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

Mark Schemes

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	• Use of $v^2 = u^2 + 2as$ (1) **Or** Use of $E_k = \frac{1}{2}mv^2$ **and** $\Delta E_{grav} = mg\Delta h$ • Use of $a = \frac{\Delta v}{\Delta t}$ **and** use of $F = ma$ (1) • Force from ground = required Force + weight (1) • 1041 N (1)	Accept use of $F = \frac{\Delta mv}{t}$ Example of calculation $v^2 = 2 \times 9.81\ \text{m s}^{-1} \times 1.6\ \text{m}$ $v = 5.6\ \text{m s}^{-1}$ $a = \frac{5.6\ \text{m s}^{-1}}{0.9} = 6.2\ \text{m s}^{-2}$ $F = 65\ \text{N} \times 6.2\ \text{m s}^{-2} = 403\ \text{N}$ Force from ground = $403\ \text{N} + (65\ \text{kg} \times 9.81\ \text{N kg}^{-1})$ $= 1040.65\ \text{N}$	4
(ii)	• bending knees increases the time to come to rest (1) • decreasing rate of change of momentum or reducing the deceleration (1) • and (hence) force (1)	Accept converse argument	3

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Use of $\Delta W = F\Delta s$ and $P = W/t$ (1) • Use of $F = ma$ (1) • $a = 0.31\ \text{m s}^{-2}$ (1)	Example of calculation: In 1 second $W = F\Delta s$ $4500\ \text{W} = F \times 34\ \text{m s}^{-1}$ Force applied by motor = 132 N $F = ma$ $132\ \text{N} = 420\ \text{kg} \times a$ $a = 0.31\ \text{m s}^{-2}$	3
(ii)	• Neglect friction forces when it starts from rest (1) **Or** Motor/Driving force independent of speed	Do not accept "force" without a description	1

Q3.

Question Number	Answer	Additional Guidance	Mark
	• Use of $p = mv$ (1) • Use of momentum conservation (1) • $v = 4.1\ \text{m s}^{-1}$ (1)	Example of calculation $p_i = (66 + 52)\ \text{kg} \times 5.6\ \text{m s}^{-1}$ $p_f = (66\ \text{kg})v + (52\ \text{kg} \times 7.5\ \text{m s}^{-1})$ $\therefore v = \frac{(661 - 390)\ \text{kg m s}^{-1}}{66\ \text{kg}} = 4.11\ \text{m s}^{-1}$	3

Q4.

Question Number	Answer	Mark
	Use of $W = VIt$ **(1)** $W = 69\ 000$ (J) **(1)** Use of efficiency = (useful energy / total energy) (x 100%) **(1)** Efficiency = 0.42 (or 42%) **(1)** **Or** Use of $P = IV$ **(1)** Use of $P = W/t$ (to calculate rate of increase of internal energy of water) **(1)** Use of efficiency = (output power / input power) (x 100%) **(1)** Efficiency = 0.42 (or 42%) **(1)** Example of calculation $W = 5.0\ \text{A} \times 230\ \text{V} \times 60\ \text{s} = 69\ 000\ \text{J}$ Efficiency = 29 000 J / 69 000 J = 0.42	**4**

Q5.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of Efficiency = useful energy output/energy input **(1)** • Uses Energy input is power (kW) × time (h) **(1)** • Efficiency = 0.87 **(1)**	Example of calculation $\text{Efficiency} = \frac{22\ \text{kWh}}{3.6\ \text{kW} \times 7\text{h}}$ Efficiency = 0.873	**3**