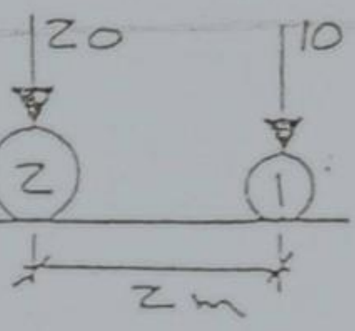
Moving Loads

Ex: Find maximum value of reaction at A due to the moving Locomotive from left to right



Sol.

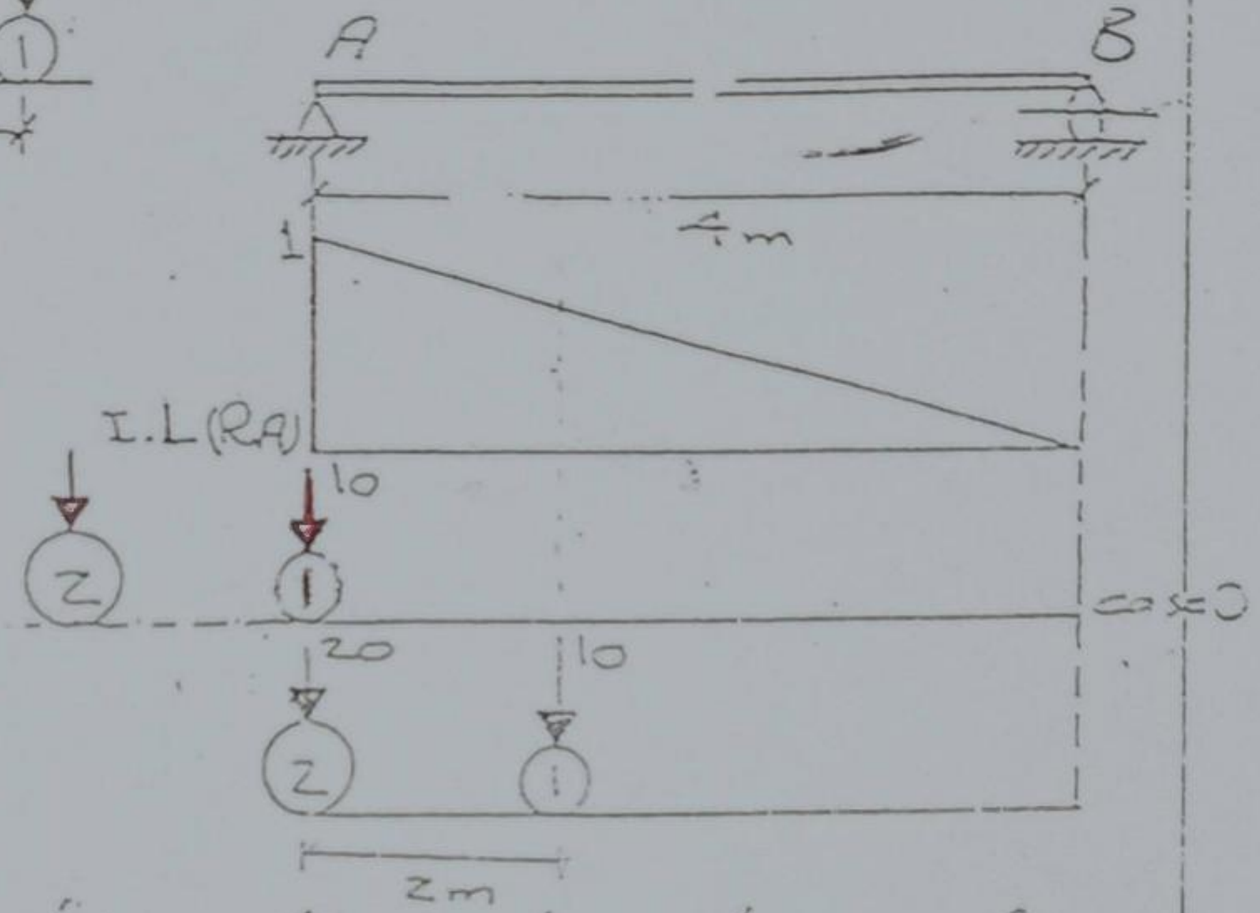
Case ①

$R_A = 1 * 10 = 10\ kN$

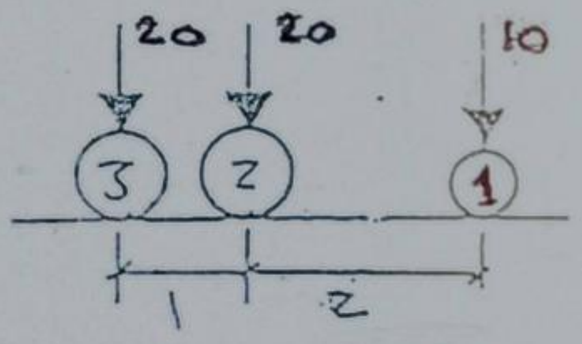
Case ②

$R_A = 20(1) + 10*(\frac{1}{2}) = 25\ kN$

$\therefore R_{A)max.} = 25\ kN$



Ex:- Find max. negative shear at c due to moving Locomotive from left to right.



Sol.

