a basic number

2 exponent

$\sqrt{}$ radial sign indicating the square root.

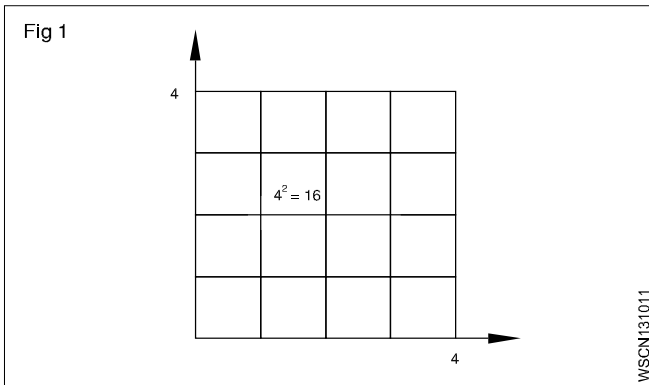$\sqrt{a^2}$ square root of 'a' squared

a² radicand

Square number

The square of a number is the number multiplied by itself.

Basic number x basic number = Square number

$a \times a = a^2$

$4 \times 4 = 4^2 = 16$

Fig 1

Splitting up

A square area can be split up into sub-areas. The largest square of 36 is made up of a large square 16, a small square 4 and two rectangles 8 each.
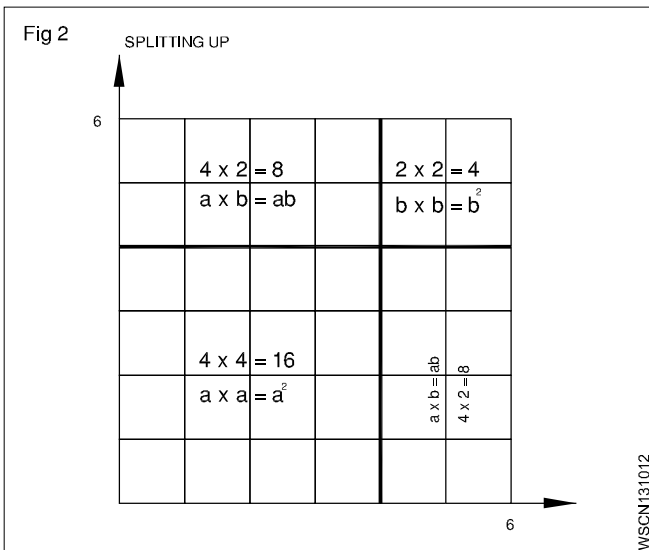
Large square 4 x 4 = 16 a^2

Two rectangles 2 x 4 x 2 = 16   2ab

Small square 2 x 2 = 4 b^2

Sum of sub-areas = 36 = $a^2 + 2ab + b^2$

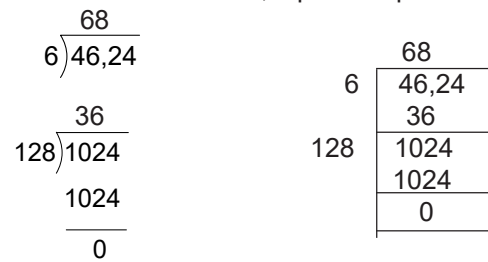$$\sqrt{36} = \sqrt{a^2 + 2ab + b^2}$$

Fig 2

SPLITTING UP

Result: In order to find the square root, we split up the square numbers.

Extracting the square root procedure

- Starting from the decimal point form groups of two figures towards right and left. Indicate by a prime symbol. $\sqrt{46,24.00}$

- Find the root of the first group, calculate the difference, bring down the next group.

- Multiply the root by 2 and divide the partial radicand.

- Enter the number thus calculated in the divisor for the multiplication.

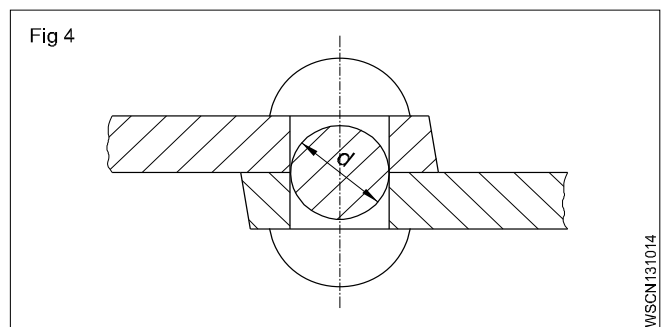
Fig 3
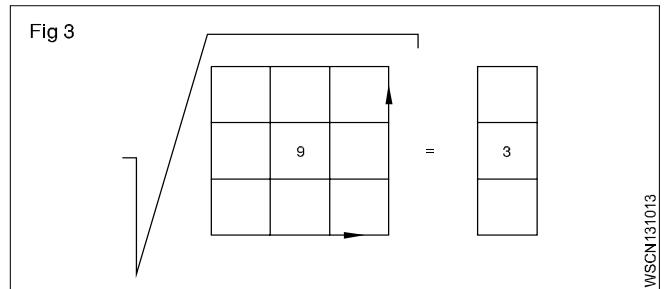
If there is a remainder, repeat the procedure.

$$\begin{array}{r} 68 \\ 6\overline{)46,24} \\ 36 \\ \hline 128\overline{)1024} \\ 1024 \\ \hline 0 \end{array}$$

$$\begin{array}{c|c} & 68 \\ 6 & 46,24 \\ & 36 \\ 128 & 1024 \\ & 1024 \\ \hline & 0 \end{array}$$

$\sqrt{46,24} = 68$

Basic number x basic number = Square

$\sqrt{\textbf{Square number}} = \textbf{basic number}$

Example

The cross-section of a rivet is 3.46 cm². Calculate the diameter of the hole.

Fig 4

Rivet cross-section is the hole cross-section.

To find d_1,

Given that Area = 3.46 cm²

Area = 0.785 x d² (formula)

3.46 cm² = d² x 0.785

$d^2 = \dfrac{3.46\ \text{cm}^2}{0.785}$

$d = \sqrt{\dfrac{3.46}{0.785}}$ cm

$d = 2.1\,\text{cm (or)}\,21\,\text{mm}$
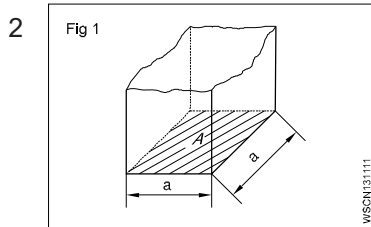
27

1 a $\sqrt{2916}$ = ——————.

   b $\sqrt{45796}$ = ——————.

   c $\sqrt{8.2944}$ = ——————.

   d $\sqrt{63.845}$ = ——————.

2 Fig 1

   A = 2025 mm^2
   a = —————mm

3 Fig 2

   A = 176.715 mm^2
   d = —————mm

4 Fig 3

   A = 65031 mm^2
   d = 140 mm
   D = —————mm

5 Fig 4

   l = 58 cm
   b = 45 cm
   $A_1 = A_2$
   a = —————cm

6 Fig 5
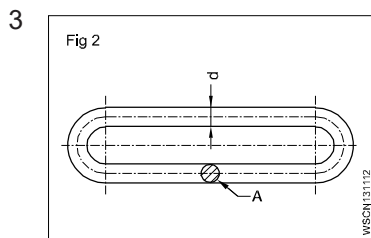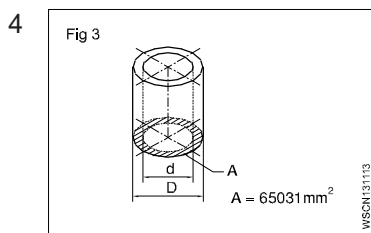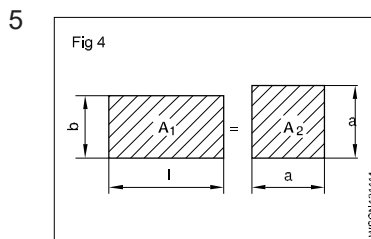
   d=140mm A=807,77 sq.cm
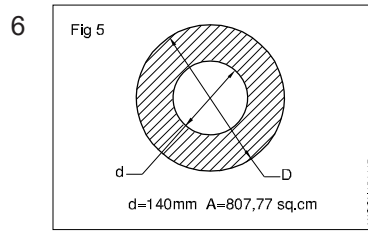
   A = 807.77 cm^2
   d = 140 mm
   D = —————mm

7 Fig 6

   a x a = 543169 mm^2
   a = —————mm

8 Fig 7

   d : l = 1:1.5
   A = 73.5 mm^2
   d = —————mm

9 Fig 8

   A$_2$-A$_1$ = ΔA = 12.7% OF A$_1$

   increase in area
   A = 12.7%
   A = 360 mm^2
   d = —————mm
   (d = diameter after the increase in area)

Square root - Applications of pythagoras theorem and related problems

1 What is the side AC if AB = 15 cm, BC = 25 cm.

$AC^2 = AB^2 + BC^2$

$= 15^2 + 25^2$

$= 225 + 625 = 850$

$AC = \sqrt{850} = 29.155$ cm

Fig 1
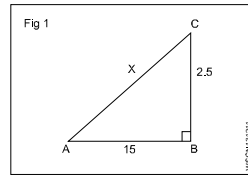
2 What is the side BC if AB = 10 cm, AC = 30 cm.

