University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: English Language
Branch: Chem. Proc. & Oil Gas Refining
Examiner: Dr. Mumtaz Zablouk

Class: First
Time: 3 hours
Date : 5 /June

Attempt All Questions

Q1: Read the following passage and answer **(Five)** questions only:

A chemical process plant starts with an idea for a completely new product, for improvement of an existing product, or for a way of producing an existing product at a lower cost. Ideas for completely new products usually come from a company's research laboratories but improvements on existing products may occur to almost anyone.

Once the executives of a company have become interested in the idea of building a new plant, their first step is usually to call for a feasibility study. Such a study involves estimating production costs for the product as well as its potential market. Since essential engineering information is usually lacking, these estimates may contain major uncertainties. If it appears that the plant will make a reasonable profit, the next step is to develop the engineering data that will be needed in designing it. This is the job of the research and development engineer. The R&D engineers who work for a CPI company are generally chemical engineers.

R&D engineers do part of their work in library with books and articles. They often work with other specialists, most often chemists, who are expert in some aspect of the problem. But there is a great deal of difference between making a product in a laboratory and making it in a chemical plant.

Because commercial production can be different from the laboratory process, the R&D engineer will often build and operate a model of the proposed plant in order to find out what kinds of problems may develop and how to solve them. When the research and development work is completed, enough information is available so that the original cost estimate can be refined to a fairly exact figure. Again, the company management has to decide whether to go ahead with the plant or to cancel the project.

If the company decides to go ahead, the next step is process design. In this stage, the chemical engineer decides what kinds of equipment will be needed for each unit operation and calculates the size of each item. He or she must also select the material that each equipment item is to be made of – usually metal, plastic, or glass and contact various equipment manufacturers about prices.

One of the tools with which the process design engineer organizes all this information is the flowsheet. This a is diagram that shows what happens from the time a raw material comes in to the plant to the time it emerges as the desired product. The R&D engineer will probably have made as simple flow sheet to help him or her understand the process, but the one made by the process design engineer will be much more complete. It will show all the pieces of equipment in the plant and how they are connected. The flow sheet will indicate the temperatures, pressures, and flows at each step of the process, and other things as well. One of these other things is the instrumentation that will be needed for operating the plant. Most processes in a CPI plant take place inside equipment and it is only by using instruments that the operators can tell what is happening.

(40 Marks)

P.T.O

1. Where do ideas for completely new products usually come from?
2. What is usually the first step once the company executives become interested in building a new plant?
3. What is the job of the research and development engineer?
4. After the work of research and development is completed, and if the company decided to go ahead, what would be the next step?
5. What does the process engineer use to organize all the information needed in building a process plant?
6. What are the instruments in a process plant used for?

Q2: Define the following: (Answer 5 only)

a. Raw material, b. Unit operation, c. Consultant, d. Flow sheet
e. Instrumentation, f. Process design.

(15 Marks)

Q3: Fill in the blanks with the following prepositions (Answer 5 only):
(on, to, at, in, by, from, with, for, of, about)

1. Which doctor is _____ duty?
2. He is busy _____ some papers.
3. They succeeded _____ crossing the wide river.
4. The doctors are not worried _____ her condition.
5. Are you sure _____ what you're saying?
6. He bought the car _____ a high price.

(10 Marks)

Q4: Put the verbs in the right tense (Answer 5 only):

1. My father (buy) this pen three days ago and I (use) it already.
2. When he saw me, he (not know) me because he (not wear) his glasses.
3. My father usually (have) milk for breakfast but today he (have) coffee.
4. He (not send) me a letter since he (leave) Iraq.
5. My sister (be) in the kitchen now, she (wash) up the dishes.
6. The children (eat) some food now because they (be) hungry.

(20 Marks)

Q5: Punctuate the following putting in capitals where necessary: (Answer 5 only)

1. he visited Babylon on a Sunday morning in march
2. i said to yousif when did ali leave for kuwait
3. in 1492 columbus discovered america
4. have you ever been to paris yes i have
5. selma said i know where ahmad lives
6. i met mr browns son in london last september

(15 Marks)

(Good Luck)

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Final Examination

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Subject: English Language
Branch: Chem. Proc. & Oil Gas Refining
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Answers

Q1:

1. Ideas for completely new products usually come from a company's research laboratories.
2. Once the executives of a company have become interested in the idea of building a new plant, their first step is usually to call for a feasibility study.
3. The job of the research and development engineer is to develop the engineering data that will be needed in designing it.
4. After the work of research and development is completed, and if the company decided to go ahead, the next step would be process design.
5. The process engineer uses a flowsheet to organize all the information needed in building a process plant.
6. Instruments in a process plant are used for operating the plant.

Q2:

a. Raw material: The material that comes into a plant, where it is processed to produce a salable product.
b. Unit operation: One of the processing steps that materials undergo in a chemical process plant. Mixing and drying are examples of unit operations.
c. Consultant: An expert in some field who sells specialized knowledge to persons who need it.
d. Flowsheet: A diagram that shows the equipment used and the steps by which a raw material is changed into a finished product.
e. Instrumentation: The devices used for measuring or controlling a property such as temperature or pressure.
f. Process design: Making the decision on equipment to be used and developing all the other information needed for building a chemical process plant.

Q3: 1. on : 2. with : 3. in : 4. about : 5. of : 6. at

Q4:

1. bought , have used
2. didn't know , was not wearing
3. has , is having
4. has not sent , left
5. is , is washing
6. are eating , are

P.T.O

Q5: Punctuate the following putting in capitals where necessary: (Answer 5 only)

1. He visited Babylon on a Sunday morning in March.
2. I said to Yousif, "When did Ali leave for Kuwait?
3. In 1492 Columbus discovered America.
4. Have you ever been to Paris? Yes, I have.
5. Selma said, "I know where Ahmad lives."
6. I met Mr. Brown's son in London last September.

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Computer Programming I
Branch: Oil & Gas Refinery Engineering
Examiner: Dr.Khalid Farhod

Time: 3 hours
Date : 11-June

Attempt five questions only

Q1: A: *Indicate whether the sentence or statement is true or false.* **(5 Mark)**

1- If two option buttons are in the Frame1 control and three option buttons are in the Frame2 control, selecting an option button in the Frame2 control will turn off all of the option buttons in the Frame1 control.
2- If the stepvalue in a For...Next statement is positive, then the startvalue must be greater than or equal to the endvalue for the loop instructions to be processed.
3- If the value of A is false and the value of B is true, then the value of A and B is true.
4- If a check box is unselected, its Value property contains the number 0.
5- The information in a data file is organized into fields and records.

B: *Change the program below from(For-Next) loop to (Do-While) loop* **(5 Mark)**

```
Private Sub Command2_Click()
For a = 1 To 5
Print "hello"
Next
End Sub
```

Q2: A: *Identify the letter of the choice that best completes the statement or answers the question.* **(5 Mark)**

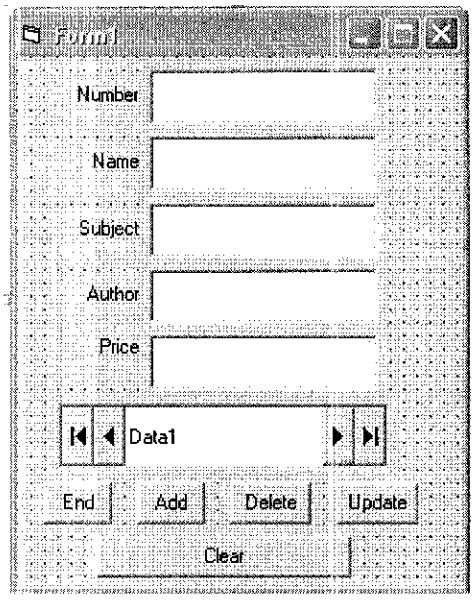
1- The first control in an array named txtNum is referred to as ____.
a. txtNum_0 b. txtNum.0 c. txtNum(0) d. txtNum.1
2- All conditions connected by the ____ operator must be true for the compound condition to be true.
a. And b. Not c. Or d. both a and b
3- Use the option button control in situations where you want to allow the user to ____.
a. enter text b. select only one choice
c. select one or more choices d. none of the above
4- Which of the following is a pretest loop?
a. Do Until b. Do While c. For Until d. b and c
5- The expression, 7 \ 2 * 2, results in ____.
a. 1 b. 1.75 c. 6 d. 7

B: *What is the Keyboard shortcut in the Microsoft Word 2010.* **(5 Mark)**

Q3: A: *Write a program (design and code) to calculate the bubble point temperature for any concentration for a mixture of Ethanol and Water. The vapor pressure of these components are calculated by the following Antoine equations:*

B: *What is the main computer component.* **(4 Mark)**

Q4: A: *Look at the following form carefully and write the code for commands End, Add, Delete, clear and Update:* **(8 Mark)**

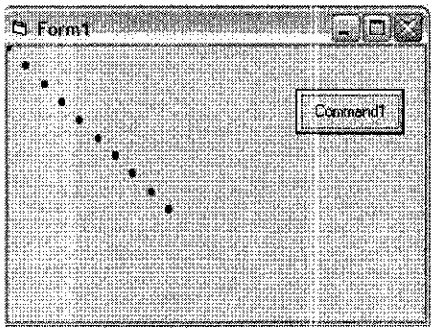


B: *What the code below produce?* **(2 Mark)**

AccBalance = InputBox("Enter the opening Account Balance", "Account Balance Query", 0)

Q5: A: *Write a program (design and code) to read two numbers and print the Smallest, use two inputbox to enter the two numbers.* **(4 Mark)**

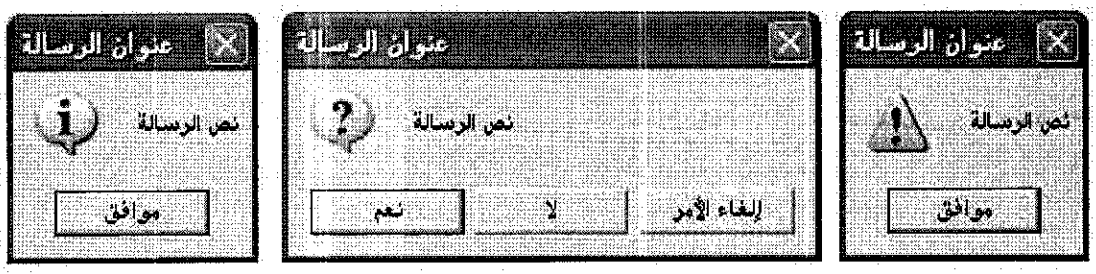
B: *Write a program (code) to draw ten point in the form of inclined line Using (Do-while) loop and (Pset)* **(6 Mark)**



Q6: A: *Write a program (design and code) to change temperature from degree Celsius (in the range from 0 to 100) to degree Fahrenheit and change the backcolor from red at 100 degree Celsius to blue at 0 degree Celsius.*

Note: $Degree\ Fahrenheit = 1.8 \times (degree\ Celsius) + 32$ **(5 Mark)**

B: *Write a computer code (only) to show the following messages.* **(5 Mark)**



follow

حلول نموذج 1

Q1/ A/

1- F 2- F 3- F 4- T 5- T

B/
```
Private sub Command1_Click()
a = 0
Do while a < 5
a = a + 1
Print "hello"
Loop
End sub
```

Q2/ A/

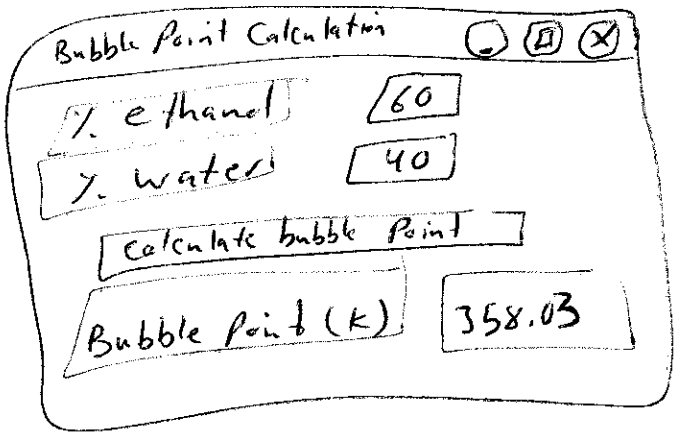
1- C 2- A 3- B 4- B 5- A

B/

1) Home - نقل المؤشر الى بداية السطر
2) End - نقل المؤشر الى نهاية السطر
3) shift + Home - تظليل النص من موقع المؤشر الى بداية السطر
4) shift + End - تظليل النص من موقع المؤشر الى نهاية السطر
5) ctrl + A - تظليل كل المستند
6) ctrl + C - نسخ النص المظلل Copy
7) ctrl + X - قص النص المظلل Cut
8) ctrl + V - لصق النص المنسوخ او المقطوع Paste
9) ctrl + I - تحويل النص المظلل الى نص مائل Italic
10) ctrl + U - خط تحت النص المظلل
11) ctrl + P - طباعة بالطابعة Print
12) ctrl + F - بحث عن كلمة معينة Find
13) ctrl + N - فتح مستند جديد NEW
14) ctrl + W - غلق المستند close

Q3/ A/ Private sub Command1_Click ( )

```
Xe = Text1 / 100
Xw = TeXT2 / 100
For T = 273.15 To 450 step 0.01
Pe = Exp (18.5242 - 3578.91 / (T - 50.5))
Pw = Exp( 18.3036 - 3816.44 / (T - 46.13))
Ke = Pe / 760
Kw = Pw / 760
Sum = Ke * Xe + Kw * Xw
if sum >= 1 Then
Exit For
End If
NEXT
lable4 = Round (T, 2)
End sub
```



B/ 1- Hardware

ⓐ Monitor ⓑ keyboard ⓒ Mouse ⓓ Speakers

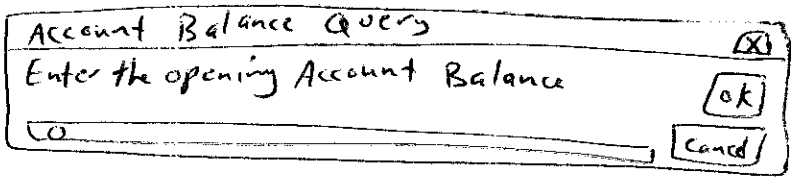
ⓔ Case ⓕ UPS

2- software

Q4/A/ Private sub Cmd New Record_Click ( )

```
Data 1. Recordset. Add New
Data1. Caption = Data 1. Recordset. Record Count + 1 -
& " of " & _
Data 1. Recordset. Record Count + 1
End Sub
```

B/



Q5/ A/

```
Privat sub form_Load ( )
  x = InPut Box ( "ادخل الرقم الاول" )
  y = InPut Box ( "ادخل الرقم الثاني" )
  if (x < y) then
    min = x
    Else
    min = y
    End If
    Print min
    End sub
```

B/

```
Privat sub Command1_Click ( )
Form1. Draw width = 5
  i=0
  Do while i < 10
  Pset (i * 200, i * 200), Rnd * 255
  i = i+1
  Loop
  End sub
```

Q6/ A/ Private Sub Form_Load ()

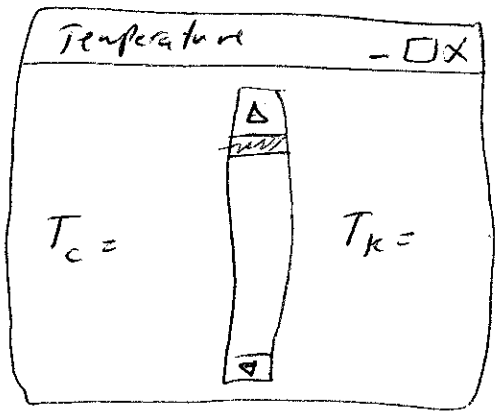
VScroll1.min = 0

VScroll1.Max = 100

VScroll1.SmallChange = 5

VScroll1.LargeChange = 10

End Sub



Privat sub VScroll1_Change ()

Label2 = 100 - Val(VScroll1.value)

Label4 = Val(Label2) * 1.8 + 32

red = 2.55 * Val(Label2)

blue = 255 - red

Form1.BackColor = RGB(red, 0, blue)

Label1.BackColor = RGB(red, 0, blue)

Label2.BackColor = RGB(red, 0, blue)

Label3.BackColor = RGB(red, 0, blue)

Label4.BackColor = RGB(red, 0, blue)

End Sub

B/

(i) → MsgBox "رسالة", vbInformation, "عنوان الرسالة"

(?) → MsgBox "رسالة", vbQuestion + vbYesNoCancel, "عنوان الرسالة"

(!) → MsgBox "رسالة", vbExclamation, "عنوان الرسالة"

University of Technology
Chemical Engineering
Department
Final Examination
2011/2012

Subject: Computer Programming (I)
Branch: Chem. Processing Eng.
Examiner:Dr.Walla'a A.Noori

Class: First
Time: 3 hours
Date 11 /June/2012

Attempt five questions only

Q.1 Write a computer program (design and code) to change the temperature from °C to K with change the background of program from red color at 100 °C to blue color at 0 °C .

Where : $T_K=273.15+T_C$

Hint : Use horizontal scroll bar.

(10 Marks)

Q.2 (A) Write a program (design and code) which can be used as information source for critical properties for several chemical components.

Component name	Formula	Tc(K)	Pc(MPa)	Zc
Methane	CH4	190.6	4.604	0.288
Ethane	C2H6	305.4	4.88	0.284
Propane	C3H8	369.8	4.249	0.281
Butane	C4H10	425.2	3.797	0.274
Pentane	C5H12	469.7	3.369	0.269

Note: Use Input box to enter the chemical component name.

(B) In Microsoft Power Point, how can you preparation of an interactive show.

(10 Marks)

Q.3 (A)What type of variable would you chose to define each type of following data (for example if name, chose string):

1. Name
2. Phone number
3. Password
4. Delivery cost
5. Examination date

(B) Define the followings:

(1) Alignment **(2)** Sort **(3)** User accounts **(4)** Hibernate **(5)**Format Painter

(10 Marks)

Follow

Q.4 Write a computer program (design and code) to change the input temperature from Fahrenheit to Celsius or in reverse, knowing :

Degree Fahrenheit = 1.8 × (degree Celsius) + 32

Degree Celsius = 0.56 × (degree Fahrenheit – 32)

Note: Use option button to select between the two operation.

(10 Marks)

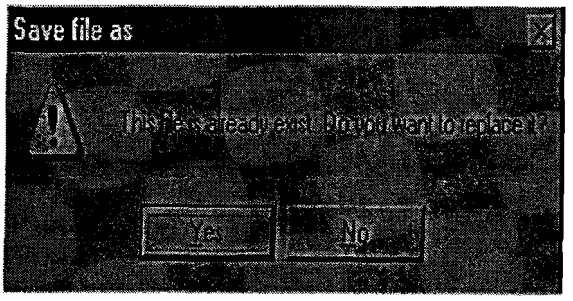
Q.5 (A) Consider the following direct substitution problem, which results from an energy balance problem.

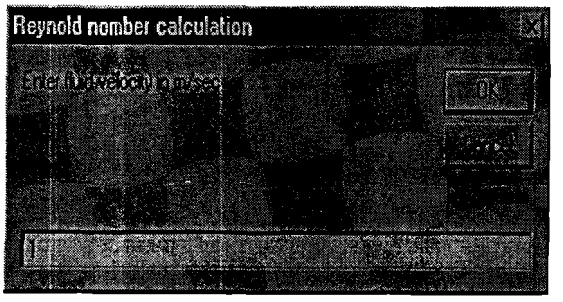
$$T_{n+1} = \frac{15.04 \times T_n}{\sqrt{(0.716 - 4.257 \times 10^{-6} T_n)}}$$

Use loop with 20 step in a program (design and code) to calculate the value of T.

Note: Use a textbox to enter the initial temperature and label to show the final temperature.

(B) Write a computer code (only) to show the following messages.





(10 Marks)

Q.6 (A) Write a computer program (design and code) to calculate Reynold number with the following input density, velocity, diameter, viscosity and decided the type of flow

Laminar flow Re<2000

Transition flow 2000<Re<4000

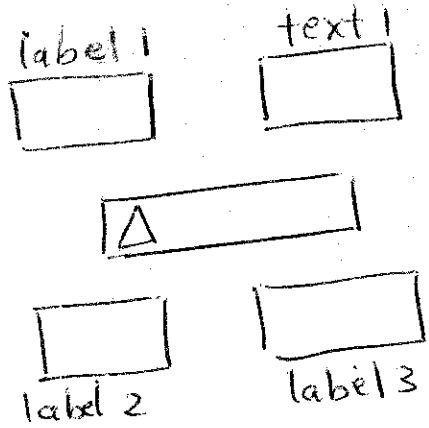
Turbulent flow Re≥4000

(B) What is the difference between an input box and a message box.

(10 Marks)

Follow

Q.1




```
Private Sub From_Load ( )
HScroll . Min = 0
H Scroll . Max = 100
H Scroll . Small Change = 5
H Scroll . Large Change = 10
End Sub
```

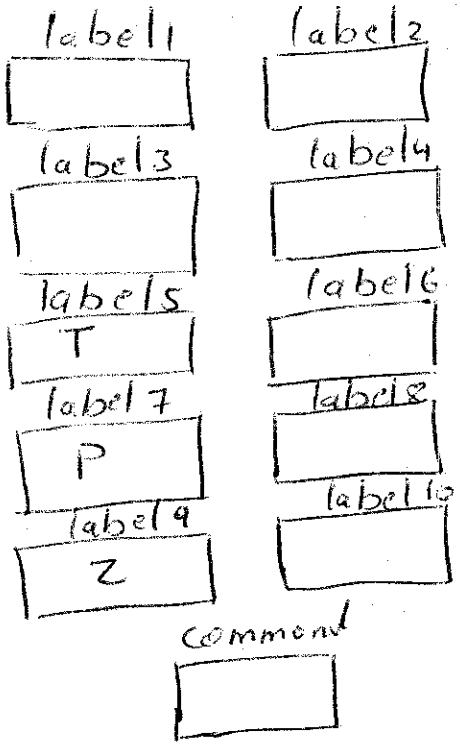
```
Private Sub HScroll_ Change ( )
label 3 = 273.15 + val ( text 1)
red = 2.55 * val (
blue = 255 - red
form 1 . BackColor = RGB ( 255 , 0 , 0 )
text 1 . Back color = RGB ( 255, 0, 0 )
label 3 . Back color = RGB ( 255 , 0 , 0 )
Else text 1 = 0 then
form . Back color = RGB ( 0 , 0 , 255 )
text 1 . Back color = RGB ( 0, 0, 255 )
label 3 . Back color = RGB ( 0 , 0 , 255 )
End If
End sub
```

Q2 / A

```
Private sub Command 1_( )
Global A ( 1 to 5 ) as string
A(1) = " Methane "
A(2) = " Ethane "
A(3) = " Propane "
A(4) = " Butane "
A(5) = " Pentane "
```

Global B (1 to 5) As Varient

B(1) = " CH_4 "
B(2) = " C_2H_6 "
B(3) = " C_3H_8 "
B(4) = " C_4H_{10} "
B(5) = " C_5H_{12} "



Global C (1 to 5) As long

C(1) = "190.6"
C(2) = "305.4"
C(3) = "369.8"
C(4) = "425.2"
C(5) = "469.7"

Global D (1 to 5) As long

D(1) = 4.604
D(2) = 4.88
D(3) = 4.249
D(4) = 3.797
D(5) = 3.369

Global E (1 to 5) as long

E(1) = 0.288
E(2) = 0.284
E(3) = 0.281
E(4) = 0.274
E(5) = 0.269

F# = Inputbox# ("Component name")

For I = 1 to 5

If F# = A(I) then

label6 = A(I)
label7 = B(I)

label 8 = C(I)
label 9 = D(I)
label 10 = E(I)
End if
Next
End Sub

Q2 /B/

العرض التفاعلي هو عرض ينتظر نقره من المستخدم على رمزين في الشريحه للانتقال الى شريحه اخرى ضمن العرض لايشترط بها ان تكون التاليه . يستخدم لانشاء هذه النقلات : الارتباطات التشعبيه (Hyperlinks) . مثل بناء عرض تفاعلي لمحاضره تعليم اللغه الانكليزيه :

الشريحه الاولى : تحوي عنوان العرض التفاعلي .

- الثانيه : تحوي عناصر المحاضره .
- الثالثه : تحوي اسماء ايام الاسبوع
- الرابع : تحوي اسماء ايام الشهر .
- الخامسه . تحوي اسماء الفصول الاربعه .

والان نبدا بانشاء الروابط :

في الشريحه الثانيه : نظلل عباره اسماء ايام الاسبوع ، نقره عين Hyperlink ستظهر نافذه جديده نضغط فيها زر Place in this Document ونختار الشريحه الثالثه ، OK . وبنفس الطريقه نكمل بقيه الشرائح والان عند تشغيل العرض بواسطه النقر على زر F5 : يمكن التفاعل معه كواجهه تفاعليه للتنقل بين الشرائح المختلفه بكفاءة .

Q3 /A/

1. String 2. long 3. long or string
4. Currency 5. date .

Q3/B/

١. Alignment : تستخدم لتحديد مكان النص في اليمين او اليسار او في الوسط وتعتبر اداة .

ب. Sort : تستخدم لترتيب البيانات تصاعدياً او تنازلياً .

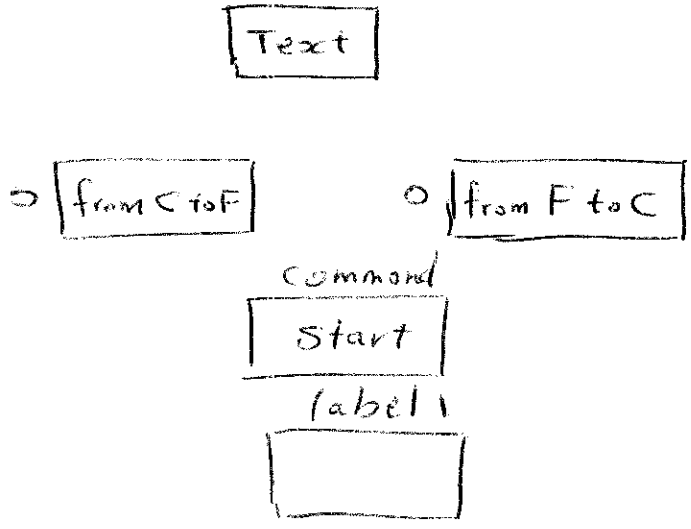
٢. User account : يمكن انشاء حساب اكثر من مستخدم في الكمبيوتر الواحد لتمكين كل شخص العمل على اعداداته الخاصة ويمكن عمل كلمة سر للدخول الى الحسابات وكذلك يمكن تحديد امكانيات بعض المستخدمين للعبث بالكمبيوتر ويوجد ثلاث انواع من الحسابات اداري ، مستخدم عادي ، الضيف .

٤. Hibernate : تستخدم للحفاظ على النوافذ المفتوحة عند اطفاء الكمبيوتر .

د. Format Painter : وهي اداة تستخدم لنقل الاعدادات مثل (لون ، نوع الخط) وغيرها من مكان الى اخر .

Q4/

```
Private Sub command1_click()
If option1.value = True then
label1.Caption = 1.8 * Text1 + 32
Else
label1.Caption = (Text1 - 32) * 0.56
End if
End Sub
```



Q5/A/

```
Command1 programing
Private sub command1_click
T = val(text1)
For i = 1 to 20
T = 15.04/((0.716 - 0.4257 * 10^(-6) * T)^0.5)
next i
label3 = T
```

Q5/B/

1. A = Msgbox ("This file is already exist. Do you want to replace it ?", 52, "save file as").

2. K = Inputbox ("Enter fluid velocity in m/sec", "Reynold number calculation", ".1").

Q6/A/

```
Private Sub Command1_click()
P = Inputbox ("Enter density")
U =   "   "  ("   "  velocity")
D =   "   "  ("   "  diameter")
M =   "   "  ("   "  viscosity")
Re = (P * U * D) / M
if Re < 2000 then
msgbox ("laminar flow", 0, "Reynold number"
```

```
: 'Else if 2000 < Re and Re < 4000 then
  msgbox ( " Transition flow ", 0, " Reynold number
  Else
  msgbox ( " Turbulent flow ", 0, "Reynold number")
  End if
  End sub
```

Q6 / B/

Input Box : صناديق الادخال اهم الاشياء في الفيجوال بيسك وتستخدم لادخال القيم من قبل المستخدم وذلك عن طريق عرض صندوق حوار يحتوي سؤال ومربع نص لادخال الاجابه وزري الامر OK/cancel للموافقة على الادخال او الغاء الامر.

