

Q1. Choose the correct expression to Fill each of the following blanks:

1. Glucose and fructose can be separated by the presence of -----.
(a. Water, b. alcohol, c. acid)
2. The elimination of a small molecules beside the formation of polymer molecules is called -----.
(a. condensation polymerization, b. addition polymerization, c. depolymerization)
3. Organic compounds in which the oxygen atom of an alcohol is replaced by sulfur is called -----.
(a. amines, b. mercaptan, c. ether)
4. The reaction of natural fat with sodium hydroxide is known -----.
(a. esterification, b. alkylation, c. saponification)
5. Hydrogenation of alkyne is ----- reaction.
(a. an elimination, b. a substitution, c. an addition)
6. The solubility is often measured in units of -----
(a. mole, b. gm., c. mole per liter)
7. ----- is one of the optical methods.
(a. potentiometry, b. spectrometry, c. chromatography)
8. ----- indicator is used in complexation titration.
(a. sodium chromate, b. metallochromic, c. starch)
9. ----- is the molecular weight divided by the number of reacting units.
(a. mole, b. molarity, c. equivalent weight)
10. An increase in temperature will ----- the equilibrium concentration of the product if the reaction is exothermic.
(a. increase, b. decrease, c. equal)

Q2. A. Calculate the pH for the titration of 20ml of 0.11M ammonia by the addition of 0mL, 11mL, 22mL, 30mL 0.1M Hydrochloric acid.
Given that K_b for ammonia = 1.79×10^{-5}

B. A substance with molecular weight of 178 has an absorbance of 0.876 in a 1.0cm cell. If the absorptivity of the substance is 2750 liter/g.cm, calculate it's molarity.

Q3. Answer any two.

- A. 250 mL of sodium sulfate solution contains ~~6~~ moles of Na_2SO_4 . How many ppm of Na_2SO_4 that it contains? Given that Mwt of $\text{Na}_2\text{SO}_4 = 142$
- B. Calculate the solubility of $\text{Fe}(\text{OH})_3$ in a solution of pH = 4
Given that K_{sp} of $\text{Fe}(\text{OH})_3 = 4.0 \times 10^{-38}$
- C. A $\text{Ba}(\text{OH})_2$ solution was standardized by titration against 0.128N HCL , 31.7mL of the base being required to neutralize 46.25 mL of the acid. Calculate the normality of the $\text{Ba}(\text{OH})_2$ solution.

- Q4. A. Give the general chemical formula of the following compounds.
 a. Carbohydrate, b. Alkane, c. Thio acid, d. Carboxylic acid, e. ketone
 B. Write the chemical structure of the following compounds.
 a. Fructose, b. Aniline, c. Naphthalene, d. Pyrrol, e. Tetraethyllead

Q5. Choose either A. Or B.

- A. Write the chemical equation for preparation of the following compounds.
 1. Toluene by wurtz-fitting reaction.
 2. Styrene by dehydration of phenylethanol.
 3. Benzoic acid from styrene.
 4. Phenol by rasching process.
 5. 2-butanol from propanone.

B. Given the product(s) of the following equations.

1. $(C_6H_{10}O_5)_x + xH_2O \xrightarrow{H^+}$
2. $(C_2H_5)_2Zn + CH_3COCl \longrightarrow$
3. $C_4H_{10} + 4S \xrightarrow{650c^{\circ}}$
4. $C_2H_2 + HCN \longrightarrow$
5. $C_2H_5SH \xrightarrow[HNO_3]{CO_2}$

University of Technology/ Chemical engineering Department

Final examination

First year

Subject :Electrical Technology (الدور الاول)

Year :2008/2009

Q1: Choose the correct answer

a-When voltage applied across a diode in such a way that the diode prohibits current, is said to be:

- 1-Reverse –biased
- 2-forward biased
- 3-open switch

b- Silicon diodes have a forward voltage

- 1-0.3 V 2-0.7 V 3-0.1 V

c-Common emitter transistor means the emitter connected directly to:

- 1-both base and collector
- 2-base only
- 3-emitter and collector

d-The resistance of most material is:

- 1-increase with temperature increased
- 2- decrease with temperature increased
- 3-stay constant during increasing or decreasing of temperature