$AC^2 = AB^2 + BC^2$

$30^2 = 10^2 + BC^2$

$900 = 100 + BC^2$

$BC^2 = 900 - 100 = 800$

$BC = 28.284$ cm

Fig 2

3 What is the side AB if BC = 20 cm, AC = 35 cm.

$AC^2 = AB^2 + BC^2$

$35^2 = AB^2 + 20^2$

$1225 = AB + 400$

$AB^2 = 1225 - 400 = 825$
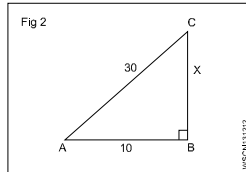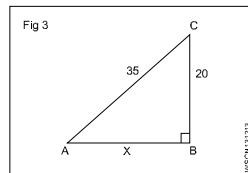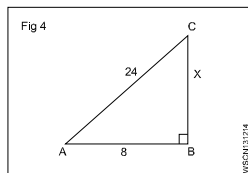
$AB = 28.72$ cm

Fig 3

4 What is the value of side BC if AB = 8 cm, AC = 24 cm.

$AC^2 = AB^2 + BC^2$

$24^2 = 8^2 + BC^2$

$576 = 64 + BC^2$

$BC^2 = 576 - 64 = 512$

$BC = \sqrt{572} = 22.63$ cm

Fig 4

5 What is the value side AC if AB = 6.45 cm, BC = 8.52 cm.

$AC^2 = AB^2 + BC^2$

$AC^2 = 6.45^2 + 8.52^2$

$AC^2 = 41.60 + 72.59$

$= 114.19$

$AC = \sqrt{114.19} = 10.69$ cm

Fig 5
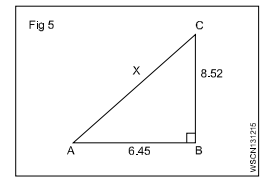
6 What is the value of side AB if BC = 3.26 cm, AC = 8.24 cm.

$AC^2 = AB^2 + BC^2$

$8.24^2 = AB^2 + 3.26^2$

$67.9 = AB + 10.63$

$AB^2 = 67.9 - 10.63$

$= 57.27$

$AB = \sqrt{57.27} = 7.57$ cm

Fig 6
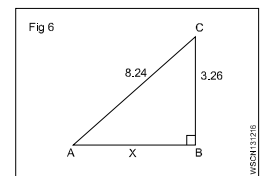
7 What is the value of side AB if AC = 12.5 cm, BC = 8.5 cm.

$AC^2 = AB^2 + BC^2$

$12.5^2 = AB^2 + 8.5^2$

$156.25 = AB + 72.25$

$AB^2 = 156.25 - 72.25$

$= 84$

$AB = \sqrt{84} = 9.17$ cm

Fig 7
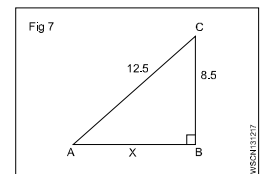
Assignment

1 What is the value of side AB, in a right angled triangle of side AC = 12.5 cm and BC = 7.5 cm.

2 What is the value of side AC, in a right angled triangle of side AB = 6.5 cm and BC = 4.5 cm.

3 What is the value of side BC, in a right angled triangle of side AC = 14.5 cm and AB = 10.5 cm.

4 What is the value of side AC, in a right angled triangle of side AB = 7 cm and BC = 5 cm.

5 What is the value of side BC, in a right angled triangle of side AC = 13.25 cm and AB = 8.75 cm.

Ratio

Introduction

It is the relation between two quantities of the same kind and is expressed as a fraction.

Expression

a, b two quantities of the same kind. $\dfrac{a}{b}$ or a:b or a ÷ b or

a in b is the ratio.

Ratio is always reduced to the lowest terms.

Example

$$7:14 = \frac{7}{14} = \frac{1}{2} = 1:2$$

Proportion

It is the equality between the ratios, a : b is a ratio and c: d is another ratio. Both ratios are equal. Then

a :b :: c : d or $\dfrac{a}{b} = \dfrac{c}{d}$

Example

250 : 2000 :: 1 : 8

Proportion fundamentals

If $\dfrac{a}{b} = \dfrac{c}{d}$ then

*   ad = bc

* $\dfrac{a}{c} = \dfrac{b}{d}$

* $\dfrac{b}{a} = \dfrac{d}{c}$

* $\dfrac{a+b}{b} = \dfrac{c+d}{c}$ and $\dfrac{a+b}{a} = \dfrac{c+d}{c}$

* $\dfrac{a-b}{b} = \dfrac{c-d}{d}$

* $\dfrac{a+b}{b+d} = \dfrac{a}{c} = \dfrac{c}{d}$

    3:4::6:8 or $\dfrac{3}{4} = \dfrac{6}{8}$

*   3 x 8 = 6 x 4

* $\dfrac{3}{6} = \dfrac{4}{8}$

* $\dfrac{4}{3} = \dfrac{8}{6}$

* $\dfrac{3+4}{4} = \dfrac{6+8}{8}$

* $\dfrac{3-4}{4} = \dfrac{6-8}{8}$

* $\dfrac{3+6}{4+8} = \dfrac{9}{12} = \dfrac{3}{4}$

> **Ratio - relation of two quantities of the same kind.**
> **Proportion - equality between two ratios.**

Example

*   A steel plate of 800 x 1400 mm is to be drawn to a scale of 1:20. What will be the lengths in the Fig 1

Fig 1
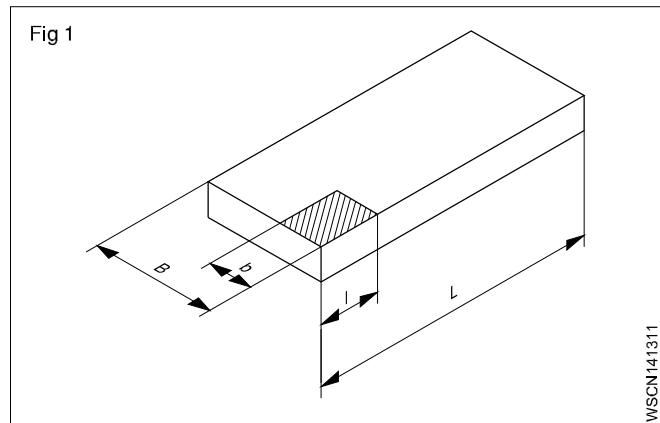
The reduction ratio is $\dfrac{1}{20}$.

B is reduced from 800 to 800 x $\dfrac{1}{20}$ = 40 mm.

L is reduced from 1400 x $\dfrac{1}{20}$ = 70 mm.

*   Find the number of teeth of the larger gear in the gear transmission shown in the Fig 2.

Fig 2
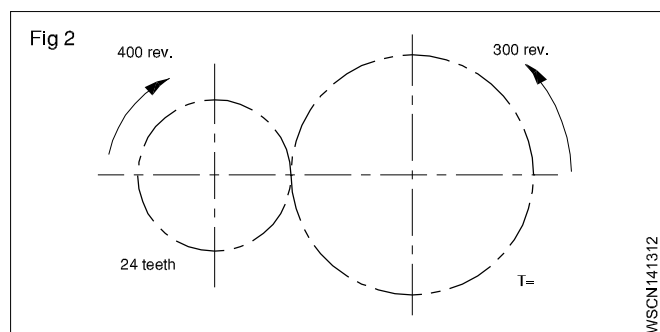
Speed ratio = 400 : 300

Teeth ratio = 24:T

$$\frac{400}{300} = \frac{T}{24}$$

$$\therefore T = \frac{24 \times 400}{300} = 32 \, \text{Teeth}$$

Find the ratio of A:B:C

If A:B= 2:3 and B:C=4:5

A:B = 2:3

B:C = 4:5

A:B = 8 :12 (Ratio 2:3 multiply by 4)

B:C = 12:15 (Ratio 4:5 multiply by 3)

∴ A:B:C   = 8:12:15

Assignment

1

Fig 1
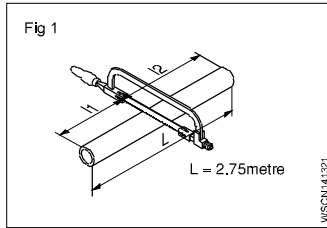
$l_1 : l_2$ = 2:3

L = 2.75 metres

l_1 = _____ metres

l_2 = _____ metres

5

Fig 5

D : d = 1.75: 1

D = 35 mm

d = _____ mm

2
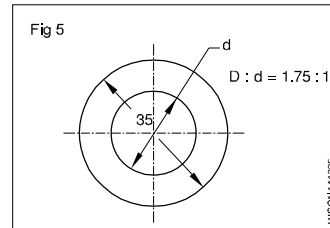
Fig 2
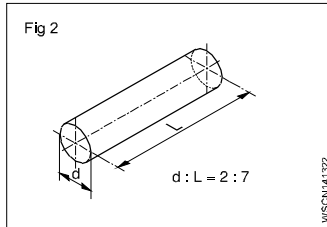
d: L of shaft = 2:7

d = 40 mm

L = _____ mm

6

Fig 6

a:s = 5:1

s = 1.5mm

a = _____ mm

3
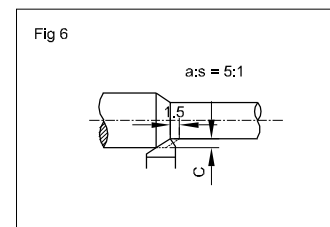
Fig 3
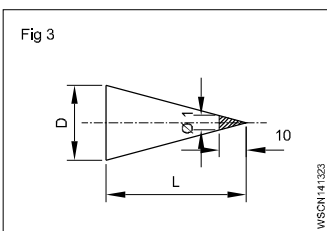
D : L=1:10

L=150mm

D= _____ mm

7 A:B=9:12

B:C=8:10

Then A:B:C= _____

8 A:B=5:6

B:C=3:4

Then A:B:C= _____

4

Fig 4
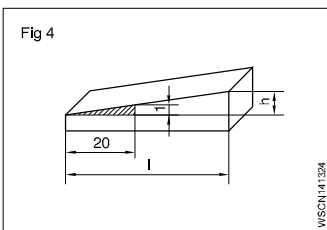
$$\frac{\Delta h}{l} = \frac{1}{20}$$

l = 140 mm

Δh = _____ mm

9 A:55=9:11

A = _____

10 15:9.3=40:x

x = _____

Workshop Calculation & Science : (NSQF) Exercise 1.2.11

31

Proportion

Description

It is the equality between the ratios, a:b is a ratio and c:d is another ratio. Both ratios are equal. Then

a : b::c : d or   e.g. 250 : 2000::1 : 8

Rule of three

A three step calculation

statement

single

multiple.

