NAVIGATION

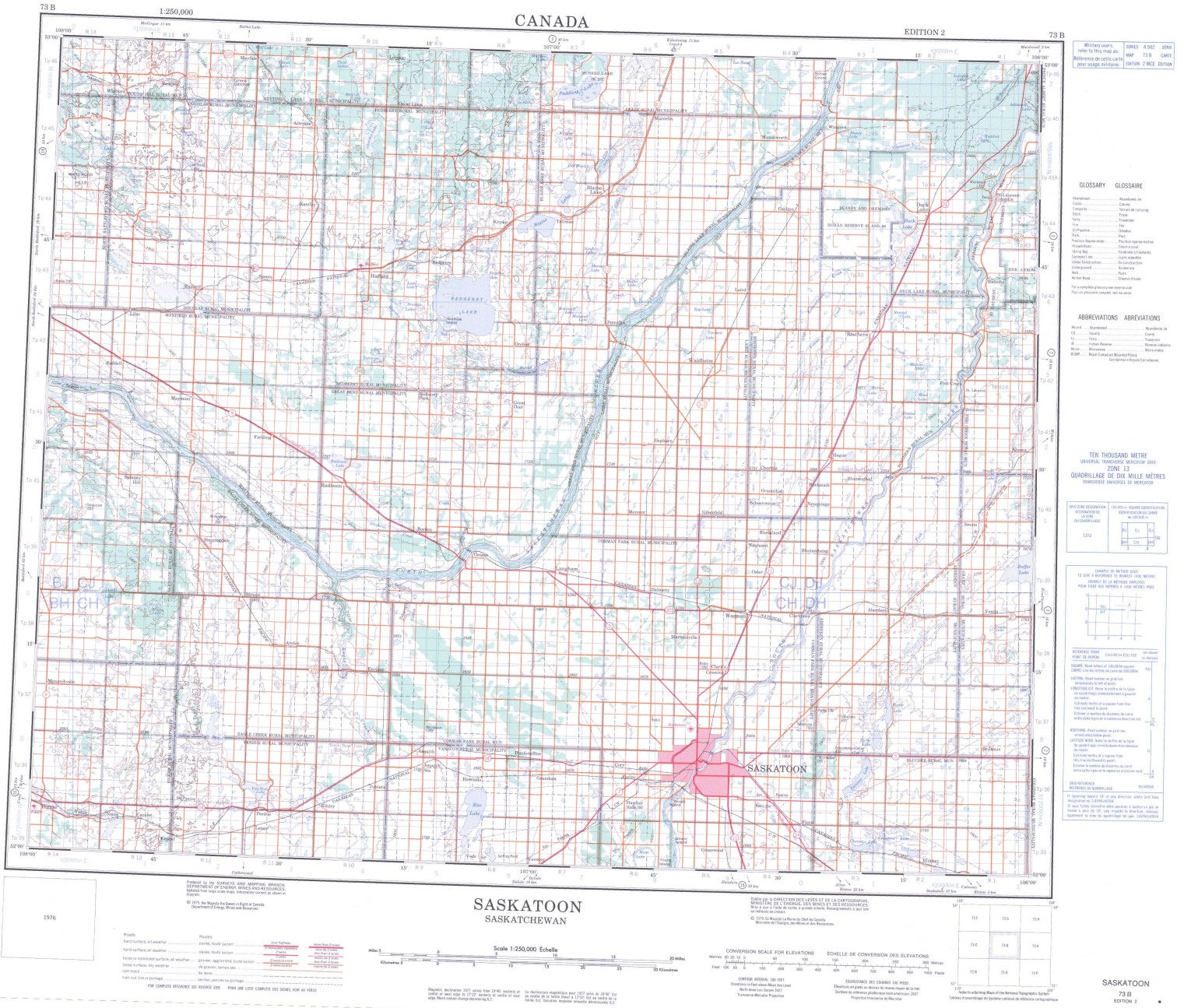
SECTION II-E

- **Topographic Maps**

TOPOGRAPHIC MAPS

Map Elements

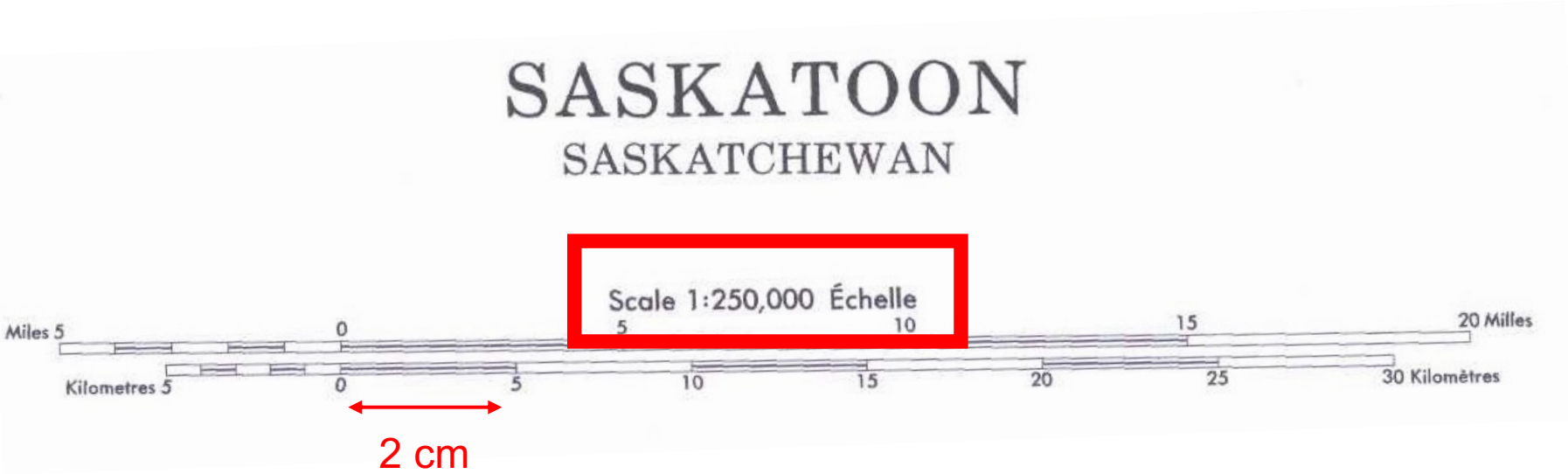
- Scales
- Contour Lines
- Coordinate Systems
  - Geographic (lat/long)
  - UTM
- Datums


73 B
1:250,000
CANADA
EDITION 2
73 B
SASKATOON
SASKATCHEWAN
1976
SASKATOON
73 B
EDITION 2

SCALES

Map Scales

- relationship of distance on map to distance on the ground



1:250 000

1 cm = 250 000 cm

1 cm = 2.5 km

1:50 000

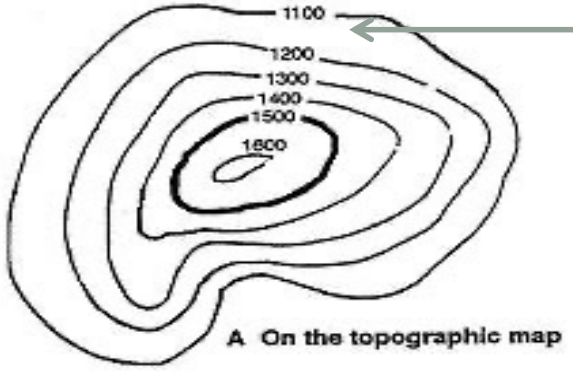
1 cm = 50 000 cm

1 cm = 0.5 km

CONTOUR LINES

The shape of a hill as seen:

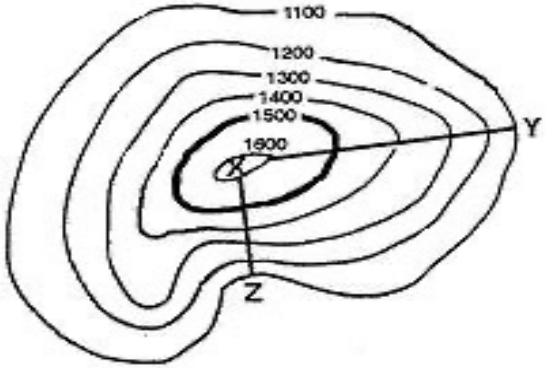
A. on a topographic map,
B. from the side (elevation),
C. in perspective.