Message Box : صناديق الرسائل قد نرغب في اعطاء رسالة معينة للمستخدم اثناء تنفيذ البرنامج ان نطلب من المستخدم ان يتخذ قرارا بشأن مسألة ما. فمثلا" اذا اراد المستخدم حفظ ملف ما ثم غيره ثم كان هذا الملف موجود الجهاز القرص فقد نرغب في سؤاله ان كان يريد الكتابة فوقه ام لا. في هذه الحالة نعرض له رسالة ونترك له حرية اختيار الاجراء المناسب.

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Eng.Drawing

Branch: chem.processing& Petroleum refinery

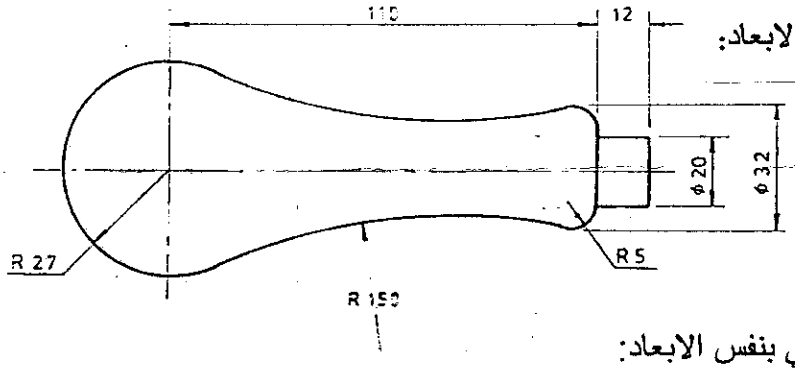
Examiner: Dr.Qusay F.

Class: First

Time: 3 hours

Date : 30/may

س1: ارسم مايلي بنفس الابعاد: (15 درجة)



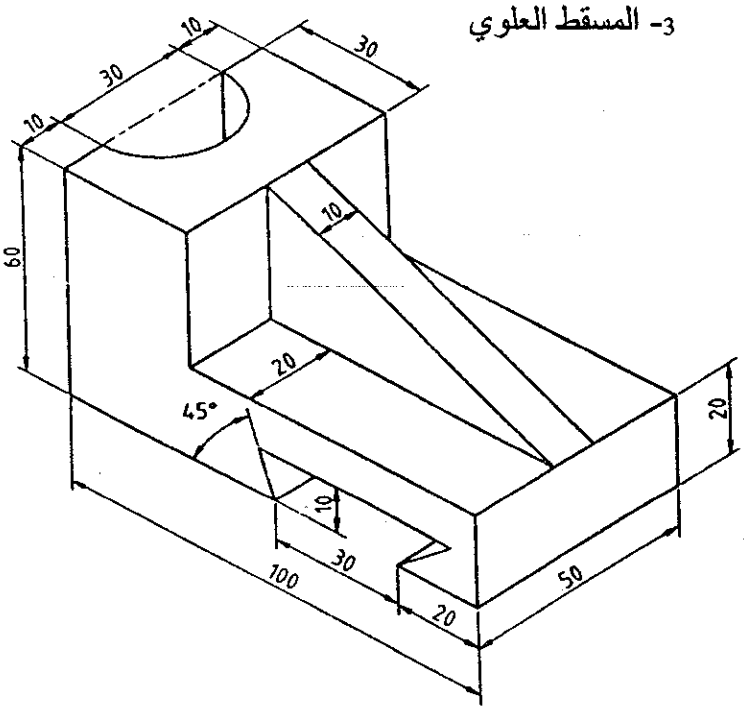
س2: ارسم لواحد مما يلي بنفس الابعاد: (35 درجة)

1- المسقط الامامي

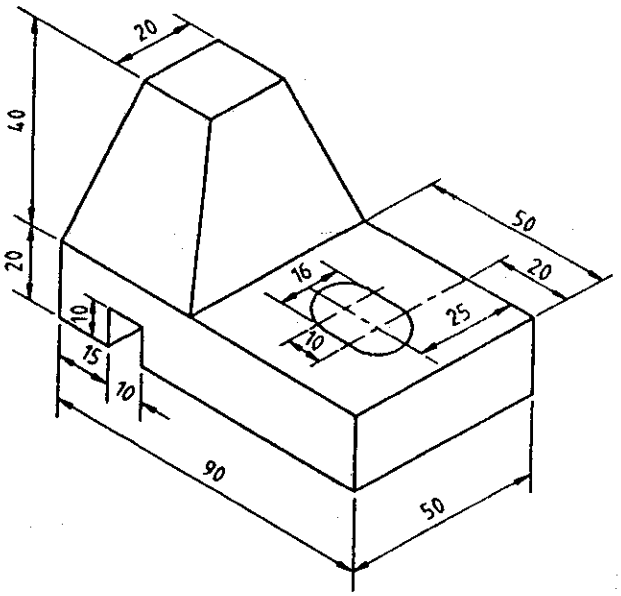
2- المقطع الجانبي

3- المسقط العلوي

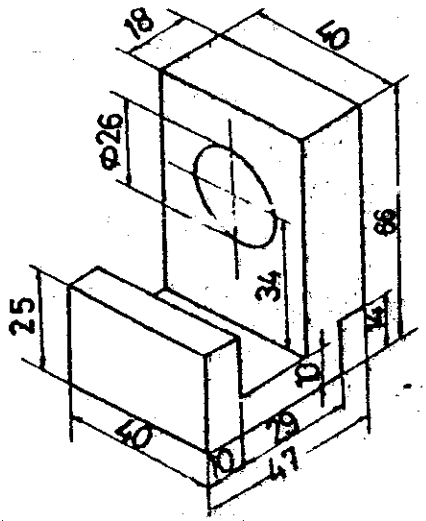
أ:



ب:



س3: ارسم الشكل الايزومتري التالي بنفس الابعاد: (25 درجة)

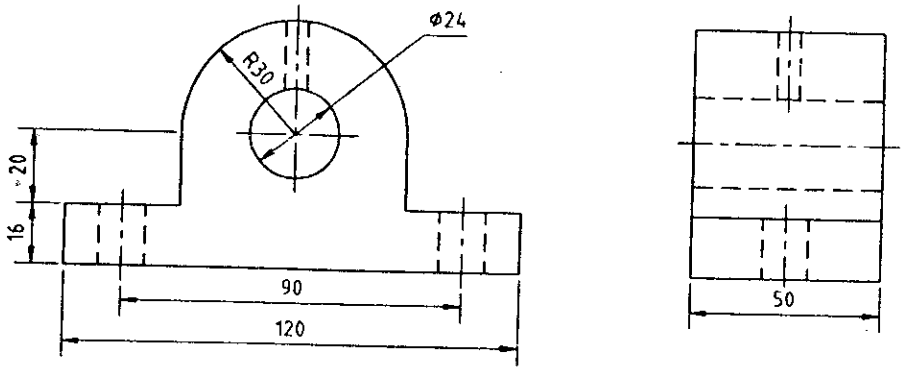


follow

س٤: (25 درجة)

ا:استنتج المسقط العلوي :

ب:اكتب خطوات رسم المسقط الامامي والمسقط العلوي ببرنامج (AUTO CAD) باستخدام احداثيات (Relative coordinate) فقط علما بان نقطة البداية هي (0.0)



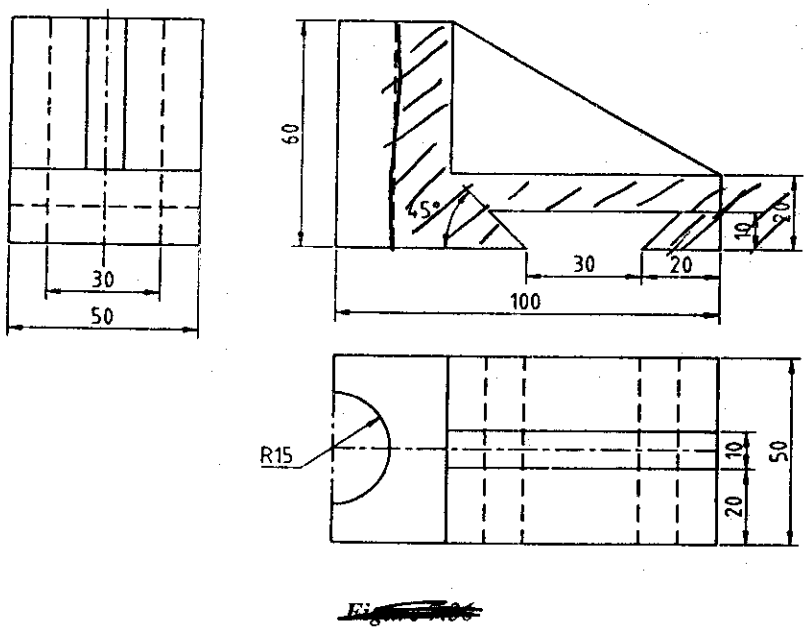
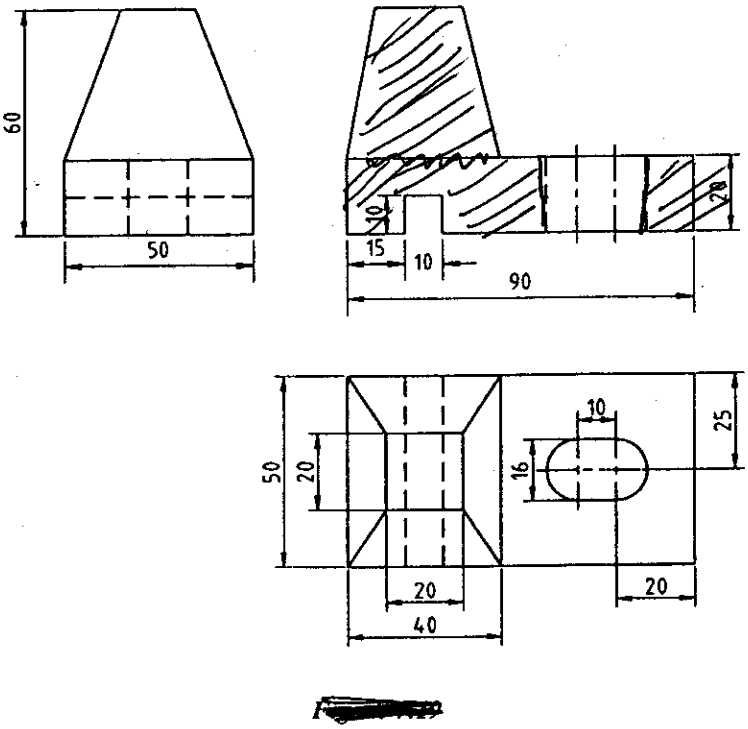


Figure No6

ص سؤ فرع م نموذج ١



ص سؤ فرع ب

نموذج ١

الخط الاساسي

Commond: Line

first : 0,0

next : @120,0

next : @0,50

next : @-120,0

next : @0,-50

Commond: Line

first : 30,0

next : @0,50

Commond: Line

first : 90,0

next : @0,50

commond: circle

center : 15,25

radius : 6

commond: circle

center : 105,25

radius : 6

commond: circle

center : 60,25

radius : 3

الخط العلوي

Commond: Line

first : 0,55

next : @120,0

next : @0,16

next : @-30,0

next : @0,20

Commond: Arc

start : 90,91

End : 30,91

radius : 30

Commond: Line

first: 30,91

next : @0,-20

next : @-30,0

next: @0,-16

س ٤ نموذج ١

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Mathematics
Branch: Both branches
Examiner: Dr. Walla'a A.Noori

Class: First
Time: 3 hours
Date : 28 /may/2012

Attempt five questions only

Q.1 (A) The region bounded by the parabola $y = x^2$ and the line $y = 2x$ in the first quadrant is revolved about the y – axis to generate a solid. Find the volume of the solid (Using the Washer Method).

(B) Prove that $\frac{1-\cos x}{1+\cos x} = \tan^2 \frac{x}{2}$ (20 Marks)

Q.2 (A) Solve the integrals

1. $\int \frac{2x^3-4x^2-x-3}{x^2-2x-3}\,dx$ 2. $\int \frac{1}{2+\sin x}\,dx$ 3. $\int \frac{1}{\sqrt{25x^2-4}}\,dx$ *where* $x > \frac{2}{5}$

(B) Find an equation for the tangent to the curve $y = x + \frac{2}{x}$ at the point (1 , 3)

(20 Marks)

Q.3 (A) Find the vector projection of $u = 6i + 3j + 2k$ onto $v = i - 2j - 2k$ and scalar component of u in the direction of v?

(B) (b) Use l'Hopital's rule to find the limits $\lim_{x\to 0}\left(\frac{x\sin x}{1-\cos x}\right)$, $\lim_{x\to 1}\left(\frac{1-x+\ln x}{x^3-3x+2}\right)$

(20 Marks)

Q.4 (A) If $z = f(x,y)$, where $x = r\cos\theta$ and $y = r\sin\theta$

1. Find $\frac{\partial z}{\partial r}$ *and* $\frac{\partial z}{\partial \theta}$
2. Show that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$

(B) Solve the equations (Using Cramer's Rule)

$2x - y + z = 5$
$3y - x - 2z = -1$
$x - 2y - z = -8$

(20 Marks)

Q.5 (A) Evaluate the integrals

$\int_0^{\sqrt{\ln\pi}} 2x\,e^{x^2}\cos\left(e^{x^2}\right)dx$, $\int_2^4 x^{2x}\,(1+\ln x)dx$, $\int_{-\pi/4}^{\pi/4} \cosh(\tan\theta)\,\sec^2\theta\,d\theta$

(B) Find the length and direction of the vector $v = -2i + 3j$ (20 Marks)

Q.6 (A) Graph the curve $r^2 = 4\cos\theta$

(B) The position of the particle is given by the equation of motion $s = f(t) = \frac{1}{1+t}$, where t is measured in seconds and s in meters. Find the velocity and the speed after 2 seconds. (20 Marks)

Follow

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

2. $\dfrac{d(\cos^{-1} u)}{dx} = -\dfrac{du/dx}{\sqrt{1-u^2}}, \quad |u| < 1$

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

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

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

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

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

$$\frac{d(\cosh^{-1} u)}{dx} = \frac{1}{\sqrt{u^2-1}}\frac{du}{dx}, \quad u > 1$$

$$\frac{d(\tanh^{-1} u)}{dx} = \frac{1}{1-u^2}\frac{du}{dx}, \quad |u| < 1$$

$$\frac{d(\coth^{-1} u)}{dx} = \frac{1}{1-u^2}\frac{du}{dx}, \quad |u| > 1$$

$$\frac{d(\operatorname{sech}^{-1} u)}{dx} = \frac{-du/dx}{u\sqrt{1-u^2}}, \quad 0 < u < 1$$

$$\frac{d(\operatorname{csch}^{-1} u)}{dx} = \frac{-du/dx}{|u|\sqrt{1+u^2}}, \quad u \neq 0$$

1. $\displaystyle\int \frac{du}{\sqrt{a^2-u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + C$ (Valid for $u^2 < a^2$)

2. $\displaystyle\int \frac{du}{a^2+u^2} = \frac{1}{a}\tan^{-1}\left(\frac{u}{a}\right) + C$ (Valid for all u)

3. $\displaystyle\int \frac{du}{u\sqrt{u^2-a^2}} = \frac{1}{a}\sec^{-1}\left|\frac{u}{a}\right| + C$ (Valid for $|u| > a > 0$)

1. $\displaystyle\int \frac{du}{\sqrt{a^2+u^2}} = \sinh^{-1}\left(\frac{u}{a}\right) + C, \quad a > 0$

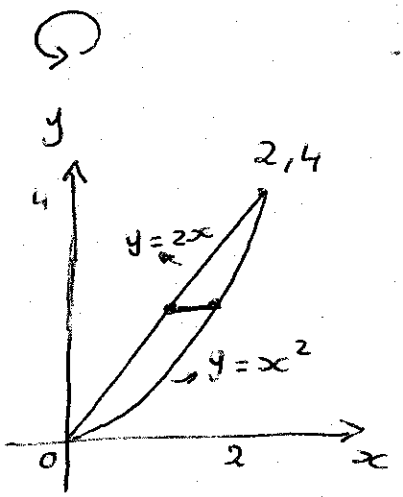
2. $\displaystyle\int \frac{du}{\sqrt{u^2-a^2}} = \cosh^{-1}\left(\frac{u}{a}\right) + C, \quad u > a > 0$

3. $\displaystyle\int \frac{du}{a^2-u^2} = \begin{cases} \frac{1}{a}\tanh^{-1}\left(\frac{u}{a}\right) + C & \text{if } u^2 < a^2 \\ \frac{1}{a}\coth^{-1}\left(\frac{u}{a}\right) + C, & \text{if } u^2 > a^2 \end{cases}$

4. $\displaystyle\int \frac{du}{u\sqrt{a^2-u^2}} = -\frac{1}{a}\operatorname{sech}^{-1}\left(\frac{u}{a}\right) + C, \quad 0 < u < a$

5. $\displaystyle\int \frac{du}{u\sqrt{a^2+u^2}} = -\frac{1}{a}\operatorname{csch}^{-1}\left|\frac{u}{a}\right| + C, \quad u \neq 0 \text{ and } a > 0$

Q.1/A/



$R(y)=\sqrt{y}$, $y=x^2 \Rightarrow x=\sqrt{y}$

$r(y)=y/2$, $y=2x \Rightarrow x=y/2$

$x^2=2x \Rightarrow x^2-2x=0$

$x(x-2)=0$, $x=0$ & $x=2$

$x=0 \Rightarrow y=0$

$x=2 \Rightarrow y=4$

$$V=\int_c^d \pi\left([R(y)]^2-[r(y)]^2\right)dy$$

$$=\int_0^4 \pi\left([\sqrt{y}]^2-[y/2]^2\right)dy$$

$$=\int_0^4 \left(y-\frac{y^2}{4}\right)dy=\pi\left[\frac{y^2}{2}-\frac{y^3}{12}\right]_0^4=\frac{8}{3}\pi .$$

Q1/B/

$$\frac{1-\cos x}{1+\cos x}=\tan^2\frac{x}{2}$$

$$\tan^2\left(\frac{x}{2}\right)=\frac{\sin^2\left(\frac{x}{2}\right)}{\cos^2\left(\frac{x}{2}\right)}=\frac{\frac{1-\cos\left(2\left(\frac{x}{2}\right)\right)}{2}}{\frac{1+\cos\left(2\left(\frac{x}{2}\right)\right)}{2}}=\frac{1-\cos x}{1+\cos x}$$

Q2/B/

$$\frac{dy}{dx}=\frac{d}{dx}(x)+2\frac{d}{dx}\left(\frac{1}{x}\right)=1+2\left(-\frac{1}{x^2}\right)=1-\frac{2}{x^2}$$

$$\left.\frac{dy}{dx}\right|_{x=1}=\left[1-\frac{2}{x^2}\right]_{x=1}=1-2=-1$$

$y=y_1+m(x-x_1) \Rightarrow y=3+(-1)(x-1)$

$y=-x+4$.

Q2/A/

1. $$\int \frac{2x^3-4x^2-x-3}{x^2-2x-3}\,dx$$

$$= \int 2x\,dx + \int \frac{5x-3}{x^2-2x-3}\,dx$$

$$= \int 2x\,dx + \int \frac{5x-3}{(x+1)(x-3)}\,dx$$

$$\begin{array}{r|l} & 2x \\ \hline x^2-2x-3 & 2x^3-4x^2-x-3 \\ & \mp 2x^3 \pm 4x^2 \pm 6x \\ \hline & 5x-3 \end{array}$$

$$\frac{5x-3}{(x+1)(x-3)} = \frac{A}{x+1} + \frac{B}{x-3} \Rightarrow \frac{5x-3}{(x+1)(x-3)} = \frac{A(x-3)+B(x+1)}{(x+1)(x-3)}$$

$$5x-3 = A(x-3)+B(x+1) \Rightarrow 5x-3 = (A+B)x + (B-3A)$$

$$A+B=5 \ \& \ -3A+B=-3 \Rightarrow A=2,\ B=3$$

$$= \int 2x\,dx + \int \frac{2}{x+1}\,dx + \int \frac{3}{x-3}\,dx = x^2 + 2\ln|x+1| + 3\ln|x-3| + c$$

2. $\int \frac{dx}{\sqrt{25x^2-4}}$, $x > \frac{2}{5}$

$$\sqrt{25x^2-4} = \sqrt{25\left(x^2-\frac{4}{25}\right)} = 5\sqrt{x^2-\left(\frac{2}{5}\right)^2}$$

$$x = \frac{2}{5}\sec\theta, \quad dx = \frac{2}{5}\sec\theta\tan\theta\,d\theta$$

$$x^2-\left(\frac{2}{5}\right)^2 = \frac{4}{25}\sec^2\theta - \frac{4}{25} = \frac{4}{25}(\sec^2\theta-1) = \frac{4}{25}\tan^2\theta$$

$$\sqrt{x^2-\left(\frac{2}{5}\right)^2} = \frac{2}{5}|\tan\theta| = \frac{2}{5}\tan\theta$$

$$\int \frac{dx}{5\sqrt{x^2-\left(\frac{4}{25}\right)}} = \int \frac{(2/5)\sec\theta\tan\theta\,d\theta}{5\cdot(2/5)\tan\theta} = \frac{1}{5}\int \sec\theta\,d\theta$$

$$= \frac{1}{5}\ln|\sec\theta+\tan\theta| + c = \frac{1}{5}\ln\left|\frac{5x}{2} + \frac{\sqrt{25x^2-4}}{2}\right| + c$$

3. $\int \frac{1}{2+\sin x}\,dx$

$$\sin x = \frac{2z}{1+z^2}, \quad dx = \frac{2\,dz}{1+z^2}$$

$$\int \frac{1}{2+\left(\frac{2z}{1+z^2}\right)}\left(\frac{2\,dz}{1+z^2}\right) = \int \frac{dz}{z^2+z+1} = \int \frac{dz}{\left(z+\frac{1}{2}\right)^2+\frac{3}{4}}$$

$$\int \frac{du}{u^2+a^2} = \frac{1}{a}\tan^{-1}\frac{u}{a} + c$$

$$\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{z+\frac{1}{2}}{\sqrt{3}/2}\right) + c = \frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2z+1}{\sqrt{3}}\right) + c$$

$$\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2\tan\left(\frac{x}{2}\right)+1}{\sqrt{3}}\right) + c.$$

Q3/A/

$$\text{Proj}_V U = \frac{U\cdot V}{V\cdot V} V = \frac{6-6-4}{1+4+4}(i-2j-2k)$$

$$= -\frac{4}{9}(i-2j-2k) = -\frac{4}{9}i+\frac{8}{9}j+\frac{8}{9}k.$$

$$|U|\cos\theta = U\cdot\frac{V}{|V|} = (6i+3j+2k)\cdot\left(\frac{1}{3}i-\frac{2}{3}j-\frac{2}{3}k\right)$$

$$= 2-2-\frac{4}{3} = -\frac{4}{3}$$

$$|V| = \sqrt{(1)^2+(-2)^2+(-2)^2} = \sqrt{9} = 3$$

Q3/B/

1. $\lim_{x\to 0} \frac{x\sin x}{1-\cos x}$ $\left(\frac{0}{0}\right)$

$$\lim_{x\to 0} \frac{x\cos x+\sin x\cdot 1}{\sin x} \quad \left(\frac{0}{0}\right)$$

$$\lim_{x\to 0} \frac{-x\sin x+\cos x+\cos x}{\cos x} = 2$$

2. $\lim_{x\to 1} \frac{1-x+\ln x}{x^3-3x+2}$ $\left(\frac{0}{0}\right)$

$$\lim_{x\to 1} \frac{-1+\frac{1}{x}}{3x^2-3} \quad \left(\frac{0}{0}\right)$$

$$\lim_{x\to 1} \frac{-1/x^2}{6x} = -1/6.$$

Q4/A/

$$\frac{\partial z}{\partial r} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial r}+\frac{\partial z}{\partial y}\frac{\partial y}{\partial r} = \frac{\partial z}{\partial x}(\cos\theta)+\frac{\partial z}{\partial y}(\sin\theta).$$

$$\frac{\partial z}{\partial \theta} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial \theta}+\frac{\partial z}{\partial y}\frac{\partial y}{\partial \theta} = \frac{\partial z}{\partial x}(-r\sin\theta)+\frac{\partial z}{\partial y}(r\cos\theta).$$

$$\left(\frac{\partial z}{\partial r}\right)^2 = \left(\frac{\partial z}{\partial x}\right)^2\cos^2\theta+2\frac{\partial z}{\partial x}\frac{\partial z}{\partial y}\cos\theta\sin\theta+\left(\frac{\partial z}{\partial y}\right)^2\sin^2\theta$$

$$\frac{1}{r^2}*\left[\left(\frac{\partial z}{\partial \theta}\right)^2 = \left(\frac{\partial z}{\partial x}\right)^2 r^2\sin^2\theta-2\frac{\partial z}{\partial x}\frac{\partial z}{\partial y}r^2\sin\theta\cos\theta+\left(\frac{\partial z}{\partial y}\right)^2 r^2\cos^2\theta\right]$$

$\because \sin^2\theta+\cos^2\theta = 1$ كما في ... بجمع المعادلتين أعلاه

$$\therefore \left(\frac{\partial z}{\partial x}\right)^2+\left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2+\frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$$

Q4/B/

$$D = \begin{vmatrix} 2 & -1 & 1 \\ -1 & 3 & -2 \\ 1 & -2 & -1 \end{vmatrix} = 2\begin{vmatrix} 3 & -2 \\ -2 & -1 \end{vmatrix} + 1\begin{vmatrix} -1 & -2 \\ 1 & -1 \end{vmatrix} + 1\begin{vmatrix} -1 & 3 \\ 1 & -2 \end{vmatrix}$$

$$\Rightarrow D = -12$$

$$x = -\frac{1}{12}\begin{vmatrix} 5 & -1 & 1 \\ -1 & 3 & -2 \\ -8 & -2 & -1 \end{vmatrix} = -\frac{1}{12}\left[5\begin{vmatrix} 3 & -2 \\ -2 & -1 \end{vmatrix} + 1\begin{vmatrix} -1 & -2 \\ -8 & -1 \end{vmatrix} + 1\begin{vmatrix} -1 & 3 \\ -8 & -2 \end{vmatrix} \right]$$

$$\Rightarrow x = 2$$

$$y = -\frac{1}{12}\begin{vmatrix} 2 & 5 & 1 \\ -1 & -1 & -2 \\ 1 & -8 & -1 \end{vmatrix} = -\frac{1}{12}\left[2\begin{vmatrix} -1 & -2 \\ -8 & -1 \end{vmatrix} - 5\begin{vmatrix} -1 & -2 \\ 1 & -1 \end{vmatrix} + 1\begin{vmatrix} -1 & -1 \\ 1 & -8 \end{vmatrix} \right]$$

$$\Rightarrow y = 3 .$$

$$z = -\frac{1}{12}\begin{vmatrix} 2 & -1 & 5 \\ -1 & 3 & -1 \\ 1 & -2 & -8 \end{vmatrix} = -\frac{1}{12}\left[2\begin{vmatrix} 3 & -1 \\ -2 & -8 \end{vmatrix} + 1\begin{vmatrix} -1 & -1 \\ 1 & -8 \end{vmatrix} + 5\begin{vmatrix} -1 & 3 \\ 1 & -2 \end{vmatrix} \right]$$

$$\Rightarrow z = 4 .$$

Q5/A/

1. $$\int_0^{\sqrt{\ln \pi}} 2x e^{x^2} \cos(e^{x^2})\, dx$$

$u = e^{x^2}$, $du = 2x e^{x^2} dx$

$x = 1 \Rightarrow u = 1$

$x = \sqrt{\ln \pi} \Rightarrow u = \pi$

$$\int_1^{\pi} \cos u\, du = \sin u \Big]_1^{\pi} = \sin \pi - \sin 1 = -0.842 .$$

2. $\int_2^4 x^{2x}(1+\ln x)\,dx$

$u = x^{2x}$, $\ln u = 2x\ln x$, $\frac{1}{u}\frac{du}{dx} = 2\ln x + 2x\frac{1}{x}$

$\frac{du}{dx} = 2u(\ln x + 1)$, $\frac{1}{2}du = x^{2x}(1+\ln x)\,dx$

$x = 2 \Rightarrow u = 16$ & $x = 4 \Rightarrow u = 65536$

$$\frac{1}{2}\int_{16}^{65536} du = \frac{1}{2}\left[u\right]_{16}^{65536} = 32760.$$

3. $\int_{-\pi/4}^{\pi/4} \cosh(\tan\theta)\sec^2\theta\,d\theta$

$u = \tan\theta$, $du = \sec^2\theta\,d\theta$

$\theta = -\pi/4 \Rightarrow u = -1$

$\theta = \pi/4 \Rightarrow u = 1$

$$\int_{-1}^{1} \cosh u\,du = \sinh(1) - \sinh(-1).$$

Q5/B/ $|V| = \sqrt{(-2)^2 + (3)^2} = \sqrt{13}$

$u = \frac{-2}{\sqrt{13}}i + \frac{3}{\sqrt{13}}j$

$\theta = \tan^{-1}\frac{3}{-2} = 56.3$ in quarter 2

$\theta = 180 - 56.3 = 123.7$

Q6/A/ θ from $-\pi/2$ to $\pi/2$

$r^2 = 4\cos\theta = 4\cos(-\theta)$, $\cos\theta = \cos(-\theta)$

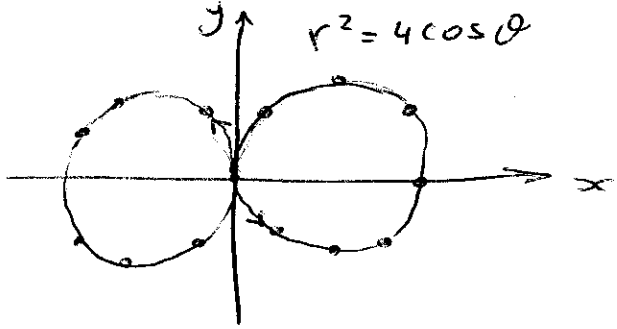
The curve is symmetric about the x-axis.

