NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Graph Theory – 3 &
Generating Functions

Picking five balls - Solution

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In the previous video the professor had post the question on the number of ways of picking 5 balls from the given 5 red, 5 blue, and 5 green balls,
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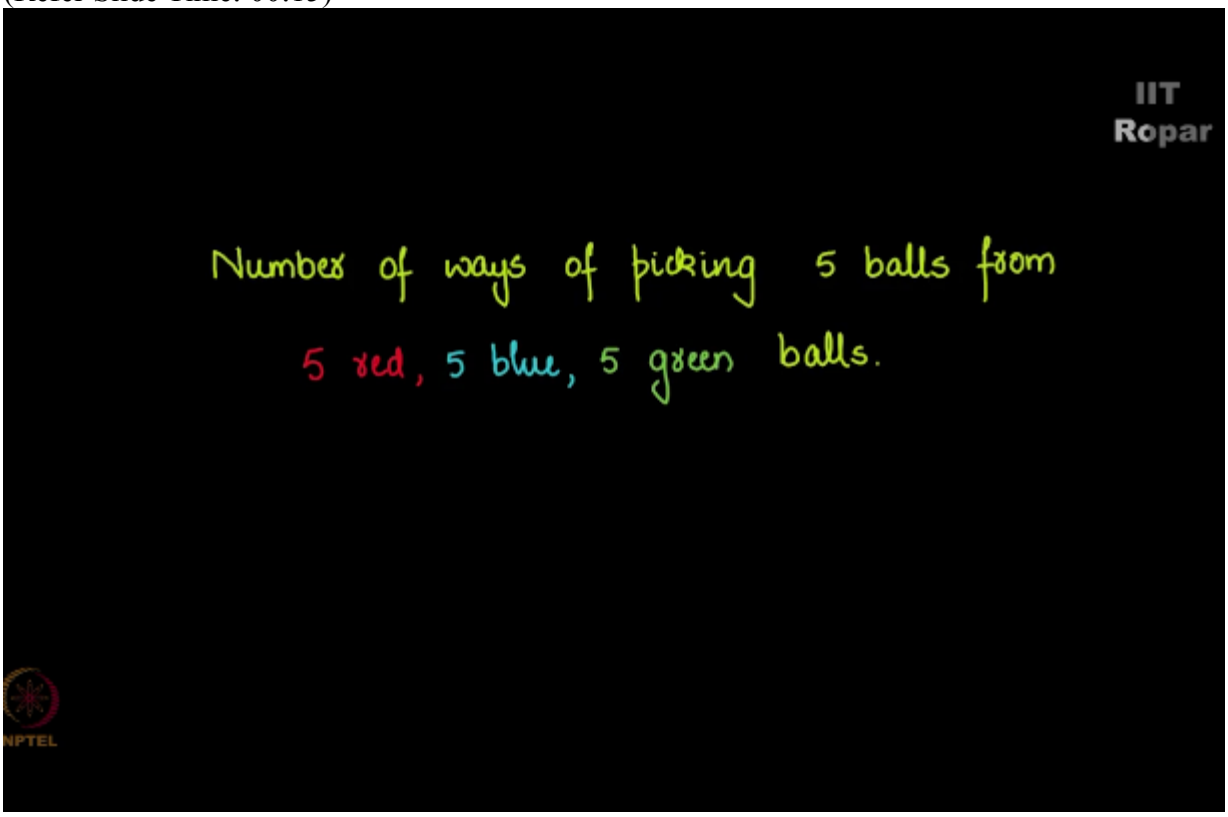

