8-P6SP18IRQ6JOSHC

9864208

FÖRSÄTTSBLAD TENTAMEN/ EXAMINATION COVER

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MARKERA MED "X"/ MARK WITH "X" ☒

IFYLLES AV STUDENT OCH TENTAMENSVAKT/
TO BE FILLED IN BY THE STUDENT AND THE INVIGILATOR:

KURSKOD / COURSE CODE: A G 1 8 1 7	EFTERNAMN / FAMILY NAME: OLIVIER
KURSNAMN / COURSE NAME: Kartprojektioner och referenssystem	FÖRNAMN / FIRST NAME: NILS
PROVKOD / TEST CODE: T E N A	NAMNTECKNING / YOUR SIGNATURE:
TENTAMENSDATUM / EXAMINATION DATE (Y/Y/Y/Y - M/M - D/D): 2024 - 01 - 09	PERSONNUMMER / PERSONAL NUMBER (Y/Y/Y/Y/M/M/D/D): 20010610 - 1751

PROGRAMKOD / PROGRAM CODE:	INLÄMNINGSTID / TIME SUBMITTED:	SIGNATUR TENTAMENSVAKT / SIGNATURE INVIGILATOR:	ANTAL BLAD / NO OF SHEETS:
GIT-3	9.15		04

MARKERA BEHANDLADE UPPGIFTER MED "X "OCH EJ BEHANDLADE UPPGIFTER MED "-" /
MARK WITH "X" PROBLEMS SOLVED. MARK WITH "-" PROBLEMS NOT ATTEMPTED

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
X	X	X																	

IFYLLES AV INSTITUTIONEN / TO BE FILLED IN BY THE DEPARTMENT:

BEDÖMNING / ASSESSMENT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

BONUSPOÄNG/ BONUS POINTS: ___ , ___

SLUTSUMMA / FINAL POINTS: ___ , ___

BETYG/ GRADE: ___

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Godkänns av examinator /
approved by Examiner...

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a. $e = \frac{\sqrt{a^2-b^2}}{a}$, $e' = \frac{\sqrt{a^2-b^2}}{b}$

$$e^2 = \frac{a^2-b^2}{a^2} \Leftrightarrow e^2a^2 = a^2-b^2 \Leftrightarrow b^2 = a^2-e^2a^2$$

$$e'^2 = \frac{a^2-b^2}{b^2} \Rightarrow e'^2 = \frac{a^2-(a^2-e^2a^2)}{a^2-e^2a^2} = \frac{a^2e^2}{a^2(1-e^2)}$$

$$= \frac{e^2}{1-e^2} \Leftrightarrow e' = \frac{\sqrt{e^2}}{\sqrt{1-e^2}} = \frac{e}{\sqrt{1-e^2}}$$

b. geodetic problems are about describing the earth on a reference ellipsoid, such as:
- calculating coordinates and shapes for objects.
- creating reference frames

c. Many triangulation-based reference systems need locally fitted reference ellipsoids. These ellipsoid have better accuracy locally but are not geocentric.

d) i) NO
ii) NO
iii) yes
iv) yes
v) NO
vi) NO

Notes

Not to be scanned!

$$h = \frac{\sqrt{e}}{R}$$

$$k = \frac{\sqrt{g}}{R\cos\phi}$$

$$\cos\theta' = \frac{f}{\sqrt{eg}}$$

$$\xi = \frac{\sqrt{eg - f^2}}{R^2\cos\phi}$$

$$e = \left(\frac{\partial x}{\partial \phi}\right)^2 + \left(\frac{\partial y}{\partial \phi}\right)^2$$

$$f = \left(\frac{\partial x}{\partial \phi}\right)\left(\frac{\partial x}{\partial \lambda}\right) + \left(\frac{\partial y}{\partial \phi}\right)\left(\frac{\partial y}{\partial \lambda}\right)$$

$$g = \left(\frac{\partial x}{\partial \lambda}\right)^2 + \left(\frac{\partial y}{\partial \lambda}\right)^2$$

$h = k \Rightarrow$ conformal

$h \cdot k = 1 \Rightarrow$ equi-distant / equivalent

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2. a) Universal Transversal Mercator.