$r^2 = 4\cos\theta \Rightarrow (-r)^2 = 4\cos\theta$

The curve is symmetric about the origin.

∴ The curve is symmetric about the y-axis.

θ	$\cos\theta$	$r = \pm 2\sqrt{\cos\theta}$
0	1	$\pm$ 2
$\pm\pi/6$	$\sqrt{3}/2$	$\simeq \pm 1.9$
$\pm\pi/4$	$1/\sqrt{2}$	$\simeq \pm 1.7$
$\pm\pi/3$	$1/2$	$\simeq \pm 1.4$
$\pm\pi/2$	0	0



Q6/B/

$$s = (1+t)^{-1} \Rightarrow v = -1(1+t)^{-2} = \frac{-1}{(1+t)^2}$$

$$v(2) = \frac{-1}{(1+2)^2} \Rightarrow v(2) = -\frac{1}{9} \text{ m/sec}$$

$$\text{Speed} = |v| = \left|-\frac{1}{9}\right| = \frac{1}{9} \text{ m/sec.}$$

University of Technology

Chemical Engineering Department

Final Examination

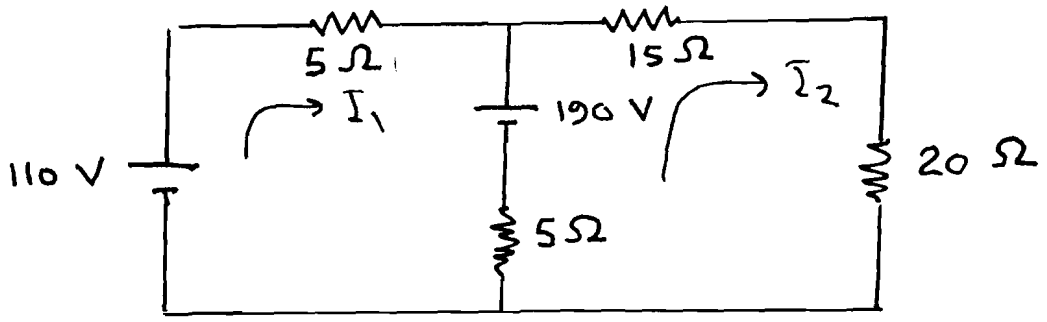
2011/2012

Subject: Electrical Tech.
Examiner: Dr.Mohamed Ibrahim
Branch: Refinary and process Engineering

Class: first
Time: 3 hours
Date :

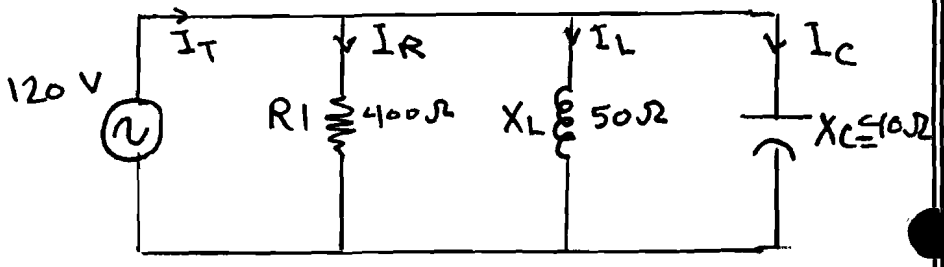
Attempt four questions only

Q1 : Find mesh currents (I_1 & I_2) for the mesh circuit shown in figure . {15Marks}



Q2 : **400 Ω** resistor , **50 Ω** inductive reactance and **40Ω** capacitive reactance are connected in parallel across **120 V** ac voltage (as shown in **figure**) .Find : {15Marks}

a- I_R, I_L, I_c and I_T
b- Phase **angle** θ
c- Draw phasor diagram



Q3 : a- Tungsten wire has a resistance **10Ω** at **20 °C** . When place in furnace of unknown temperature it was found to be **60 Ω** . What is the temperature of the furnace (**α= 0.005Ω/ °C**)

{7Marks}

b- a motor use **1200 W**. How much energy in kilowatthours is used in a week by eight motors if they are all in use **10 hours** per day (**h/day**) for a **6**-day week .Compute the total cost if the utility is **6 Dinar** per kilowatthour. {8Marks}

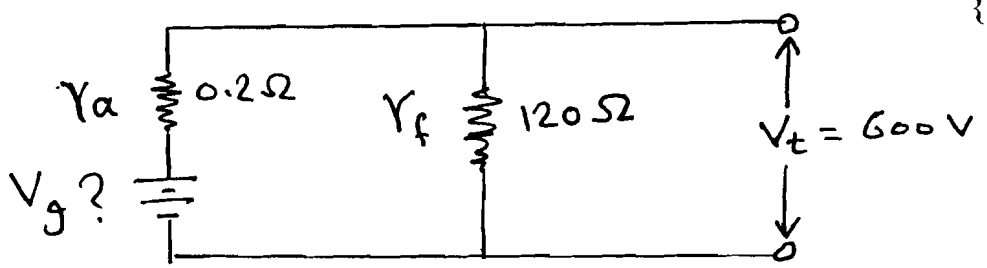
Follow

Q4 : **a** – An iron ring has a length of **50cm** and cross-sectional area of **2 cm^2**.It is wound uniformly with **600 turns** of wire.The current in the winding is **0.06A** and the flux in the ring is **6x10^{-6} wb**. Find the flux density **B**, field intensity **H** and permeability **μ**. {7Marks}

B - Shunt generator(**figure 3**) has :

a terminal voltage **600 V** at rated laod , a power of **75 KW** ,field resistance **120Ω** and armature resistance **0.2 Ω** .Find the generated voltage V_g.

{7Marks}



Q5 : if an ac voltage has a peak value of **155.6 V** ,frequency **100HZ** .Find :

a-the phase angle at which instantaneous voltage is **110V**.

b-the **period**(**T**) of waveform.

c-the **rms value** of the voltage.

d-the **average value** of the voltage.

f-draw the waveform and locate the above points on the waveform .

g-if the ac voltage is applied across **10Ω** in series .Find the current and voltage drop a cross resistance and draw the phasor diagram.

{15Marks}

اجوبة الكهرباء المرحلة الاولى الدور الاول
2011/2012

Q1:

Mesh 1

$$110 - 5I_1 - 190 - 5I_1 + 5I_2 = 0$$
$$-10I_1 + 5I_2 = 80 \quad -- \quad (1)$$

Mesh 2

$$190 - 15I_2 - 20I_2 - 5I_2 + 5I_1 = 0$$
$$190 - 40I_2 + 5I_1 = 0$$
$$5I_1 - 40I_2 = -190 \quad -- \quad (2)$$

From eqn 1 and 2

$$-10I_1 + 5I_2 = 80$$
$$5I_1 - 40I_2 = -190 \quad \times 2$$

وبالجمع

$$-75I_2 = -300$$

$$\therefore I_2 = 4A$$

بالتعويض عن I_2 في المعادلة 1

$$-10I_1 + 5 \times 4 = 80$$

$$I_1 = -6A$$

Q 2 : 1

$$I_R = \frac{V_T}{R} = \frac{120}{40} = 0.3\,A$$

$$I_L = \frac{V_T}{X_L} = \frac{120}{50} = 2.4\,A$$

$$I_C = \frac{V_T}{X_C} = \frac{120}{40} = 3.0\,A$$

$X_L > X_C$ ∴ Capacitive circuit

$$\therefore I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$$

$$= \sqrt{(0.3)^2 + (3.0 - 2.4)^2} = 0.67\,A$$

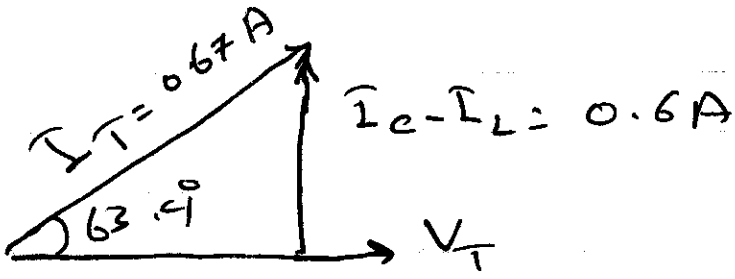
$$\theta = \tan^{-1}\left(\frac{I_C - I_L}{I_R}\right)$$

$$= \tan^{-1}\frac{3 - 2.4}{0.3} = \tan^{-1} 2$$

$$\therefore \theta \cong 63.4^\circ$$

∴ I_T lead V_T

$$Z_n = \frac{V_T}{I_T} = \frac{120}{0.671} = 179\,\Omega$$



Q3 a:

$$R_t = R_0 + R_0(\alpha \Delta T)$$

$$60 = 10 + 10(0.005(T_2 - 20))$$

$$50 = 50 \times 10^{-3}(T_2 - 20)$$

$$\therefore 50 + 50 \times 10^{-3} T_2 = 50 \times 10^{-3} \times 20$$

$$\therefore T_2 = 1000\ ^{\circ}C$$

Q3 b:

$$\text{Energy} = 1.2\ kw \times \frac{10\ h}{day} \times 6\ day = 72\ kwh$$

for eight motors:

$$\text{Energy} = 8 \times 72\ kwh = 576\ kwh$$

Total cost = kwh x unit cost

$$= 576 \times 6$$

$$= 3456 \text{ Dinar}$$

Q4 a:

Flux density $B = \frac{\Phi}{A} = \frac{6\times10^{-6}\ wb}{2\times10^{-4}}$

$= 3\times10^{-2}\ T$

$H = \frac{Ni}{\ell} = \frac{600 \times 0.06}{0.5}$

$= \frac{36}{0.5} = \frac{360}{5} = 72\ At/m$

$\mu = \frac{B}{H} = \frac{2\times10^{-2}}{72} \simeq 3\times10^{-4}$

~~$\mu_r = 0.83 \times 1256 \times 10^{-6}$~~

Q4 B:

The rated current is I_L

$I_L = P / V_t = \frac{75000}{600} = 125\ A$

$I_f = \frac{V_t}{r_f} = \frac{600}{120} = 5A$

$I_a = I_f + I_L = 5 + 125 = 130\ A$

$\therefore V_g = V_t + I_a r_a$

$= 600 + 130(0.2)$

$= 626\ V$

Q 5:

a: Phase angle at 110 v

$V = V_m \sin\theta$

$110 = 155.6 \sin\theta$

$\therefore \sin\theta = \frac{110}{155.6} = 0.7$

$\therefore \theta = 45°$

b: The Period T:

$T = \frac{1}{f} = \frac{1}{100}$

$= 10^{-2}$ sec

c: The rms value of the voltage

$V_{rms} = V \times 0.707 = 155.6 \times 0.707$

$= 108.92$ Volts

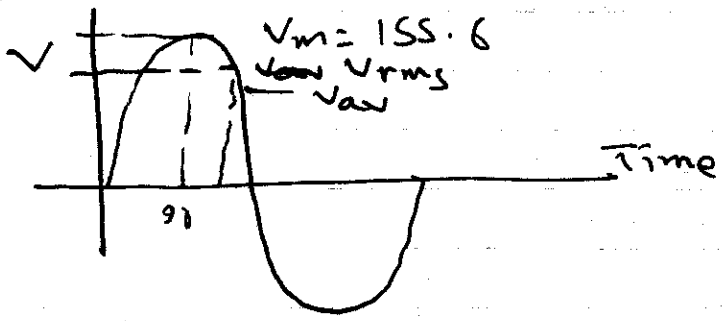
d:

$V_{av} = V \times 0.637$

$= 155.6 \times 0.637$

$\simeq 93.36$ Volts

e: The waveform



f:

$P = \frac{V}{I}$

$I = \frac{155.6}{10} = 15.56$ A

University of Technology
Chemical Engineering
Department
Final Examination
2011/2012

Subject:Chemistry
Both Branches
Examiner:fatin saffu

Class: first
Time: 3 hours
Date : 3 /june

Q1. Fill only five of the following points.

1-In volhard method, the end-point is located by using-------- as an indicator.

2- The use of buffers is very important to----------.

3- A chromatogram is a plot of ---------- as function of ----------.

4- The most important polysaccharides are ----------and ----------.

5- ---------- is the addition of two or more different monomers in order to produce a polymer.

6- ---------- is used as a test for the unsaturation in the molecules.

7- ----------is the most titrant used as complexing agent. **(10 marks)**

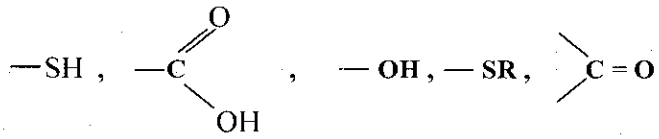
Q2. A- Calculate the change in pH upon adding 1.0ml of 0.1M hydrochloric acid to 10.0 ml of a buffer Solution consist of 0.2 M phenol and 0.2M sodium phenoxide. Given that dissociation constant for phenol = 1.3×10^{-10}. **(5 marks)**

B- 250 ml of sodium sulfate solution contains 6 μmoles of sodium sulfate. How many ppm of Sulfate that it contains. Given that atomic weight of S = 32, O = 16. **(5 marks)**

Q3. A- Calculate the equivalent weight of ferric oxide. Given that atomic weight of Fe = 56, O = 16

B- Calculate the normality of solution containing 5.267 gm/L of $K_2Cr_2O_7$ (the chromium is reduced to Cr^{+3}). Molecular weight of $K_2Cr_2O_7$ =294. **(10 marks)**

Q4. A- Write the names of organic compound classes that contain the following functional groups.



(5 marks)

B- Write the chemical equation with the catalyst (if present) for the preparation of the following compounds(answer only three). **(5 marks)**

1.Benzoic acid from ethylbenzene

2. Ethylmethylketone from diethylzinc

3. Tetraethyllead from ethylchloride

4. m-Xylene from toluene

Q5. Answer only two of the following.

A-Write the chemical structure of the following compounds (answer only five).
Pyrrole, Starch, Pyran, Polyvinylchloride, Methylpropionate, Hexanoic acid, Cyclohexane thiol **(5 marks)**

B- What are the classes of carbohydrates? Write the chemical formula and the name of only one Compound of each class. **(5 marks)**

C- Write the importance of reforming process on gasoline. **(5 marks)**

D- write the chemical equation for the nitration and halogenation of naphthalene **(5 marks)**

Follow

Q1. 1. Ferric ammonium sulfate, 2. maintain the pH of solution at a desired level, 3. detector responses, time, 4. Cellulose, starch, 5. Copolymerization, 6. Baeyer's test, 7. EDTA (Ethylene diamine tetra acetic acid)

Q2 A. pH_1 before addition of HCl $= pKa + \log \frac{[C_6H_5O^-]}{[C_6H_5OH]}$

$$pH_1 = -\log 1.3\times10^{-10} + \log \frac{0.2}{0.2} = 9.89$$

$$C_6H_5O^- + H^+ \longrightarrow C_6H_5OH$$

mmole of phenol produced = HCl reacted $= 1 \times 0.1 = 0.1$ mmol

" " Phenoxide reacted $= 1 \times 0.1 = 0.1$ mmol.

Final conc. of $C_6H_5OH = \frac{10\times0.2 + 0.1}{} = 0.191$

" " " $C_6H_5O^- = \frac{10\times0.2 - 0.1}{} = 0.173$

$$pH_2 = pKa + \log \frac{[C_6H_5O^-]}{[C_6H_5OH]} = -\log 1.3\times10^{-10} + \log \frac{0.173}{0.191}$$

$$= 9.89 - 0.043 = 9.847$$

Change in pH $= pH_2 - pH_1$

$= 9.847 - 9.89 = -0.043$

B. mass of sulfate $= 6 \times 96 = 576$ Mg

ppm of sulfate $= \frac{576}{250} = 2.3$

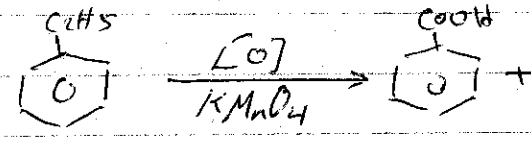
Q3. A equivalent weight of $Fe_2O_3 = \frac{M.wt \text{ of } Fe_2O_3}{6}$

$$= \frac{(56\times2) + (3\times16)}{6} = \frac{112+48}{6} = 26.67$$

B. eq. wt. $= \frac{294}{6} = 49$ gm/eq.

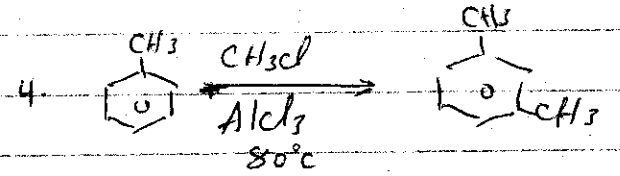
no. of eq. $= \frac{5.267}{49} = 0.1074$ eq/L $= 0.1074$ N.

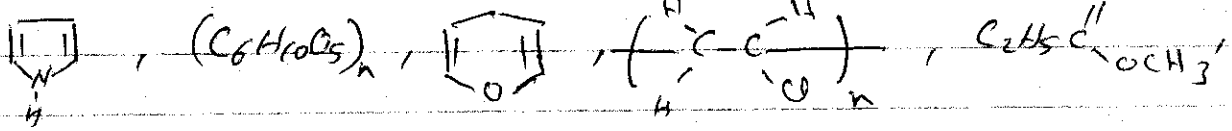
Q4 A. mercaptan, Carboxylic acid, Alcohol, Thioether, Ketone.

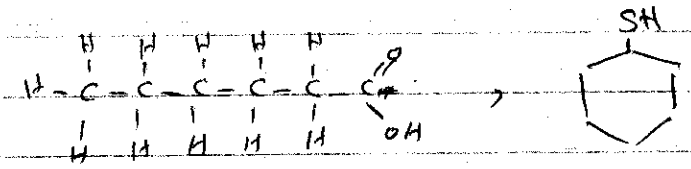
B. 1. 

2. $(C_2H_5)_2Zn + CH_3-\overset{O}{\overset{\|}{C}}-Cl \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-C_2H_5 + ZnCl_2$

3. $4C_2H_5Cl + 4Na/Pb \xrightarrow{\text{Pressure}} (C_2H_5)_4Pb + 3Pb + 4NaCl$

4. 

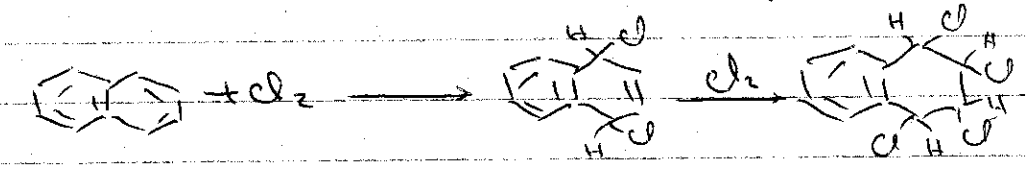
Q5 A. 

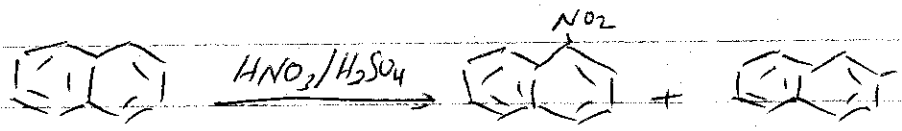


13.

1. Monosaccharides	glucose	$C_6H_{12}O_6$
2. Di, tri saccharides	sucrose	$C_{12}H_{22}O_{11}$
3. poly saccharides	starch	$(C_6H_{10}O_5)_n$

C. Reforming process converts the continuous chain hydrocarbons into branching structures, which have higher value as motor fuels, that is higher octane rating.

D. 



95% α-nitro naphthalene 5% β-nitro naphthalene

University of Technology

Chemical Engineering Department

Final Examination – First Attempt

2011/2012

Subject: Principles of Chem. Eng.
Branch: Both branches
Examiner: Dr. Issam K. Salih

Class: First
Time: 3 hours
Date : 24 /may /2012

Note: Attempt four questions only

Q1: A : What is the temperature that its value in Rankine scale is ten times that in Celsius scale ?

(7 Marks)

B : Phosphoric acid solution with specific gravity of 1.218 consists of 35 wt % H_3PO_4. Calculate $^{\circ}$Be , molarity , normality , composition as mol % and average molecular weight of solution .
Given that : molecular weight of $H_3PO_4 = 98$.

(18 Marks)

Q2 : A gaseous mixture (F) consists of 16 mol % CS_2 and 84 mol % air is continuously fed to the absorption column at a rate of 1000 lb mole / hr . Liquid benzene (L) is fed to the top of the column in order to absorb CS_2 . The product liquid stream (P) consists of 90 mol % benzene and 10 mol % CS_2 , whereas the exit gas stream (G) contains 96 mol % air , 2 mol % CS_2 and 2 mol % benzene . Make material balance calculations to calculate the flow rates of streams (G),(L) and (P) with checking .

(25 Marks)

Q3 : Two tanks connected by a valve which is initially closed . The first tank , with volume of 400 ft^3 , contains nitrogen at 30 psia and 99 $^{\circ}$F . The second tank contains a paraffinic gas at 56 psia and 149 $^{\circ}$F . When the valve is opened and the gases are completely mixed , it is found that the partial pressure of nitrogen is 16.8 psia and that of the paraffinic gas is 25.2 psia .The mass of the gaseous mixture is found to be 230 lb . Assuming ideal behavior of gases , calculate :

(a) lb moles of each gas .
(b) Volume of the second tank in ft^3 .
(c) Final temperature of the mixture in $^{\circ}$F .
(d) Identify the paraffinic gas .
Given that : R = 10.73 psia . ft^3 / lb mole $^{\circ}$R .

(25 Marks)

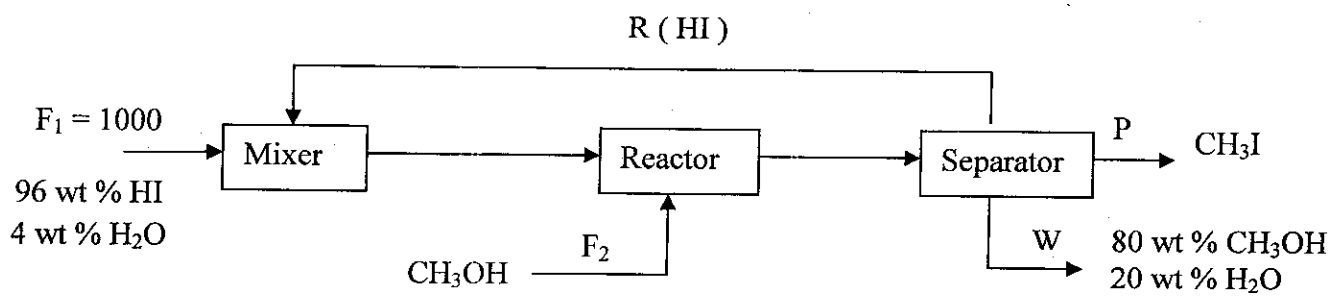
Follow

Q4 : Methyl iodide is produced by adding hydroiodic acid to an excess amount of methanol according to the following reaction :

$$HI + CH_3OH \longrightarrow CH_3I + H_2O$$

Mwt.	128	32	142	18

Fresh hydroiodic acid solution (F_1) consists of 96 wt % HI are fed to the process at a rate of 1000 lb / hr . The degree of completion of the reaction is 40 % . The recycle stream (R) consists of HI only .Calculate the flow rates of streams P , W , F_2 and R shown in the following flow diagram with complete checking .



(25 Marks)

Q5 : Steam at 45 bar and 450 °C ($V_1 = 70$ liter / kg , $\bar{U}_1 = 3006$ kJ / kg) enters a turbine at a velocity of 60 m / sec and flow rate of 500 kg / hr . The steam leaves the turbine at the same level of the inlet point at 1 bar and 100 °C ($\bar{V}_2 = 1700$ liter / kg , $\bar{U}_2 = 2506$ kJ / kg) and at a velocity of 300 m / sec . Heat is lost from the turbine at a rate of 10,000 kcal /hr.

Calculate : (a) the specific change in enthalpy ($\Delta\bar{H}$) in kJ / kg .
(b) the shaft work produced from the turbine in kW .

(25 Marks)

Conversion Factors :

1m = 3.28 ft	1 lb_m = 453.6 gm	1 J = 1 liter . kPa
1ft = 12 in = 30.48 cm	1 ft^3 = 7.48 gal = 28.32 liters	1 kJ = 10 bar . liter
1in = 2.54 cm	1 atm = 14.7 psi = 101.3 kPa	1 Btu = 252 cal = 778 ft .lb_f
1lb_f = 4.448 N	1 bar = 100 kPa	1 kcal = 4.184 kJ

Q1 B

∴ Basis = 1 liter of sol.

$B_c = 145 - \frac{145}{SPg} =$

$= 145 - 119 = 26$

mass of $H_3PO_4 = 1218\,(0.35) = 426.3$ gm

$\text{mole} = \frac{426.3}{98} = 4.35$ mol

mass $H_2O = 1218\,(0.65) = 791.7$ gm

mole $H_2O = 43.98$ Total moles 48.33

∴ mol % $H_3PO_4 = \frac{4.35}{48.33} \times 100 = 9\%$

mol water $= \frac{43.98}{48.33} = 91\%$

Molarity $= \frac{4.35}{1}$, Normality $= 4.35(3) = 13N$

$(Mwt)_{avg} = 98(0.09) + 18(0.91)$

$= 8.82 + 16.38 = 25.2$

Solution 2

Basis: 100 gm of sol.