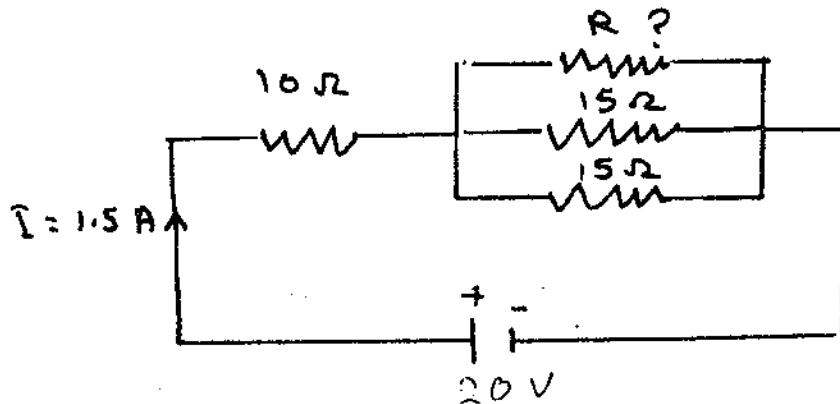
f-the induced emf of a dc machine is:

- 1-directly proportional to speed of armature
- 2-inversely proportional to speed of armature
- 3-proportional to square of speed

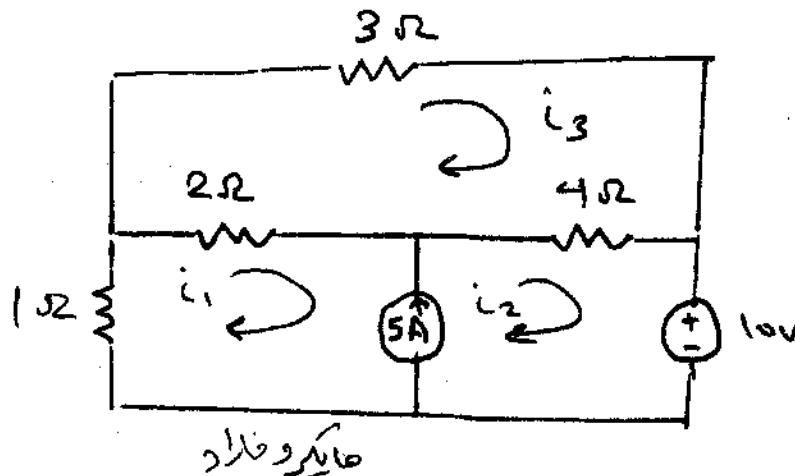
G-in the circuit with self inductance the required time by the current to attain a value of maximum is called:

- 1-Time constant
- 2-Final time

Q2-For the circuit shown in figure, calculate the value of resistor R when the total current taken by the network is 1.5 A



Q3-Solve for the current in each of the circuit shown in figure



Q4- Capacitor of 30uf connected in series with a resistor of 500 ohm across 100V dc supply find:

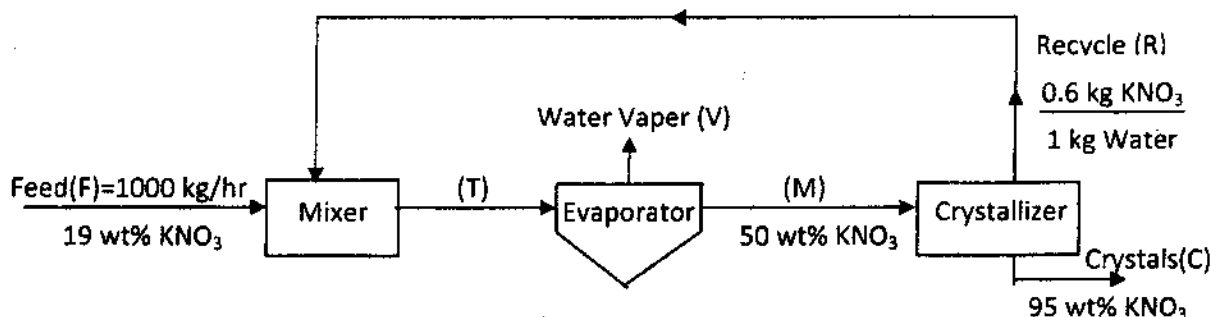
- 1-Time constant of the circuit
- 2 -intial charging current
- 3-charging current after 0.05 sec
- 4-voltage across the resistor after 0.05 sec

