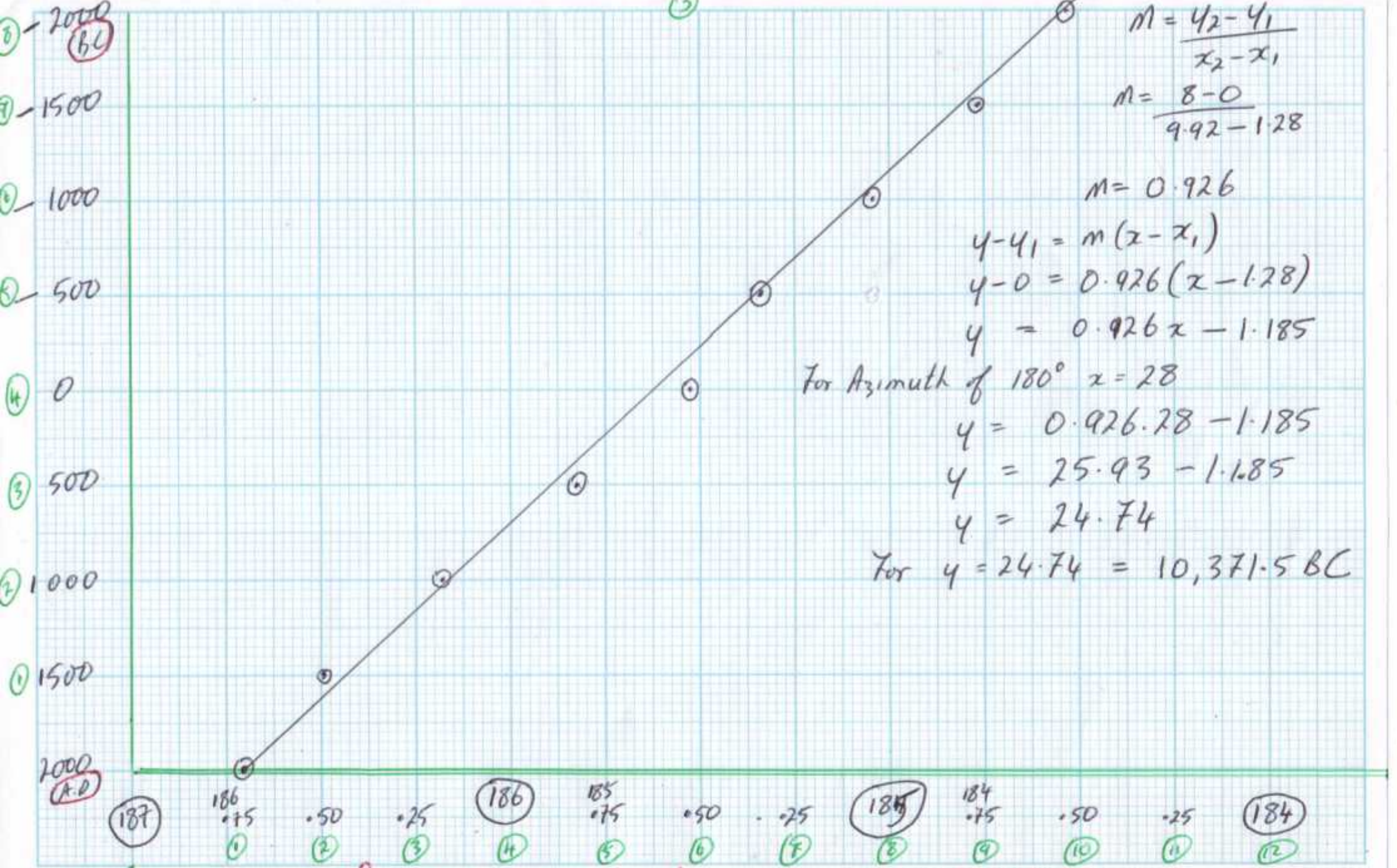
E.S.R.L. Global Monitoring Division GRAD GROUP Latitude 53.780131, Longitude -8.31608, @1400 hours. Daylight saving time applied.				
21/12	Azimuth (o.)	Solar Noon	Declination (o.)	Elevation (o.)
2000 BC	184.52	13.40:39	-23.92	12.26
1950 BC	184.56	13.40:30	-23.91	12.27
1500 BC	184.76	13.39:38	-23.87	12.30
1000 BC	185.03	13.38:30	-23.81	12.34
500 BC	185.32	13.37:15	-23.75	12.38
0	185.52	13.36:26	-23.69	12.43
500 AD	185.84	13.35:05	-23.63	12.47
1000 AD	186.17	13.33:42	-23.57	12.51
1500 AD	186.49	13.32:22	-23.50	12.56
2000 AD	186.68	13.31:34	-23.44	12.61
2012 AD	186.67	13.31:35	-23.44	12.61
2013 AD	186.70	13.31:27	-23.44	12.61
22/12				
2000 BC	184.42	13.41:06	-23.91	12.28
1950 BC	184.45	13.40:58	-23.90	12.28
1500 BC	184.65	13.40:07	-23.86	12.32
1000 BC	184.92	13.38:59	-23.80	12.36
500 BC	185.21	13.37:45	-23.75	12.39
0	185.40	13.36:57	-23.68	12.45
500 AD	185.72	13.35:35	-23.63	12.48
1000 AD	186.05	13.34:13	-23.57	12.52
1500 AD	186.37	13.32:52	-23.51	12.56
2000 AD	186.56	13.32:.04	-23.43	12.62
2012 AD	186.56	13.32:05	-23.43	12.62
2013 AD	186.59	13.31:57	-23.43	12.62

Question 1

The E.S.R.L data suggest that progressing backwards in time Azimuth tends towards 180 degrees at 1400 hours at Tonroesouterrain.

Assuming that this progression is linear determine when this might have been, by extrapolating the given data.



