應力，假設在 10 MPa 時，開始產生滑移(slip)變形；則鋁單晶的臨界分解剪應力(critical resolved shear stress)爲何？
   (a) 17 MPa　(b) 14 MPa　(c) 10 MPa　(d) 6 MPa　(e) 4 MPa

6. 將冷加工純銅一半再結晶(recrystallization)所需的時間取對數當縱座標，而取絕對溫度倒數當橫座標，所得的曲線圖形爲
   (a) C 形　(b) S 形　(c) 直線　(d) 彎曲向上　(e) 彎曲向下

7. 下列哪一現象與動態應變時效(dynamic strain aging)無關
   (a) 明確降伏點(sharp yield point)　(b) 降伏應力與溫度無關
   (c) 加工硬化速率變大　(d) 鋸齒狀應力應變曲線
   (e) 應變速率敏感率(strain rate sensitivity)很小

8. 對自由能(Gibbs free energy)敘述，下列何者是<u>錯誤的</u>？
   (a) 自由能是成份、溫度、壓力的函數　(b) 自由能隨溫度上升而變大
   (c) 自由能愈低的相愈容易存在　(d) 低溫時焓對自由能的影響較大
   (e) 高溫時熵對自由能的影響較大

9. Which alloy system with the 3 phases transformation reaction is a suitable one for preparation of the **amorphous** materials: (a) Eutectic　(b) Peritectic　(c) Eutectoid　(d) Peritectoid　(e) Monotectic.

10. The **Hall-Patch equation** states the flow stress proportional to n^{th} power of the grain size.
    n = (a) 1/2　(b) 1/3　(c) -1/2　(d) -1/3　(e) –1/4.

11. Which is the mechanism to cause the **martensite phase hardening** in a steel:
(a) Antiphase domain boundary and Solid solution strengthening;
(b) Grain size refining and Precipertation hardening;
(c) Residual stress and Grain size refining;
(d) Precipertation hardening and Solid solution strengthening;
(e) Solid solution strengthening and Residual stress.

12. The **solubility of Carbon** in f.c.c. Iron is much greater than that in b.c.c. Iron. Which of the following statement is the reason?
(a) Packing factor
(b) Position shape for the interstitial solid solution
(c) Slip system in f.c.c. is well defined
(d) Slip lines in b.c.c. is wavy
(e) Ferromagnetic and paramagnetic transformation.

13. What conclusion could be made from the **Kirkendall effect**?
(a) Diffusion is always an interstitial site diffusion
(b) Diffusion in substitutional solid solution is temperature depent
(c) Diffusion in substitutional solid solution is a vacancy mechanism
(d) Diffusion is caused by two or more atoms cooperative movement
(e) Matano method to solve the Diffusivity

14. The **Fick's Second law** is derived based on which one?
(a) Conservation of matter;
(b) Interstitial diffusion mechanism;
(c) Thermodynamic first law;
(d) Thermodynamic second law;
(e) Maxwell-Boltzmann distribution.

15. Which diffusion couple provides the **apparent diffusivity** close to the real **grain-boundary-diffusion coefficient**:
(a) Large grain-size polycrystalline specimen at high temperature;
(b) Large grain-size polycrystalline specimen at low temperature;
(c) Small grain-size polycrystalline specimen at high temperature;
(d) Small grain-size polycrystalline specimen at low temperature;
(e) Single crystal specimen at low temperature.

16. In derivation of the critical particle radius in a **homogeneous nucleation**, which two energies should be considered:
(a) Chemical free-energy change and Induced lattice strain energy
(b) Chemical free-energy change and Increased surface free-energy
(c) Induced lattice strain energy and Increased surface free-energy
(d) Chemical free-energy change and Close-packed plane factor
(e) Created surface free-energy and Constitutional supercooling

17. What does Frank-Hertz experimental result tell you?
(a) an elastic collision between electrons and atoms leads to energy transfer
(b) conservation of energy
(c) wave-particle duality
(d) existence of atomic energy states
(e) none of the above

18. Assume somebody sends an electromagnetic signal (ν_0) from the Earth, which is received by a spaceship at outer space. What is the frequency shift of the EM signal due to gravity?
(a) $+ \ GM\nu_0/Rc^2$
(b) $- \ GM\nu_0/Rc^2$
(c) $+ \ GM\nu_0/Rc$
(d) $- \ GM\nu_0/Rc$
(e) none of the above
(G: Gravity constant, M: Earth mass, R: radius of Earth, h: Planck constant and c: speed of light)