Q5- alternating current of a frequency 50 Hz has a maximum value of 100A .How long it take for current to attain values of 30,60,100 A

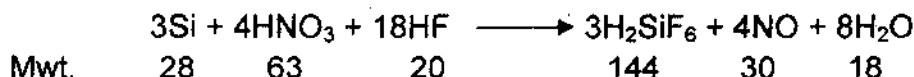
ملاحظه : الإجابة عن اربع أسئلة فقط

ملاحظة: أجب عن أربعة أسئلة فقط

Q1:- Potassium nitrate solution (F) containing 19%wt KNO₃ is continuously fed to the process consists of mixer, evaporator, and crystallizer at a rate of 1000 kg/hr as shown in the following flow diagram. Calculate the flow rates of streams C, V, R, T & M and composition as (wt %) of the total feed stream (T) with complete checking.



Q2:- Silicon rods with total mass of 168 lb are allowed to react with 900 lb of nitric acid solution containing 70 wt% HNO₃ and 1080 lb of HF according to the reaction:



The reaction goes to completion. Nitrogen oxide (NO) is evolved as a gas stream (G) which is separated from other reaction products (P).

Calculate: (a) the limiting reactant and the excess reactants.

(b) % excess & % conversion for each of the excess reactants.

(c) the mass of nitrogen oxide evolved (G) & the reaction product (P) with its composition.

Note: Check the accuracy of calculation by computing total mass input and output.

Q3:- (A) A mixture consists of 20 mol% ethanol (C₂H₅OH), 35 mol% ethyl acetate (C₄H₈O₂) and 45 mol% acetic acid (CH₃COOH).

Calculate (a) composition of the mixture as wt% .

(b) average molecular weight of the mixture.

(c) wt% of oxygen in the mixture.

Given that: atomic weights of C= 12 , H= 1 , O= 16 .

(B) A pressure vessel with volume of 85 ft³ contains ethylene (C₂H₄) at 38 °C and absolute pressure of 50.5 atm (non-ideal behavior). Calculate the mass in pounds of ethylene using compressibility factor method.

Given that: T_c = 282.7 K, P_c = 50.5 atm , R = 1.3145 atm.ft³ / lbmole K.

Q4:- Industrial fuel consists of 80 mol % ethane (C_2H_6) & 20 mol % N_2 at 75 °F and 35psia is fed to the furnace through a pipe of 6 in diameter at a rate of 2.5 lbmole / min. The fuel is completely burned with 50% excess air and the flue gases leave the furnace at 520 °F and 14.7 psia . Assuming ideal gaseous behavior, calculate:

- volumetric flow rate of the fuel in (ft^3 / min).
- velocity of the fuel in (m / sec).
- lbmoles of air input to the furnace per minute .
- Orsat analysis of the flue gases.
- volumetric flow rate of the flue gases leaving the furnace in (ft^3 / min).

Given that : $R = 10.73 \text{ psia} \cdot ft^3 / lbmole \cdot ^\circ R$

$1 \text{ ft} = 12 \text{ in} = 30.48 \text{ cm}$, $1 \text{ m} = 3.28 \text{ ft}$.

Q5:- Two liters of benzene (C_6H_6) are heated from 20 °C to 100 °C at 1 atm. Plot the path of the process on enthalpy – temperature diagram , and calculate (a) the specific enthalpy change ($\Delta \hat{H}$) in kJ/mol and (b) the total change in enthalpy in kJ.

The following data are available for benzene:

Heat capacity of liquid (C_{pL}) = $126.5 + 0.234 T$

Heat capacity of vapor (C_{pV}) = $74.06 + 0.33 T - 2.52 \times 10^{-4} T^2$

where C_p are given in J / mol. °C and T in °C.

Normal boiling point (T_b) = 80 °C

Latent heat of vaporization ($\Delta \hat{H}_v$) = 30765 J / mol.

Melting point or freezing temperature (T_m) = 5.5 °C

Latent heat of fusion ($\Delta \hat{H}_{fusion}$) = 9837 J / mol.

Specific gravity = 0.879 .

Note: Answer THREE questions only:

Q1:

A) Complete the following sentences: (Answer four only):

1. The----- command deletes the objects you select from the drawing.
2. A rectangular array is a pattern of objects generated into----- and -----.
3. The ----- command automatically rounds a sharp corner with a radius.
4. ----- creates a parallel copy of selected objects.
5. The Scale command is used to ----- or ----- the size of objects in a drawing.