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8 - 0}{9.92 - 1.28}$$

$$m = 0.926$$

$$y - y_1 = m(x - x_1)$$

$$y - 0 = 0.926(x - 1.28)$$

$$y = 0.926x - 1.185$$

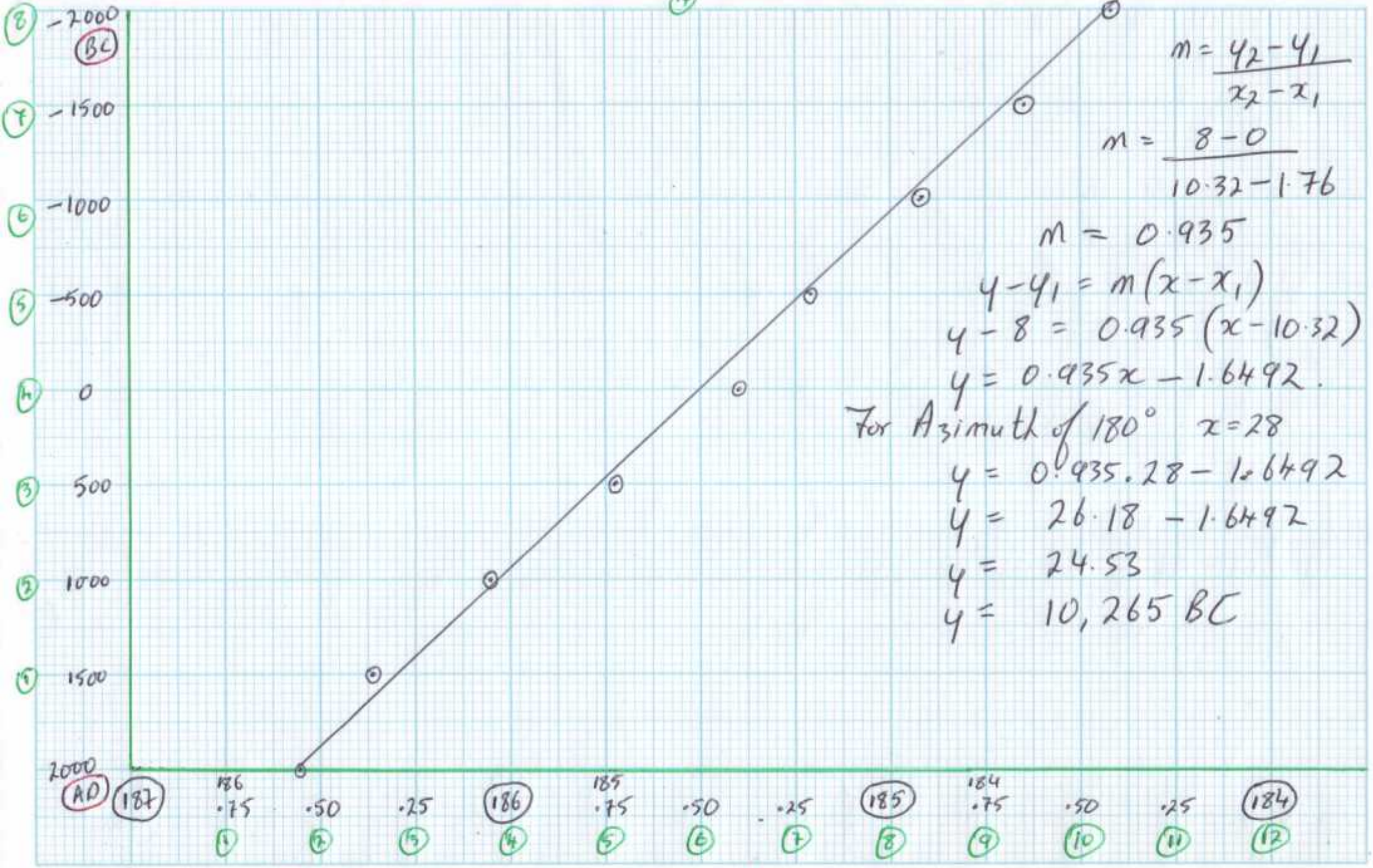
For Azimuth of 180° $x = 28$

$$y = 0.926 \cdot 28 - 1.185$$

$$y = 25.93 - 1.185$$

$$y = 24.74$$

For $y = 24.74$ = 10,371.5 BC



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8 - 0}{10.32 - 1.76}$$

$$m = 0.935$$

$$y - y_1 = m(x - x_1)$$

$$y - 8 = 0.935(x - 10.32)$$

$$y = 0.935x - 1.6492.$$

For Azimuth of 180° $x = 28$

$$y = 0.935.28 - 1.6492$$

$$y = 26.18 - 1.6492$$

$$y = 24.53$$

$$y = 10,265\ BC$$

YEAR

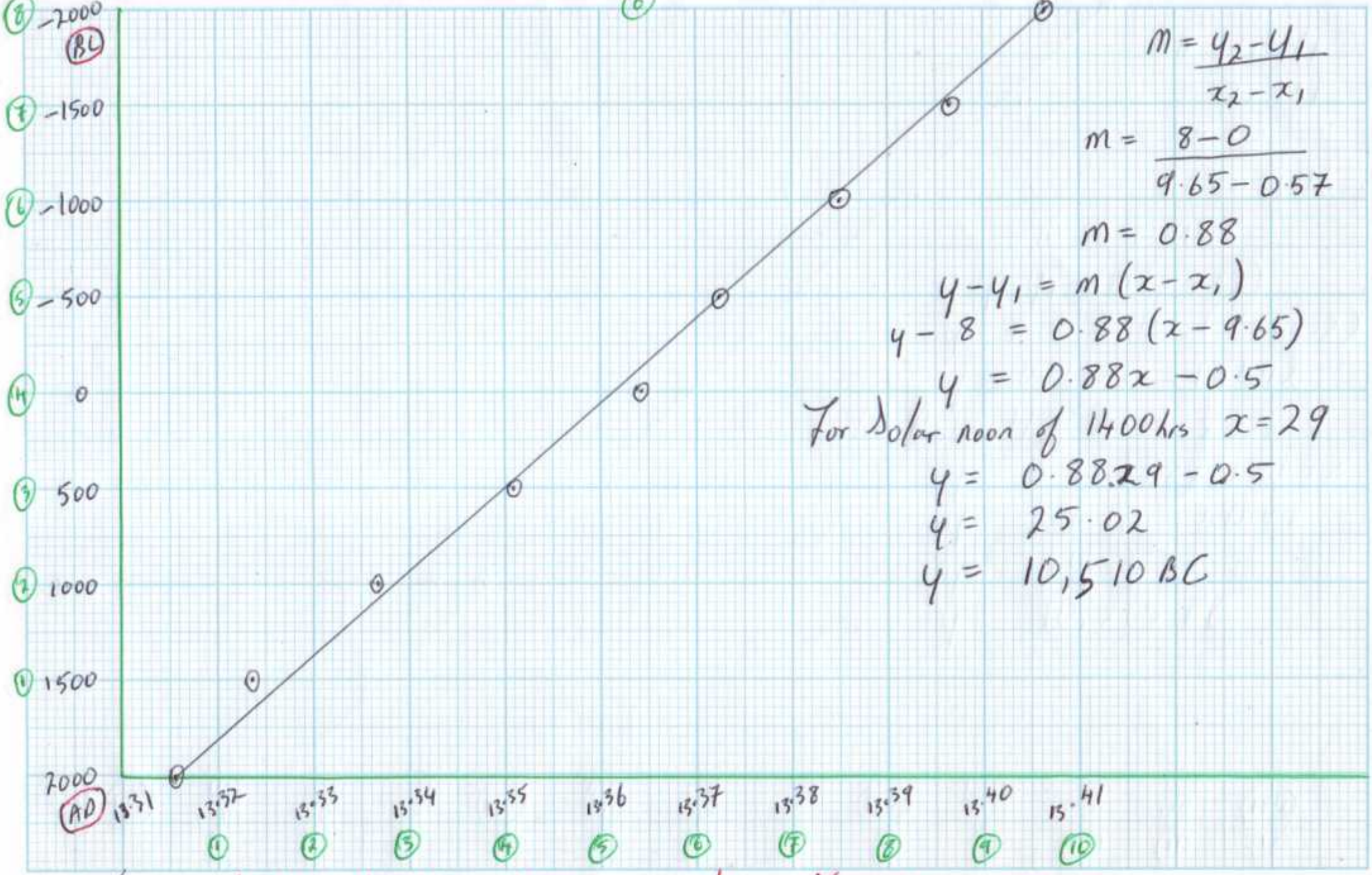
AZIMUTH° @ 14:00 hrs 22/12 TONADESOUTERRAIN.

(5)

Question 2

The E.S.R.L data suggest that progressing backwards in time solar noon tends towards 1400 hours at Tonroesouterrain.

Assuming that this progression is linear determine when this might have been by extrapolating the given data.