Direct proportion

The more in one the more in the other - An increase in one denomination produces an increase in the other. (Fig 1)

Fig 1
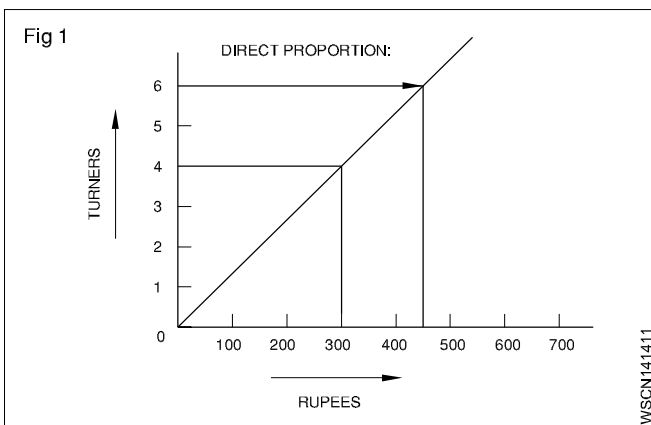
Example

4 turners earn 300 Rupees. How much will 6 Turners earn?

Statement
4 turners = 300 Rupees

Single

1 Turner = 75 Rupees

Multiple
6 Turners = 6 x 75 = 450 Rupees

Result - The more the more.

Indirect or inverse proportion

The more in one the lesser other - Increase in one quantity will produce a decrease in the other. (Fig 2)

Fig 2
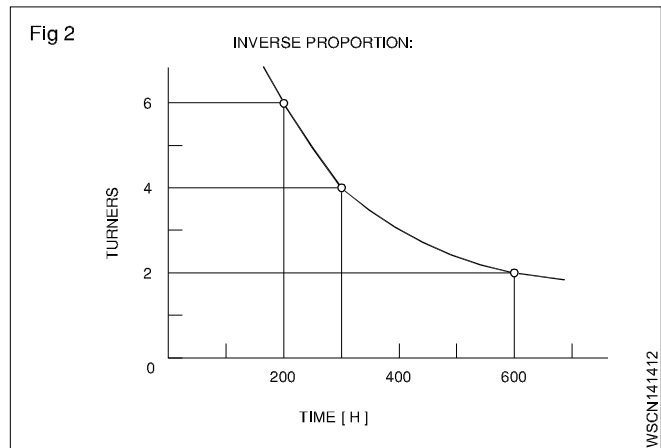
Example

Four turners finish a job in 300 hours. How much time will 6 turners take to do the same job?

Solution procedure in three steps:

Statement
4 turners taken = 300 hours

The time will reduce if 6 turners to do the same job. Therefore this is inverse propotion.

Multiple fraction $\dfrac{4 \text{ Turners}}{6 \text{ Turners}} \times 300 \text{ hours}$

6 Turners   = 200 hours

Result - The more the less.

Problems involving both

Example

Two turners need three days to produce 20 pieces. How long does it take for six turners to produce 30 such pieces?

Statement

2 turners, 20 piece = 3 days
6 turners, 30 pieces = how many days.

First step (Fig 3)

Statement   2 turners for 20 pieces = 3 days

1 turner for 20 pieces = 3 x 2 = 6 days

Multiple 6 turners for 20 pieces = $\dfrac{6}{6}$ = 1 day

Fig 3
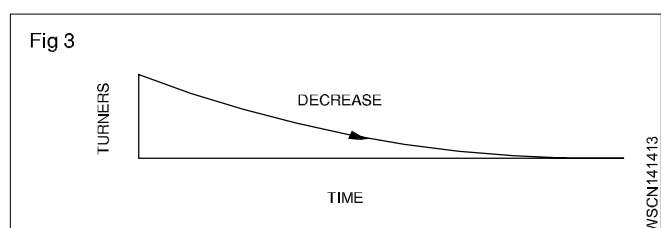
Inverse proportion - The more the less.

Second step (Fig 4)

Fig 4
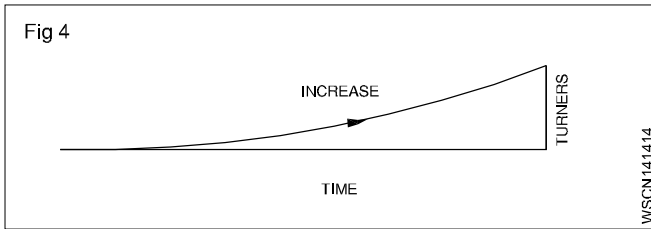
Statement	6 turners for 20 pieces	= 1 day
Single	6 turners for 1 piece	= $\frac{1}{20}$ days
Multiple	6 turners for 30 pieces	= $\frac{1}{20}$ x 30 = 1.5 days

Direct proportion - The more the more.

Solve the problem by first writing the statement and proceed to single and then to the multiple according to the type of proportion that is involved.

Introduction

Proportional fundamentals, as applicable to motor vehicle calculations are discussed below.

Simple Proportion

• Proportion

∴ This is an equality between two ratios

Examples

• If one vehicle fleet uses 30 litres of petrol per day how much petrol is used by 6. Vehicles operating under similar condition.

One vehicle uses petrol = 30 litres per day.

Then six vehicles will use = 6 Times as much

= 6 x 30 = 180 litres/day.

• If 4 vehicles of a fleet use 120 gallons of petrol per day how much petrol will be used by 12 vehicles operating under the same condition.

4 vehicles use 120 gallons per day

1 Vehicle will use $\frac{120}{4}$ = 30 gallons/day

12 vehicles will use 12 x 30 = 360 gallons/day

Both examples are called simple proportion because only two quantities were used and the day is common for both ratios.

Compound and Inverse proportions

• Compound proportions

Example

If 5 Fitter take 21 days to complete overhauling of 6 vehicles how long 7 Fitters will take to over haul 8 vehicles (Assume time of overhauling each vehicle is constant)

In this both direct and indirect proportions are used.

• 1 Fitter will over haul 1 vehicle in days (shorter time).

• Quantities (No. of days) are taken in last as that is the answer required in this case.

Ans: 7 Fitters will overhaul 8 vehicles in 20 days.

$$\left(\frac{21 \times 5}{6 \times 7} \times 8 \right) = 20 \text{ days}$$

Inverse proportion

Some times proportions are taken inversely.

Examples

• If one water pump fills the fuel tank in 12 minutes, two pumps will take half the time taken.

The time should not be doubled.

• If two pumps take 30 minutes to fill up a tank how long will 6 similar pumps take this to fill this tank.

Ans: Time taken by 6 pumps = $\frac{30 \times 2}{6}$ = 10 minutes

Proportional parts in combustion equation

Introduction

Proportion of quantities form an important factor in the combustion process of a fuel. The following happens during the combustion process.

Fuel is a hydro carbon substance. The combustion air is supplied from atmosphere and contains oxygen and nitrogen. Now the following chemical changes take place during combustion of a fuel.

• Carbon burns with oxygen and forms Co and Co_2

(Carbon monoxide and carbon dioxide.)

• Hydrogen burns with oxygen and becomes water (H_2O)

• Sulphur burns with oxygen and becomes sulphur dioxide.

• Nitrogen is an inert gas and does not take part in combustion.

Method of finding proportional parts in one lb of a substance

To be found out now

• Proportion of oxygen and hydrogen in one lb/Kg of water.

• Proportion of hydrogen and carbon in one lb/kg of fuel.

Examples

- The chemical formula for water is H_2O. This means 2 atoms of hydrogen and one atom of oxygen combined to make one molecule of water. If oxygen atom weighs 16 times as much as hydrogen find out the proportions in one kg of water.

Solution

Parts by weight of water are as below

Oxygen = 16/2 = 8kg

Hydrogen = 1/1 = 1kg

Total   = 8+1= 9kg

- A hydrocarbon fuel has formula C_6H_{14}. This shows one molecule of fuel contain 6 atoms of carbon and 14 atoms of hydrogen. If the carbon atom weighs 12 times as the hydrogen atom, find the proportionate parts of hydrogen and carbon in one kg of fuel.

Solution

Parts of carbon by weight
= 6 x 12 = 72
Parts of hydrogen by weight = 14.

Total No. of parts = 72 + 14 = 86.

Weight of Carbon = 72/86 = 0.8372 kg

Weight of Hydrogen 14/86 = 0.1628 kg

Ratio and Proportion

Proportion of air quantity required for combustion process

Mass of air required for complete combustion of fuel depends on the following factors and is called Air - fuel Ratio

- Carbon, Hydrogen, Sulphur are to burn with oxygen in the combustion process.

- It has been found that the following quantities of air

(by wt) are required for this purpose to supply sufficient quantity of oxygen.

- For complete combustion of 1kg of carbon = of oxygen

- For complete combustion of 1 kg of hydrogen = 8kgs of oxygen

- For complete combustion of 1 kg of sulphur = 1 kg of oxygen

- Formula for calculation of mass of air for complete combustion.

Air contains 23% oxygen and 77% nitrogen

Mass of air = Mass of oxygen x for each constituent

$$\text{For Carbon} = 2\frac{2}{3} \times \frac{100}{23} = 11.6 \text{kg.of air}$$

$$\text{For hydrogen} = 8 \times \frac{100}{23} = 34.8 \text{kg.of air}$$

$$\text{For sulphur} = 1 \times \frac{100}{23} = 4.35 \text{ kg.of air}$$

**Total**   50.75 Kg

Hence 50.75 kg of air is to be supplied to the engine for combustion of 1 kg of fuel.

