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Cbse 12 Applied Mathematics

Unit 1

Modulo Arithmetic
Congruence Modulo
Simple Arithmetic functions
Allegation or Mixtures
Numerical problems on boats and streams ,partnership,pipes and cisterns ,races and games ,scheduling
Numerical inequalities

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Modular Arithmetic

When we divide two integers we will have an equation that looks like the following

$$\frac{A}{B} = Q \text{ remainder } R$$

A = dividend

B = divisor

Q = quotient

R = Remainder

$A \bmod B \equiv R$

Ex $\frac{13}{5} = 2$ remainder 3

$13 \bmod 5 = 3$

When you divide by 3 for example the R can be $\{0, 1, 2\}$ only.

$\frac{0}{3} = 0 \quad R = 0$

$\frac{1}{3} = 0 \quad R = 1$

$\frac{2}{3} = 0 \quad R = 2$

$\frac{3}{3} = 1 \quad R = 0$

$\frac{4}{3} = 1 \quad R = 1$

$\frac{5}{3} = 1 \quad R = 2$

$\frac{6}{3} = 2 \quad R = 0$

The R starts at 0 and Increases by 1 each time

The remainders start at 0 and increases by 1 each time. Until the number reaches 1 less that the number we are dividing. After that the sequence repeats.

We can visualize this modulo operator by using Circles.

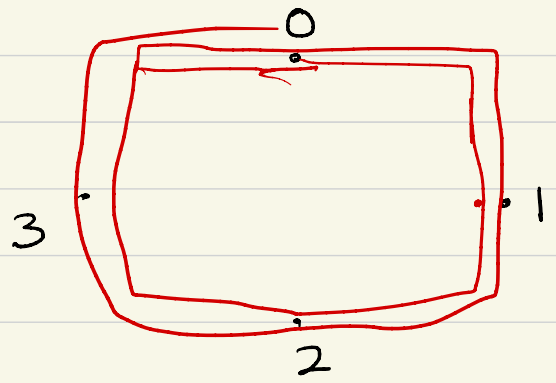
To find A mod B

① Construct this clock for size B

② Start at 0 and move the clock A steps.

③ Wherever we land is our station

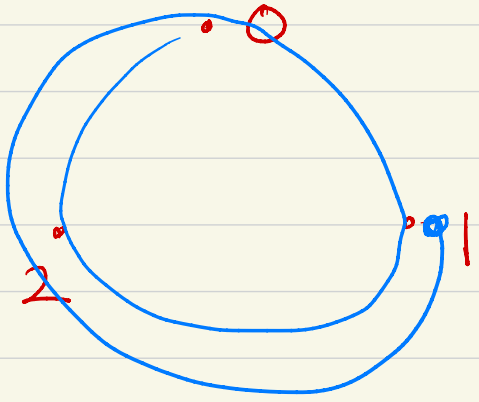
Ex 8 mod 4 =



Ex Try 7 mod 2 Ans 1

Ex2 $-5 \bmod 3$

with a modules of 3 we make a clock 0, 1, 2



5 numbers anticlockwise

Answer = 1

For negative nos use this method

1) $-5 \bmod 3$

$$3 \overline{)-5} \quad 2, \quad 6, \quad 1$$

Hence 1

2) $-10 \bmod 3$ Ans 2

3) $-7 \bmod 4$ Ans 1

Congruence Modulo

$$A \equiv B \pmod{C}$$

A is Congruent to B modulo C

Practice

① What is $17 \bmod 7$

② $-14 \bmod 2$

③ $-13 \bmod 1$

④ $-49 \bmod 1$

⑤ $-6 \bmod 18$

⑥ $29 \bmod 4$

⑦ $6 \bmod 18$

Answer

① 3 ② 0 ③ 0 ④ 1 ⑤ 12

⑥ 1 ⑦ 6

Congruence Modulo

$$A \equiv B \pmod{c}$$

1) $\equiv$ Symbol of Congruence

$$26 \equiv 11 \pmod{5}$$

$\because$ $26 \bmod 5 = 1$ Equivalence class is 1

$11 \bmod 5 = 1$ Same equivalence class.

Practice

Ex1 $x \equiv -11 \pmod 8$

Which of the following integers are Valid Solutions of x

(A) -39 (B) -32 (C) 6 (D) 27 (E) 46 (F) None Obabare.

