國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：兵器系統工程碩士班 造船及海洋工程碩士班 車輛及運輸工程碩士班	考試科目： 工程數學	第 1 頁，共 1 頁	考試時間 80 分鐘

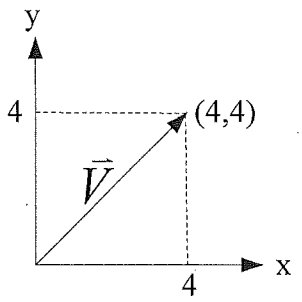
計算題（共計 10 題，每題 10 分，合計 100 分）

1. 解微分方程式 $\frac{dy}{dx}=20x-10$

2. 求初始解問題 $E-L\frac{dI(t)}{dt}-RI(t)=0,\quad I(0)=0$

3. 求方程式 $g(t)=5te^{-5t}$ 之拉氏轉換(Laplace Transform)

4. 請以單位向量表示法表達下圖 $\vec{V}$ 之向量



5. 已知向量 $\vec{\mathbf{a}}=\{2,\ -3\ \ 1\}$，$\vec{\mathbf{b}}=\{-1,\ \ 1,\ \ -2\}$，求與 $\vec{a}\times\vec{b}$ 同向之單位向量?

6. 已知向量 $\vec{u}=[1,\ 2,\ 1]$，$\vec{v}=[4,\ -2,\ -1]$，試求 $\vec{u}\bullet\vec{v}$

7. 已知 $\mathbf{A}=\begin{bmatrix}3 & 1\\ -2 & 4\end{bmatrix}$，試求 3**A**

8. 求函數 $G(s)=\frac{2(s+1)}{s(s^2+s+2)}$ 之反拉氏轉換(Inverse Laplace Transform)

9. 求圓柱螺線 $\vec{\mathbf{r}}=\{a\cos t,\ \ a\sin t,\ \ bt\}$ 在 $t=\frac{\pi}{6}$ 處的切線方程式

10. 試求點 $P_1(3,\ 4,\ 1)$至平面 *3x-2y+2z=10* 之距離

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系(所)別：機械工程碩士班 航空太空工程碩士班	考試科目：工程數學	第 1 頁，共 2 頁	考試時間 80 分鐘

計算題(共計 10 題，每題 10 分，合計 100 分)

1. Solve $y' = x^2(1+y^2)$

2. Solve the following equation

$$\left(2+2x^2\sqrt{y}\right)ydx+\left(x^2\sqrt{y}+2\right)xdy=0$$

3. Solve the initial value problem

$$y'''-9y''+27y'-27y=54\sin 3x$$
$$y(0)=3.5,\quad y'(0)=13.5,\quad y''(0)=38.5$$

4. Using the Laplace transform, solve the initial value problem

$$\begin{cases} y_1' = -4y_1 - 2y_2 + t \\ y_2' = 3y_1 + y_2 - t \end{cases} ; \quad y_1(0)=5.75,\quad y_2(0)=-6.75$$

5. Prove the convolution theorem.

6. Find the length of the following circular helix from $t = 0$ to π.

$$\begin{cases} x = \cos t \\ y = \cos t \\ z = t \end{cases}$$

7. $A = \begin{bmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{bmatrix}$, please find the eigenvalues and eigenvectors.

8. Using Green's theorem, Evaluate $\int_C \mathbf{F}(\mathbf{r})\cdot d\mathbf{r}$ counterclockwise around the boundary curve C of the region R, where $\mathbf{F}(\mathbf{r})=[-y^3, x^3]$, C the circle $x^2+y^2=25$.

9. Find the type, transform the normal form, and solve.

$$\frac{\partial^2 u}{\partial x^2}+2\frac{\partial^2 u}{\partial x\partial y}+\frac{\partial^2 u}{\partial y^2}=0$$

10. Solve the followings by Cauchy Integral Formula.

(a) $\oint_{|z|=2}\frac{\sin z}{z^2+1}dz$ (5%)

(b) $\oint_{|z|=1}\frac{\sin z}{z^4}dz$ (5%)

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系(所)別：資訊工程碩士班	考試科目：線性代數	第 1 頁，共 1 頁	考試時間:80 分鐘

計算題（共 10 題, 每題 10 分, 合計 100 分）

1. Perform the operations on the matrices A=$\begin{bmatrix}-3 & 1\\ 2 & 2\\ -1 & 5\end{bmatrix}$, B=$\begin{bmatrix}-1 & 1 & -1 & 3\\ 2 & 5 & -3 & 1\end{bmatrix}$, and C = $\begin{bmatrix}3 & 2 & -2 & 1\\ 1 & 6 & -2 & 4\end{bmatrix}$.

   a. A(B+C) (5%) b. $B^TA^T + C^TA^T$ (5%)

2. Let $\vec{A}$=(-2, 4,1) and $\vec{B}$=(3,1,5) be two vectors. Evaluate the cross product $\vec{A}\times\vec{B}$

3. From problem (2), please evaluate the inner product $\vec{A}\cdot\vec{B}$

4. Let S = $\left\{\begin{bmatrix}1 & 0\\ 0 & 0\end{bmatrix}, \begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}, \begin{bmatrix}0 & 0\\ 0 & 1\end{bmatrix}\right\}$. Show that the span of S is the subspace of $M_{2\times2}$ (2×2 matrix) of all symmetric matrices.

5. Compute the determinant of the matrix $\begin{bmatrix}2 & 4 & 1\\ -2 & -5 & 4\\ -4 & 9 & 10\end{bmatrix}$

6. Let $\vec{A}$=(2,5,-3), $\vec{B}$=(-4, 1,9) and $\vec{C}$=(4,0,2) be three vectors. Find the linear combination $2\vec{A}-3\vec{B}+\vec{C}$

7. Find a basis and the dimension of the subspace W of R^4 spanned by (1, 4, -1, 3), (2, 1, -3, -1), and (0, 2, 1, -5).

8. Let T : $R^3 \rightarrow R^3$ be the linear transformation defined by T(x, y, z) = (x+2y-z, y+z, x+y-2z). Find a basis and the dimension of the image U of T.

9. Solve the following linear system:
   x+y+z-w= -3, 2x+3y+z-5w= -9, x+3y-z-6w= -7, -x-y-z=1

10. Let the matrix $\mathbf{A} = \begin{bmatrix}1 & 0 & 0\\ 6 & -2 & 0\\ 7 & -4 & 2\end{bmatrix}$. Show that A is diagonalizable.

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系(所)別：空間科學碩士班	考試科目：測量學	第 1 頁，共 1 頁	考試時間 80 分鐘

一、問答題(共 10 題，每題 6 分，共計 60 分)

1、測量的目的為何？(5 分)　平面測量與大地測量如何區分？(5 分)

2、1 甲等於多少坪？(5 分)　1 坪等於多少平方公尺？(5 分)

3、於1:1000 比例尺圖上量得某段距離 D＝168.68mm ，中誤差 $m_D = \pm 0.15mm$ ，請詳列計算式計算 D 之實際距離及其中誤差。

4、高程測量時，要求水準儀與前後視水準尺距離相等，此舉可消除何種誤差？

5、觀測 A 至 C 之平距數次，其值分為10.120m 、10.140m 、10.110m 、10.130m 及10.110m ，請詳列計算式計算此段距離之最或是值及其中誤差。

6、以單角法測水平角之記錄如下表，請詳列計算式計算水平角 ∠AOB 。

測站	觀測點	鏡位	水平方向讀數
O	A	正	0° 00′05″
		倒	179° 59′59″
	B	正	25° 09′56″
		倒	205° 09′50″

7、中誤差之幾何意義為何？

8、導線測量中，其邊長400m之測距誤差為2cm ，請詳列計算式計算相應之測角誤差。

9、作 GPS 定位觀測時最少需要幾顆衛星以上？(5 分)　理由為何？(5 分)

10、有一角度測 20 回，得中誤差為±0.42″，問至少再增加幾測回觀測，其中誤差可提昇至±0.28″。

二、申論及計算題(共 2 題，每題 20 分，共計 40 分)

11、試述三角測量之作業程序？

12、已知 A($N_A \pm m_N$、$E_A \pm m_E$) 及 B(N_B、E_B) 兩點坐標，請詳列計算式計算 A 至 B 之距離 S 的中誤差 m_S 。

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系(所)別：軍事工程碩士班	考試科目：工程力學	第 1 頁，共 1 頁	考試時間 80 分鐘

共 10 題，每題 10 分，共計 100 分

1. 請解釋以下名詞：
   (a) 均質性(Homogenous) (3 分)
   (b) 等向性(Isotropic) (3 分)
   (c) 脆性(Brittle) (2 分)
   (d) 延展性(Ductile) (2 分)

2. (a)請舉例說明何謂靜載重(Dead Load)與活載重(Live Load)？(5 分)
   (b)在考慮結構的設計載重時該如何考量上述兩種載重的影響？(5 分)

