Q- A heavy uniform chain lies on horizontal table top If coefficient of friction between the chain and the table top is 0.25 then what is the maximum fraction of the length of the chain that can hang over the edge of the table?

Let the mass per unit length of the chain be λ and its length be L. Let the length of the hanging part of the chain be x.

The weight of the hanging part of the chain will be $\lambda x g$

And the weight of the part of the chain lying on the table will be $(L-x)\lambda g$

Hence limiting friction force acting on the chain due to table will given by

$$F = \mu N = \mu (L-x) \lambda g$$

For the chain to be in limiting equilibrium (just not sliding) the limiting friction on the lying part of the chain must balance the weight of the hanging part of the chain and hence

$$\lambda x g = \mu (L-x) \lambda g$$

Or $x = \mu(L-x)$

Or $x = \mu L/(1+\mu)$

Gives $\frac{x}{L} = \frac{\mu}{1+\mu}$

Or $\frac{x}{L} = \frac{0.25}{1+0.25} = 0.2$

Thus the maximum fraction of the chain can hang over the edge of the table is

$$f = 0.2 = 20\%$$