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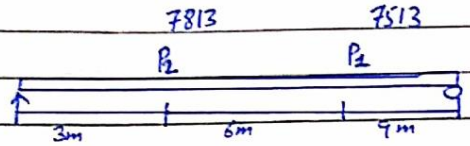
Paper : Engineering Mechanics:

Q1: Find the support reaction - Show all your calculation.

$P_1 = 200 + 5 \cdot ID)$, $P_2 (500 + 5 \cdot ID)$.

Sol:

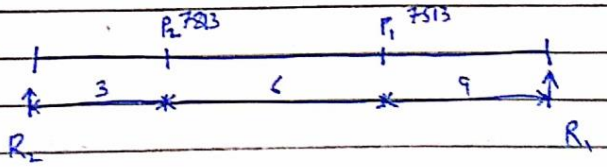


$P_1 = 200 + 7313$

$\Rightarrow P_1 = 7513$

$P_2 = 500 + 7313$

$P_2 = 7813.$



Equation of equilibrium.

$\Sigma F_H = 0 \Rightarrow \Sigma F_H = 0.$

$\Sigma F_V = 0.$

$\Sigma M = 0.$

$\rightarrow \Sigma F_V = 0.$

$\Sigma M_{R_1} = 0$ (-) (+)

$7513 \times 9 + 15 \times 7813 - R_2 \times 18 = 0$.

$R_2 = \frac{67617 + 117195}{9}$

$R_2 = \frac{184812}{9}$ Unit.↑

$\Sigma M_{R_1} = 0$.

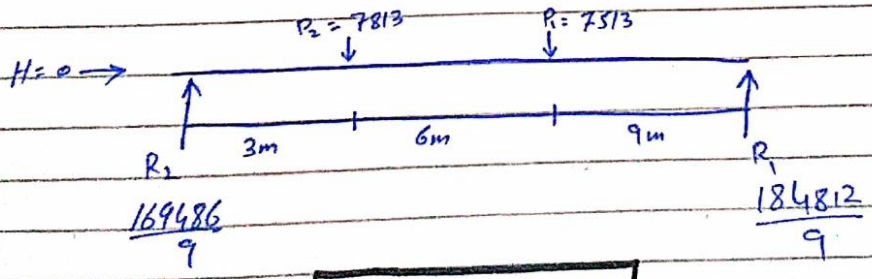
3×7513

$-\downarrow +\uparrow \Sigma F_V = 0$.

$R_2 - 7513 - 7813 + \frac{184812}{9} = 0$.

$R_2 = \frac{169486}{9}$ Unit ↑

complet force body diagrams.



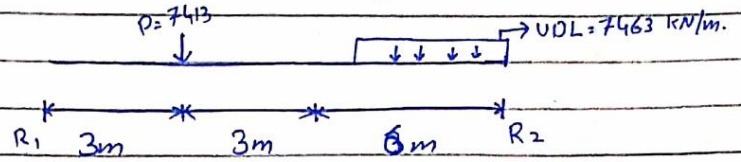
$R_1 = 20534.66$

Q.No:2: Draw neat Shear force diagram. Show calculation.

(100+7313), UDL = (150+7313)

Soli-

Free body diagram.



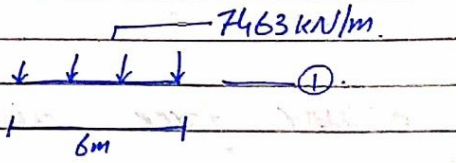
P = 100+7313 = 7413.

UDL = 150+7313 = 7463

$\uparrow \Sigma F_U = 0$

$\Sigma F_V = 0$

$\uparrow M = 0$.

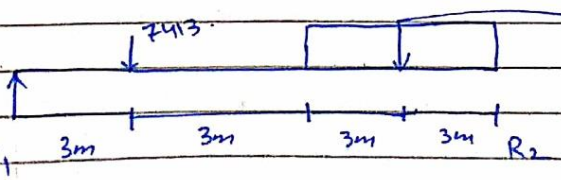


$(+) \circlearrowleft \Sigma M_{R_1} = 0$ (−↻ +↺)

$-3\times7413 - 9\times44778 + 12\times R_2 = 0$.

To find Point load — ②.