3. 一結構系統若處於平衡狀態，其平衡方程式為何？

4. 何謂中性軸，請以梁繪圖說明之。

5. 在桁架結構系統中，何謂零力桿件(Zero-Force Member)？

6. 一矩形斷面(寬為 b、高為 h)，試求此斷面對形心軸的面積二次矩(慣性矩)。

7. 承上題，試求此斷面對形心軸的面積一次矩。

8. 已知一平面應力以下列矩陣表示，請計算其最大主應力、最小主應力與最大剪應力。

$$[\sigma_{ij}]=\begin{bmatrix}\sigma_x & \tau_{xy}\\ \tau_{yx} & \sigma_y\end{bmatrix}=\begin{bmatrix}120 & 80\\ 80 & 20\end{bmatrix}$$

9. 請列出尤拉柱之挫曲載重公式，並說明其相關參數。

10. 請說明如何繪製應力莫爾圓(Mohr's Circle)與定義極點(Pole)。

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系(所)別：大氣科學碩士班	考試科目： 應用數學	第 1 頁，共 1 頁	考試時間 80 分鐘

計算題(共 10 題，每題 10 分，共計 100 分)

1. 試解此常微分方程式 $y'=\frac{y}{x+y}$ 。

2. 兩向量 $\vec{A}=(0,1,-1)$ 、 $\vec{B}=(1,-2,1)$ ，求 $\vec{A}\times\vec{B}=?$

3. 試解此常微分方程式 $2(y^3-2)+3xy^2y'=0$, $y(3)=1$ 。

4. $f(x)=\tan x$ ，求 $f'(x)=?$

5. 試求下列函數之傅立葉級數 $f(x)=x^2-x+3$, $-2\le x\le 2$ 。

6. 求曲線 $x^3+y^3-2x+3y-3=0$ 在點(1,1)之切線方程式。

7. 已知向量 $\vec{F}=2xy\,\vec{i}+xe^y\,\vec{j}+2z\,\vec{k}$ ，求 $\nabla\times\vec{F}$ 。

8. 解二階微分方程 $x^2y''-4xy'+4y=0$ 。

9. 計算無窮級數 $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\cdots$ 之值。

10. 已知 $A=\begin{pmatrix}-1 & 6 & 2 & 14 & -22\end{pmatrix}$ 、 $B=\begin{pmatrix}-3\\2\\6\\0\\-4\end{pmatrix}$ ，AB 解為何？

國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：光電工程碩士班	考試科目：工程數學	第 1 頁，共 1 頁	考試時間 80 分鐘

題目一頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. Solve $\cos(x+y)dx+(3y^2+2y+\cos(x+y))dy=0$

2. Solve $y''+5y'+6y=e^{-2t}$

3. Solve the initial value problem. $y''+9y=0,\quad y(0)=0.2,\quad y'(0)=-1.5$

4. Solve $x^2y''-5xy'+9y=0$

5. Solve $(D^5-3D^4+3D^3-D^2)y=0$ (Hint:D=d/dt)

6. $\vec{a}=[2,0,3],\vec{b}=[0,4,1],\vec{c}=[5,6,0]$, Find $\vec{a}\cdot(\vec{b}\times\vec{c})$

7. Evaluate $\int_{(\pi/2,\pi)}^{(\pi,0)}(\frac{1}{2}\cos\frac{1}{2}x\cos 2ydx-2\sin\frac{1}{2}x\sin 2ydy)$

8. Using Laplace transform to solve $xy''+2y'+(2-x)y=2e^x,\quad y(0)=0$

9. Find the eigenvalues and corresponding eigenvectors of the matrix

$$A=\begin{bmatrix}1&1&1\\0&0&1\\1&1&0\end{bmatrix}$$

10. Find the Fourier Transform of the function

$$f(x)=e^{-ax^2},\quad (a>0)$$

國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：電子工程碩士班(計算機組)	考試科目：工程數學	第 1 頁，共 1 頁	考試時間 80 分鐘

題目一頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. 求下列算式之解

   (1) 求 $\frac{dy}{dx}=3x^2e^{-y}$ 之通解？ (5%)

   (2) 若 $y(1)=0$，求特解？ (5%)

2. 解線性常微分方程式 $y'-y=e^{2x}$？

3. 求下列微分方程式的特解？
   $y''-4y'+4y=0$ 且初始條件 $y(0)=3, y'(0)=4$

4. 解下列微分方程式初始值問題？

   $$y''-y=0, y(0)=6, y'(0)=-2$$

5. 試證 $\frac{1}{6}x\sin(3x)$ 為 $y''+9y=\cos(3x)$ 之解。

6. 求下列方程式之通解與特解

   $$y'+4y\cot 2x=6\cos 2x, y(\tfrac{1}{4}\pi)=2$$

7. 求 $2x\sin 3ydx+3x^2\cos 3ydy=0$ 之通解？

8. 求下述矩陣 A 的反矩陣(A^{-1})？

   $$A=\begin{bmatrix}-1 & 1 & 2\\ 3 & -1 & 1\\ -1 & 3 & 4\end{bmatrix}$$

9. 矩陣 $A=\begin{bmatrix}4 & 3\\ 1 & 2\end{bmatrix}$，試求矩陣之(1)特徵方程式(2)特徵值(Eigenvalue)(3)特徵向量(Eigenvector)?

10. 若 M 與 N 都是大小為 $n\times n$ 的矩陣，而 M 為可逆矩陣，請證明

    $(MNM^{-1})^2=MN^2M^{-1}$。

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系(所)別：電子工程碩士班（一般組）	考試科目：工程數學	第 1 頁，共 1 頁	考試時間 80 分鐘

題目一頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. The matrices $A=\begin{bmatrix}1 & 2 & 1\\ 2 & 3 & 4\\ 5 & 6 & 6\end{bmatrix}$, $B=\begin{bmatrix}0 & 2 & 3\\ 3 & 1 & 1\\ 4 & 0 & 0\end{bmatrix}$, $C=\begin{bmatrix}1 & 2\\ 2 & 2\\ 1 & 4\end{bmatrix}$, $D=\begin{bmatrix}-2 & 4\\ 3 & 5\\ -4 & 6\end{bmatrix}$, try to find (1) $A+B=?$ (2) $6C-D=?$ (3) $A\cdot C-B\cdot D=?$

2. Use the fact that $\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$ and $\Gamma(\alpha+1)=\alpha\,\Gamma(\alpha)$, find the Laplace transform of: (1) $f(t)=t^{-1/2}$ (2) $f(t)=t^{7/2}$

3. Find the complete solution of the differential equation: $\dot{y}(t)+5y(t)=6$.
   Initial Condition: $y(0)=0$.

4. Show that the given functions are orthogonal on the indicated interval
   $f_1(x)=\cos x,\ f_2(x)=\sin^2 x;\ x\in[0,\ \pi]$

5. If $f(t)=3[u(t)-2u(t-T)]$, where $u(t)$ is the step function, try to find the Laplace transform of the $f(t)$.

6. Given $\mathbf{A}=\begin{bmatrix}1 & 0 & 1\\ -1 & 1 & 2\\ 0 & 0 & 1\end{bmatrix}$, find $\mathbf{A}^{\mathrm{T}}$, $\mathbf{A}^{-1}$, $\mathbf{A}^2$, and $\det(\mathbf{A})$

7. Find the Laplace transform of the function: $f(t)=\begin{cases}0, & t<0\\ (t^2+1)\sin(\omega t), & t\geq 0\end{cases}$.

8. Solve the initial value problem, $\ddot{y}(t)-6\dot{y}(t)+9y(t)=0\quad y(0)=3,\ \dot{y}(0)=2$

9. If $x(t)=3e^{-\alpha t}\cos(\omega_0 t)u(t)+4e^{-\alpha t}\sin(\omega_0 t)u(t)$, where $u(t)$ is the step function, and $\alpha>0$, try to find the Fourier Transform $X(j\omega)$.

10. Expand $f(x)=1+x^2,\ 0<x<L$
    (1) in a Fourier cosine series (2) in a Fourier sine series

Hint: $\dot{y}(t)=\frac{dy(t)}{dt}$, and $\ddot{y}(t)=\frac{d\dot{y}(t)}{dt}$.