19. Which statement for hydrogen atomic spectra is **incorrect**?
(a) Fine-structure induced by spin-orbital interaction
(b) Energy splitting of fine-structure is $2\mu_B\mathbf{B}$ (μ_B: Bohr magnetron and **B**: orbital angular momentum induced magnetic field
(c) frequency of Lyman series is proportional to $(1\text{-}1/n^2)$
(d) selection rule $\Delta l=\pm 1$ (l: orbital quantum number)
(e) existence of hydrogen isotopes shifts the hydrogen atomic spectral lines to longer wavelength

20. A particle of mass **m** and energy **E** incident on a step potential barrier of height **U0 (>E)**. What is the distance from the surface of the barrier to the point at which the probability of finding the particle drops by e^{-1} ? (a) $\dfrac{\hbar}{\sqrt{2m(U0-E)}}$ (b) $\dfrac{\hbar}{2\sqrt{2m(U0-E)}}$ (c) $\dfrac{\hbar}{2\sqrt{m(U0-E)}}$ (d) $\dfrac{\hbar}{\sqrt{m(U0-E)}}$
(e) none of the above

21. A beam of X-ray is incident on a sheet of graphite. What is the angle between the incident beam and the scattered beam with the largest wavelength shift?
(a) 0° (b) 45° (c) 90° (d) 135° (e) 180°

22. Which statement is **incorrect**?
(a) ***matter*** wave can be described by a probability wave of finding that matter
(b) the de Broglie wavelength is described by h/p (h: Planck constant and p: momentum)
(c) particle mass is equal to $\hbar k / c$ (k: wave number ad c: speed of light)
(d) particle velocity is equal to $d\omega/dk$
(e) phase velocity is equal to ω/k

23. Which statement is **incorrect**?
(a) particle energy will decrease after tunneling through an energy barrier
(b) the tunneling probability of a particle through a barrier of width $\boldsymbol{d}$ is proportional to e^{-2kd}
(c) energy levels of quantum harmonic oscillators are equally spaced
(d) particle energy in infinite well is proportional to quantum number $\boldsymbol{n^2}$
(e) hydrogen energy level is proportional to $1/\boldsymbol{n^2}$

24. Which statement regarding to electron spin is **incorrect**?
(a) existence of spin is confirmed by Stern-Gerlach experiment
(b) origin of "abnormal" Zeeman effect
(c) magnitude of spin angular momentum is $\sqrt{3}\hbar/2$ for hydrogen atom
(d) spin quantum number is 1/2 for proton
(e) spin quantum number is 0 for neutron

25. Which statement is true?
(a) The quantum number s describe the orbital angular momentum of the electron
(b) The only value s, the quantum number describes the spin angular momentum of the electron. Its value is always equal to 1/2
(c)The angular momentum due to electron spin is 1/2 ħ
(d) spin magnetic quantum number is always equal to 1/2
(e) the orbital quantum number determine the spin angular momentum.

26. Which statement is **incorrect?**
(a) No two electrons in an atom can exist in the same quantum state.
(b) A quantum state is described by 4 quantum numbers
(c) Photons obey the exclusion principle
(d) protons are fermions
(e) in general, the electrons in a subshell remain unpaired.

27. Given that the spacing between vibrational energy levels of the HCl molecule is 0.36 eV, calculate the effective force constant. $\hbar = 6.58\times10^{-6}$ eV. The reduced mass of the system is 1.61×10^{-27} kg.
(a) 480 N/m (b) 4800 N/m (c) 48000 N/m (d) 48 N/m (e) 0.48 N/m

28. The carbon monoxide CO molecule has the lowest rotational energy equal to 7.61×10^{-23} J. Its reduced mass is 1.14×10^{-26} kg. $\hbar = 1.054\times10^{-34}$ Js. Find out the bond length.
(a) 10 nm (b) 1.1 nm (c) 0.11 nm (d) 110 nm (e) 0.011 nm

29. Which statement is **incorrect?**
(a) average molecular energy of idea gas is 3kT/2
(b) the r.m.s speed of the idea-gas molecule is $(3kT/m)^{1/2}$
(c) When energy is high enough, the distribution function of electrons approaches that of the idea-gas molecules
(d) no limit to number of particles per state for bosons
(e) the number of electron states of free electrons in a metal decrease with increasing energy.