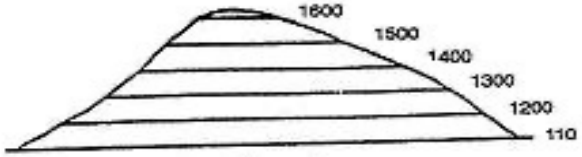
A On the topographic map

numbers indicate elevation

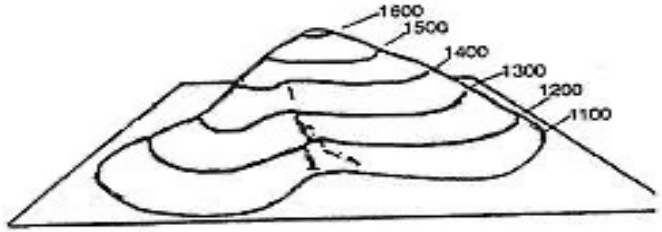
closer lines = steeper slope



D. Steepness of various routes. The Y – X route would be much less steep than the Z – X route.

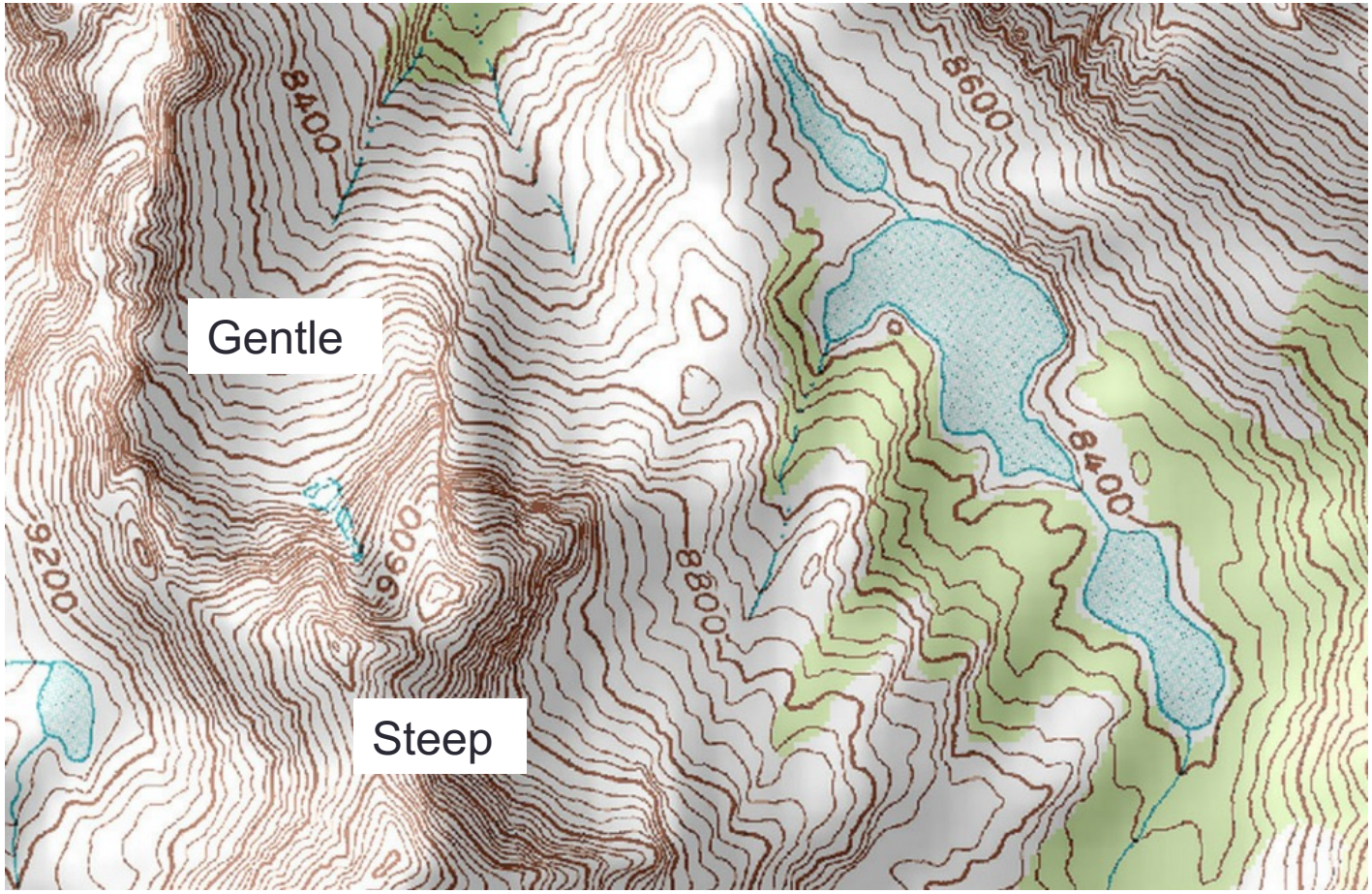


B. Elevation

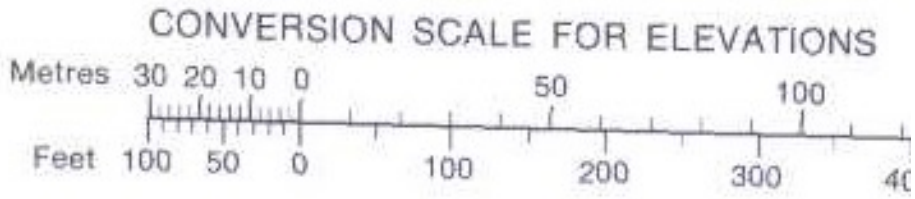


C. In perspective

CONTOUR LINES



CONTOUR LINES



CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