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8 - 0}{9.65 - 0.57}$$

$$m = 0.88$$

$$y - y_1 = m(x - x_1)$$

$$y - 8 = 0.88(x - 9.65)$$

$$y = 0.88x - 0.5$$

For Solar noon of 1400 hrs $x = 29$

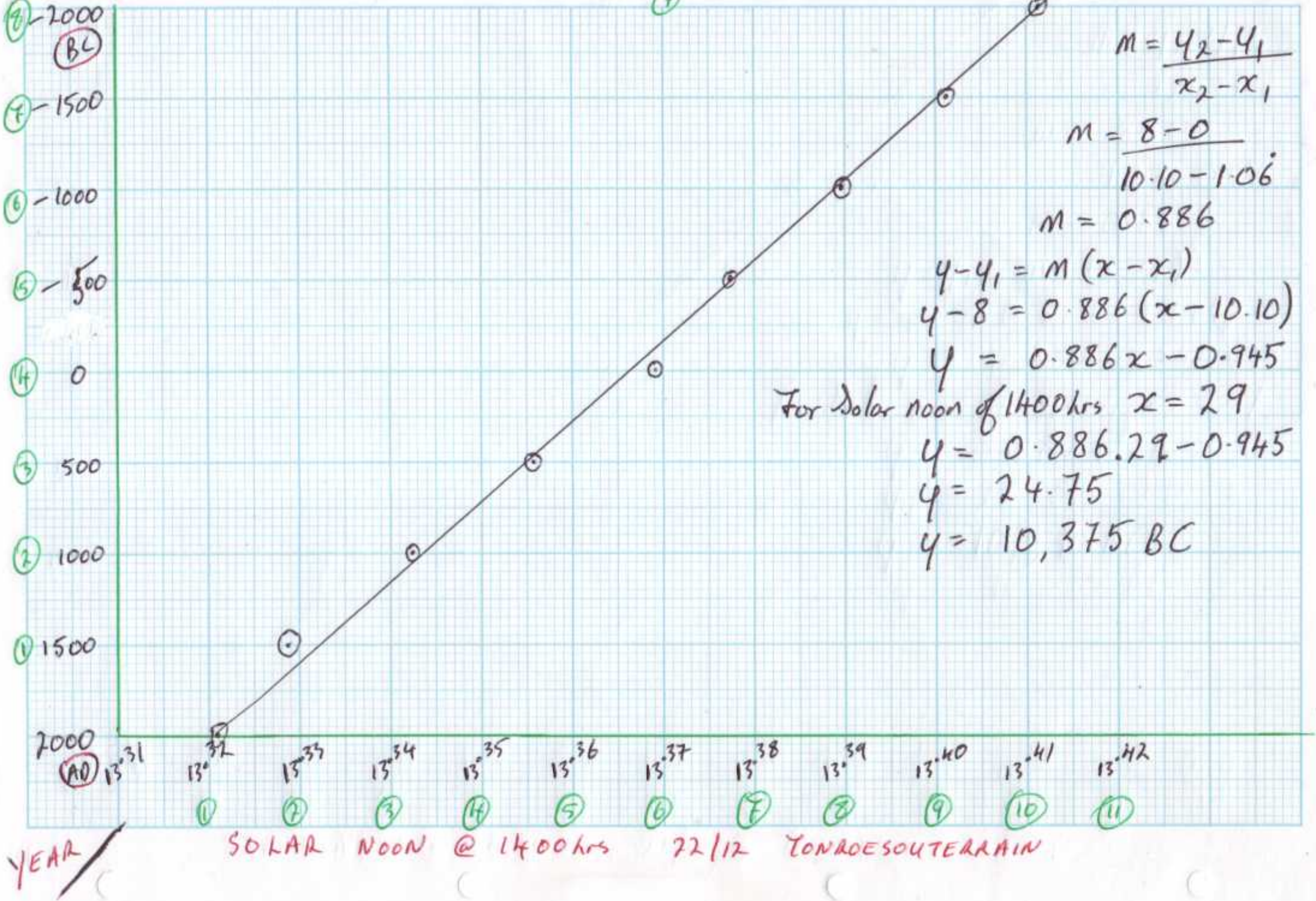
$$y = 0.88 \cdot 29 - 0.5$$

$$y = 25.02$$

$y = 10,510$ BC

YEAR

SOLAR NOON @ 14:00 hrs 21/12 TON ROE SOUTERRAIN.



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8 - 0}{10.10 - 1.06}$$

$$m = 0.886$$

$$y - y_1 = m(x - x_1)$$

$$y - 8 = 0.886(x - 10.10)$$

$$y = 0.886x - 0.945$$

For Solar noon of 1400hrs $x = 29$

$$y = 0.886.29 - 0.945$$