B) In dimensions and texts, what is the meaning of the followings?

1. Offset from origin.
2. Extend beyond dim line.

C) Use circle command to draw a 0.125" radius circle, and use polar array command to duplicate it six items about a center point (7.125, 3.75)?

Q2:

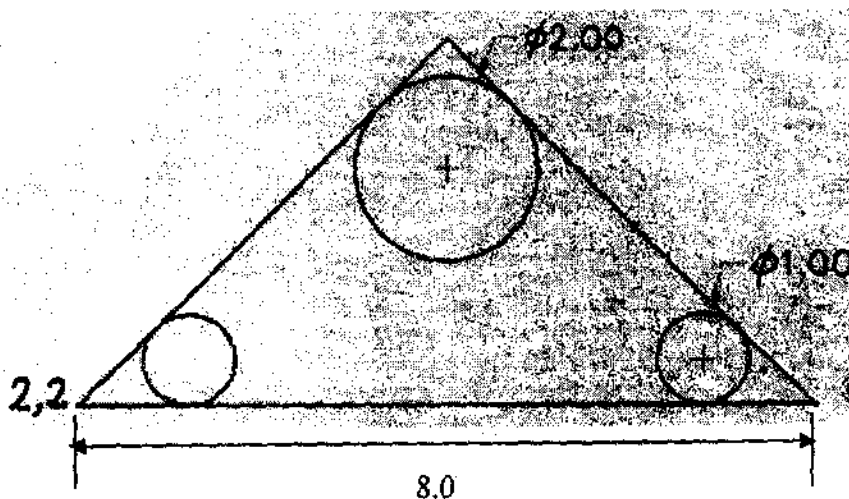
A) In what pull – down menu is the following commands found? (Answer four only):

1. Layer
2. Arc
3. Zoom
4. Aligned
5. Trim

B) What are the differences between?

1. Freeze & Hide layers?
2. Hardware & Software?

C) Use Auto CAD program commands to draw figure below.



Q3:

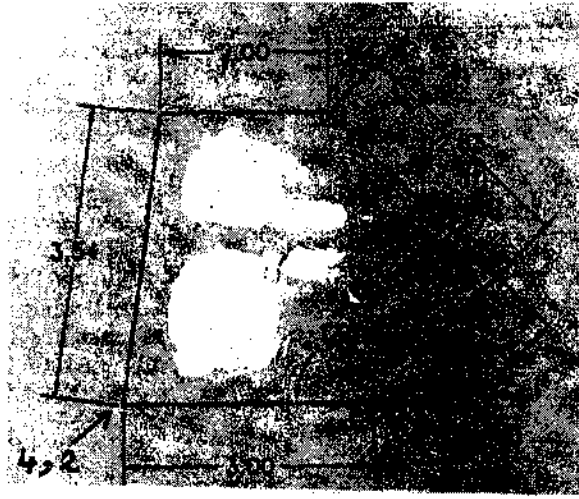
A) How can you enter the following commands quickly at the keyboard? (Answer four only):

1. Explode
2. Hatch
3. Multiline Text
4. Regen
5. Rotate

B) Briefly describe the methods of producing rectangles

TURN OVER

C) Create the shape in figure below?



Hint: Use polar coordinate.

Q4:

A) Define the followings (Answer four only):