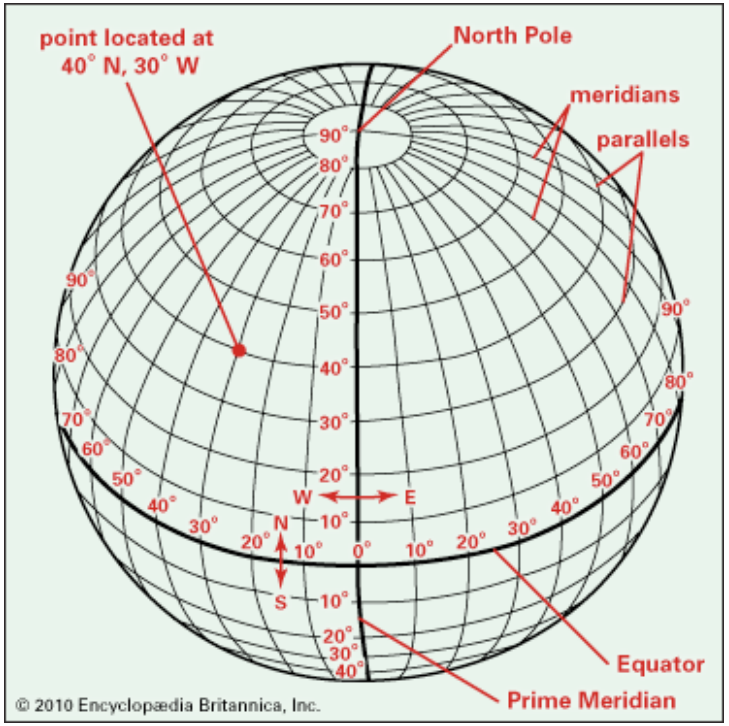
COORDINATE SYSTEMS

Coordinate Systems

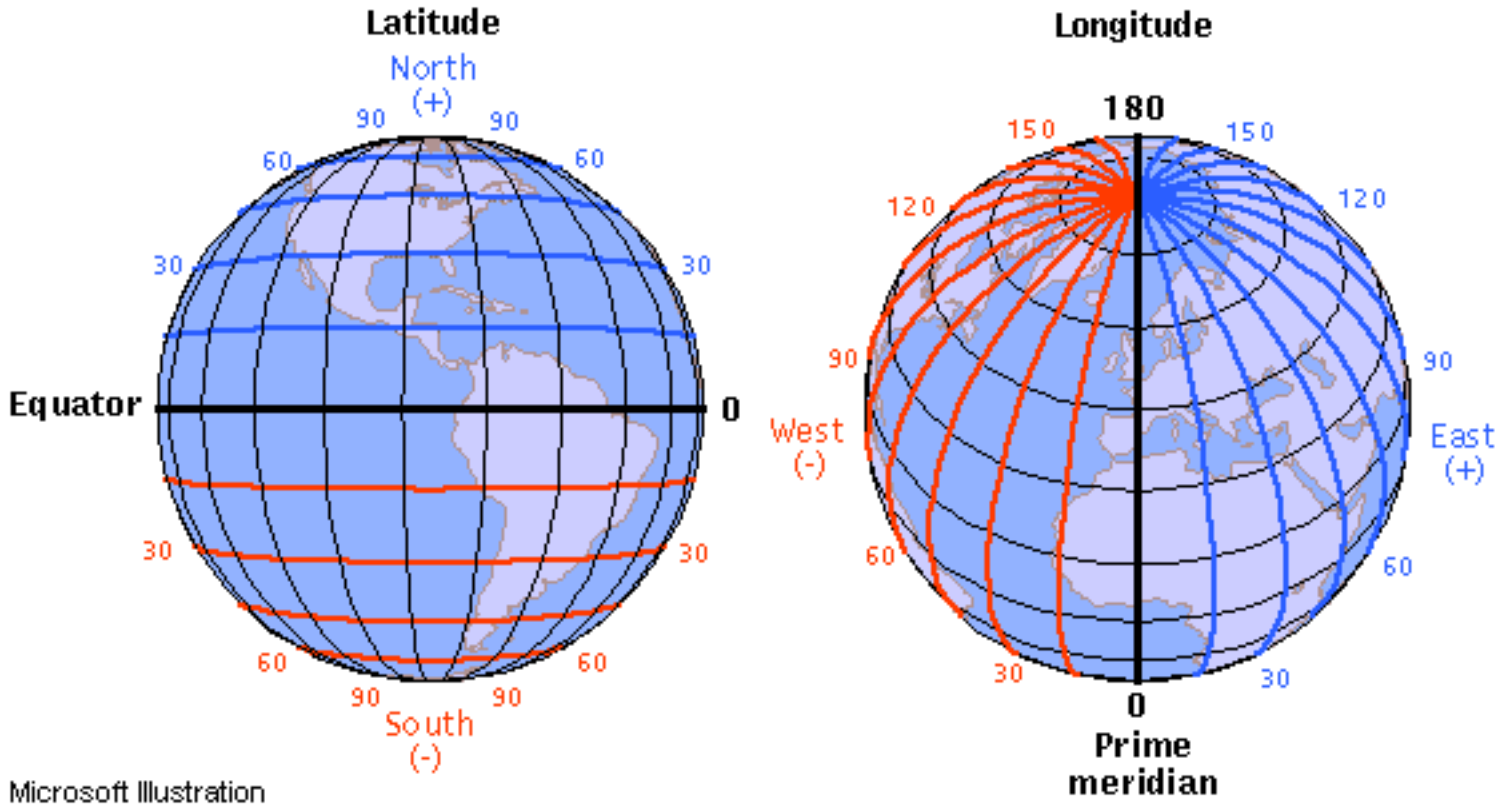
- divide the world into segments
- used to identify precise locations (“coordinates”)

Two main coordinate systems:

- Geographic (“Lat/Long”)
- Universal Transverse Mercator (“UTM”)

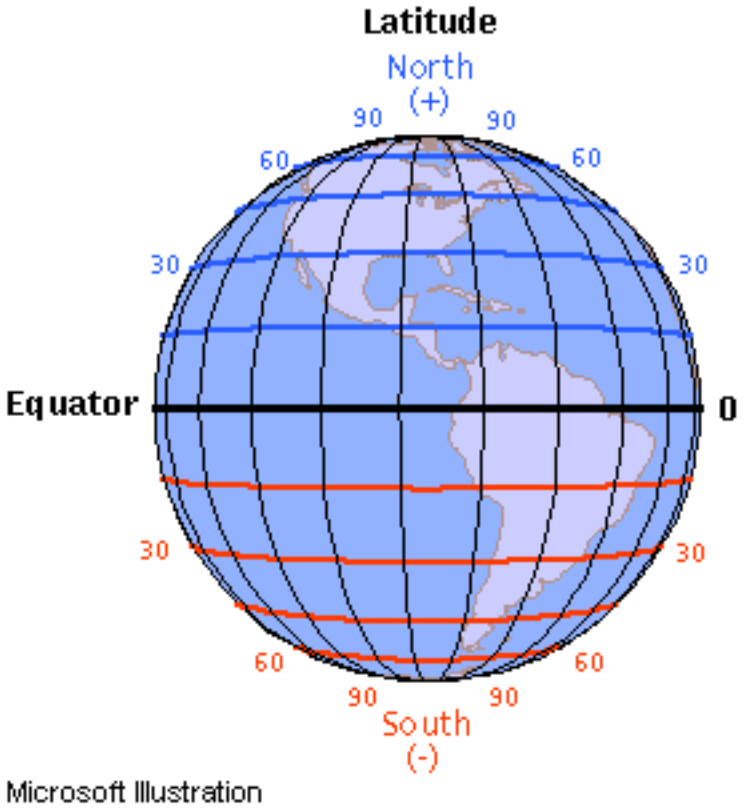


GEOGRAPHIC SYSTEM



Divides the world into “degrees”
Typical system used for digital maps
e.g. 52.49528°N 116.1008°W