well the condition was that at least one of each color has to be picked,
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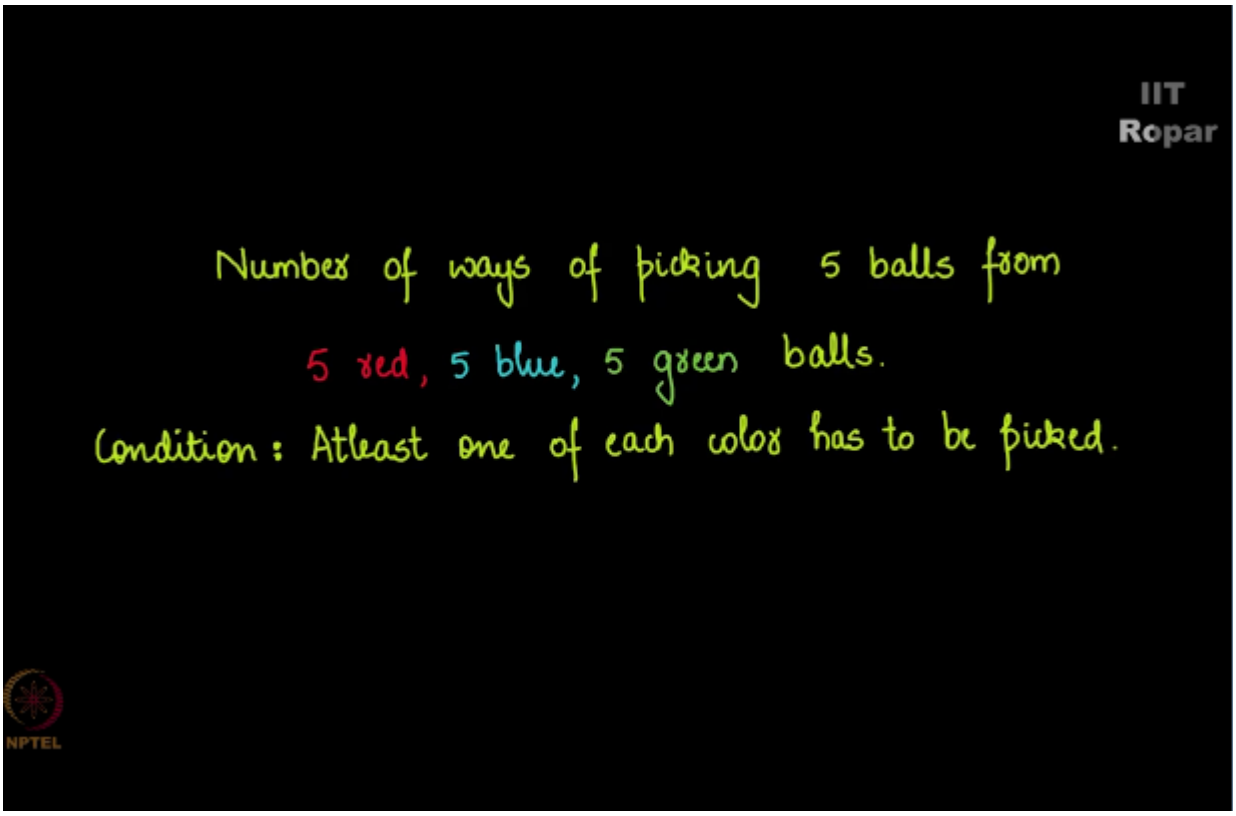

at the end the professor also gave you an answer, in the sense that he told you to observe the connection between the coefficient of the polynomial of some term in a polynomial and the answer for this question.

Well, let us just write down things properly and see if we can solve it, so the three colors of the balls blue, red, and green and I'm now going to write the valid possibilities for picking 5 balls, so there must be one of each color, so this is the blue column, this is the red column and this is the green column,