1. BCC

2. Osnap

3. Divide

4. CPU

5. Page break preview

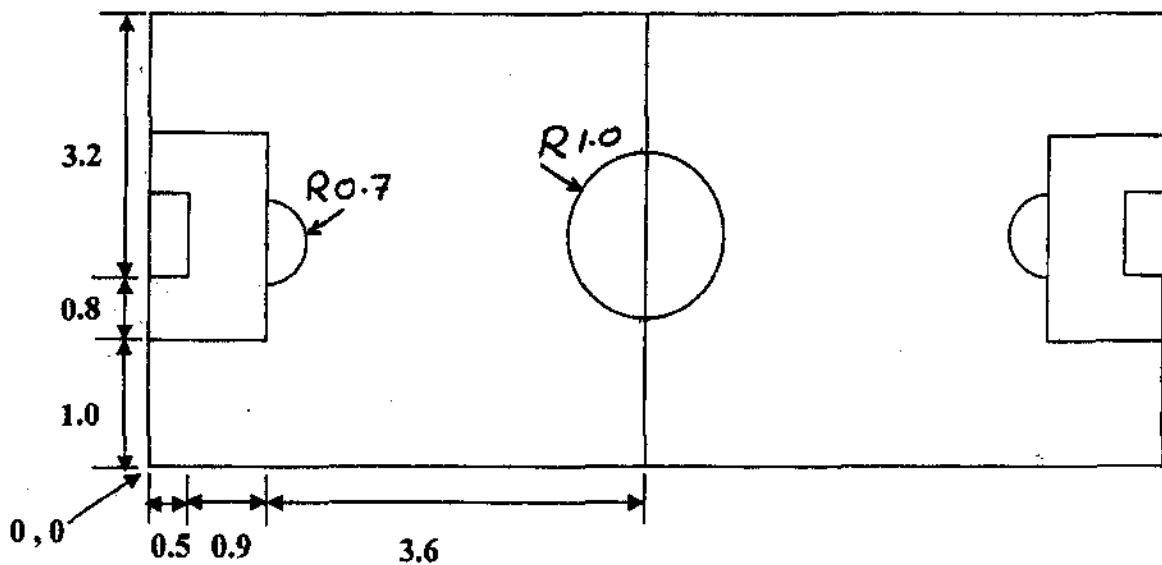
B) In the commands line below:

Specify first extension line origin or <select objects>

Specify second extension line origin [Mtext/Text/Angle/Horizontal/Vertical/Rotate]

What are the meanings of the above underlined commands?

C) Write down main steps to draw figure below using Auto CAD program commands?



Hint: Use absolute coordinate & Mirror command.

Good Luck!

Answer Four Question Only

Q1) A- Graph $r = -1 + \cos\theta$ in polar form stating the period, and the symmetric axis.

B- Find the following:

1- $\int \frac{2x^3}{\sqrt{x^2-1}} dx$

2- $\int e^{-2x} \sin 2x dx$

3- $\int \frac{x^2+8}{x^2-5x+6} dx$

Q2) A- Find the volume of the solid generated by revolving the region bounded by $y = 2$ about the line $y = -1$

B- Find the four roots of $(-1 - \sqrt{-1})$

Q3) A- 1- $\lim_{x \rightarrow 0} \frac{e^x + e^{-x} - x^2 - 2}{\sin^2 x - x^2}$

2- $\lim_{x \rightarrow +0} \frac{\log_b(1+2x)}{\log_a(1-3x)}$

3- $\lim_{\theta \rightarrow 0} \frac{\cos \theta - 1}{\theta}$

B- If $y = \sinh t$ and $x = \cosh t$ then proof that $\frac{d^2 y}{dx^2} + \frac{1}{y} \frac{dy}{dx} = \frac{xy^2 - 1}{y^3}$

Q4) A- Find x , y and z if:

$$\sec x + \csc y + \cot z = 5$$

$$2 + 4\cot z = 3 \sec x$$

$$2\sec x + 2\cot z = 4 + \csc y$$

B- Proof that $\sec h^{-1} y = \ln\left(\frac{1 + \sqrt{1-y^2}}{y}\right)$

Q5) A- Air pumped out from a spherical balloon at a rate of $100 \text{ cm}^3/\text{sec}$. How fast is the radius of the balloon decreased when the diameter is 50 cm.

B- Find the following:

1- $\int \frac{z}{z^3 - z^2 - 6z} dz$

2- $\int \frac{dx}{x^2 \sqrt{x^2 + 4}}$

3- $\int \frac{dx}{x^2 - \sqrt{x}}$

$$\sinh^{-1} x = \ln(x + \sqrt{x^2 + 1})$$

$$\cosh^{-1} x = \ln(x + \sqrt{x^2 - 1})$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$\sec^2 \theta = 1 + \tan^2 \theta$$