Case ①

$V_c = 10(-\frac{1}{2}) + 20(-\frac{1}{6}) + 20(0)$

$V_c = -8.33\ kN$

Case ②

$V_c = 20(-\frac{1}{2}) + 20(-\frac{1}{3}) + 10*(\frac{1}{6}) = -15\ kN$

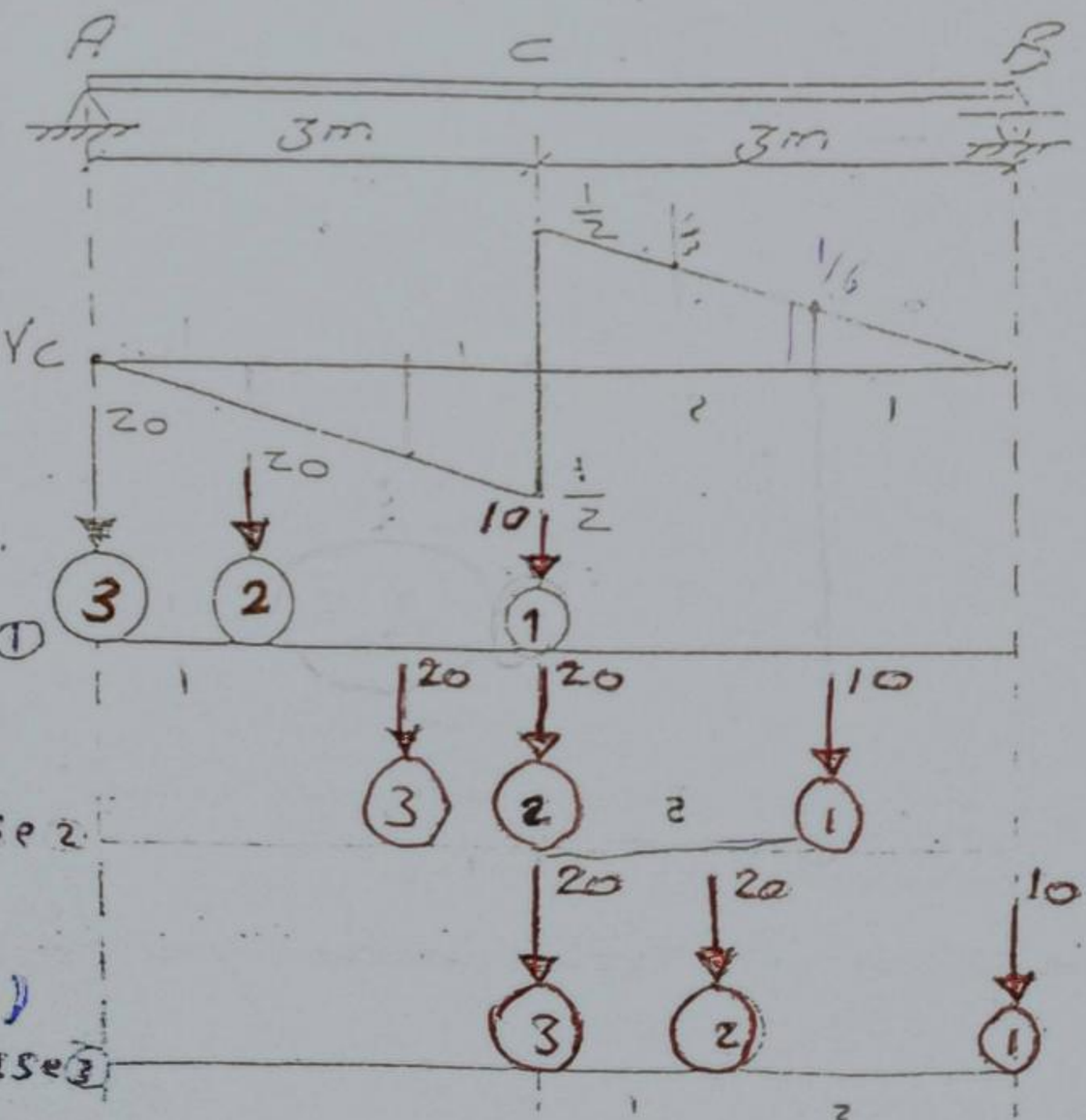
Case ③

$V_c = 20(-\frac{1}{2}) + 20(\frac{1}{5}) + 10(0)$

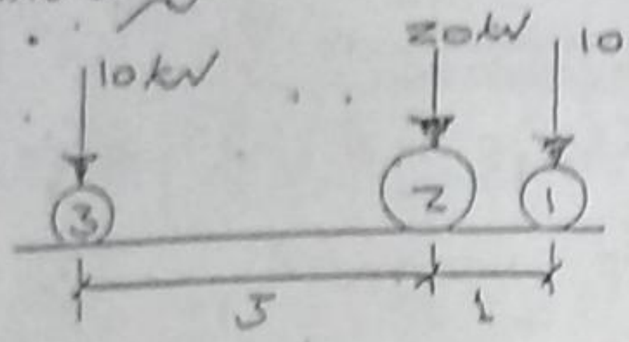
$V_c = -3.33\ kN$

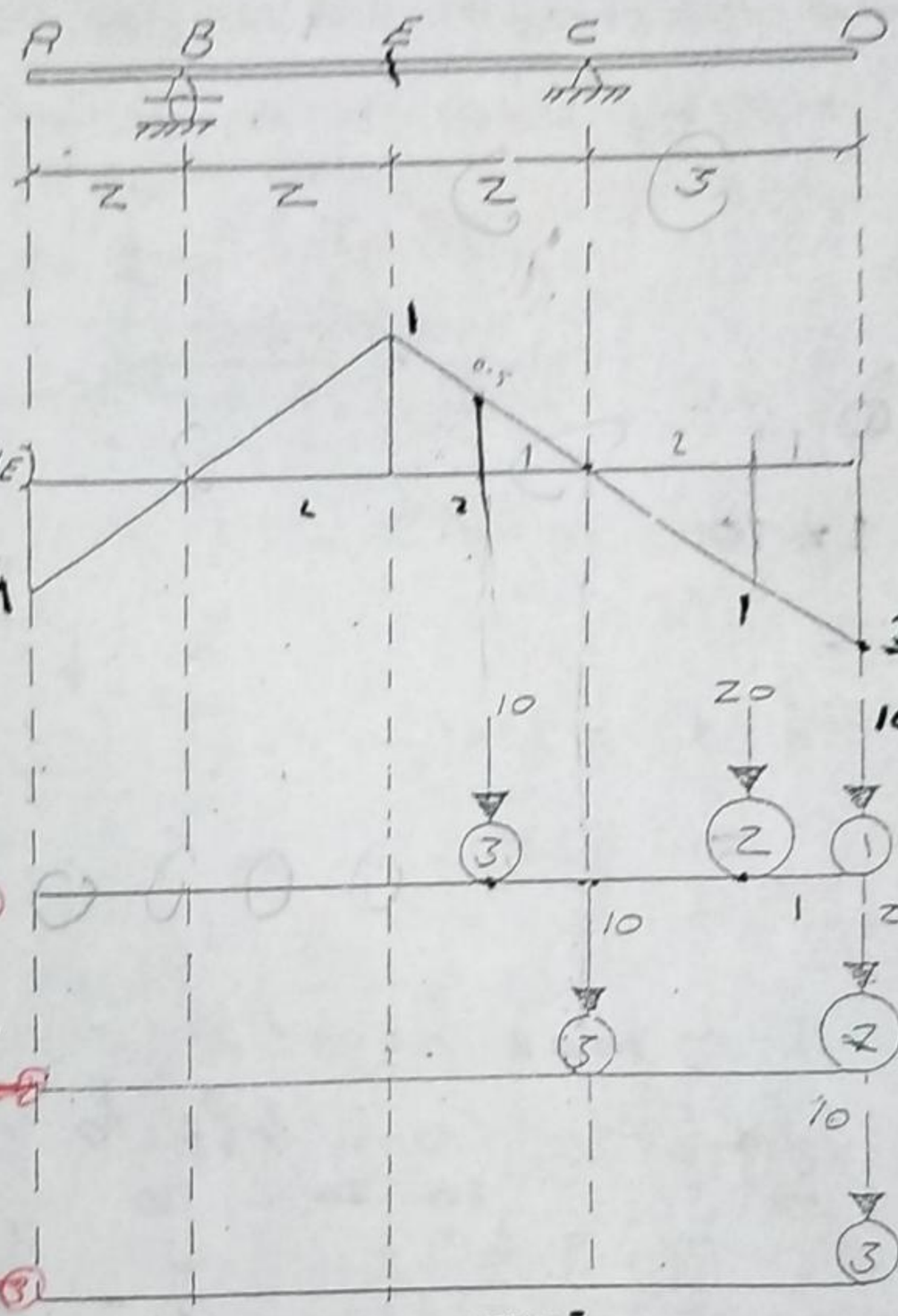
$\therefore V_{c)max} = 15\ kN$

$V_{c)max} = -15\ kN$



Ex:- Find max. negative bending moment at point (E) for the beam shown due to the moving Locomotive from left to right.





Sol.

Case ①

$M = 10\left(-\frac{3}{2}\right) + 20(-1) + 10\left(\frac{1}{2}\right)$

$M = -30$ kN.m

Case ②

$M = 20\left(-\frac{3}{2}\right) + 10(0)$

$M = -30$ kN.m

Case ③

$M = 10\left(-\frac{3}{2}\right) = -15$ kN.m