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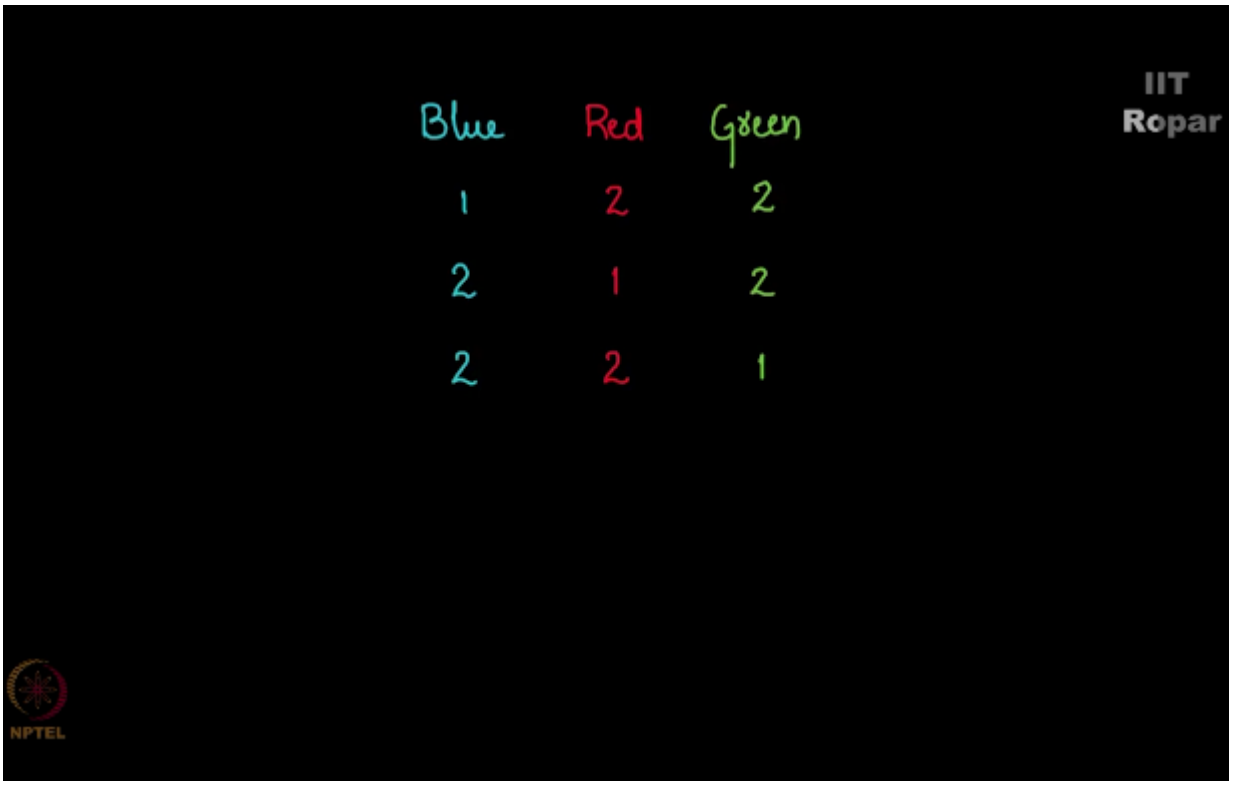

so 1 blue, 2 red, 2 green, this is valid, now I can also write it as 2 1 2, and 2 2 1, so these are the 3 ways, but I can also write it as 1 blue, 1 red, and 3 green this is also valid, so the immediate answer would be, next step would be 3 1 1, and 1 3 1, right, now can we have any other possibility, let us see, so in case I write 4 here in the place of blue balls, I cannot write 4, do you see why? because in case I write 4 here, I'm forced to write 1 in red, but what will I write in green, it's a question mark, right, I cannot write anything in the place of green, because I'm already done with 5 balls, this is not valid,