Vol. of sol. $= \frac{m}{\rho} = \frac{100}{1.218} = 82.1\ cm^3 = 0.0821$ liter

Moles of $H_3PO_4 = \frac{35}{98} = 0.357$ mol

Moles of $H_2O = \frac{65}{18} = 3.611$ mol } Total = 3.968 mol

∴ Molarity $= \frac{0.357}{0.0821} = 4.35M$, Normality $= 4.35(3) = 13N$

Mol % $H_3PO_4 = \frac{0.357}{3.968} \times 100 = 9\%$

Mol % $H_2O = \frac{3.611}{3.968} \times 100 = 91\%$

A

$T_R = T_F + 460$

$= (1.8\,T_C + 32) + 460$

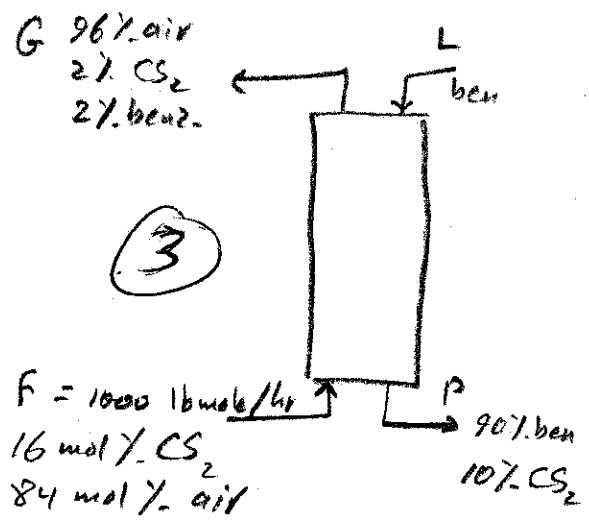
$10T = 1.8T + 492$

$8.2T = 492 \longrightarrow T = \frac{492}{8.2} = 60^\circ C$

$T_R = 600^\circ R$ $(T_F = 140^\circ F)$

Q-2

basis: 1 hr = 1000 lbmole of F



1- Air balance

$$F\left(\frac{84}{100}\right) = G\left(\frac{96}{100}\right)$$ (15)

$$840 = 0.96G$$

$$\therefore G = \frac{840}{0.96} = 875 \text{ lbmole/hr}$$

2- CS_2 balance

$$F\left(\frac{16}{100}\right) = G\left(\frac{2}{100}\right) + P\left(\frac{10}{100}\right)$$

$$160 = 875(0.02) + 0.1P$$

$$P = \frac{160 - 17.5}{0.1} = \frac{142.5}{0.1} = 1425 \text{ lbmole/hr}$$ (14)

3- Benzene balance

$$L = G\left(\frac{2}{100}\right) + P\left(\frac{90}{100}\right)$$

$$= 875(0.02) + 0.9(1425)$$

$$= 17.5 + 1282.5 = 1300 \text{ lbmole/hr}$$ (15)

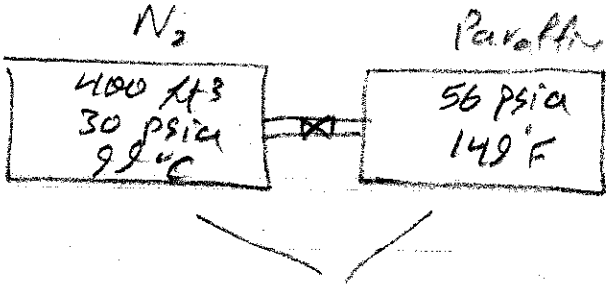
4- Checking T.M.B.

Input = F + L = 1000 + 1300 = 2300 lbmole/hr

Output = G + P = 875 + 1425 = 2300 lbmole/hr

(3)

Q.3



(a) $n_{N_2} = \frac{P_1 V_1}{R T_1} = \frac{30(400)}{10.73(559)}$

$= \underline{2.0 \text{ lbmole}}$

$P_{tot.} = 16.8 + 25.2 = 42 \text{ psia}$

$P_{N_2} = 16.8 \text{ psia}$

$P_P = 25.2 \text{ psia}$

Mass = 230 lb

$y_{N_2} = \frac{16.8}{42} = 0.4 = \frac{2}{n_{tot.}}$

$\therefore n_{tot.} = \frac{2}{0.4} = 5 \text{ lbmoles}$

$\therefore n_p = 5 - 2 = \underline{3 \text{ lbmoles}}$

(b) $V_2 = \frac{n_p R T}{P} = \frac{3(10.73)(609)}{56} = \underline{350 \text{ ft}^3}$

(c) $T_{final} = \frac{PV}{nR} = \frac{42(400+350)}{5(10.73)} = 587.1 \text{ °R}$

$= \underline{127.1 \text{ °F}}$

(d) mass of $N_2 = 2(28) = 56$ lb

$\therefore$ mass of the paraffinic gas $= 230 - 56 = 174$ lb

$\therefore M_{wt} = \frac{\text{Total mass}}{\text{total moles}} = \frac{174}{3} = 58$

$C_n H_{2n+2} = 58$

$12(n) + 1(2n+2) = 58 \Longrightarrow n = \frac{58-2}{14} = \underline{4}$

$\therefore$ The gas is <u>butane</u> $C_4 H_{10}$

Q.4

Basis: 1 hr ≡ 1000 lb of F_1

HI input = $1000\left(\frac{26}{100}\right) = 960$ lb = 7.5 lbmole = HI reacted

CH_3I produced = $7.5(142) = \underline{1065}$ lb/hr = P

Water produced from reaction = $7.5(18) = 135$ lb

Water input + water produced = Water output

$$40 + 135 = 175 = W\left(\frac{20}{100}\right)$$

$$\therefore W = \frac{175}{0.2} = \underline{875} \text{ lb/hr}$$

Methanol output = $875\left(\frac{80}{100}\right) = 700$ lb

Methanol input = Methanol output + Methanol reacted

$$= 700 + 7.5(32)$$

$$= 700 + 240 = \underline{940} \text{ lb/hr} = F_2$$

Checking: Input = $F_1 + F_2 = 1000 + 960 = 1960$

Output = $P + W = 1065 + 875 =$

$$\text{deg of completion} = \frac{\text{HI reacted}}{\text{HI input to the reactor}} = \frac{40}{100} = \frac{960}{960 + R}$$

$$960 = 384 + 0.4R$$

$$\therefore R = \frac{576}{0.4} = \underline{1440} \text{ lb/hr}$$

Checking

∴ HI input to the reactor = $960 + 1440 = 2400$ lb

HI reacted = $2400\left(\frac{40}{100}\right) = 960$ lb

HI unreacted = $2400\left(\frac{60}{100}\right) = 1440$ lb = R

Q-5

Steam at 45 bar and 450 °C ($\bar{V}_1 = 70$ liter/kg, $\bar{U}_1 = 3006$ kJ/kg) enters a turbine at a velocity of 60 m/sec and flow rate of 500 kg/hr. The steam leaves the turbine at the same level of the inlet point and at 1 bar and 100 °C ($\bar{V}_2 = 1700$ liter/kg, $\bar{U}_2 = 2506$ kJ/kg) at a velocity of 300 m/sec. Heat is lost from the turbine at a rate of 10,000 kcal/hr

Calculate: (a) the specific change in enthalpy ($\Delta\bar{H}$) in kJ/kg.
(b) the shaft work produced from the turbine in kW.

Given that: 1 kJ = 10 bar.liter, 1 kcal = 4.184 kJ

$$\Delta\bar{U} = \bar{U}_2 - \bar{U}_1 = 2506 - 3006 = -500 \text{ kJ/kg}$$

$$\Delta P\bar{V} = P_2\bar{V}_2 - P_1\bar{V}_1 = 1(1700) - 45(70) = -1450 \text{ bar.liter/kg} \times \frac{1 \text{ kJ}}{10 \text{ bar.liter}}$$

$$3150 = -145 \text{ kJ/kg}$$

$$\Delta\bar{H} = \Delta\bar{U} + \Delta P\bar{V}$$

$$= -500 - 145 = -645 \text{ kJ/kg} \qquad 14$$

$$\frac{\Delta V^2}{2g_c} = \frac{(300)^2 - (60)^2}{2(1)} = 43,200 \text{ J/kg} = 43.2 \text{ kJ/kg} \qquad 6$$

$$500 \frac{\text{kg}}{\text{hr}} (-645 + 43.2) = -41840 - W_s$$

$$W_s = 300900 - 41840 = 259060 \text{ kJ/hr} \times \frac{\text{hr}}{3600}$$

$$= \frac{72}{5} \text{ kW}$$

14

$$m(\Delta\bar{H} + \Delta E_k) = Q - W_s$$

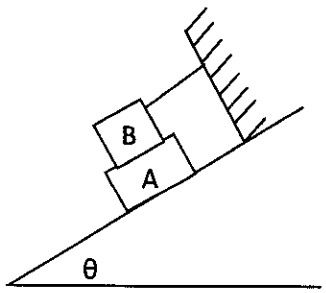
University of Technology
Chemical Engineering
Department
Final Examination
2011/2012

Subject: Mechanic & Strength of Material
Branch: Both branch
Examiner: Dr. Eman J. & Dr.Jenan A.

Class: First
Time: 3 hours
Date : 13/June

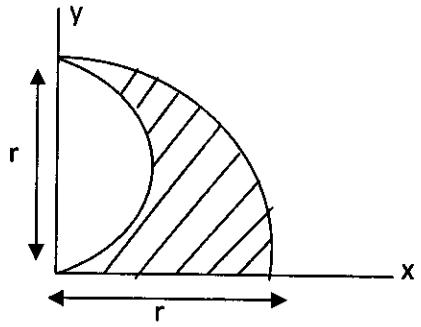
Attempt four questions only

Q1: Find the value of (θ), if the block (A) is about to slide as shown in figure below, weight of block (A) is $20kg_f$ and of (B) is $10kg_f$ and (μ) =0.2, calculate the tension force in the cord.



[25]

Q2: Locate the centroid of the shaded in figure below created by cutting a semicircle of diameter (r) from a quarter circle of radius (r).

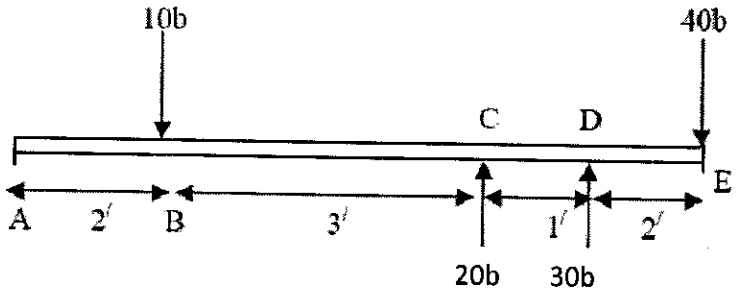


[25]

Q3:

A: compute the total elongation of 50m aluminum wire caused by a tensile load of 70 MPa. Find the change in temperature that may cause the same elongation. E=70 GN/m^2, $\alpha = 25x10^{-6}\ K^{-1}$.

B: Compute the moment sums about point A, B, C, D, & E.



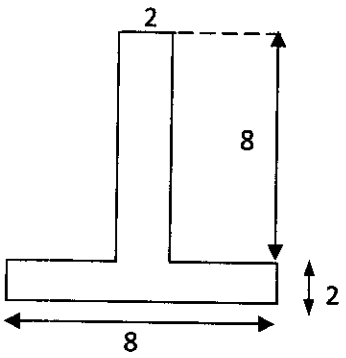
[25]

Follow ↓

Q4:

A: (60mm) square bar of 1m is subjected to an axial tensile load of 360 KN. Compute the total elongation in the lateral diameter. E= 200 GN/m^2, □ = 0.3.

B: Determine the moment of inertia of T-section shown in the figure below with respect to its centroidal X_o-axis. Given that: $I_o = \frac{bh^3}{12}$

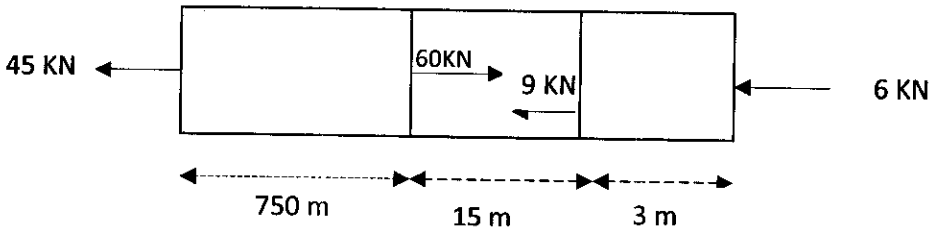


[25]

Q5:

A: A closed cylindrical tank used to store compressed air with internal diameter of 600 mm. the pressure of the air inside the tank is 3.5 Mpa. If $\sigma_{y.p}$ = 250 MPa, $N_{y.p}$ = 3.5. Calculate the thickness of the tank wall.

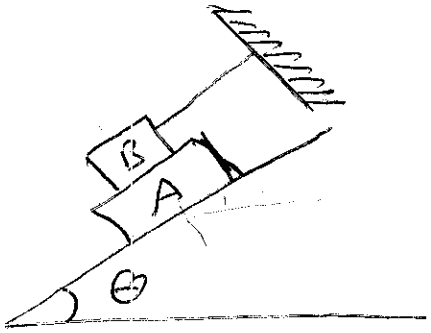
B: Determine the elongated in each portion shown in figure below. E = 90 GN/m^2, A = 1000 mm^2.



[25]

Good Luck

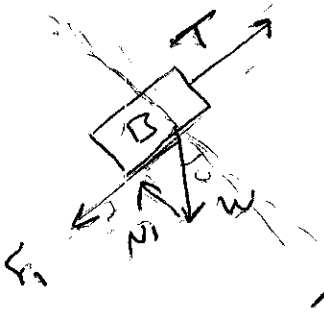
Q/ Find the value of θ, If the block (A) is about to slide as shown in the figure below - Weight of the block (A) is (20 kg) and B is 10 kg and $\mu = 0.2$, Calculate the tension force in the cord



Solution

Block B $\Rightarrow W_1 = 10\ kg_f$

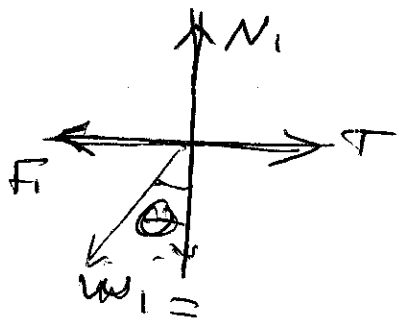
T = Tension force
قوة الحبل تكون توتر



$\Sigma F_x = 0$

$T - F_1 - W_1 \sin\theta = 0$

$$T - F_1 - 10\sin\theta = 0 \quad \text{---(1)}$$



$\Sigma F_y = 0$

$N_1 - W_1 \cos\theta = 0$

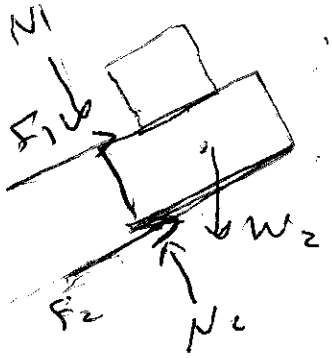
$$N_1 = 10\cos\theta \quad \text{---(2)}$$

$$F_1 = \mu N_1 = 0.2 N_1 \quad \text{---(3)}$$

Block A

Block A slide down then the friction up

follow $\Longrightarrow$



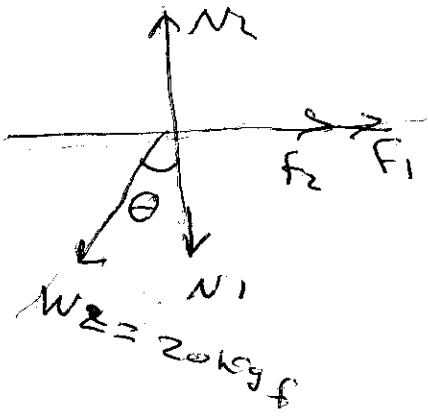
$\Sigma F_x = 0$

$F_1 + F_2 - W_2 \sin\theta = 0$

$\boxed{F_1 + F_2 - 20\sin\theta = 0}$ ——— (4)

$\Sigma F_y = 0$

$N_2 - N_1 - W_2 \cos\theta = 0$



$\boxed{N_2 - N_1 - 20\cos\theta = 0}$ ——— (5)

Sub eq. 2 into eq. (5) for N_1

$\therefore N_2 = N_1 + 20\cos\theta$

$N_2 = 10\cos\theta + 20\cos\theta$

$\therefore \boxed{N_2 = 30\cos\theta}$ ——— (6)

$\boxed{F_2 = \mu N_2 = 0.2 N_2}$ ——— (7)

Sub. eq. (3) & (7) into (4)

$0.2N_1 + 0.2N_2 - 20\sin\theta = 0$

$0.2(10\cos\theta) + 0.2(30\cos\theta) = 20\sin\theta$

$2\cos\theta + 6\cos\theta = 20\sin\theta$

$8\cos\theta = 20\sin\theta$

$\frac{\sin\theta}{\cos\theta} = \tan\theta = \frac{8}{20}$

$\therefore \theta = \tan^{-1}\frac{8}{20} = 21.8°$

eq 2 $\Rightarrow N_1 = 10\cos\theta = 10\cos(21.8)$

$= 9.3$ kgf

eq 3 $= F_1 = 0.2N_1 = 0.2(9.3) = 1.86$ kgf

eq (1) $T = F_1 + 10\sin\theta$

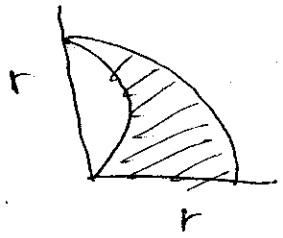
$= 1.86 + 10\sin(21.8)$

$= 5.574$ kgf.

Q2

locate the Centroide of the shaded area in the figure below created by cutting a semicircle of diameter (r) from a quarter circle of radius (r)

Solution



$$x_c = \frac{\Sigma a_i x_i}{A}$$

$$y_c = \frac{\Sigma a_i y_i}{A}$$

Shape	x	y	a	ax	ay
Quarter-circle	$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$	$\frac{4r}{3\pi} \times \frac{\pi r^2}{4}$ $\frac{r^3}{3}$	$\frac{4r}{3\pi} \times \frac{\pi r^2}{4}$ $\frac{r^3}{3}$
Semicircle	$\frac{4(r/2)}{3\pi} = \frac{4r}{6\pi} = \frac{2r}{3\pi}$	$\frac{r}{2}$	$-\frac{\pi (r/2)^2}{2} = -\frac{\pi r^2}{8}$	$\frac{\pi r^2}{8} \times \frac{2r}{3\pi}$ $= -\frac{r^3}{12}$	$-\frac{\pi r^2}{8} \times \frac{r}{2}$ $= -\frac{\pi r^3}{16}$

$$x_c = \frac{a_1 x_1 + a_2 x_2}{A}$$

$$A = \Sigma a = a_1 + a_2 = \frac{\pi r^2}{4} - \frac{\pi r^2}{8} = \frac{2\pi r^2 - \pi r^2}{8} = \frac{\pi r^2}{8}$$

$$\bar{x}_c = \frac{\frac{r^3}{3} - \frac{r^3}{12}}{\frac{\pi r^2}{8}} = \frac{\frac{3r^3}{12}}{\frac{\pi r^2}{8}} = \frac{2r}{\pi} = 0.637r$$

$$\bar{y}_c = \frac{a_1 y_1 + a_2 y_2}{A}$$

$$= \frac{\frac{r^3}{3} - \frac{\pi r^3}{16}}{\frac{\pi r^2}{8}} = \frac{\frac{16r^3 - 3\pi r^3}{16 \times 3}}{\frac{\pi r^2}{8}} = \frac{8}{\pi r^2}\left\{\frac{16r^3 - 3\pi r^3}{16 \times 3}\right\}$$

$$= 0.349\,r$$

∴ The Centroid of shaded area is

$(0.637r, 0.349r)$

Q.3 13/1

Compute the total elongation of (50 m) aluminum wire caused by a tensile load of (70 MPa) Find the change in temperature that may cause the same elongation

$E = 70\ GN/m^2$, $\alpha = 25 \times 10^{-6}\ ^\circ C^{-1}$

Solution

$$\delta = \frac{PL}{AE} = \frac{\sigma L}{E}$$

$$= 70 \times 10^6\ \frac{N}{m^2} \times 50m \times 10^3\ \frac{mm}{m} \Big/ 70 \times 10^9\ \frac{N}{m^2}$$

$= 50$ mm elongated from force

elongated from Force = elongated from change in temperature

$$\delta_F = \delta_T$$

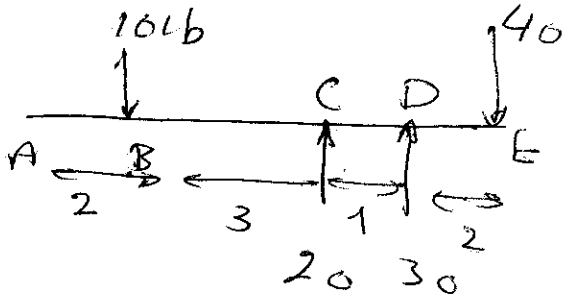
$$\delta_T = \alpha \cdot L\ \Delta T$$

$$50\ mm = 25 \times 10^{-6}\ ^\circ C^{-1} \times 50 \times 10^3 \times \Delta T$$

$$\Delta T = \frac{50}{50 \times 10^3 \times 25 \times 10^{-6}} = 40\ ^\circ C$$

Q.3

13/ Compute the moment sums about A B, C, D and E.



$\Sigma M_A = 10 \times 2 - 20 \times 5 - 30 \times 6 + 40 \times 8$

$= 60$ lb-ft

$\Sigma M_B = -20 \times 3 - 30 \times 4 + 40 \times 6 = 60$ lb.ft

$\Sigma M_C = -10 \times 3 - 30 \times 1 + 40 \times 3 = 60$ lb.ft

$\Sigma M_D = -10 \times 4 + 20 \times 1 + 40 \times 2 = 60$ lb.ft

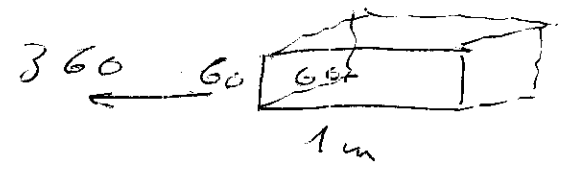
$\Sigma M_E = -10 \times 6 + 20 \times 3 + 30 \times 2 = 60$ lb.ft.

Q.4

A/ A (60 mm) square bar of (1 m) length is subjected to an axial tensile load of (360 KN)

Compute the total elongation in the lateral diameter.

$E = 200\ GN/m^2$ $\quad \nu = 0.3$



$$\nu = -\frac{\epsilon_D}{\epsilon_L}$$

$$\epsilon_L = \frac{\sigma_L}{E} \qquad \epsilon = \frac{\sigma_L}{\epsilon_L} \quad , \sigma_L = \frac{P}{A}$$

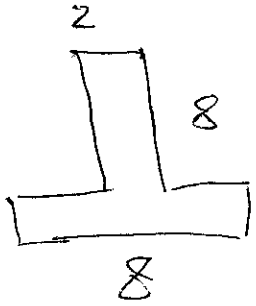
$$\sigma_L = \frac{P}{A} = \frac{360\ KN \times 10^3}{60 \times 60\ mm^2 \times 10^{-6}} = 100 \times 10^6\ N/m^2$$

$$= 100\ MPa$$

$$\epsilon_L = \frac{100 \times 10^6}{200 \times 10^9} = 5 \times 10^{-4}$$

$$\epsilon_D = -\nu \cdot \epsilon_L = -0.3 \times 5 \times 10^{-4} = -7.5 \times 10^{-3}\ mm$$

Q.4 B/ Determine the moment of inertia of T-section shown in the figure below with respect to



Solution

$$I_x = \Sigma I_o + \Sigma A d^2$$

Shape	I_o	A	d	Ad^2
8 × 2	$\frac{bh^3}{12}$ $\frac{2 \times (8)^3}{12}$ $= 85.33$	2×8 $= 16$	$\frac{8}{2} + 2$ 6	$16 \times (6)^2$ $= 576$
8 × 2	$\frac{bh^3}{12} = \frac{8 \times 2^3}{12}$ $= 5.33$	2×8 $= 16$	$\frac{2}{2} = 1$	$16 \times (1)^2$ 16
	$\Sigma I_o = 90.66$			$\Sigma Ad^2 = 592$

$$\therefore I_x = 90.66 + 592 = 682.66 \text{ cm}^4$$

Q5/ A:

A closed cylindrical tanks used to store compressed air with internal diameter of (600 mm), the, the pressure of the air inside the tank is (3.5 MPa) if $\sigma_{y.p} = 250$ MPa, $N_{y.p} = 3.5$, Calculate the thickness of the wall of the tanks.

Solution

$D = 600$ mm $\qquad P = 3.5$ MPa

$$\sigma_t = \frac{P.D}{2.t}$$

$$\frac{\sigma_{y.p}}{N_{y.p}} = \frac{P.D}{2t}$$

$$\frac{250\ MPa}{3.5} = \frac{3.5\ MPa * 600\ mm}{2 * t}$$

$$t = 14.7\ mm$$

$$\sigma_L = \frac{P.D}{4t}$$

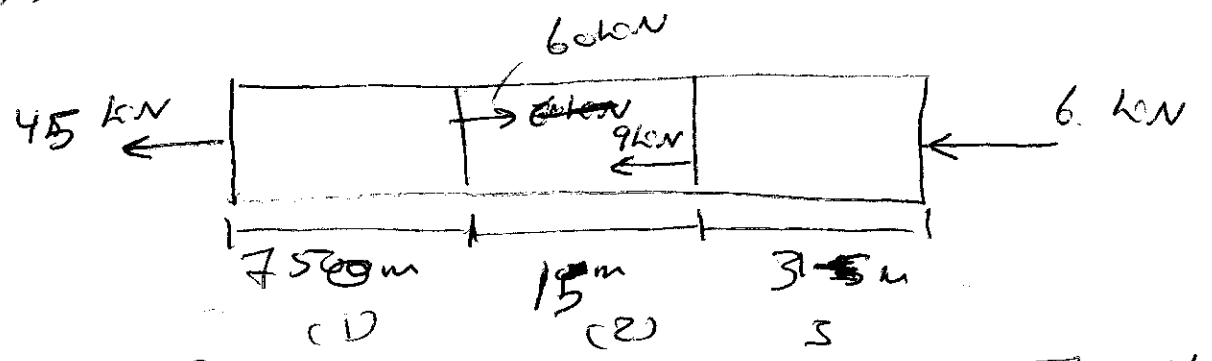
$$\frac{250}{3.5} = \frac{3.5 * 600}{4 * t}$$

$$t = 7.32\ mm$$

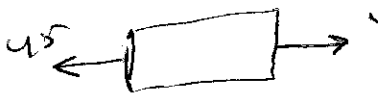
∴ Required thickness should be $= 14.7$ mm

Q5/ B9

Determine the elongated in each portion and the total elongation shown in figure below, $E = 90\ GN/m^2$, $A = 1000\ mm^2$



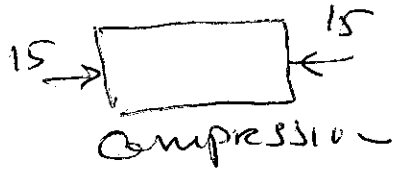
$$\delta_1 = \frac{P.L}{AE}$$



$$\delta_1 = \frac{(45\times10^3)N \times 7500\ m \times \frac{10^3\ mm}{m}}{1000\ mm^2 \times 90\times10^9}$$

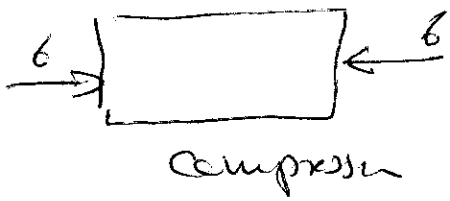
$$= 375\ mm$$

$$\delta_2 = \frac{(15\times10^3) \times 15 \times 10^3}{1000 \times 90\times10^9}$$



$$= 2.50\ mm$$

$$\delta_3 = \frac{(6\times10^3) \times 3 \times 10^3}{1000 \times 90\times10^9}$$



$$= 0.2\ mm$$

$$\delta_{Total} = 375 + 2.5 + 0.2 = 377.7\ mm$$

الأسئلة
الأمتحانية
مع حلولها

الدور الثاني

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject:Chemistry

Both Branches:

*Examiner:*fatin saffu

Class: first

Time: 3 hours

Date : 9/9

Q1. Fill in the blanks only five of the following points.