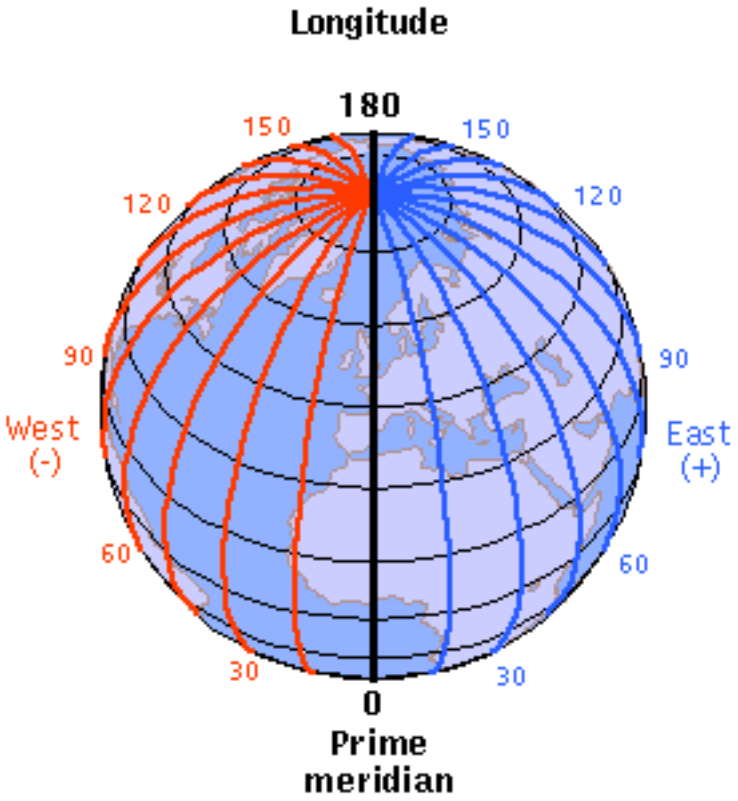
GEOGRAPHIC SYSTEM



Lines of Latitude ("parallels")

- Equator = 0°
- Poles = 90°
- North of Eq +
- South of Eq –

GEOGRAPHIC SYSTEM

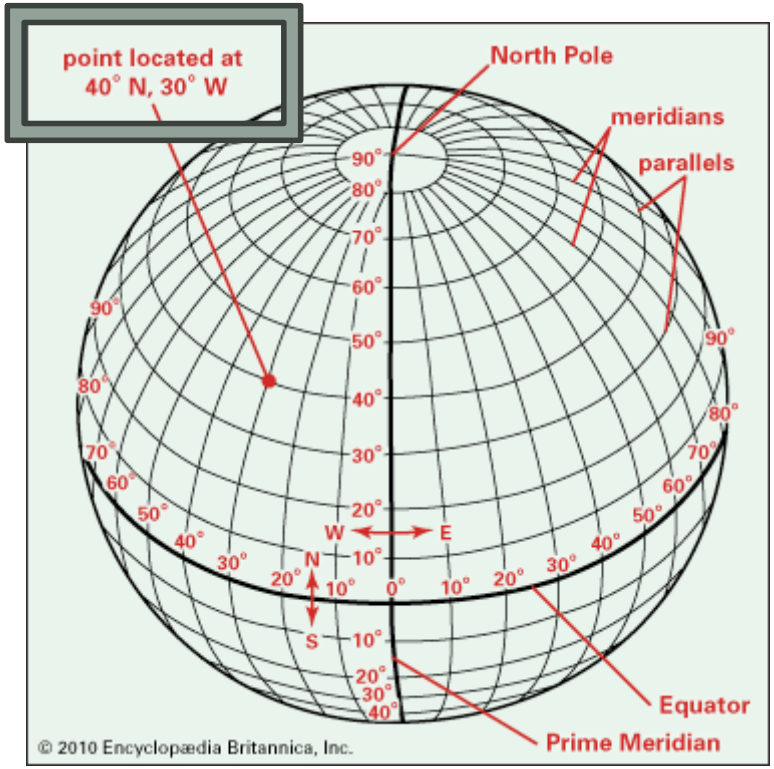


Lines of Longitude ("meridians")

- Prime Meridian = 0°
- East of PM +
- West of PM -

GEOGRAPHIC SYSTEM

Coordinates



Latitude first, then longitude

In Canada, ALL coordinates will be:

NORTH of the Equator

WEST of the Prime Meridian

Therefore, your first number will always be “N” or “+”, and your second number will always be “W” or “-”

e.g. 52°N 116°W or 52°, -116°

GEOGRAPHIC SYSTEM

Dividing Degrees

- required for precision of location
- different ways to divide degrees give us

3 “Position Formats” for lat/long

Decimal Degrees (DD)

hddd.ddddd°

Degrees Decimal Minutes (DDM)

hddd°mm.mmm’

Degrees Minutes Seconds (DMS)

hddd°mm’ss.s”

GEOGRAPHIC SYSTEM

Decimal Degrees: 52.49528°, -116.1008°

- Degrees are divided into tenths, hundredths, thousandths, etc.

  TYPICALLY USED ON SEARCHES

Degrees Decimal Minutes: 52°29.72', -116°06.05'

- Each degree is subdivided into 60 segments, known as minutes (')
- Minutes are subdivided into tenths and hundredths

Degrees Minutes Seconds: 52°29'43", -116°06'03"

- Each degree is divided into 60 minutes (')
- Each minute is subdivided into 60 more segments, called seconds (")

GEOGRAPHIC SYSTEM

Converting Coordinates

1° = 60’

degrees → minutes

- multiply by 60

minutes → degrees

- divide by 60

1’ = 60”

minutes → seconds

- multiply by 60

seconds → minutes

- divide by 60

DMS: 52°29’43”

43”/60 = 0.72

DDM: 52°29.72’

29.72’/60 = 0.4953

DD: 52.4953°

GEOGRAPHIC SYSTEM

Converting Coordinates

1° = 60’

degrees → minutes

- multiply by 60

minutes → degrees

- divide by 60

1’ = 60”

minutes → seconds

- multiply by 60

seconds → minutes

- divide by 60

DD: 52.4953°

0.4953° x 60 = 29.72

DDM: 52°29.72’

0.72’ x 60 = 43

DMS: 52°29’43”

GEOGRAPHIC SYSTEM

Converting Coordinates

Enter Degrees Minutes Seconds latitude:

Enter Degrees Minutes Seconds longitude:

Convert to Decimal | Clear Values

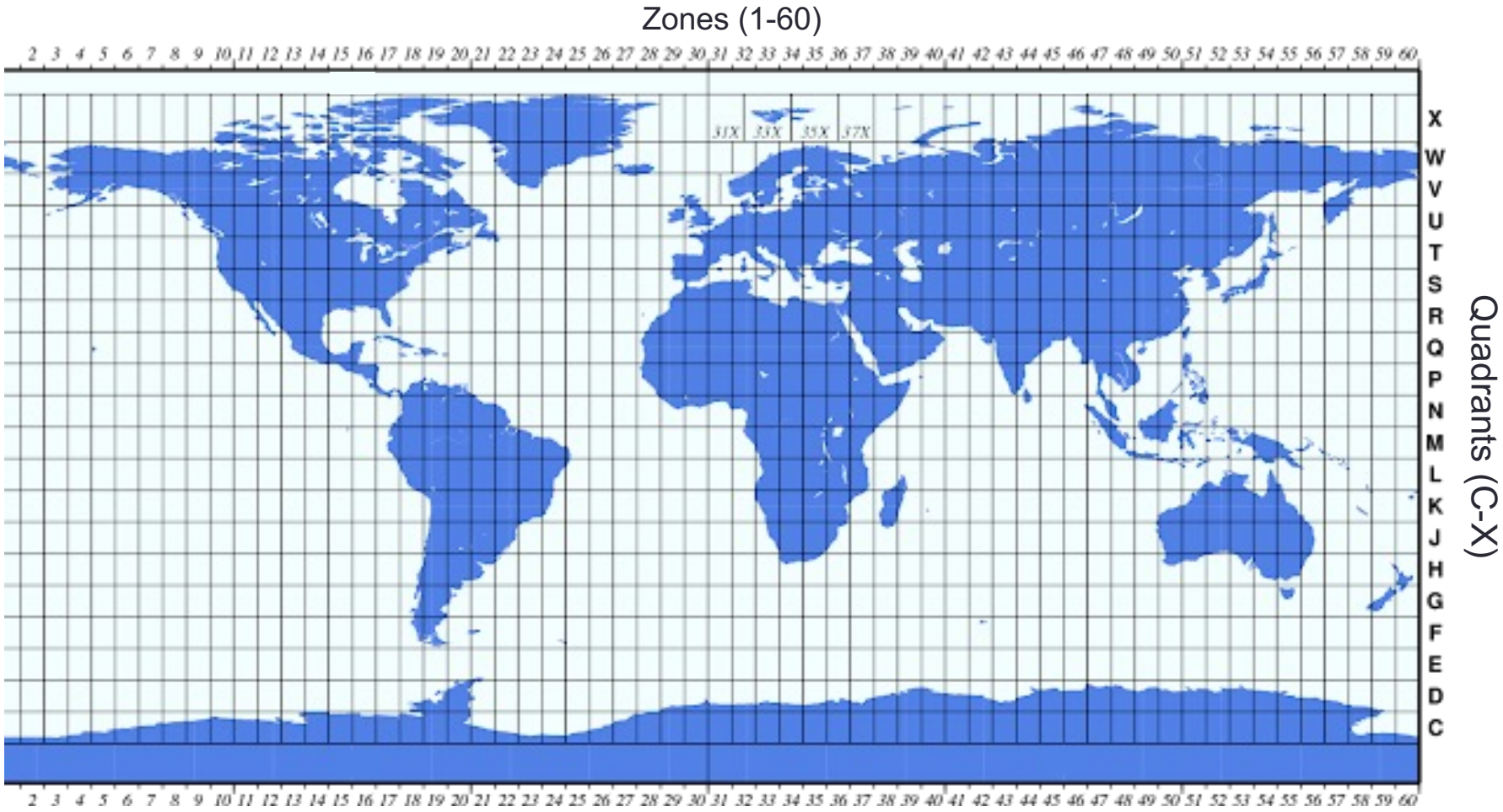
Results: Latitude: Longitude:

Type the latitude and longitude values to convert into **UTM** (Universal Transverse Mercator) coordinate system.

Latitude	Longitude	
0.000000	0.000000	Convert

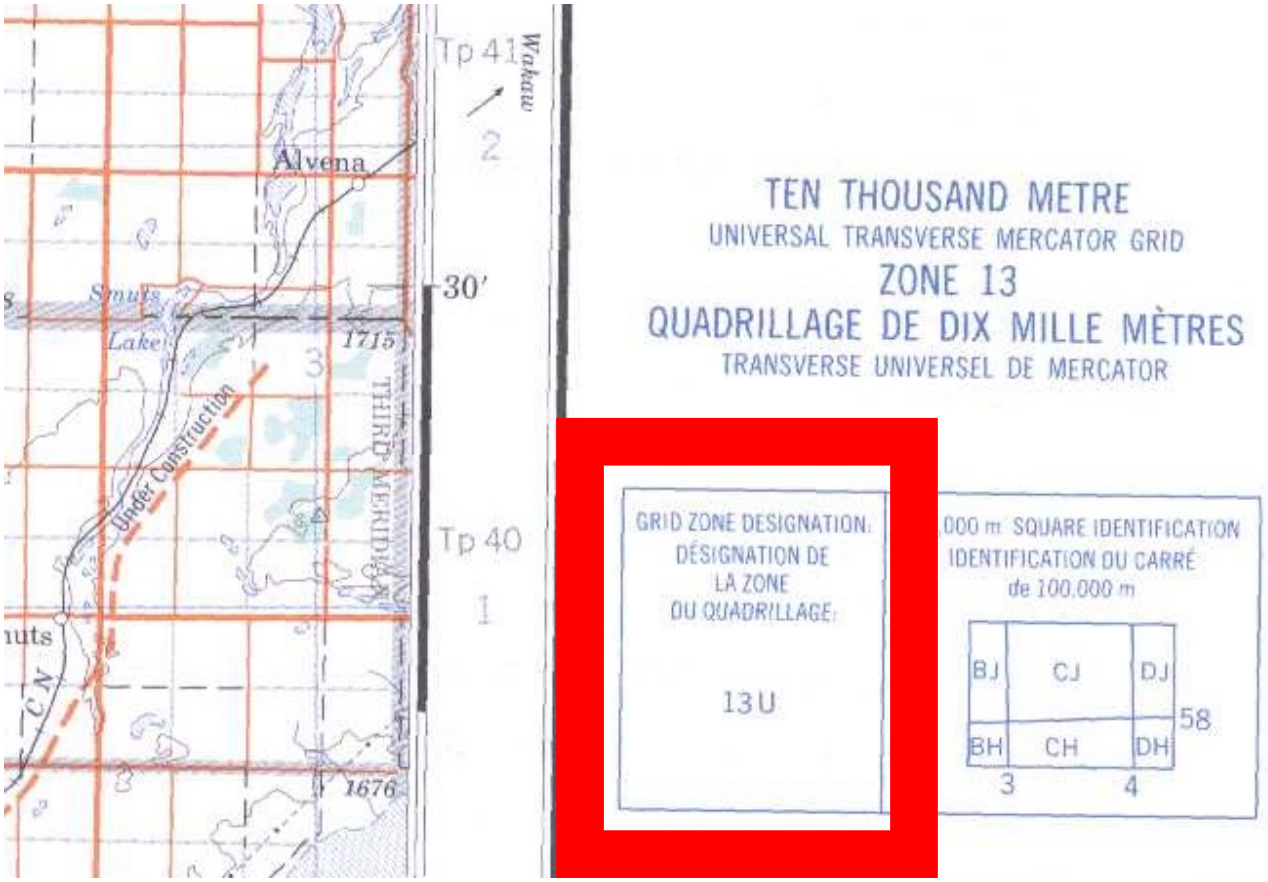
UTM Easting	UTM Northing	UTM Zone
UTM Easting	UTM Northing	UTM Zone