$\therefore M^{\ominus}_{max.} = -30$ kN.m

Absolute Maximum Bending Moment is Simple span under a series of Moving Concentrated loads:

خطوات العمل :-

١. أجد محصلة الأحمال وموقعها.

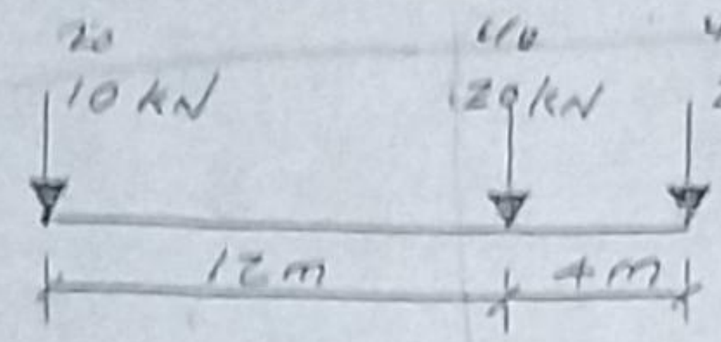
٢. أضع $\frac{L}{2}$ العتبة في منتصف المسافة بين المحصلة واقرب حمل ثقيل لها (أما اذا كان الحمل الأقرب خفيفاً فاجرب حالتين).

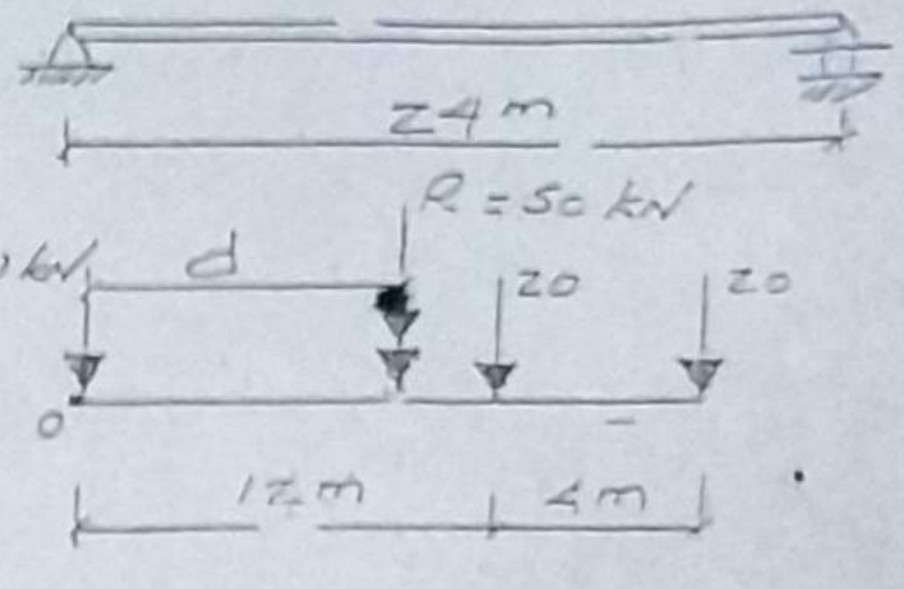
٣. اتأكد بأن الحمل الخطير يكون تحت اثقل حمل قريب عند $\frac{L}{2}$ العتبة عادة.

ملاحظة هامة :-

في حالة كون طول الأحمال الجسر او مسافي لطول العتبة تستبعد الأحمال الزائدة (الخفيفة البعيدة عادة) بحيث يكون طول الأحمال المتبقية والتي تؤخذ في التحليل اقل من طول العتبة لقليل

Ex: Calculate the absolut maximum bending moment in a simple span of 24 m under action of the shown Locomotive