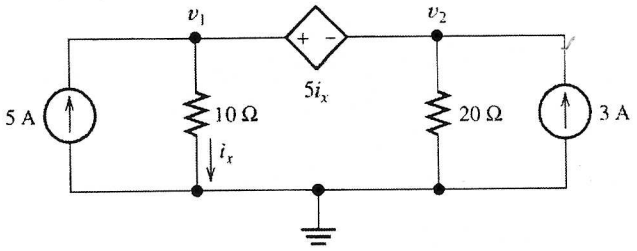
30. What is the average electron energy for Al at T=0 K? The highest energy occupied by electrons of Al at T=0 K is 11.8 eV. (a) 1.18 eV (b) 11.8 eV (c) 5.9 eV (d) 7.08 eV (e) 3.54 eV.

31. Which statement is true?
(a) The I-V curve shows that I always increases with increasing V in a tunnel diode
(b) The I-V curve is symmetric in forward and reverse bias regimes
(c)The boundary of the first Brillouin zone in a 1-D case occurs at a/π (a is the distance between two atoms)
(d) The response of an electron in a crystal is not the same as that of a free electron
(e) The Ohm's law state that the resistivity of the substance depends on the electric field.

32. Which statement is **incorrect**?
(a) the drift velocity of electron is typically higher than the thermal velocity
(b) the resistivity is inversely proportional to the mean free path
(c) both electrons and holes in semiconductors contribute to the conductivity
(d) The sign of the Hall measurement for semiconductors can not determine exclusively the type of the dominated carrier
(e) The energy gap of semiconductors is a function of temperature.

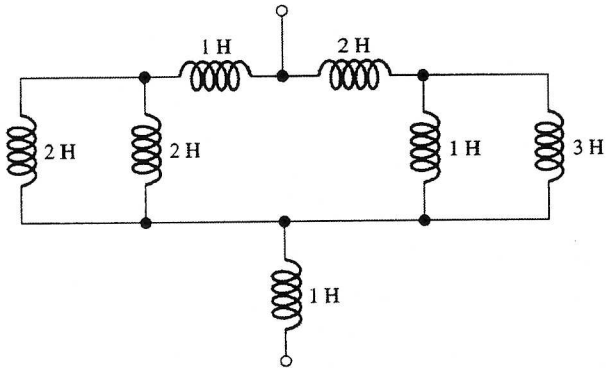
33. Find the value of i_x.

(a) 6.4A (b) 7.4A (c) 8.4A (d) 9.4A (e) 10.4A



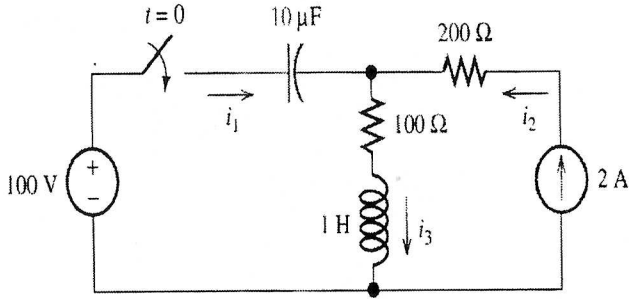
34. Find the equivalent inductance for the series-parallel combinations shown in below.

(a) 1.158H (b) 2.158H (c) 3.158H (d) 4.158H (e) 5.158H

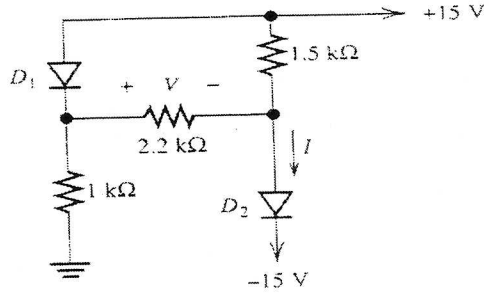


35. Find the steady-state value of i_3 for the circuit shown in below.

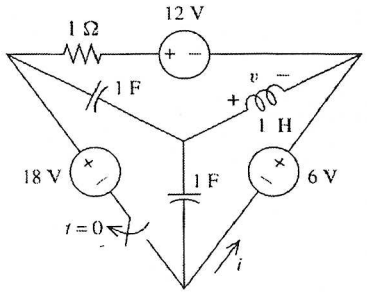
(a) 1A (b) 2A (c) 3A (d) 4A (e) 5A



36. Find the closest value of current " I " for the circuits in the following figure assuming that the diodes are ideal. (a) 1 mA (b) 2 mA (c) 3 mA (d) 4 mA (e) 5 mA



37. The circuit is in dc steady state at t = 0-.find v(0+), (a) 2.5V (b) 3V (c) 3.5V (d) 4V (e) 0V



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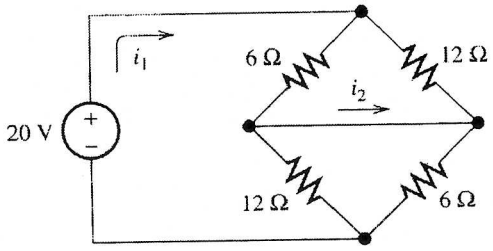
38. Repeat the problem 37, find the value of i(0+) .