> **As the combustion process is not even more quantity of air than 50.7 kg is to be supplied to the engine.**
>
> **The calculations involved in the combustion equations is beyond the scope of ITI students as it involves chemistry and physics for computing the proportions of different elements.**
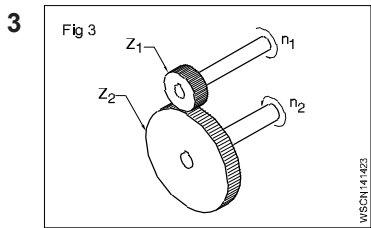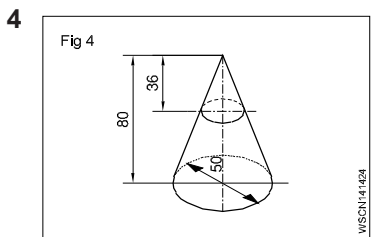
Assignment

1

Fig 1
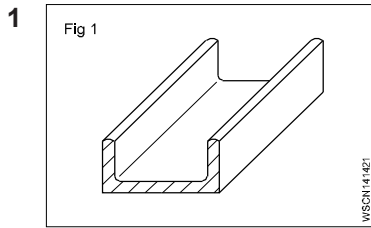
Length = 6.1 metre

Weight = 32 kgf

Weight of 1 metre of the same channel = _____ kgf

2

Fig 2
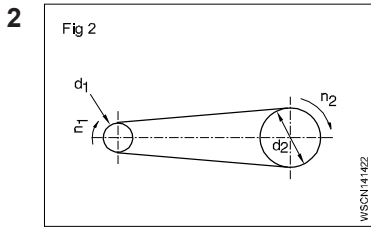
d_1 = 120 mm

d_2 = 720 mm

n_1 = 1200 rpm

n_2 = _____ rpm

3

Fig 3

Z_1 = 42 T

n_2 = 96 rpm

n_1 = 224 rpm

Z_2 = _____ T

4

Fig 4

D = 50 mm

H = 80 mm

h = 36 mm

d = _____ mm

5 If a mechanic assembles 8 machines in 3 days, how long he will take to assemble 60 machines.

6 In an autoshop the grinding wheel makes 1000 rpm and the driven pulley is 200 mm dia. If the driving pulley is 150 mm dia. Find out the rpm of the driving pulley.

7 In a gearing of a vehicle the following facts are found.

   A 180 mm dia of gear meshes with 60mm dia gear. If the bigger gear makes 60 rpm. What will be the rpm of smaller gear.

8 A vehicular job is completed by 5 mechanics in 4 days. If only 3 mechanics are available, in how many days the work can be completed.

9 In a gearing arrangement of a vehicle a gear having 26 teeth is meshing with a gear of 52 teeth. The dia of 52 teeth gear is 200mm. Find out the diameter of 26 teeth gear wheel.

10 If two water pumps take 45 minutes to fill up a tank how long will 4 similar pumps will take to fill this tank.

11 In a belt-pulley drive the driving pulley is of 12 cm diameter and rotates at 360 rpm. Find the rpm of driven pulley whose diameter is 20 cm.

12 To overhaul a gear box, 12 mechanics are needed to complete the work in 5 days. If only 7 mechanics are available, how many days they will be able to complete the overhauling work.

13 Express in simple ratios the following

   a $45 \div 60$ b   40 paise $\div$ Rs 4.00

   c $\dfrac{20mm}{4 \text{ metres}}$ d $4°C \div 100°C$

14 Air contains 22% oxygen and 78% nitrogen by mass (weight). Calculate the quantity of air (mass of air) required for complete combustion of unit mass fuel (The main constitutents that take part in combustion process are carbon, hydrogen and sulphur)

   Note: Given the following data (Solve the problem)

   a   1 kg of carbon requires $2\dfrac{2}{3}$ kg of oxygen.

   b   1 kg of hydrogen requires 8 kg of oxygen.

   c   1 kg of sulphur requires 1 kg of oxygen.

15 A fuel is a hydro carbon substance of C_7H_{14}. This shows each molecule of fuel contains 7 atoms of carbon and 14 atoms of hydrogen. If carbon atomic weight is 12 times greater than hydrogen atom, find out the proportionate parts of hydrogen and carbon in one kg of fuel.

16 A vehicle worth Rs.20,000/- can be insured at a cost of Rs.150/-. How much will it cost to insure a vehicle worth Rs.24000/- for one year and 3 month at the same rate. (Compound proportion)

Percentage

Percentage is a kind of fraction whose denominator is always 100. The symbol for percent is %, written after the number. e.g. 16%.
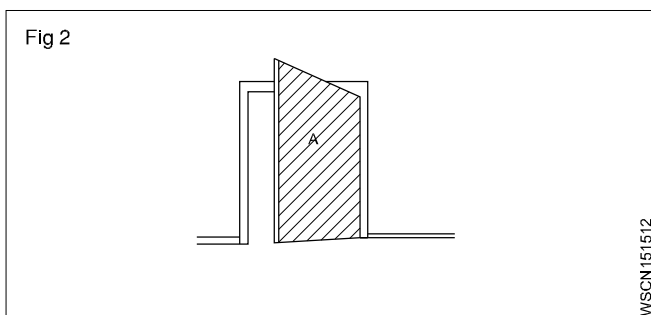
Ex.

In decimal form, it is 0.16. Percentage calculation also involves rule of three. The statement (the given data), for unit, and then to multiple which is for calculating the answer. (Fig 1)

Fig 1

25 BOX = 100%
4 BOX = ?

WSCN151511
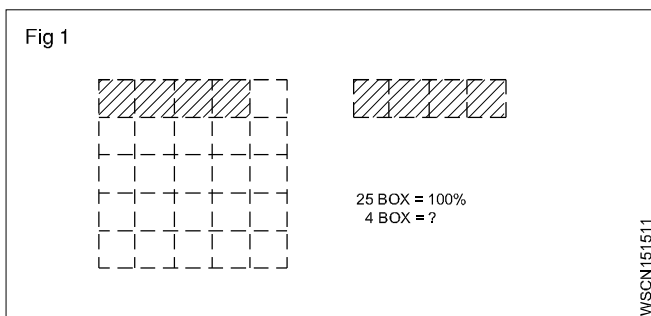
Example

The amount of total raw sheet metal to make a door was 3.6 metre^2 and wastage was 0.18 metre^2. Calculate the % of wastage. (Fig 2)

Fig 2

WSCN151512

Solution procedure in three steps.

Statement:

Area of door (A) = 3.6 m^2 = 100 %.

Wastage = 0.18 m^2

Single: $\dfrac{100}{3.6}$ 1 m^2

Multiple: for 0.18 m^2 = $\dfrac{100}{3.6}$ x 0.18.

Wastage = 5%.

Conclusion

The three steps involved are,

step one   :   describe the situation (availability)

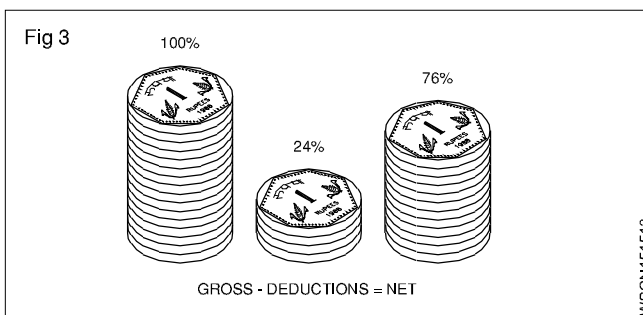step two   :   decide for unit

step three :   proceed for the multiple.

36

Example

A fitter receives a take-home salary of 984.50 rupees.

If the deduction amounts to 24%, what is his total salary? (Fig 3)

Total pay 100%

Fig 3

100%

76%

24%

GROSS - DEDUCTIONS = NET

WSCN151513

Deduction 24%

Take home salary 76%

If the take home pay is Rs.76, his salary is 100.

For 1% it is $\dfrac{1}{76}$

For Rs.984.50, it is $\dfrac{1}{76}$ x 984.50.

For 100% it is $\dfrac{984.50}{76}$ X100 = 1295.39

100% i.e. gross pay = Rs.1295.40.

Example 1

75 litres of oil is taken out from a oil barrel of 200 litres capacity. Find out the percentage taken in this.

Solution

% of oil taken = Oil taken out (litres) / Capacity of Barrel (litres) x 100

$= \dfrac{75}{200}$ x 100 $= 37\frac{1}{2}$%

Example 2

A spare part is sold with 15%. Profit to a customer, to a price of Rs.15000/-. Find out the following (a) What is the purchase price (b) What is the profit.

Solution: CP = x,

CP = cost price

SP = sale price

SP = CP + 15% of CP

$15000 = x + \dfrac{15\,x}{100} = \dfrac{100\,x + 15\,x}{100}$

$$x = \frac{1500000}{115} = 13043.47$$

Profit = SP-CP = 15000-13043.47 = 1956.53

Purchase price = Rs.13,043/-, Profit = Rs. 1957

Example 3

Out of 80000 cars, which were tested on road, only 16000 cars had no fault. What is the percentage in this acceptance.

$$= \frac{160000}{80000} \times 100 = \frac{100}{5} = 20\%$$

Example 4

The price of a motor cycle dropped to 92% of original price and now sold at Rs.18000/- What was the original price.

Solution

Present price of Motor cycle Rs.18000

This is the value of 92% of original price

$$\text{Original Price} = 18000 \times \frac{100}{92} = \frac{1800000}{92}$$

$$= Rs.19565$$

Example 5

A Motor vehicle uses 100 litres of Petrol per day when travelling at 30 kmph. After top overhauling the consumption falls to 90 litres per day. Calculate percentage of saving.

Solution

Percentage of saving = Decrease in consumption/Original consumption x 100
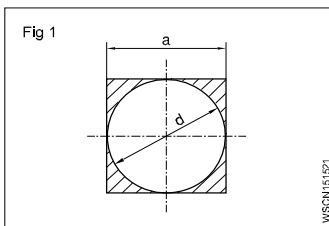
$$= (100 - 90) \frac{litres}{100} \times 100$$

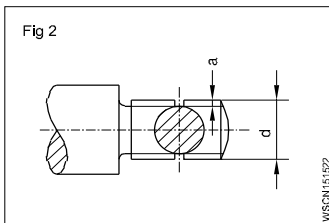$$= \frac{10}{100} \times 100$$

= 10% Saving in fuel.

Assignment

1.

Fig 1

a = 400mm (side of square)

d = 400 mm

Wastage = _____ %.

2.

Fig 2

d = 26mm

'a' depth of u/cut =

2.4mm

reduction of area at

cross-section

= _____ %

3.

Fig 3
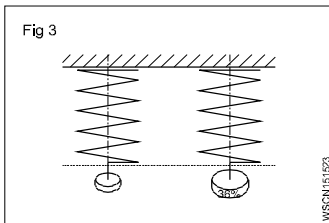
Percentage of increase

= 36%

Value of increase

= 611.2 N/mm²

Original tensile strength

= _____ N/mm².

4.

