



**University Of Technology**  
**Building and Construction Eng. Dept.**  
**Final Exam(1<sup>st</sup> attempt) – 2013/2014**



Subject :Digital Cartography

Class: Second

Branch :Geomatics

Time : 3 Hours

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Date : 9 / 6 / 2014

**Answer four (4) equations**

ملاحظة تسترجع الأسئلة مع الدفتر الامتحاني

(Q1)

(A) Distribute the values of scale factor on UTM zone (Draw the case). (10 degree)

(B) Find the value of the convergence of map scale 1/250000 at the center and at all corners of the map if the geographic coordinates of the SW corner are

(15 degree)

$$\phi = 28^{\circ} 30' 30'' \text{N}$$

$$\lambda = 43^{\circ} 30' 30'' \text{ E}$$

(Q2)

(A) List the steps to construct a simple cylindrical map projection , draw the case, and show the main uses of map produced . (15 degree)

(B) Explain by drawing the relation between linear distortion and the position of points on earth? (10 degree)

(Q3 )

(A) Find the geographic coordinate of point (P) if

$$\phi_K = 20^{\circ} 20' \text{N}$$

$$\lambda_K = 22^{\circ} 22' \text{E}$$

And the spherical distance (KP) = 600.60 km.

Declination angle between K and P =  $50^{\circ} 30'$

(15 degree)

(B) Find out the angular distortion formula and discuss the conformality condition of map projection (Draw the case). (10 degree)

(Q4)

(A) When  $(x=532323.5295\text{m})$ ,  $(y=266161.7648\text{m})$  and  $(x'=266161.7648\text{m})$

$(y'=532323.5295\text{ m})$ . Find  $\alpha$  between the two coordinate systems, if the origin is fixed in both coordinate system and the rotation of axes is clockwise. (15 degree)

(B) List all the differences between the vector and raster data in digital mapping.

(10 degree)

(Q5)

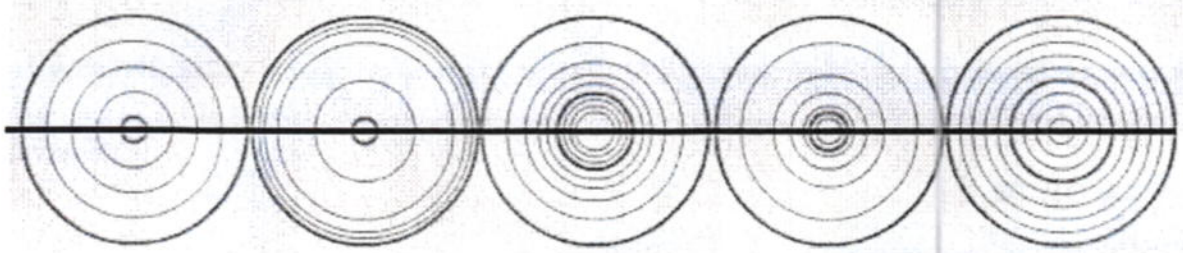
(A) Define a topographic map and show main steps of producing a base topographic map scale (1/25000). (10 degree)

(B) Define the generalization and explain one of its main elements. (5 degree)

(C) Match by lines between (a) & (b) figures below and discuss why. (10 degree)

ملاحظة حل فرع C : يتم رسم الخطوط على ورقة الاسنلة فيما يتم الشرح لكل رسم في الدفتر الامتحاني

(a)