Point load = $7463 \times 6 = 44778$.



$$\Rightarrow R_2 = \frac{3\times 7413 + 9\times 44778}{12}$$

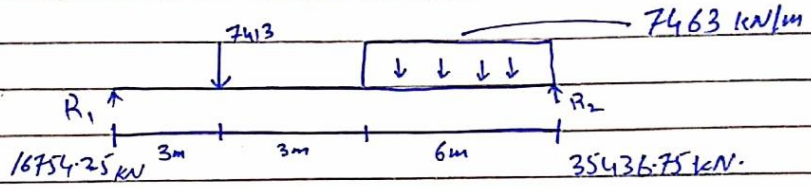
$$R_2 = 35436.75 \text{ kN}.$$

-ive ↓ ↑ +ive $F_v = 0$.

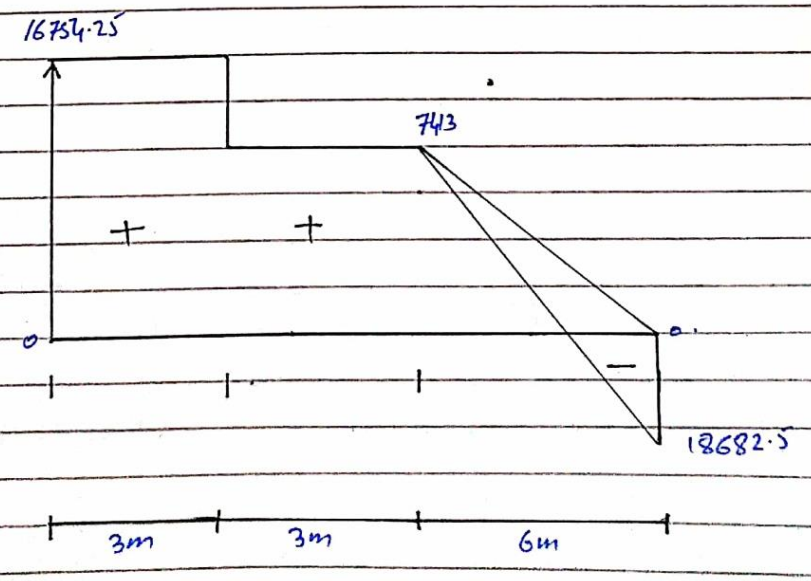
$$R_1 - 7413 - 44778 + 35436.75 = 0$$

$$\Rightarrow R_1 = 7413 + 44778 - 35436.75$$

$$\Rightarrow R_1 = 16754.25 \text{ kN}.$$



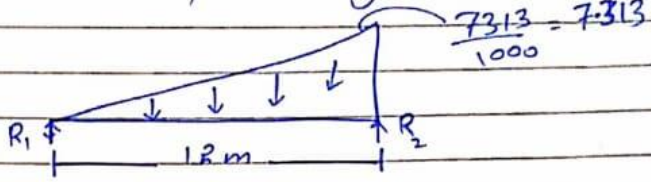
Shear force diagram.



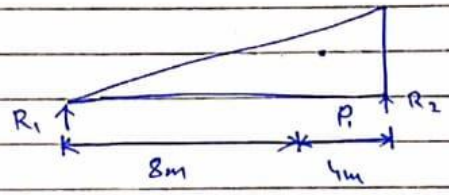
Q3: Draw neat shear force diagram and bending moment diagram. Show calculation.
UVL = Student ID/1000.

Sol:-

Free body diagram.



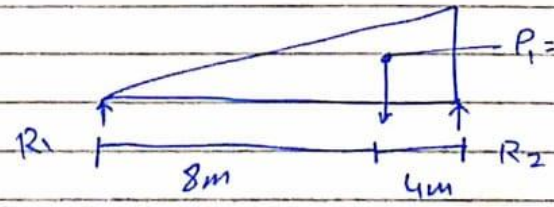
To find Point load.



