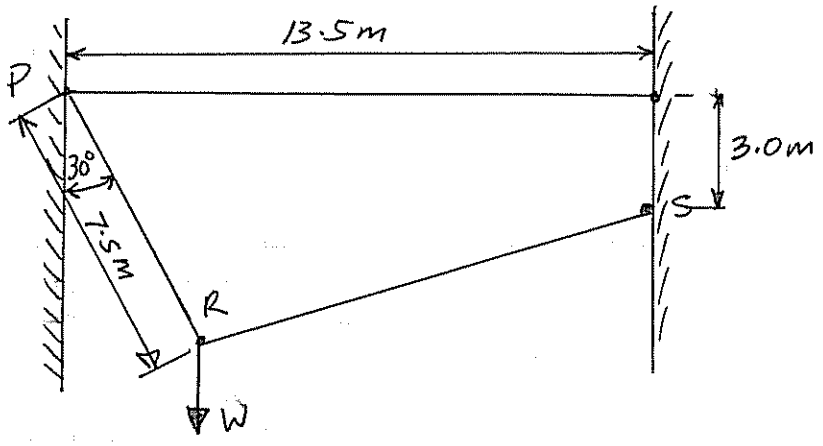
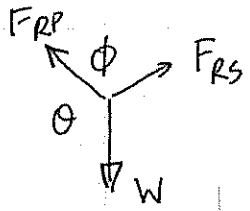
Homework 4 | Solution.

Question 1.

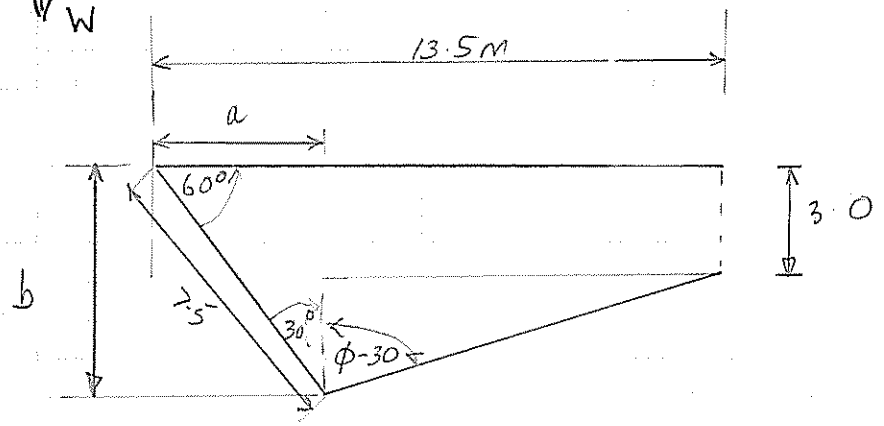


FBD



$\theta = 150^\circ$

$\phi = ?$



$a = 7.5 \cos 60 = 7.5 \sin 30$

$b = 7.5 \cos 30$

$$\phi - 30 = \tan^{-1}\left(\frac{13.5 - a}{b - 3.0}\right)$$

$$\phi = 30 + \tan^{-1}\left(\frac{13.5 - 7.5 \sin 30}{7.5 \cos 30 - 3.0}\right)$$

a) IV) - None of the above

b) d_o

c) $\theta = 150$

$\phi = 100.3°$

Substituting in 1.b) d.

$$F_{RP}\cos 30 + F_{RS}\cos 70.3 = 10\,kN \quad -1)$$

$$-F_{RP}\cos 60 + F_{RS}\cos 19.7 = \phi \quad -2)$$

Rewriting

$$0.87\,F_{RP} + 0.34\,F_{RS} = 10 \quad -3)$$

$$-0.50\,F_{RP} + 0.94\,F_{RS} = \phi \quad -4)$$

Divide 3) by 0.85

Divide 4) by 0.50

$$F_{RP} + 0.4\,F_{RS} = 11.5 \quad 5)$$

$$-F_{RP} + 1.9\,F_{RS} = 0 \quad 6)$$

Add 5) and 6) and solves for F_{RS}

$$2.3\,F_{RS} = 11.5$$

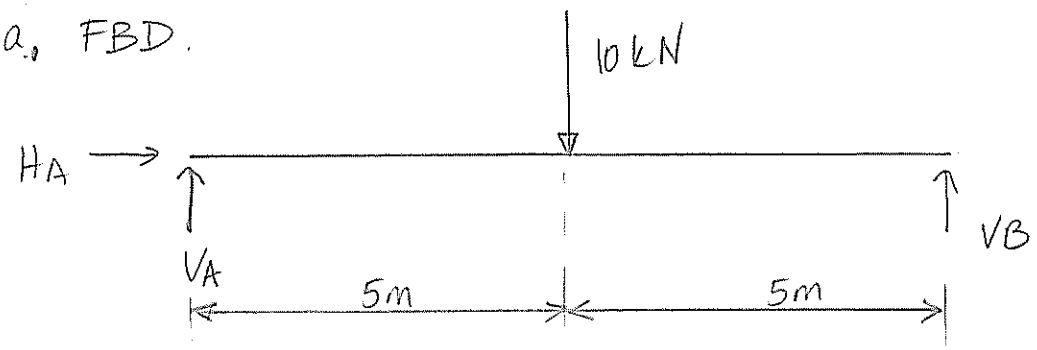
$$\underline{F_{RS} = 5\ kN} \quad -7)$$

Substitute F_{RS} in equation 6.