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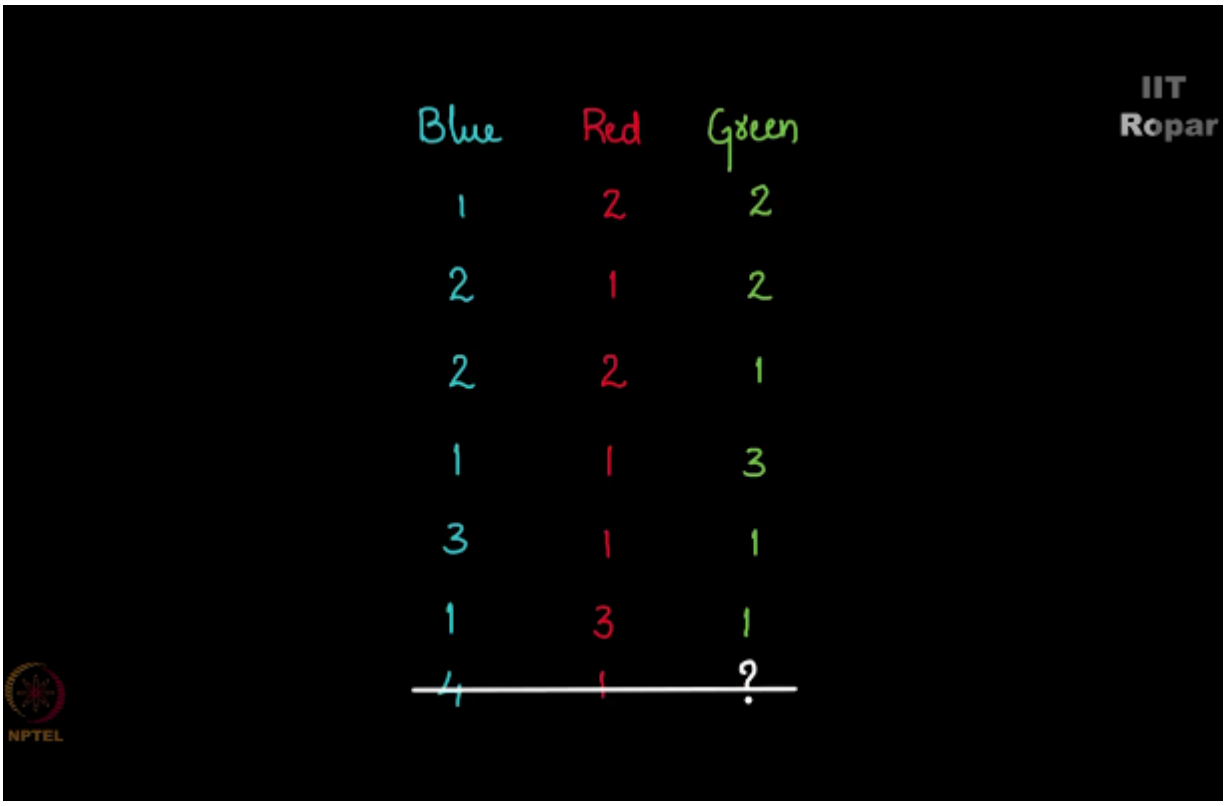

in case I write 5, it is very obvious that, that is not a valid possibility, so the only possibilities we see are these 6 possibilities.

So we had also seen a polynomial expression for these possibilities, the professor had mentioned that X + X square + X cube this is for blue, and the same for red, and for green too,

