

Sunlighting

- 1 Find the Latitude of the 'Arctic Circle' and the 'Tropic of Cancer' given that the maximum value of declination is 23.4° , and that anywhere within the 'Arctic Circle' experiences 24 hours of sunlight for at least one day in the year, and that within the 'Tropics' the sun is at zenith at least once in the year. ($66.6^\circ, 23.4^\circ$)

- 2 Determine the Azimuth as measured from South if the Azimuth of the sun is 253° measured clockwise from North. 73° West

- 3 Calculate for a Latitude of 52° North, Longitude 0° , the position in the sky of the sun at the following times;
 - i) 10am GMT on the 12th December $\gamma = 10.4^\circ, z = 27.9^\circ$ East
 - ii) 4pm BST on the 16th July $\gamma = 43.8^\circ, z = 65.9^\circ$ West

- 4 A tower block located at a Latitude of 52° North is 40m high and has a 10m square plan which is oriented such that one façade faces due south, i.e. the normal to the face of the building points in a southerly direction at an azimuth of 0° (180° from North).

For the two times given in question 3, calculate the length of the shadow cast by the building if the ground is horizontal, calculate the area of ground covered by the shadow of the building and sketch the shadows of the building on a plan to a scale of 1:2000. (i) 218m, 2946m^2
 (ii) 41.7m, 551m^2

- 5 Sketch simple stereographic sunpath diagrams for the Latitudes;
 - i) 51.3° North, $\gamma_{\text{noon}} = 15.3^\circ, 38.7^\circ, 62.1^\circ, z_{\gamma=0} = 50.6^\circ, 129.4^\circ$
 - ii) 77° North, $\gamma_{\text{noon}} = -13^\circ, 36.4^\circ, \gamma_{\text{midnight}} = 10.4^\circ$ N
 - iii) 10° South. $\gamma_{\text{noon}} = 56.6^\circ$ N, 80° N, 76.6° S, $z_{\gamma=0} = 66.2^\circ, 113.8^\circ$

(note: draw only the sunpaths for the solstices and the equinoxes but include hour lines at two hourly intervals.)

- 6 If the building described in Q4 were to be located at the three Latitudes given in Q5, estimate the number of hours during the summer and winter solstices when sunlight would be incident on the various façades.

(i)				(ii)				(iii)			
N	S	E	W	N	S	E	W	N	S	E	W
Wint.	0	$7\frac{1}{2}$	$3\frac{3}{4}$	Wint.	0	0	0	Wint.	11	0	$5\frac{1}{2}$
Equ.	0	12	6	Equ.	0	12	6	Equ.	6	0	6
Sum.	7	9	$8\frac{1}{4}$	Sum.	13	11	12	Sum.	0	13	$6\frac{1}{2}$