2) $x \equiv 5 \pmod{13}$

(A) -21 (B) 5 (C) 17 (D) 29 (E) 31 (F) None

(3) $x \equiv -4 \pmod 3$

(A) -33 (B) -1 (C) 12 (D) 35 (E) None

(4) $x = 17 \pmod 5$

(A) -44 (B) -4 (C) 8 (D) 12 (E) 14 (F) None

(5) $x = -7 \pmod{12}$

(A) -43 (B) -5 (C) 5 (D) 29

(E) 43 (F) None

(6) $x \equiv 26 \pmod{7}$

(A) -23 (B) -2 (C) 3

(D) 17 (E) 28 (F) none.

Answer 1) F ② A, B, E ③ B, D

④ D ⑤ A, C, D ⑥ A, B.

Find the least possible Values of x Which Satisfy the equations.

① $21 \equiv x \pmod 5$

Solution

$21 - x = 5n$ ↙ multiple of 5

Least value of $x = 1$

② $53 \equiv x \pmod 3$ CW

Ans $x = 2$

③ $87 \equiv x \pmod 7$ CW.

④ $79 \equiv x \pmod 4$ HW

⑤ $95 \equiv x \pmod 3$ HW.

⑥ $58+x \equiv 5 \pmod 7$

$58+x-5 = 7n$

$53+x = 7n.$

$n = 8$

$\therefore \quad x = 3$

⑦ $28+x \equiv 5 \pmod 4$ ω

8) $47+x \equiv 7 \pmod 3$

ω.

⑨ $73+x \equiv 3 \pmod 6$

⑩ $23 \equiv (x+5) \pmod 3$

$23-(x+5) = 3n$

$17-x = 3n$

but $\quad x = 2$

(11) $92 \equiv (x+7) \pmod 6$ CW

(12) $57 \equiv (x+3) \pmod 3$ HW

(13) $93 \equiv (x+2) \pmod 6$ HW

(14) $53 = \frac{x}{6} \pmod 3$

$$53 - \frac{x}{6} = 3n$$

So $x = 12$ ∵ nearest 5

(15) $23 \equiv \frac{x}{5} \pmod 7$ CW

(16) $83 \equiv \frac{x}{6} \pmod 5$

HW

(17) $3x \equiv 4 \pmod 5$

$3x - 4 = 5n$.

$x = 8$

18) $7x \equiv 3 \pmod 5$ Q.E.D

19) $5x \equiv 4 \pmod 6$

20) $x \equiv 5 \pmod 7$

$2x - 5 \equiv p \pmod 7$ Find p.

Solution

$x - 5 = 7n$ $\therefore$ $x = 12$

$2x - 5 = 19$

$19 - p = 7n$ $\therefore$ $p = 5$

21) $x \equiv 3 \pmod 5$

$3x - 4 \equiv p \pmod 7$

Find p

22) $x \equiv 5 \pmod 3$

$7x - 2 \equiv p \pmod 5$

$p =$ ___

23) $5x \equiv 4 \pmod 6$

$5x - 4 \equiv 6n$

$x = 8,$ next nos. $14, 20,$

Ans ② $x = 2$ ③ $x = 3$

④ $x = 3$ ⑤ $x = 2$

⑦ $x = 1$ ⑧ $x = 2$ ⑨ $x = 2$

⑪ $x = 1$ ⑫ $x = 2$

⑬ $x = 1$

⑮ $23 - \frac{x}{5} = 7n.$

$23 - \frac{x}{5} = 21$

$23 - 21 = \frac{x}{5} \Rightarrow x = 2$

⑯ $83 - \frac{x}{6} = 80$ $x = 18$

18) $7x - 3 = 5n.$

$x = 4$

19) $5x - 4 = 6n$ $x = 2$

21) $x \equiv 3 \pmod 5$

$x - 3 = 5n \qquad x = 8$

$20 \equiv p \pmod 7$

$20 - p = 7 \qquad p = 6$

22) $p = 4$

Allegation or Mixture

When two or more ingredients are mixed, mixtures can be of two types.

- Simple mixture
- Complex mixture.