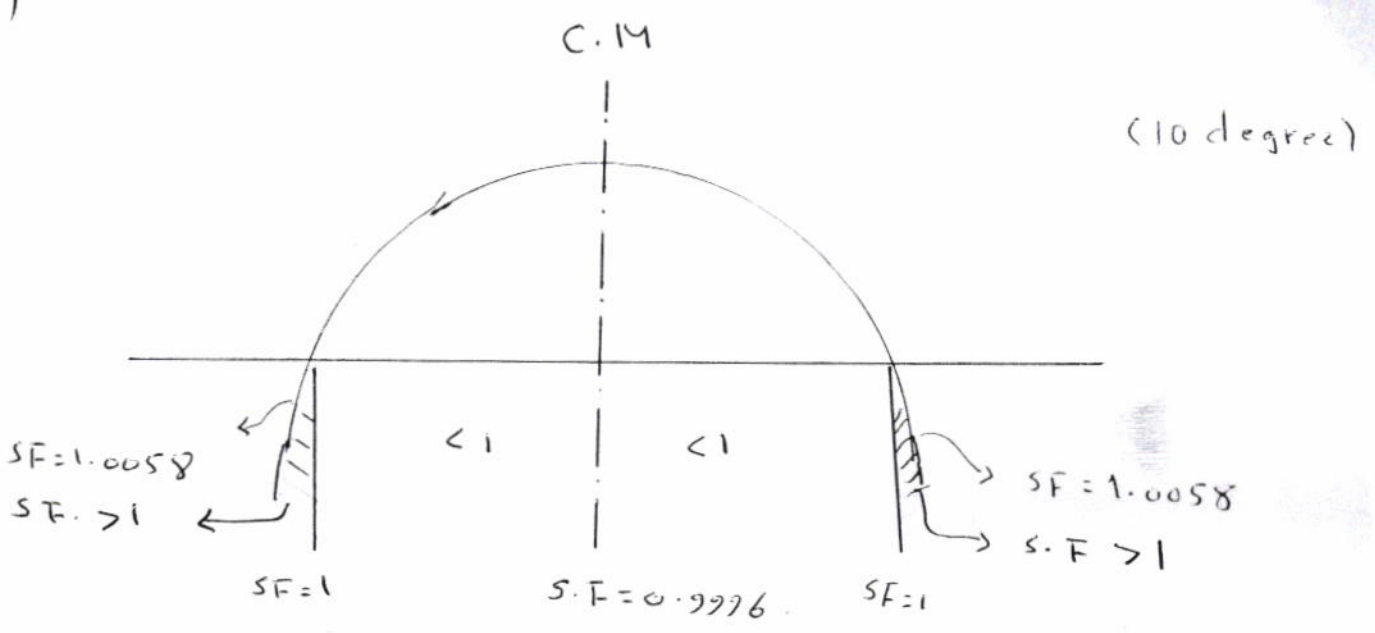
(b)



*Good Luck*

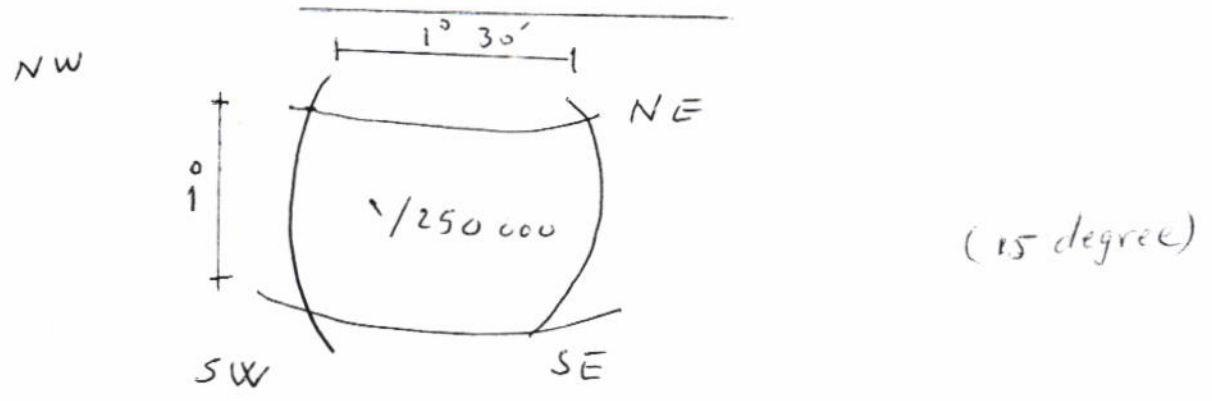
الحل النهائي لاستمارة الخرائط الرسمية فرع ٥، جبر مائيل الدور ١٤١٤

Q. A)



The circle intersect the cylinder in UTM projection

Q. B)



- SW Corner :  $\phi = 28^{\circ} 30' 30'' N$  ,  $\lambda = 43^{\circ} 30' 30'' E$
- SE Corner :  $\phi = 28^{\circ} 30' 30'' N$  ,  $\lambda = 45^{\circ} 00' 30'' E$
- NW Corner :  $\phi = 29^{\circ} 30' 30'' N$  ,  $\lambda = 43^{\circ} 30' 30'' E$
- NE Corner :  $\phi = 29^{\circ} 30' 30'' N$  ,  $\lambda = 45^{\circ} 00' 30'' E$

$$\phi_{center} = 29^{\circ} 00' 30'' N \quad \lambda_{center} = 44^{\circ} 15' 30'' E$$