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

$$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$$

$$\cos^2 \theta = \frac{1 + \cos 2\theta}{2}$$

$$\sin^2 \theta = \frac{1 - \cos 2\theta}{2}$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\frac{d(\sin^{-1} u)}{dx} = \frac{du/dx}{\sqrt{1-u^2}} \quad -1 < u < 1$$

$$\frac{d(\tan^{-1} u)}{dx} = \frac{du/dx}{1+u^2}$$

$$\frac{d(\sec^{-1} u)}{dx} = \frac{du/dx}{|u|\sqrt{u^2-1}} \quad |u| > 1$$

$$\frac{d(\cos^{-1} u)}{dx} = -\frac{du/dx}{\sqrt{1-u^2}}$$

$$\frac{d(\csc^{-1} u)}{dx} = -\frac{du/dx}{|u|\sqrt{u^2-1}} \quad |u| > 1$$

$$\frac{d(\cot^{-1} u)}{dx} = -\frac{du/dx}{1+u^2}$$

$$\int \frac{du}{\sqrt{1+u^2}} = \sinh^{-1} u + C$$

$$\int \frac{du}{\sqrt{u^2-1}} = \cosh^{-1} u + C$$

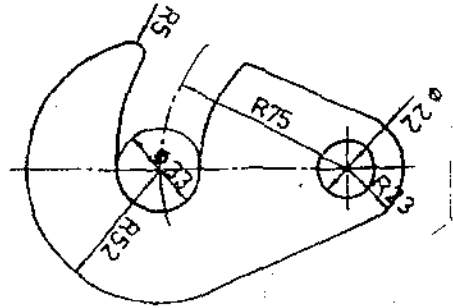
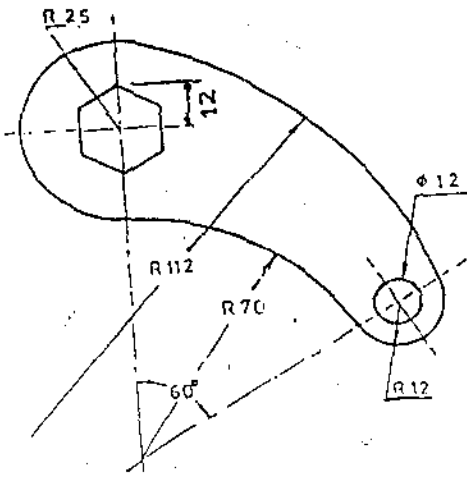
$$\int \frac{du}{u\sqrt{1-u^2}} = -\sec^{-1} |u| + C$$

$$\int \frac{du}{u\sqrt{1+u^2}} = -\csc^{-1} |u| + C$$

$$\int \frac{du}{1-u^2} = \begin{cases} \tanh^{-1} u + C & \text{if } |u| < 1 \\ \coth^{-1} u + C & \text{if } |u| > 1 \end{cases}$$

س¹ : ارسم لواء واحد مما يلي مع وضع الابعاد :

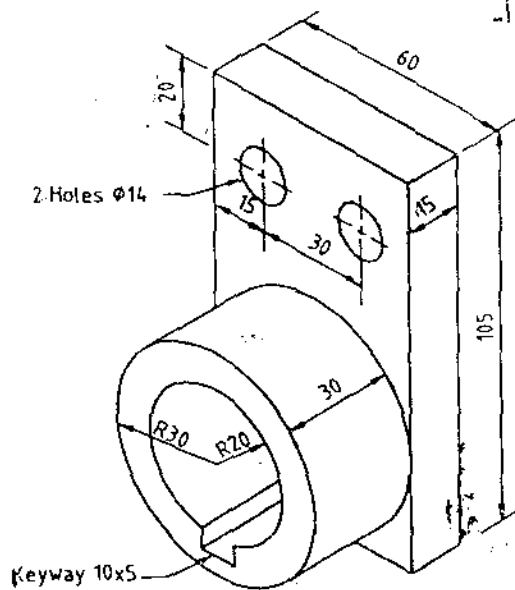
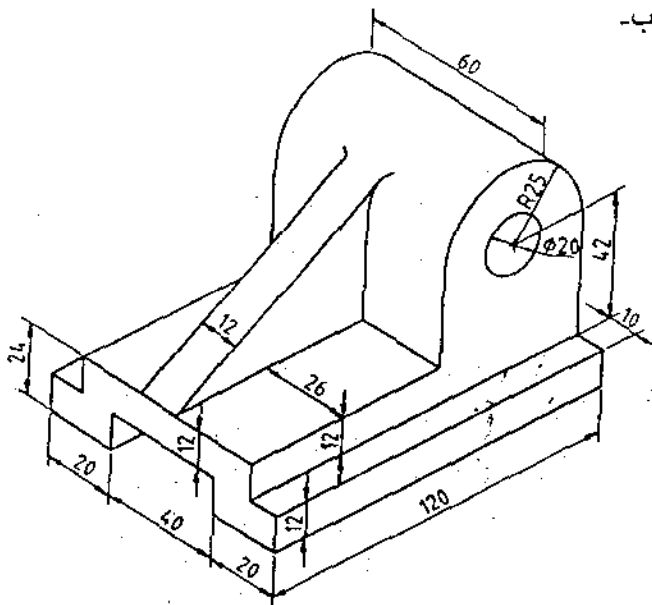
بـ



