EXAMPLE 2.3
Calculation of Gravity at various latitudes and heights

INPUTS:

Equatorial radius	R_0 =	6378137	m
Ellipsoid eccentricity	f =	0.003353	
Gravitational constant	μ =	3.99E+14	m^3s^{-2}
Earth rate	ω_{ie}	7.29E-05	rad s^{-1}

	Case	(a)	(b)	(c)	(d)	(e)	(f)
Latitude	L_b (degrees) =	45	45	45	0	90	60
Latitude	L_b (radians) =	0.785398163	0.785398	0.785398	0	1.570796	1.047198
Height	h_b (metres) =	1000	0	10000	1000	1000	1000

Polar radius, $R_P = (1-f)R_0$	6356752.314	m
Eccentricity, e	0.081819191	

Surface acceleration due to gravity (Somigliana model)

From (2.134),

$$g_0(L_b) \approx 9.7803253359 \frac{(1+0.001931853 \sin^2 L_b)}{\sqrt{1-e^2\sin^2 L_b}} \text{ m s}^{-2}$$

Down component of acceleration due to gravity

From (2.139),

$$g_{b,D}^n(L_b,h_b) \approx g_0(L_b)\left\{1-\frac{2}{R_0}\left[1+f\left(1-2\sin^2 L_b\right)+\frac{\omega_{ie}^2 R_0^2 R_P}{\mu}\right]h_b+\frac{3}{R_0^2}h_b^2\right\}$$

North component of acceleration due to gravity

From (2.140),

$$g_{b,N}^n(L_b,h_b) \approx -8.08\times 10^{-9} h_b \sin 2L_b \text{ m s}^{-2}$$

Case	(a)	(b)	(c)	(d)	(e)	(f)
$g_0(L_b) \approx$	9.806197771	9.806198	9.806198	9.780325	9.832185	9.819177
$g_{b,D}^n(L_b,h_b) \approx$	9.803112948	9.806198	9.775415	9.777238	9.829102	9.816093
$g_{b,N}^n(L_b,h_b) \approx$	-0.00000808	0	-8.1E-05	0	-9.9E-22	-7E-06