$S = \Delta\lambda \sin \phi \Rightarrow$  The zone of Map is 38/with C.M. =  $45^{\circ}$

$\delta_{SW} = 00^{\circ} 42' 43.03''$  ,  $S_{SE} = 00^{\circ} 00' 14.32''$  ,  $\delta_{NW} = 00^{\circ} 44' 4.99''$

$S_{...} = 0^{\circ} 11' 11.11''$  ,  $S_{...} = 0^{\circ} 11' 11.11''$



Q2. A)

1. Draw the equator  $\Phi_0$  with its true length.

$$L_{\Phi_0} = 2\pi R * \text{scale}$$

2. Divide the equator to equal divisions like  $10^\circ$

$$\lambda_{10} = \frac{2\pi R}{360^\circ} * 10^\circ * \text{scale}$$

3. Sign the intersections of meridian with equator

4. Draw straight lines perpendicular to the equator from the points of intersections.

5. Draw the parallels with straight lines with its true distances from the equator like  $10^\circ$

$$L_{10^\circ} = \frac{2\pi R}{360^\circ} * 10^\circ * \text{scale}, \text{ so the length of}$$

any great circle = length of equator, and all parallel has a distortion =  $\frac{L \text{ of parallel on proj}}{L \text{ of parallel on earth}}$   
$$= \frac{2\pi R}{2\pi R \cos \Phi} = \sec \Phi$$

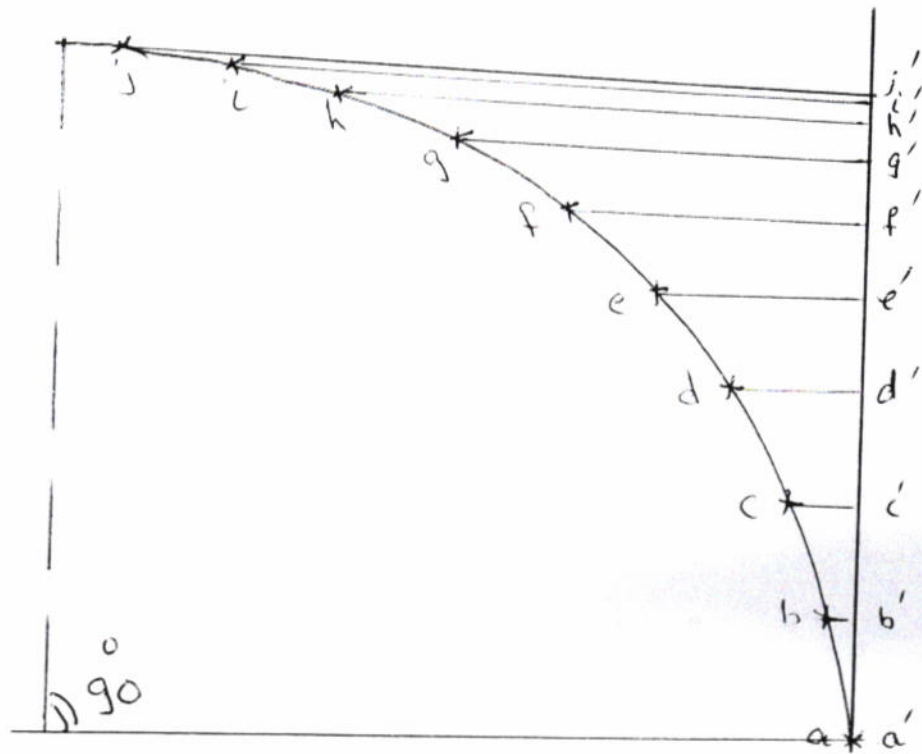
6. the length of meridians between poles is true in this projection

7. All parallels has been exaggerated by  $\sec \theta$  except equator

8. poles are infinty exaggerated

(15 degree)

Q<sub>2</sub>. B)



The value of linear distortion is changed from place to another and it is increased as well as the the position be near the poles and the curvature increased, that means also the relation between linear distortion and changing the direction of points according to the formula

$$M_{\alpha} = \sqrt{a^2 \sin^2 \alpha + b^2 \cos^2 \alpha}$$

(linear distortion)

(10 degree)

