Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

(a) (i) 8.3 rev = 8.3 × 2 π rad ✓ (= 52 rad)

Use of $\omega_2^2 = \omega_1^2 + 2\alpha\theta$

$0 = 6.4^2 + 2 \times \alpha \times 52$ ✓

If eqtn(s) of motion used correctly with θ = 8.3 (giving α = 2.5), give 2 out of first 3 marks.

OR use of $\theta = \frac{1}{2}(\omega_1 + \omega_2)t$ leading to t = 16.25 s and $\omega_2 = \omega_2 + \alpha t$

α = (−) 0.39 ✓ rad s^{-2} ✓

Accept: s^{-2}

Unit mark is an independent mark

4

(ii) $T = I\alpha$

$= 8.2 \times 10^{-3} \times 0.39 = 3.2 \times 10^{-3}$ N m ✓

Give CE from a i

1

(b) (i) ($W = T\theta$ or $W = T\omega t$) where $\theta = 0.78 \times 270$ √ (= 210 rad)

$= 3.2 \times 10^{-3} \times 210 = 0.67$ J ✓

Give CE from a ii

2

$$\text{ratio} = \frac{900 \times 270}{0.67} \text{ or } \frac{2.4(3) \times 10^5}{0.67}$$ ✓

(b) (ii) $= 3.6 \times 10^5$ ✓

CE from b i. Must be in the form: number × 10^5 with number calculated correctly.

900×270 or $2.4(3) \times 10^5$ or equivalent must be seen for 1st mark

1 mark for only writing 3.6×10^5

2

(Total 9 marks)

Q2.

(a) Use of $I = \Sigma mr^2$ or expressed in words ✓

With legs close to chest, more mass at smaller *r*, so *I* smaller

2

(b) (i) Angular momentum is conserved / must remain constant **OR** no external torque acts √

WTTE

as *I* decreases, *ω* increases and vice versa to maintain *I ω* constant ✓
OR as *I* varies, *ω* must vary to maintain *I ω* constant

2

(ii) (Angular velocity increases initially then decreases (as he straightens up to enter the water)).

No mark for just ang. vel starts low then increases then decreases, i.e. for describing ω only at positions 1,2 and 3.

With one detail point e.g. ✓

- Angular velocity when entering water is greater than at time *t* = 0 s.
- Angular velocity increases, decreases, increases, decreases
- Maximum angular velocity at *t* = 0.4 s
- Greatest rate of change of ang. vel. is near the start
- Angular velocity will vary as inverse of M of I graph

1

(c) angular. momentum = 10.9 × 4.4 = 48 (N m s) ✓

(ω_{max} occurs at minimum *I*)

Allow 6.3 to 6.5. If out of tolerance e.g. 6.2 give AE for final answer

minimum *I* = 6.4 kg m^2 (at 0.4 s) ✓

6.4 × ω_{max} = 48 leading to

ω_{max} = 7.5 rad s^{-1} ✓

3

(Total 8 marks)