$$y = 24.75$$

$$y = 10,375\ BC$$

Answers- Questions 1 and 2

10,375BC +/- 122.5 years (Mean 10,380BC)

(I) The consistency of the answers suggest that linear extrapolation of E.S.R.L data is a legitimate exercise.

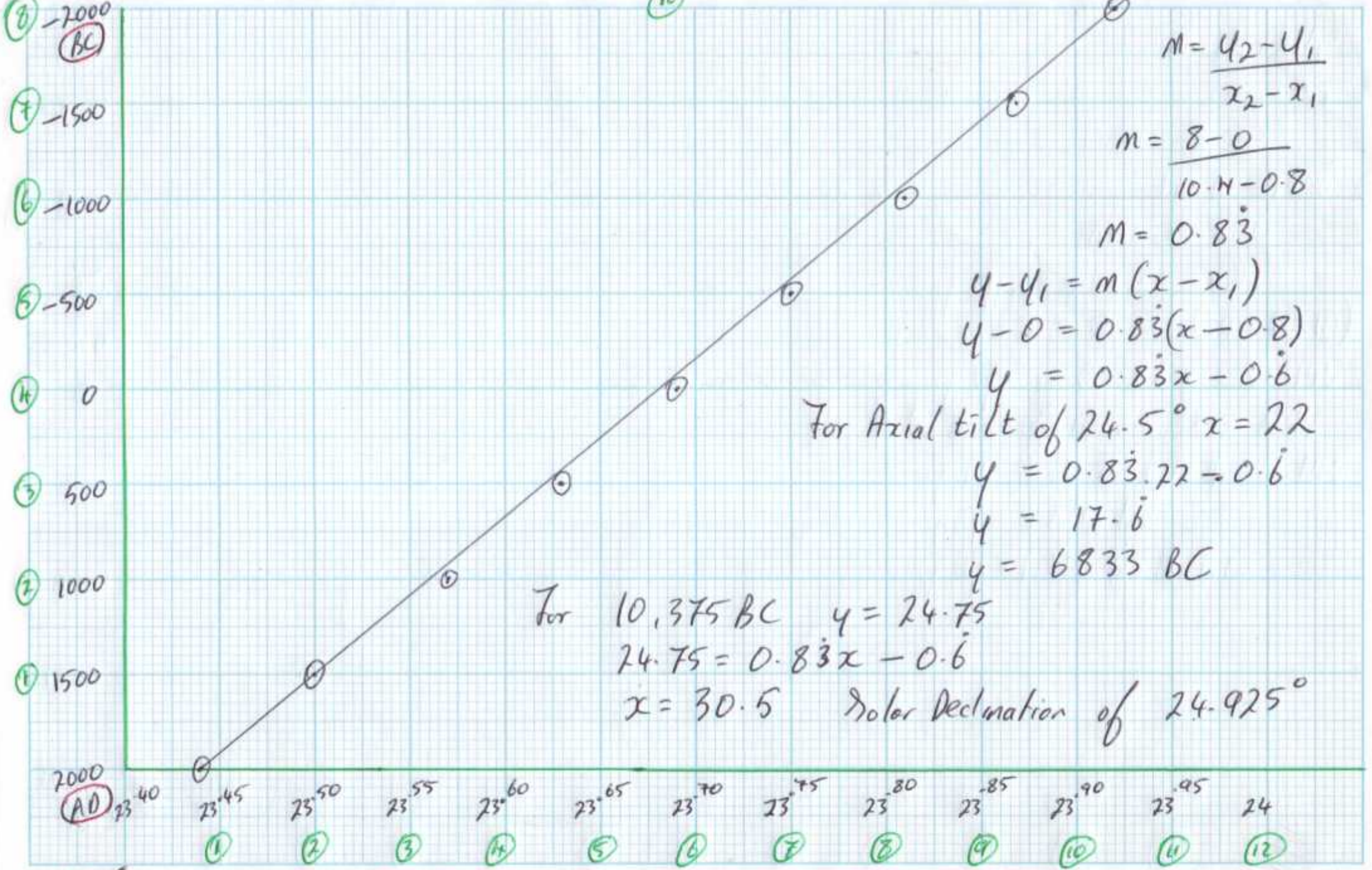
(II) The answers mean going backwards in time toward 10,375BC Tonroesouterrain comes to face directly south at that time of day when its optimal function and solar noon are the same (2pm GMT)

(III) And conversely that at 10,375BC Tonroe was slightly in excess of 7 degrees (28minutes of time) longitude west of its current position.