(a) 0A (b) 3A (c) 3.5A (d) 4A (e) 2A

39. Find the value of i_2.

(a) 0.533A (b) 0.633A (c) 0.733A (d) 0.833A (e) 0.933A



40. 下列何者爲真

(a) 電阻並聯, 總電阻會增加

(b) 電容串聯, 總電容會增加

(c) 電感並聯, 總電感會增加

(d) 以上皆是

(e) 以上皆非

41. Find the values (in mA) of I_{D1} and I_{D2} for the circuit as shown in figure, assuming that the diodes are ideal.

(a) 5, 5 (b) 0, 10 (c) 5, 0 (d) 0, 5 (e) 2.5, 2.5

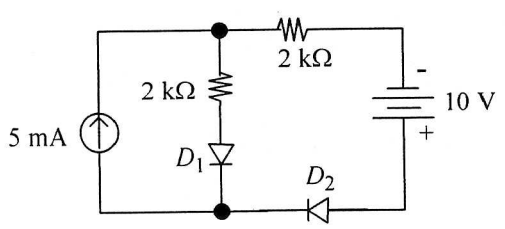


Figure for problem 41

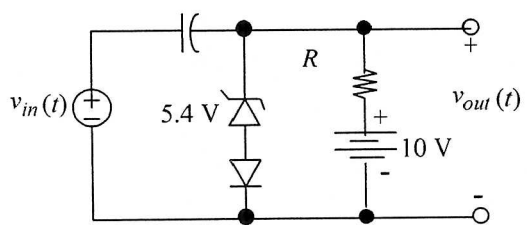


Figure for problem 42

42. Consider the circuit shown in figure. Assume the capacitor is large enough so that the voltage across it does not discharge through R appreciably during one cycle of input. What is the steady-state output voltage $v_{out}(t)$ (in volts) if $v_{in}(t) = 4\sin(\omega t)$. The reverse breakdown voltage of the Zener diode is shown. Allow a 0.6-V forward drop for the diodes.
(a) $4\sin(\omega t)$ (b) $4\sin(\omega t) + 6$ (c) 5.4 (d) 6 (e) $4\sin(\omega t) + 2$

43. For the circuit shown in figure, let the transistor have $\beta = 100$ and neglect the effect of r_o. Use $V_{BE} = 0.7$ V and assume all capacitances are infinite. What is the dc Q-point collector current I_{CQ}?
(a) 4.3 mA (b) 4.1 mA (c) 4.8 mA (d) 7.5 mA (e) 5.0 mA

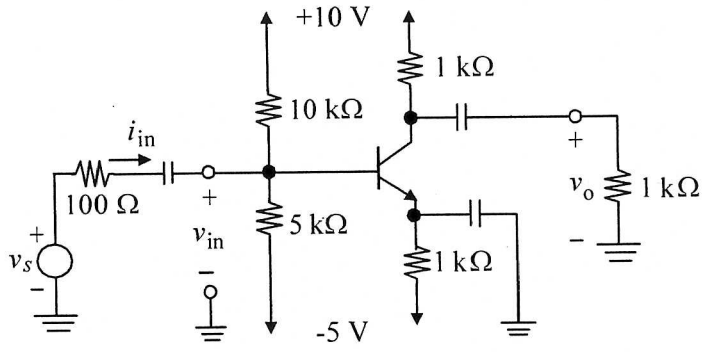


Figure for problems 43-44

44. As in the problem 43, find the value of small-signal voltage gain $A_v = v_o/v_s$.
(a) –158.4 (b) –79.2 (c) –66.6 (d) –48.4 (e) –43.4

45. For the circuit shown in figure, the n-channel depletion FET has $V_{to} = -4$ V and $I_{DSS} = 10$ mA. Find the values of I_{DQ} and V_{DSQ}, assuming all capacitances are infinite.
(a) 6 mA; 4 V (b) 5 mA; 5 V (c) 10 mA; 0 V (d) 2.55 mA; 7.45 V (e) 7.85 mA; 2.15 V.

