Energy, Work & Power MS1

Question Number	Answer	Mark
1	Use of power = 660 × mass **(1)** (or see 4.62) Use of energy transferred = power × time **(1)** (allow power = 660) Use of $E_k = \frac{1}{2} mv^2$ **(1)** $v = 1.1$ (m s^{-1}) **(1)** [since *m* cancels it is possible to get 1.1 if 2 mistakes are made – need to check the working. Ignore power of ten errors in the mass] <u>Example of calculation</u> Power supplied by body = (660 W kg^{-1}) × (0.70 × 10^{-6} kg) = 4.62 × 10^{-4} W Energy transferred = (4.62 × 10^{-4} W) × (0.85 × 10^{-3} s) = 3.93 × 10^{-7} J $v = \sqrt{\frac{2 \times 3.93 \times 10^{-7} \text{ J}}{0.70 \times 10^{-6} \text{ kg}}}$ $v = 1.06$ m s^{-1}	**4**
	Use of $a = \frac{v - u}{t}$ **(1)** $a = 1200$ or 1300 m s^{-2} (ecf *v* or "show that" value) **(1)** <u>Example of calculation</u> $a = \frac{1.06 \text{ m s}^{-1} - 0}{0.85 \times 10^{-3} \text{ s}}$ $a = 1250$ m s^{-2}	**2**

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2	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** the <u>oar</u> exerts a force on the water (1) by <u>N3</u> the water exerts an opposite force (on the oar) (1) there is a resultant / net / unbalanced force (1) by <u>N1/N2</u> the boat accelerates (1)	**4**
	work done = area under the graph (1) Value in range of 400 - 600 (J) (1) Accurate value in range 501 - 540 (J) (1) <u>Example of calculation</u> 0.2 0 m × 100 N = 20 J 26.2 squares × 20 J = 524 (J)	**3**
	See/use power = $\frac{\text{work done}}{\text{time}}$ (1) **Or** divides energy by time per stroke (60/24 or 2.5 s) Multiplies energy by rate (24/60 or 0.4 s^{-1}) (1) Power = 210 W (ecf from part (b)(i)) (show that value gives 200 W) (1) <u>Example of calculation</u> Time per stroke = 60/24 = 2.5 s Power = $\frac{524\text{ J}}{2.5\text{ s}}$ = 210 W	**3**
	Friction / drag / resistance with the <u>water</u> (1) (causes) K.E. / turbulence / movement of the water (1)	**2**
	(The boat and the rower have the same velocity but) the rower and the boat have different masses (1)	**1**
	Total for Question 18	**13**

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Question Number	Answer		Mark
3	The balloon has the maximum/great**est** speed/velocity **Or** the great**est** distance is covered in the shortest/same time	**(1)**	**1**
	Use of $\Delta E_{grav} = mg\Delta h$ (with a Δh and not just h) Use of average rate of energy transfer = $\frac{\text{energy}}{0.15\text{ s}}$ (do not penalise power of ten errors for MP2) Average rate of energy transfer = 0.18 – 0.19(W) Example of calculation $\Delta E_{grav} = 0.004\text{ kg} \times 9.81\text{ N kg}^{-1} \times (1.8\text{ m} - 1.1\text{ m}) = 0.027\text{ J}$ Average rate of energy transfer = $\frac{0.027\text{ J}}{0.15\text{ s}} = 0.18\text{ W}$	**(1)** **(1)** **(1)**	**3**
	Total for question 12		**4**

Question Number	Answer		Mark
4	Force × distance moved in the direction of the (applied) force (An equation with defined terms and the direction stated of the distance can score this mark)	**(1)**	**1**
	Use of $KE = \frac{1}{2}mv^2$ (with any velocity in m s^{-1}) Use of Work done $= Fd$ (with any energy) $d = 85$ m **Or** Use of $F = ma$ to find the acceleration Use of suitable equation(s) of motion to find the braking distance $d = 85$ m Example of calculation $KE_{before} = \frac{1}{2} \times 1.5 \times 10^3\text{ kg} \times (24.6\text{ m s}^{-1})^2 = 4.54 \times 10^5\text{ J}$ $KE_{after} = \frac{1}{2} \times 1.5 \times 10^3\text{ kg} \times (13.4\text{ m s}^{-1})^2 = 1.35 \times 10^5\text{ J}$ Transfer of KE = $4.54 \times 10^5\text{ J} - 1.35 \times 10^5\text{ J} = 3.19 \times 10^5\text{ J}$ $3.19 \times 10^5\text{ J} = 3750\text{ N} \times d$ $d = 85.1$ m	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
	Total for question 13		**4**

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