

**Engineering Tripos Part IIA: Module 3C8
Machine Design**

Numerical answers – 2022

1. (b) $\phi = \cos^{-1}\left(\frac{1}{\sqrt{1+2\tan^2\theta}}\right)$, (c)(i) $\Omega R\phi = (-\tan\theta \quad -\tan\theta \quad 0)^T$,
(c)(ii) $\frac{-2\Omega\tan\theta}{\sqrt{1+2\tan^2\theta}}$ along the common normal direction
2. (a) $-1; \frac{ae_1}{be_2}$
2. (b) $\alpha = \frac{\left(\frac{ae_1+1}{be_2}\right)}{2}, \beta = \left(\frac{ae_1}{be_2} - 1\right)/2$
2. (c) $\frac{\alpha}{\alpha+\beta/2}$
3. (a)(i) 50 m/s, 3.30 (a) (ii) 90 s approx., b(ii) 40 s approx., choosing $G=6.6$
4. (a) 1.26 T (b) 6008