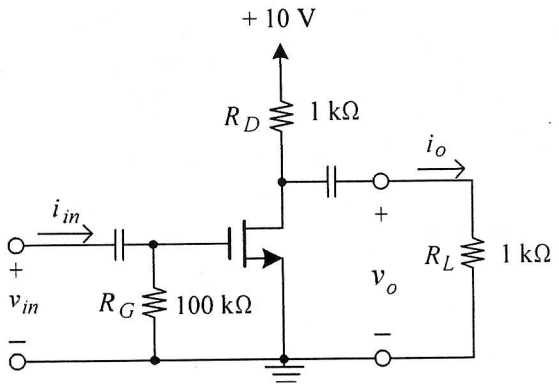


Figure for problems 45-46

46. For the circuit shown in figure, the n-channel depletion FET has $V_{to} = -2$ V and $I_{DSS} = 5$ mA. Find the voltage gain $A_v = v_o/v_{in}$, assuming $r_d = 2$ kΩ and all capacitances are infinite.

(a) 2.5 (b) –2.0 (c) –2.5 (d) –5.0 (e) –3.33.

47. Assume the OP amp in the circuit, as shown in figure, is ideal. Analyze the circuits to find the values of v_o (in volts).

(a) –8 (b) –2 (c) 0 (d) –4 (e) 2

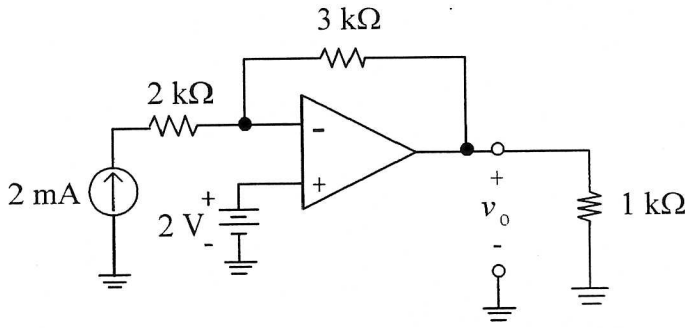


Figure for problem 47

48. Two amplifiers with the following characteristics are cascaded in the order of 2, 1.

Amplifier 1: $A_{vo1} = 12$, $R_{i1} = 1$ kΩ, $R_{o1} = 100$ Ω

Amplifier 2: $A_{vo2} = 20$, $R_{i2} = 2$ kΩ, $R_{o2} = 200$ Ω

Find the open-circuit voltage gain of the overall cascaded connection.

(a) 200 (b) 32 (c) 229 (d) 160 (e) 240

49. Which of the following covalent bonds has the largest dipole moment?

(a) C-C (a) C-H (c) C-O (d) H-N (e) H-F

50. Which of the following best explains the relative stabilities of the eclipsed and staggered forms of ethane?

The _____form has the most_____ strain.

(a) eclipsed; steric (b) eclipsed; torsional (c) staggered; steric

(d) staggered; torsional (e) none of the above

51. Which of the following is the best reaction sequence to use if one wants to accomplish a Markovnikov addition of water to an alkene with minimal skeletal rearrangement?

(a) water + dilute acid (b) water + concentrated acid

(c) oxymercuration-demercuration (d) hydroboration-oxidation

(e) none of the above

52. Which of the following alcohols will react most rapidly with the Lucas reagent (HCl, $ZnCl_2$)?

(a) $(CH_3)_3COH$ (b) $CH_3CH_2CH_2CH_2OH$ (c) $CH_3CHOHCH_2CH_3$

(d) $(CH_3)_2CHCH_2OH$ (e) none of the above

53. Which of the following is the strongest acid?

(a) CH_3NH (b) CH_3OH (c) CH_3SH (d) CH_3OCH_3 (e) CH_3Cl

54. In electrophilic aromatic substitution reactions a chlorine substituent:

(a) is a deactivator and a m-director.

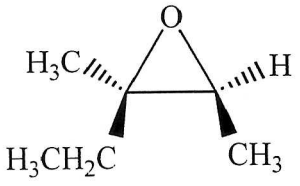
(b) is a deactivator and an o,p-director.

(c) is an activator and a m-director.

(d) is an activator and an o,p-director.

(e) none of the above.