國防大學理工學院102學年度博、碩士班招生□博士班■碩士班 考試試題			
系（所）別：化學工程碩士班	考試科目：基礎數學	第 1 頁，共 2 頁	考試時間：80 分鐘

問答及計算題（共 20 題，每題 5 分，合計 100 分）

1. $U(x,y,z)=2x^2-yz+xz^2$ ； $x=\cos t$ ； $y=t^2-t+1$ ； $z=4e^{-t}$ 求 $\frac{dU}{dt}_{t=0}$ 之值為何？

2. 求解 $\lim_{x\to 1}\frac{x^2-x-6}{x^2-3x-10}$

3. 解 $\int_0^{\infty} e^{-bx}\sin(ax)dx$

4. $\lim_{x\to 2}\frac{ax^2+2x-b}{x-2}=3$ ，求 a, b

5. 解 $\int_0^{\infty} e^{-(ax^2+b)}dx$ $a>0$, $b>0$

6. 求解 $\lim_{x\to-\infty}(x+\sqrt{x^2+2x})$

7. $y(x)=\frac{3e^x}{1+2e^x}$ 求此函數之定義域及值域為何？

8. 令 $f(x)=\frac{(3x^2-4x+1)^5}{(2x^4+3x^2-6)^7}$ ，求 $f'(1)$

9. 解 $\int\frac{13}{x\ell nx}dx$

10. 令 $f(x)=\sin^4(x^2+3x)$ ，求 $f'(x)$

11. 解 $\int 4^{\sqrt{2x+1}}dx$

12. 令 $f(x)=x^3-12x$ ，求 $f(x)$ 之反曲點

13. 解 $\int\cos^3 x dx$

14. 解 $\int e^{(x-e^x)}dx$

15. $\lim_{x\to 0}\frac{\int_0^{x^2} u\cot u du}{x^6}$

16. 解 $\int\sin^{-1}x dx$

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系（所）別：化學工程碩士班	考試科目：基礎數學	第 2 頁，共 2 頁	考試時間：80 分鐘

17. $g(x)=\int_{\sqrt{x}}^{x^2}\frac{t^2}{t^6+1}dt$，求 $g'(1)=?$

18. 求函數 $f(x)=x^3-2x^2+x-1$與函數 $g(x)=-x^2+3x-1$ 之交點

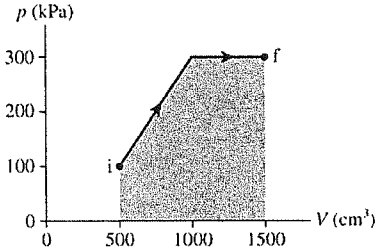
19. 解 $\int_{-3}^{4}|-3x+6|dx$

20. 求函數 $f(x)=x^3-2x^2+x-1$與函數 $g(x)=-x^2+3x-1$ 之交點所夾之面積

國防大學理工學院 102 學年度博、碩士班招生□博士班■碩士班 考試試題			
系(所)別：材料科學與工程碩士班	考試科目： 普通物理	第 1 頁，共 1 頁	考試時間 80 分鐘

計算題（共計 10 題，每題 10 分，合計 100 分）

1. 某氣體實驗，從狀態 i 到狀態 f ，如下圖，請問做功(work)多少 ？



2. 一艘船在大海中，向北航行 50 公里，之後再向東偏南(往東方順時針 30°方向) 航行了 100 公里，請問距離原點多遠?

3. 一鑽石高 1.5 cm，放在一凹面鏡前 20cm，此凹面鏡曲率半徑為 30 cm ，請問成像在何處？

4. 一人以 9.8 m/s 的初速將球向上拋，在忽略空氣阻力的情形下，請問球最高可以到達多高？

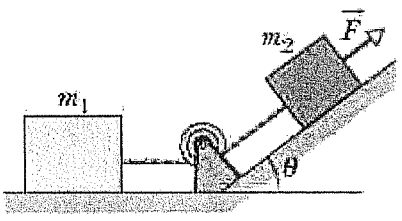
5. 一屋內約有空氣分子 2,000 mol，開冷氣後溫度由之前 30°C 降到 24°C 假設屋內氣壓不變，且為理想氣體，其 γ (即 Cp/Cv)值為 1.4，R=8.31 J/(K · mol)。求屋內空氣分子的內能改變量為多少 ？

6. 有一個質量為 90 kg 的男人站在電梯內，此時電梯以向上 1.4 m/s^2 之加速度運動。問該男人作用於電梯地板之力的大小約為多少？

7. 請簡述熱力學第二定律對熵(Entropy)的描述?

8. 強度為 I_0 之非偏振光通過兩個偏振片(Polaroids)，若一者之偏振方向為垂直，另一者與垂直夾角為 30°，則透射光之強度為何？

9. 大小 16.0 N 的一個力作用在一質量為 m_2= 1.00 kg 的聯邦紙箱上，如下圖所示，此力沿著平面往上提，此平面傾斜與水平夾角 θ =45 °，同時以一條繩子連接在水平地板的郵件聯合服務處的箱子，其質量為 m_1 = 3.00 kg。地板、斜面、滑輪都沒有摩擦力，滑輪和繩子的質量都可以忽略，請計算繩子的張力。



10. 將高度h_0的物體，置於焦距f透鏡前d_0的距離，若所成之像到透鏡的距離為d_i，則像的高度絕對值為何？

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系（所）別：化學工程碩士班	考試科目：化工數學	第 1 頁，共 2 頁	考試時間：80 分鐘

問答及計算題（共 20 題，每題 5 分，合計 100 分）

1. 求極限值 $\lim_{x\to+\infty}\sqrt[3]{\frac{16x+5}{2x-8}}$

2. 已知 $\frac{dy}{dx}=\frac{x}{y}$，則 $\frac{d^2y}{dx^2}$ 為何？

3. 解微分方程式 $y'=\frac{x}{y^2\sqrt{1+x^2}}$

4. 求函數 $f(x,y,z)=sin(xyz)$ 之梯度(Gradient) ∇f

5. 決定一個 k 值使得 $\begin{vmatrix}1 & 2 & -3\\ -k & 1+3k & 3-k\\ 0 & -6 & 5\end{vmatrix}=36$

6. 解一階線性常微分方程 $\frac{dy}{dx}+2xy=2x\cos(x^2)$

7. 求方程式 $xy'+y=x\sin 2x$ 的通解

8. 解 *Bernoulli* 常微分方程 $x^3\frac{dy}{dx}+x^2y=2y^{-\frac{4}{3}}$

9. 解微分方程 $y'+y=y^2$

10. 展開微分方程式 $(3xy+y^2)+(x^2+xy)\frac{dy}{dx}=0$，令 $ydx+xdy=d(xy)$，利用 x 為積分因子，解微分方程 $(3xy+y^2)+(x^2+xy)\frac{dy}{dx}=0$

11. 計算 $\int_{(0,1)}^{(2,3)}(2xy-1)\,dx+(x^2+1)\,dy$ 沿著路徑 $y=\frac{x^2}{2}+1$

12. 解微分方程式 $y''-y=e^x+2e^{2x}$

13. 若矩陣 $A=\begin{bmatrix}1 & -1\\ 2 & 3\end{bmatrix}$，求反(Inverse)矩陣 A^{-1} 的轉置(Transpose)矩陣 $(A^{-1})^T$

14. 求方程式 $x^2y''-2xy'+9y=0$ 之齊性解

15. 方程式 $xy''+2y'=x$；利用 Euler-Cauch 方程式規則全微分化求通解

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系（所）別：化學工程碩士班	考試科目：化工數學	第 2 頁，共 2 頁	考試時間：80 分鐘

16. 依三角函數恆等式 $cos(bt+c)=cos\,bt\,cos\,c+sin\,bt\,sin\,c$，求方程式 $L[\cos(bt+c)]$ 之 Laplace 變換。

17. 求 $\int_0^2\int_0^{\sqrt{4-x^2}} sin(x^2+y^2)dydx$ 之值。(提示：以極作標變換求解)

18. 若 $f(x)=|x|, -\pi\le x\le\pi$ 且 $f(x+2\pi)=f(x)$, 試求 $f(x)$ 的傅立葉級數(Fourier series)？

19. 試證明 $f(x)=x^2$ 為偶函數

20. 求三個相鄰向量 $2\vec{j}+\vec{k}$, $\vec{i}-\vec{j}$, $-\vec{j}+4\vec{k}$，所圍平行六面體體積。

I. 填充題（共 15 題, 每題 3 分, 合計 45 分）

1. In C programming language, _____allows code to be repeatedly executed. (3%)
2. A_____algorithm works by recursively breaking down a problem into two or more sub-problems of the same (or related) type, until these become simple enough to be solved directly. (3%)
3. According to different function of database query language, there are two language we can use, one is DDL(data definition language), the other is _____.(3%)
4. The key concept of von Neumann model is _____.(3%)
5. There are three main services of Cloud computing, which includes IaaS, PaaS, and _____.(3%)
6. An attribute in a relation of a database that serves as the primary key of another relation in the same database is called a _____. (3%)
7. A table that has all key an attribute defined, no repeating groups, and an identified primary key is said to be in _____. (3%)
8. SCTP (Stream Control Transmission Protocol) association allows _____ IP addresses for each end. (3%)
9. In a DHT-based (Distributed Hash Table) P2P (Peer-to-Peer) network, each data item and peer is mapped to a point in large address, how many address spaces are in a DHT-based network? _____.(3%)
10. About flow control mechanism, who needs to warn to slower or stop the delivery? _____(3%)
11. Which data structure represents a waiting line and limits insertions to be made at the back of the data structure and limit removals to be made from the front? _____(3%)
12. IC (Integrated Circuits) chips used in computers are usually made of _____. (3%)
13. The errors that can be pointed out by the compiler are _____. (3%)
14. _____is a path in an undirected graph that visits each vertex exactly once. (3%)
15. For 100 Mbps Ethernet the minimum packet length is 1200 bytes, please compute maximum transmission packets per second for 100 Mps Ethernet for minimum length packets. _____ (3%)

II. **問答題（共 10 題，合計 55 分）**

16 Please convert -11.0625 to the IEEE 754 floating-point standard using single-precision format.(4%)

17 What is memory thrashing and how does it affect computer's operation system? How to prevent it? (5%)

18 What are the differences between a trap and an interrupt? What is the use of each function? (5%)

19 What is the difference between virtual memory and main memory? (5%)

20 Describe the similarity and difference between deadlock and starvation? (5%)

21 Please describe the reason to build up distribution system? (5%)

22. For a processor X it has 43 float instructions and 57 integer instructions. A new system Y has come which cans speedup float instructions by 4 but unfortunately it affects the integer instructions with the reduction by 2. What is the overall speedup? (5%)

