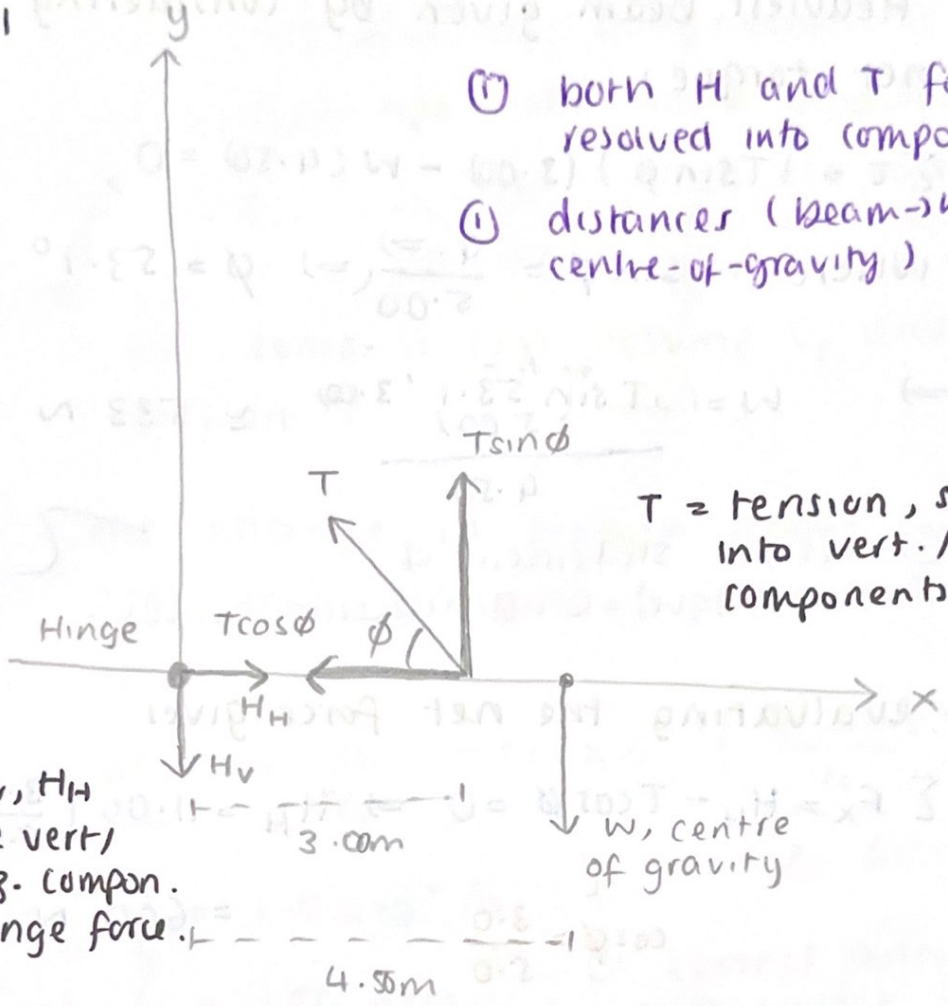
1.1



(1) both H and T forces, resolved into components.

(1) distances (beam→hinge, centre-of-gravity)

T = tension, split into vert./horiz. components.

• H_V, H_H are vert/horiz. compon. of hinge force.

• Since the beam is at rest, the net force and torque is zero, i.e., $\Sigma F_x = 0$, $\Sigma F_y = 0$ & $\Sigma \tau = 0$.

• distance from hinge to cable $= \sqrt{5^2 - 4^2} = 3.00\text{m}$

• let the torque in the anti-clockwise dir^{n} be positive.

1.2. Heaviest beam given by considering net torque:

$$\Sigma \tau = (T \sin\phi)(3.00) - W(4.50) = 0,$$

where $\sin\phi = \frac{4.00}{5.00}$

$$\Rightarrow \quad W = \frac{1.00\times10^3\left(\frac{4.00}{5.00}\right)(3.00)}{4.50} \approx 533\ N.$$

① correct statement of net torque = 0 ② numerical answer.

1.3. evaluating the net force gives

$$\Sigma F_x = H_H - T\cos\phi = 0 \Rightarrow H_H = 1000\left(\frac{3.0}{5.0}\right)$$

$$\cos\phi = \frac{3.0}{5.0} \qquad = 600\ N.$$

and

$$\Sigma F_y = T\sin\phi - H_V - W = 0$$

$$\Rightarrow \quad H_V = 1000\left(\frac{4.0}{5.0}\right) - 533 = 267\ N$$

or your value of W (1.2)

① ① correct resolution of forces in x- and y-directions.

2.1. The amount of compression is dependent upon the bulk modulus K:

$$K = -V_0 \frac{\Delta P}{\Delta V}$$

① correct equation for bulk modulus with minus sign.

for some initial volume V_0 and pressure P.

the change in pressure above atmospheric pressure ($1\,atm = 1.01 \times 10^5\,Pa$) is

$$\Delta P = -K \frac{\Delta V}{V_0} = -(15 \times 10^9)\left(-\frac{0.001 V_0}{V_0}\right)$$

i.e., $\Delta V = -0.001 V_0$

either Pa or atm. is fine.

$$= 1.5 \times 10^7\ Pa$$

$$= 150\ atm.$$

① correct answer with correct ΔV.

2.2. pressure increases by 1.0×10^4 Pa for every km underwater.

$$\text{depth} = \frac{\Delta P}{1.0 \times 10^4} = \frac{1.5 \times 10^7}{1.0 \times 10^4} = 1500\ m.$$

$$\Rightarrow \text{depth} = 1.5\ km$$

① correct answer + statement.

Bone compression is not an issue — huge pressures are needed for just a 0.10% compression. Diving 1.5km is canny far, too.