$\Phi_3.A)$

$$\cos(90 - \Phi_p) = \cos(90 - \Phi_k) \cos\left(\int_{k_p}^0\right) + \sin(90 - \Phi_k) \sin\left(\int_{k_p}^0\right) \cdot \cos \alpha_{kp}$$

$$\sin \Phi_p = \sin \Phi_k \cos\left(\int_{k_p}^0\right) + \cos \Phi_k \cdot \sin\left(\int_{k_p}^0\right) \cdot \cos \alpha_{kp}$$

$$\int_{k_p}^0 = \frac{\int_{k_p}}{R} \cdot \frac{180}{\pi} = 5^\circ 24' 4.47''$$

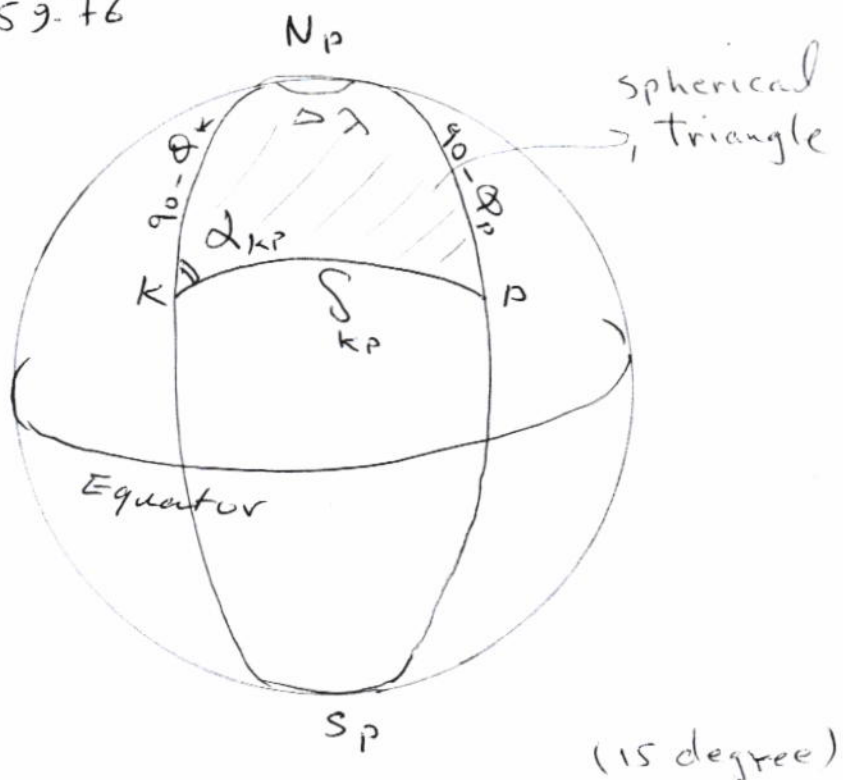
$$\Phi_p = 23^\circ 42' 36.11''$$

$$\frac{\sin \Delta \lambda}{\sin\left(\int_{k_p}^0\right)} = \frac{\sin \alpha_{kp}}{\sin(90 - \Phi_p)}$$

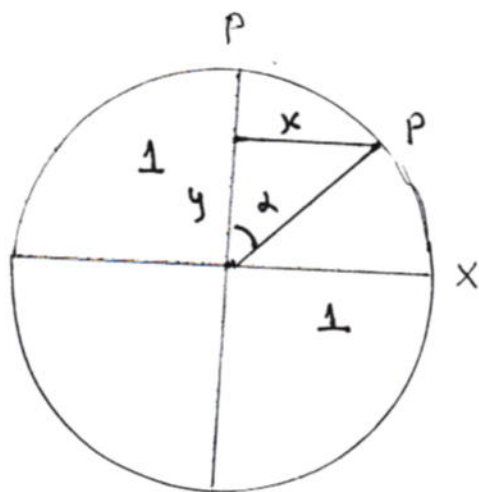
$$\Delta \lambda = 4^\circ 32' 59.76''$$