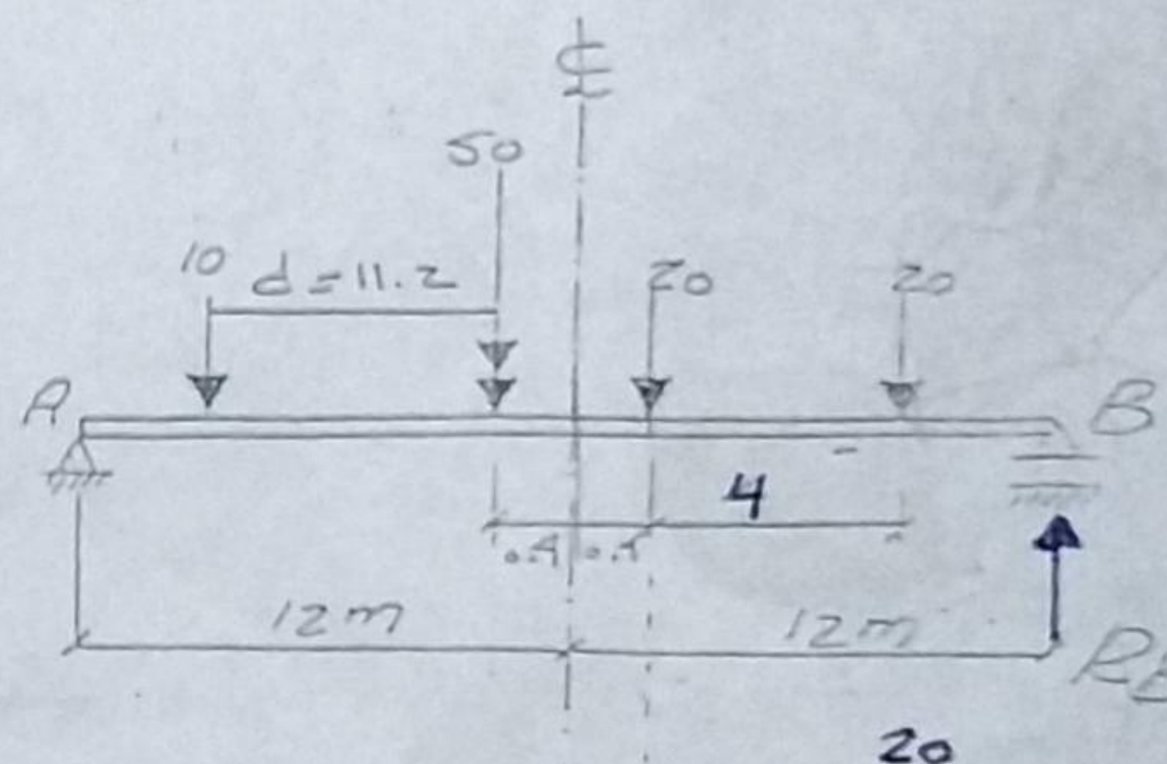
Sol.

$R = 20 + 20 + 10 = 50\ kN \downarrow$

$M_{R\ at\ o} = M^{Load}_{at\ o}$

$50 * d = 20(12) + 20(16)$

$\Rightarrow d = 11.2$



Beam AB

$\Sigma M_A = 0$ ⊕

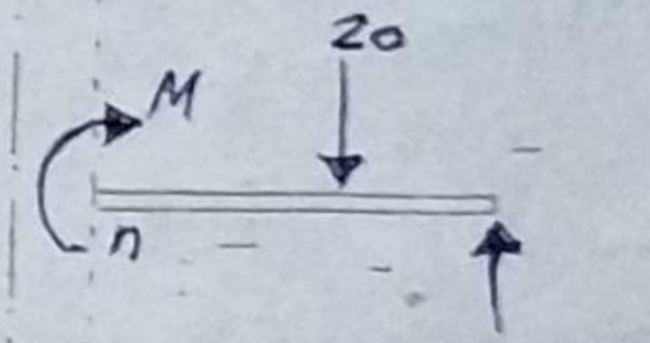
$B_y(24) - 50(12 - 0.4) = 0$

$B_y = 24.166\ kN$

From nB

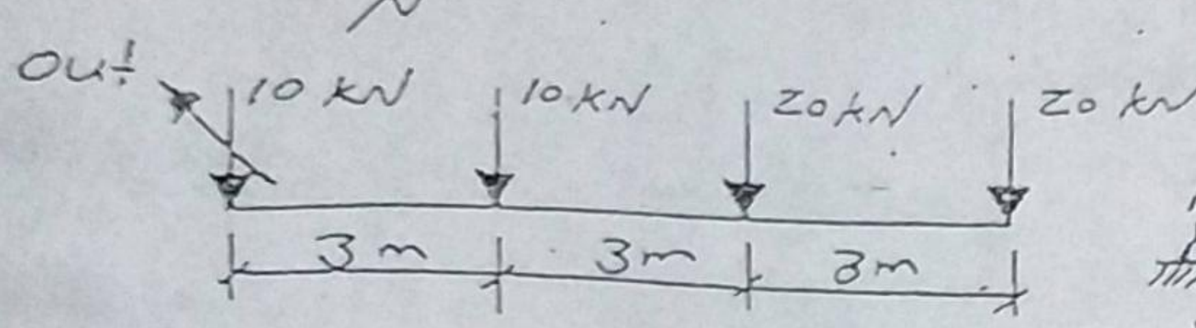
$\Sigma M_n = 0$ ⊕

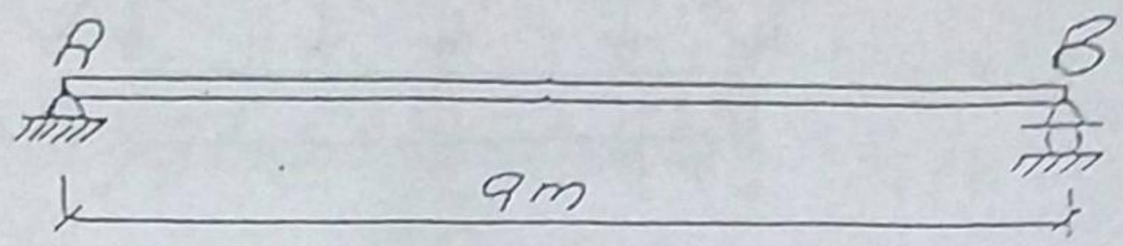
$M + 20(4) - 24.166(11.6) = 0$



∴ Absol. $M_{max.} = 200.333\ kN.m$

Ex:- Find the absolute maximum bending moment of the simply supported beam AB due to the moving Loads shown in figure.