55. What alkene would you treat with RCO_3H in order to obtain the compound below and its enantiomer?



(a) (Z)-2-methyl-2-pentene (b) (E)- 2-methyl-2-pentene

(c) (Z)- 3-methyl-2-pentene (d) (E)- 3-methyl-2-pentene

(e) 3-methyl-1-pentene

56. Which of the compounds below undergoes solvolysis in aqueous ethanol most rapidly?

(a) cyclohexyl bromide (b) methyl iodide (c) isopropyl chloride

(d) 3-chloropentane (e) 3-iodo-3-methylpentane

57. Which of the molecule will be appeared as an ionic form at pH 2.0?

(a) acetone (b) benzaldehyde (c) glutamate

(d) lysine (e) cysteine

58. Which of the following serves as the best dienophile in a Diels-Alder reaction?

(a) CH_2=CH-$N(CH_3)_2$ (b) CH_2=CH-CN (c) CH_2=CH-CH_3

(d) CH_2=CH-O-CH_3 (e) CH_2=CH_2

59. Which would you expect to absorb UV energy at the longest wavelength?

(a) isoprene (b) 1,3-cyclcohexadiene (c) 1,3,5-hexatriene

(d) ethane (e) *beta*-carotene

60. Which proton(s) are usually responsible for a peak in the proton NMR spectrum between delta 9 and 10?.

(a) the ring protons of an aromatic aldehyde

(b) the methyl protons of a ketone

(c) the protons on the alpha-carbon of an aldehyde or ketone

(d) the –CH=CH- protons of a conjugated aldehyde or ketone

(e) the –CH=O of an aldehyde

61. Which one is useful for converting a terminal alkyne to an aldehyde of the same carbon content?

(a) H_2O and a trace of acid.

(b).O_3 and then $(CH_3)_2S$

(c) hydroboration with disiamylborane, then hydrogen peroxide oxidation

(d) pyridinium chlorochromate (a complex of pyridine, HCl, and pyridine)

(e) Hg^{2+}, H_2SO_4, H_2O.

62. What is the product of the most common mode of fragmentation of a carboxylic acid in mass spectrometry?

(a) a cycloalkane (b) an alkene (c) an alkyne (d) an alcohol (e) an aldehyde

63. Which of the following compounds is a *meso* compound?

(a) *trans*-1,2-dichlorocyclopropane (b) *cis*-1-chloro-2-bromocyclopropane

(c) *cis*-1,2-dichlorocyclopropane (d) *trans*-1-chloro-2-bromocyclopropane

(e) 1,1-dichlorocyclopropane

64. In what way do thymine and uracil differ in their molecular structures?

(a) Uracil contains an additional double bond in its ring

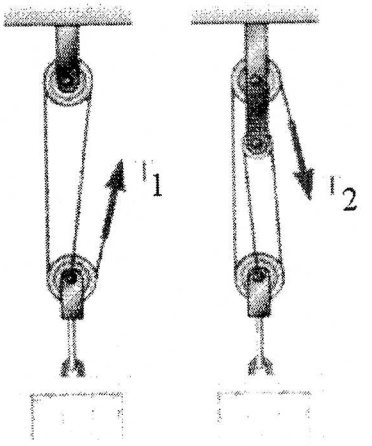
(b) Thymine contains an additional methyl group

(c) Thymine contains an additional methylene group

(d) Uracil contains an additional nitrogen atom in its ring

(e) Thymine contains an additional carbonyl group

65. A 150-kg crate is supported by the following rope-and-pulley arrangements as shown. Determine the tensions T_1 and T_2 in the rope.

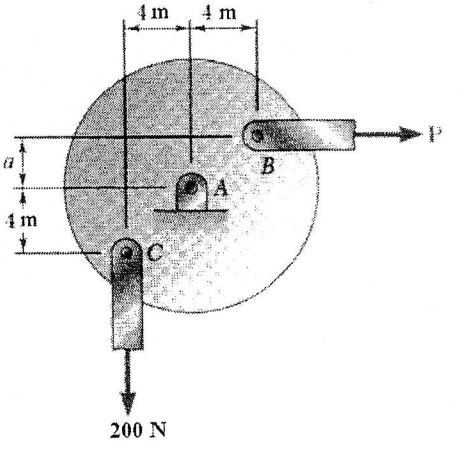


(a) T_1=150 N, T_2=150 N (b) T_1=50 N, T_2=37.5 N

(c)T_1=1471.5 N, T_2=367.9 N (d) T_1=490.5 N, T_2=490.5 N

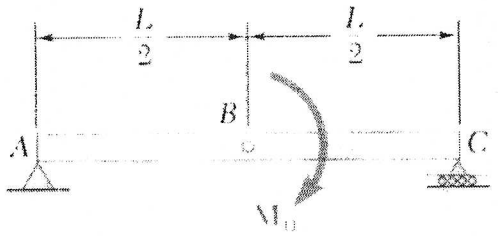
(e)T_1=490.5 N, T_2=367.9 N

66. Horizontal and vertical links are hinged to a wheel, and forces are applied to the links as shown. Knowing that a = 3 m, determine the value of P.