Rule of Allegation

$$\frac{\text{Quantity of cheaper}}{\text{Quantity of dearer}} = \frac{\text{Cost price of Dearer} - \text{Mean price}}{\text{Mean price} - \text{Cost price of Cheaper}}$$

Cost price of Cheaper
C

Cost price of dearer.
D

M

Quantity of cheaper
D − M

Quantity of dearer.
M − C

(1) A Shopkeeper mixes 30 kg of type A rice of Rs 40/kg and 45 kg of type B rice of Rs 30/kg. Find price of the formed mixture.

$$\frac{30}{45} = \frac{30 - M}{M - 40}$$

$$M = 34$$

(2) In what ratio should Tea at the rate of Rs40/kg be mixed with Tea at rate of Rs27/kg. So that mixture may cost Rs30

$$\frac{\text{Q of cheaper}}{\text{Q of dearer}} = \frac{40-30}{30-27} = \frac{10}{3}$$

10 : 3

③ In what ratio must two kinds of Sugar at Rs 1.15 per kg and Rs 1.24 per kg. must be mixed so that by Selling at Rs 1.15 a profit of 25% is gained

SP = 1.50 profit 25%. (CP) 1.25 = SP
CP = 1.20

115 124

120

(124 − 120) 120 − 115

4 5

Ans 4 : 5

4) Two Varieties of rice are mixed in the ratio 2 : 3

Price of the mixture is Rs12/kg and price of the cheaper is Rs 10/kg. What is the price of the other Variety

Ans Rs 13.33 kg.

5) In what ratio must water be mixed with milk Costing Rs12 per litre in order to get a mixture worth Rs 8 per litre.

Ans 1:2

6) In what ratio must a grocer mix at Rs 60 a kg and Rs 65/kg So that by Selling at 68.20 Rs/kg he gains 10%

Ans 3:2

* ① In 50 gm alloy of gold and Silver. The gold is 80% by weight. How much gold should be mixed to this alloy so that the weight of gold will be 95%. (Ans 150gm)

② Cost of two types of pulses is Rs 15 and Rs 20 / kg respectively. If both the pulses are mixed together in the ratio 2:3 then what should be the price of mixed Variety of pulses per kg.

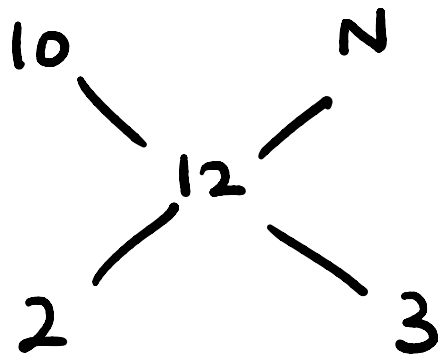
Ans Rs 18/kg.

9) A dealer has 1000 Kg Sugar and he sells a part of it at 8% profit and the rest of it at 18% profit. The overall profit he earns is 14%. What is the quantity which is sold at 18%. (Ans 600 kg)

10) How many kg of sugar costing Rs 9 must be mixed with 27 kg of Sugar costing Rs 7/kg so that there may be a gain of 10% by selling the mixture at Rs 9.24/kg. (63 kg)

Answer / Hints

4)



$$\frac{2}{3} = \frac{N-12}{12-10}$$

N = Rs 13.33 per kg.

5)

Cost of 1 kg of water	Milk
0	12

8

$$\frac{\text{Q of water}}{\text{Q of Milk}} = \frac{12-8}{8-0} = \frac{4}{8} = \frac{1}{2}$$

$12-8$ $\quad$ $8-0$

6) (Cost price) 1.10 = 68.2

Net Cost = 62

60 $\quad$ 65

62

$65-62$ $\quad$ $62-60$

ratio 3:2

7) 80 % 100 % When pure gold is added it is 100%.

95%

100−95 95−80.

Ratio 5 : 15 or 1 : 3

So for 50 gm of alloy

150 gm of gold should be added.

8) $\frac{2}{3} = \frac{20-x}{x-15}$ $x = 18$

9) $\frac{Q_1}{Q_2} = \frac{18-14}{14-8} = \frac{2}{3}$

Q of Sugar sold at 18% profit

10) 9 7

8.40

1.4 0.6

7 : 3 ratio ∴ 63kg

$\frac{3}{5} \times 1000 = 600$ kg

Pipes and Cisterns

① If x hr are required to fill up a tank then in 1hr $= \frac{1}{x}$

1. **Inlet:**

   A pipe connected with a tank or a cistern or a reservoir, that fills it, is known as an inlet.