23. Assuming that computer take 1 cycle for 4 loads and 5 store instructions take 10 cycles, and 2 branches take 3 cycles, find the execution time of each program on a 3 GHz MIPS processor? (5%)

24. Describe the process of compiling a C program from the source code to the final executable file. You may draw a diagram to describe it. (4%)

25. Using5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? (12%)

Stop-and-Wait Protocol	Max. Send W_{size}		Max. Receive W_{size}	
Go-Back-N Protocol	Max. Send W_{size}		Max. Receive W_{size}	
Selective-Repeat Protocol	Max. Send W_{size}		Max. Receive W_{size}	

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系(所)別：軍事工程碩士班	考試科目：營建管理與施工	第 1 頁，共 1 頁	考試時間 80 分鐘

共 10 題，每題 10 分，共計 100 分

1. 請說明砌磚工程的「破縫」與「滿漿」。

2. 請比較國軍營舍規劃(營級單位)，集中式衛浴與套房式衛浴的優缺點。

3. 我國「政府採購法」所稱之採購(Procurement)，有那三種「採購」？

4. 已知某工程作業如下表：

作業名稱	先行作業	工期(天)	契約金額（萬元）	每日金額（萬元）
A	—	2	20	10
B	—	3	30	10
C	A	3	30	10
D	B	4	40	10
E	B	5	50	10
F	C 、D、E	2	20	10

試繪製該工程作業網圖(Activities Network)並標明要徑作業(Critical Path Activity)。

5. 承上題，試計算總工期天數。

6. 承上題，繪製標準工程預定進度曲線圖(Target S-Curve)。

7. 國軍工程投資案在專案管理上，以最低標決標採購有何優、缺點？

8. 水灰比大小對混凝土施工及結構安全有何影響？

9. 請說明建築物空調負荷的構成與計算空調負荷的目的。

10. 何謂高爐水泥？其應用範圍與效益為何？設計上有何注意事項？

國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：大氣科學碩士班	考試科目： 普通氣象學	第 1 頁，共 1 頁	考試時間 80 分鐘

簡答題(共 10 題，每題 10 分，共計 100 分)

1. 請寫出理想氣體狀態方程式，並逐一說明其各項物理意義。
2. 熱帶地區的天氣分析以哪一種氣象要素為主？並請說明原因。
3. 請說明什麼是露點溫度？同一氣壓下，氣溫和露點溫度的差異有何物理意義？
4. 請簡述斜溫圖在天氣分析預報上有何用途？
5. 請任意列舉您所知道的三種重要的溫室氣體，並說明何者對於暖化貢獻度最高？
6. 試述何謂「焚風」？並請說明其生成原因。
7. 請說明比濕和相對濕度有何不同？
8. 對流層內的乾絕熱遞減率與濕絕熱遞減率有何不同？大小關係為何？
9. 請繪圖說明東風過山時渦度場和氣流南北向的變化。
10. 19世紀南美洲秘魯的漁民發現，中太平洋及東太平洋赤道附近的表面海水異常暖化，而這種現象經常發生在聖誕節前後，因此稱為「聖嬰現象」。請說明在此期間大氣的環流與平均值有何不同？

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系(所)別：空間科學碩士班	考試科目：製圖學	第 1 頁，共 1 頁	考試時間 80 分鐘

一、問答題(共 10 題，每題 6 分，共計 60 分)

1、比較台灣及澎湖地區之 UTM、2 度 TM 之中央子午線、坐標原點、中央經線尺度比。

2、TWVD2001(TaiWan Vertical Datum 2001)之定義？

3、地圖投影三大要素為何？

4、五千分之一基本地形圖之首曲線間距為幾公尺。

5、請列舉 5 項圖廓外資料。

6、通常「地理資訊系統」應具備那些功能？

7、網格模型依網格型狀，可分為那些種類？

8、何謂顏料三原色，並說明何為「減色」效果？

9、在印刷學中「打樣(Proofing)」的目的為何？

10、請說明何謂「原稿(Original Copy)」？

二、申論題(共 2 題，每題 20 分，共計 40 分)

11、請說明「雲端技術」對未來「地理資訊系統(GIS)」發展的影響為何？

12、何謂數值高程模型(Digital Elevation Model; DEM)，並列舉其功能及效益。

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系（所）別：材料科學與工程碩士班	考試科目：基礎數學	第 1 頁，共 2 頁	考試時間：80 分鐘

問答及計算題（共 20 題，每題 5 分，合計 100 分）

1. $U(x,y,z)=2x^2-yz+xz^2$ ； $x=\sin t$ ； $y=t^2-t+1$ ； $z=3e^{-t}$ 求 $\frac{dU}{dt}_{t=0}$ 之值為何？

2. 計算 $\int x\sin^3\left(x^2\right)\cos\left(x^2\right)dx$

3. $\int_0^{\infty} e^{-(ax^2+bx+c)}dx \quad (a>0,\ b>0,\ c>0)$

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

5. 求 $\int\frac{1}{x\ln x}dx$

6. 求 $\int_1^2 \ln x\,dx$

7. 求 $\int\sin^4 x dx$

8. 當 $y=\left(x^2+1\right)^{\sin x}$，求 dy/dx

9. $g(x)=\int_{\sqrt{x}}^{x^2}\frac{t^2}{t^4+1}dt$ 求 $g'(1)=?$

10. 求 $\int\frac{e^x}{4+9e^{2x}}dx$

11. $y^2=\ln(x^2+y^2)$ 求 $\frac{dy}{dx}$

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系（所）別：材料科學與工程碩士班	考試科目：基礎數學	第 2 頁，共 2 頁	考試時間：80 分鐘

12. 求 $\int \frac{5x+3}{x^3-2x^2-3x} dx$

13. (a) $\lim_{x\to\infty}(x-\sqrt{x^2+x})$, (b) $\lim_{x\to\infty}(\sqrt{x^2+4x+1}-x)$(每小題 2.5 分，共 5 分)

14. 求 $\frac{dy}{dx}=\frac{x+3x^2}{y^2}$ 之解，其在 x=0 時 y=6

15. 求 $\int_{-2}^{2}(x+2x^3)^{\frac{1}{3}}dx$

16. 求 $\int_0^{2\pi}|\sin x|\,dx$

17. 求 $\int \frac{1+x^2}{(x-1)^3}dx$

18. 求 $\int_0^2 \frac{1}{\sqrt{4-x^2}}\,dx$

19. $y(x)=x^{\cos x}$ 求 $y'(x)$

20. 求 $\int \tan^5 x\,dx$

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系(所)別：材料科學與工程碩士班	考試科目：材料科學導論	第1頁，共2頁	考試時間：80分鐘

一、名詞解釋（共7題，每題4分，合計28分）

1.anisotropy

2.hardenability

3.Bragg law

4.creep

5.eutectic reaction

6.T-T-T curve

7.fatigue failure

二、簡答題（共12題，每題6分，合計72分）

8.請說明並簡單畫出金屬材料於凝固過程(solidification process)中的現象。

9.何謂固溶體？固溶方式可分為哪幾種？

10.何謂再結晶(re-crystallization)過程，並請說明再結晶的驅動力為何?

11.在X光繞射中，何謂結構因子？試以結構因子推導出FCC晶系會產生繞射之平面為何？

12.拉伸實驗為測試材料強度的基本方法之一，請繪出其所測出之Engineering Stress - Strain曲線及Ture Stress-Strain 曲線，並解釋其定義。

13.試述在固態擴散中之費氏第一定律(Fick's first law)及費氏第二定律(Fick's second law)，其分別可應用於哪一種狀態。

14.請計算FCC結構元素其在(100)面的面緊密堆積因子為何? (Radius of iron $R = 0.1241$ nm)

15.試畫出含碳量0.4 wt%之亞共析鋼(Hypoeutectoid steel)從沃斯田鐵(Austenite)溫度緩慢冷卻至室溫時之金相微觀結構。

16.請推導臨界分解剪應力(critical resolved shear stress)，$\tau_R = \sigma \cos\phi \cos\lambda$ 。

17.試述熱力學第一及第二定律。

18.請說明在晶體材料中會存在哪些種類的缺陷?

19.假設在兩種不同溫度下，鐵原子在鎳元素中的擴散係數如下表: (每小題 3 分，共 6 分)

$T(K)$	$D\ (m^2/s)$
1273	9.4×10^{-16}
1473	2.4×10^{-14}

(a)請計算 D_0 的值及擴散活化能 Q_d 的值。

(b)請計算在 1373 K 時的擴散係數為何?

