1 (a) A swimmer is swimming at a constant speed in a pool. Drag forces due to the water oppose the motion of the swimmer.

Explain why the swimmer travels at constant speed.

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…..……………………………………………………………………………………………...……..[2]

(b) The power output P of a swimmer used to overcome the drag forces travelling when at speed v is given by

$$P=\frac{1}{2}C_{D}\rho Av^{3}$$

where C_D is the drag coefficient, ρ is the density of water and A is the frontal area of the swimmer.

In an experiment to measure the C_D for freestyle, the data for a particular swimmer is collected. The data is shown in Table 1.1.

Table 1.1

quantity	magnitude	uncertainty
P/ W	294	± 2
ρ/ kg m^{-3}	1000	± 1
A/ m^2	0.20	± 0.01
v/ m s^{-1}	1.4	± 0.1

Determine the C_D of the swimmer, with its actual uncertainty. Give your answer to an appropriate number of significant figures.

$$C_D = \text{……………….} \pm \text{……...….} \quad [4]$$

(c) **(i)** Derive, from the definition of power, an expression of the drag force F experienced by the swimmer in terms of the velocity v.

[2]

(ii) Hence or otherwise, calculate the work done by the swimmer to overcome the drag force when he swims a distance of 50 m at a constant speed of 1.4 m s^{-1}.

work done = ……………….. J   [2]

[Total: 10]

[Turn over