UTM SYSTEM

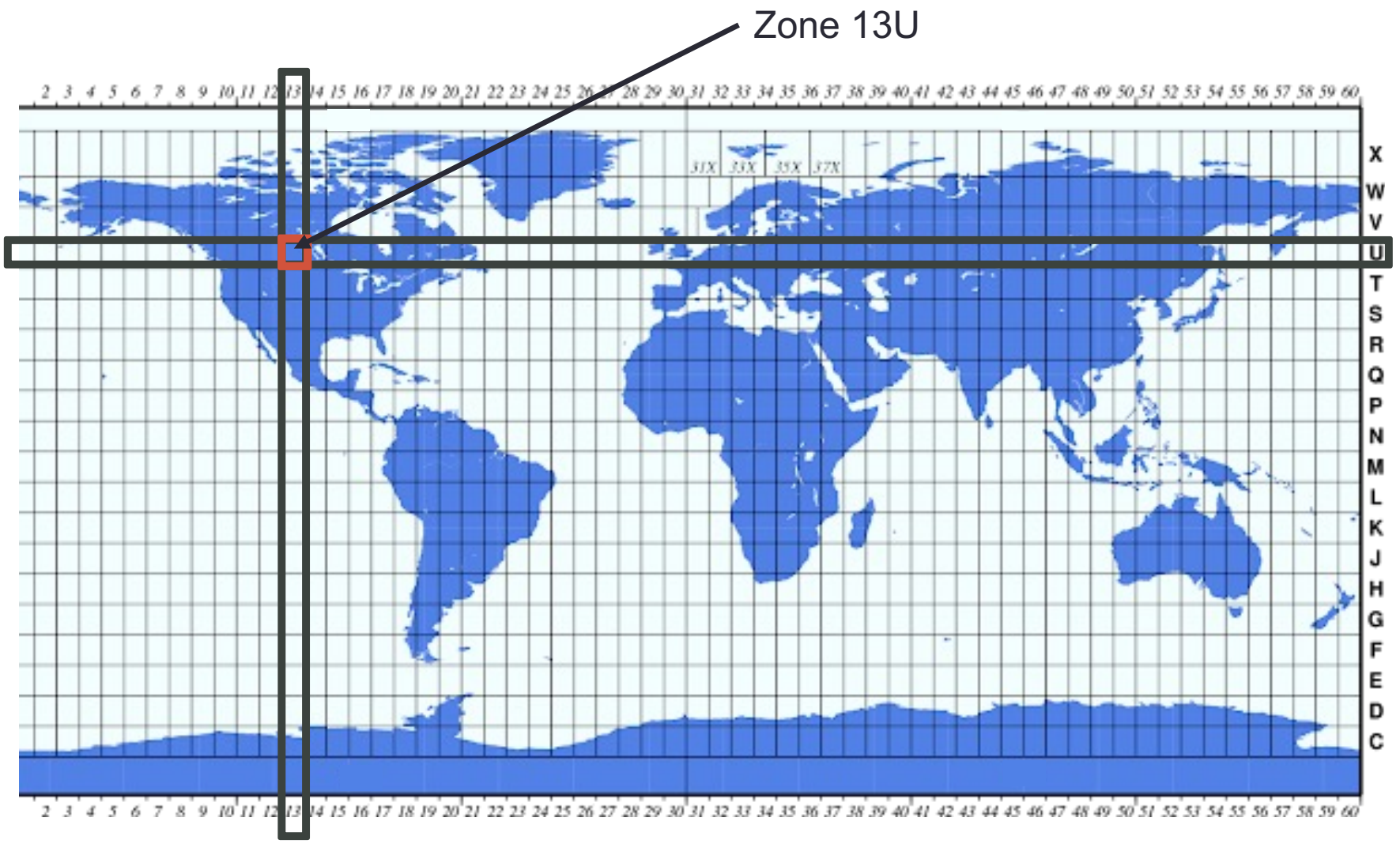


A grid system dividing a 2D projection of the world into zones and quadrants
Typical grid system for topographic paper maps
e.g. Zone 11U 561048E 5816283N

UTM SYSTEM

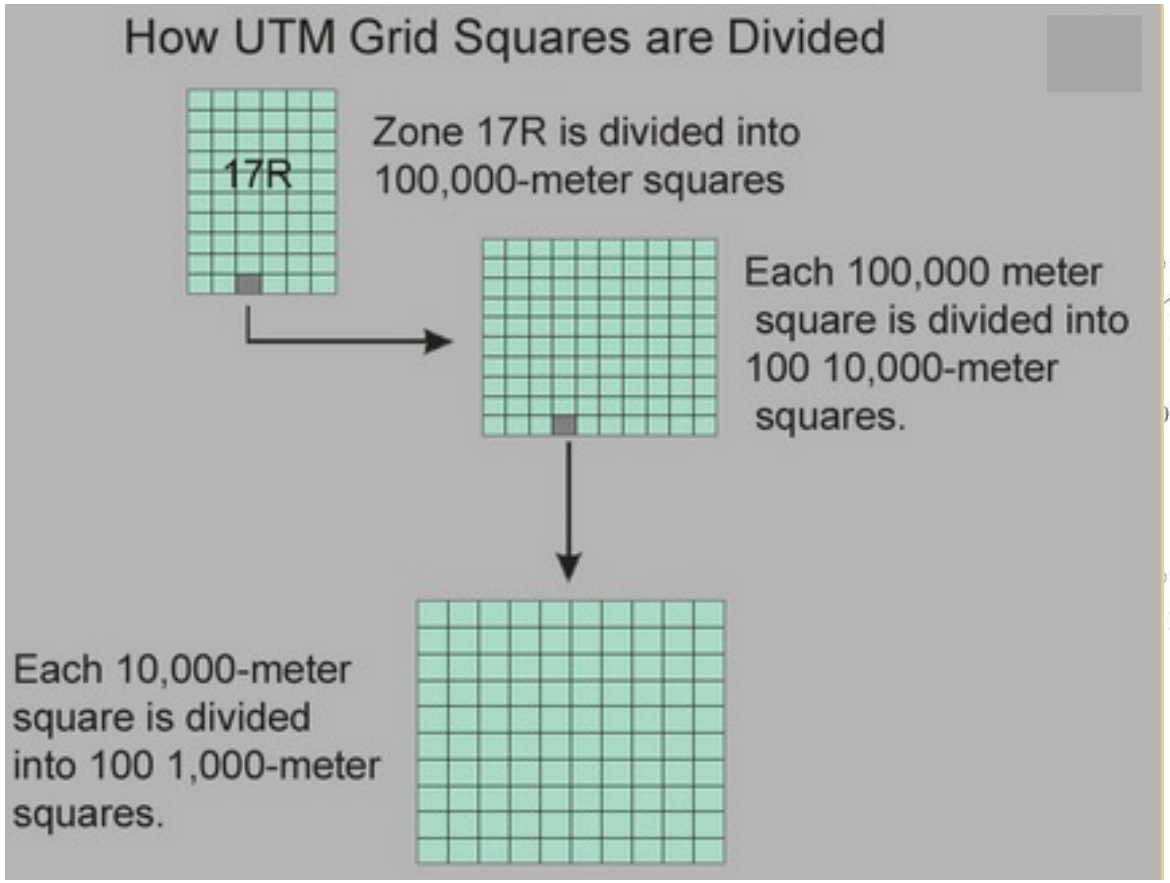

Tp 41
Wakaw
2
Alvena
30'
Smuts
Lake
1715
3
THIRD MERIDIAN
Under Construction
Tp 40
1
C N
1676
TEN THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 13
QUADRILLAGE DE DIX MILLE MÈTRES
TRANSVERSE UNIVERSEL DE MERCATOR
GRID ZONE DESIGNATION:
DÉSIGNATION DE
LA ZONE
OU QUADRILLAGE:
13U
000 m SQUARE IDENTIFICATION
IDENTIFICATION DU CARRÉ
de 100,000 m
BJ
CJ
DJ
58
BH
CH
DH
3
4

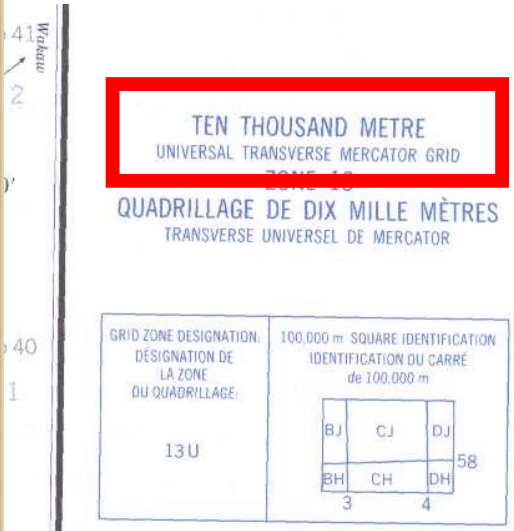
UTM SYSTEM


Zone 13U
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
31X 33X 35X 37X
X W V U T S R Q P N M L K J H G F E D C