   Outlet:

   A pipe connected with a tank or cistern or reservoir, emptying it, is known as an outlet.

2. If a pipe can fill a tank in x hours, then:

   part filled in 1 hour $= \frac{1}{x}$.

3. If a pipe can empty a tank in y hours, then:

   part emptied in 1 hour $= \frac{1}{y}$.

4. If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $y > x$), then on opening both the pipes, then

   the net part filled in 1 hour $= \left(\frac{1}{x} - \frac{1}{y}\right)$.

5. If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $x > y$), then on opening both the pipes, then

   the net part emptied in 1 hour $= \left(\frac{1}{y} - \frac{1}{x}\right)$.

Examples

① Pipe M and N are running together and can fill the Cistern in 6min. If M takes 5 min less than N to fill the Cistern, then time in which N alone can fill the Cistern is ____

Ans $M \rightarrow x$ min
$N \rightarrow x+5$

$$\frac{1}{x} + \frac{1}{x+5} = \frac{1}{6} \qquad x = 10$$

$\therefore$ N fills in 15 min

② A Cistern normally takes 10hr to be filled by a tap but because of one open outlet

it takes 5 hrs more. In how many hours will the outlet pipe empty the Cistern.

Singee pipe $1/10$

Both pipes $1/15$

To solve $\frac{1}{10} - \frac{1}{x} = \frac{1}{15}$

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{15}$$

$$= \frac{15-10}{150}$$

$x = 30$hrs

So it will empty in 30hrs

③ Two pipes fill a tank in 12 and 20 hrs. The pipes are opened Simultaneously and it is found that due to leakage at the bottom it takes 30 min more If Cistern is full in What time would the leak empty it

If Both operate $\frac{1}{12} + \frac{1}{20} = \frac{2}{15}$

or $\frac{15}{2}$ hrs = 7.5 hrs.

due to leakage it is 8 hrs.

$$\frac{1}{12} + \frac{1}{20} - \frac{1}{x} = \frac{1}{8}$$

$$\frac{2}{15} - \frac{1}{8} = \frac{1}{x}$$

$$x = 120 \text{ hrs}$$

Exercises

1. Three pipes A, B and C can fill a tank from empty to full in 30 minutes, 20 minutes, and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P,Q and R respectively. What is the proportion of the solution R in the liquid in the tank after 3 minutes?

2. Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in:

3. A pump can fill a tank with water in 2 hours. Because of a leak, it took $2\frac{1}{3}$ hours to fill the tank. The leak can drain all the water of the tank in:

   A. $4\frac{1}{3}$ hours

   B. 7 hours

   C. 8 hours

   D. 14 hours

5. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. The time required by the first pipe is:

   A. 6 hours

   B. 10 hours

   C. 15 hours

   D. 30 hours

6. Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 3 gallons per minute. All the three pipes working together can fill the tank in 15 minutes. The capacity of the tank is:

   A. 60 gallons

   B. 100 gallons

   C. 120 gallons

   D. 180 gallons

7. A tank is filled in 5 hours by three pipes A, B and C. The pipe C is twice as fast as B and B is twice as fast as A. How much time will pipe A alone take to fill the tank?

   A. 20 hours

   B. 25 hours

   C. 35 hours

   D. Cannot be determined

   E. None of these

8. Two pipes A and B together can fill a cistern in 4 hours. Had they been opened separately, then B would have taken 6 hours more than A to fill the cistern. How much time will be taken by A to fill the cistern separately?

   A. 1 hour

   B. 2 hours

   C. 6 hours

   D. 8 hours

9. Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank?

   A. 12 min

   B. 15 min

   C. 25 min

   D. 50 min

10. Two pipes A and B can fill a tank in 15 minutes and 20 minutes respectively. Both the pipes are opened together but after 4 minutes, pipe A is turned off. What is the total time required to fill the tank?