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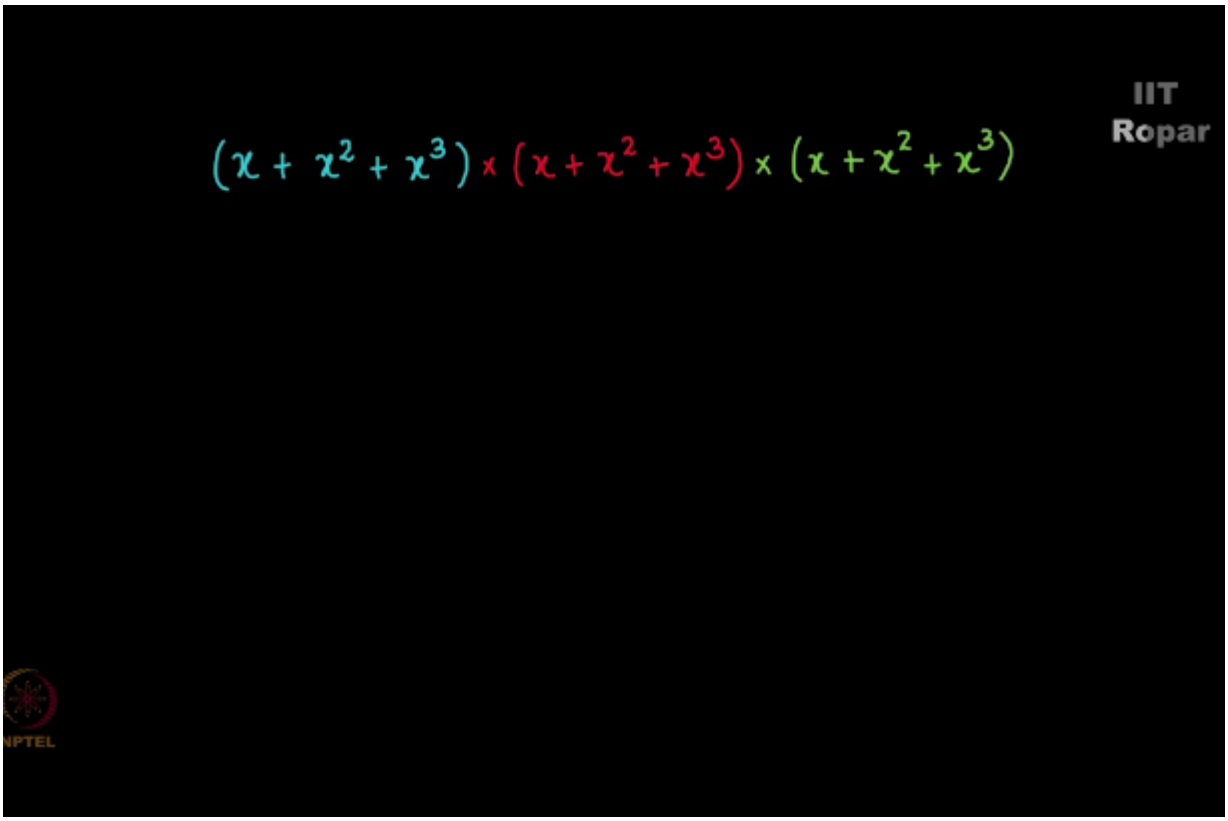
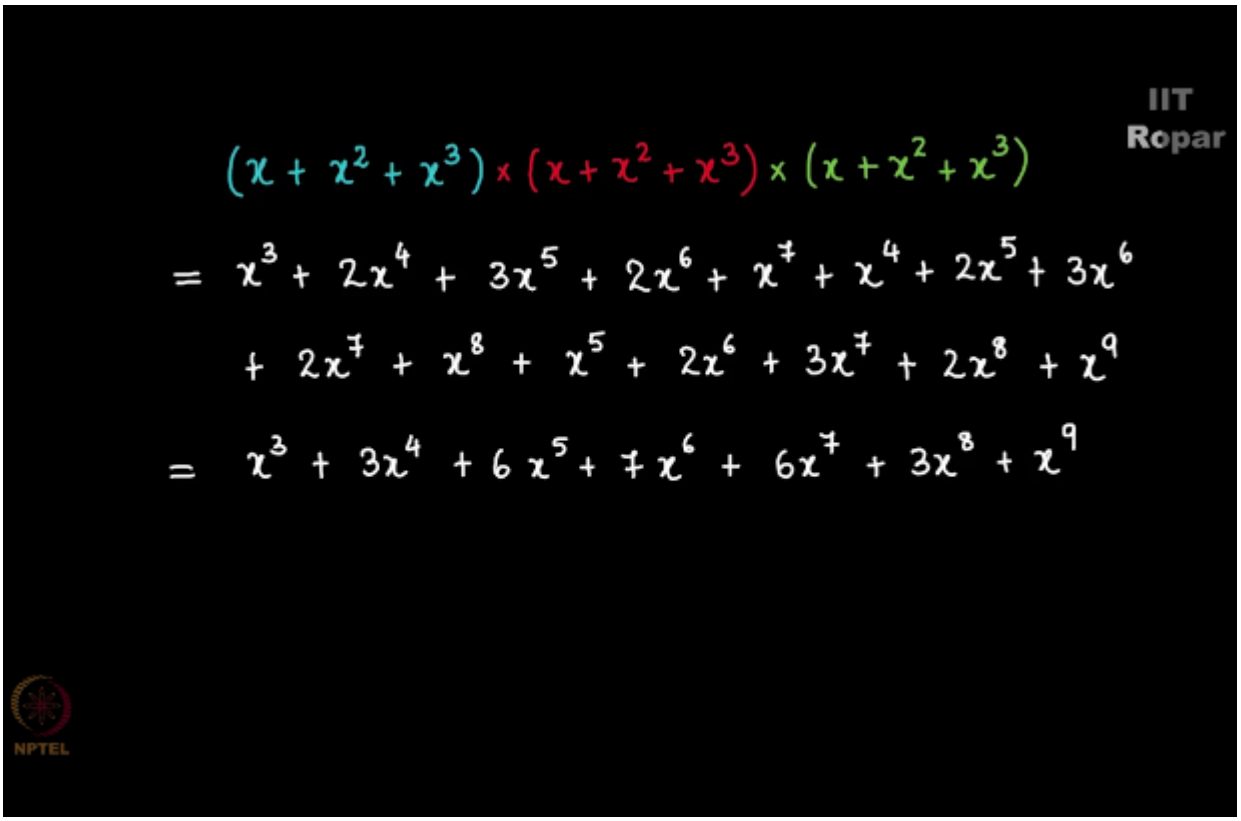