$R = 10 + 20 + 20 = 50\ kN$

$M_R = M_F$

$50 * d = 20(3) + 20(6)$

$d = 2.25\ m$

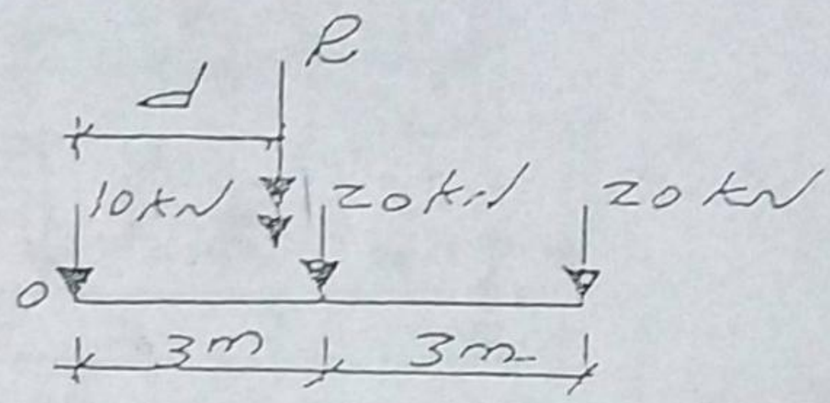
$\sum M_A = 0$ ⊕

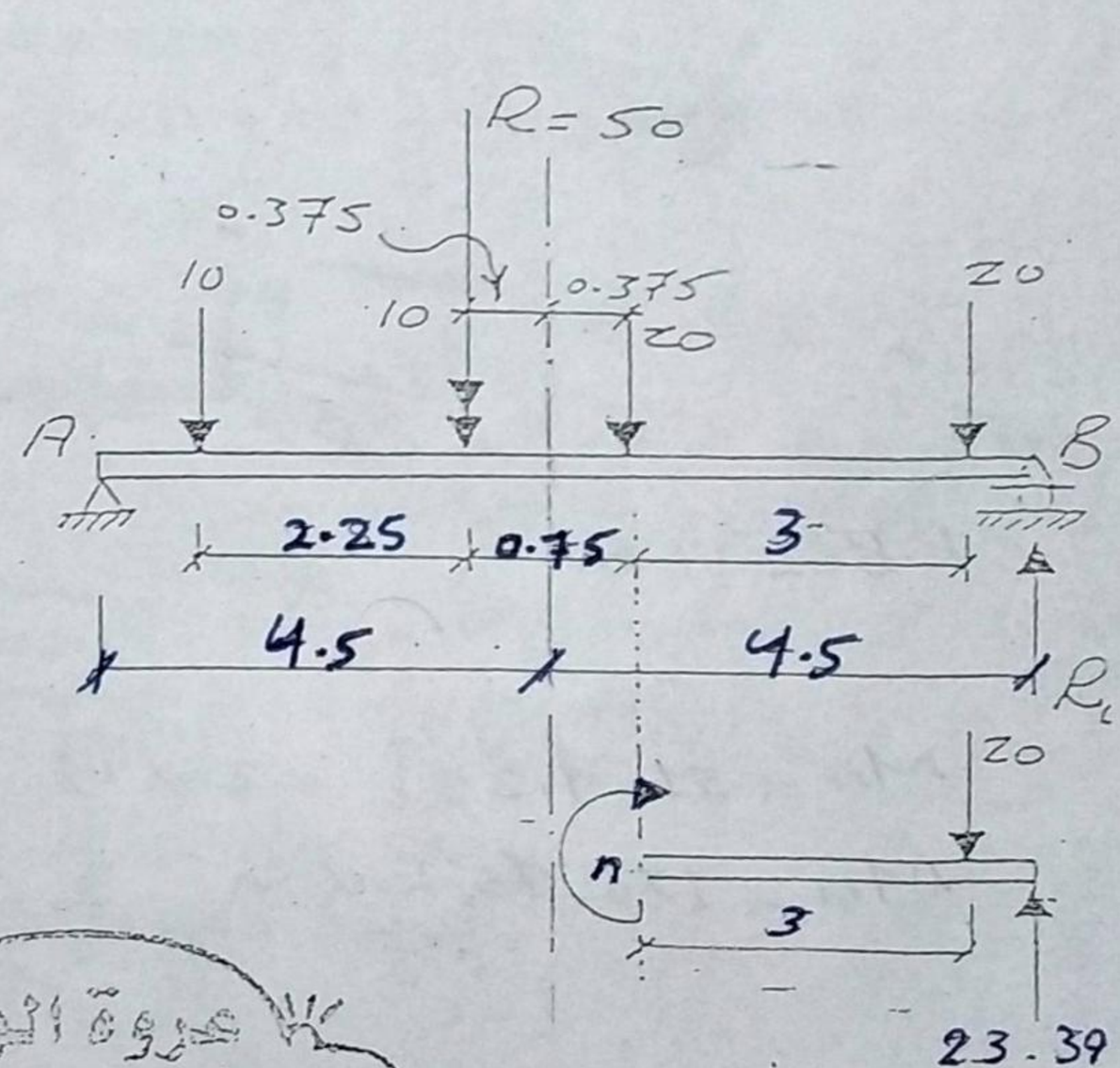
$50(4.5 - 0.375) = 9R_B$

$R_B = 23.39\ kN$

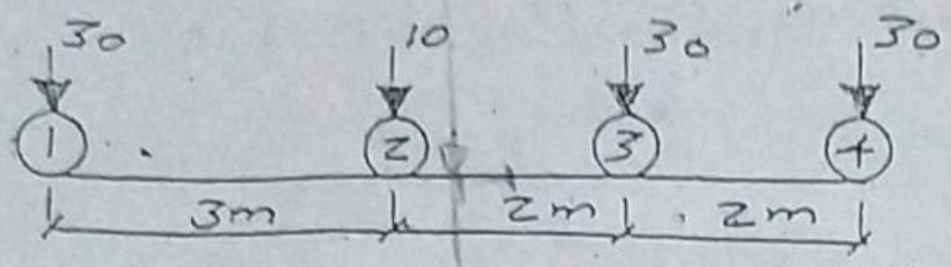
$M_n = 23.375(4.5 - 0.375) - 20(3)$

$M_n = 36.42\ kN.m$

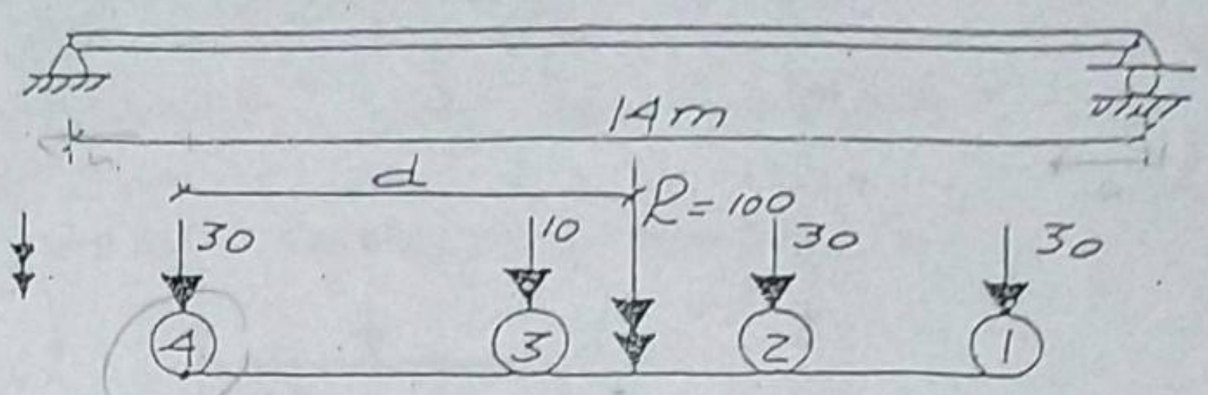




Ex:- Calculate the absolute maximum moment in a span of 14 m due to the moving Locomotive



(AA)



Sol.