    A. 10 min. 20 sec.

    B. 11 min. 45 sec.

    C. 12 min. 30 sec.

    D. 14 min. 40 sec.

Exercises

1. Three pipes A, B and C can fill a tank from empty to full in 30 minutes, 20 minutes, and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P,Q and R respectively. What is the proportion of the solution R in the liquid in the tank after 3 minutes?

$3\left(\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right)=3\times\frac{11}{60}=\frac{11}{20}$

Party held by C $3/10$

ratio $\frac{3}{10}:\frac{11}{20}=\frac{6}{11}$

2. Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in:

$\frac{1}{5}+\frac{1}{6}-\frac{1}{12}=\frac{17}{60}$ $\frac{60}{17}=3\frac{9}{17}$

3. A pump can fill a tank with water in 2 hours. Because of a leak, it took $2\frac{1}{3}$ hours to fill the tank. The leak can drain all the water of the tank in:

A. $4\frac{1}{3}$ hours
B. 7 hours
C. 8 hours
D. 14 hours ✓

$\frac{1}{2}-\frac{3}{7}=\frac{1}{14}$

5. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. The time required by the first pipe is:

A. 6 hours
B. 10 hours
C. 15 hours
D. 30 hours

First pipe x Second $x-5$ third $x-9$

$\frac{1}{x}+\frac{1}{x-5}=\frac{1}{x-9}$ $x=15$

6. Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 3 gallons per minute. All the three pipes working together can fill the tank in 15 minutes. The capacity of the tank is:

A. 60 gallons
B. 100 gallons
C. 120 gallons
D. 180 gallons ✓

Emptying power of waste pipe

$\frac{1}{15}-\frac{1}{20}+\frac{1}{24}=-\frac{1}{40}$ Total Capacity 120 gallons

7. A tank is filled in 5 hours by three pipes A, B and C. The pipe C is twice as fast as B and B is twice as fast as A. How much time will pipe A alone take to fill the tank?

A. 20 hours
B. 25 hours
C. 35 hours ✓
D. Cannot be determined
E. None of these

$A = x$ hrs $\quad B = x/2$

$C = x/4$

$\frac{1}{x} + \frac{2}{x} + \frac{4}{x} = \frac{1}{5} \quad x = 35$

8. Two pipes A and B together can fill a cistern in 4 hours. Had they been opened separately, then B would have taken 6 hours more than A to fill the cistern. How much time will be taken by A to fill the cistern separately?

A. 1 hour
B. 2 hours
C. 6 hours
D. 8 hours

$\frac{1}{x} + \frac{1}{x+6} = \frac{1}{4} \quad x = 6$

9. Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank?

A. 12 min ✓
B. 15 min
C. 25 min
D. 50 min

$\frac{1}{20} + \frac{1}{30} = \frac{1}{12}$

10. Two pipes A and B can fill a tank in 15 minutes and 20 minutes respectively. Both the pipes are opened together but after 4 minutes, pipe A is turned off. What is the total time required to fill the tank?

A. 10 min. 20 sec.
B. 11 min. 45 sec.
C. 12 min. 30 sec.
D. 14 min. 40 sec. ✓

In 4 min $4\left(\frac{1}{15} + \frac{1}{20}\right) = \frac{7}{15}$

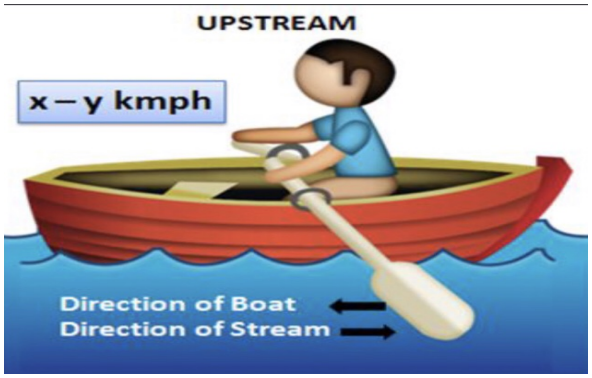
Balance $1 - \frac{7}{15} = 8/15$

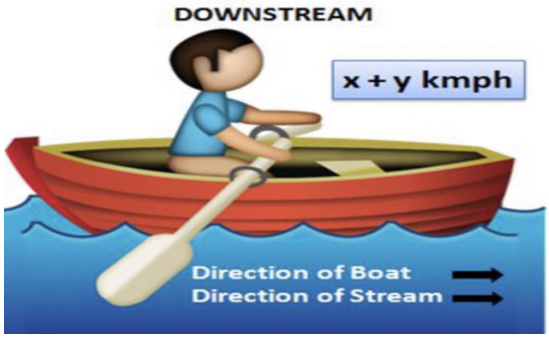
B per minute $\frac{1}{20}$

$\frac{1}{20} : \frac{8}{15} = 1 : x$

$x = 14$ min 40 sec.