right, now let me just expand these polynomials I'll multiply them and the expansion goes like this, X cube + 2X to the 4 + 3X to the 5 + 2X to the 6 + X to the 7 + X to the 4 + 2X to the 5 + 3X to the 6 + 2X to the 7 + X to the 8 + X to the 5 + 2X to the 6 + 3X to the 7 + 2X to the 8 + X to the 9, so once we expand we get this, but we can further simplify it, so the simplified version would look something like this, X cube + 3X to the 4 + 6X to the 5 + 7X to the 6 + 6X to the 7 + 3X to the 8 + X to the 9,



now the professor had told you to observe the coefficient of X to the 5, so what is it? We see that the coefficient of X to the 5 is 6, do you see that we had 6 valid possibilities for picking 5 balls and the coefficient of X to the 5 here is 6, do you see the relation?

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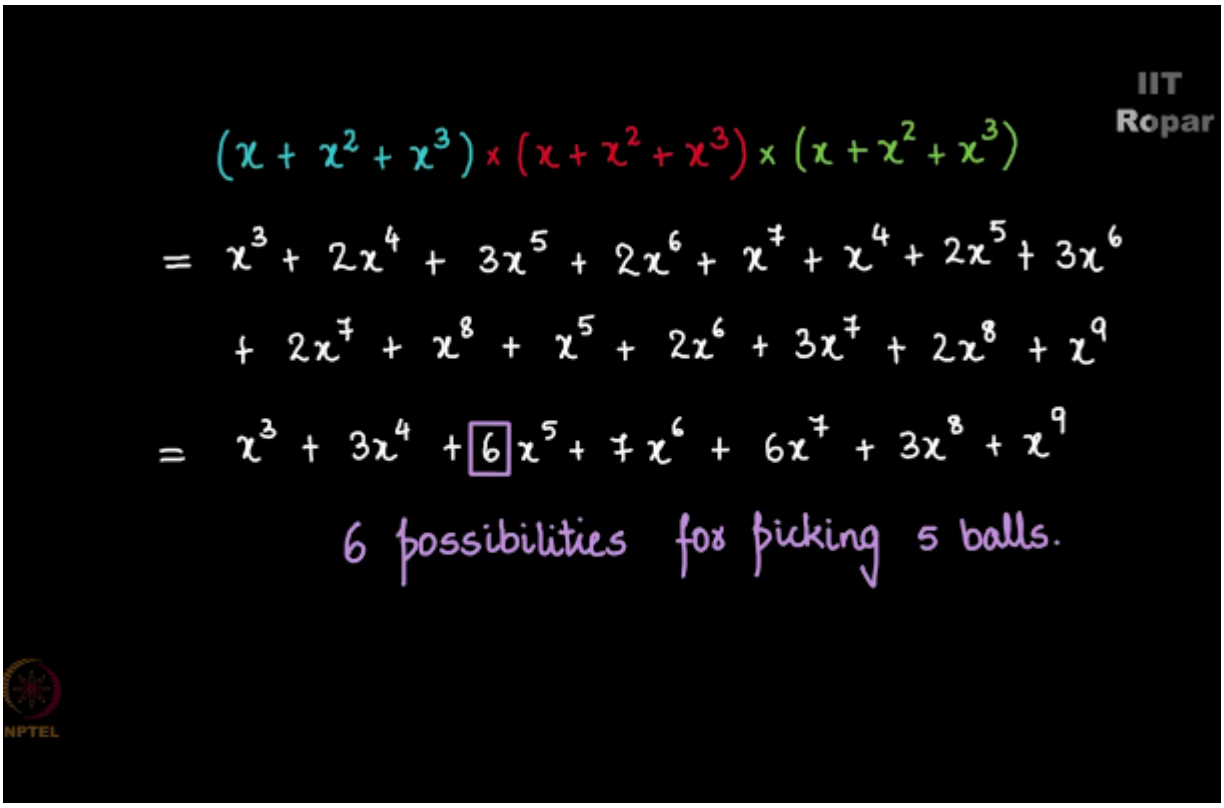
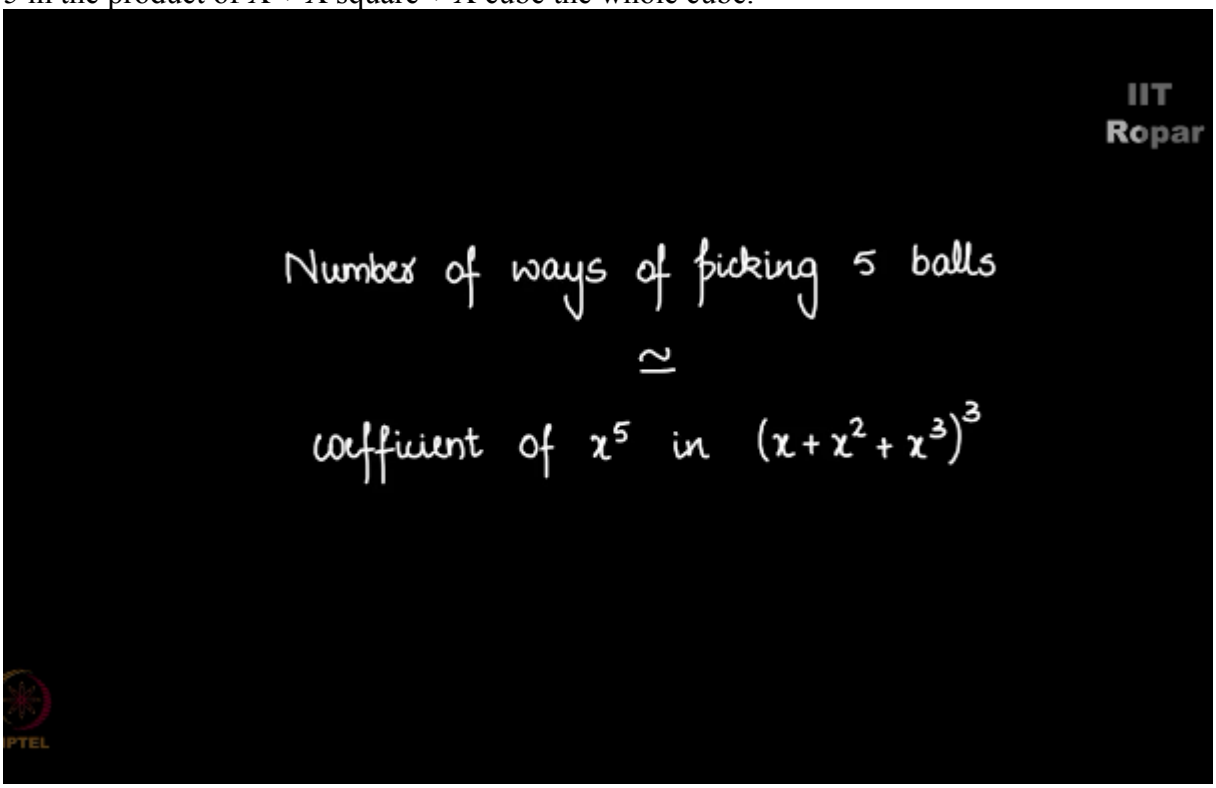


Well, the relation is the number of ways of picking 5 balls is same as the coefficient of X to the 5 in the product of X + X square + X cube the whole cube.



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