Torque and Power calculation

Torque:

Weight = m = 100 kg

Gravitational acceleration =a = 9.81 m/s^2

Torque $= T =$ Force $\times$ $Displacement(moment\ arm)$

Force $= F =$ Mass $\times$ $Gravitional\ accleration$

F = 100 kg $\times$ 9.81 m/s^2

F = 981 kg m/s^2 $=$ 981 N

Moment arm:

Assume a typical moment arm for the hip joint is about 0.2 m or 20 cm but this can vary based on body structure.

So:

Torque $= T$ = 981 N $\times$ $0.2\ m$ = 196.2 Nm.

Power:

Power $=$ $Torque$ $\times$ Angular velocity

P = T $\times$ ω

Here ω is the angular velocity in radian per second.

1: Converting hip joint angles to radian

$$\text{Extension} = 20^\circ = 20 \times \frac{\pi}{180} = 0.349\ rad$$

$$\text{Flexion} = 120^\circ = 120 \times \frac{\pi}{180} = 2.094\ rad$$

2: Assume a time for movement.

Let’s say the movement from extension to flexion occurs in 1 second.

$$\omega = \frac{\Delta t}{\Delta t} = \frac{2.094\ rad - 0.349\ rad}{1\ sec} = 1.745\ {}^{rad}/_{sec}\ .$$

So:

$$\text{Power} = 196.2\ \text{Nm} \times 1.745\ {}^{rad}/_{sec}$$

$$P = 342.5\ \text{watt}$$

Torque: Approximately 196.2 Nm.

Power: Approximately 342.5 watt.