س² : ارسم لما يلي بنفس الابعاد :

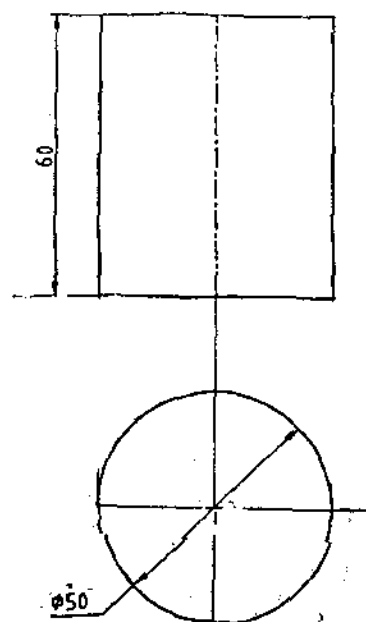
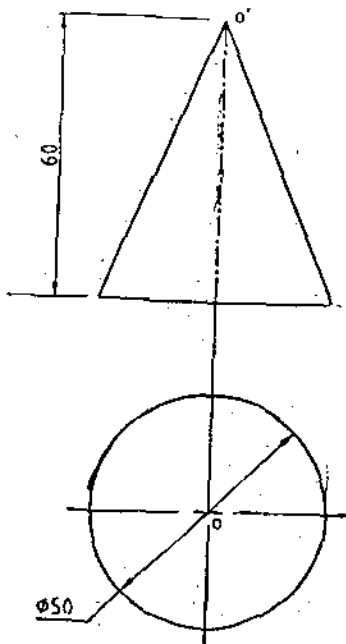
- 1- المقطع الامامي.
- 2- المسقط الجانبي.
- 3- المسقط الافقي (العلوي).

بـ

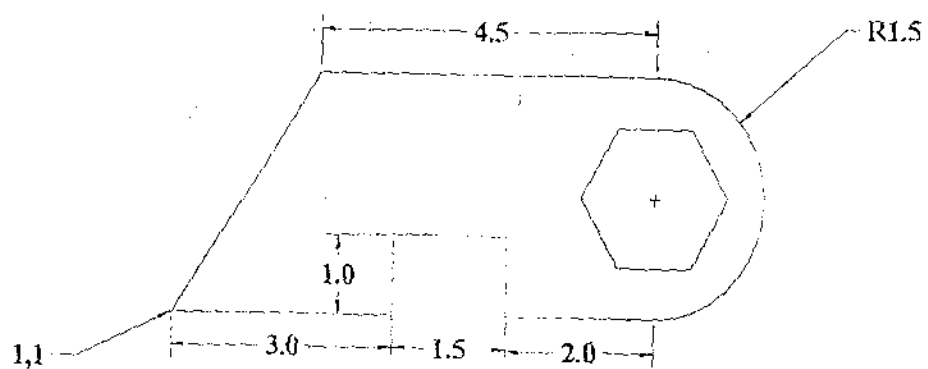


س³ : ارسم الشكل الايزومتري لواء مما يلي :

بـ



س 4 : أكتب خطوات رسم الشكل التالي ببرنامج (AUTOCAD) بإبعاد pline وبنصف قطر 1 inch مستخدما الخيار (In scribed in circle).

