Exercise 3.5

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1. Which of the following pairs of linear equations has unique solution, no solution, or infinitely many solutions. In case there is a unique solution, find it by using cross multiplication method.

(i)
$$x - 3y - 3 = 0$$
 and $3x - 9y - 2 = 0$
(iii) $3x - 5y = 20$ and $6x - 10y = 40$

(ii)
$$2x + y = 5$$
 and $3x + 2y = 8$
(iv) $x - 3y - 7 = 0$ and $3x - 3y - 15 = 0$

Solutions:

(i) Given,
$$x - 3y - 3 = 0$$
 and $3x - 9y - 2 = 0$
 $a_1/a_2 = 1/3$, $b_1/b_2 = -3/-9 = 1/3$, $c_1/c_2 = -3/-2 = 3/2$
 $(a_1/a_2) = (b_1/b_2) \neq (c_1/c_2)$

Since, the given set of lines are parallel to each other they will not intersect each other and therefore there is no solution for these equations.

(ii) Given,
$$2x + y = 5$$
 and $3x + 2y = 8$ $a_1/a_2 = 2/3$, $b_1/b_2 = 1/2$, $c_1/c_2 = -5/-8$ $(a_1/a_2) \neq (b_1/b_2)$

Since they intersect at a unique point these equations will have a unique solution by cross multiplication method:

$$x/(b_1c_2-c_1b_2) = y/(c_1a_2 - c_2a=) = 1/(a_1b_2-a_2b_1)$$

 $x/(-8-(-10)) = y/(15+16) = 1/(4-3)$
 $x/2 = y/1 = 1$
 $\therefore x = 2$ and $y = 1$

(iii) Given,
$$3x - 5y = 20$$
 and $6x - 10y = 40$

$$(a_1/a_2) = 3/6 = 1/2$$

 $(b_1/b_2) = -5/-10 = 1/2$
 $(c_1/c_2) = 20/40 = 1/2$

$$a_1/a_2 = b_1/b_2 = c_1/c_2$$

Since the given sets of lines are overlapping each other there will be infinite number of solutions for this pair of equation.

(iv) Given,
$$x - 3y - 7 = 0$$
 and $3x - 3y - 15 = 0$

$$(a_1/a_2) = 1/3$$

$$(b_1/b_2) = -3/-3 = 1$$

$$(c_1/c_2) = -7/-15$$

$$a_1/a_2 \neq b_1/b_2$$

Since this pair of lines are intersecting each other at a unique point, there will be a unique solution.

By cross multiplication,

$$x/(45-21) = y/(-21+15) = 1/(-3+9)$$

$$x/24 = y/ -6 = 1/6$$

$$x/24 = 1/6$$
 and $y/-6 = 1/6$

$$\therefore$$
 x = 4 and y = 1.

2. (i) For which values of a and b does the following pair of linear equations have an infinite number of solutions?

$$2x + 3y = 7$$

$$(a - b) x + (a + b) y = 3a + b - 2$$

(ii) For which value of k will the following pair of linear equations have no solution?

$$3x + y = 1$$

$$(2k-1) x + (k-1) y = 2k + 1$$

Solution:

(i)
$$3y + 2x - 7 = 0$$

$$(a + b)y + (a-b)y - (3a + b - 2) = 0$$

$$a_1/a_2 = 2/(a-b)$$
, $b_1/b_2 = 3/(a+b)$, $c_1/c_2 = -7/-(3a + b - 2)$

$$a_1/a_2 = b_1/b_2 = c_1/c_2$$

Thus
$$2/(a-b) = 7/(3a+b-2)$$

$$6a + 2b - 4 = 7a - 7b$$

$$a - 9b = -4$$
(i)

$$2/(a-b) = 3/(a+b)$$

$$2a + 2b = 3a - 3b$$

Subtracting (i) from (ii), we get

$$4b = 4$$

$$b = 1$$

Substituting this eq. in (ii), we get

$$a - 5 \times 1 = 0$$

$$a = 5$$

Thus at a = 5 and b = 1 the given equations will have infinite solutions.

(ii)
$$3x + y - 1 = 0$$

$$(2k-1)x + (k-1)y - 2k-1 = 0$$

$$a_1/a_2 = 3/(2k - 1)$$
,

$$a_1/a_2 = 3/(2k-1)$$
, $b_1/b_2 = 1/(k-1)$, $c_1/c_2 = -1/(-2k-1) = 1/(2k+1)$

For no solutions

$$a_1/a_2 = b_1/b_2 \neq c_1/c_2$$

$$3/(2k-1) = 1/(k-1) \neq 1/(2k+1)$$

$$3/(2k-1) = 1/(k-1)$$

$$3k - 3 = 2k - 1$$

$$k = 2$$

Therefore, for k = 2 the given pair of linear equations will have no solution.