Question 3

(I) By extrapolation of the E.S.R.L data determine when the earth may have reached solar delclination of 24.5 degrees (which is its maximum axial tilt).

(II) What the solar declination would have been @ 10,275BC (assuming the progression is linear).



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8 - 0}{10.4 - 0.8}$$

$$m = 0.8\dot{3}$$

$$y - y_1 = m(x - x_1)$$

$$y - 0 = 0.8\dot{3}(x - 0.8)$$

$$y = 0.8\dot{3}x - 0.\dot{6}$$

For Axial tilt of $24.5°$ $x = 22$

$$y = 0.8\dot{3}.22 - 0.\dot{6}$$

$$y = 17.\dot{6}$$

$$y = 6833 \text{ BC}$$

For 10,375 BC $y = 24.75$

$$24.75 = 0.8\dot{3}x - 0.\dot{6}$$

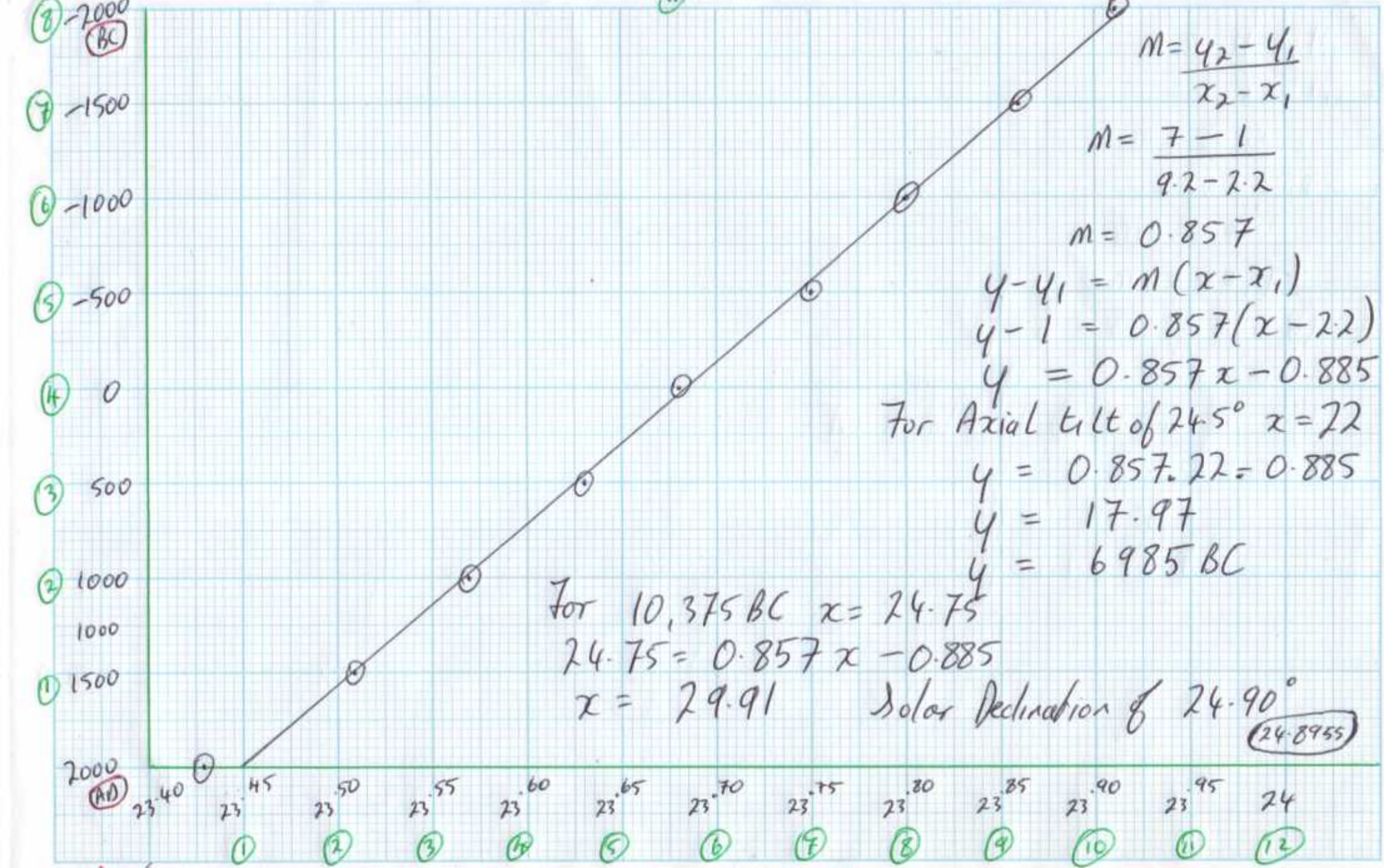
$x = 30.5$ Solar Declination of $24.925°$

YEAR

SOLAR DECLINATION ≠ AXIAL TILT OF EARTH

in degrees

21/12



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{7 - 1}{9.2 - 2.2}$$

$$m = 0.857$$

$$y - y_1 = m(x - x_1)$$

$$y - 1 = 0.857(x - 2.2)$$

$$y = 0.857x - 0.885$$

For Axial tilt of 24.5° $x = 22$

$$y = 0.857 \cdot 22 = 0.885$$

$$y = 17.97$$

$$y = 6985 \text{ BC}$$

For 10,375 BC $x = 24.75$

$$24.75 = 0.857x - 0.885$$

$$x = 29.91$$

Solar Declination of 24.90° (24.8955)

22/12

Answers Question 3

(i) Solar declination of 24.5 degrees would have occurred at Tonroe at winter solstice (21/22 December) at about 6900BC at 1400hours.