Boats and streams





Man's/Boat's Speed = X
Stream/Current/River speed = Y

∴ Downstream speed = X+Y
Upstream speed = X-Y

X:Y = 7:1

∴X = 7Y

$$\textbf{Speed} = \frac{\textbf{Distance}}{\textbf{Time}}$$

$$\therefore \textbf{Upstream speed} = \frac{4.2\text{km}}{14\text{ min}} = \textbf{0.3km/min}$$

Upstream speed = X-Y = 7Y-Y = 0.3 km/min

∴ Y = 0.05 km/min

Downstream speed = X+Y = (7Y+Y) = 8Y = 8 x 0.05 = 0.4 km/mi

$$\text{Downstream time} = \frac{\text{Distance}}{\text{Speed}} = \frac{18.4\text{km}}{0.4\text{ km/min}}$$

$$\textbf{Downstream time taken} = \frac{184}{4} = \textbf{46 minutes}$$

1. **Downstream/Upstream:**

   In water, the direction along the stream is called **downstream**. And, the direction against the stream is called **upstream**.

2. If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr, then:

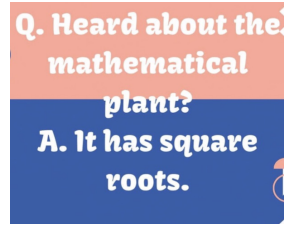
   Speed downstream = $(u + v)$ km/hr.

   Speed upstream = $(u - v)$ km/hr.

3. If the speed downstream is a km/hr and the speed upstream is b km/hr, then:

   Speed in still water = $\frac{1}{2}(a + b)$ km/hr.

   Rate of stream = $\frac{1}{2}(a - b)$ km/hr.



1. A boat can travel with a speed of 13 km/hr in still water. If the speed of the stream is 4 km/hr, find the time taken by the boat to go 68 km downstream.
   - **A.** 2 hours
   - **B.** 3 hours
   - **C.** 4 hours
   - **D.** 5 hours

2. A man's speed with the current is 15 km/hr and the speed of the current is 2.5 km/hr. The man's speed against the current is:
   - **A.** 8.5 km/hr
   - **B.** 9 km/hr
   - **C.** 10 km/hr
   - **D.** 12.5 km/hr

3. A boat running upstream takes 8 hours 48 minutes to cover a certain distance, while it takes 4 hours to cover the same distance running downstream. What is the ratio between the speed of the boat and speed of the water current respectively?
   - **A.** 2 : 1
   - **B.** 3 : 2
   - **C.** 8 : 3
   - **D.** Cannot be determined
   - **E.** None of these

4. A motorboat, whose speed in 15 km/hr in still water goes 30 km downstream and comes back in a total of 4 hours 30 minutes. The speed of the stream (in km/hr) is:
   - **A.** 4
   - **B.** 5
   - **C.** 6
   - **D.** 10

5. In one hour, a boat goes 11 km/hr along the stream and 5 km/hr against the stream. The speed of the boat in still water (in km/hr) is:
   - **A.** 3 km/hr
   - **B.** 5 km/hr
   - **C.** 8 km/hr
   - **D.** 9 km/hr

6. A boat running downstream covers a distance of 16 km in 2 hours while for covering the same distance upstream, it takes 4 hours. What is the speed of the boat in still water?