(Hint: $D = D_0 \exp(-\frac{Q_d}{RT})$)

國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：電子工程碩士班(計算機組)	考試科目：數位邏輯設計	第 1 頁，共 2 頁	考試時間 80 分鐘

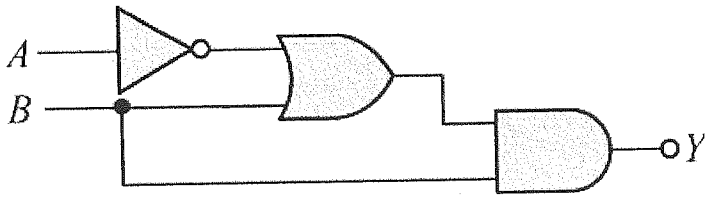
題目兩頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. 數字系統：

   (1)一串的 32 個位元有多少個位元組? (5%)

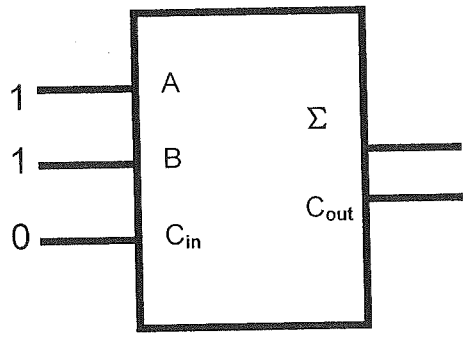
   (2)使用兩個位元組可表示的最大十進位數值為何? (5%)

2. 化簡下圖之電路，使用最少閘產生輸出 Y：



3. 請畫出 AND、OR、XOR、NAND、NOR 等邏輯閘之真值表(輸入以二個為主).

4. 求下圖全加器中輸出為何 ?



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系(所)別：電子工程碩士班(計算機組)	考試科目：數位邏輯設計	第 2 頁，共 2 頁	考試時間 80 分鐘

5. 化簡問題：

(1) 請化簡 $Z=(\overline{A}+B)(A+B)$ (5%)

(2) 請化簡 $x=ACD+\overline{A}BCD$ (5%)

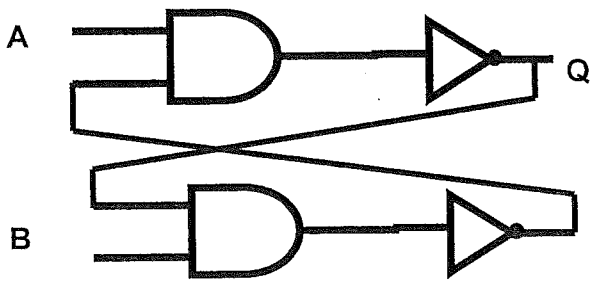
6. 請利用卡諾圖化簡 $y=\overline{C}(\overline{ABD}+D)+A\overline{B}C+\overline{D}$.

7. 設計一電路：有兩個輸入 x、y 以及四個 LED 燈：L0、L1、L2、L3。當輸入 xy 分別為 00、01、10、11 時分別點亮 L0、L1、L2、L3。

8. 以卡諾圖將 F(W.X.Y.Z)=∑(0.2.5.7.8.10.13.15) 化為 SOP 標準式.

9. 請用 8 位元二補數法表示 -127_{10}

10. 請說明以下的正反器如何運作 ？



國防大學理工學院 102 學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：光電工程碩士班	考試科目：電子學	第 1 頁，共 2 頁	考試時間 80 分鐘

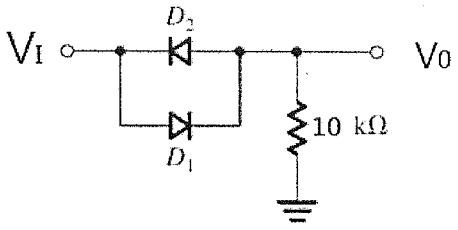
題目二頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. 寫出理想運算放大器(The ideal operational amplifier)的五個基本特性。

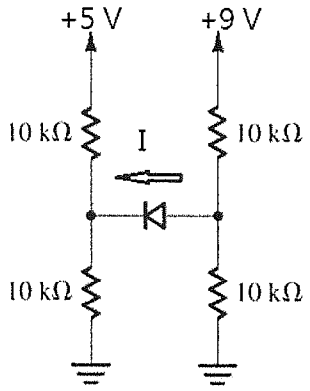
2. 請畫出 zener diode 之等效電路，並寫出 I_Z 與 V_Z 之關係式！

3. 雙極性接面電晶體(BJTs)的小訊號等效電路中，電阻 r_π 與 r_e 的轉換公式為何？

4. 計算以下電路圖中的輸出電壓 V_0， 其中輸入電壓 V_I 為頻率 1 kHz、振幅 5 V 的正弦波。(假設二極體的截止電壓是 0.5 V 且如果加在二極體的偏壓小於截止電壓，通過二極體的電流為零。)



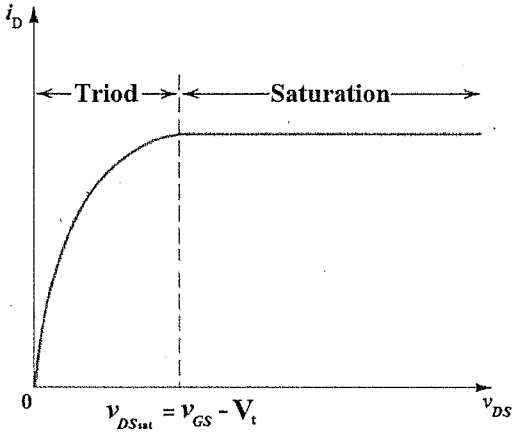
5. 計算以下電路圖中的電流 I。(假設二極體的截止電壓為 0.5 V 且如果加在二極體的偏壓小於截止電壓，通過二極體的電流為零。)



6. 雙極性接面電晶體(BJTs)的小訊號等效電路中，電阻 r_π 與 r_e 的轉換公式為何？

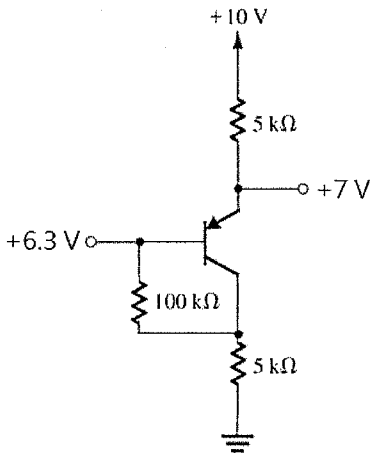
7. 對 MOSFET 而言，請說明何謂「Channel-length modulation effect」？

8. 下圖為加強型 NMOS 的汲極電流 i_D 對汲極-源極偏壓 v_{DS} 的特性曲線。藉由比較 v_{DS}、v_{GS} 及 V_t 判斷以下的問題；(a) 此NMOS處在三極管區(triode region)的條件為何? (b) 此NMOS 處在飽和區(saturation region)的條件為何? (c) 此 NMOS 處在截止狀態(cut off state)的條件為何? (v_{GS}: 為閘極到源極的偏壓。V_t: 為臨界電壓)

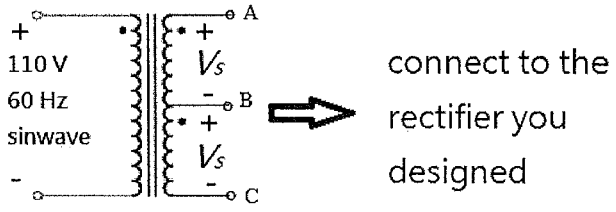


9. 計算以下電路圖中 pnp 電晶體的電流增益。此電晶體操作在作用模態(active mode)且在集極電流 $i_C = 0.45$ mA 時的基極到射極偏壓 $v_{BE} = 0.69$ V。

(提示: $i_c = I_s e^{v_{EB}/V_T}$, $\beta = \frac{i_C}{i_B}$, 室溫 $V_T = 25$ mV, $e^{0.4} = 1.49$)



10. 請以兩個二極體及一個電阻為以下的變壓器及輸入電壓設計一個全波整流電路，請畫出你設計的電路圖及整流後的波形。



國防大學理工學院102學年度博、碩士班招生□博士班■碩士班 考試試題			
系（所）別：化學工程碩士班	考試科目：化工動力學(含化工熱力學)	第 1 頁，共 2 頁	考試時間：80 分鐘

一、名詞解釋與簡答：（共 10 題，每題 4 分，小計 40 分）

1. Which equation is the least-complex equation of state (EOS)?
2. The principle of corresponding state
3. What is the microscopic view of entropy?
4. The Clausius-Clapeyron relation
5. What are the definitions of system and open system?
6. Non-elementary reactions
7. For the isothermal gaseous reaction 2 A → 3 B, what is the change fraction of volume (ε_A)?
8. Heterogeneous reactions
9. What are the shrinking core model and its application?
10. Conservation of mass

二、計算題：(共 4 題，每題 15 分，小計 60 分)

11. Using Hess's Law and equations (1)-(3) below, find $H°$ at 25° C for the oxidation of $C_2H_5OH(l)$.

$$C_2H_5OH\,(l) + 3O_2\,(g) \rightarrow 3H_2O\,(l) + 2CO_2\,(g)$$

(1) $C_2H_4\,(g) + 3O_2\,(g) \rightarrow 2CO_2\,(g) + 2H_2O\,(l)$ $\quad H° = -1411$ kJ

(2) $C\,(\text{graphite}) + 3H_2\,(g) + (1/2)\,O_2\,(g) \rightarrow C_2H_5OH\,(l)$ $\quad H° = -278$ kJ

(3) $C_2H_4\,(g) + H_2O\,(l) \rightarrow C_2H_5OH\,(l)$ $\quad H° = -44$ kJ

12. Proof $[\frac{\partial}{\partial T}(\frac{G}{RT})]_P = -\frac{H}{RT^2}$

13. The decomposition of liquid A is first order reaction. In a batch reactor after 5 minutes, the conversion of A is 50%. How many time does it take if the A conversion is 75%?