1.In Mohr method, the end-point is located by the addition of ----------.

2. ---------- indicators are widely used in complexation titrations.

3.Titration curves are graphs of ---------- versus ----------.

4.---------- is used to determine the excess amount of the titrant by titration with another Standard solution.

5.A one normal solution is that contains one ----------of solute per liter of solution.

6. Formality is the number of ---------- of solute in each liter of solution. **(10 marks)**

Q2. A- How many grams of K^+ presented in one liter of 500 ppm of KClO3 solution Given that molecular weight of KClO3 = 122, atomic weight of K = 39. **(5 marks)**

B- A substance with molecular weight of 178 has an absorbance of 0.876 in 1 cm cell. If the Absorptivity of the substance is 2750 liter / gm.cm, calculate it's molarity? **(5 marks)**

Q3. Calculate the pH and plot the resulting titration curve for the titration of 50 ml of 0.1M acetic acid by the addition of 0,15, 25, 50, 55ml of o.1M NaOH. Given that Ka = 1.75×10^{-5} **(10 marks)**

Q4. A- Give the general chemical formula of the following compounds (Answer only five)

Carbohydrates, dithioacids, esters, organo-lithium compounds, sec-alcohols, primary amines **(5 marks)**

B- Write the chemical equation with the catalyst (if present) for the preparation of the following compounds(answer only three). **(5 marks)**

1) m-xylene from toluene.

2) 1. Butanol from propylmagnesium bromide.

3) 1.Pentanol from Butyl lithium.

4) Propyl mercaptan from propyl chloride.

Q5. Answer only two of the following

A- What is the general chemical formula of Gringard reagents? Write the chemical reaction for Preparation of only two different organic compounds (different classes) from such reagents? **(5 marks)**

B- Write the chemical structure of the following compounds (answer only five). **(5 marks)**

Thiophene, Polypropylene, Methylphenyl sulfide, Benzoic acid, 3.methyl pentanal, 2.heptanone.

C- What is the type of polymerization reaction between 1,2 Ethane diol and Terephthalic acid? Write the chemical equations. (5 marks)

Q1- 1. Sodium chromate, 2. Metallochromic, 3. pH, added volume of titrant, 4. Back titration, 5. equivalent weight, 6. formula weight,

Q2 - A) mmoles $KClO_3 = \frac{500}{122} = 4$

g. atom $K^+ = 4$ mg. atom

mass of $K^+ = 4 \times 39 = 159$ mg $= 0.159$ g.

B) $C = \frac{A}{\epsilon b} = \frac{0.876}{2750} \times \frac{1}{178} = 1.79 \times 10^{-6} M.$

Q3) at 0.0 ml

$$\frac{x \cdot x}{0.1 - x} = 1.75 \times 10^{-5}$$

$$x = [H^+] = \sqrt{1.75 \times 10^{-5} \times 0.1} = 1.32 \times 10^{-3} M \Rightarrow pH = -\log[H^+] = 2.88$$

at 15 ml

mmol HOAc $= 50 \times 0.1 = 5$

mmol OH^- added $= 15 \times 0.1 = 1.5$

remaining HOAc $= 5 - 1.5 = 3.5$ mol.

$$pH = -\log 1.75 \times 10^{-5} + \log \frac{1.5/65}{3.5/65}$$

at 25 ml

mol HOAc $= 5$

mol OH^- $= 25 \times 0.1 = 2.5$

remaining HOAc $= 5 - 2.5 = 2.5$

$$pH = -\log 1.75 \times 10^{-5} + \log \frac{2.5/75}{2.5/75} = 4.76$$

at 50 ml

mol HOAc $= 5$

mol OH^- $= 5$

mol OAc^- produced $= 5$

$$[OAc^-] = \frac{5}{100} = 0.05$$

$$[OH^-] = \sqrt{\frac{K_w}{K_a}[OAc^-]} = \sqrt{\frac{10^{-14}}{1.75 \times 10^{-5}} \times 0.05} = 5.35 \times 10^{-6}$$

$pOH = 5.27$ $pH = 8.73$

at 55 ml

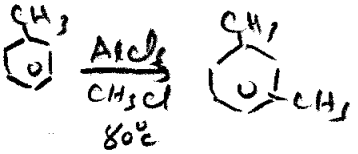
$55 \times 0.1 = 5.5$ mmol of OH^- added

mmol excess $OH^- = 5.5 - 5 = 0.5$

$[OH^-] = \frac{0.5}{105} \Rightarrow pOH = -\log \frac{0.5}{105}$

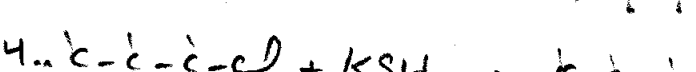
$pH = 14 - pOH$

Q4) A. $C_x(H_2O)_y$, RCS_2H, $R-C(=O)-OH$, $R-Li$, $R-\underset{R'}{\overset{H}{C}}-OH$, RNH_2.

B. 1. 

2. 

3. 

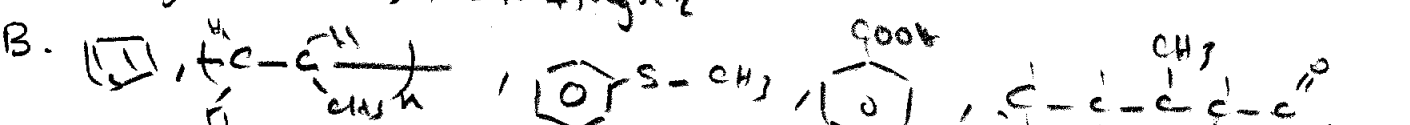
4. 

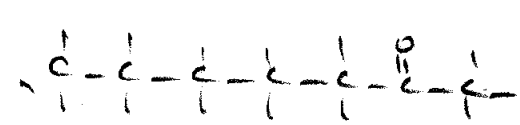
Q5) A. $RMgX$

$RMgX + H_2O \rightarrow R-H + Mg(X)(OH)$

$RMgX + H_2C=O \rightarrow R-CH_2-OH$

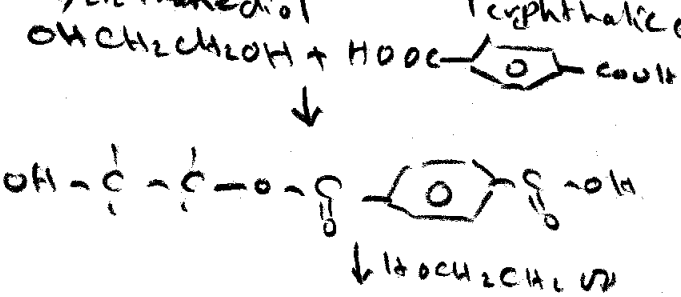
$RMgX + R'X \rightarrow R-R' + MgX_2$

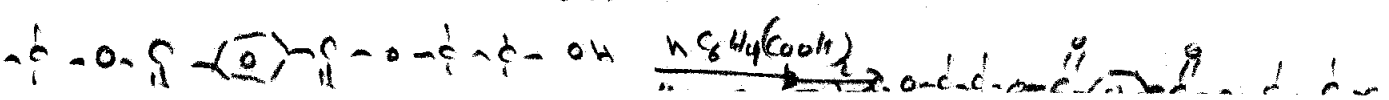
B. 



C. Condensation polymerization

1,2 Ethanediol $OHCH_2CH_2OH$ + Terephthalic acid $HOOC-C_6H_4-COOH$





University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Computer Programming I
Branch: Oil & Gas Refinery Engineering
Examiner: Dr.Khalid Farhod

Class: First
Time: 3 hours
Date : 11-June

Attempt five questions only

Q1: A: *Indicate whether the sentence or statement is true or false.* **(5 Mark)**

1- If command buttons are centered along the bottom of the screen, each button must be the same height and the same width.
2- In Visual Basic, you create a menu in the Menu Editor.
3- If a condition evaluates to false, the instructions in a Do While loop will not be processed.
4- The Rnd function produces integers within the 0 to 1 range, excluding both the 0 and the 1.
5- In Windows applications, the Save As command allows the user either to save a new file or to save an existing file under a new name.

B: *What will be the value of J after this code is executed?* **(5 Mark)**

```
Dim I As Integer, J As Integer
J = 0
Do While I = 7
   I = I + 1
   J = J + 1
Loop
```

Q2: A: *Identify the letter of the choice that best completes the statement or answers the question.* **(5 Mark)**

1-All conditions connected by the ____ operator must be true for the compound condition to be true.
a. And b. Not c. Or d. both a and b
2- A text box's ____ event occurs when the contents of the text box are changed.
a. Change b. Click c. Enabled d. Generate
3- Mathematical operators are evaluated ____ the relational operators.
a. after b. at the same time as
c. before d. none of the above
4- The ____ property determines whether an object is visible or hidden.
a. Appearance b. Display c. Visible d. Hidden
5- Use a(n) ____ control in situations where you want to allow the user to select any number of choices from a group of one or more independent and nonexclusive choices.
a. check box b. image box c. option button d. text box

B: *What is the types of Graphics in the Microsoft Word 2010.* **(5 Mark)**

Q3: A: *Write a program (design and code) to decide the type of flow in a pipe. Laminar for Re. No. less than 2000 and turbulent for Re. No. larger or equal to 2000.*

Knowing that: $Re.No. = \frac{\rho \times u \times d}{\mu}$

Note: 1.use Msgbox to show the flow type laminar or turbulent.
2. use four inputbox to enter the values of Density (ρ), Velocity (u), diameter (d) and viscosity (μ)

(6 Mark)

Follow

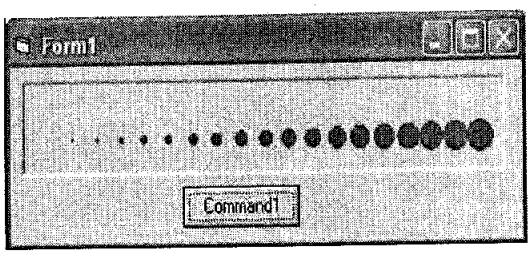
B: *What is most options used in the Control panel for the operation system Windows 7* **(4 Mark)**

Q4: **A:** *define the following objects in the Microsoft Access 2003* **(8 Mark)**
(a) Macro (b) Modules (c) Query (d) Reports

B: *What the code below produce?* **(2 Mark)**
Value = MsgBox("Is it OK to save Data?", vbOKCancel + vbQuestion, "About to Save")

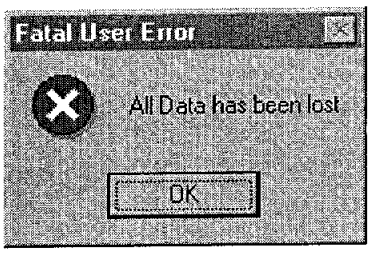
Q5: **A:** *Write a program (design and code) to read names and marks of ten students in one subject and print the name and mark of the student who have the highest mark.* **(5 Mark)**
Note: use two inputbox

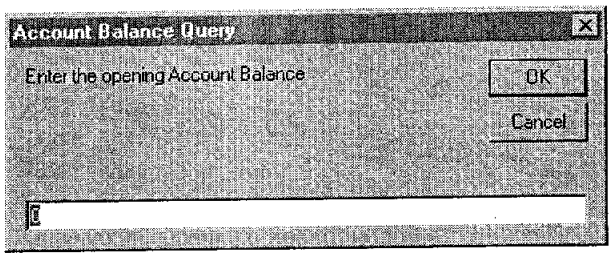
B: *Write a program (code) to draw the form below Using (Pset) and (Draw width)* **(5 Mark)**



Q6: **A:** *Write a program (code only) for moving to the first record in the table of database using Data Control object.* **(6 Mark)**

B: *Write a computer (code only) to show the following messages.* **(4 Mark)**





حلول نموذج 2

Q1/ A/

1- F 2- T 3- T 4- F 5- T

B/ Zero

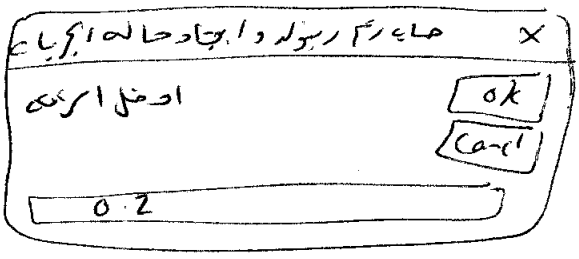
Q2/ A/

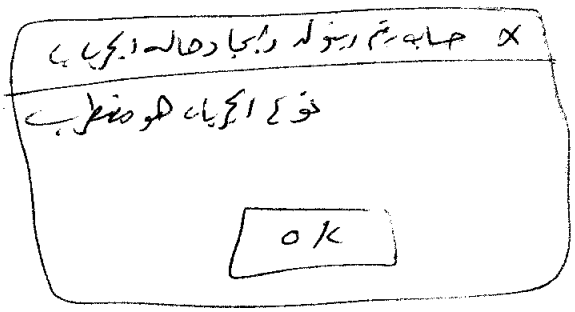
1- A 2- A 3- C 4- C 5- A

B/ ① shapes ② Pictures ③ clip Art
④ Smart Art ⑤ statistical charts

Q3/ A/

```
Privatsub Command1_ click ()
U = Inputbox ("ادخل اسرعة", "حساب رقم ريبوله وايجاد حالة الكهيان", "")
D = Inputbox ("ادخل قطر الاطبوب", "حساب رقم ريبوله وايجاد حالة الجريان", "")
P = Inputbox ("ادخل الكثافة", "حساب رقم ريبوله وايجاد حالة الجريان", "")
M = Inputbox ("ادخل اللزوجة", "حساب رقم ريبوله وايجاد حالة الجريان", "")
Re = (U * D * P) / M
If Re < 2000 Then
Msgbox "حساب رقم ريبوله وايجاد حالة الجريان", 0, "نوع الجريان هو انسيابي"
Else
Msg box "حساب رقم ريبوله وايجاد حالة الجريان", 0, "نوع الجريان هو مضطرب"
End If
```





B/ ① Date and Time ② Desktop Gadgets
③ Device Manager ④ Devices and printers
⑤ Folder options ⑥ Programs and features
⑦ Region and Language ⑧ User Accounts

Q4/ A/

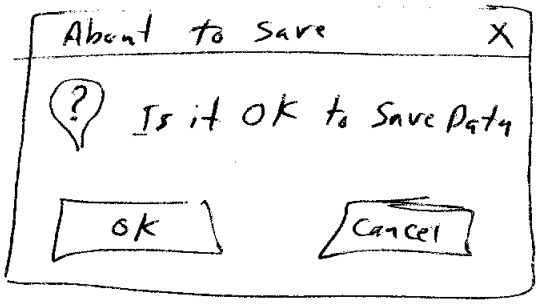
a/ Macro: تقوم بأتمتة قاعدة البيانات الخاصة بك (تنفيذ الكثير من العمل في وقت واحد)

b/ Module: عبارة عن برامج تساعد المبرمج في تكوين لغات البرمجة الخاصة لقاعدة البيانات

c/ Query: تستخدم لتجميع البيانات التي تطلبها من الجدول (كائن الاستعلام عن البيانات
ورقة الجداول تساعدة العلاقات بين الجداول).

d/ Reports: ورقة تستخدم لتلخيص البيانات (عرض التقارير وتنسيقها).

B/



Q5/ A/

```
Private Sub Form_Load
Dim stu_name(10) As string
Dim mark(10) As single
For i = 1 To 10
stu_name(i) = InputBox ("ادخل اسم الطالب")
mark(i) = InputBox ("ادخل درجة الطالب")
Next i
max = 0
For i = 1 To 10
If mark(i) >= max Then
 max = mark(i)
 Nam = stu_nam(i)
 End If
Print Nam, Max
  End Sub
```

B/
```
Private Sub Command1_Click()
For i = 2 To 20
x = X + 250 : y = 500
Picture1.Pset (x, y), VbRed
Picture1.DrawWidth = i
Next
End Sub
```

Q6/ A/
```
Private Sub cmdFirst_Click()
On Error Goto Error
Data1.Recordset.MoveFirst
Error:
if Err.Number = 30 Then
  Exit Sub
End If
End Sub
```

B/

(X) → Msgbox "All Data has been lost", 16, "Fatal User Error"

```
AccBalance = Inputbox("Enter the opening Account Balance"; "
Account Balance Query", 0)
```

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: :Eng.Drawing

Branch: :chem.processing& Petroleum refinery

Examiner: Dr. Qusay F.

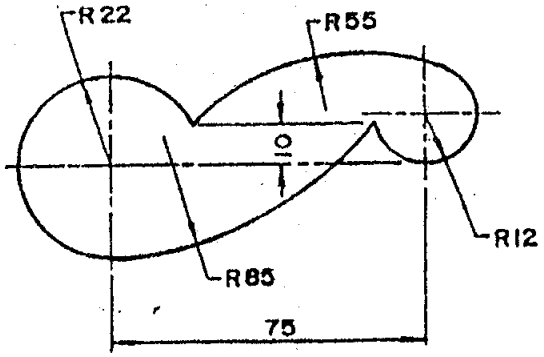
Class: First

Time: 3 hours

Date : 4/9/2012

س[1]/ ارسم ما يلي بنفس الابعاد:

(15 درجة)

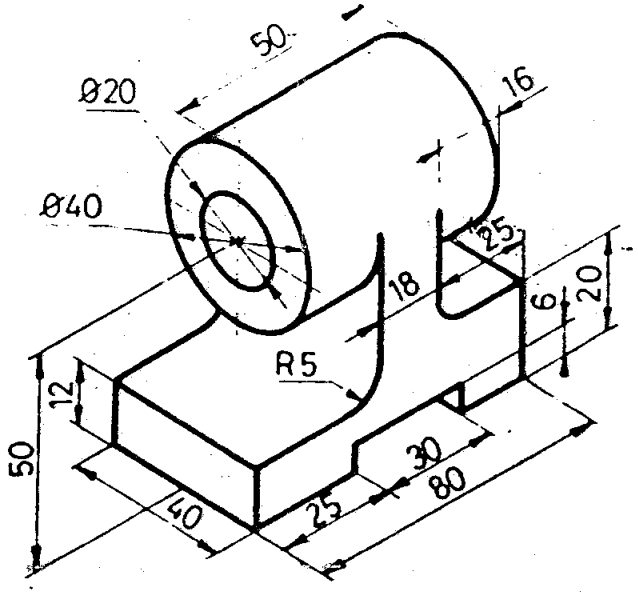


س[2]/ ارسم لواحد مما يلي بنفس الابعاد:

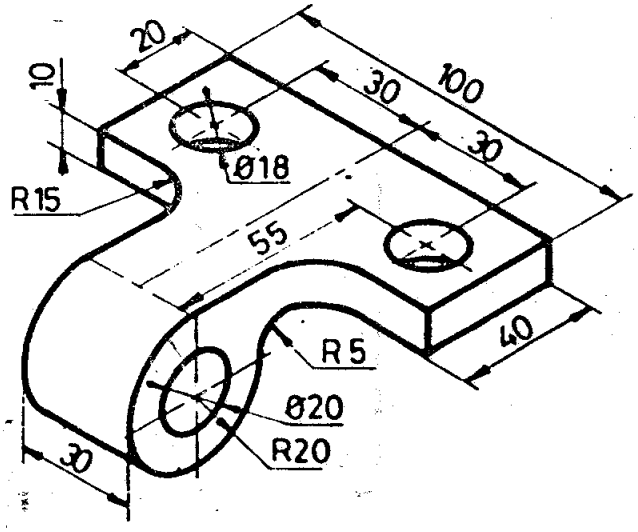
(35 درجة)

1- المقطع الامامي
2- المسقط الجانبي
3- المسقط العلوي

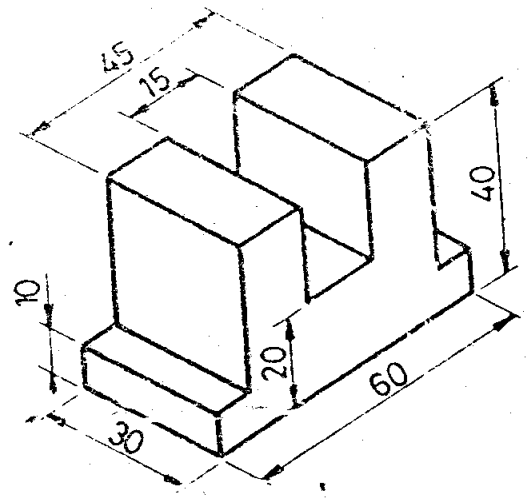
أ /



ب /



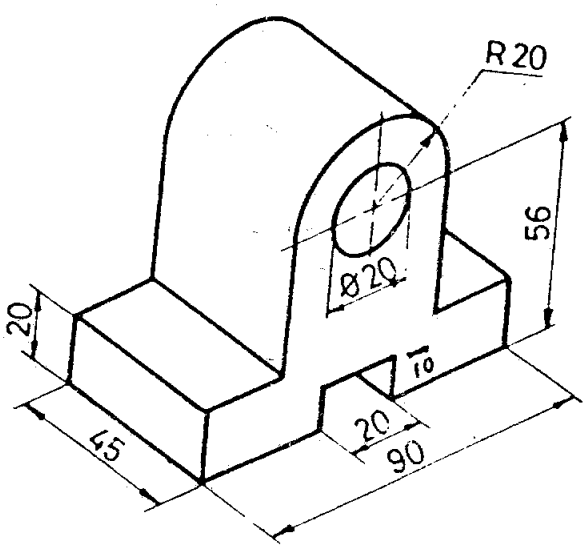
س3: ارسم الشكل الايزومتري التالي بنفس الابعاد: (25 درجة)



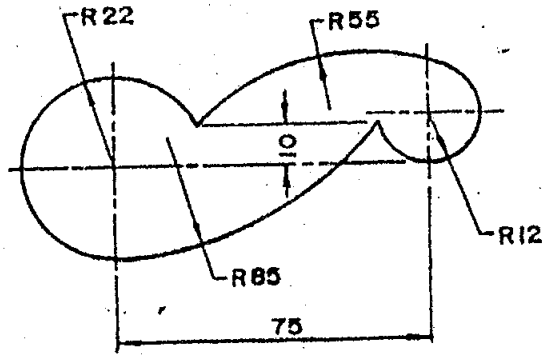
س4/

أ/ استنتج المساقط الثلاثة للرسم التالي (25 درجة)

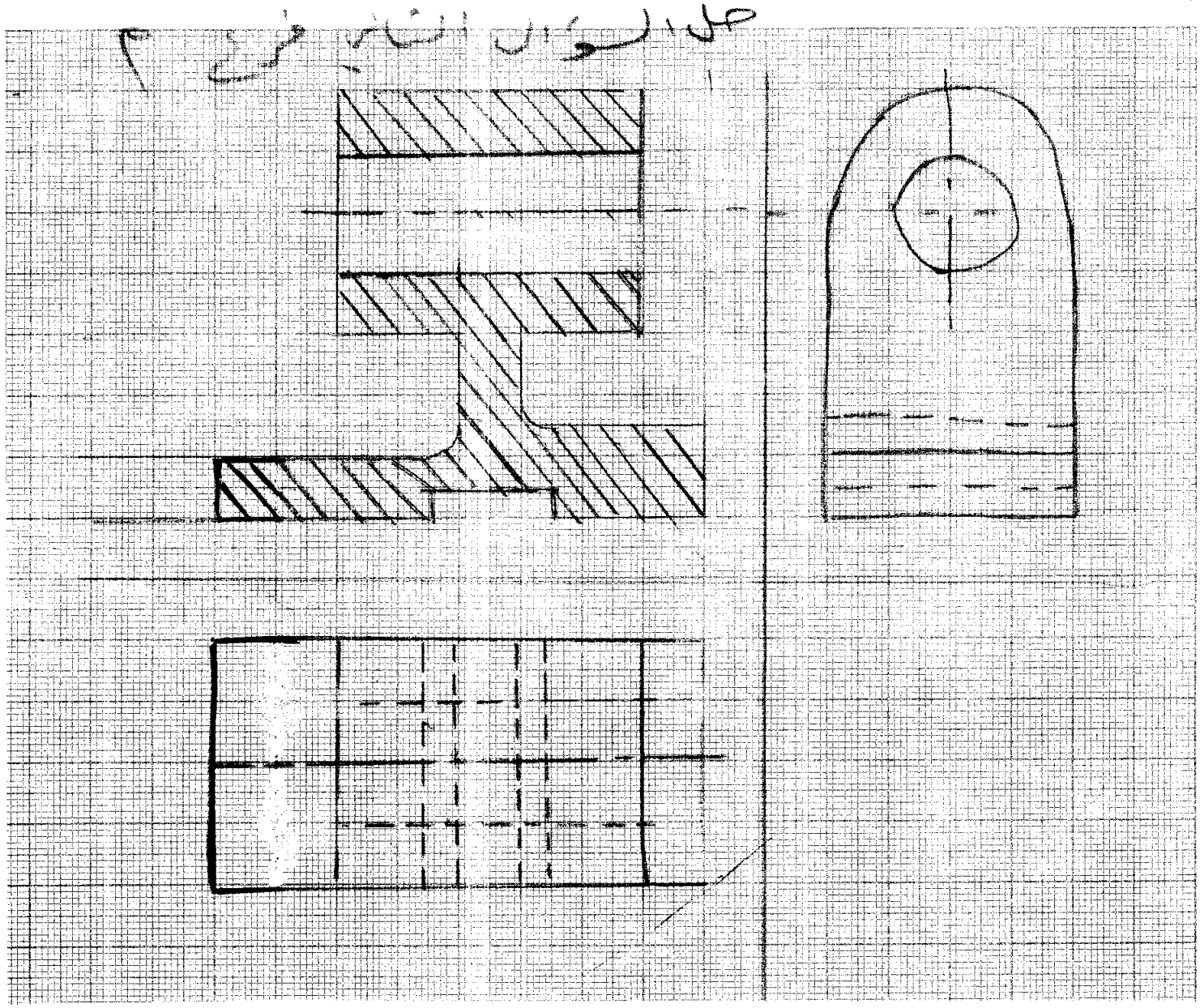
ب/ اكتب خطوات رسم المسقط الامامي و المسقط الجانبي باستخدام برنامج (AUTOCAD) و ذلك باستخدام احداثيات (Relative coordinate) فقط علماً ان نقطة البداية هي (0,0)