   A. 4 km/hr

   B. 6 km/hr

   C. 8 km/hr

   D. Data inadequate

7. The speed of a boat in still water in 15 km/hr and the rate of current is 3 km/hr. The distance travelled downstream in 12 minutes is:

   A. 1.2 km

   B. 1.8 km

   C. 2.4 km

   D. 3.6 km

8. A boat takes 90 minutes less to travel 36 miles downstream than to travel the same distance upstream. If the speed of the boat in still water is 10 mph, the speed of the stream is:

   A. 2 mph

   B. 2.5 mph

   C. 3 mph

   D. 4 mph

9. A man can row at 5 kmph in still water. If the velocity of current is 1 kmph and it takes him 1 hour to row to a place and come back, how far is the place?

   A. 2.4 km

   B. 2.5 km

   C. 3 km

   D. 3.6 km

10. A boat covers a certain distance downstream in 1 hour, while it comes back in $1\frac{1}{2}$ hours. If the speed of the stream be 3 kmph, what is the speed of the boat in still water?

A. 12 kmph

B. 13 kmph

C. 14 kmph

D. 15 kmph

E. None of these

Solutions next page

① Downstream speed = 13+4

= 17 Km/hr

$$\text{Time} = \frac{68}{17} = 4 \text{ hr.}$$

② Mans speed = 15 − 2.5

= 12.5 km/hr.

∴ against Current

= 12.5 − 2.5

= 10 km/hr

③ $$\frac{s}{u-v} = 8\frac{48}{60} = 8\frac{4}{5} = \frac{44}{5}$$

$$\frac{s}{u+v} = 4$$

$$\frac{u+v}{u-v} = \frac{44}{5} \times \frac{1}{4} = \frac{11}{5}$$

$$5u + 5v = 11u - 11v$$

$$16v = 6u \qquad \frac{u}{v} = \frac{16}{6} = \frac{8}{3}$$

4) Speed downstream = $(15+x)$ km/hr

upstream = $(15-x)$ km/hr.

$$\frac{30}{15+x} + \frac{30}{15-x} = 4\frac{1}{2}$$

$$x = 5$$

5) $u+v = 11$

$u-v = 5$

$2u = 16$ $\quad u = 8$ km/hr

6) down stream = 8 km/hr.

upstream = 4 km/hr.

$\therefore$ Speed = 6 km/hr

7) Speed downstream = $15+3$

$= 18$ Kmph.

Distance $= 18 \times \frac{12}{60} = 3.6$ Km

8) $\frac{36}{10-x} + \frac{36}{10+x} = \frac{90}{60}$

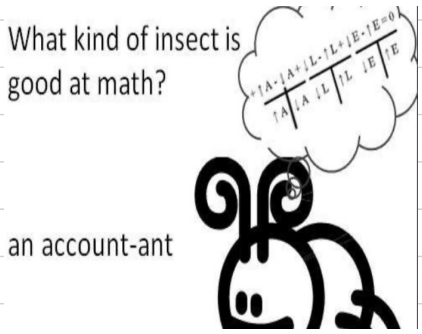
$x = 2$ mph.

9) downstream $= 6$ km/hr.

upstream $= 4$ km/hr.

$\frac{x}{6} + \frac{x}{4} = 1$

$x = 2.4$ km.