Fig 4
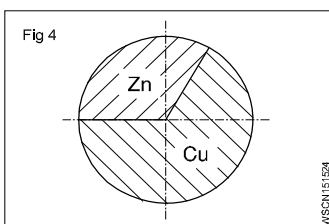
Copper in alloy = 27 kg

Zinc in alloy = 18 kg

% of Copper

= _____ %

% of Zinc = _____ %.

5.

Fig 5
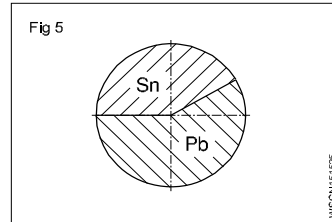
Weight of alloy = 140 Kgf

Weight of Sn 40%

Pb = _____ Kgf

Sn = _____ Kgf.

6.

Fig 6

Shaded portion

= _____ %.

7.

Fig 7

Compression length = _____ %.

8.

Fig 8

d = 360 mm

a = 0.707 x d

Wastage = _____ %.

Workshop Calculation & Science : (NSQF) Exercise 1.2.13

37

9

Cu = 36 Kg

Zn = 24 Kg

Cu = _____ %

Zn = _____ %

10
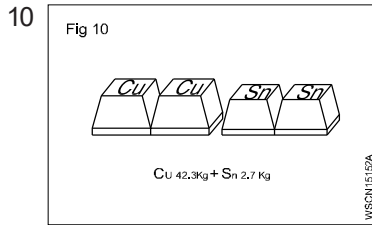
Cu = 42.3 Kg

Sn = 2.7 Kg

Cu _____ %

Sn = _____ %.

11 What is the selling price, If a trader buys a spare part for Rs.195/- This is 65% of selling price.

12 What is the purchase price if 25% profit is added to it, If a Motor cycle tyre is sold for Rs.300/-.
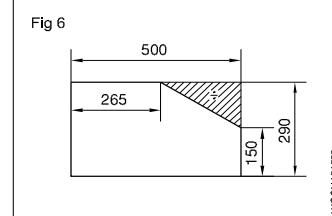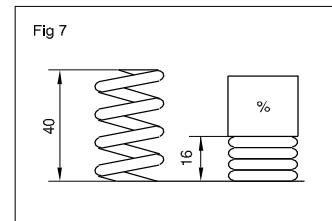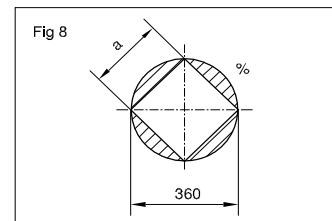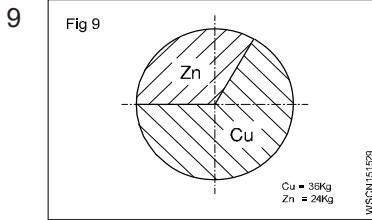
13 How many m^3 of elements of air present in 120 m^3 of air, If the composition of Air is 23% of Oxygen and 77% of Nitrogen.

14 How many kg of each of these elements are found. If an Engine bearing made of alloy of 40 kg consists of the following constitutents.

a) Copper (Cu) - 86%

b) Tin (Sn) - 10%

c) Zinc (Zn) - 4%

15 How much weight of these elements are found to exist. If a solder consists of 35%. Tin and 65% Lead. In a solder of 40 kg.

16 Find out the following:

1 Average consumption per journey.

2 Average consumption per mile.

3 Using the average consumption express maximum consumption as a percentage of the average correct to two decimal places. If the total petrol consumption of car on 4 different journeys each of 200 miles are found to be as 6.65, 7.5, 6.85,7.05 gallons respectively.

17 In a Transport workshop, the following expenditure was found to be occuring on the capital income.

1 40% income spent on tyres

2 30% income spent on fuel and lubricants

3 10% income spent on spare parts

If the month end saving comes to Rs.2000/- what is the total income?

18 What is the final weight of the machined job if a casting weighs 80kg. During preliminary machining weight is reduced by 4% and final machining by 5%.

19 What is the weight of zinc, copper and tin, casting weight is 25kg. If a casting has 35% zinc, 40% copper and 25% tin.

20 What is the total weight of a solder, if solder consists of 35% tin 65% lead, and tin consists 14 grams.

21 What is the total annual income of the salesman, if a salesman gets a monthly pay of Rs.1000 and a commission of 2.5% on his sale. In one year sale amount is Rs.60,000.

22 What is the total income of a man, if he spends 15% of his income on agriculture, 21% on family, 24% on education of children and he saves Rs.360.

23 What is the percentage of his savings, if a person's monthly salary is Rs.450 and saves Rs.90 every month.

Conversion of Fraction into Percentage

1 Convert $\dfrac{1}{2}$ into percentage.

> Solution: $\dfrac{1}{2}$ x 100
>
> = 50%

2 Convert $\dfrac{1}{11}$ into percentage

> Solution: $\dfrac{1}{11}$ x 100 = $\dfrac{100}{11}$
>
> = 9.01%

Convert the following fraction into percentage.

1 $\dfrac{1}{4}$

2 $\dfrac{1}{5}$

3 $\dfrac{2}{3}$

4 $\dfrac{3}{8}$

Conversion of Percentage into Fraction

1 Convert 24% into fraction.

> Solution: $\dfrac{24}{100} = \dfrac{6}{25}$

2 Convert $33\dfrac{1}{3}$ % into fraction.

> Solution: $\dfrac{33\frac{1}{3}}{100} = \dfrac{\frac{100}{3}}{100} = \dfrac{100}{3} \times \dfrac{1}{100}$
>
> $= \dfrac{1}{3}$

Convert the following percentage into fraction

1 15%

2 $87\dfrac{1}{2}$%

3 80%

4 12.5%

Conversion of Decimal Fraction into Percentage

1 Convert 0.35 into percentage.

> Solution: 0.35 x 100
>
> = 35%

2 Convert 0.375 into percentage.

> Solution: 0.375 x 100
>
> = 37.5%

Convert the following Decimal Fraction into Percentage

1 0.2

2 0.004

3 0.875

4 0.052

Conversion of Percentage into Decimal fraction

1 Convert 30% into decimal fraction.

> Solution: $\dfrac{30}{100}$ = 0.3

2 Convert $33\dfrac{1}{3}$% into decimal fraction.

> Solution: $\dfrac{33\frac{1}{3}}{100} = \dfrac{\frac{100}{3}}{100} = \dfrac{100}{3} \times \dfrac{1}{100}$
>
> $= \dfrac{1}{3}$ = 0.333

Convert the following percentage into decimal fraction

1 15%

2 7%

3 $12\dfrac{1}{2}$%

4 90%

Module:2 Square Root, Ratio and Proportion percentage वर्गमूल, अनुपात और समानुपात प्रतिशत

Q1. What is the square root of 529? | 529 का वर्गमूल क्या है?
(A) 13
(B) 23
(C) 33
(D) 43
answer:B,

Q2. What is the square root of 0.017? | 0.017 का वर्गमूल क्या है?
(A) 0.001
(B) 0.13
(C) 0.00001
(D) 0.000001
answer:B,

Q3. What is the definition of ratio? | अनुपात की परिभाषा क्या है?
(A) Relation of two quantities of the same kind | एक ही तरह की दो मात्राओं का संबंध
(B) Relation of two quantities of the different kind | विभिन्न प्रकार की दो मात्राओं का संबंध
(C) Equality between two ratios | दो अनुपातों के बीच समानता
(D) Inequality between two ratios | दो अनुपातों के बीच असमानता
answer:A,

Q4. What is the ratio of 4 kg to 800 grams? | 4 किलो ओर 800 ग्राम मे क्या अनुपात है?
(A) 5 : 1
(B) 4 : 8
(C) 8 : 4
(D) 2 : 4
answer:A,

Q5. What percentage of 80 is 20? | 80 का 20 प्रतिशत क्या है?
(A) 0.8
(B) 0.4
(C) .25
(D) 0.2
answer:C,

Q6. How much is 8% of 40 kg? | 40 kg का 8 प्रतिशत कितना है?
(A) 2.2 kg
(B) 3.2 kg
(C) 4.2 kg
(D) 5.2 kg
answer:B,

Q7. Convert 0.456 decimal fraction into percentage? | 0.456 दशमलव भिन्न को प्रतिशत में बदलिए?
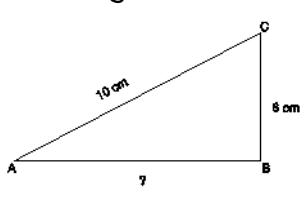
(A) 45.6%

(B) 0.0456%

(C) 0.456%

(D) 0.0456%

answer:A,

Q8. What is the x value for $x^2 + 6^2 = 10^2$? | $x^2 + 6^2 = 10^2$ के लिए x मान क्या है?

(A) 4

(B) 6

(C) 8

(D) 10

answer:C,

Q9. What is the side AB if AC = 10 cm and BC = 6 cm? | यदि AC = 10 सेमी और BC = 6 सेमी है, तो AB भुजा का मान क्या है?

(A) 8 cm

(B) 6 cm
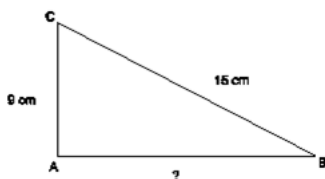
(C) 5 cm

(D) 4 cm

answer:A,

Q10. What is the side AB, if BC = 15 cm and AC = 9 cm? | यदि BC = 15 सेमी और AC = 9 सेमी है तो AB भुजा का मान क्या है?

(A) 4 cm

(B) 8 cm

(C) 10 cm

(D) 12 cm

answer:D,

Q11. What is the length L2, if total length (L) is 2.75 metre and L1 : L2 = 2 : 3? | यदि कुल लंबाई (L) 2.75 मीटर और L1: L2 = 2: 3 है? तो L2 का मान क्या होगा?

