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

Q1.

The turntable of a microwave oven has a moment of inertia of 8.2×10^{-3} kg m^2 about its vertical axis of rotation.

(a) With the drive disconnected, the turntable is set spinning. Starting at an angular speed of 6.4 rad s^{-1} it makes 8.3 revolutions before coming to rest.

(i) Calculate the angular deceleration of the turntable, assuming that the deceleration is uniform. State an appropriate unit for your answer.

angular deceleration _____ unit _____

(4)

(ii) Calculate the magnitude of the frictional torque acting at the turntable bearings.

torque _____ N m

(1)

(b) The turntable drive is reconnected. A circular pie is placed centrally on the turntable. The power input to the microwave oven is 900 W, and to cook the pie the oven is switched on for 270 seconds. The turntable reaches its operating speed of 0.78 rad s^{-1} almost immediately, and the friction torque is the same as in part (a)(ii).

(i) Calculate the work done to keep the turntable rotating for 270 s at a constant angular speed of 0.78 rad s^{-1} as the pie cooks.

work done _____ J

(2)

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(ii) Show that the ratio

$$\frac{\text{energy supplied to oven}}{\text{work done to drive turntable}}$$

is of the order of 10^5.

_____

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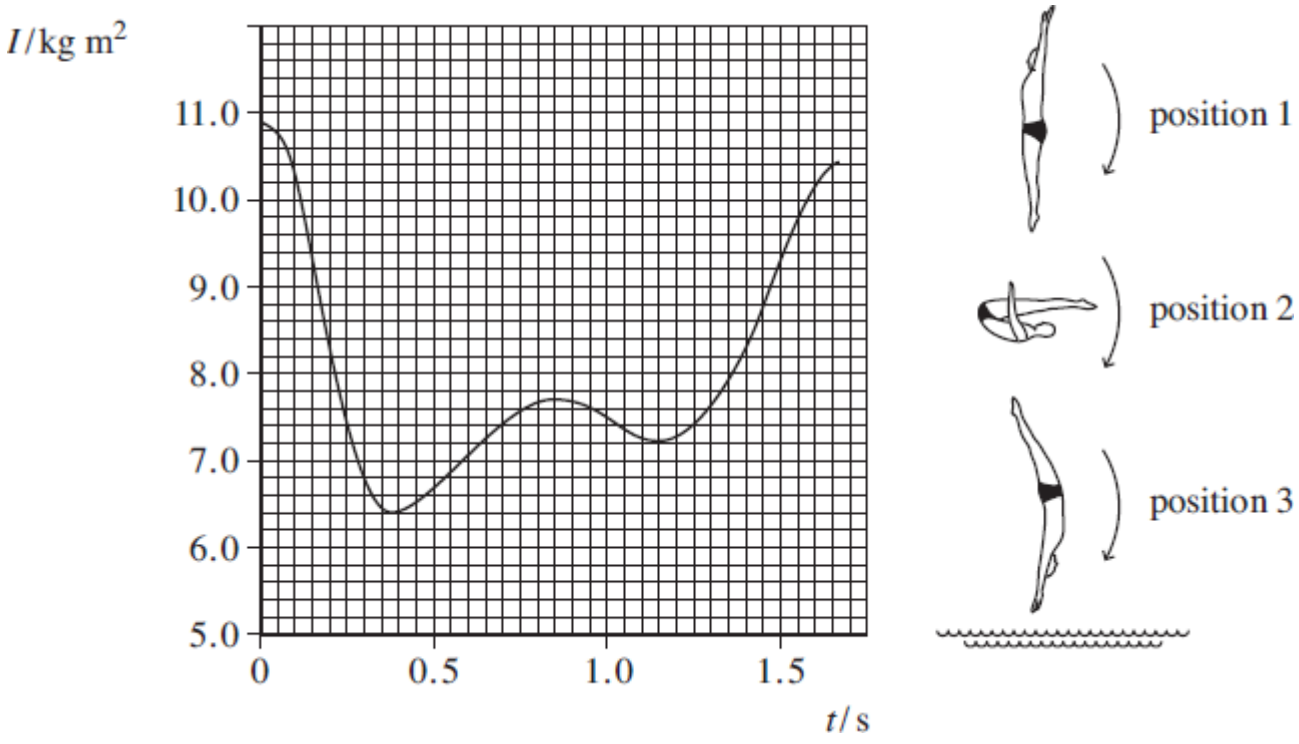
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(2)

(Total 9 marks)

Q2.

The graph below shows how the moment of inertia *I* of a diver performing a reverse dive varies with time *t* from just after he has left the springboard until he enters the water.



The diver starts with his arms extended above his head (position 1), and then brings his legs towards his chest as he rotates (position 2). After somersaulting in mid-air, he extends his arms and legs before entering the water (position 3).

(a) Explain how moving the legs towards the chest causes the moment of inertia of the diver about the axis of rotation to decrease.

_____

_____

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(2)

(b) (i) Explain in terms of angular momentum why the angular velocity of the diver varies during the dive.

_____

_____

_____

_____

_____

(2)

(ii) Describe how the angular velocity of the diver varies throughout the dive.

_____

_____

_____

_____

(1)

(c) At time $t = 0$ the angular velocity of the diver is 4.4 rad s^{-1} and his moment of inertia about the axis of rotation is 10.9 kg m^2.

With reference to the graph above calculate the maximum angular velocity of the diver during the dive.

angular velocity _____ rad s^{-1}

(3)

(Total 8 marks)

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