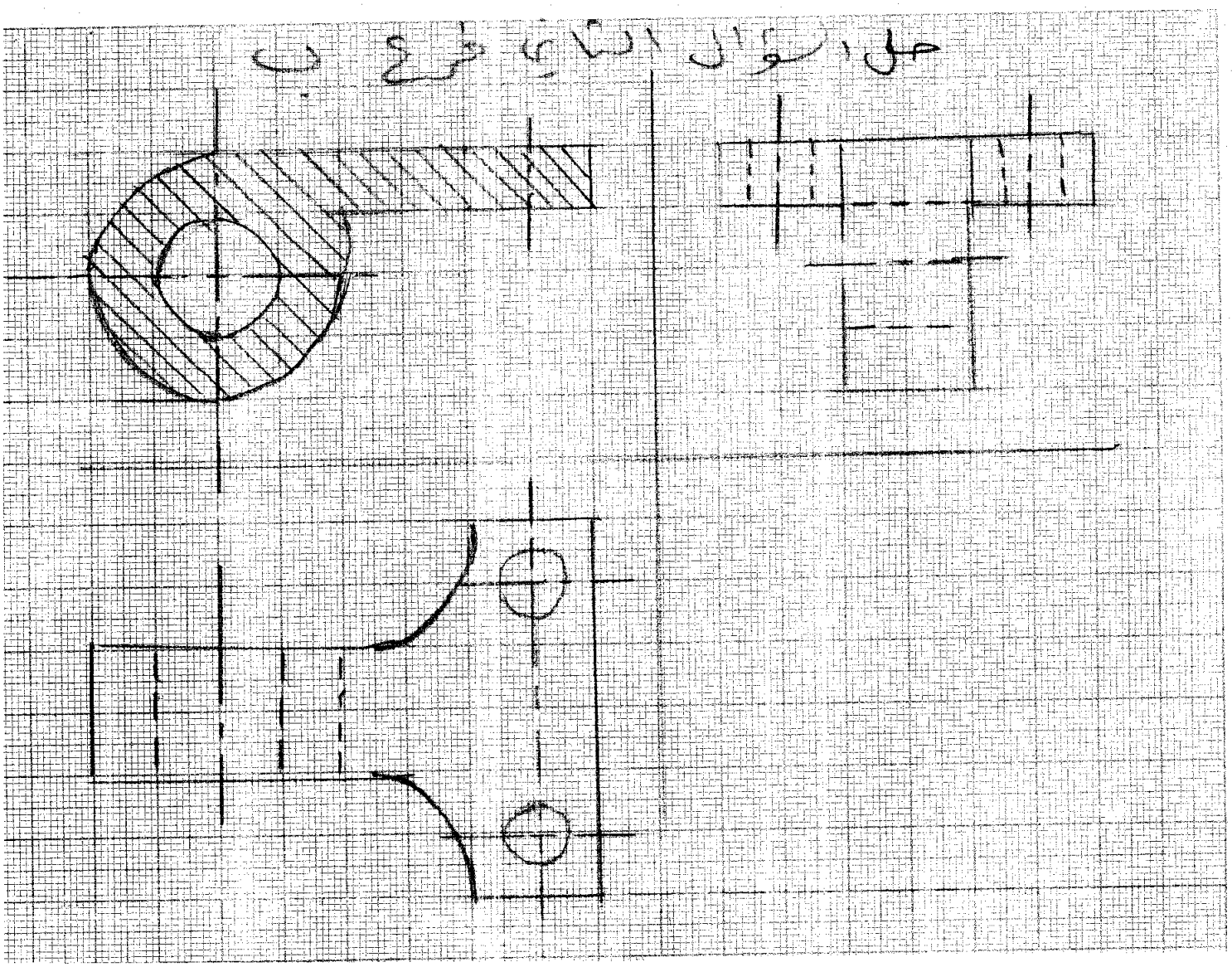
حل س1: [redacted]



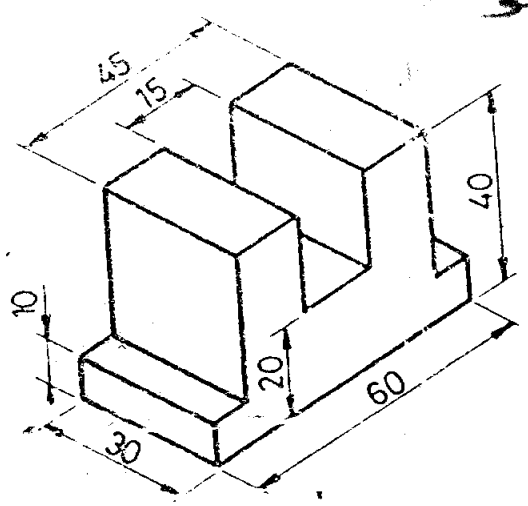
حل السؤال الثاني



حل السؤال الثاني فرع ب



حل السؤال الثالث



Front

Commond : Line

Specify first point 0,0

" next " : @35,0

" " " : @0,10

" " " : @20,0

" " " : @0,-10

" " " : @35,0

" " " : @ 0,20

" " " : @ -25,0

" " " : @ 0,36

Commond : Arc

Start point : 65,56

End " : 25,56

Radius : 20

Commond : Line

Specify first point : 25,56

" next " : @ 0,-36

" " " : @ -25,0

" " " : @ 0,-20

Commond : Circle

Center : 45,56

Radius : 10

Side

command : Line

Specify first point : 100,0

" next " : @ 45,0

" " " : @ 0,76

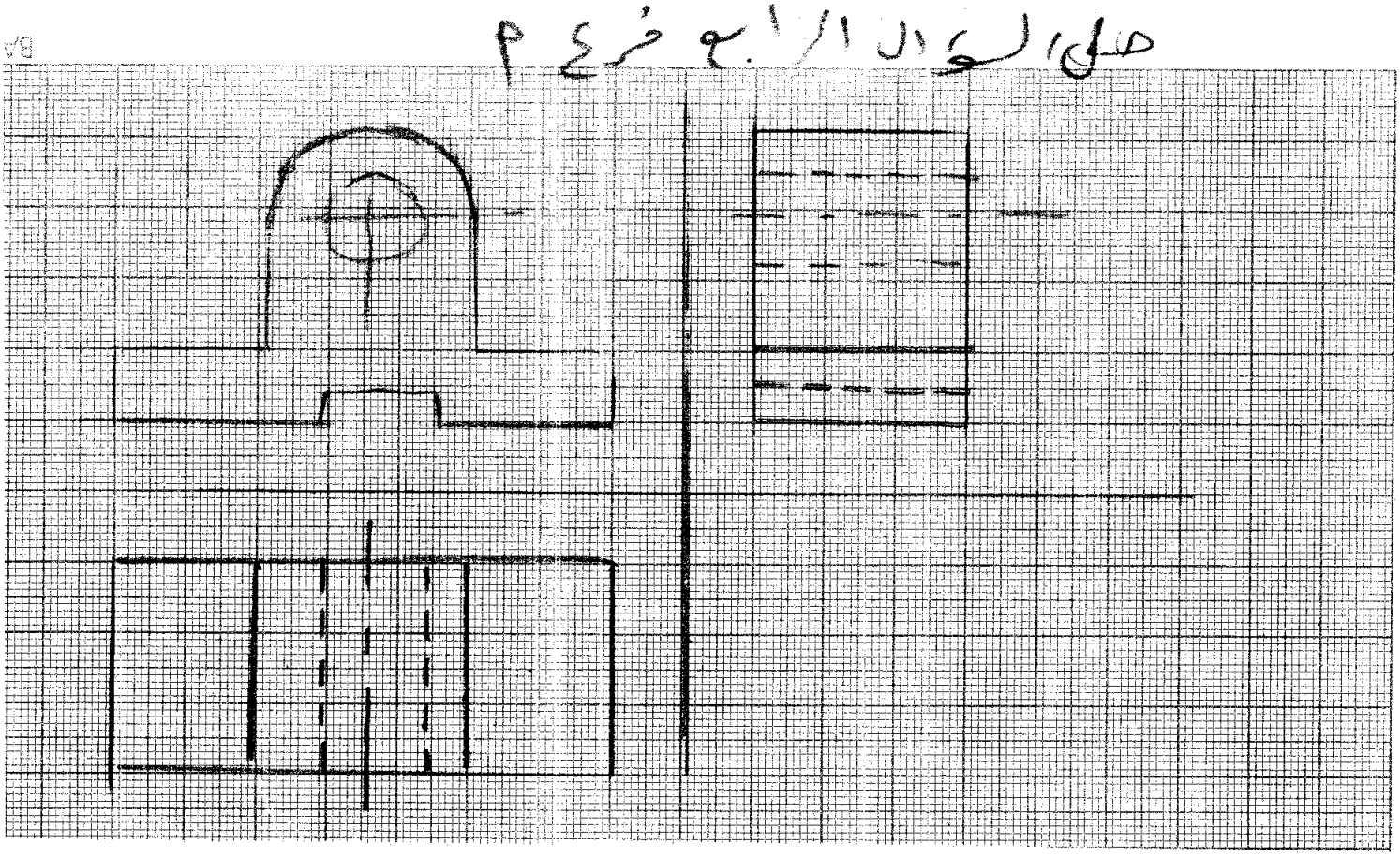
" " " : @ -45,0

" " " : @ 0,-76

command : Line

Specify first point : 100,20

" " " : @ 45,0



University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: electrical technology

Examiner: Dr.Mohamed Ibrahim

Class: first

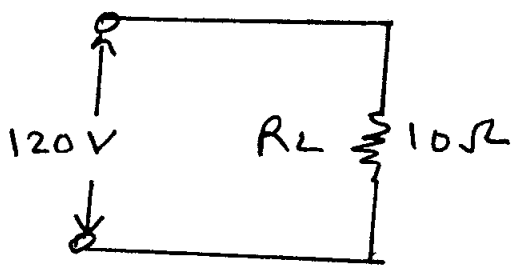
Time: 3 hours

Date :

Attempt four questions only

Q1:A: Small factory uses **eight** motors each has a power of **1200W**. How much energy in kilowatt-hours is used in a weak by a factory if all motors in use **10** hours per day(h/day) for a **6** day weak? . Find also the total cost of the bill If the utility rate is **6** Dinar per kilowatt-hour {8Marks}

B: How much current will flow in the circuit of copper conductor **200ft length** shown In figure .Consider the resistivity of copper is **10.4** and cross sectional area is **6550CM**. {7 Marks}



Q2: a generator has :

Rated power output=**8KW**, rated voltage =**240V** , armature resistance =**0.8Ω** , field resistance =**120Ω** and Rotational losses at full load =**800 KW.** Find :

a:generator current $\mathbf{I_L}$ {8 Marks}

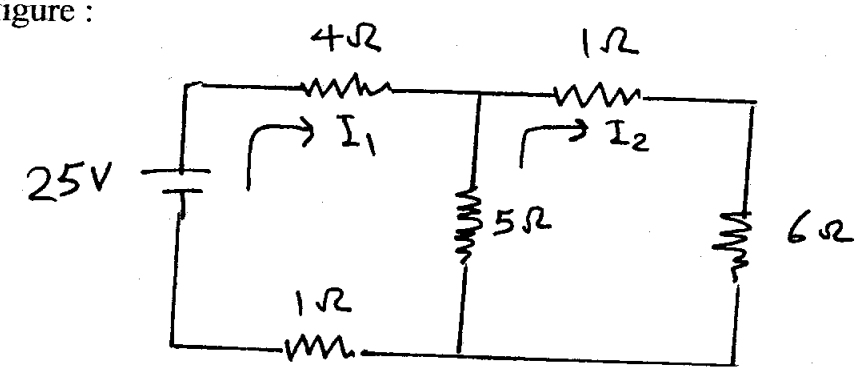
b-armature current $\mathbf{I_a}$

c-copper losses

d- Efficiency at full load

Follow

Q3:Find **all current** through the resistances by the **mesh current** method for the circuit shown in figure :



Q4: a sine wave ac voltage has a peak value of **155.6 V** and frequency **500KHZ.**

Find : {15 Marks}

A- The phase angle at which instantaneous voltage is **110V** ?
B- The period of waveform for **one cycle** and **two cycle** ?
C- The **rms** value and **average value** ?
D- Draw the waveform and locate the above points on the waveform ?
E- Wavelength at a given frequency when the speed of light=$\mathbf{3x10^8 m/s}$?
F- The maximum value of current when the wave voltage is applied across load resistance 5Ω
G- The instantaneous value of current at **angle $\mathbf{60^0}$**
H- Draw **the phasor diagram** between the current and voltage

Q5:A - Explain the principle of generating dc voltage {7Marks}

B-write the formula of each of following electrical law: {8Marks}
Kirchhoffs laws ,Ohms law , Faraday laws ,Ohms law for magnetic circuit (define each symbol)

Q 2: A generator has

a rated power output = 8 KW

Rated Voltage = 240 V

armature resistance = 0.8 Ω Field resistance = 120 Ω

Rotational losses at full load = 800 KW

Find (a) generator current I_L

(b) armature current I_a

(c) copper losses

(d) efficiency at full load

$$I_L = \frac{\text{Power output}}{V_t} = \frac{8000}{240} = 33.3$$

$$I_f = \frac{V_t}{r_f} = \frac{240}{120} = 2\ A$$

$$I_a = I_f + I_L = 33.3 + 2 = 35.3\ A$$

Copper losses : $I_a^2 r_a^2 = (35.3)^2 (0.8)^2$

$= 1246 * 0.64$

$= 797.5\ W$

Field losses = $I_f^2 r_f = (2)^2 * 120$

$= 4 \times 120$

$= 520\ W$

Total Copper losses = $520 + 797.5$

$= 1317.5\ W$

Total losses = Total Copper loss + Rotational losses

$= 1317.5 + 800$

$= 2117.5\ W$

$\therefore \eta = \frac{\text{output}}{\text{output + losses}} = \frac{8000}{2117.5 + 8000} = \frac{8000}{10117} = 79\%$

Q1 (2) Eight

Q1 a; small factory uses eight motors each has a power of 1200 W.
How much energy in kilowatthours is used in a week by a factory if they are all in use 10 h per day (h/day) for a 6 day week?
find the total cost if the utility rate is 60 per kilowatthour

$$E = 1.2\ kw \times \frac{10\ h}{day} \times 6\ days = 72\ kwh$$

$$E = 8 \times 72\ kwh = 576\ kwh$$

$$T_{cost} = 576 \times 6 = 3456\ cents$$

$$=$$

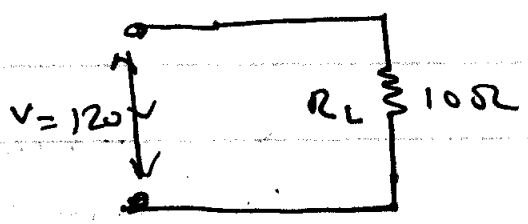
---

b) (1) b; How much current will flow in the circuit if Copper Conductor 200 ft is used when $\rho = 10.4$ and cross sectional area is A = 6530 CM.

$$R = \rho \frac{l}{A} = \frac{10.4(200)}{6530} = 0.319\ \Omega$$

$$R_T = R + R_L = 0.319 + 10 = 10.319\ \Omega$$

$$\therefore I = \frac{V}{R_T} = \frac{120}{10.319} = 11.6\ A$$



Q4: If an ac voltage has a peak value of 155.6 v, frequency 100 Hz

Find:

a - the phase angle at which instantaneous voltage is 110 v ?

b - the Period of waveform

c - the rms value

d - the average value

f - draw the waveform and locate the above points on the waveform

$$T = \frac{1}{f} = \frac{1}{100}$$

$$T = 1 \times 10^{-2}\ s$$

$$V = V_m \sin\theta$$

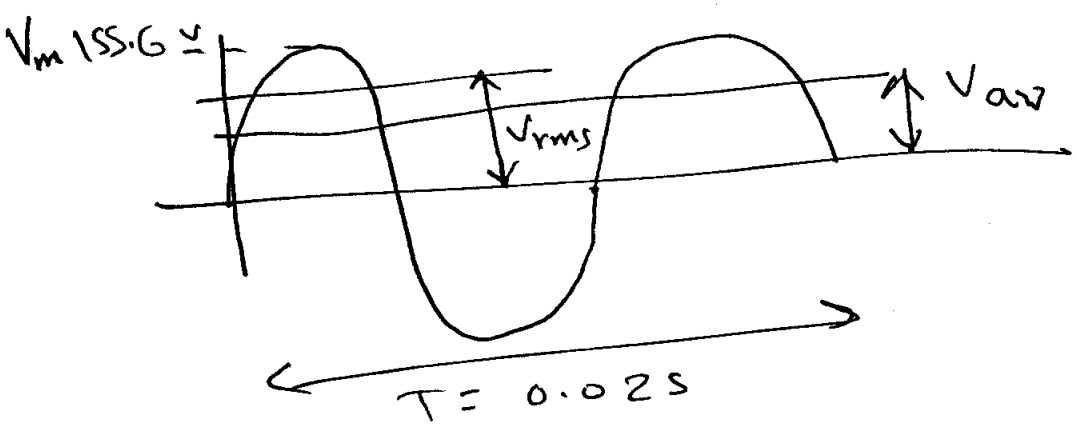
$$110 = 155.6 \sin\theta$$

$$\theta = \arcsin\frac{V}{V_m} = 45^\circ$$

$$V_{rms} = 0.707 \times \text{peak value}$$

$$= 0.707 \times 155.6$$

$$V_{av} = 0.637\ V_m = 0.637 \times 155.6$$



Q#1. ac voltage has a peak value of 155.6 v, frequency 500 KHz Find

a - The phase angle at which instantaneous voltage is 110 v?

b - The period of waveform 1 cycle and 2 cycle.

c - The rms value

d - The average value

f - draw the waveform and locate the above points on the waveform

$V = V_m \sin\theta$ $\quad T = \frac{1}{f} = \frac{1}{10 \times 10^3} = 1 \times 10^{-2}$ s

$110 = 155.6 \sin\theta$

$\theta = \text{arc}\sin\frac{V}{V_m} = 45^\circ$

$V_{rms} = 0.707 \times$ Peak value

$= 0.707 \times 155.6 = 110$ V

$V_{av} = 0.637\, V_m = 0.637 \times 155.6$

$= 99.1$ V

$T = \frac{1}{f} = \frac{1}{500 \times 10^3} = \frac{1}{5 \times 10^8} = 0.2 \times 10^{-8} = 2 \times 10^{-7}$

$= 0.002 \times 10^{-6}$

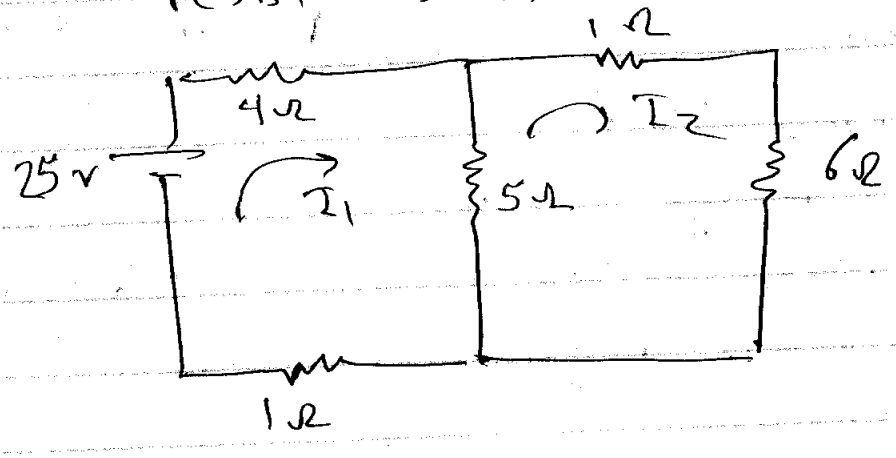
$= 0.002 \times 10^{-3}$

one cycle $T = 2 \times 10^{-6} = 2$ μs

2 cycle $= 2T = 4 \times 10^{-6} = 4$ μs

Q3: Given: ~~$V_A = 58V$, $V_B = 10V$, $R_1 = 4\Omega$, $R_2 = 3\Omega$~~

Q3: Find all current through the resistances by the mesh-current method



mesh (1)

$$25 = 4I_1 + 5I_2 + 1I_1 - 5I_2$$

$$25 = 10I_1 - 5I_2 \quad \text{——— (1)}$$

or

mesh (2)

$$5I_2 + 1I_2 + 6I_2 + 3I_2 - 5I_1 = 0$$

$$X2 \quad -15I_2 - 5I_1 = 0 \quad \text{——— (2)}$$

$$\therefore 30I_2 = 10I_1 \quad \text{(3)} \qquad \text{(2)} \text{ و } \text{(1)}$$

$$25 = 10I_1 - 5I_2 + 30I_2 - 10I_1$$

$$25 = 25\ I_2$$

$$\therefore I_2 = 1\ A$$

$\therefore$ من (3) نجد

$$\therefore I_1\ 30 \times 1 = 10\ I_1$$

$$\therefore I_1 = \frac{30}{10} = 3\ A$$

Q5: (A) جواب السؤال الخامس

A simple dc generator consists of an armature coil with a single turn of wire. This armature coil cuts across the magnetic field to produce voltage. If a complete path is present, current will move through the circuit in the direction shown by the arrows (Fig. 11-2*a*). In this position of the coil, commutator segment 1 is in contact with brush 1, while commutator segment 2 is in contact with brush 2. As the armature rotates a half turn in a clockwise direction, the contacts between the commutator segments and the brushes are reversed (Fig. 11-2*b*). Now, segment 1 is in contact with brush 2 and segment 2 is in contact with brush 1. Because of this commutator action, that side of the armature coil which is in contact with either of the brushes is always cutting across the magnetic field in the same direction. Therefore, brushes 1 and 2 have constant polarity, and a pulsating direct current is delivered to the external load circuit.

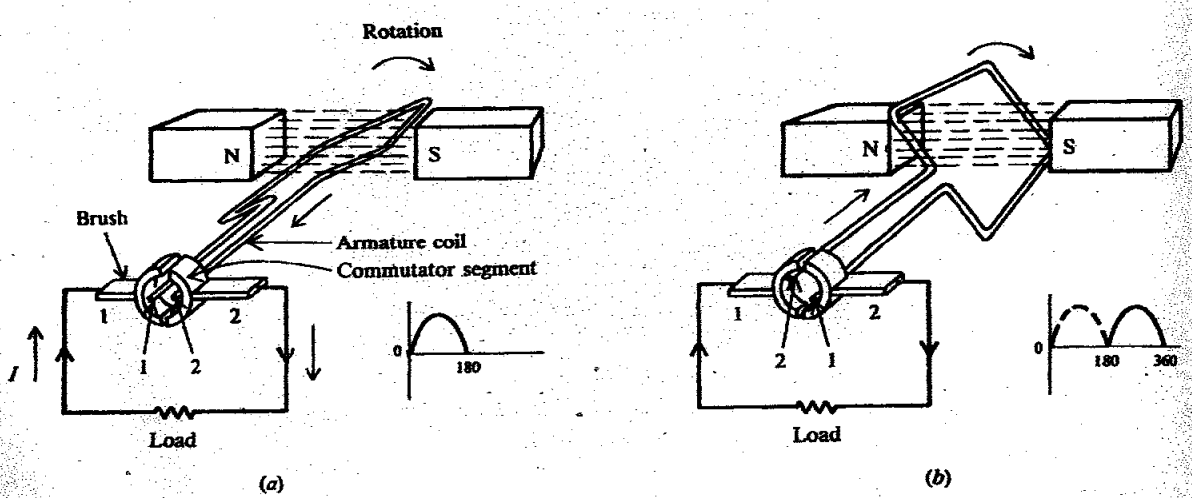


Fig. 11-2 Basic operation of a dc generator

Example 11.1 A dc generator with a single coil produces a pulsating dc output. By using more coils and combining their output, a smoother waveform can be obtained. Draw a voltage output waveform that results when a second coil is added to the armature and placed perpendicular to the first coil.

See Fig. 11-3. Notice that a voltage is included at all times. Although the current still pulsates, the output is smoother. In practical generators, many coils are wound around the armature to produce a still smoother dc output.

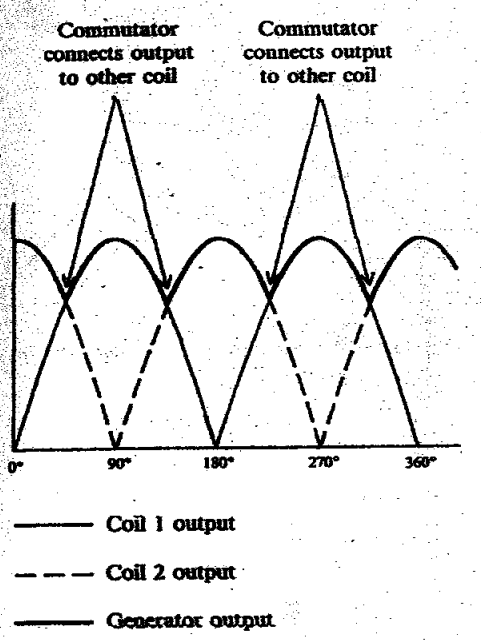


Fig. 11-3 Output of a two-coil dc generator

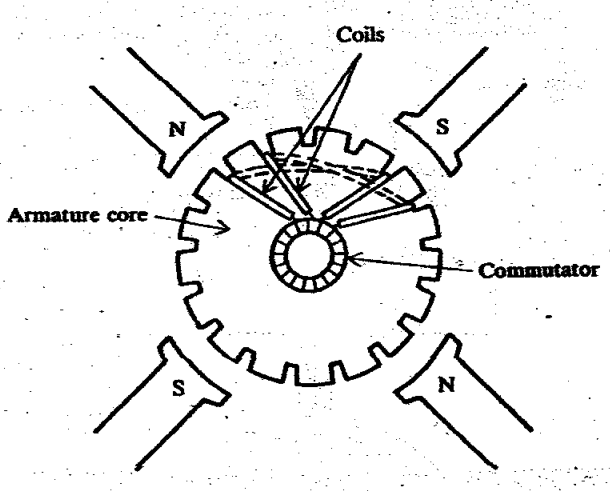


Fig. 11-4 Simplex lap winding

Q5B : جواب السؤال

(1) Kirchnotts Laws

Voltage applied = Sum of voltage drops

$$V_A = V_1 + V_2 + V_3$$

The voltage applied to a closed circuit equals the sum of the voltage drops in that circuit

(2) ohm's Law!

ohm's law defines the relationship between Current, Voltage and resistance.

$$I = \frac{V}{R}$$

I current
V voltage
R = resistance

(3) Faraday law!

The value of the induced voltage depends upon the number of turns of a coil and how fast the conductor cuts across the lines of force or flux.

$$V_{ind} = N \frac{\Delta \Phi}{\Delta t}$$

V_{in} = induced voltage, V
N = number of turns in a coil
$\Delta \Phi / \Delta t$ = rate at which the fluk cuts across the conductor, Wb/s.

(4) ohms law for magnetic circuit

$$\Phi = \frac{mmf}{R}$$

Φ = magnetic flux
mmf = magnetomotive force (At)
R = Reluctance, At/Wb

Note: Answer All questions

Q1: Read the following passage and answer **(Seven)** questions only:

Because chemical plant equipment is so different from that used in the laboratory, one of the major jobs of R&D engineers is to decide what kinds of equipment must be used to carry out a commercial chemical process. They also determine the sizes of equipment needed. Before designing the full-sized plant, the R&D engineer usually constructs a pilot plant, actually a small model of the final plant, containing small versions of the equipment. Pilot plants are particularly useful when designing continuous process plants which are so different from the research laboratory. A continuous process pilot plant will usually run twenty four hours a day with three or four groups of operators and engineers, each group working for eight hours. This is called shift work, and each group is called a shift. Most often, shifts work from 8 a.m. to 4 p.m., 4 p.m. to midnight, and midnight to 8 a.m. A fourth shift is needed if the plant is to run during weekends, although many pilot plants shut down at that time. This arrangement makes pilot plant experimentation unattractive to many chemical engineers who prefer to work during the day and leave the evening and night shifts to specially trained operators. However, a pilot plant is often complicated that engineers are required on all shifts.

Since the basic purpose of the pilot plant is to gather information, there are frequent changes of flowrates, pressures, and temperatures. R & D engineers are always looking for that combination of conditions that will enable them to produce the maximum amount of product at the minimum price. As information is gathered, it is passed along to the company's management. This may be done by memoranda and telephone calls but in most companies, once a month, the R & D engineers write all they have learned during the past month in a progress report. These become their main record of accomplishment. The purpose of R & D is to gather information: since a company's management judges R & D engineers by the reports they submit, a great deal of work goes into the reports' preparation. When the research and development project is completed, information on the various progress reports is consolidated into a final report that details everything learned during the research. This final report is invaluable to the process design engineers who will design the full-scale plant.

There is one thing about R & D that many engineers find frustrating: a project is seldom finished. As with all research, there are always more ideas than time or manpower. Eventually, the work must end, even get into full-scale production. The decision to end a project is usually made by the head of the research laboratories in consultation with the executives of the company.

1. What is the major job of R&D engineers?
2. When are pilot plants particularly useful?
3. What are the usual time period for each shift?
4. Why is pilot plant work unattractive to some engineers?
5. What do chemical engineers look for when running a pilot plant?
6. How do R & D engineers pass on information to a company management?
7. Why do many engineers find R&D frustrating?
8. Who usually decides when a research project should be ended? (14 Marks) P.T.O

Q2: Define **(Five)** of the following:

1.Laboratory; 2.Hopper; 3.Batch process; 4. Pilot plant; 5.Chemical process Industries; 6.Feasibility study.