(A) 1.1 metre

(B) 1.25 metre

(C) 1.65 metre
(D) 1.75 metre
answer:C,

Q12. How many days a mechanic takes to assemble 64 machines if he assembles 8 machines in 3 days? | यदि एक मेकेनिक को 8 मशीनों को असेंबल करने 3 दिन लगते है तो उसे 64 मशीनों को असेंबल करने में कितने दिन लगेंगे?
(A) 20 days
(B) 22 days
(C) 24 days
(D) 26 days
answer:C,

Q13. What is the percentage of copper if the casting weight of copper 42.3 kg and tin weight 2.7 kg? | यदि कास्टिंग मे तांबे का वजन 42.3 कलोग्राम और टिन का वजन 2.7 कलोग्राम है तो तांबे का प्रतिशत क्या होगा?
(A) Cu 92%
(B) Cu 94%
(C) Cu 96%
(D) Cu 98%
answer:B,

Q14. A motorcycle tyre is sold for Rs 300/- what is the purchase price if 25%profit is added to it. | यदि एक मोटरसाइकल टायर को 300/- में बेचा जाता है, ओर उसे 25% लाभ होता है तो खरीद का मूल्य क्या है?
(A) Rs 200
(B) Rs 220
(C) Rs 240
(D) Rs 260
answer:C,

Q15. What is the decimal fraction of conversion of 18.5%? | 18.5% को दशमलव भिन्न मे बदलीये ?
(A) 0.185
(B) 0.175
(C) 0.165
(D) 0.195
answer:A,

SQUARE ROOTS

EXERCISES

□ Choose the Correct Answer

1. If $(a^m)^n = a^{mn}$, choose the correct value of $(2^3)^2$.

    (a) 128

    (c) 32

    (b) 64

    (d) 16

Ans. (a) ● (c) (d)

2. Square root of 225 is _____

    (a) 25

    (b) 20

    (c) 15

    (d) 10

Ans. (a) (b) ● (d)

3. CE key indicates _____

(a) Clear totally

(b) Clear entry only

(c) Clear memory

(d) None of the above

Ans. (a) ● (c) (d)

4. Square root of 0.09 is _____ [NCVT]

(a) 0.3

(b) 0.03

(c) 0.003

(d) 0.0009

Ans. ● (b) (c) (d)

5. Simplification of $\frac{1}{\sqrt{3}-\sqrt{2}}$ is _____ [NCVT]

(a) 31.46

(b) 3.146

(c) 0.3146

(d) 0.03146

Ans. (a) ● (c) (d)

6. $[(2)^5]^2 =$ _____

(a) 20

(b) 200

(c) 1024

(d) 704

Ans. (a) (b) ● (d)

7. $36^2 - 24^2 =$ _____

(a) 470

(b) 630

(c) 720

(d) 640

Ans. (a) (b) ● (d)

8. Which one of the following is not a perfect square?

(a) 144

(b) 169

(c) 256

(d) 367

Ans. (a) (b) (c) ●

9. $5^2 + (x)^2 + (30)^2 = (31)^2$; Find the value of x.

(a) 9

(b) 8

(c) 7

(d) 6

Ans. (a) (b) (c) ●

10. Find the value of $\sqrt{1.21} - \sqrt{0.01}$.

(a) 1

(b) $\sqrt{1.2}$

(c) 0.81

(d) 0.99

Ans. ● (b) (c) (d)

11. Which of the following is a type of calculator?

(a) General

(b) Scientific

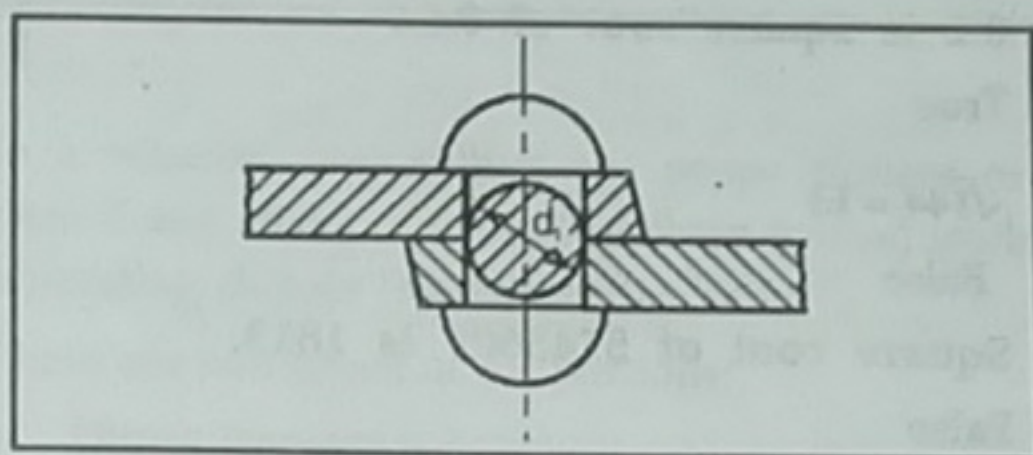(c) Both (a) and (b)

(d) None of the above

Ans. (a) (b) ● (d)

12. In how many parts is the keyboard of a general calculator divided ?

(a) Two
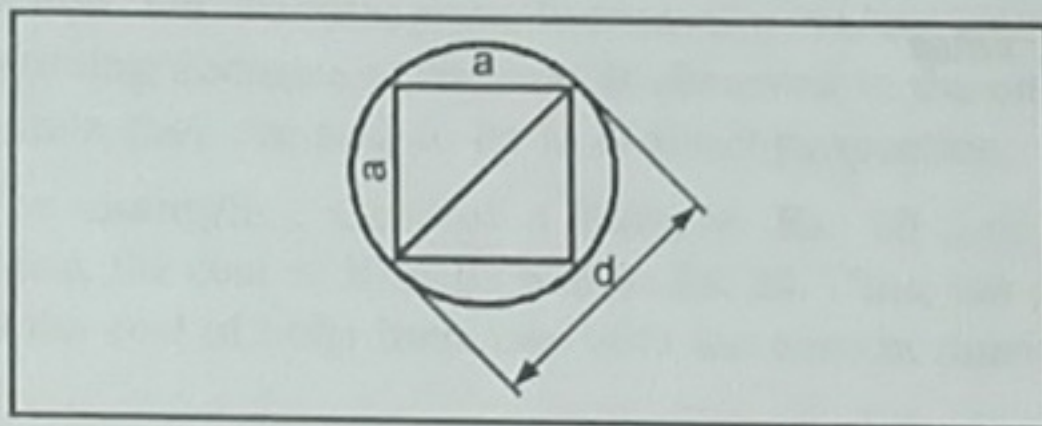
(b) Three

(c) Four

(d) Five

Ans. (a) (b) (c) ●

□ **Do as Directed**

1. A = 50.26 mm²

d = _____ mm

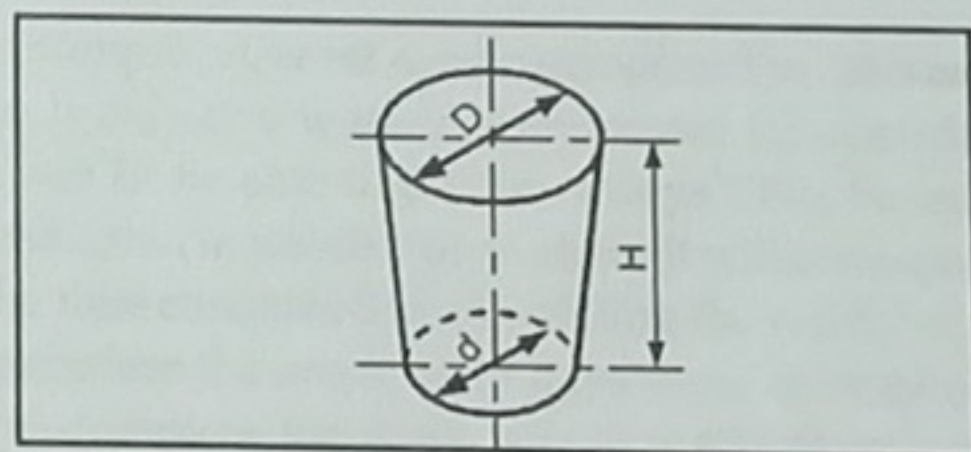Ans. d = 8 mm

2. a = 42.42 cm

d = _____ cm

Ans. d = 60 cm

3. V = 13.88 liter

D = 29 cm

H = 32 cm

d = _____ cm

Ans. d = 18 cm

4. Cross sectional area (A) = 314.16 mm²

$d =$ _____ mm
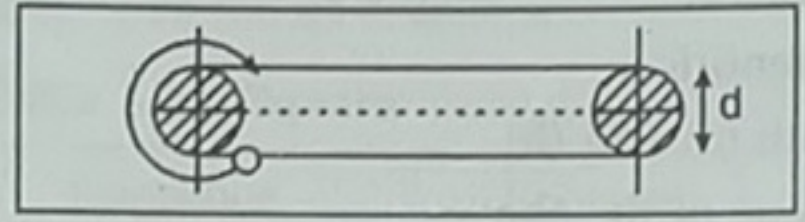
Ans. $d = 20$ mm.

5. $a = 10$ m

$b = 6$ m

$h = 3$ m

$A =$ _____ m²
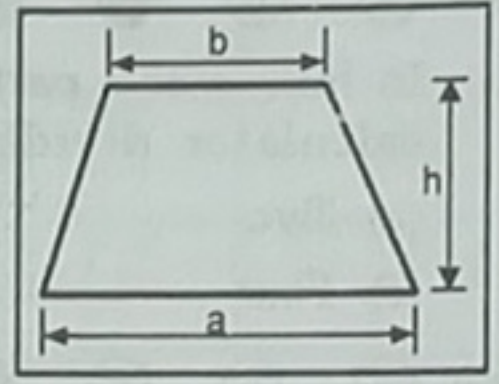
Hint : $A = \frac{1}{2}(a+b) \times h$

Ans. $A = 24$ m².