14. For a parallel reaction

$$A + B \xrightarrow{k_1} C(desired\ product)$$

$$A + B \xrightarrow{k_2} D(undesired\ product)$$

$$\frac{r_D}{r_C} = \frac{dC_D}{dC_C} = \frac{k_2}{k_1} C_A^{-0.5} C_B^{1.5}$$

where $k_1 = 100\exp(-15{,}000/RT)$ and $k_2 = 200\exp(-10{,}000/RT)$

How should you do if you want to increase the yield of the product C?

國防大學理工學院 102 學年度博、碩士班招生□博士班■碩士班 考試試題			
系（所）別：化學工程碩士班	考試科目：物理化學	第 1 頁，共 1 頁	考試時間：80 分鐘

計算及簡答題（共 20 題，每題 5 分，合計 100 分）

1. For a first-order reaction has a rate constant (k). What is the value of half-life ($t_{1/2}$)?
2. The effect of increasing pressure results in the depression of melting point for water. Explain your reasoning.
3. Estimate T-V diagram for the Carnot cycle.
4. When carbon dioxide is taken into account, the mass percentages are 75.52 (N_2), 23.15 (O_2), 1.28 (Ar), and 0.05 (CO_2). What are the partial pressures when the total pressure is 2.7 atm?
5. A dimerization $2A \rightarrow A_2$ is found to be first order, with the follow mechanism: $A \xrightarrow{k_1} A^*$; $A^* + A \xrightarrow{k_2} A_2$ What is the value of $[A^*]$?
6. Explain the term "positive azeotrope".
7. A mole of ideal gas is compressed isothermally at 300 K to half of its original volume. What is the entropy change in this process?
8. Which kind of binary liquid mixture is called an "ideal solution"?
9. Given the following heat of formation values, calculate the heat of reaction for: $C_3H_{8\,(g)} + O_{2\,(g)} \rightarrow CO_{2\,(g)} + H_2O_{(l)}$

   ΔH_f values in kJ/mol for: $C_3H_{8\,(g)} = -103.8$, $O_{2\,(g)} = 0$, $CO_{2\,(g)} = -393.5$, $H_2O_{(l)} = -285.8$
10. What would expect when the ΔG of a reaction system is negative?
11. Calculate ΔG for the reaction: $2\,NO_{2\,(g)} \rightarrow 2\,N_{2\,(g)} + O_{2\,(g)}$

    ΔG in kJ/mol for: $NO_{2\,(g)} = 51.30$
12. Explain the terms "extensive property" and "intensive property".
13. What is the area enclosed by the Carnot cycle?
14. What is the reaction order with respect to A and B of a $2A + B \rightarrow$ products elementary reaction?
15. Using the Arrhenius equation that at room temperature (20℃) a temperature increase of 10℃ will double the reaction rate, determine E_a.
16. It is always said that the constant-pressure heat capacity (C_p) is infinite. Why?
17. An ideal gas is adiabatically expanded through a throttling valve. What is the value of ΔH?
18. What is the point group of H_2O.
19. A sample of 2.0 mol of Xe is freely expanded at 25℃ isothermally from 10L to 20L. what is the value of ΔS?
20. Is it possible for two A molecules and two B molecules to be bring to collide at the same time to produce two A-B molecules? Explain your reasoning.

國防大學理工學院102學年度博、碩士班招生□博士班■碩士班 考試試題			
系（所）別：化學工程碩士班	考試科目：普通化學	第 1 頁，共 3 頁	考試時間：80 分鐘

計算及簡答題（共 20 題，每題 5 分，合計 100 分）

1. Consider the following atomic symbols. How many protons, neutrons, and electrons does each element have? (每小題2.5分，共5分)

   (a) $^{24}_{12}Mg$ (b) $^{108}_{47}Ag$

2. Compare the Fahrenheit, Celsius, and Kelvin temperature scales. Write down the conversions between any two of these scales.

3. What are some of the physical properties that distinguish metals from nonmetals?

4. Define the terms of reactants, products and stoichiometric coefficient as they refer to chemical reactions.

5. A piece of titanium metal with a mass of 20.8 g is heated in boiling water to 99.5°C and then dropped into a coffee cup calorimeter containing 75.0 g of water at 21.7°C. When thermal equilibrium is reached, the final temperature is 24.3°C. Calculate the specific heat capacity of titanium. (specific heat of water, $c = 4.184$ J/g°·C)

6. A sample of the explosive TNT ($C_7H_5N_3O_6$) has a mass of 650.5 g. How many moles of TNT are in this sample? How many molecules are in this sample?

7. The explosive known as 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX) contains 16.22% carbon, 2.72% hydrogen, 37.84% nitrogen, and 43.22% oxygen by mass. Determine its empirical formula.

8. A chemist requires 1.5 M hydrochloric acid, HCl, for a series of reactions. The only solution available is 6.0 M HCl. What volume of 6.0 M HCl must be diluted to obtain 5.0 L of 1.5 M HCl?

9. In the combustion of methane, how many moles of O_2 are required if 6.75 mol of CH_4 is to be completely consumed?

10. If 28.2 g of P_4 is allowed to react with 18.3 g of S_8, which is the limiting reactant?

    $$8\ P_4 + 3\ S_8 \rightarrow 8\ P_4S_3$$

11. If a current of 15 A is run through an electrolysis cell for 2.0 hours, how many moles of electrons have moved? (Faraday's constant, $F = 96{,}485$ C·mol^{-1})

12. A small sample of gas is generated in a laboratory. In a 125 mL vessel, it exerts 115 torr of pressure. Then a valve is opened and the gas expands until its volume is 175 mL. If the temperature is constant throughout this process, what is the new pressure of the gas?

13. Carbon dioxide (CO_2) can be removed from a stream of gas by reacting it with calcium oxide (CaO) to form calcium carbonate ($CaCO_3$). If we react 5.50 L of CO_2 at STP with excess CaO, what mass of calcium carbonate will form?

    $$CO_{2(g)} + CaO_{(s)} \rightarrow CaCO_{3(s)}$$

14. 408 J of work is done on a system that releases 185 J of heat. What is the energy change in the system?

15. Heating a 24.0 g aluminum can raises its temperature by 15.0 °C. Find the value of q for the can. (specific heat of aluminum, c = 0.900 J/g°·C)

16. Calculate the standard cell potentials of the following cells:

$Fe_{(s)} \mid Fe^{2+}_{(aq)} \parallel Cu^{2+}_{(aq)} \mid Cu_{(s)}$

$Fe^{2+}_{(aq)} + 2\ e^- \rightarrow Fe_{(s)} \qquad E° = -0.44$ V

$Cu^{2+}_{(aq)} + 2\ e^- \rightarrow Cu_{(s)} \qquad E° = 0.337$ V

17. Suppose that we wish to study the possible galvanic corrosion between zinc (Zn) and chromium (Cr), so we set up the following cell: $Cr_{(s)} \mid Cr^{2+}_{(aq)} \parallel Zn^{2+}_{(aq)} \mid Zn_{(s)}$

$Cr^{2+}_{(aq)} + 2\ e^- \rightarrow Cr_{(s)} \qquad E° = -0.91$ V

$Zn^{2+}_{(aq)} + 2\ e^- \rightarrow Zn_{(s)} \qquad E° = -0.763$ V

What is the chemical reaction that takes place and what is the standard free energy change for that reaction? (F = 96485 J·V^{-1}·mol^{-1})

18. For the following oxidation/reduction reactions, identify the half-reactions and label them as oxidation or reduction:

(a) $Cu_{(s)} + Ni^{2+}_{(aq)} \rightarrow Ni_{(s)} + Cu^{2+}_{(aq)}$

(b) $2\ Fe^{3+}_{(aq)} + 3\ Ba_{(s)} \rightarrow 3\ Ba^{2+}_{(aq)} + 2\ Fe_{(s)}$

19. Draw the structure of 2,4,6-Trinitrotoluene (TNT).

20. The conversion of ozone to oxygen, $2\ O_3 \rightarrow 3\ O_2$, was studied in an experiment, and the rate of ozone consumption was measured as 2.5×10^{-5} mol·L^{-1}·s^{-1}. What was the rate of O_2 production in this experiment?

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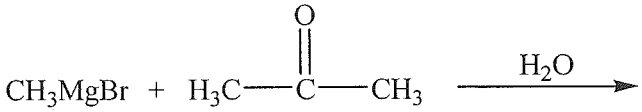
系（所）別：化學工程碩士班	考試科目：普通化學	第 3 頁，共 3 頁	考試時間：80 分鐘

For atomic weight, a number in parenthesis indicates the mass number of the most stable isotope.

