2a) $V_D = 2.15$ m/s ; $a_D = 8.41$ m/s^2 ; $K_{DE} = 12.3$ rad/s (↺)

3a) $V_D = 2.05$ m/s ; $\omega_{AB} = 2.5$ r/s ; $\omega_{CB} = 11.67$ r/s ; $\omega_{BD} = 4.44$ r/s

Velocity of rubbing at A = 204 mm/s and D = 67 mm/s.

$T_A = 217.5$ N m

4a) $P = (T_1 - T_2)V$ ∴ $T_1 - T_2 = 1000$ N

$T_1/T_2 = e^{\mu\theta} = 2.37$ ∴ $T_1 = 1730$ N and $T_2 = 730$ N.

$T_0 = (T_1 + T_2)/2 = 1230$ N.

Initial tension is increased by 10%. ∴ $T_0' = 1.1 \times 1230 = 1353$ N.

$T_0' = (T_1 + T_2)/2$ ∴ $T_1 + T_2 = 2706$ ∴ $T_1 = 803$ N & $T_2 = 1903$ N

$P = (T_1 - T_2)V = 2750$ N.

4b) $\theta_0 = 60 \times \pi/180 = 1.047$ rad ; $\theta_R = 90 \times \pi/180 = 1.57$ rad.

$V_a = \pi N s/2\theta_a = 1.76$ m/s ; $V_d = \pi N s/2\theta_d = 1.17$ m/s

$f_a = \pi^2 N^2 s/2\theta_a^2 = 166.55$ m/s^2 ; $f_d = \pi^2 N^2 s/2\theta_d^2 = 74.07$ m/s^2

5a) $R = mT/2 = 240$ mm ; $r = mt/2 = 160$ mm.

Max. possible length of path of approach = $r \sin\phi$

Actual length of path of approach = $r \sin\phi$ (0.4)

Actual length of path of recess = $R \sin\phi$ (0.4)

∴ $0.4 r \sin\phi = \sqrt{R_a^2 - (R\cos\phi)^2} - R\sin\phi$ ∴ $R_a = 248.3$ mm.

Addendum on the wheel = 248.3 − 240 = 8.3 mm

$0.4 R \sin\phi = \sqrt{r_a^2 - (r\cos\phi)^2} - r\sin\phi$ ∴ $r_a = 174$ mm.

Addendum on the pinion = 174 − 160 = 14 mm.

Arc of contact = $0.4\left(\frac{r\sin\phi + R\sin\phi}{\cos\phi}\right)$ = 58.2 mm.