A global map projection with:

- 60 longitude zones, 6° each
- scale factor: 0.9996
- False northing: 10 000 km if southern hemisphere
- False easting: 500 km
- 20 latitude bands with some variations.

b) a./

$$e = \left(\frac{\partial x}{\partial \bar\phi}\right)^2 + \left(\frac{\partial y}{\partial \bar\phi}\right)^2 = (R\cos\lambda)^2 + (-R\sin\lambda)^2 = \underline{R^2}\,(\underbrace{\cancel{\cos^2\lambda + \sin^2\lambda}}_{=1})$$

$$f = \left(\frac{\partial x}{\partial \bar\phi}\right)\left(\frac{\partial x}{\partial \lambda}\right) + \left(\frac{\partial y}{\partial \bar\phi}\right)\left(\frac{\partial y}{\partial \lambda}\right) = (R\cos\lambda)\left(R\sin\lambda\left(\frac{\pi}{2}-\bar\phi\right)\right) + (-R\sin\lambda)\left(R\cos\lambda\left(\frac{\pi}{2}-\bar\phi\right)\right)$$

$$= R^2\cos\lambda\sin\lambda\left(\frac{\pi}{2}-\bar\phi\right) - R^2\sin\lambda\cos\lambda\left(\frac{\pi}{2}-\bar\phi\right) = \underline{0}$$

$$g = \left(\frac{\partial x}{\partial \lambda}\right)^2 + \left(\frac{\partial y}{\partial \lambda}\right)^2 = \left(R\sin\lambda\left(\frac{\pi}{2}-\bar\phi\right)\right)^2 + \left(R\cos\lambda\left(\frac{\pi}{2}-\bar\phi\right)\right)^2$$

$$= R^2\sin^2\lambda\left(\frac{\pi}{2}-\bar\phi\right)^2 + R^2\cos^2\lambda\left(\frac{\pi}{2}-\bar\phi\right)^2$$

$$= R^2\left(\frac{\pi}{2}-\bar\phi\right)^2 (\underbrace{\cancel{\sin^2\lambda + \cos^2\lambda}}_{=1}) = \underline{R^2\left(\frac{\pi}{2}-\bar\phi\right)^2}$$

$$\begin{cases} e = R^2 \\ f = 0 \\ g = R^2\left(\frac{\pi}{2}-\bar\phi\right)^2 \end{cases}$$

b./

$$h = \frac{\sqrt{e}}{R} = \frac{\sqrt{R^2}}{R} = \frac{R}{R} = \underline{1}$$

$$k = \frac{\sqrt{g}}{R\cos\bar\phi} = \frac{\sqrt{R^2\left(\frac{\pi}{2}-\bar\phi\right)^2}}{R\cos\bar\phi} = \frac{R\left(\frac{\pi}{2}-\bar\phi\right)}{R\cos\bar\phi} = \underline{\frac{\frac{\pi}{2}-\bar\phi}{\cos\bar\phi}}$$

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continue 2.

c./ $\cos\theta' = \frac{f}{\sqrt{eg}} = \frac{0}{\sqrt{eg}} = 0 \Rightarrow \theta' = a\cos(0) = 90°$

d./ $\varepsilon = \frac{\sqrt{eg - f^2}}{R^2 \cos\bar{\phi}} = \frac{\sqrt{eg}}{R^2\cos\bar{\phi}} = \frac{\sqrt{R^2 \cdot R^2(\frac{\pi}{2}-\phi)^2}}{R^2\cos\bar{\phi}} = \frac{R^2(\frac{\pi}{2}-\phi)}{R^2\cos\bar{\phi}}$

$= \frac{(\frac{\pi}{2}-\phi)}{\cos\bar{\phi}}$

e. $1 \neq \frac{\pi}{2} - \bar{\phi} \Rightarrow h \neq k \Rightarrow$ not conformal

$1 \cdot \frac{(\frac{\pi}{2}-\phi)}{\cos\bar{\phi}} \neq 1 \Rightarrow h \cdot k \neq 1 \Rightarrow$ not equivalent

answer: neither.

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a./ Conventional international origin

The mean pole positions in 1900-1905.
used as a fixed reference point for terrestrial referenc systems. The (TRS) need a fixed pole to define the Rotation axis and the poles are constantly moving.

b./ J2000.0 is a time epoch of January 1st, ut1 = 12:00, year 2000 in the julian calendar.
Since "everything" is changing with time and reference systems need fixed references. This time epoch is used to define celestial reference systems.

c.

$(\phi, \lambda, h)_{SWEREF\,99} \longrightarrow (x, y, z)_{SWEREF\,99}$ GRS 80 ellipsoid

$(x, y, z)_{SWEREF\,99} \longrightarrow (x, y, z)_{RT\,90}$ Helmert's transformation

$(x, y, z)_{RT\,90} \longrightarrow (\phi, \lambda, h)_{RT\,90}$ Bessel's 1841 ellipsoid

$(\phi, \lambda, h)_{RT\,90} \longrightarrow (x, y)_{RT\,90}$ Bessel's 1841 ellipsoid.