□ State whether 'True' or 'False'

1. 0.2 is square root of 0.04

Ans. True

2. $\sqrt{144} = 13$

Ans. False

3. Square root of 5745609 is 1813.

Ans. False

4. 6.27 + 1437.8 + 34.87 + 8.84 = 1487.78

Ans. True

5. 427.91 + 2.134 + 0.004 + 92.7 = 588.03

Ans. False

□ Fill in the Blanks

1. $\sqrt[n]{a} \times \sqrt[n]{b} =$ _____

Ans. $\sqrt[n]{ab}$

2. $pa^n + qa^n =$ _____

Ans. $a^n (p + q)$

3. $\sqrt[bn]{a^{bm}} =$ _____

Ans. $a^{\frac{m}{n}}$

4. $\sqrt[n]{a^n} =$ _____

Ans. a

5. $\sqrt{1225} =$ _____

Ans. 35

□ Answer the Following Questions in B

1. Simplify : $\sqrt{8} + \sqrt{18} - 2\sqrt{2}$

Ans. 4.242

2. Find the square root of 12.

Ans. 3.464

3. $\sqrt{0.0081} =$

Ans. 0.09

4. $\sqrt{0.0225} =$

Ans. 0.15

5. Find the square root of 0.0036.

Ans. 0.06

RATIO AND PROPORTION

□ **Choose the Correct Answer**

1. Weight of one casting is 2 kg whereas weight of another casting is 200 grams. Compare the weights.

   (a) 1 : 10

   (b) 10 : 1

   (c) 1 : 5

   (d) 5 : 1

   Ans. (a) ● (c) (d)

2. Choose the missing number of the fract

   $$\frac{11}{13} = \frac{?}{91}$$

   (a) 57

   (b) 67

   (c) 77

   (d) 87

   Ans. (a) (b) ● (d)

3. An alloy weighing 72 kg contains elements A, B and C in population 1 : 2 : 3, weights of A, B and C will be _____

(a) 36:24:12

(b) 12:36:24

(c) 24:12:36

(d) 12:24:36

Ans. (a) (b) (c) ●

4. $1\frac{1}{2} : 2\frac{1}{4}$ in the simplest form is _____

(a) 12 : 18

(b) 8 : 12

(c) 6 : 9

(d) 2 : 3

Ans. (a) (b) (c) ●

5. In an alloy, ratio of copper and zinc is 7 : 2. If bell of weight 45 kg is made from this alloy, what quantity of copper will be used?

(a) 35 kg

(b) 20 kg

(c) 15 kg

(d) 10 kg

Ans. ● (b) (c) (d)

6. The comparision by division of two similar quantities is called _____

(a) ratio

(b) proportion

(c) percentage

(d) ratio and proportion

Ans. ● (b) (c) (d)

7. Simplest form of 72 : 64 is _____
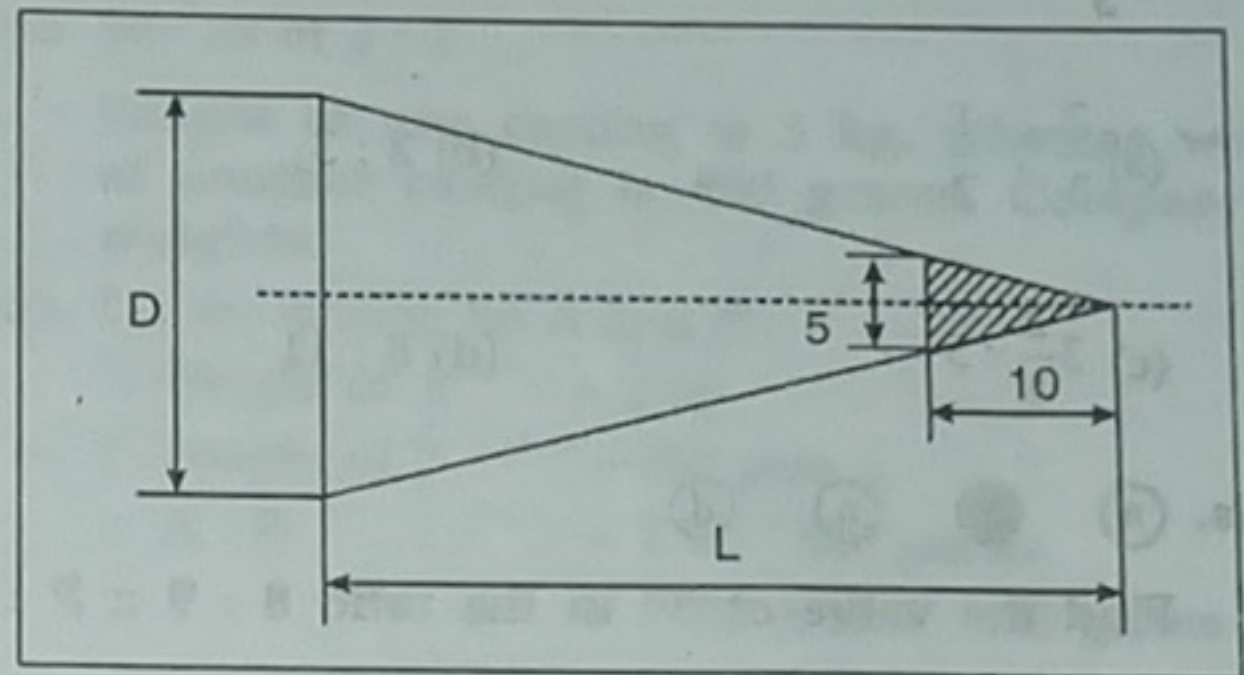
(a) 3 : 7

(b) 3 : 2

(c) 8 : 9

(d) 9 : 8

Ans. (a) (b) (c) ●

8. If A : B = 2 : 3 and B : C = 4 : 5, find A : B : C ?

(a) 2 : 3 : 5

(b) 4 : 5 : 8

(c) 9 : 10 : 12

(d) 8 : 12 : 15

Ans. (a) (b) (c) ●

9. The ratio between diameter of cone (d) to the length (L) is 1 : 10. If L is 200 mm, what will be the diameter of cone (d) ?

(a) 20 mm

(b) 15 mm

(c) 10 mm

(d) 5 mm

Ans. ● (b) (c) (d)

10. The relationship between number of persons engaged for a work and number of working days is :

(a) proportion

(b) ratio

(c) direct proportion

(d) inverse proportion

Ans. (a) (b) ● (d)

11. If 5 : 8 = x : 16, then x = _____

(a) 20

(b) 25

(c) 10

(d) 40.

Ans. (a) (b) ● (d)

12. Select the odd one out.

(a) 8 : 15

(b) 15 : 8

(c) $\frac{8}{15}$

(d) None of the above

Ans. (a) ● (c) (d)

13. In the word 'BALLOONS', find the ratio between vowel letters and consonant letters.

(a) 3 : 5

(b) 3 : 8

(c) 5 : 3

(d) 8 : 5

Ans. ● (b) (c) (d)

14. If 8 cats, 12 dogs and 3 rabbits are in a store of pet animals, then the ratio 8 : 23 is for _____

(a) dogs to cats

(b) cats to dogs

(c) rabbits to cats

(d) cats to all animals

Ans. (a) (b) (c) ●

15. Which of the following ratios is equivalent to $1\frac{1}{3} : 2$?

(a) $\frac{2}{3} : \frac{1}{2}$

(b) $2 : 3$

(c) $3\frac{2}{3} : 5$

(d) $8 : 11$

Ans. (a) ● (c) (d)

16. Find the value of 'P' in the ratio $8 : 9 :: P : 72$.
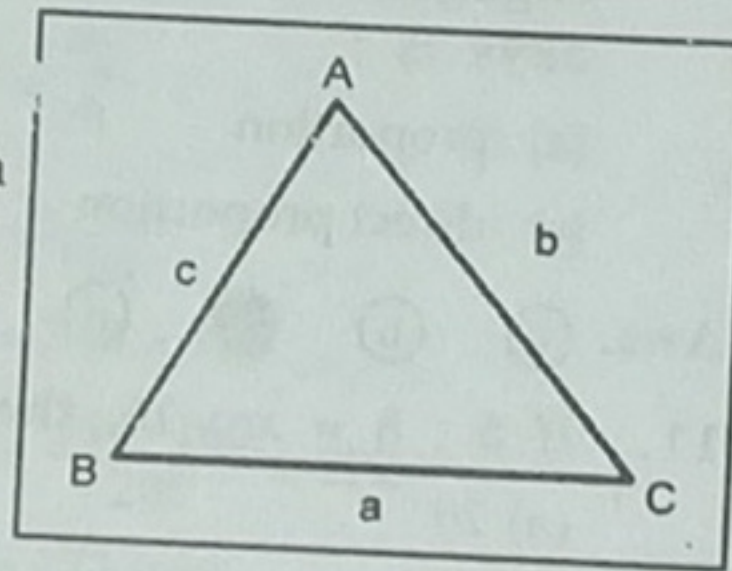
(a) 8

(b) 9

(c) 64

(d) 72

Ans. (a) (b) ● (d)

