2019-Ph-H2-Q2

Section: Our Dynamic Universe
Topic: Forces, Energy and Power

Summary:
A student of mass $m = 55\,\text{kg}$ abseils down a building using a rope attached at point X, making an angle of 15° to the vertical wall.
We are to:
(a) calculate the student's weight W,
(b) find the tension T in the rope,
(c) determine what happens to T as the angle decreases.

(a) Weight W:
$W = mg = 55 \times 9.8 = 539\,\text{N} \approx 540\,\text{N}.$

(b) Tension T:
The vertical component of tension balances weight:
$T\cos 15^\circ = W.$

$$T = \frac{W}{\cos 15^\circ} = \frac{540}{0.9659} \approx 560\,\text{N}.$$

(c) Effect of decreasing angle:

- As the angle decreases, $\cos\theta$ increases.
- Therefore, $T = W/\cos\theta$ decreases.

Answer: Tension decreases as the rope becomes closer to vertical.

Guidance for Students:

- Always resolve tension into vertical and horizontal components.
- For static cases, vertical forces balance the weight.

Revision Tips:

- $W = mg$ (ensure units in N).
- Use $T = W/\cos\theta$ when rope is angled.
- Visualise forces with a diagram — it clarifies the trig relationships.