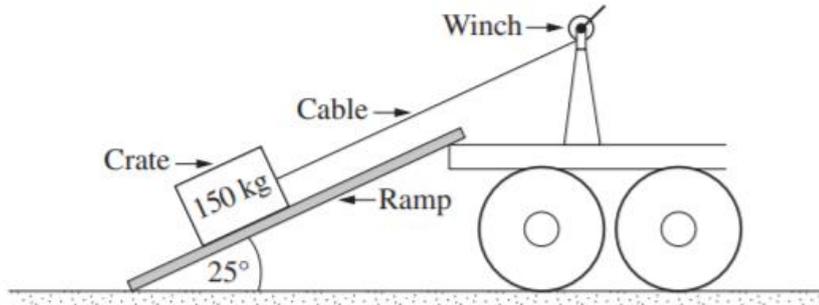**Solving Friction Problems**

2015 HSC Q26a

A winch mechanism is used to pull a 150 kg crate up a ramp and onto a transport vehicle.

The winch cable is parallel to the ramp.

The crate is at the point of sliding up the ramp.

Calculate the tensile force in the cable at this point if the coefficient of friction between the crate and the ramp is 0.3.
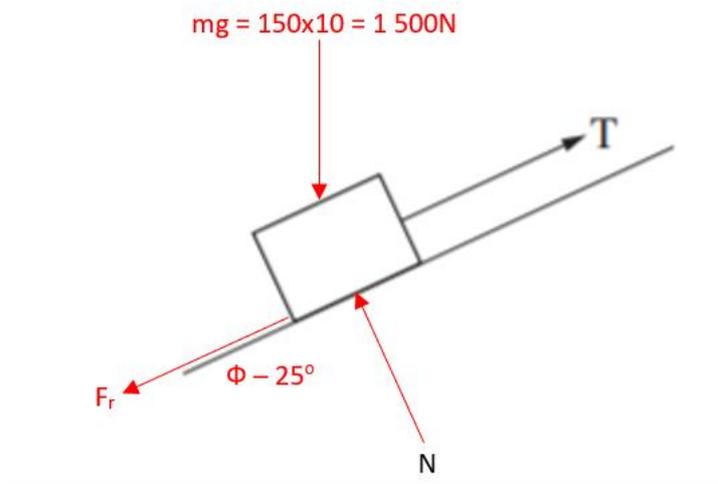
Process.

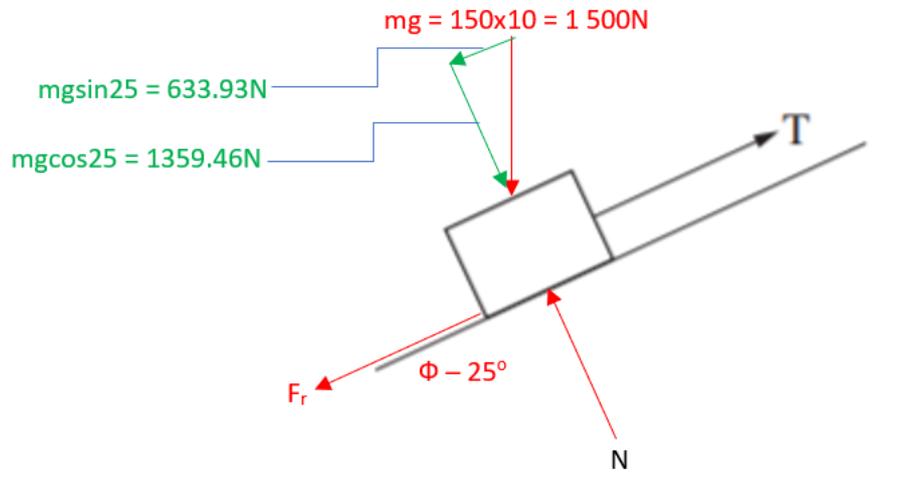1. Highlight all relevant information and analyse the question.
   Analysis (mental notes to self)
   - sliding up ramp so friction acts down ramp
   - point of sliding therefore $\Sigma F = 0$, conditions of equilibrium

2. Draw a free body diagram including all forces and relevant information

mg = 150x10 = 1 500N

3. Resolve all forces (along the plane, into the plane)

mg = 150x10 = 1 500N

mgsin25 = 633.93N

mgcos25 = 1359.46N

T

$\Phi - 25°$

F_r

N

4. Apply conditions of equilibrium and calculate.

$\Sigma F \nearrow = 0$

$0 = F_r + mgsin25 - T$ $F_r = \mu N$ $\mu = 0.3$

                                       $= 0.3 \times 1359.6$ $N = mgcos25$ (since $\Sigma F \searrow = 0$)

                                         $= 407.84N$ $= 1359.46$

$T = F_r + mgsin25$

   $= 407.84 + 633.93$

T = 1 041.77 N