Point load

$$P_1 = \frac{1}{2}(7.313) \times 12$$

$$P_1 = 43.878 \text{ kN}.$$



To find the Reaction.

$$\Sigma M_{R_1} = 0.$$

$$-8 \times P_1 + 12 \times R_2 = 0.$$

$$12 R_2 = 8 P_1$$

$$\Rightarrow 12 R_2 = 8 (43.878$$

$$12 R_2 = 351.024.$$

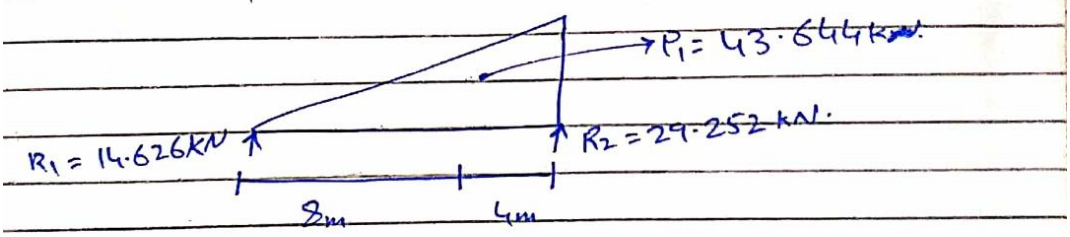
$$R_2 = 29.252. \text{ KN}.$$

$$\downarrow + \uparrow \quad \Sigma F_v = 0$$

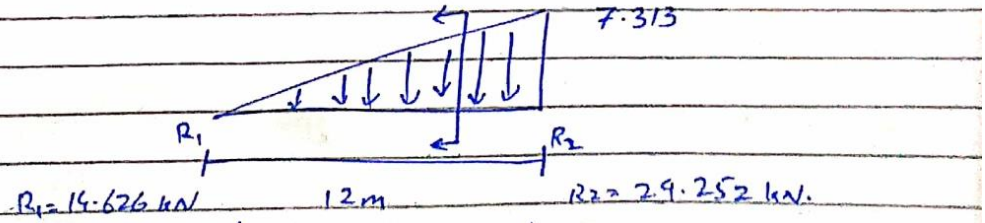
$$R_1 - 43.878 + R_2 = 0.$$

$$R_1 - 43.878 + 29.252 = 0.$$

$$R_1 = 14.626 \text{ KN}.$$

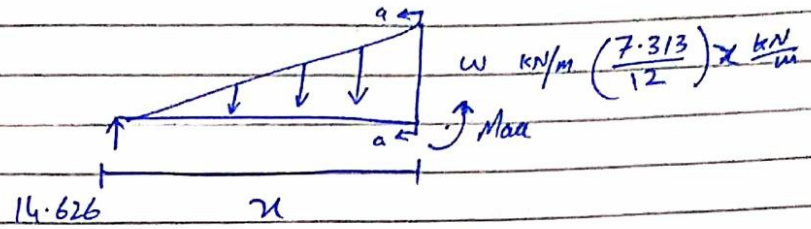


Force shear force ~~diagram~~ at different Section.



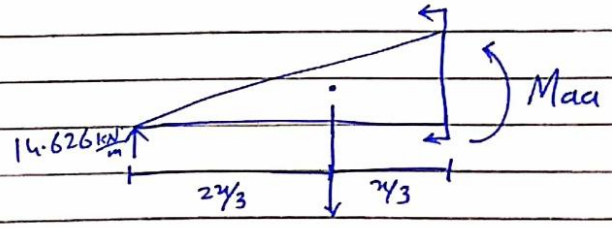
$(0 \leq x \leq 12m)$

Take Section a=a.



From law of similer triangle.

$$\frac{7.313 \text{ kN/m}}{12 m} = \frac{7.313/12}{x}$$



$$Maa + \left(\frac{x}{3}\right)(P_1) - (14.626)x = 0.$$

$$P_1 = \left(\frac{7.313}{12}\right) x \times \frac{x}{2}$$

$$P_1 = \frac{7.313 x^2}{24}$$

$$\Rightarrow Maa = -\frac{x}{3} - 7.313 \frac{x^2}{24} + 14.626x.$$

$$Maa = -\frac{x}{3} 7.313 + 14.626x.$$

$$Maa = \frac{x^3}{72} 7.313 + 14.626x.$$

$$Maa = \frac{-7.313 x^3}{72} + 14.626x \quad \text{——— (a)}$$

at $x = 0m$.

$\Rightarrow$ $M_{aa} = 0\ kN/m$.

at $x = 12m$.

$\Rightarrow$ $M_{aa} = 0\ kN/m$.

Are the points where the bending moment is zero.