3. Solve the following pair of linear equations by the substitution and cross-multiplication methods:

$$8x + 5y = 9$$

$$3x + 2y = 4$$

Solution:

$$8x + 5y = 9$$
(1)

$$3x + 2y = 4$$
(2)

From equation (2) we get

$$x = (4 - 2y)/3$$
(3)

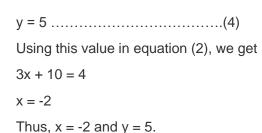
Using this value in equation 1, we get

$$8(4-2y)/3 + 5y = 9$$

$$32 - 16y + 15y = 27$$

$$-y = -5$$





Now, Using Cross Multiplication method:

$$8x +5y - 9 = 0$$

 $3x + 2y - 4 = 0$
 $x/(-20+18) = y/(-27 + 32) = 1/(16-15)$
 $-x/2 = y/5 = 1/1$
 $\therefore x = -2$ and $y = 5$.

- 4. Form the pair of linear equations in the following problems and find their solutions (if they exist) by any algebraic method:
- (i) A part of monthly hostel charges is fixed and the remaining depends on the number of days one has taken food in the mess. When a student A takes food for 20 days she has to pay Rs.1000 as hostel charges whereas a student B, who takes food for 26 days, pays Rs.1180 as hostel charges. Find the fixed charges and the cost of food per day.
- (ii) A fraction becomes 1/3 when 1 is subtracted from the numerator and it becomes 1/4 when 8 is added to its denominator. Find the fraction.
- (iii) Yash scored 40 marks in a test, getting 3 marks for each right answer and losing 1 mark for each wrong answer. Had 4 marks been awarded for each correct answer and 2 marks been deducted for each incorrect answer, then Yash would have scored 50 marks. How many questions were there in the test?
- (iv) Places A and B are 100 km apart on a highway. One car starts from A and another from B at the same time. If the cars travel in the same direction at different speeds, they meet in 5 hours. If they travel towards each other, they meet in 1 hour. What are the speeds of the two cars?
- (v) The area of a rectangle gets reduced by 9 square units, if its length is reduced by 5 units and breadth is increased by 3 units. If we increase the length by 3 units and the breadth by 2 units, the area increases by 67 square units. Find the dimensions of the rectangle.

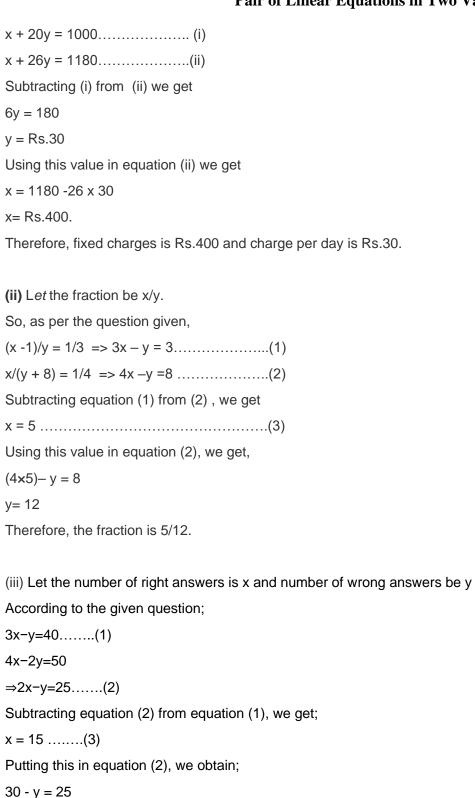
Solutions:

(i) Let x be the fixed charge and y be the charge of food per day. According to the question,



Or y = 5

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Therefore, number of right answers = 15 and number of wrong answers = 5

Hence, total number of questions = 20

(iv) Let x km/h be the speed of car from point A and y km/h be the speed of car	oi car iro	om point B
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If the car travels in the same direction, 5x - 5y = 100 x - y = 20(i) If the car travels in the opposite direction, x + y = 100(ii)

Solving equation (i) and (ii), we get x = 60 km/h....(iii)

Using this in equation (i), we get, 60 - y = 20y = 40 km/h

Therefore, the speed of car from point A = 60 km/h

Speed of car from point B = 40 km/h.

(v) Let,

The length of rectangle = x unit

And breadth of the rectangle = y unit

Now, as per the question given,

$$(x-5)(y+3) = xy-9$$

$$3x - 5y - 6 = 0$$
....(1)

$$(x + 3) (y + 2) = xy + 67$$

$$2x + 3y - 61 = 0$$
....(2)

Using cross multiplication method, we get,

$$x/(305 +18) = y/(-12+183) = 1/(9+10)$$

$$x/323 = y/171 = 1/19$$

Therefore, x = 17 and y = 9.

Hence, the length of rectangle = 17 units

And breadth of the rectangle = 9 units