Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) $F = 0.11 \times \cos 45$ (= 0.078 N) ✔
$T = F \times 0.12$ on each arm = 9.4×10^{-3} N m
Total $T = 3 \times 9.4 \times 10^{-3} = 0.028$ N m ✔

Do not allow sin 45 instead of cos 45 but give CE for 2nd mark.
No CE for 2nd mark if no attempt to resolve force i.e. no cos or sin.

2

(b) (i) Initially friction torque < applied torque so spinner accelerates / frictional torque increases with speed ✔
Eventually applied torque = friction / resistive torque and spinner angular speed remains constant ✔

For a full answer is in terms of 'force' rather than 'torque' give max 1 mark.

2

(ii) 240 rev min^{-1} = 25 rad s^{-1} OR use of $P = T\omega$ with attempt to convert rev min^{-1} to rad s^{-1} ✔
$P = T\omega$
$P = 0.028 \times 25 = 0.70$ W ✔

Accept attempt such as multiplying by π or dividing by π or 2π, or dividing 240 by 60 and not using 2π.
No CE for incorrect ω
T must be either 0.028 or 0.03 Nm
0.75 W if 3×10^{-2} used

2

(c) (i) Use of $\theta = \frac{1}{2}(\omega_1 + \omega_2)\, t$ OR $\theta = 13 \times 2\pi$ ✔
$= 0.5 \times 25 \times t$
$t = 6.5$ s ✔

CE for ω^1 from b ii

2

(ii) E_K = mean power × time
$= 0.35 \times 6.5 = 2.3$ J
OR
$E_K = T\theta = 0.028 \times 26\pi = 2.3$ J ✔

CE for values of θ and t from c i and P from b ii
Allow use of $E_K = \frac{1}{2} I\omega^2$ with I from part c iii
If T = 0.03 N m used, $E_K = 2.4(5)$ J

1

(iii) $E_K = \frac{1}{2} I\omega^2$

$I = 2 E_K / \omega^2 = 7.3 \times 10^{-3}$ kg m^2 ✔

If 2 J used for E_K, $I = 6.3 \times 10^{-3}$ kg m^2

Alternative: use of $I = T / \alpha$

Where α = 25/ans c i

When $T = 3 \times 10^{-2}$, $I = 7.76 \times 10^{-3}$ kg m^2

CE for ω

1

[10]

Q2.

(a) T = power/ω

Torque = 2500/0.47

5320 N m value to 2 or more sf needed

3

(b) (i) Deceleration= 0.47/34= 0.0138 (rad s^{-2})

moment of inertia = torque / angular deceleration
=5000/0.0138 = 3.57×10^5

kg m^2 (Allow N m s^2)

3.8×10^5 if 5320 used

3

(ii) Suitable equation of motion used with correct data but omitted minus sign

8.0 radian Allow (their $\omega/2\pi$)

1.27 revolutions

Condone 1 revolution

(allowed for thinking question refers to complete revolutions)

3

(c) (i) $F = 65 \times 2.2 \times 0.47^2$

32(31.6 N)

2

(ii) Force produced by friction between the feet and the roundabout

Centripetal force has to act through the centre of mass of the operator
or
The resultant of the frictional force and normal reaction has to pass through the centre of mass

Any indication (eg on diagram) of wrong direction = 0

2

(iii) Ticks 4th box

1

[14]