Question #76244, Physics Mechanics Relativity

A differential wheel and axle has a wheel diameter [D1] of 300mm and axle diameters of [D2] 100 and [D3] 75mm. The effort required to raise a load of 50kg is 55 N and the effort required to raise a load of 200kg is 180N. Determine the following:

(i) The velocity ratio,

(ii) The law of the machine,

(iii) The efficiency of the machine when raising a load of 100kg.

Solution

i) The velocity ratio

$$VR = \frac{2D_1}{D_2 - D_3} = \frac{2(300)}{100 - 75} = 24$$

ii) $E = a + bW$

$$55 = a + b50(9.81)$$

$$180 = a + b200(9.81)$$

$$a = 13.33, b = 0.085$$

The law of the machine

$$E = 13.33 + 0.085W$$

iii)

$$E = 13.33 + 0.085\big(100(9.81)\big) = 96.715 \, N.$$

$$MA = \frac{W}{E} = \frac{100(9.81)}{96.715} = 10.143$$

The efficiency of the machine when raising a load of 100kg

$$\eta = \frac{MA}{VR} = \frac{10.143}{24} = 0.423 \; or \; 42.3\%$$

Answer provided by https://www.AssignmentExpert.com