$F_{RP} = 9.5\ kN.$

Question 2.

a) a. FBD.



b. i) $V_A + V_B = 10\ kN$

ii) $H_A = 0$

iii) $\circlearrowleft +$) $-10 * 5 + V_B * 10 = 0$

c) Solving 2) a) b. iii)

$V_B = 5\ kN.$

Substituting $V_B = 5kN$ into 2a) b. i)

$V_A = 5\ kN$

$H_A = 0$ from 2a) b. ii)

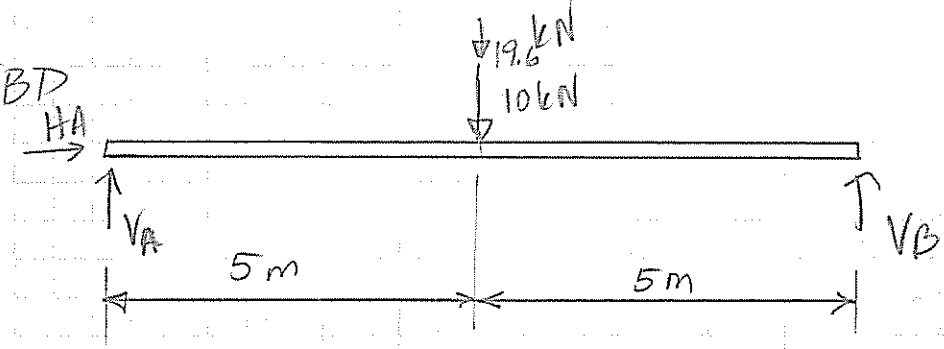
b). a. Equivalent weight = $200\,kg/m * 10m * 9.8\,m/s^2$

$= 19600\,N$

$= 19.6\,kN.$

applied at the centre of the beam

b. FBD



c) i) $V_A + V_B = 29.6\,kN$

ii) $H_A = 0$

iii) $(+\circlearrowleft) -29.6 * 5 + V_B * 10 = 0$

d. Solving 2b). c. iii)

$V_B = 14.8\,kN$

Substituting $V_B = 6\,kN$ into 2b) c. i)

$V_A = 14.8\,kN$

$H_A = 0$ from 2b) c. ii).

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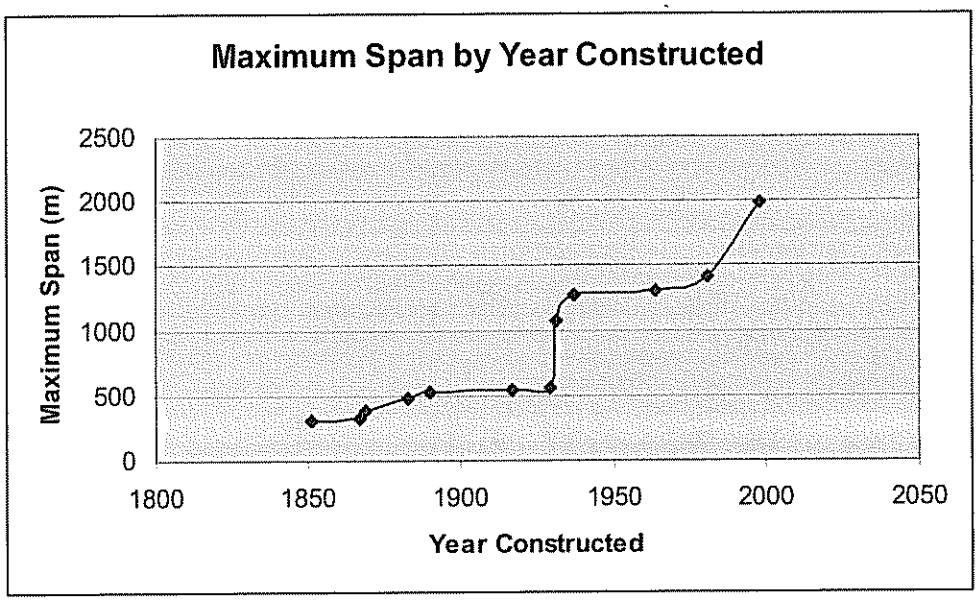
Homework 4, Question 4.
Sample Answer

a) Data on span length by year constructed for bridges was obtained from http://www.hut.fi/Units/Departments/R/Bridge/chronological .html. The data is plotted below.



b) The plot suggests an increasing trend in span length over time. Perhaps what is more interesting is that there are plateaux and then a jump in maximum span length around 1930 and then in the late 1990's suggesting either a design breakthrough or a change in technology such as new materials.
c) The plot indicates that the maximum span for bridges will continue to increase. Based on past history we would expect maximum span to stay fairly constant at around 2000 m for several years and then another jump to occur.