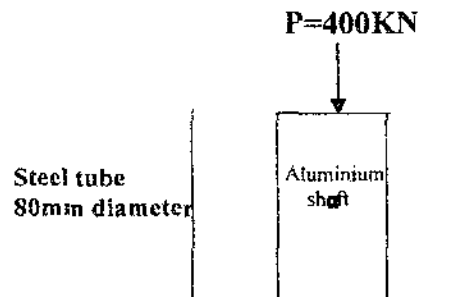


Note: Answer FOUR Questions only

Q1:

A/ Compute the minimum internal diameter of the steel tube shown in figure (1):

$$\nu = 0.3, E_{\text{Aluminium}} = 70 \times 10^9 \text{ N/m}^2$$

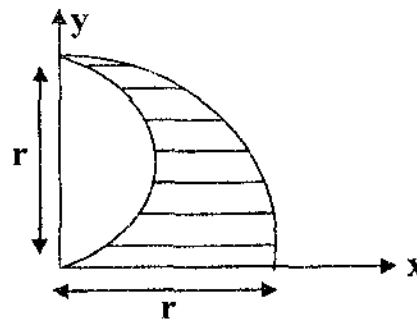


B/ Explain briefly stress –strain diagram.

Figure (1)

Q2:

A/ Locate the centroid of the shaded area in Fig. (2) created by cutting a semicircle of diameter (r) from a quarter circle of radius (r).



Figure(2)

B/ Determine the resultant of the forces system shown in Fig. (3) and its x & y intercepts.

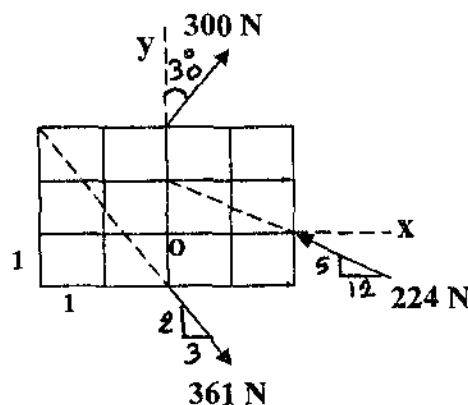


Figure (3)

Q3:

A/ Find the value of (θ), if the block (A) is about to slide as shown in figure (4), weight of block (A) is (20) kgf and of (B) is (10) kgf and (μ) = 0.2, calculate the tension force in the cord.

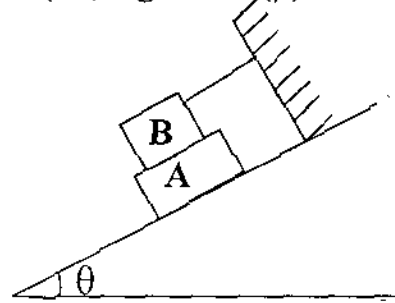


Figure (4)

B/ calculate total elongation caused by the weight of the body.

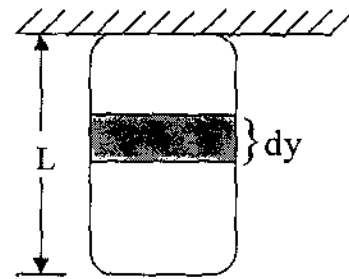


Figure (5)

Q4:

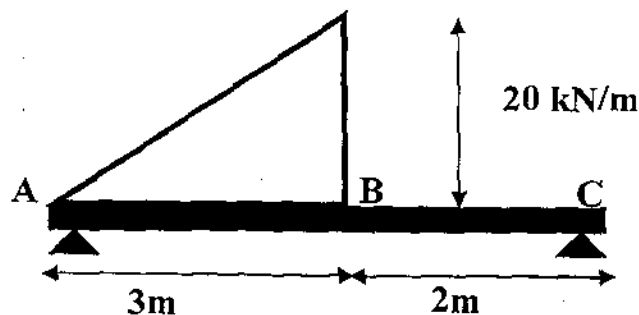
Steel rod (2.5)m long is secured between two walls. If the load on the rod is (zero) at (20)C°, compute the stress when the temperature drops to (-20) C°. The cross section area of the rod is (1200) mm², $\alpha=11.7\text{Mm/m } ^\circ\text{C}$ and $E=200\text{GN/m}^2$ assuming:

- 1) that the walls are rigid.
- 2) that the walls spring together a total distance of (0.5)mm as the temperature drops.

Q5:

A/ Explain briefly the methods of supporting some types of beams.

B/ Write shear and bending moment equations and draw shear and bending diagram of beam loaded as shown in figure below:



Good Luck