UNIT 12 AG Marking Scheme.

p. 12-14.

a) $\omega = \omega_0 + \alpha t$

b) $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$.

c) $\omega^2 = \omega_0^2 + 2\alpha\theta$

/3 (-1.5 for no derivation)

p. 12-16

b) data /2

c) $F_1 d_1 = F_2 d_2$. /1

d) $\tau_1 = \tau_2$ for all data points. /1

/4

p. 12-20

a) Mr^2 /1

b) Mr^2

c) Mr^2

d) Mr^2

(b–d) /1

e) Mr^2. /1

/3

p. 12-21

a) hoop. mass dist. away from rot. axis. /1

b) hoop. (larger I). /1

c) disk (smaller I, less resistance to τ). /1

d) disk faster. /1

/4

p. 12-23

a) $I = 1.69 \times 10^{-4}$ kg m^2. /1

b) $\pi r_i^2 - \pi r_{i-1}^2$

$\Delta I_i = \frac{A_i}{A} \cdot M r_i^2$ /3

$I = \sum_i \Delta I_i$

1 pt if calcs not general.

c) spreadsheet. /3.

ΔA_i ΔI_i I

d) $\frac{\text{numerical}}{\text{theo.}} \times 100\%$. /1

e) { more rings /1
{ use r_i = avg of r_{outer} & r_{inner}

neither 0.5

f) $k = \sqrt{\frac{I}{M}} = 9.2 \times 10^{-3}$ m. /1

UNITS -0.5

/10

P. 12-26.

UNITS -0.5 Conversion -0.5

/8

a) CD's

$r_d = 0.06\,m$ $M_d = 0.060\,kg$

$I_d = \frac{1}{2}MR^2 = \frac{1}{2}(0.060)(0.06)^2 = 1.08 \times 10^{-4}\ kg\,m^2$ /1

hole

$r_h = 0.007m$ $M_h = \frac{A_{hole}}{A_{disk}} \cdot M_d = \frac{0.007^2 \pi}{0.06^2 \pi} \cdot 0.060\,kg = 8.17 \times 10^{-4}\,kg$ /1

$\frac{1}{2}MR^2$

$I_h = \frac{1}{2}(8.17 \times 10^{-4})(0.007)^2 = 2.0 \times 10^{-8}\,kg \longleftrightarrow I_h << I_d$ /1

$\Rightarrow I_{CD} = I_d - I_h = 1.08 \times 10^{-4}\ kg\,m^2$ /1

b) $r_s = 0.025m$ $M_s = 0.006\,kg$

$I_s = \frac{1}{2}MR^2 = \frac{1}{2}(0.006)(0.025)^2 = 1.88 \times 10^{-6}\ kg\,m^2$. /1

c) $I = I_{CD} + I_s = 1.1 \times 10^{-4}\ kg\,m^2$ /1

(or: $I \approx I_{CD} = 1.08 \times 10^{-4}\ kg\,m^2$).

d) $m = 0.05\,kg$ $r_s = 0.025m$. /2

(SP12-4 assumption OK $\Rightarrow \alpha = \frac{3}{4} \approx \frac{mgr}{I}$) but Bonus +2 pts

e) $\tau = I\alpha$
$\tau = rF$
$mg - F_T = ma = m\alpha r$

$\Rightarrow \boxed{\alpha = \frac{mgr}{mr^2 + I}} = \frac{(0.05)(9.8)(0.025)}{(0.05)(0.025)^2 + 1.1 \times 10^{-4}} = 87\,rad/s^2.$

($I \approx \frac{1}{2}MR^2$.)

p. 12-28

- experimental procedure - enough details to repeat. /2
- data: /2
- calculations:

  α from slope of ω vs t. /2

/6

p. 12-29

/2 UNITS -0.5

a) α_{th} =

Correspondance

BONUS +2

α_{exp} = should be close if correct eqn's were used.

$$\sigma_{exp} = \sqrt{\frac{\sum (x_i - \langle x \rangle)^2}{N-1}}$$

b) Yes or No + reasonable justification.

/2