$\sum F_V = 0$.

$$14.626 - 7.313\ \frac{x^2}{24} - V = 0.$$

at $V = 0$.

$$14.626 - 7.313 - V = 0.$$

$$14.626 - 7.313\ \frac{x^2}{24} - 0 = 0.$$

$$\left(\frac{x^2}{24}\right) 7.313 = 14.626.$$

$$0.304\,x^2 = 14.626.$$

$$x^2 = \frac{14.626}{0.304}$$

$$x^2 = 48.11$$

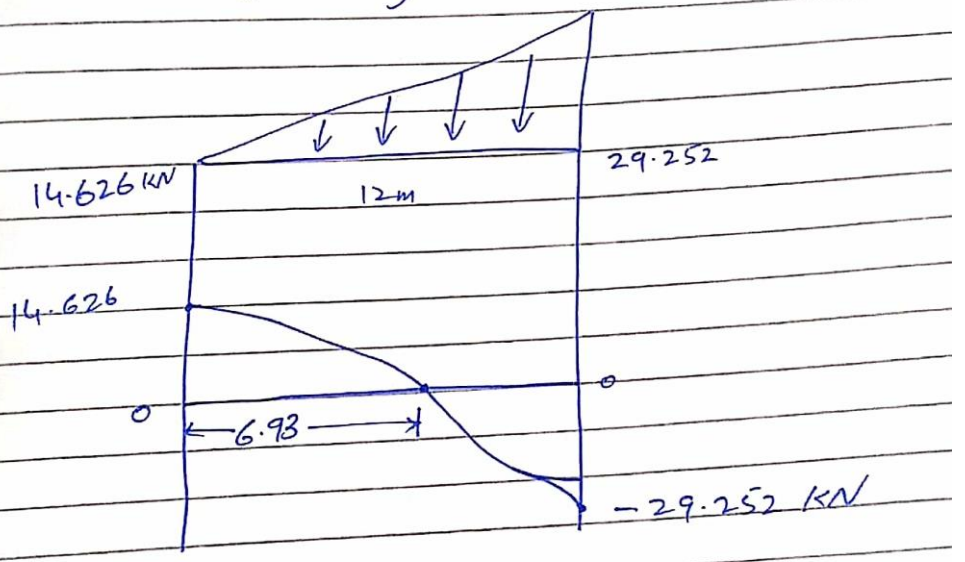
$$\sqrt{x^2} = \sqrt{48.11}$$

at $x = 6.93$ $V = 0$.