(ii) The Milankovitch cycles suggest that maximum earth axial tilt occurred about 8700

~ Solar declination is not the same as earth axial tilt as other factors such as apsidial orbital precession and orbital eccentricity would also affect it (see appendix 1).

~ This opens up the possibility that solar declination in excess of maximum earth axial tilt may have obtained before 6900BC.

(III) The data suggest that at 10,375BC solar declination at Tonroe at winter solstice (21/22 December) at 1400 hours would have been 24.9 degrees.

~ This is 1.46 degrees more/lower than now

~ For the shaft of light to penetrate the small creep passage and enter the northern (now filled in) section of the cave solar declination needs to be about 2.45 degrees lower than now (Deficit ~1 degree)

~ For optimal cave function (Basic cave mathematics section proof of question 3) solar declination needs to be 3.84 degrees lower than now. (Deficit 2.38 degrees)

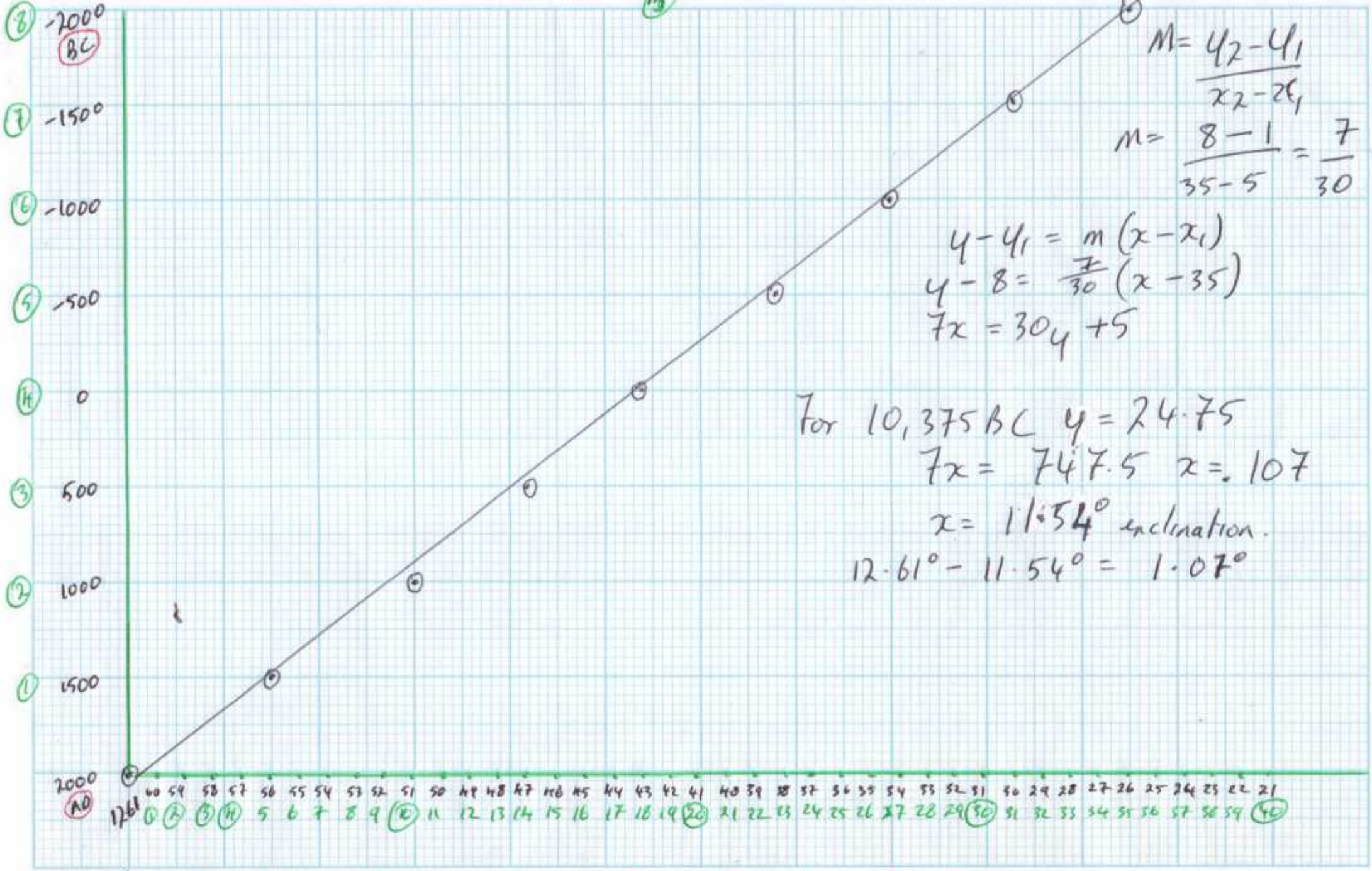
~ The alignment of Tonroesouterrain to the midday sun at winter solstice (21-22 December) at 1400 hours could not have occurred without an adjustment in solar declination of 2.38 degrees in excess of what can be accounted for by the extrapolated data for the shaft of light to be projected onto the west wall of the northern section (now filled in) of the cave, or of 1 degree in excess of what can be accounted for by the extrapolated data for the shaft of light to be projected into the northern (now filled in) section of the cave, at all.

~ This would require a rotation of the earth relative to its axis of rotation such that Tonroe would be moved in excess of 2.30 south in latitude.

~ Only periodic reversals of the polarities of the Suns magnetic fields could accomplish this.

Question 4.