(10 Marks)

Q3: Put the verbs in brackets in the correct tense: **(Answer Five only)**

1.The plane for Basrah just (take) off.
2.My brother (work) in this bank since last year.
3.The train (leave) the station now.
4.The bus started while a woman (get) on.
5.Ahmad (buy) a computer last week.
6.He wishes tomorrow (be) a holiday.

(10 Marks)

Q4: Choose the right answer **(Answer Five only)**:

1.Last week they ---- a tea party. (have, had, will have, are having)
2.Letters ---- usually sent by air. (is, am, was, are)
3.The cell phone ---- now. (rang, ring, rung, is ringing)
4.Two days ago there ----- a lot of people at the stadium. (was, will be, are, were)
5.She hasn't finished cooking -----. (ago, already, just, yet)
6.She works as if she ----- a machine. (is, are, be, were)

(5 Marks)

Q5:Fill in the blanks with the following preposition **(Answer Five only)** :

(on , to , at , in , by , from , with , between , for , of)

1.She was born ----1956.
2.They are waiting ---- the train.
3.The postman comes ----- motorcycle.
4.He saw me ----- Sunday evening.
5.Shatha sat ---- her brother and sister.
6.He meets his friend ---- the bus stop.

(5 Marks)

Q6: Punctuate the following putting in capitals where necessary **(Answer Eight Only)**

1.friday is a holiday in iraq
2.mr john said ive had a pleasant walk along the river euphrates
3.zaid and i are clever aren't we
4.bahrain and saudi arabia lie in asia while libya and tunisia are in africa
5.lets go to the iraqi museum next thursday
6.when we finish our work they said well leave for beirut
7.the english channel was first crossed by captain webb in august 1875
8.mosul is a city lying on the river tigris
9.have you been to paris yes i have

(16 Marks)

Answers:

1. The major jobs of R&D engineers is to decide what kinds of equipment must be used to carry out a commercial chemical process.
2. Pilot plants are particularly useful when designing continuous process plants.
3. The usual time period for each shift is 8 hours.
4. Pilot plant work is unattractive to some engineers because they prefer to work during the day.
5. Chemical engineers are always looking for that combination of conditions that will enable them to produce the maximum amount of product at the minimum price.
6. R&D engineers pass on information to a company management by memoranda and telephone calls.
7. Engineers find R&D frustrating because a project is seldom finished.
8. The head of the research laboratories usually decides when research project should be ended.

Q2:

Q3: (ex. 44,46,47)

1. The plane for Basrah has just taken off.
2. My brother has been working (or has worked) in this bank since last year.
3. is leaving
4. was getting on
5. bought
6. were

Q4: (ex. 53)

1.had; 2.are; 3.is ringing; 4.were; 5.yet; 6.were

Q5: (ex.16)

1.in; 2.for; 3.by; 4.on; 5.between; 6.at

Q6: (ex.65)

1. In 1492 Columbus discovered America.
2. Dr. Zeki will leave for Germany at 8 a.m. next Monday, won't he? Yes, he will.
3. The river Nile rises in Central Africa, runs through Sudan and Egypt.
4. The English Channel was first crossed Captain Webb in August 1875.
5. Mosul is a city lying on the river Tigris.
6. The nine planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. (planets=الكواكب السيارة)
7. Did Layla's brother buy this car in England last June?
8. Have you been to Paris? Yes I have.
9. Yousif and I are clever, aren't we?

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Mathematics
Branch: Both branches
Examiner: Dr. Walla'a A.Noori

Class: First
Time: 3 hours
Date : 05 /09/2012

Attempt five questions only

Q.1 (A) Find the length of the curve $y = (x/2)^{2/3}$ from x = 0 to x = 2.

(B) Use l'Hopital's rule to find the limits $\lim_{x\to 0}\left(\frac{x(\cos x-1)}{\sin x - x}\right)$, $\lim_{x\to\infty}\left(\frac{\sqrt{9x+1}}{\sqrt{x+1}}\right)$

(20 Marks)

Q.2 (A) Solve the integrals

1. $\int \frac{-2x+4}{(x^2+1)(x-1)^2}\,dx$ 2. $\int y\,\sinh y\,dy$ 3. $\int \frac{1}{\sqrt{4+x^2}}\,dx$

(B) Find the slope of the line tangent to the curve $y = sin^5 x$ at the point where x=π/3.

(20 Marks)

Q.3 Find (1) vector perpendicular to the plane of P(1, -1, 0), Q(2, 1, -1), & R(-1, 1, 2). (2) area of the triangle. (3) unit vector perpendicular to the plane.

(20 Marks)

Q.4 If resistors of R_1, R_2, & R_3 ohms are connected in parallel to make an R-ohm resistor, the value of R can be found from the equation $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Find the value of $\partial R/\partial R_2$ when $R_1 = 30$, $R_2 = 45$, & $R_3 = 90$ ohms.

(20 Marks)

Q.5 (A) Evaluate the integrals

1. $\int_3^{11} \frac{dx}{\sqrt{2x+3}}$ 2. $\int_{\pi/4}^{\pi/2}(1+e^{cot\theta})\,csc^2\theta\,d\theta$ 3. $\int_1^4 \frac{2\sqrt{x}}{\sqrt{x}}\,dx$

(B) Replace polar equation by equivalent Cartesian equation r = 1 – cosθ.

(20 Marks)

Q.6 (A) How rapidly will the fluid level inside a vertical cylindrical tank drop if we pump the fluid out at the rate of 3000 lit/min.

(B) Solve the equations (Using Cramer's Rule)

2x + 4y + 2z = 16
2x – y – 2z = -6
4x + y – 2z = 0

(20 Marks)

Follow ⮌

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

2. $\dfrac{d(\cos^{-1} u)}{dx} = -\dfrac{du/dx}{\sqrt{1-u^2}}, \quad |u| < 1$

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

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

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

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

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

$$\frac{d(\cosh^{-1} u)}{dx} = \frac{1}{\sqrt{u^2-1}}\frac{du}{dx}, \quad u > 1$$

$$\frac{d(\tanh^{-1} u)}{dx} = \frac{1}{1-u^2}\frac{du}{dx}, \quad |u| < 1$$

$$\frac{d(\coth^{-1} u)}{dx} = \frac{1}{1-u^2}\frac{du}{dx}, \quad |u| > 1$$

$$\frac{d(\operatorname{sech}^{-1} u)}{dx} = \frac{-du/dx}{u\sqrt{1-u^2}}, \quad 0 < u < 1$$

$$\frac{d(\operatorname{csch}^{-1} u)}{dx} = \frac{-du/dx}{|u|\sqrt{1+u^2}}, \quad u \neq 0$$

1. $\displaystyle\int \frac{du}{\sqrt{a^2-u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + C$ (Valid for $u^2 < a^2$)

2. $\displaystyle\int \frac{du}{a^2+u^2} = \frac{1}{a}\tan^{-1}\left(\frac{u}{a}\right) + C$ (Valid for all u)

3. $\displaystyle\int \frac{du}{u\sqrt{u^2-a^2}} = \frac{1}{a}\sec^{-1}\left|\frac{u}{a}\right| + C$ (Valid for $|u| > a > 0$)

1. $\displaystyle\int \frac{du}{\sqrt{a^2+u^2}} = \sinh^{-1}\left(\frac{u}{a}\right) + C, \quad a > 0$

2. $\displaystyle\int \frac{du}{\sqrt{u^2-a^2}} = \cosh^{-1}\left(\frac{u}{a}\right) + C, \quad u > a > 0$

3. $\displaystyle\int \frac{du}{a^2-u^2} = \begin{cases} \frac{1}{a}\tanh^{-1}\left(\frac{u}{a}\right) + C & \text{if } u^2 < a^2 \\ \frac{1}{a}\coth^{-1}\left(\frac{u}{a}\right) + C, & \text{if } u^2 > a^2 \end{cases}$

4. $\displaystyle\int \frac{du}{u\sqrt{a^2-u^2}} = -\frac{1}{a}\operatorname{sech}^{-1}\left(\frac{u}{a}\right) + C, \quad 0 < u < a$

5. $\displaystyle\int \frac{du}{u\sqrt{a^2+u^2}} = -\frac{1}{a}\operatorname{csch}^{-1}\left|\frac{u}{a}\right| + C, \quad u \neq 0 \text{ and } a > 0$

Q1/A/ $\frac{dy}{dx} = \frac{2}{3}\left(\frac{x}{2}\right)^{-1/3}\left(\frac{1}{2}\right) = \frac{1}{3}\left(\frac{2}{x}\right)^{1/3}$, $x \neq 0$

$y = \left(\frac{x}{2}\right)^{2/3} \Rightarrow y^{3/2} = \frac{x}{2} \Rightarrow x = 2y^{3/2}$

$\frac{dx}{dy} = 2 \cdot \frac{3}{2} y^{1/2} = 3y^{1/2}$

$x = 0 \Rightarrow y = 0$

$x = 2 \Rightarrow y = 1$

$$L = \int_c^d \sqrt{1+\left(\frac{dx}{dy}\right)^2}\, dy = \int_0^1 \sqrt{1+(3y^{1/2})^2}\, dy$$

$$L = \frac{1}{9}\int_0^1 (1+9y)^{1/2} \cdot 9\, dy = \frac{1}{9} \cdot \frac{2}{3}(1+9y)^{3/2}\Big]_0^1$$

$L = 2.27$.

B/1. $\lim_{x\to 0} \frac{x(\cos x - 1)}{\sin x - x} = \lim_{x\to 0} \frac{-x\sin x + \cos x - 1}{\cos x - 1}$

$\lim_{x\to 0} \frac{-x\cos x - 2\sin x}{-\sin x} = \lim_{x\to 0} \frac{x\cos x + 2\sin x}{\sin x}$

$\lim_{x\to 0} \frac{-x\sin x + 3\cos x}{\cos x} = \frac{3}{1} = 3$.

2. $\lim_{x\to\infty} \frac{\sqrt{9x+1}}{\sqrt{x+1}} = \sqrt{\lim_{x\to\infty}\left(\frac{9x+1}{x+1}\right)} = \sqrt{\lim_{x\to\infty}\left(\frac{9}{1}\right)}$

$= \sqrt{9} = 3$.

Q2/A/1. $\int \frac{-2x+4}{(x^2+1)(x-1)^2}\, dx$

$$\frac{-2x+4}{(x^2+1)(x-1)^2} = \frac{Ax+B}{x^2+1} + \frac{C}{x-1} + \frac{D}{(x-1)^2}$$

$$\frac{-2x+4}{(x^2+1)(x-1)^2} = \frac{(Ax+B)(x-1)^2 + C(x-1)(x^2+1) + D(x^2+1)}{(x^2+1)(x-1)^2}$$

$\Rightarrow$ $A = 2$, $C = -2$, $B = 1$, $D = 1$

$$\therefore \int \frac{-2x+4}{(x^2+1)(x-1)^2}\,dx = \int \left(\frac{2x+1}{x^2+1} - \frac{2}{x-1} + \frac{1}{(x-1)^2} \right) dx$$

$$= \int \left(\frac{2x}{x^2+1} + \frac{1}{x^2+1} - \frac{2}{x-1} + \frac{1}{(x-1)^2} \right) dx$$

$$= \ln(x^2+1) + \tan^{-1}x - 2\ln|x-1| - \frac{1}{x-1} + C$$

2. $\int y \sinh y\,dy$ $\quad u = y \quad du = dy$

$dv = \sinh y\,dy \quad v = \cosh y$

$\int u\,dv = u \cdot v - \int v\,du$

$= y\cosh y - \int \cosh y\,dy = y\cosh y - \sinh y + C$

3. $\int \frac{dx}{\sqrt{4+x^2}}$ $\quad x = 2\tan\theta \quad dx = 2\sec^2\theta\,d\theta$

$4 + x^2 = 4 + 4\tan^2\theta = 4(1+\tan^2\theta) = 4\sec^2\theta$

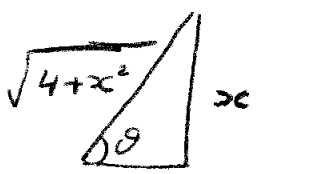
$$\int \frac{dx}{\sqrt{4+x^2}} = \int \frac{2\sec^2\theta\,d\theta}{\sqrt{4\sec^2\theta}} = \int \frac{\sec^2\theta\,d\theta}{|\sec\theta|} = \int \sec\theta\,d\theta$$

$\ln|\sec\theta + \tan\theta| + C$

$\ln\left|\frac{\sqrt{4+x^2}}{2} + \frac{x}{2}\right| + C$

$\ln\left|\sqrt{4+x^2} + x\right| + C'$

$C' = C - \ln 2$.



$x = 2\tan\theta$

$\tan\theta = x/2$

$\sec\theta = \sqrt{4+x^2}/2$

B/ $\frac{dy}{dx} = 5\sin^4 x \frac{d}{dx}(\sin x) = 5\sin^4 x \cos x$

$$\left.\frac{dy}{dx}\right|_{x=\pi/3} = 5\left(\frac{\sqrt{3}}{2}\right)^4\left(\frac{1}{2}\right) = \frac{45}{32}.$$

Q3/ $\overrightarrow{PQ} = (2-1)i + (1+1)j + (-1-0)k = i + 2j - k.$

$\overrightarrow{PR} = (-1-1)i + (1+1)j + (2-0)k = -2i + 2j + 2k.$

$$\overrightarrow{PQ} \times \overrightarrow{PR} = \begin{vmatrix} i & j & k \\ 1 & 2 & -1 \\ -2 & 2 & 2 \end{vmatrix} = \begin{vmatrix} 2 & -1 \\ 2 & 2 \end{vmatrix} i - \begin{vmatrix} 1 & -1 \\ -2 & 2 \end{vmatrix} j + \begin{vmatrix} 1 & 2 \\ -2 & 2 \end{vmatrix} k$$

$= 6i + 6k.$

2. $|\vec{PQ} \times \vec{PR}| = |6i + 6K|$

$= \sqrt{(6)^2 + (6)^2} = 6\sqrt{2}$ parallelogram area

The triangle's area $= 6\sqrt{2}/2 = 3\sqrt{2}$

3. $n = \dfrac{\vec{PQ} \times \vec{PR}}{|\vec{PQ} \times \vec{PR}|} = \dfrac{6i + 6K}{6\sqrt{2}} = \dfrac{1}{\sqrt{2}} i + \dfrac{1}{\sqrt{2}} K.$

Q4/ $\dfrac{\partial}{\partial R_2}\left(\dfrac{1}{R}\right) = \dfrac{\partial}{\partial R_2}\left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}\right)$

$-\dfrac{1}{R^2}\left(\dfrac{\partial R}{\partial R_2}\right) = 0 - \dfrac{1}{R_2^2} + 0$

$\dfrac{\partial R}{\partial R_2} = \dfrac{R^2}{R_2^2} = \left(\dfrac{R}{R_2}\right)^2$

$\dfrac{1}{R} = \dfrac{1}{30} + \dfrac{1}{45} + \dfrac{1}{90} = \dfrac{1}{15} \Rightarrow R = 15$

$\therefore \dfrac{\partial R}{\partial R_2} = \left(\dfrac{15}{45}\right)^2 = \dfrac{1}{9}$

Q5/A/ 1. $\displaystyle\int_3^{11} \frac{dx}{\sqrt{2x+3}} = \frac{1}{2}\int_3^{11} (2x+3)^{-1/2}\, 2\,dx = \frac{1}{2}\left[\frac{(2x+3)^{1/2}}{1/2}\right]_3^{11}$

$= 2$

2. $\displaystyle\int_{\pi/4}^{\pi/2} (1 + e^{\cot\theta}) \csc^2\theta\, d\theta$

$u = \cot\theta$, $du = -\csc^2\theta\, d\theta$

$\theta = \pi/4 \Rightarrow u = 1$

$\theta = \pi/2 \Rightarrow u = 0$

$\displaystyle\int_{\pi/4}^{\pi/2} \csc^2\theta\, d\theta - \int_1^0 e^u\, du = -\cot\theta\Big]_{\pi/4}^{\pi/2} - e^u\Big]_1^0 = e$

3. $\displaystyle\int_1^4 \frac{2^{\sqrt{x}}}{\sqrt{x}}\, dx$ $\quad u = x^{1/2}$, $du = \frac{1}{2}x^{-1/2}\,dx$

$2\,du = \dfrac{dx}{\sqrt{x}}$

$$\int_1^4 2^{x^{1/2}} \cdot x^{-1/2}\,dx \qquad x=1 \Rightarrow u=1 \qquad x=4 \Rightarrow u=2$$

$$2\int_1^2 2^u\,du = 2\left[\frac{2^u}{\ln 2}\right]_1^2 = \frac{4}{\ln 2}.$$

B/ $r = 1-\cos\theta \Rightarrow r^2 = r - r\cos\theta \Rightarrow x^2+y^2 = \sqrt{x^2+y^2} - x$

$$(x^2+y^2)+x = \sqrt{x^2+y^2} \Rightarrow ((x^2+y^2)+x)^2 = (\sqrt{x^2+y^2})^2$$

$$(x^2+y^2)^2 + 2(x^2+y^2)x + x^2 = x^2+y^2$$

$$x^4 + 2x^2y^2 + y^4 + 2x^3 + 2y^2x - y^2 = 0$$

Q6/A/ $V = 1000\pi r^2 h$, $(1\,m^3 = 1000\ lit)$

$$\frac{dv}{dt} = \frac{dv}{dh}\cdot\frac{dh}{dt} = 1000\pi r^2 \frac{dh}{dt} = -3000$$

$$\frac{dh}{dt} = -\frac{3000}{1000\pi r^2} = -\frac{3}{\pi r^2} \quad m/min$$

if $r = 1\,m \Rightarrow \frac{dh}{dt} = \frac{-3}{\pi} \approx -0.95\ m/min = -95\ cm/min.$

if $r = 10\,m \Rightarrow \frac{dh}{dt} = \frac{-3}{100\pi} \approx -0.0095\ m/min = -0.95\ cm/min$

B/ $$D = \begin{vmatrix} 2 & 4 & 2 \\ 2 & -1 & -2 \\ 4 & 1 & -2 \end{vmatrix}$$

$$D = 2\begin{vmatrix} -1 & -2 \\ 1 & -2 \end{vmatrix} - 4\begin{vmatrix} 2 & -2 \\ 4 & -2 \end{vmatrix} + 2\begin{vmatrix} 2 & -1 \\ 4 & 1 \end{vmatrix} = 4$$

$$x = \frac{1}{4}\begin{vmatrix} 16 & 4 & 2 \\ -6 & -1 & -2 \\ 0 & 1 & -2 \end{vmatrix}$$

$$x = \frac{1}{4}\left[16\begin{vmatrix} -1 & -2 \\ 1 & -2 \end{vmatrix} - 4\begin{vmatrix} -6 & -2 \\ 0 & -2 \end{vmatrix} + 2\begin{vmatrix} -6 & -1 \\ 0 & 1 \end{vmatrix}\right] = 1$$

$$y = \frac{1}{4}\begin{vmatrix} 2 & 16 & 2 \\ 2 & -6 & -2 \\ 4 & 0 & -2 \end{vmatrix}$$

$$y = \frac{1}{4}\left[2\begin{vmatrix} -6 & -2 \\ 0 & -2 \end{vmatrix} - 16\begin{vmatrix} 2 & -2 \\ 4 & -2 \end{vmatrix} + 2\begin{vmatrix} 2 & -6 \\ 4 & 0 \end{vmatrix}\right] =$$

$$z = \frac{1}{4}\begin{vmatrix} 2 & 4 & 16 \\ 2 & -1 & -6 \\ 4 & 1 & 0 \end{vmatrix}$$

$$z = \frac{1}{4}\left[2\begin{vmatrix} -1 & -6 \\ 1 & 0 \end{vmatrix} - 4\begin{vmatrix} 2 & -6 \\ 4 & 0 \end{vmatrix} + 16\begin{vmatrix} 2 & -1 \\ 4 & 1 \end{vmatrix}\right] = 3$$

University of Technology

Chemical Engineering Department

Final Examination

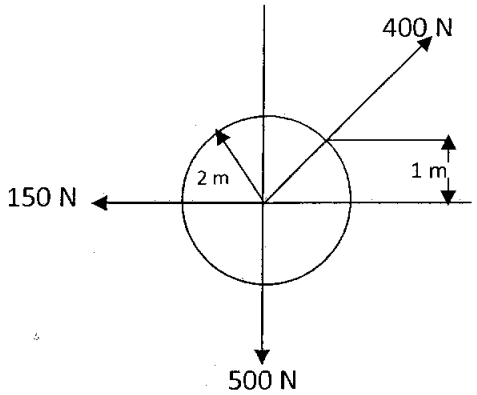
2011/2012

Subject: Mechanic &Strength of Material
Branch: Both branch
Examiner: Dr. Eman J. & Dr. Jenan A.

Class: First
Time: 3 hours
Date: .....

Attempt four questions only

Q1: Find the resultant of the force system shown in the figure **below and its direction:**

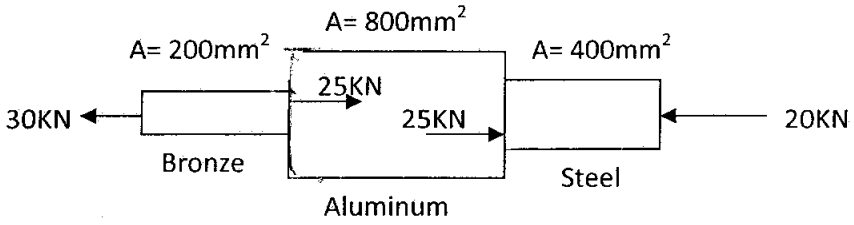


[25]

Q2:

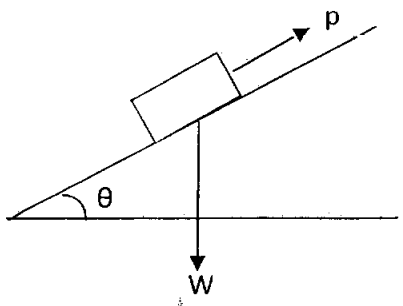
A: Compute the total elongation of brass bar of 2 m length caused by axial tensile load of 96 MPa. Find the change in the temperature that may cause the same elongation. Given that $\propto = 20 \times 10^{-6}\ K^{-1}$, $E = 120\ GN/m^2$.

B: Determine the stress in each bar in the figure below:



[25]

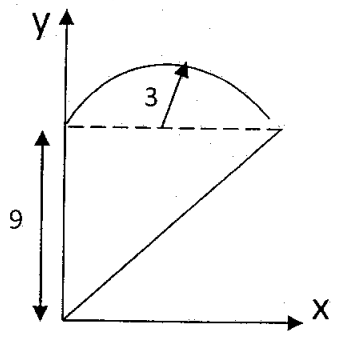
Q3: An effort (p) of 200kg parallel to the plane is required to just move a certain body up an inclined plane of angle $\theta=15^\circ$. If the angle of inclination of the plane is made $\theta=20^\circ$, the effort (p) required again applied parallel to the plane is found to be 230kg. Find the weight of the body and the coefficient of friction.



[25]

Follow

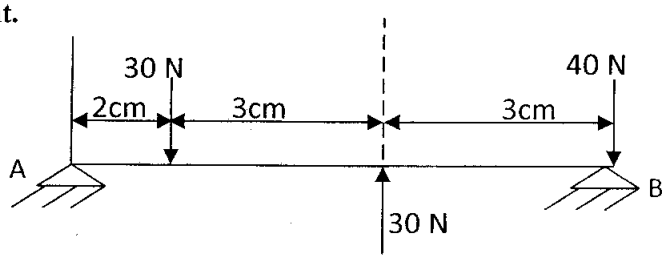
Q4: Determine the coordinates of centroid of the area shown in the figure below with respect to the given axes.



[25]

Q5:

A: **A parallel force system acts on the bar shown in the figure below. Determine the magnitude and position of the resultant.**

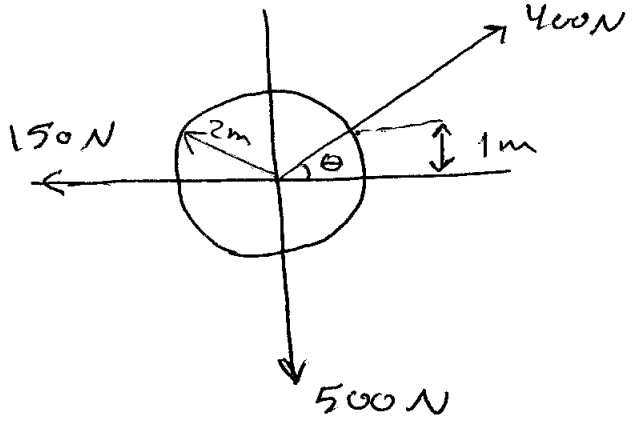


B: A spherical storage tank of (25m) diameter is used to store gas. If the thickness of the thin wall is (12mm) and the centering stress is (150 Mpa), calculate the maximum allowable pressure of the gas.

[25]

Good Luck

Q_1: Find the resultant of the force system shown in the figure below and its direction



Solution

$$\sin\theta = \frac{1}{2}$$

$$\therefore \theta = 30^\circ$$

$$\Sigma Fx = 400\cos 30 - 150 = 196.4\ N$$

$$\Sigma Fy = 400\sin 30 - 500 = -300N$$

$$R = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$$

$$= \sqrt{(196.4)^2 + (-300)^2}$$

$$= \quad N$$

$$\text{Tan}\,\theta_R = \frac{\Sigma Fy}{\Sigma Fx} = \frac{-300}{198.7} = -1.51$$

$$\therefore \theta_R = \text{Tan}^{-1}(-1.51)$$

$$= -56.50^\circ$$

Q2

A: Compute the total elongation of brass bar of 2m length caused by axial tensil load of 96 MPa. Find the change in temperature that may cause the same elongation. given that $\alpha = 20 \times 10^{-3}\ k^{-1}$, $E = 120\ GN/m^2$

Solution

$$\delta_L = \frac{PL}{AE} = \frac{\sigma_L L}{E}$$

$$= \frac{(96 * 10^6)\frac{N}{m^2}\ (2 * 10^3)\ mm}{(120 * 10^9)\ \frac{N}{m^2}}$$

$$= 1.6\ mm$$

$$\delta_T = \delta_L = \alpha * L * \Delta T$$

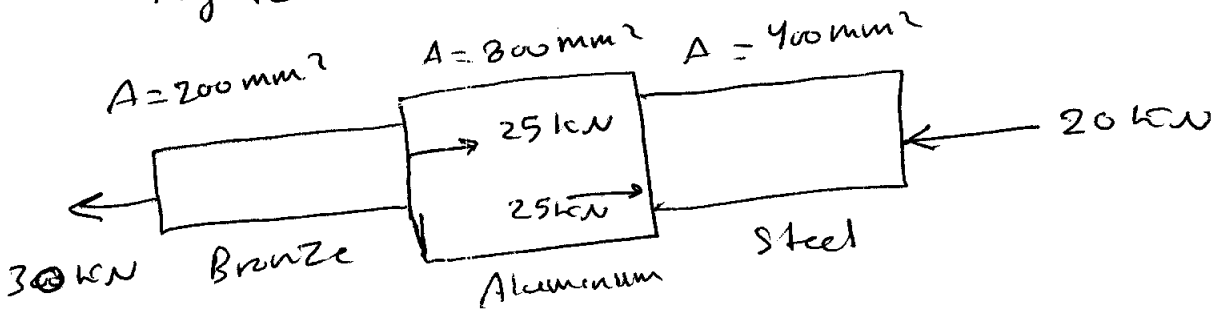
$$\Delta T = \frac{\delta_T}{L \cdot \alpha}$$

$$= \frac{1.6\ mm}{(2 * 10^3)_{mm}\ (20 * 10^{-6})_{k^{-1}}}$$

$$= 40^\circ k$$

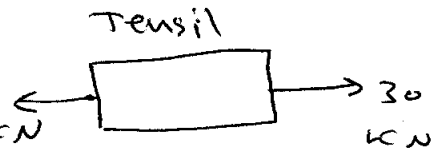
Q2

B: Determine the stress in each bar in the figure below:



$$\sigma = \frac{P}{A}$$

Bronze



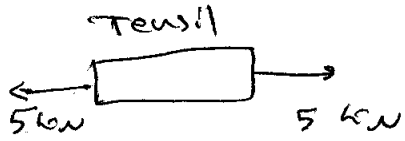
$$\sigma_B = \frac{30\ (kN) \times 10^3\ \frac{N}{kN}}{200\ mm^2 \times 10^{-6}\ \frac{m^2}{mm^2}}$$

$$= 150 \times 10^6\ N/m^2 = 150\ MN/m^2$$

$$= 150\ MPa$$

Elongation

Aluminum



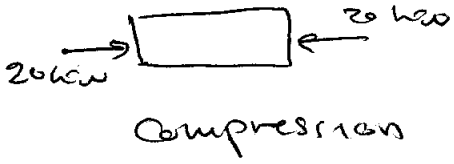
(Elongation)

$$\sigma_A = \frac{5 \times 10^3}{800 \times 10^{-6}}$$

$$= 6.25 \times 10^6\ N/m^2 = 6.25\ MN/m^2$$

$$= 6.25\ MPa$$

Steel



Compression

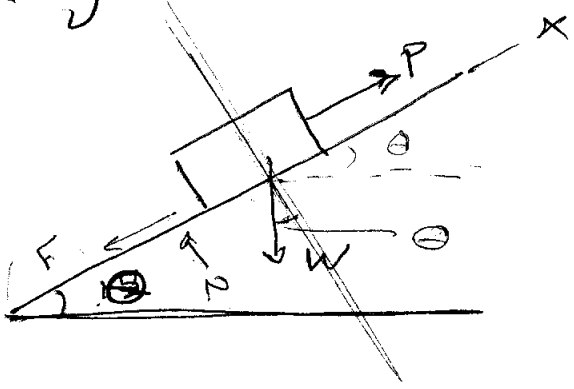
$$\sigma_S = \frac{20 \times 10^3}{400 \times 10^{-6}}$$

$$= 50 \times 10^6\ N/m^2$$

$$= 50\ MN/m^2$$

$$= 50\ MPa$$

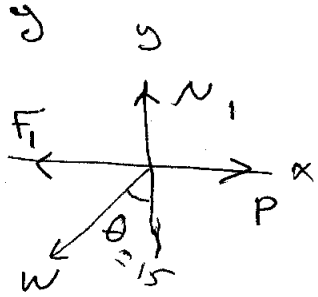
Q_3: An effort (P) of 200 kg parallel to the plane is required to just move a certain body up an inclined plane of angle 15°. If the angle of inclination of the plane is made 20°, the effort (P) required again applied parallel to the plane is found to be 230 kg. Find the weight of the body and the coefficient of friction.