$$M_{aa} = \frac{-7.313(6.93)^3}{72} + 14.626(6.93)$$

$$M_{aa} = 67.55 \text{ kN/m}$$

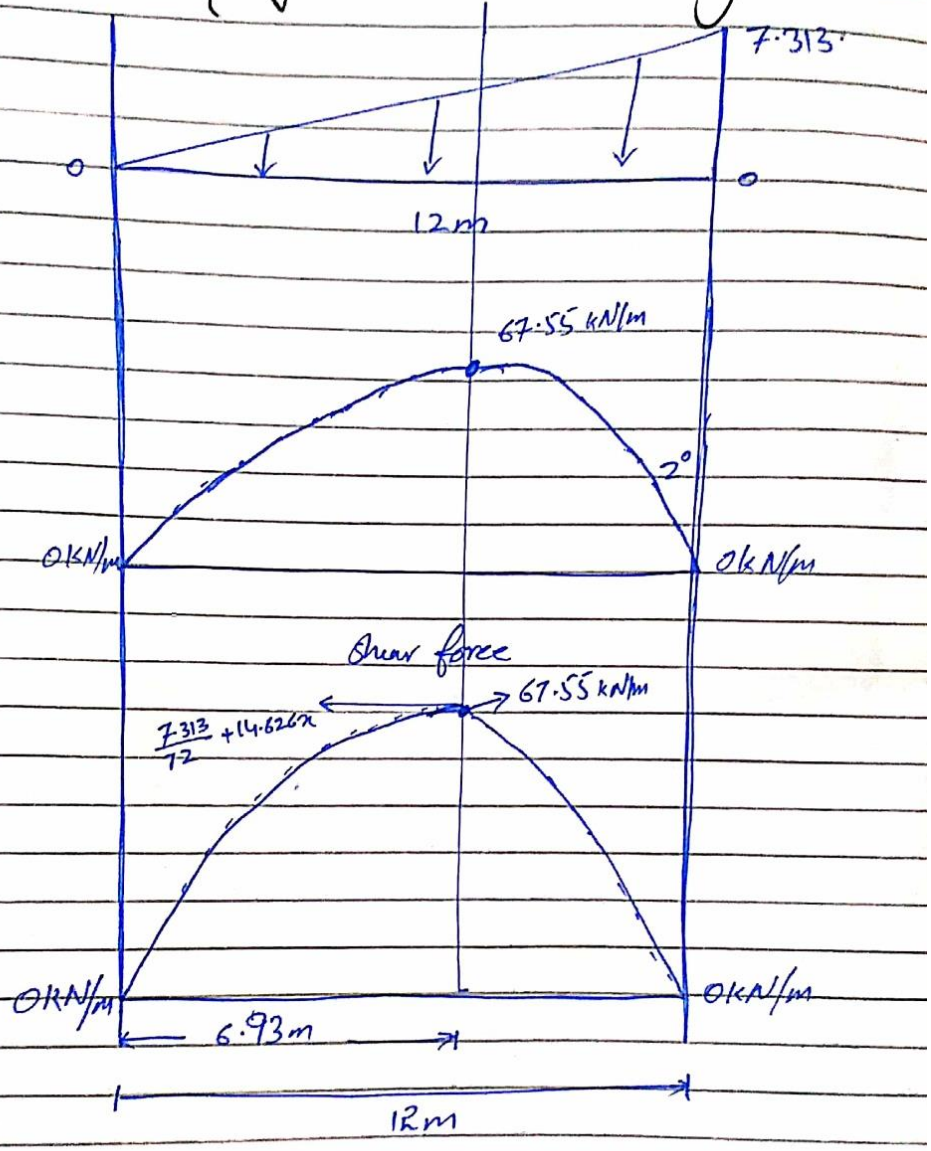
Shear force diagram.



Bending moment diagram.

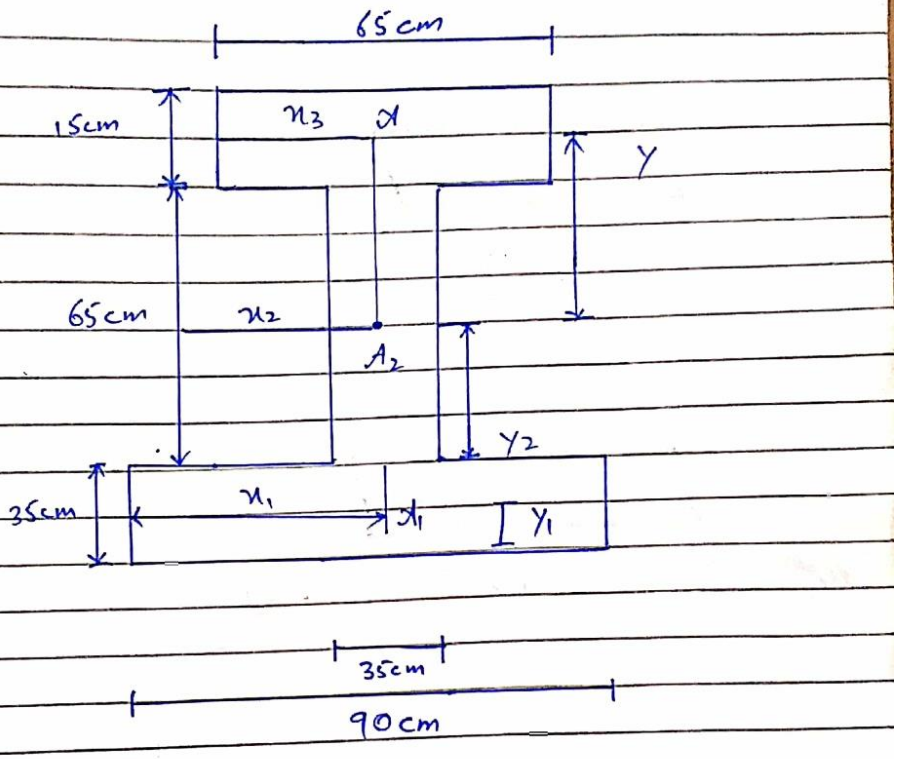
P.T.O.