By extrapolation of the E.S.R.L. data determine what the Solar Elevation might have been at Tonroesouterrain at Winter Solstice (21st /22nd December) at 1400 hours at 10,375 BC (assuming the progression is linear).



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{8-1}{35-5} = \frac{7}{30}$$

$$y - y_1 = m(x - x_1)$$

$$y - 8 = \frac{7}{30}(x - 35)$$

$$7x = 30y + 5$$

For 10,375 BC $y = 24.75$

$$7x = 747.5 \quad x = .107$$

$x = 11.54°$ inclination.

$12.61° - 11.54° = 1.07°$

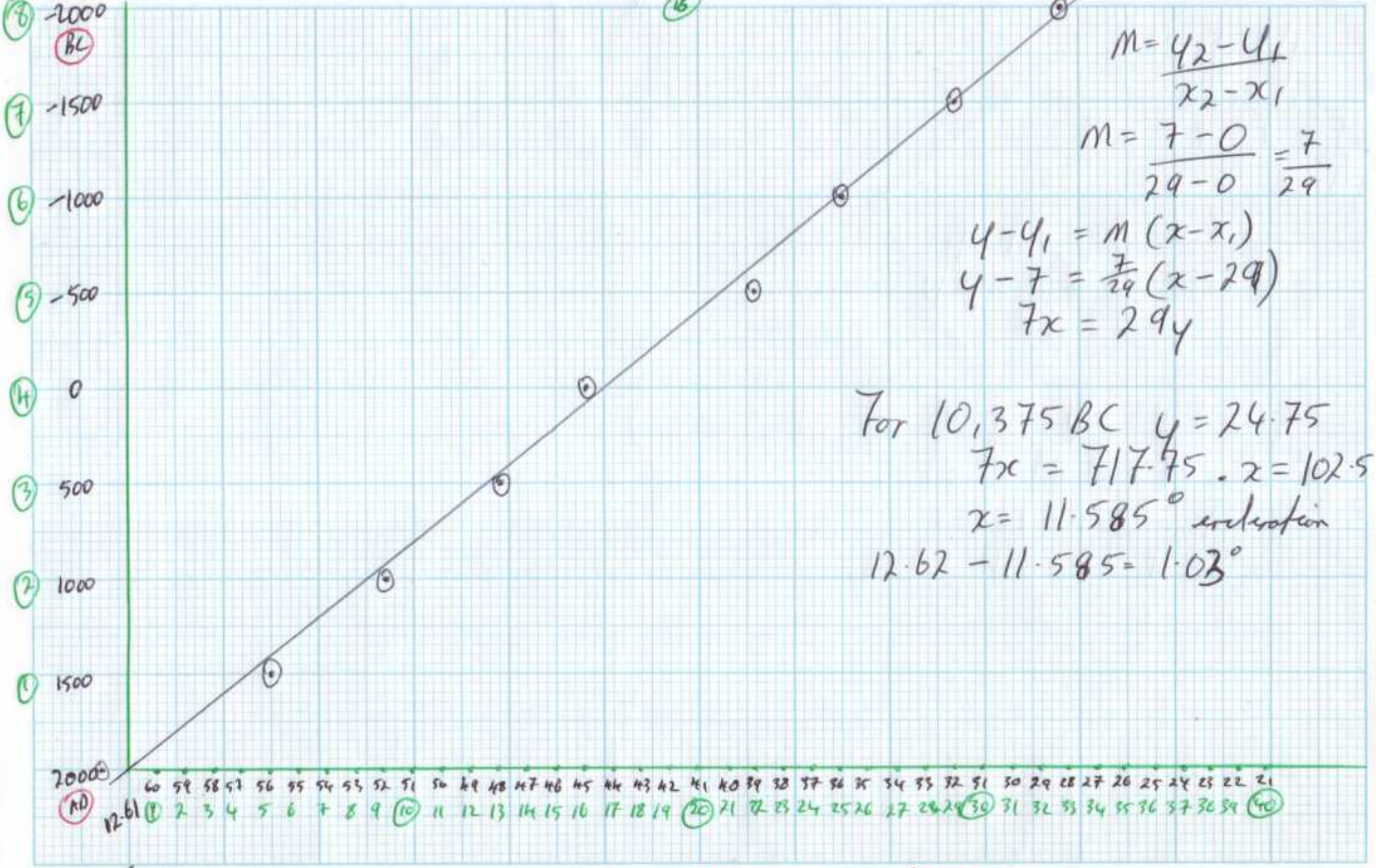
YEAR

ELEVATION @ 1400 hrs 21/12

LATITUDE 53.780131

LONGITUDE -8.31608

TONROE SOUTH TERRAIN



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{7 - 0}{29 - 0} = \frac{7}{29}$$

$$y - y_1 = m(x - x_1)$$

$$y - 7 = \frac{7}{29}(x - 29)$$

$$7x = 29y$$

For 10,375 BC $y = 24.75$

$7x = 717.75$. $x = 102.5$

$x = 11.585°$ inclination

$12.62 - 11.585 = 1.03°$

YEAR / ELEVATION° @ 1400 hours 22/12

LATITUDE 53.780131

LONGITUDE -8.31608

TONROE SOUTERRAIN

Answer Q4.

The data suggest that at 10375 BC Solar Elevation at Tonroe at Winter Solstice 1400 hours (21st/22ndDecember) would have been 11.56 degrees.

This is 1.05 degrees lower than now.

For the shaft of light to penetrate the small creep passage and enter the northern (now filled in) section of the cave
Solar Elevation needs to be 2.45 degrees lower than now .
Deficit 1.4 degrees.

For optimal cave function (Basic Cave Mathematics section Proof of Q3) such that the shaft of light would enter the northern (now filled in)section of the cave and be projected up onto its western wall
Solar Elevation needs to be 3.84 degrees lower than now .
Deficit 2.8 degrees.

This is probably a more reasonable conclusion than that derived from Question 3 but requires a greater rotation of the Earth relative to its axis of rotation (0.41 degrees).