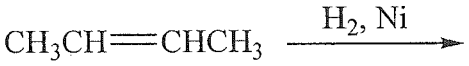
國防大學理工學院102學年度博、碩士班招生□博士班■碩士班 考試試題			
系（所）別：化學工程碩士班	考試科目：有機化學	第 1 頁，共 3 頁	考試時間：80 分鐘

問答題（共 20 題，每題 5 分，合計 100 分）

1. Provide the major organic product in the following reaction.



2. Provide the major organic product in the reaction below.

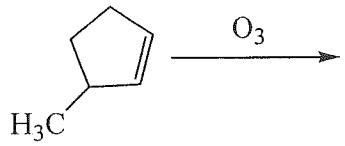


3. Suggest the products for the following reactions: (每小題 2.5 分，共 5 分)

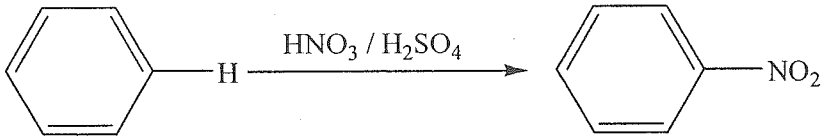
(a) Reaction of propene CH_3-CH=CH_2 with hydrogen bromide (HBr).

(b) Reaction of propene with hydrogen bromide under the irradiation with ultraviolet light.

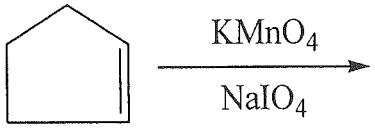
4. Provide the major organic product in the reaction below.



5. Propose a mechanism for the following nitration reaction:

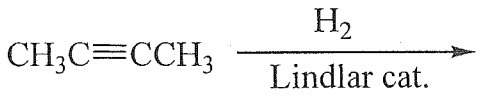


6. Provide the major organic product in the reaction below.



7. Write out the 1,2-adduct and 1,4-adduct from the reaction of HCl with 1,3-butadiene (H_2C=CH-CH=CH_2).

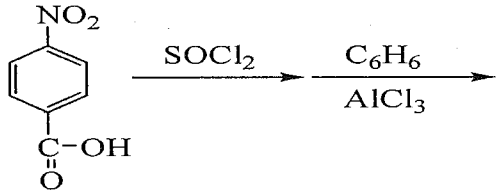
8. Provide the major organic product in the reaction below.



9. Explain the following terms : (每小題 2.5 分，共 5 分)

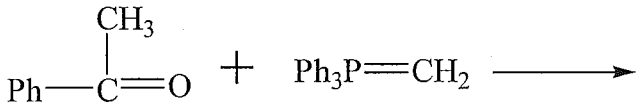
(a) Newman Projection. (b) Fisher Projection.

10. Predict the structure of the major organic product in the reaction below.



11. C_3H_6BrCl shows three equivalent integrations at δ = 2.28, 3.55 and 3.70 ppm away from the TMS reference in ^1H NMR spectrum. Propose its structure.

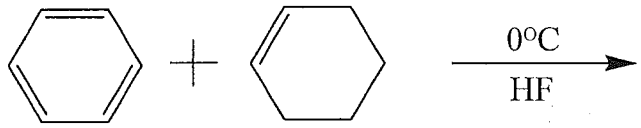
12. Predict the structure of the major organic product in the reaction below.



13. For Mass Spectroscopy(MS), explain : (每題 2.5 分，共計 5 分)

(a) Base Peak (b) Molecular Ion Peak

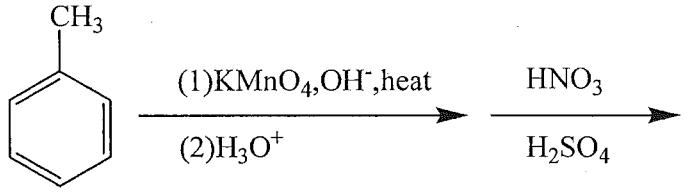
14. Provide the major organic product in the reaction below.



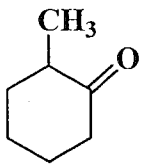
15. Explain the following stereochemistry terms : (每小題 2.5 分，共 5 分)

(a) Racemization (b) Meso Compound

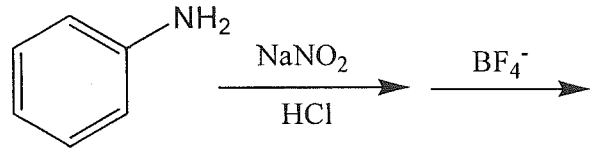
16. Provide the major organic product in the reaction below.



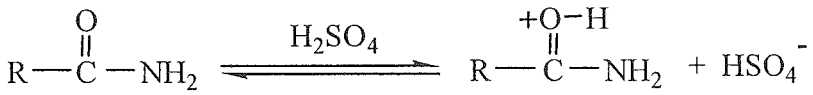
17. Show the tautomerism of the following compound in the terms of keto form and enol form.



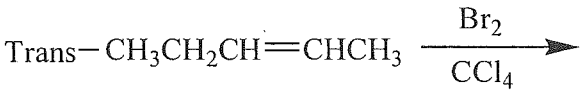
18. Provide the major organic product in the reaction below.



19. Protonation of an amide occurs on oxygen rather than on nitrogen. Suggest a reason for this behavior.



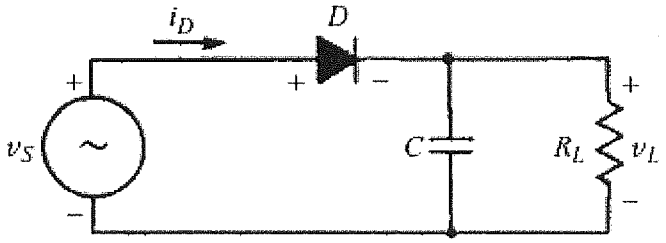
20. Provide the major organic product in the reaction below.



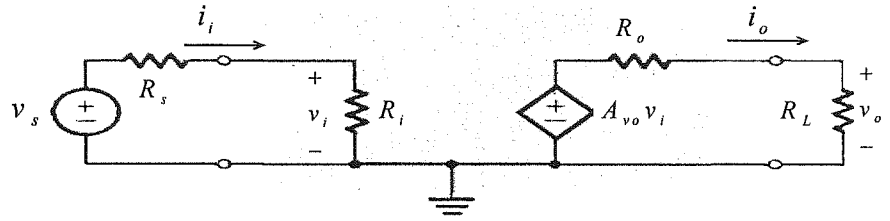
國防大學理工學院102學年度博、碩士班招生 □博士班■碩士班 考試試題			
系(所)別：電子工程碩士班（一般組）	考試科目：電子學	第 1 頁，共 3 頁	考試時間 80 分鐘

題目三頁，共十題，每題十分，總計一百分。作答時題號請標示清楚，並盡量作答，閱卷採部分給分。請不要用鉛筆作答，否則以零分計。

1. 下列電路圖之 D 為理想二極體，請畫出 v_L 的輸出波形並說明此一電路相關應用，其中 $v_S = 10\sin(120\pi t)$ V, C=5000 μF, R_L=1kΩ.



2. 請表示下圖之電壓增益 v_o / v_s



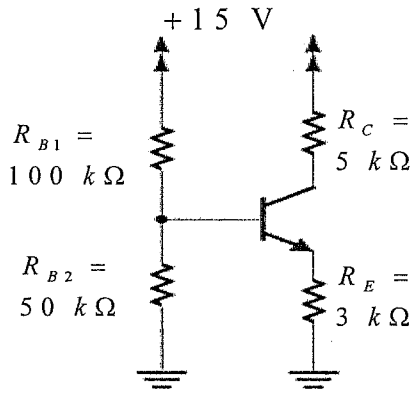
3. 請說明負回授(negative feedback)放大器特性。

4. 考慮使用 4 位元數位字元D = $b_3b_2b_1b_0$來代表一類比信號v_A，其變化範圍介於 0V 至+15V 之間，寫出數位字元D來代表(a)0V、(b)1V、(c)2V 以及(d)5V。

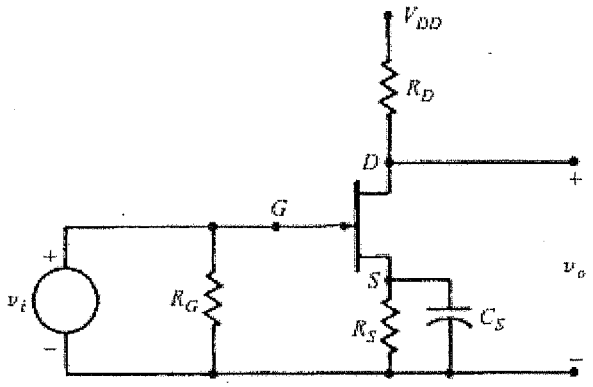
5. 請比較場效電晶體(Field-Effect Transistor)與雙極接面電晶體(Bipolar Junction Transistor)二者間的主要差別。