(a)P=100 N, (b) P=200 N (c) P=267 N (d) P=300 N (e) P=333 N.

67. For a beam and loading shown, determine the maximum absolute values of the shear V_{max} and bending moment M_{max}.

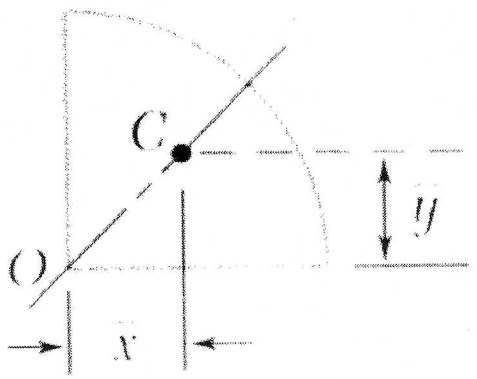


(a) $V_{max}=M_0/L$, $M_{max}=M_0/2$ (b) $V_{max}=0.5M_0/L$, $M_{max}=M_0/2$

(c) $V_{max}=M_0/L$, $M_{max}=M_0$ (d) $V_{max}=0.5M_0/L$, $M_{max}=M_0$

(e) $V_{max}=M_0/L$, $M_{max}=2M_0$

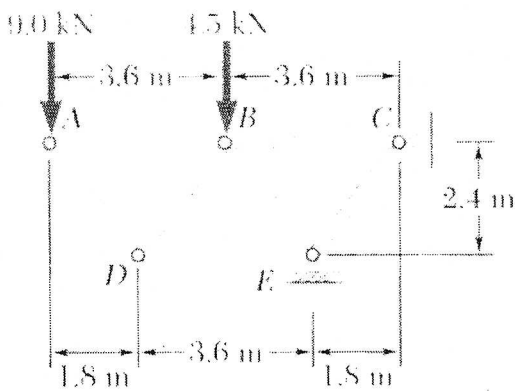
68. The centroid of the quarter-circular area $(\bar{x}, \bar{y})$ is



(a) $(\bar{x}, \bar{y})=(\frac{4r}{3\pi}, \frac{4r}{3\pi})$ (b) $(\bar{x}, \bar{y})=(\frac{3r}{4\pi}, \frac{3r}{4\pi})$ (c) $(\bar{x}, \bar{y})=(\frac{3r}{2\pi}, \frac{3r}{2\pi})$

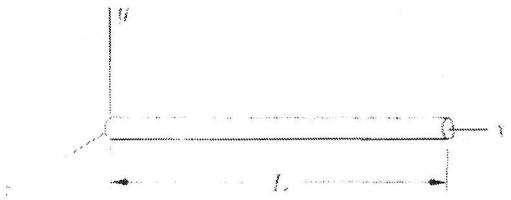
(d) $(\bar{x}, \bar{y})=(\frac{4r}{3\pi}, \frac{3r}{4\pi})$ (e) $(\bar{x}, \bar{y})=(\frac{2r}{3\pi}, \frac{2r}{3\pi})$

69. Determine the magnitude of the force in member *AD* of the truss shown.



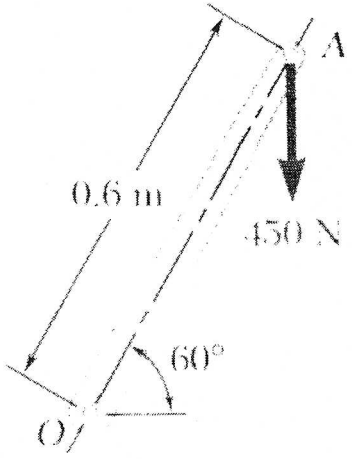
(a) F_{AD}=4.5 kN (b) F_{AD} =6.75 kN (c) F_{AD} =9.0 kN (d) F_{AD} =11.25 kN (e) F_{AD} =13.5 kN

70. Determine the moment of inertia of a slender rod of length L and mass m with respect to an axis which is perpendicular to the rod and passes through one end of the rod.



(a) $I_y = mL^2$ (b) $I_y = \frac{1}{2}mL^2$ (c) $I_y = \frac{1}{3}mL^2$ (d) $I_y = \frac{1}{4}mL^2$ (e) $I_y = \frac{1}{12}mL^2$

71~72. A 450 N vertical force is applied to the end of a lever which is attached to a shaft at O as shown.