Solution

(1) P = 200 kg

$\theta = 15°$



$\Sigma F_x = 0$

$P - f_1 - W \sin\theta = 0$

$200 - f_1 - W \sin 15 = 0$

$\therefore \boxed{W \sin 15 = 200 - f_1}$ ---(1)

$\boxed{f_1 = \mu N_1}$ ---(2)

sub eq(2) int eq(1)

$\therefore \boxed{W \sin 15 = 200 - \mu N_1}$ ---(3)

$\Sigma F_y = 0$

$N_1 - W \cos 15 = 0$

$\therefore \boxed{N_1 = W \cos 15}$ ---(4)

sub eq. (4) int (3)

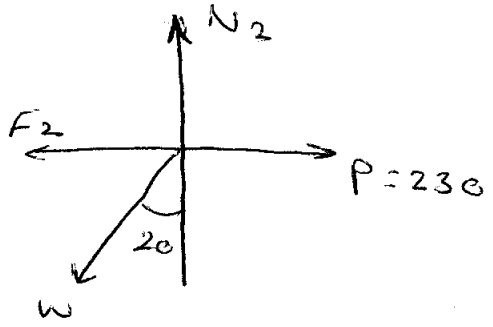
$\therefore \boxed{W \sin 15 = 200 - \mu W \cos 15}$ ---(5)

$\boxed{0.259\, W = 200 - 0.966\, \mu W}$

تكملة السؤال الثاني

2) $P = 230$ kg

$\theta = 20°$



$P - F_2 - w\sin\theta = 0$

$230 - F_2 - w\sin 20 = 0$

$w\sin 20 = 230 - F_2$ ------ (6)

$F_2 = \mu N_2$ ---------- (7)

$w\sin 20 = 230 - \mu N_2$ ------ (8)

$\Sigma F_y = 0$

$N_2 - w\cos 20 = 0$

$N_2 = w\cos 20$ ------ (9)

sub (9) into (8)

$w\sin 20 = 230 - \mu w\cos 20$ ---- (10)

$0.342\ w = 230 - 0.94\ \mu w$

Solve eq. 5 and eq 10 to find w and μ

$0.259\ w = 200 - 0.966\ \mu w$

$0.342\ w = 230 - 0.94\ \mu w$

From eq 5

$$0.966\,\mu w = 200 - 0.259$$

$$\mu w = \frac{200}{0.966} - \frac{0.259}{0.966}\,w$$

$$\mu w = 207.04 - 0.268\,w \quad --(11)$$

sub eq (11) into eq (10)

$$0.342\,w = 230 - 0.94(207.04 - 0.268w)$$

$$0.342w = 230 - 194.62 + 0.252\,w$$

$$0.342w - 0.252w = 230 - 194.62$$

$$0.09w = 35.38$$

$$w = \frac{35.38}{0.09} = 393.1$$

eq (11)

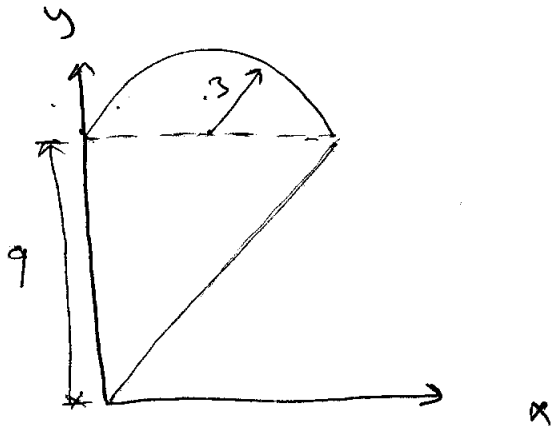
$$\mu(393.1) = 207.04 - 0.268(393.1)$$

$$\mu = \frac{207.04}{393.1} - 0.268$$

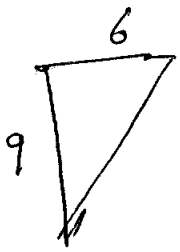
$$= 0.26$$

Q4: Determine the coordinates of centroid of the area shown in the figure below with respect to the given axes.

Given that



Shape

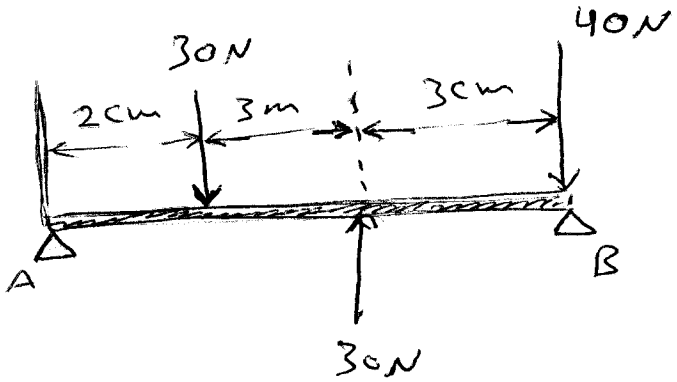
Shape	x	y	a	ax	ay
	3	$\frac{4r}{3\pi}+9$ $=\frac{4(3)}{3\pi}+9$ $=10.27$	$\frac{\pi r^2}{2}$ $\frac{\pi(3)^2}{2}$ $=14.13$	$3*14.13$ $=42.39$	$10.27*$ 14.13 $=145.12$
	$\frac{6}{3}$ $=2$	or $\frac{h}{3}=\frac{9}{3}=3 \rightarrow 9-3$ $\frac{2(9)}{3}=6$ $=6$	$\frac{1}{2}(6)(9)$ $=27$	$27*2$ $=54$	$27*6$ $=162$
			$A=\Sigma a$ $=41.13$	$\Sigma ax=$ 96.13	307.12

$$\bar{x}=\frac{\Sigma ax}{A}=\frac{96.39}{41.13}=2.34$$

$$\bar{y}=\frac{\Sigma ay}{A}=\frac{307.12}{41.13}=7.47$$

$\therefore$ The centroid $(2.34, 7.47)$

Q_5 A: A parallel force system acts on the bar shown in the figure below. Determine the magnitude and position of the resultant.



Solution

$R = -30 + 30 - 40 = -40\ N$

$\Sigma M_A = 30 * 2 - 30 * 5 + 40 * 8$

$= 60 - 150 + 320 = 230\ N \cdot m$

$M_A = F \cdot d$

$d = \frac{M_A}{F} = \frac{230}{40} = 5.75\ m$

The resultant $R = 40$ down and the position of the resultant is at 5.75 m

Q5

B: A spherical storage tank of 25m diameter is used to store gas. If the thickness of the thin wall is 12 mm and the centering stress is 150 MPa, calculate the maximum allowable pressure of the gas.

Solution

$$\sigma_c = \frac{PD}{4t}$$

$$150\ MPa = \frac{P * 25\ m * 10^3\ \frac{mm}{m}}{4 * 12\ mm}$$

$$P = \frac{4 * 12 * 150}{25 * 10^3}$$

$$= 0.282\ MPa$$

Note : Attempt four questions only

Q1: A gaseous fuel consists of 80 mol % CH_4 , 10 mol % H_2 and 10 mol % N_2 is burned with 40 % excess air . 80 % of methane is burned to CO_2 and the rest is burned to CO , whereas all hydrogen is converted to H_2O .

Calculate : (a) the molar ratio of air input to the fuel .

(b) the Orsat analysis of the flue gas .

(c) the molar ratio of water vapour to the dry flue gas .

(25 marks)

Q2:- Silicon rods with total mass of 168 lb are allowed to react with 900 lb of nitric acid solution containing 70 wt% HNO_3 and 1080 lb of HF according to the reaction:

$$3Si + 4HNO_3 + 18HF \longrightarrow 3H_2SiF_6 + 4NO + 8H_2O$$

Mwt.	28	63	20	144	30	18

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 it's composition.

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

(25 marks)

Q3:- (A) A mixture consists of 20 mol% ethanol (C_2H_5OH), 35 mol% ethyl acetate ($C_4H_8O_2$) and 45 mol% acetic acid (CH_3COOH).

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 .

(13 marks)

(B) A pressure vessel with volume of 85 ft^3 contains ethylene (C_2H_4) at 38 °C and absolute pressure of 50.5 atm (non-ideal behavior). Calculate the mass in pounds of ethylene using compressibility factor method.

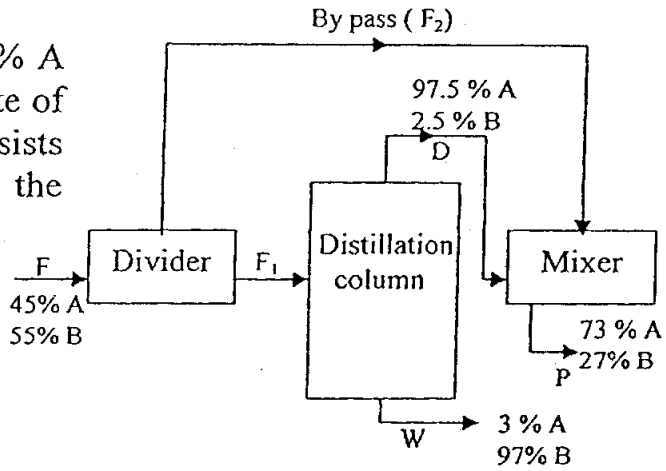
Given that: T_c = 282.7 K, P_c = 50.5 atm , R = 1.3145 atm.ft^3 / lbmole K.

(12 marks)

Q4:

A binary mixture (F) consists of 45 wt % A and 55 wt % B are continuously fed at a rate of 1000 kg / hr to the distillation process consists of bypass flow arrangement as shown in the following flow diagram .

Calculate the flow rates of all steams in process with complete checking .



(25 marks)

Q5 - Ethylene (C_2H_4) is fed to a heat exchanger at a rate of 10 mol/ sec so that it is heated from 40 °C to 100 °C by a hot 35 °API gas oil which flows at a rate of 0.5 kg / sec with inlet temperature of 130 °C. Calculate:

a-the enthalpy change of ethylene in J/sec.
b-the outlet temperature of gas oil assuming no change of its phase.
c-the volumetric flow rate of gas oil in m^3/hr.

Given that: mean heat capacity of gas oil (Cp_m) = 2.15 kJ / kg °C.
heat capacity of ethylene is given by the following relation:
$Cp = 40.75 + 0.115\ T - 6.9 \times 10^{-5}\ T^2$ where Cp in J / mol. °C and T in °C.

(25 marks)

Conversion Factors :

1m = 3.28 ft
1ft = 12 in = 30.48 cm
1in = 2.54 cm
1lb_f = 4.448 N

1 lb_m = 453.6 gm
1 ft^3 = 7.48 gal = 28.32 liters
1 atm = 14.7 psi = 101.3 kPa
1 bar = 100 kPa

1 J = 1 liter . kPa
1 kJ = 10 bar . liter
1 Btu = 252 cal = 778 ft .lb_f
1 kcal = 4.184 kJ

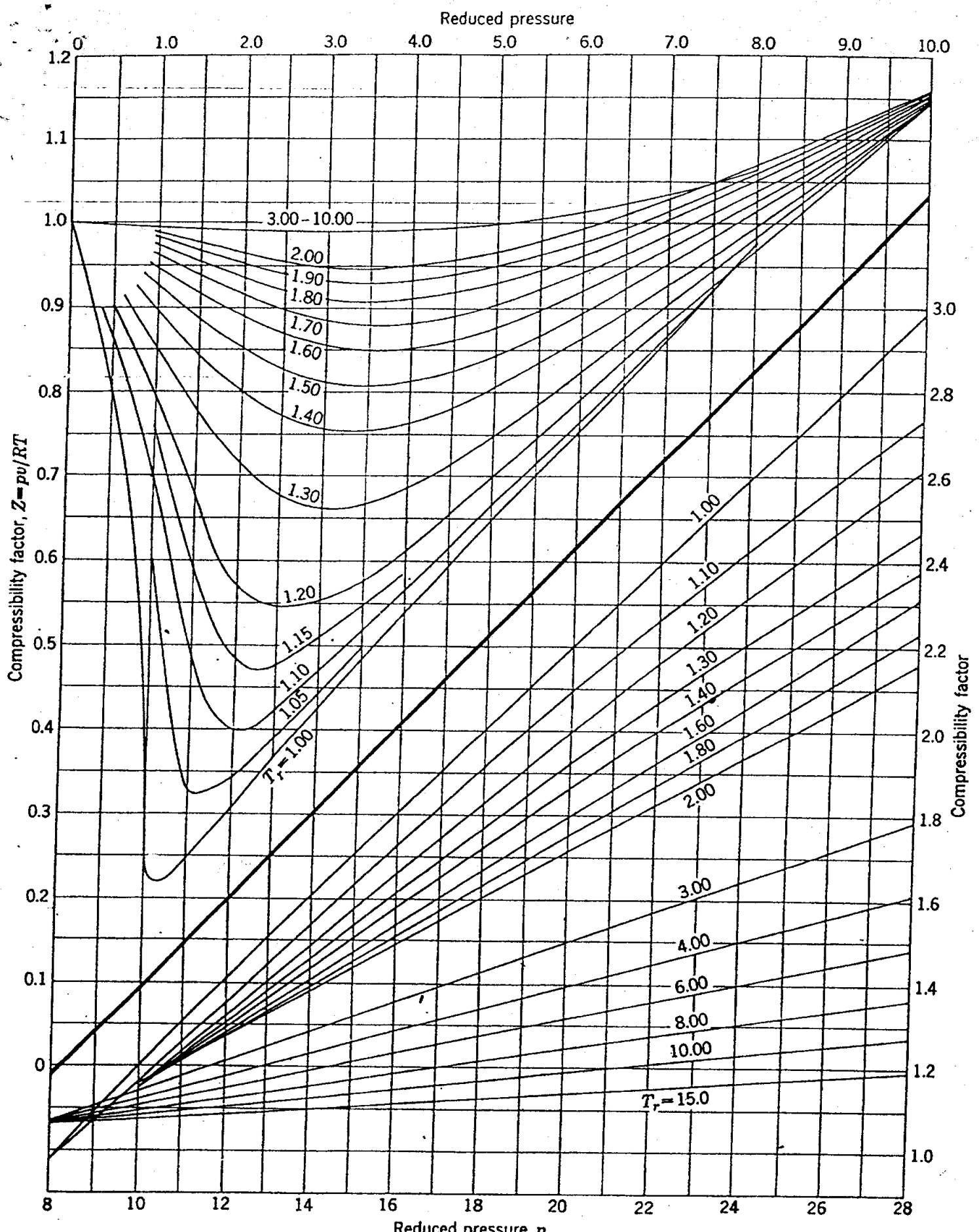


FIG. 4-4b. Generalized compressibility-factor diagram. Medium- and high-pressure range. (*Based on data compiled by A. L. Lydersen, R. A. Greenkorn, and O. A. Hougen, Generalized Thermodynamic Properties of Pure Fluids, Univ. Wisconsin, Eng. Expt. Sta., Rept. 4, 1955. By permission.*)

University of Technology

Chemical Engineering Department

Final Examination

2011/2012

Subject: Computer Programming (I)
Branch: Chem. Processing Eng.
Examiner: Dr.Walla'a A.Noori

Class: First
Time: 3 hours
Date 12/9 /2012

Attempt five questions only

Q.1) Write a computer program (design and code) to change the temperature from ^{O}C to K with change the background of program from red color at 100 ^{O}C to blue color at 0 ^{O}C .

Where : $T_K=273.15+T_C$

Hint : Use vertical scroll bar.

(10 Marks)

Q 2) Write a program (design and code) which can be used as database for Atomic weights of chemical elements with the follwing list of information.

chemical elements	H	He	Na	Al	Cl	O	Cr	Fe
Atomic Weights (gm/mol)	1.008	4.003	22.990	26.982	35.453	15.999	51.996	55.847

Note: Use inputbox to enter the chemical element name.

(10 Marks)

Q3): Write a computer program (design and code) which can be used to change the length between cm to inch or foot or in reverse if you know.

1 inch=2.54 cm

1 foot=30.28 cm

1 foot=12 inch

Note:

Use 3 option buttons to show the options of length change.

Use label to show the resulted length with its unit

(10 Marks)

Follow

Q 4 :(A) Fill in the blanks:-

1. The result of Sqrt(((9 + 7) / (4 * 2)) + 2) is _____.

2. The result of a = (3 + 2)^2 - 4 / 2 is _____.

3. A=_____ ("Enter your name").

4. The command dim A(2,3) as string generate an array contains _____elements.

5. The property used to change the time period in a timer is_____.

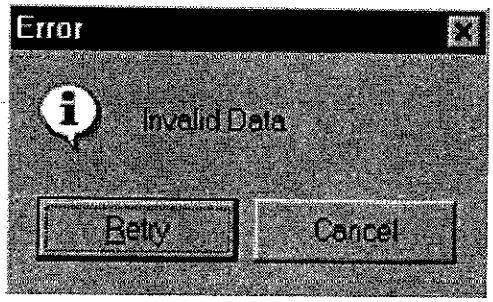
(B) Define the followings:

(1) Alignment (2) Sort (3) User accounts (4) Slide Master (5) Control Panel

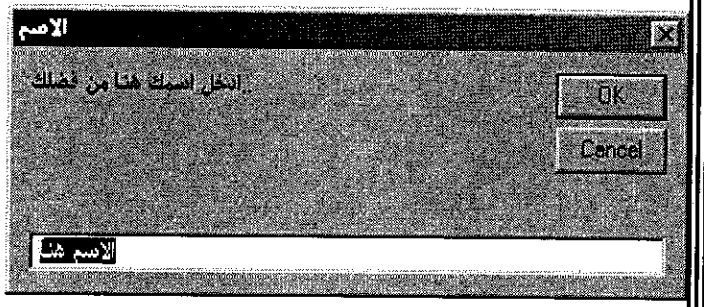
(10 Marks)

Q5 (A): Write a computer code (only) to show the following messages.

1)



2)



(B) In Microsoft Power Point, how can you do a Custom Animation? Explain.

(10 Marks)

Q6: Use loop in a program to calculate the bubble point of ternary system (Pentane 9 mol%, Hexane 57 mol% and Heptane 34 mol%). The vapor pressure of these components are calculated by the following Antoine equations:

Pentane Po1=exp(13.8183-2477.07/(T+233.21)

Hexane Po2=exp(13.8216-2697.55/(T+224.37))

Heptane Po3=exp(13.8587-2911.32/(T+216.64))

Where

Ki= P oi /Pt
Pt=760
yi =Ki×xi
At Bubble point ∑yi=∑Ki×xi =1

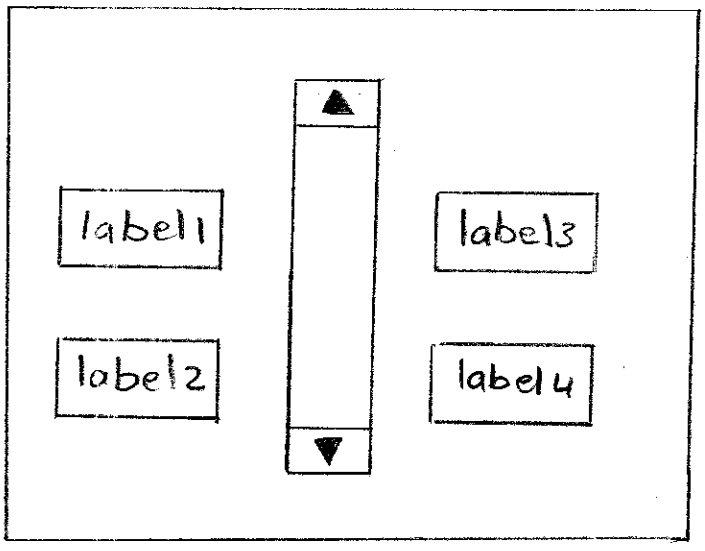
(10 Marks)

Follow

Q1/

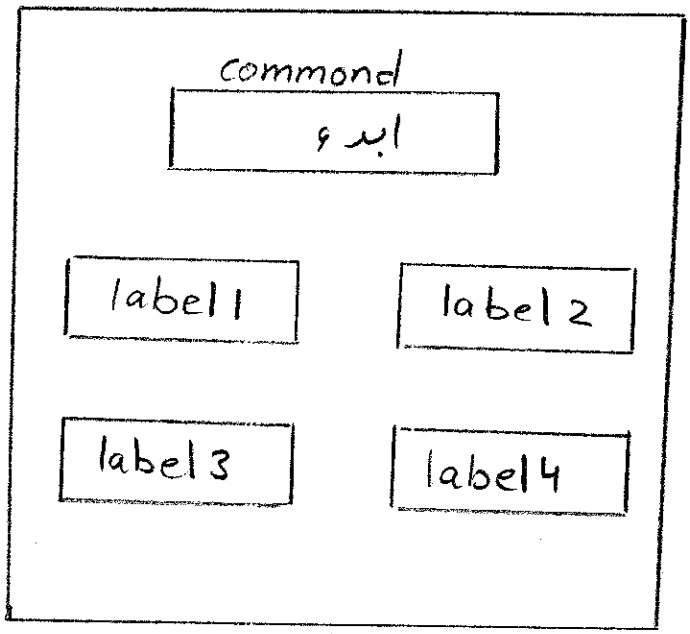
```
Private sub form_load ( )
Vscroll1.Min = 0
Vscroll1.Max = 100
Vscroll1.Smallchange = 5
Vscroll1.Largechange = 10
End sub

Private sub Vscroll1_change ( )
label2 = 100 - val (Vscroll1.value)
label4 = val (label2) * 1.8 + 32
red = 2.55 * val (label2)
blue = 255 - red
form1.Backcolor = RGB (red, 0, blue)
label1.Backcolor = RGB (red, 0, blue)
label2.Backcolor = RGB (red, 0, blue)
label3.Backcolor = RGB (red, 0, blue)
label4.Backcolor = RGB (red, 0, blue)
End Sub.
```



Q2/

```
Dim x(8) As String
Dim y (8) As single
x(1) = "H"
x(2) = "He"
  .
  .
  .
x(8) = "Fe"
Y(1) = 1.008
Y(2) = 4.003
  .
  .
  .
Y(8) = 55.847
A$ = inputBox$ ( "Enter Chemical Element Name" )
For i = 1 To 8
if A$ = x(i) then
label 2 = x (i)
label 4 = Y(i)
End if
Next
End Sub
```



Q4/ A/

1. The result of Sqrt (((9+7)/(4*2))+2) is 2.
2. The result of a = (3+2)^2-4/2 is 23.
3. A = input box ("Enter your name").
4. The command dim A(2,3) as string generate an array contains 12 elements.
5. The property used to change the time period in a timer is interval.

B/

١. Alignment : تستخدم لتحديد مكان النص في اليمين او اليسار او في الوسط وتعني المحاذاة .

٢. Sort : تستخدم لترتيب البيانات تصاعدياً او تنازلياً .

٣. User account : يمكن انشاء حساب المستخدم في الحاسبة الواحدة لتمكين كل شخص العمل من اعداداته الخاصة ويمكن مثل كلمة سر للدخول الى الحاسبات وكذلك يمكن تحديد امكانيات بعض المستخدمين للعبث بالحاسبة ويوجد ثلاثة انواع من الحسابات اداري، مستخدم عادي، الضيف .

٤. Slide Master : يكون موجود في برنامج Microsoft Power Power تستخدم لاضافة نقوش ثابتة في كل الشرائح .

٥. Control Panel : (لوحة السيطرة) تستخدم لتغيير مظهر واعدادات الـ Windows بحيث تسمح للمستخدم بالتحكم في السيطرة على (Desktop Gadgets ، Date & Time ، Devices & printers ، Device Manager ، Folder Options ، .....) .

Qs/ A/

1. B = MSGBox (" Error " , 69 , " Invalid Data ")

2 A$ = InputBox$ (" ادخل اسمك هنا من فضلك " , " الاسم " , " الاسم هنا ")

B/

تحريك العناصر في الشريحة : Custom Animation

- لاضافة حركة لاي عنصر Object في الشريحة ننقر عليه اولا" ثم ننقر على الشكل المطلوب تحريكه (اي ان اضافة الحركات يكون بالتسلسل) ثم ننقر شريط الحركة Animation ثم ننقر ايكونة اضافة حركة Add ✧+ .
- لاستعراض المشروع ضمن لوحة العمل : ننقر شريط الحركة Animation ثم ايكونة Preview .
- لاستعراض المشروع على كامل الشاشة (Full Screen) نضغط على زر F5 من لوحة المفاتيح .
- لمسح حركة ننقر على رقم الحركة في الشريحة ثم نضغط على زر امسح (Delete) من لوحة المفاتيح .
- لتغيير تسلسل حركة ننقر على رقم الحركة المطلوب تقديمها او تأخيرها ثم ننقر على شريط الحركة Animation ثم ننقر على ▲ Move Earlier لتقديم الحركة او ▼ Move Later لتأخيرها الحركة .
- لاضافة حركة ضمنية باختيار العنصر المطلوب ننقر على شريط الحركة Animation ثم ايكونة اضافة حركة Add Animation ✧+ ثم اختيار حركة ضمنية Emphasis .

Q6/

```
Private sub command1_Click
xPo1 = Text1/100
xPo2 = Text2/100
xPo3 = Text3/100
For T = 273.15 To 450 step 0.01
Po1 = Exp(13.8183 - 2477.07/(T+233.21))
Po2 = Exp(13.8216 - 2697.55/(T+224.37))
Po3 = Exp(13.8587 - 2911.32/(T+216.64))
KPo1 = Po1/760
KPo2 = Po2/760
KPo3 = Po3/760
Sum = KPo1 * xPo1 + KPo2 * xPo2 + KPo3 * xPo3
if sum >= 1 then
Exit for
End if
Next
label5 = Round(T,2)
```