6. 請畫出 npn BJT(Bipolar Junction Transistor)電晶體之剖面圖。

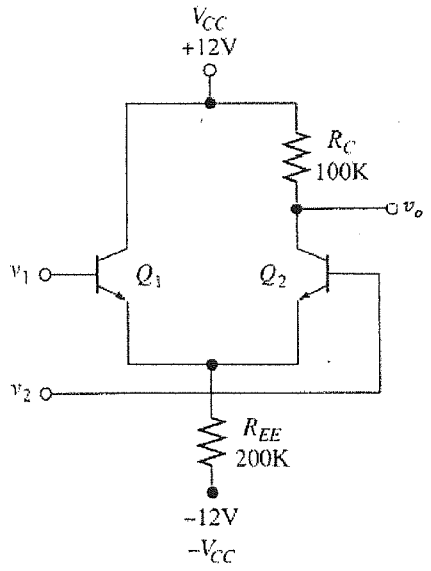
7. 計算下圖之基極電流I_B與射極電流I_E。假設$\beta = 100, V_{BE} = 0.7V$



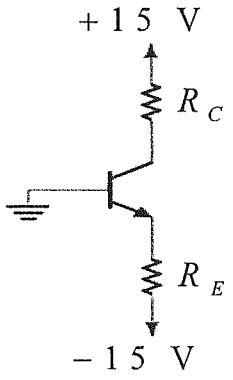
8. 請畫出下列電路之小信號電路模型，並求電壓增益值$A_v = v_o/v_i$，其中$R_D = 3k\Omega, \mu = 60, r_{ds} = 30k\Omega$。



9. 差動放大器如下圖，求其共模增益(common-mode gain)及共模拒斥比(common-mode rejection ratio)。



10. 下圖電路之電晶體的 $\beta = 100$ 且在 $i_C = 1mA$ 時 $v_{BE} = 0.7V$，設計一個電路當流經集極(collector)電流為 2mA 且集極(collector)電壓 $V_C = +5V$ 時之 R_C 與 R_E 之值。[Hint: 其中 $\ln 2 = 0.693$ 且 $i_C = I_S e^{v_{BE}/v_T}$，在室溫時熱電壓 $V_T = 25mV$，I_S 為飽和電流]



I. Vocabulary: Choose the answer that best completes the meaning of the sentence 20%

字彙測驗：共十題，每題二分，共二十分。

1. You cannot arrest someone based on your _____.
   (A) translations (B) suspicions (C) recreations (D) celebrations

2. He has a _____, but he can do almost everything that other people can do.
   (A) reliability (B) liability (C) disability (D) productivity

3. The Navy Seals have to undergo _____ training that prepares them to take up dangerous missions.
   (A) generous (B) rigorous (C) religious (D) prosperous

4. Police are warning of an increased number of ____ in this area. Residents are advised to lock their doors and windows before leaving.
   (A) break-ups (B) break-downs (C) break-ins (D) break-outs

5. Physical labor can exhaust the body very quickly. Similarly, _____ study can rapidly reduce mental power, too.
   (A) receptive (B) desirable (C) excessive (D) available

6. The situation in our cities with regard to traffic is going from bad to worse. We will never find solution to the _____.
   (A) dilemma (B) climax (C) guardian (D) opportunity

7. It was _____ back and forth in the wind. In fact, I thought it might break.
   (A) wading (B) stuttering (C) blowing (D) swaying

8. The flash light is getting _____; it needs new batteries.
   (A) dim (B) humid (C) shiny (D) essential

9. After a long day at work most people feel _____.
   (A) knocked out (B) turned down (C) broken down (D) worn out

10. ____ is the feeling of anger and unhappiness you may have if someone you love show interest in others.
    (A) Embarrassment (B) Jealousy (C) Pride (D) Concentration

II. Grammar and Structure: Choose the correct answer 30%

文法與結構測驗：共十題，每題三分，共三十分。

11. Edward was sitting in an armchair resting. He was tired because _____.
(A) he was working hard
(B) he's been working hard
(C) he'd been working hard
(D) he's worked hard

12. Travis _____ the dress.
(A) suggested that Karen buy
(B) suggested that Karen buys
(C) suggested Karen to buy
(D) suggested Karen buys

13. Where _____? Which hairdresser did you go to?
(A) did you cut your hair
(B) have you cut your hair
(C) did you have cut your hair
(D) did you have your hair cut

14. "Do you know where _____?" "No, he didn't say."
(A) Tom has gone
(B) has Tom gone
(C) has gone Tom
(D) Tom goes

15. I know I locked the door. I clearly remember _____ it.
(A) locking
(B) to lock
(C) to have lock
(D) lock

16. He _____ to find a job, but he had no luck.
(A) tried hard
(B) tried hardly
(C) hardly tried
(D) hard tried

17. A: _____ mathematics interesting?
B: I don't think so.
(A) Are
(B) Be
(C) Being
(D) Is

18. That is the intersection _____ the accident took place.
(A) at where
(B) when
(C) at which
(D) why

19. Which of the following contains an error?
(A) Because it was raining, we held the annual company picnic inside.
(B) Because she had left her laptop at home, she didn't have access to her files.
(C) Because he had far too many PowerPoint slides.
(D) All of the above.

20. Tanya graduated from college last year. If she _____, I think her mother _____ to leave.
(A) didn't graduate, would tell
(B) hasn't graduated, would have told
(C) wasn't graduated, would told
(D) hadn't graduated, would have told

III. Reading Comprehension: Choose the best answer. 30%
閱讀測驗：共十題，每題三分，共三十分。

21-28 are from the following passage:

Carbohydrates, which are sugars, are an essential part of a healthy diet. They provide the main source of energy for the body, and they also ***function*** to flavor and sweeten foods. Carbohydrates range from simple sugars like glucose to complex sugars such as amylose and amylopectin. Nutritionists ***estimate*** that carbohydrates should make up about one-fourth to one-fifth of a person's diet. This translates to about 75-100 grams of carbohydrates per day.

A diet that is deficient in carbohydrates can have an adverse effect on a person's health. When the body lacks a sufficient amount of carbohydrates, it must then use its protein supplies for energy, a process called gluconeogenesis. ***This***, however, results in a lack of necessary protein, and further health difficulties may occur. A lack of carbohydrates can also lead to ketosis, a build-up of ketones in the body that causes fatigue, lethargy, and bad breath.

21. What is the main idea of this passage?
(A) Carbohydrates are needed for good health.
(B) Carbohydrates prevent a build-up of proteins.
(C) Carbohydrates can lead to ketosis.
(D) Carbohydrates are an expendable part of a good diet.

22. The word "function" as used in line 2 refers to which of the following?
(A) neglect
(B) serve
(C) dissolve
(D) confess

23. In line 4, the word "estimate" could be replaced by ___.
(A) disbelieve
(B) declare
(C) calculate
(D) wonder

24. According to the passage, what do most nutritionists suggest?
(A) Sufficient carbohydrates will lead to lack of protein.
(B) Carbohydrates are simple sugars called glucose.
(C) Carbohydrates should make up about a quarter of a person's daily diet.
(D) Carbohydrates should be eaten in very small quantities.

25. Which of the following do carbohydrates NOT do?
(A) prevent ketosis
(B) cause gluconeogenesis
(C) provide energy for the body
(D) flavor and sweeten food

26. Which of the following best describe the author's tone?
    (A) sensitive
    (B) emotional
    (C) informative
    (D) regretful

27. What does the word "this" in paragraph 2, line 3, refer to?
    (A) using protein supplies for energy
    (B) converting carbohydrates to energy
    (C) having a deficiency in carbohydrates
    (D) having an insufficient amount of protein

28. Which of the following best describes the organization of this passage?
    (A) cause and effect
    (B) contrast and comparison
    (C) specific to general
    (D) definition and example

29-30 are from the following passage:

One identifying characteristic of minerals is their relative hardness, which can be determined by scratching one mineral with another. In this type of test, a harder mineral can scratch a softer one, but a softer mineral is unable to scratch the harder one. The Mohs' hardness scale is used to rank minerals according to hardness. Ten minerals are listed in this scale, ranging from talc with a hardness of 1 to diamond with a hardness of 10. On this scale, quartz (number 7) is harder than feldspar (number 6) and is therefore able to scratch it; however, feldspar is unable to make a mark on quartz.

29. What is the main idea of this passage?
    (A) diamonds, with a hardness of 10 on the Mohs' scale, can scratch all other minerals
    (B) the hardness of a mineral can be determined by its ability to make a mark on other minerals
    (C) a softer mineral cannot be scratched by a harder mineral
    (D) talc is the first mineral listed on the Mohs' scale

30. Which of the following best states the subject of this passage?
    (A) The hardness of diamonds
    (B) Feldspar on the Mohs' scale
    (C) Recognizing minerals in their natural state
    (D) Identifying minerals by means of a scratch test

IV. Translation: Translate the following sentences into Chinese. 20%
    31~32 翻譯成中文，共二題，每題十分，共二十分。

31. Pheromones are chemicals that animals, including insects, produce. When an ant finds food, it takes a piece and returns to the nest. Along the way, it releases a trail of pheromones. Other ants follow the trail to find the food.

32. Even as the debate over the fate of Taiwan's No. 4 Nuclear Power Plant raged on with no conclusion in sight, news broke on the other side of the Earth that radioactive waste stored underground has been leaking at a rate of 150 to 300 gallons per year.