Bending Moment diagram.



Q4: A: Find the centroid of the given shap.

Sol:-



A_1	3150 cm²	x_1	45	$Y_1 = 17.5$
A_2	2275 cm²	x_2	45	$Y_2 = 50$
A_3	975 cm²	x_3	45	$Y_3 = 107.5$
ΣA	6400 cm²			

$$\bar{x}_c = \frac{A_1 x_1 + A_2 + x_2 + A_3 + x_3}{A_1 + A_2 + A_3}$$

$$y_c = \frac{A_1 y_1 + A_2 y_2 + A_3 y_3}{A_1 + A_2 + A_3}$$

$$x_c = \frac{3150(45) + (2275)(45) + 975(45)}{3150 + 2275 + 975}$$

$$\boxed{x_c = 45.}$$

$$y_c = \frac{(3150)(175) + (2275)(50) + (975)(1075)}{3150 + 2275 + 975.}$$

$$\boxed{y_c = 42.76}$$

Q4:b: for mid area ------ moduli.

Sol:-

Given data!

area = 65 x 35.

Required = ?

Moment of Inertia = ?
Radius of gyration = ?
Section of moduli = ?

for moment of inertia.

$$I_x = \frac{1}{3} bh^3$$

$$= \frac{1}{3}(65) \times (35)^3$$

$$\frac{1}{3}(65)(35)^3 = 928958\ mm^4$$

$$I_y = \frac{1}{3} b^3 h$$

$$\frac{1}{3}(65)^3(35) = 3203958\ mm^4$$

$$I_{x'} = \frac{1}{12} bh^3$$

$$= \frac{1}{12}(65)(35)^3 = 6635.41\ mm^4$$

$$I_{y'} = \frac{1}{12} b^3 h.$$

$$\frac{1}{12}(65)^3(35) = 800989\ mm^4.$$

$$J_c = \frac{1}{12} bh(b^2 + h^2).$$

$$\frac{1}{12}(65)(35)((65)^2 + (35)^2).$$

$$= 1033229.16\ mm^4.$$

Q5: Explain work, Energy & Power..... daily life.

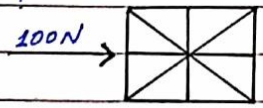
Work:-

The application of a force through certain distance is known as work. It measured in Joules (J).

Work = Force x Distance travelled in direction of force.

Example:

A box is pushed across a floor by a constant force of 100 N. what is the work done by the force to move the box 5m?



Force = 100N.
distance = 5 m.

$W = Fs$

$W = 100 \times 5$

$W = 500 J$.

Energy:-

Energy is the measure of the ability of an object or a system to perform.

There are many types of energy.

Kinetic Energy:-

Energy of an object due to its speed.

Gravitational potential energy:

Energy of an object due to position in a gravitational field.

Elastic Potential energy:

Energy stored when an object is stretched or compressed.

Chemical energy:-

Energy stored in chemical bonds.

Nuclear Energy:-

Energy stored in Nuclei.

Heat Energy:-

Hot things have more energy than their cold counterparts.

Example:-

1 joule is the MKS unit of energy is equal to the force of one Newton acting through one meter.

Energy transfer:

1. Gravitational Energy.
2. Kinetic energy
3. light energy
4. Heat energy.

Example:-

A supermarket employ lifts a baked bean tin weight 250 g from the floor to a shelf 2m high. How much gravitational potential energy does it gain? $g = 9.81 N/kg$.

Sol..

$$\Delta E_p = mg\Delta h.$$

$$0.250 \times 9.81 \times 2$$

$$= 4.9 J$$

Power:-

Power is the rate at which work is done, or the rate at which energy is transfered.

Power = work done / time taken.

$$P = \frac{W}{t}.$$

where:

Power is measured in watts (w).
Workdone or energy transfer is measured in joules (J)
Time is measured in seconds (s).

Example:-

A crane lifts a load of 1500 kg to a hight of 25m at a steady rate, in a time of 2 min

what is the power of crane.

$$\Delta E_p = mg\Delta h.$$

$$W = 1500 \times 9.81 \times 25$$

$$W = 367875 \text{ j}.$$

$$P = \frac{W}{t} \Rightarrow \frac{367875}{120}$$

$$P = 3066 \text{ w}.$$