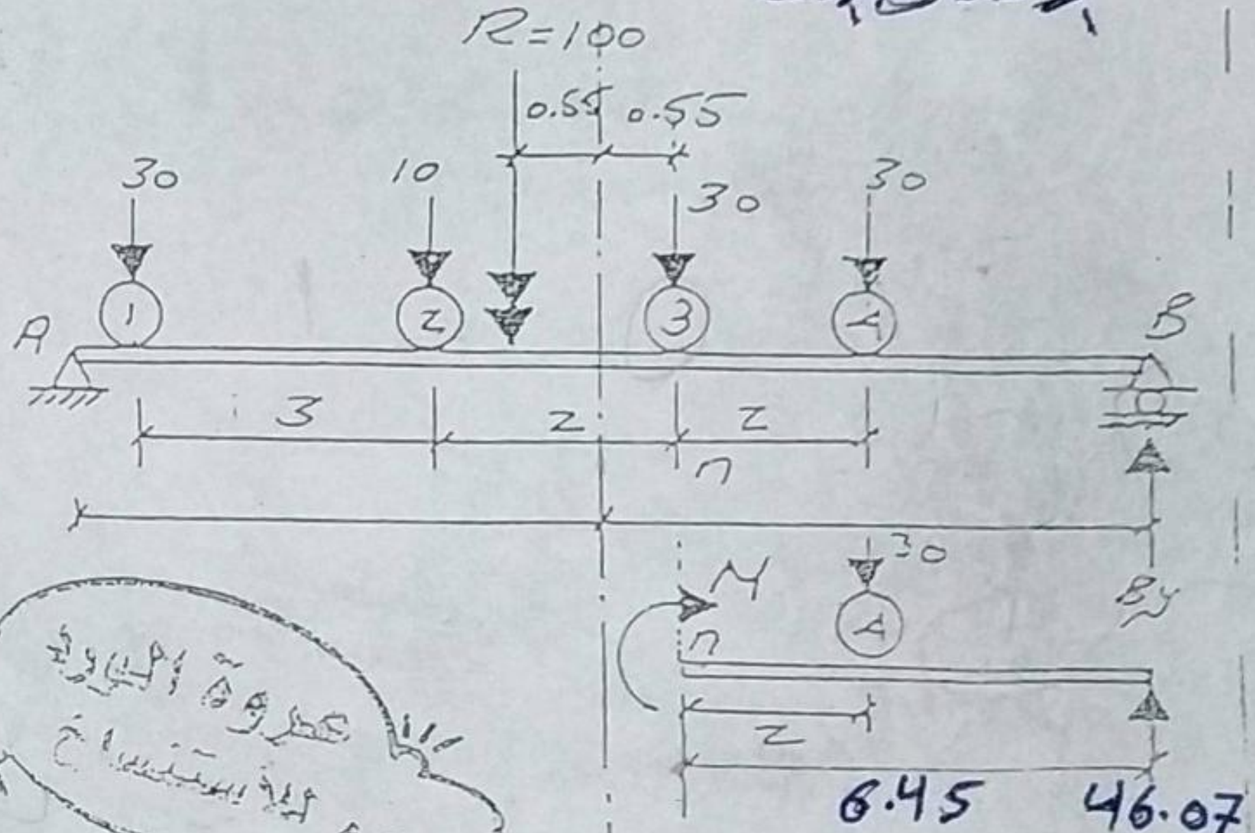
$R = 30 + 10 + 30 + 30 = 100\ kN$ ↓

$\Sigma M_o = 0$

$100 * d = 10(3) + 30(5) + 30(7)$

$d = 3.9\ m$

الاحتمال الأول



$\Sigma M_A = 0$ (⊕)