71. Determine the horizontal force **F** applied at A which creates the same moment about O.

(a) **F**=135 N→ (b) **F**=135 N ← (c) **F**=260 N→ (d) **F**=260 N ← (e) **F**=300 N→

72. Determine the magnitude of the smallest force $|\mathbf{F}|$ applied at A which creates the same moment about O.

(a) $|\mathbf{F}|$=135 N (b) $|\mathbf{F}|$=260 N (c) $|\mathbf{F}|$=300 N (d) $|\mathbf{F}|$=450 N (e) $|\mathbf{F}|$=225 N

73. Find the polar moment of inertia of a circle (with the radius of r) with respect to any point on its circumference.

(a) $\pi r^4/2$ (b) πr^4 (c) $3\pi r^4/2$ (d) $2\pi r^4/2$ (e) $5\pi r^4/2$

74. Select the wrong statement listed in the following

(a) Factor of safety = Required strength/Actual strength,

(b) Margin of safety = (Actual strength – Required strength) /Required strength,

(c) Allowable stress based on yield strength= Yield strength/Factor of safety,

(d) Allowable load = (Allowable stress) x (Area),

(e) Ductile metal such as steel have proportional limits in compression very close to those in tension.

75. Select the wrong statement listed in the following:

(a) No stress can be developed in the statically determinate truss, as shown, when it is subjected to a uniform temperature ($\Delta T_1 = \Delta T_2$) change in each member,

(b) No stress can be developed in the statically determinate truss, as shown, when it is subjected to a non-uniform temperature ($\Delta T_1 \neq \Delta T_2$) change in each member,

(c) No stress can be developed in the statically determinate truss which composed by two different members, as shown, when it is subjected to a uniform temperature ($\Delta T_1 = \Delta T_2$) change in each member,

(d) No stress can be developed in the statically determinate truss which composed by two different members, as shown, when it is subjected to a non-uniform temperature ($\Delta T_1 \neq \Delta T_2$) change in each member,

(e) None of the above

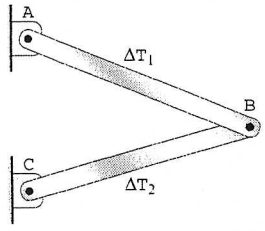


Figure for Problem 75

76. For a circular bar(homogeneous and isotropic) in torsion and it follows Hooke's law, which statement listed in the following is wrong:

(a) The maximum shear stress occurs on the surface of the bar,

(b) The shear stress within the bar vary linearly with the distance from the center of the bar,

(c) The shear stresses acting on a cross-sectional plane are accompanied by shear stresses of the same magnitude acting on longitudinal planes,

(d) The maximum shear stress is proportional to the applied torque T and inversely proportional to the moment of inertial,

(e) Circular tubes are more efficient than solid bars in resisting torsional loads.

77~78 For the beam with overhangs, as shown, subjected to two loads, one downward and the other upward.

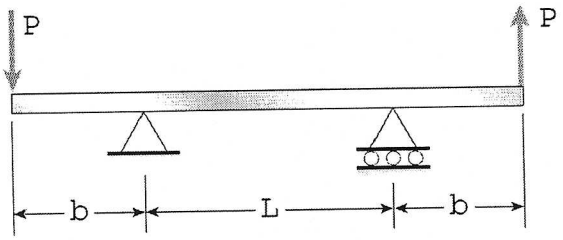


Figure for Problems 77 and 78

77. Determine the shear force V at the midpoint of the beam

(a) P (1 + 2b/L) (b) 2P (1 + b/L) (c) P(1+b/L)/2 (d) 2Pb/L (e) (P + 1)b/L

78. Determine the bending moment M at the midpoint of the beam

(a) -PL/2 (b) 0 (c) PL/16 (d) PL/4 (e) PL/2

79.~80. At a point on the surface of a pressurized cylinder, the material is subjected to a biaxial stresses $\sigma_x = 90$ MPa and $\sigma_y = 20$ MPa.

79. The normal stress acting on an element inclined at an angle $\theta = 30^0$.

(a) 60 MPa (b) 72.5MPa (c) 85 MPa (d) 100 MPa (e) 110 MPa

80. The shear stress acting on an element inclined at an angle $\theta = 30^0$ (select the closer one)

(a) 0 MPa (b) 20 MPa (c) 30 MPa (d) -20 MPa (e) – 30 MPa