10) down stream $= x+3$

upstream $= x-3$

$(x+3) \times 1 = (x-3) \cdot \frac{3}{2}$

$x = 15$ kmph

One-Step Inequalities

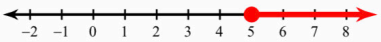
Numerical inequalities

Solve each inequality and gra

1) $-12 > x - 7$

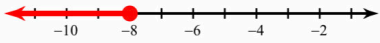
$x < -5$

2) $-1 + r \geq 4$



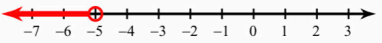
$r \geq 5$

3) $n - 6 \leq -14$



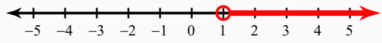
$n \leq -8$

4) $b - 7 < -12$



$b < -5$

5) $a - 17 > -16$

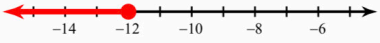


$a > 1$

6) $15 + x \leq 0$

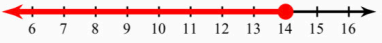
$x \leq -15$

7) $3 + v \leq -9$



$v \leq -12$

8) $8 \geq n - 6$

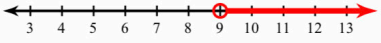


$n \leq 14$

9) $-3x > 3$

$x < -1$

10) $\frac{n}{3} > 3$



$n > 9$

11) $\frac{k}{4} < -4$

$k < -16$

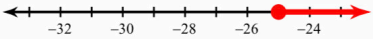
12) $-9x \geq -90$

$x \leq 10$

13) $0 \geq 7n$

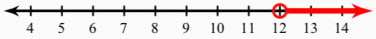
$n \leq 0$

14) $\frac{m}{5} \geq -5$



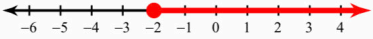
$m \geq -25$

15) $-13x < -156$



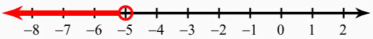
$x > 12$

16) $32 \geq -16p$



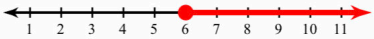
$p \geq -2$

17) $-8 > v - 3$



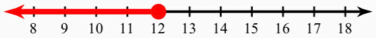
$v < -5$

18) $11 \leq 5 + x$



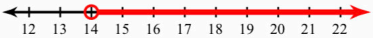
$x \geq 6$

19) $25 \geq n + 13$



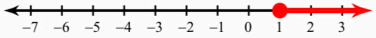
$n \leq 12$

20) $-168 > -12a$



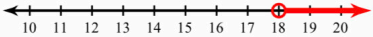
$a > 14$

21) $-3 \leq x - 4$



$x \geq 1$

22) $\frac{r}{3} > 6$

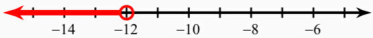


$r > 18$

23) $12n \geq 84$

$n \geq 7$

24) $-22 > -10 + b$



$b < -12$

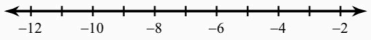
One-Step Inequalities

Numerical inequalities

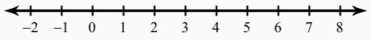
Period

Solve each inequality and graph its solution.

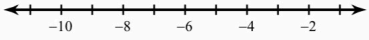
1) $-12 > x - 7$



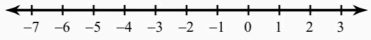
2) $-1 + r \geq 4$



3) $n - 6 \leq -14$

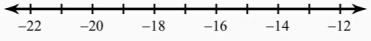


4) $b - 7 < -12$

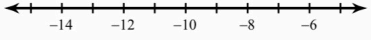


5) $a - 17 > -16$

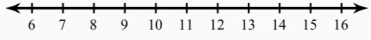
6) $15 + x \leq 0$



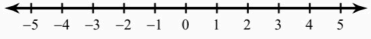
7) $3 + v \leq -9$



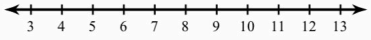
8) $8 \geq n - 6$



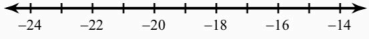
9) $-3x > 3$



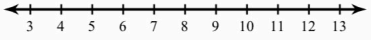
10) $\frac{n}{3} > 3$



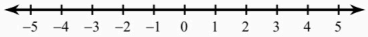
11) $\frac{k}{4} < -4$



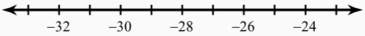
12) $-9x \geq -90$



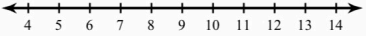
13) $0 \geq 7n$



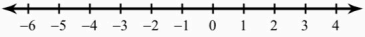
14) $\frac{m}{5} \geq -5$



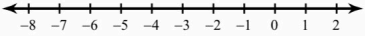
15) $-13x < -156$



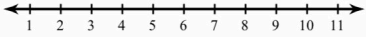
16) $32 \geq -16p$



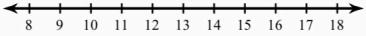
17) $-8 > v - 3$



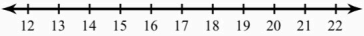
18) $11 \leq 5 + x$



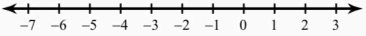
19) $25 \geq n + 13$



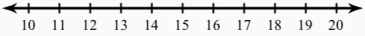
20) $-168 > -12a$



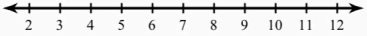
21) $-3 \leq x - 4$



22) $\frac{r}{3} > 6$



23) $12n \geq 84$



24) $-22 > -10 + b$