Again such rotation could only result from major changes in the Suhs Magnetic Fields.

Conclusions from the E.S.R.L. data.

1. The answers to Questions 1 and 2 suggest that it is reasonable to assume that Tonroesouterrain may have been built in alignment to the midday sun at winter solstice (21st/22nd December) at 1400 hours.

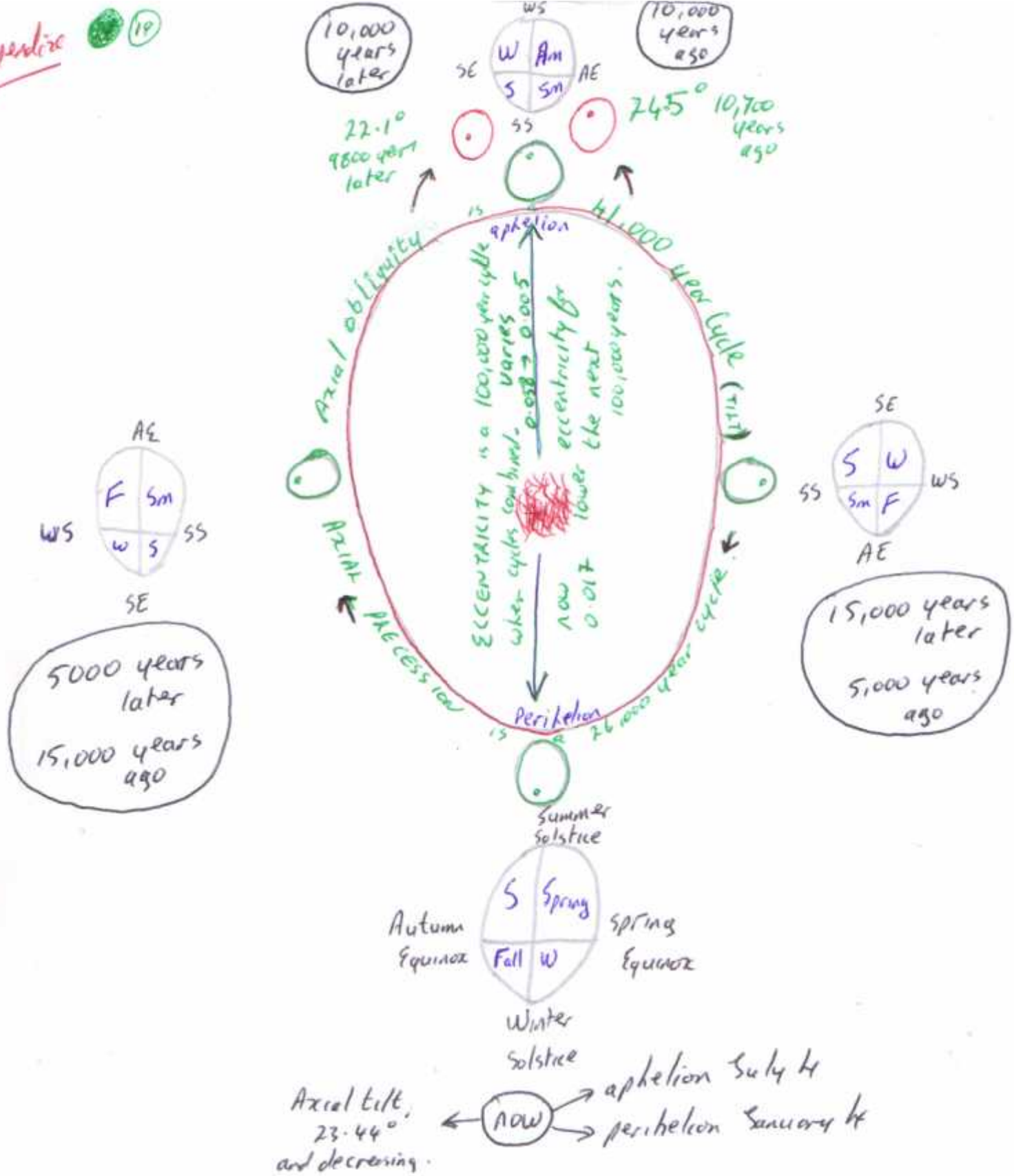
2. The answers to Questions 3 and 4 suggest that alignment of Tonroesouterrain to the midday sun at winter solstice (21st/22nd December) at 1400 hours
such that the cave would function optimally (ie the shaft of light would be projected well up onto the western wall of the northern (now filled in) section of the cave)
would have to be adjusted by a factor in excess of 3
(1.46+1.05=2.51 divided by 2 =1.255 multiplied by 3 =3.765
which is less than the 3.84 degrees required (Proof of Q3 Basic Cave Mathematics).

   This would position Tonroe significantly north in latitude of its current position,
   consistent with the last Ice Age
   which could only be accounted for by reversals of the Suns magnetic fields.
   Should this be the case (as in the case of Venus which is now upside-down spinning counter to all other planets in our solar system)
   this phenomenon seems to be just nudging Earth along the direction it is going anyway.

= Therefore the data suggest a maximum age for Tonroesouterrain of 10,375 BC and a minimum age of 3113BC.

= Confirmation of all these conclusions derived from analysis of Tonroesouterrain would require examination in similar depth of a sister souterrain aligned to equinox and/or summer solstice.
Such caves possibly exist within the Rathcroghan complex.

Appendix (19)



Axial tilt, 23.44° and decreasing.

NOW → aphelion July 4
NOW → perihelion January 4

ORBIT (ANNUAL) AROUND THE SUN

ORBITAL PRECESSION: Loss of 20 seconds (time) per year shunts the Earth back in this direction

AXIAL PRECESSION or PRECESSION OF THE EQUINOXES is a cycle of ~ 21,636 years, adjusted by apsidal orbital precession, the effects of general relativity and the effects of the oblateness of the Sun.