UTM SYSTEM

Each grid section is divided into smaller squares using “grid lines”





UTM SYSTEM

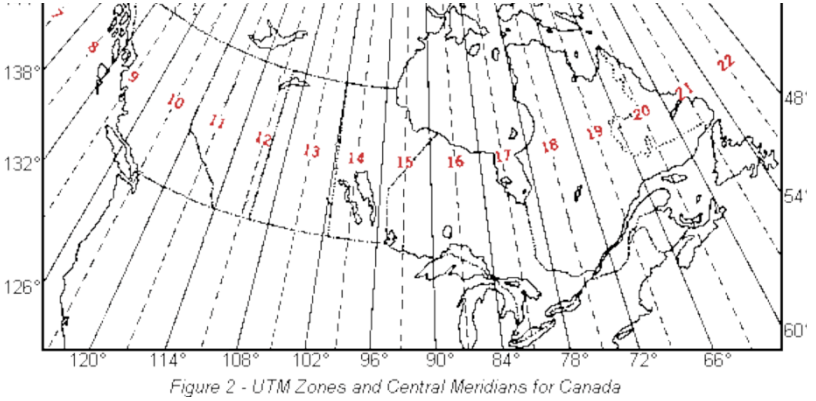


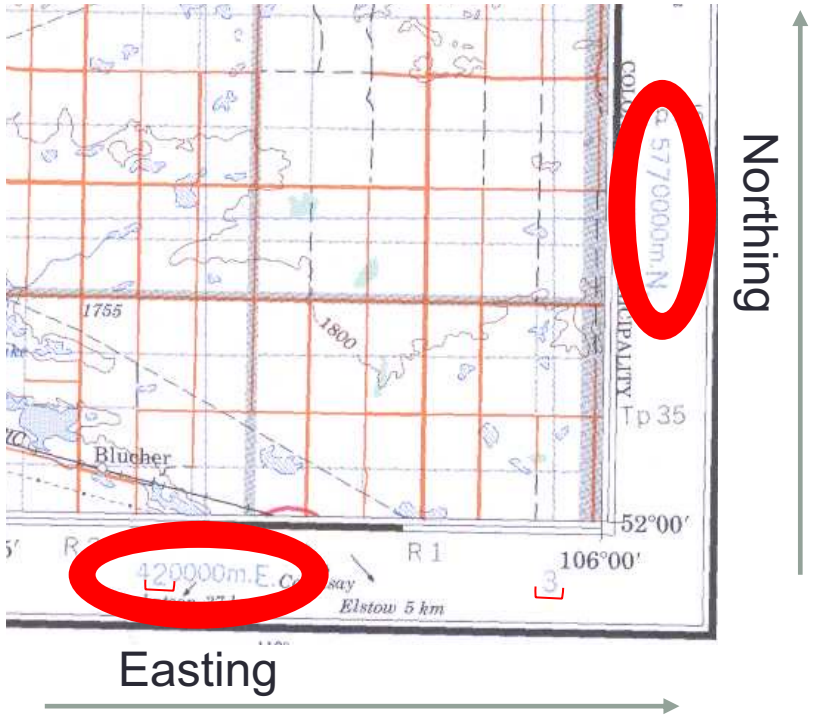
Figure 2 - UTM Zones and Central Meridians for Canada

Vertical Grid Lines ("EASTINGS")

- Labelled based on the central meridian (500,000 m)
- Increase as you move East

Horizontal Grid Lines ("NORTHINGS")

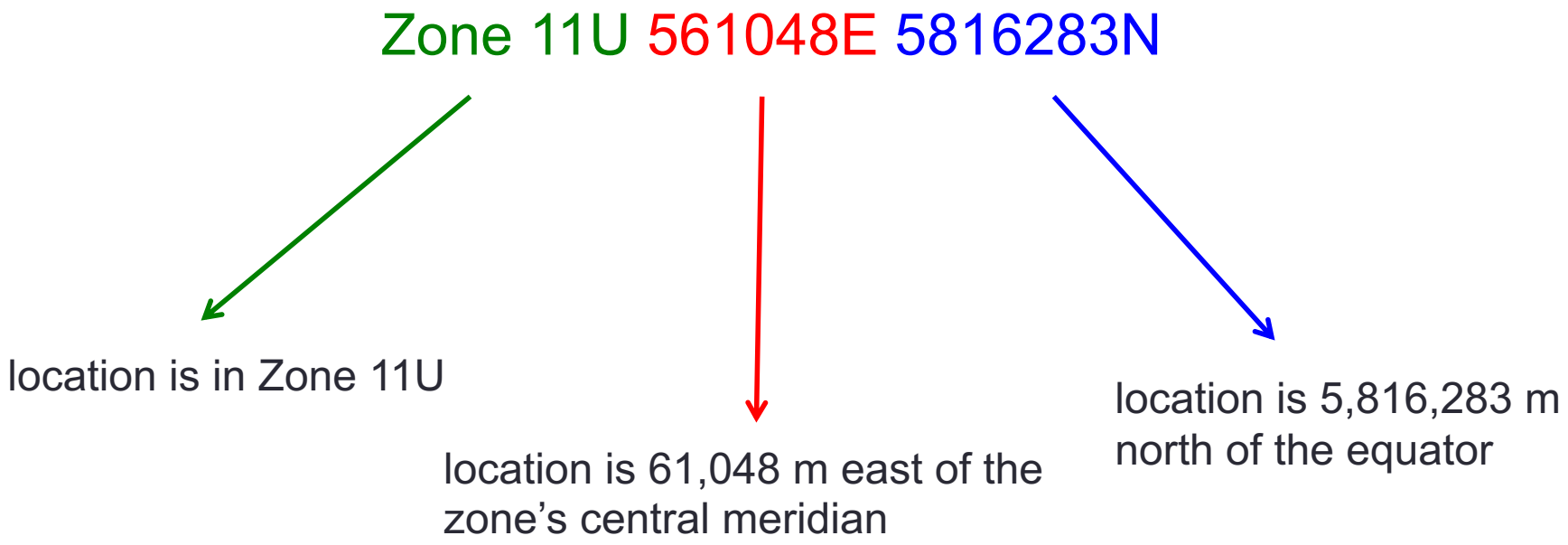
- Labelled based on equator (0 m)
- Increase as you move North



UTM SYSTEM

UTM COORDINATE = ZONE EASTING NORTHING

e.g. Zone 11U 561048E 5816283N



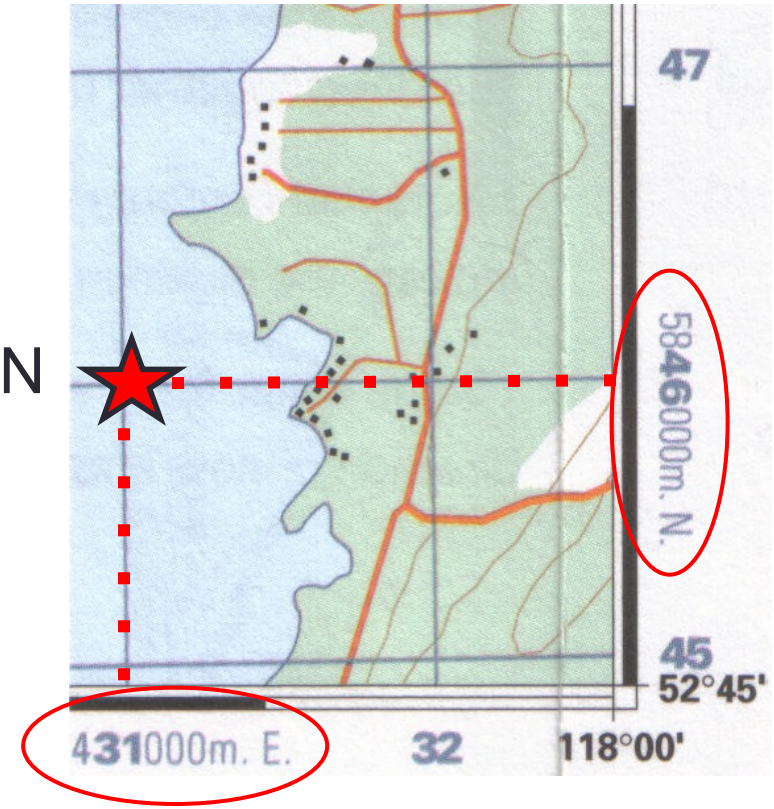
UTM SYSTEM

Finding a UTM coordinate for a location on a map:

- Find what Easting and what Northing intersect at that point

Easting stated first, then northing:

431000E, 5846000N



UTM GRID

To refer to a location between grid lines, estimate (or measure with a ruler) how many metres east and north the point is located from grid lines

431800E, 5846400N

EASTING:

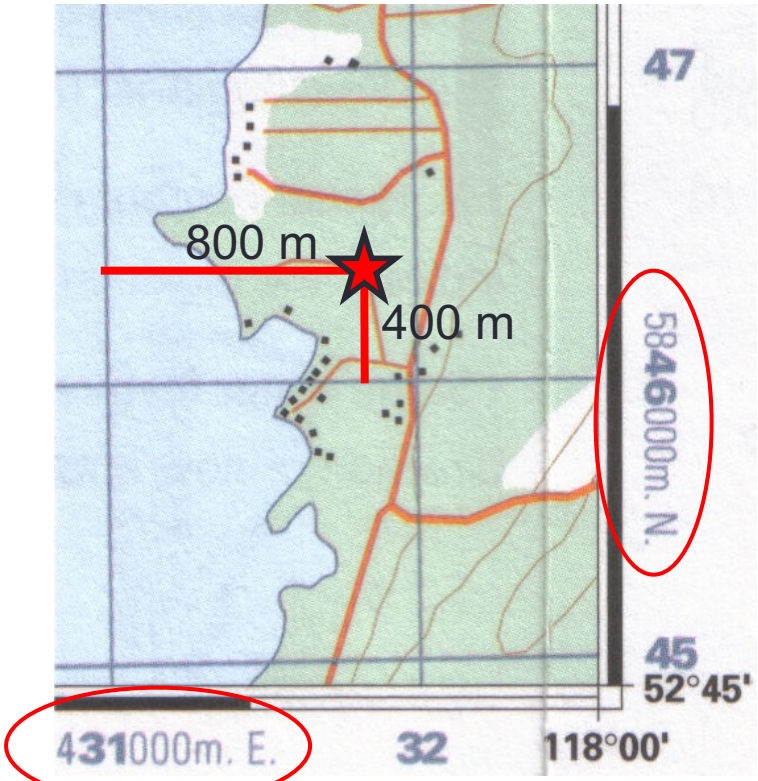
Estimate how many metres the point is to the East of a grid line, and add that to the Easting of the grid line

- 431000 m + 800 m = 431800 m

NORTHING:

Estimate how many metres the point is North of a grid line, and add that number to the Northing of the grid line

- 5846000 m + 400 m = 5846400 m



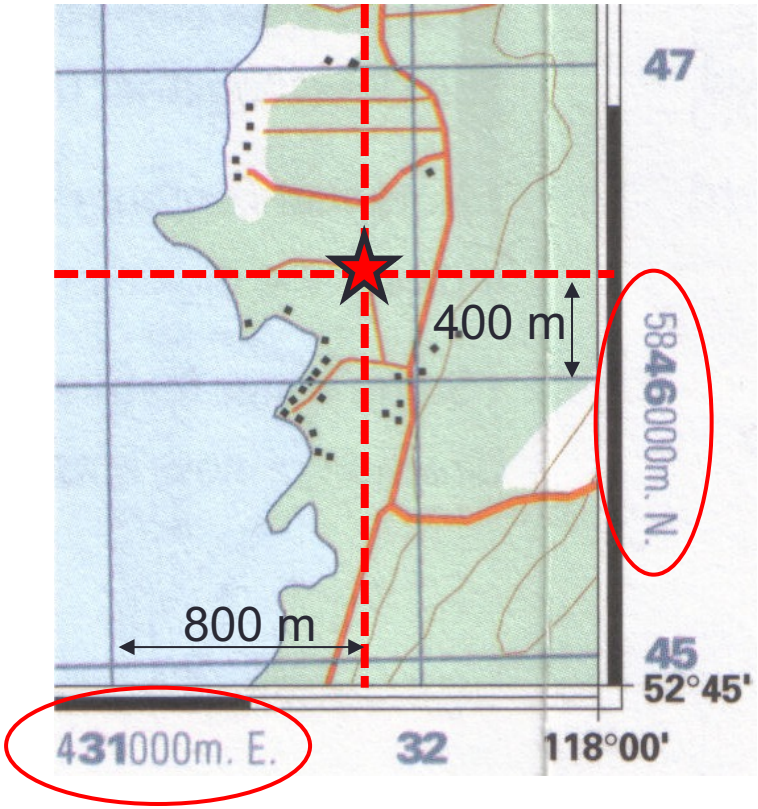
UTM SYSTEM

Plotting a coordinate:

431800E, 5846400N

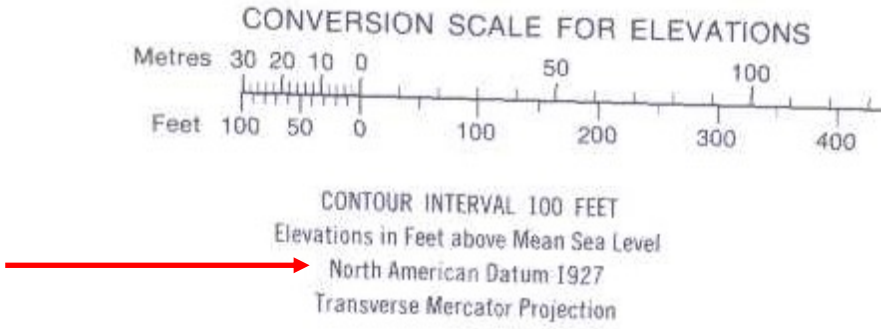
EASTING:
Estimate 800 m East of the 431000 m grid line

NORTHING:
Estimate 400 m North of the 5846000 m grid line



DATUMS

- A *datum* is a reference system of surveyed points used to plot grid lines on a map
  - North American Datum 1927 (NAD 27) – older topographic maps
  - North American Datum 1983 (NAD 83) – newer topographic maps
  - World Geodetic System 1984 (WGS 84) – digital maps



Additional Resources

More information on topographic maps:
https://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/national-topographic-system-maps/topographic-maps-tips-and-hints/9809

Buy or download topographic maps:
https://www.canmaps.com/topo/buy-topo-maps.htm

Short video on lat/long:
https://www.youtube.com/watch?v=-RVsZsK_r1c

More information on UTM:
http://www.land-navigation.com/utm_grid.html
https://www.youtube.com/watch?v=LcVIx4Gur7I

Visual explanation of datum:
https://www.youtube.com/watch?v=xKGlMp__jog