$$\lambda_p = \lambda_k + \Delta \lambda = 22^\circ 22' + 4^\circ 32' 59.76''$$

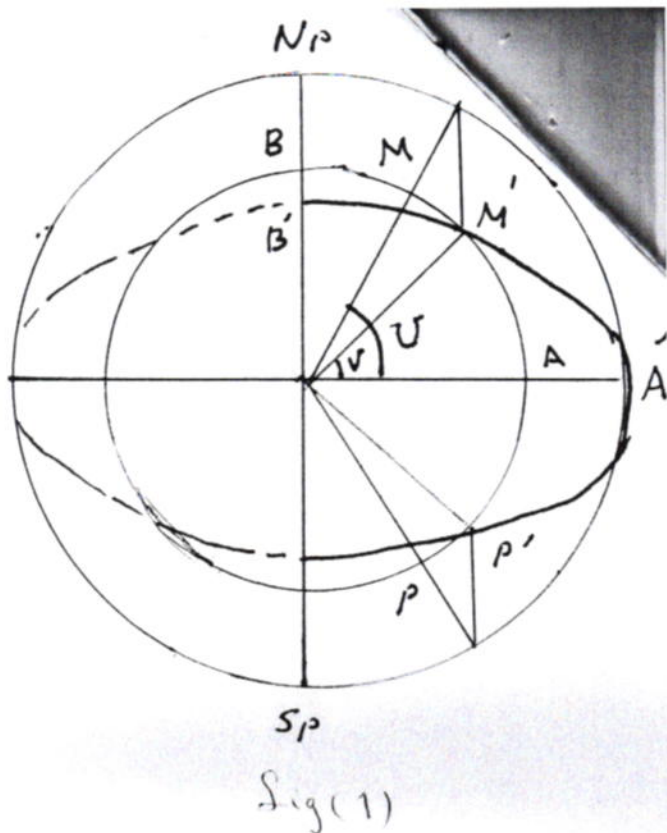
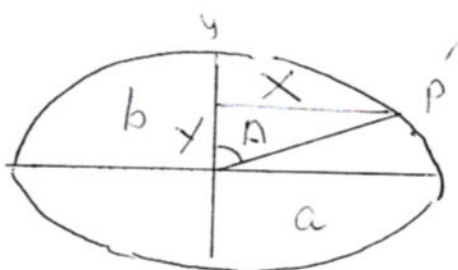
$$\lambda_p = 26^\circ 54' 59.76''$$



Q3. B.)



fig(2)



from fig(2) the angle  $\alpha$  on circle has been changed to  $(A)$  on ellipse after projection so -

$$\sin A = \frac{x}{\sqrt{x^2 + y^2}} = \frac{ax}{M_d \sqrt{x^2 + y^2}} \quad \left\{ \begin{array}{l} \text{(use the Definition of linear)} \\ \text{distortion since } \frac{x}{1} = \frac{x}{a} \end{array} \right.$$

$$\cos A = \frac{y}{\sqrt{x^2 + y^2}} = \frac{by}{M_d \sqrt{x^2 + y^2}} \quad \left\{ \begin{array}{l} M_d = \sqrt{a^2 \frac{x^2}{x^2 + y^2} + b^2 \frac{y^2}{x^2 + y^2}} \end{array} \right.$$

$$\therefore \sin A = \frac{a}{M_d} \sin \alpha, \cos A = \frac{b}{M_d} \cos \alpha$$

(10 degree)

$$M_d = a \frac{\sin \alpha}{\sin A} = b \frac{\cos \alpha}{\cos A}$$

$$\therefore a \sin \alpha \cdot \cos A - b \cos \alpha \sin A = 0$$

$$a [\sin(A + \alpha) - \sin(A - \alpha)] = b [\sin(A + \alpha) + \sin(A - \alpha)]$$

$$\therefore (a - b) \sin(A + \alpha) = (a + b) \sin(A - \alpha)$$

$$\sin(A - \alpha) = \frac{a - b}{a + b} \sin(A + \alpha)$$

$$[ \text{Let } A - \alpha = \omega ]$$

$$\therefore \sin \frac{\omega}{2} = \frac{a - b}{a + b}$$

$$\text{The conformality Condition } \sin \frac{\omega}{2} = \frac{a - b}{a + b} = 0 \Rightarrow a = b \text{ (circle)}$$

Q4. A)

Since the rotation is clockwise :

$$x' = x \cos \alpha - y \sin \alpha$$

$$y' = y \cos \alpha + x \sin \alpha$$

$$\begin{aligned} 266161.7648 &= 532323.5295 \cos \alpha - 266161.7648 \sin \alpha \\ 532323.5295 &= 266161.7648 \cos \alpha + 532323.5295 \sin \alpha \end{aligned} \quad \left\{ \begin{array}{l} *2 \\ *1 \end{array} \right.$$

$$\Rightarrow \cos \alpha = 0.7999999999$$

$$\alpha = 36^{\circ} 52' 11.63''$$

15 degree