$100(7 - 0.55) = B_y(14)$

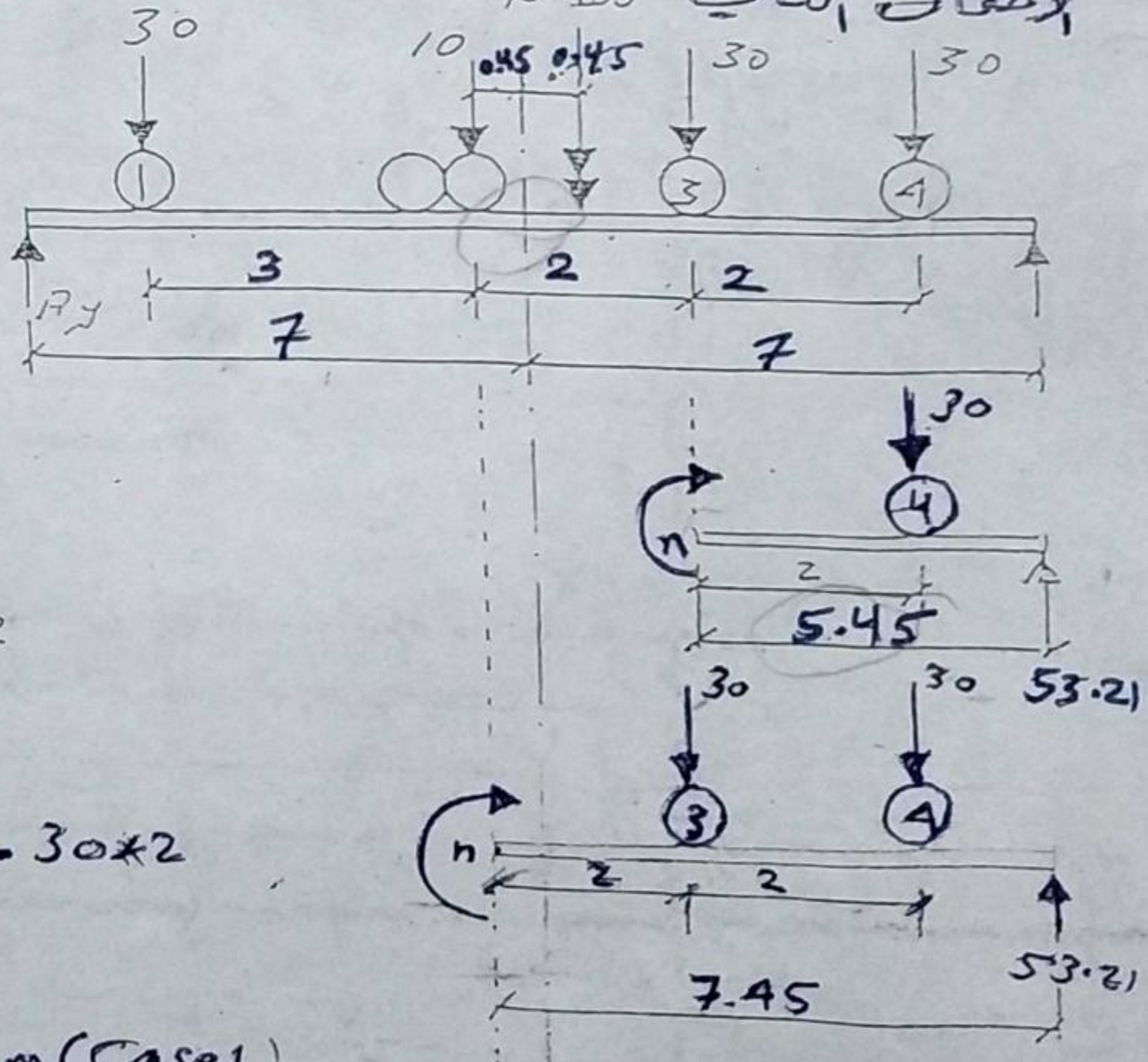
$B_y = 46.07\ kN$

$\Sigma M_n = 0$ (⊕)

$M + 30(2) - 46.07(6.45) = 0$

$\therefore M_n = 237.15\ kN.m$

الاحتمال الثاني



$\Sigma M_A = 0$ (⊕)

$B_y(14) = 100(7 + 0.45)$

$B_y = 53.21\ kN$

$M_n = 53.21(5.45) - 30 * 2$

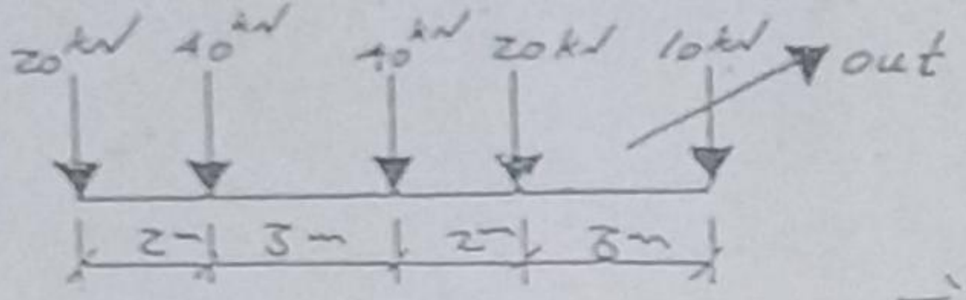
$M_n = 230\ kN.m$

$M_n = 53.21 * 7.45 - 30 * 4 - 30 * 2$

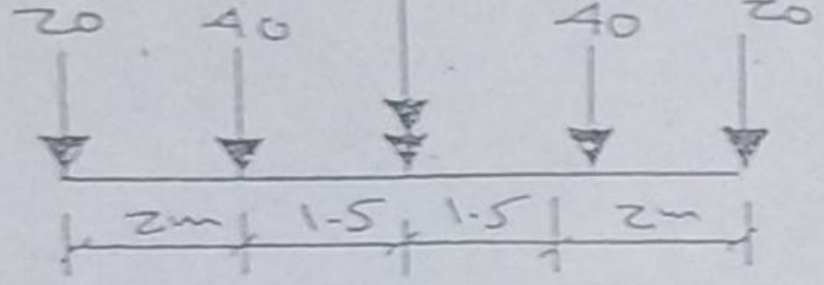
$M_n = 216.41\ kN.m$

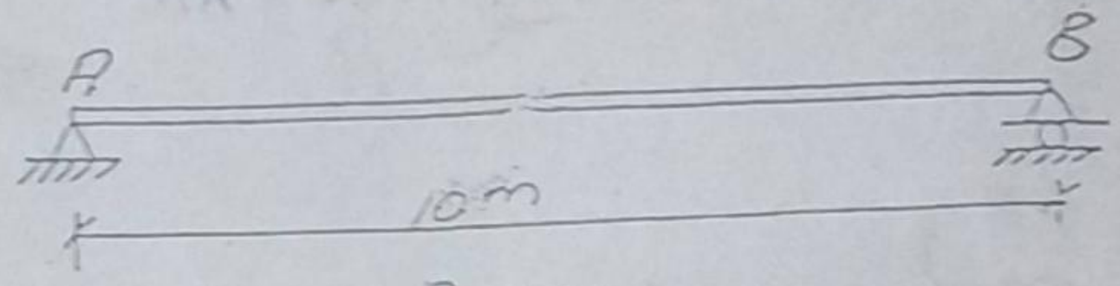
Absol. $M_{max.} = 237.15\ kN.m$ (Case 1)

Ex:- Calculate the absolut maximum moment in a span of 10m due to the moving Locomotive.

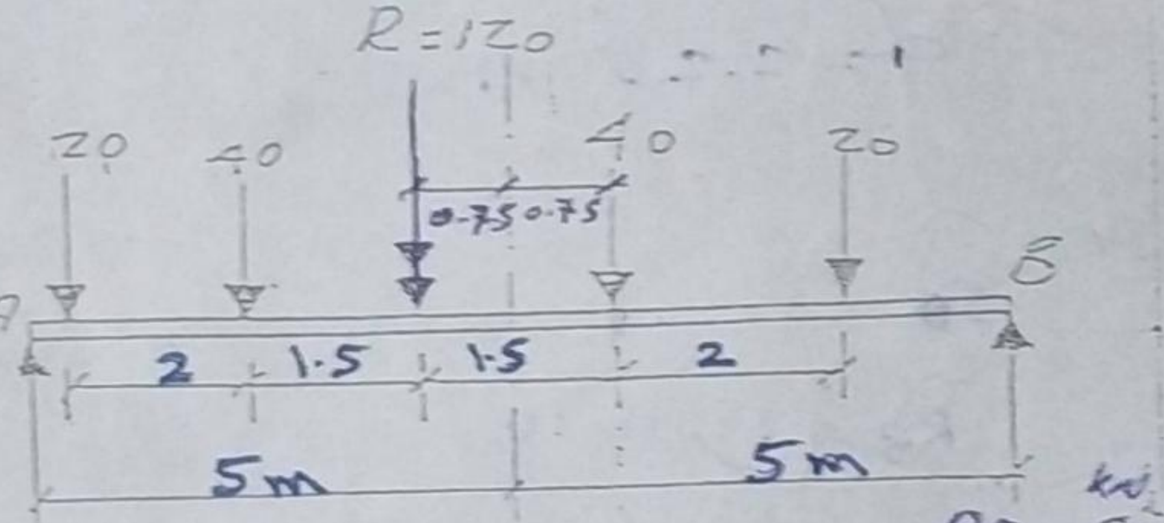


بما أن طول الحمال مساوي إلى طول العبرة ، اذاً يجب ازالة أحد الحمال والتي 10kN لأنها خفيفة وبعيدة.





