1.(a) Using (2b) with $D_1 = 100$, $D_2 = 1.5 \times 100 = 150$ mm
then $g = 707.3$ and $C \approx 352.8$ mm
checking length, from (2a) with $C = 353$, is O.K.
Note that centre distances to nearest mm is more than adequate, in view of belt tolerances.

(b) - as (a) with $D_2 = 200$ mm gives $C = 310$ mm

(c) - as (a) with $D_2 = 315$ mm gives $C \approx 194.3$ mm
and checking length from (2a) gives $L = 1102$ mm.
So, by trial and error, $C = 193 \rightarrow L = 1100$ mm.
Conclusion - (2b) is generally never enough without further trials.
Note that installation would be different here as L is only just $> (D_1 + D_2)/2$, the minimum.

2(a) $k_\pi = 1 - \exp(-0.512\pi) = 0.800$

$v = \pi d n = \pi \times 0.1 \times 4200/60 = 22.0$ m/s.

$P_0 = k_\pi v [F (L_0/2vT_0)^{1/m} - M/D - \rho v^2]$ - see (5b)

$= 0.8 \times 22.0 [3216 (1.717/2 \times 22.0 \times 93.6E6)^{0.09} - 23.93/0.1 - 0.09682 \times 22.0^2]$

$\frac{m}{s} [N (m \frac{s}{m} \frac{1}{s}) Nm \frac{1}{m} \frac{kg}{m} \times \frac{m^2}{s^2} \equiv N]$

$= 17.6 (460.4 - 239.3 - 46.8) = 3.07$ kW

which tallies with the code.

(b) Repeating (a) with $L = 3080$ mm replacing $L_0 = 1717$ mm
$P_\pi = 3.50$ kW.
So increased belt length gives increased capacity by factor of $3.50/3.07 = 1.14$. This is not quite in accord with code value of 1.13 since this latter is an approximation to cover all drives with a 3080mm belt.

(c) Repeating (a) with $T = 10E3 \times 3600 = 36E6$ s in lieu of T_0
$P_\pi = 3.79$ kW - an increase of 24% on P_0.

3. Insert values into (5b) to allow repetitive solution for P_π (kW) for given D (m) and v (m/s):-

$P_\pi = 0.8 v [3216 (1.717/2 v \times 93.6E6)^{0.09} - 23.93/d - 0.09682 v^2] \times 10^{-3}$ kW

$\frac{m}{s} [N (m \frac{s}{m} \frac{1}{s}) Nm \frac{1}{m} \frac{kg}{m} \frac{m^2}{s^2} = N]$ kN/N.

$= 0.4863 v^{0.91} - 0.01914 v/d - 0.07743 \times 10^{-3} v^3$ kW

values of which are plotted overleaf.

A second plot, of peak rating from the above formula versus pulley diameter, illustrates clearly the diminishing gains to be had from increase in pulley size.

From (5c) the effectiveness, ρ, is:-

$\rho = (P/F k_\theta v z)(2 v T_0/L_0)^{1/m}$

$= (P_\pi \times 10^3/3216 \times 0.8 \times v \times 1)(2v \times 93.6E6/1.717)^{0.09}$