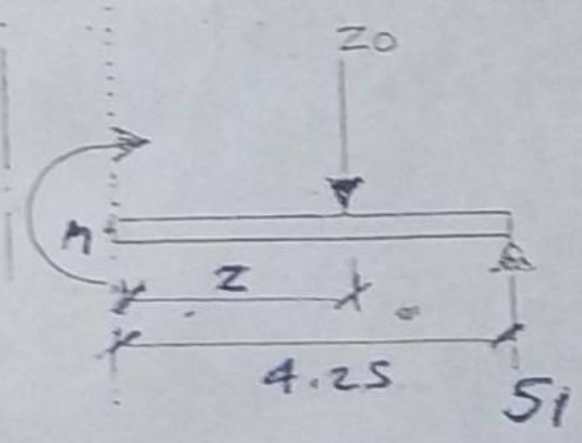
$R = 20 + 40 + 40 + 20 = 120\,kN$



$\Sigma M_A = 0$ ⟲

$120(5 - 0.75) = 10\,R_B$

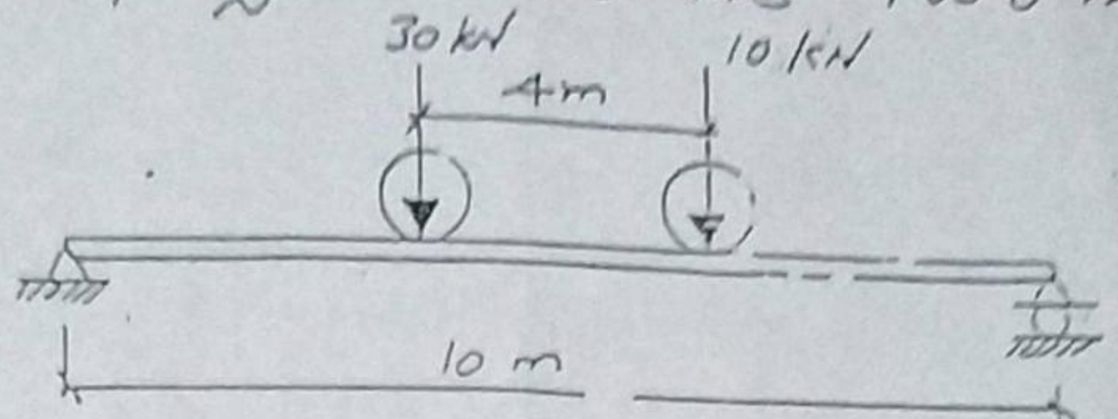
$R_B = 51\,kN$



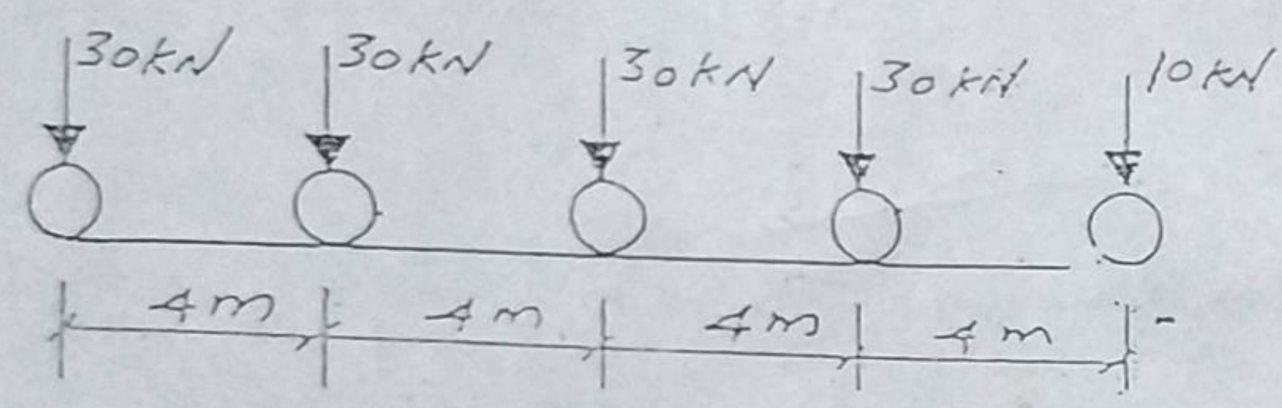
$M_n = 51(4.25) - 20(2)$

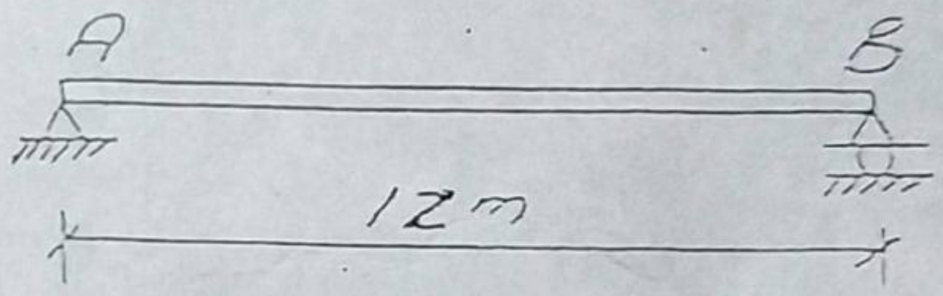
$M_n = 176.75\,kN.m$

H.W ① :- Find the absolute maximum bending moment of beam AB of fig. due to the two moving Loads shown.



H.W ② :- Find absolute maximum bending moment in the beam AB shown in fig. due to the series of moving concentrated Loads shown.





H.W ③ :- Find Absol Mmax. due to the shown Locomotive over a simply supported beam of :-

① - span 20m.

② - span 10 m.