❏ Do as Directed

1. $a : b : c = 3 : 4 : 5$

$c = 170$ mm

$a = $ ___ mm

$b = $ ___ mm

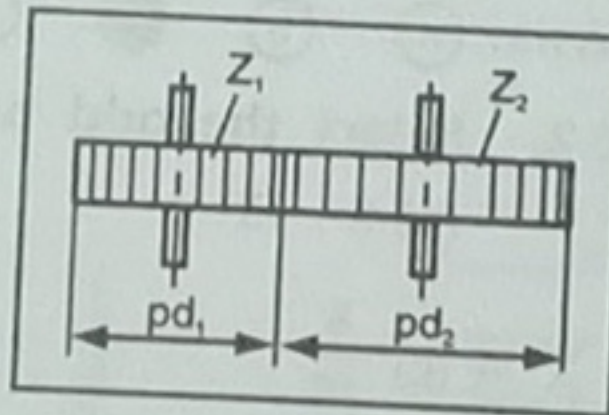Ans. $a = 102$ mm

$b = 136$ mm
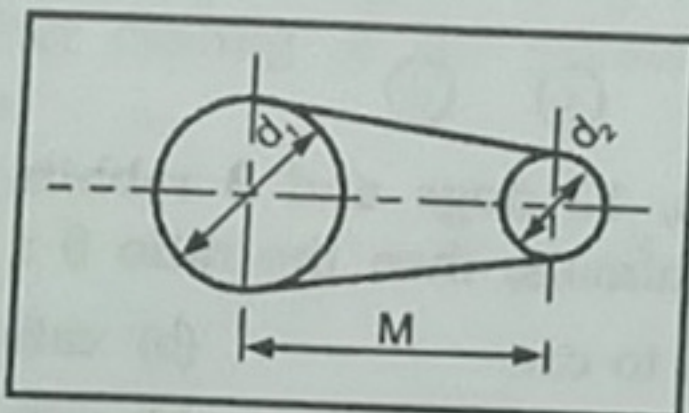
2. $pd_1 = 120$ mm

$i = 3 : 5$

$pd_2 = $ ___ mm

Ans. $pd_2 = 72$

3. $d_1 + d_2 = 900$ mm

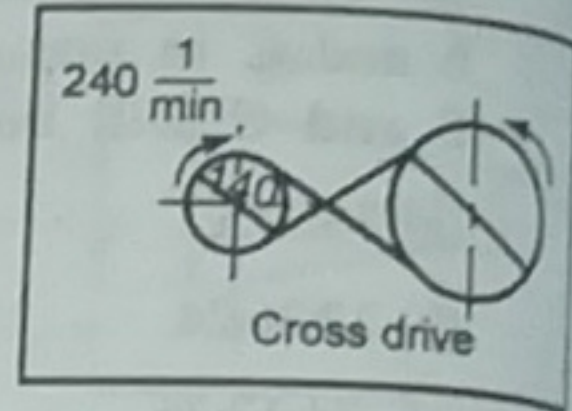Transmission ratio, $i = 1 : 2$

$d_1 = $ ___ mm

$d_2 = $ ___ mm

Ans. $d_1 = 600$ mm $d_2 = 300$ mm

4. $d_1 = 140$ mm

$d_2 = 300$ mm

$n_1 = 240$ rpm

$n_2 = $ ___ rpm

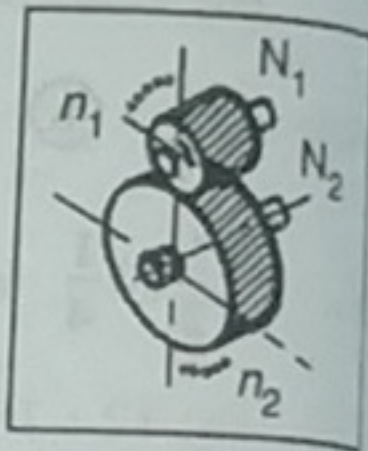Ans. $n_2 = 112$ rpm

5. $Z_1 = 24$ T

$Z_2 = 72$ T

$n_1 = 135$ rpm

$n_2 = $ ___ rpm

Ans. $n_2 = 45$ rpm

❏ State whether 'True' or 'False'

1. Ratio of $\frac{3}{4}$ to $\frac{6}{2}$ is $i : 2$.

Ans. False

2. If $A : B = 5 : 6$ and $B : C = 3 : 4$ then $A : B : C = 5 : 6 : 8$

Ans. False

3. Average of three numbers is 12 and average of first two numbers is 9, then third number is 18

Ans. True

4. Average of 4.5, 6.78 and 4.009 is 5.09.

Ans. True

❏ Fill in the Blanks

1. Average diameter of 6 shafts is 42 mm, then their total diameter is _____

Ans. 252 mm

2. Ratio of 40 to 500 is _____

Ans. $2 : 25$

3. Ratio of $\frac{3}{4}$ to 3 is _____

Ans. $1 : 4$

4. Ratio of 1 cm to 1 inch is _____

Ans. $1 : 2.54$ cm

5. _____ : $28 :: 3 : 7$

Ans. 12

[Hint : 1 in. = 2.54 cm]

❑ **Answer the Following Questions in Brief**

1. If the ratio of angles of a triangle is 2 : 7 : 11, then find the value of its angles.

Ans. Value of its angles are 18°, 63° and 99°.

2. Three men A, B and C can complete a job independently in 5, 6 and 8 days respectively. C leaves the job after one day. Find how many more days A and B together will take to complete the remaining job?

Ans. 1.38 days

3. A and B can do a work in 15 days, A and C in 12 days and B and C in 10 days. If A, B and C all work together, in how many days they complete the work?

Ans. 8 days

4. Ratio of radius of 2 circles is 3 : 2. Find the ratio of their parameter.

Ans. $3\pi : 2\pi$ or $3 : 2$

5. Weight of one casting is 3 kg, whereas weight of another casting is 400 grams. Compare the weights.

Ans. Let the casting be A and B

∴ Weight of A   = 3 kg

∴ Weight of B   = 400 grams.

∴ A : B   = 3 kg : 400 grams

         = 3,000 grams : 400 grams

         = 30 : 4

         = 15 : 2

A : B = 15 : 2   **Ans.**

❑❑❑

PERCENTAGE

EXERCISES

❏ Choose the Correct Answer

1. Percentage is a kind of fraction whose denominator is always _____

   (a) 50
   (b) 75
   (c) 100
   (d) 150

   Ans. (a) (b) ● (d)

2. 2% of 2 = _____

   (a) 0.4
   (b) 0.04
   (c) 0.004
   (d) 0.0004

   Ans. (a) ● (c) (d)

3. 30% of ₹3000 is _____

   (a) 90
   (b) 300
   (c) 600
   (d) 900

   Ans. (a) (b) (c) ●

4. 16% of 500 is _____

   (a) 8000
   (b) 800
   (c) 80
   (d) 20

   Ans. (a) (b) ● (d)

5. $\frac{1}{25}$ can be expressed as _____ %

   (a) 0.2
   (b) 4
   (c) 2
   (d) 5

   Ans. (a) ● (c) (d)

6. If 2.5% of 240 = x + 3.2% of 150, find the value of x :

   (a) 12
   (b) 1.6
   (c) 1.2
   (d) 6

   Ans. (a) (b) ● (d)

7. 52% of 666 + x = 500; Find the value of x :

   (a) 138.33
   (b) 168.46
   (c) 144.54
   (d) 153.68

   Ans. (a) (b) (c) ●

8. 25% of 1472 = x% of 2500; Find the value of x :

   (a) 15.45
   (b) 14.72
   (c) 15
   (d) 12.50

   Ans. (a) ● (c) (d)

9. Numerator of a fraction is increased by 10% and denominator is increased by 20%, then the resultant fraction is $\frac{11}{15}$. Find the original fraction:

   (a) $\frac{7}{12}$
   (b) $\frac{4}{5}$
   (c) $\frac{3}{5}$
   (d) $\frac{5}{12}$

   Ans. (a) ● (c) (d)

10. A's income is 150% of B and C's income is 120% of A. Total income of A, B and C is 86,000. Find out the income of C.

    (a) 30,000
    (b) 32,000
    (c) 20,000
    (d) 36,000

    Ans. (a) (b) (c) ●

11. 40% of 15% of $\frac{3}{4}$ of a number is 153. Find the number.

    (a) 3200
    (b) 3650
    (c) 3400
    (d) 3600

    Ans. (a) (b) ● (d)

12. 448 is the difference between 89% and 73% of a number. Find out 49% of this number.

    (a) 1372
    (b) 1426
    (c) 1218
    (d) 1124

    Ans. ● (b) (c) (d)

13. Express $\frac{2}{5}$ in form of percentage.

    (a) 20%
    (b) 30%
    (c) 40%
    (d) 50%

    Ans. (a) (b) ● (d)

14. Convert $\frac{9}{40}$ into percentage.

    (a) 18.1%
    (b) 22.5%
    (c) 30.5%
    (d) None of the above

    Ans. (a) ● (c) (d)

15. Convert 66.5 into percentage.

(a) 665%

(b) 6650%

(c) 66.5%

(d) None of the above

Ans. (a) ● (c) (d)

16. Convert 0.05 into percentage.

(a) 0.05%

(b) 5%

(c) 50%

(d) None of the above

Ans. (a) ● (c) (d)

17. 20% of 1223 is _____

(a) 244.6

(b) 301.88

(c) 358.2

(d) None of the above

Ans. ● (b) (c) (d)

18. 225% of 22 is _____

(a) 22.5

(b) 31.5

(c) 39.5

(d) 49.5

Ans. (a) (b) (c) ●

❑ **Do as Directed**
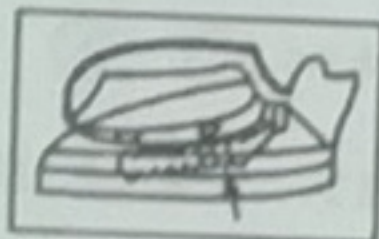
1. No. of irons manufactured

(n)= 220

Rejected = 20%

Accepted = _____ units

Rejected = _____ units

Ans. Accepted = 176 units

Rejected = 44 units

2. D = 50 mm

d = 20 mm

Shaded part = _____ %

Ans. Shaded part = 84%.
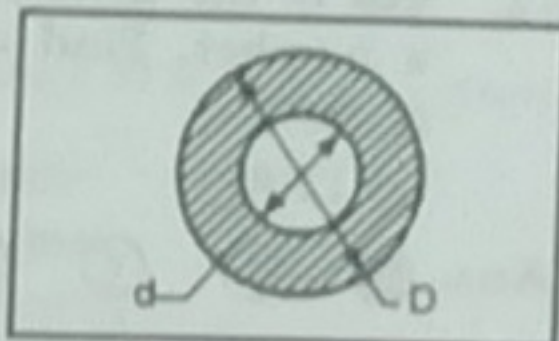
3. D = 50 mm

d = 40 mm

Shaded part = _____ %

Ans. Shaded part = 36%.
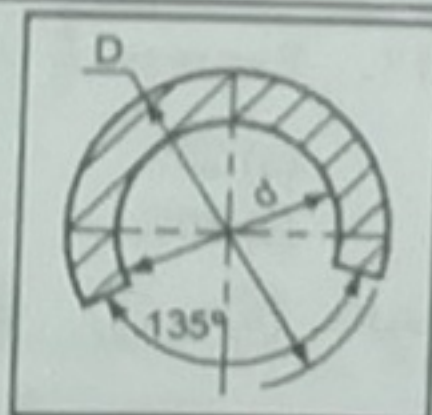
4. Normal Production= 6250

Decrement in Production= 65.6%

Production = _____

Ans. Production = 2150.

5. Input (P) = 3 kilowatt

Output (P) = 2546 Joule/sec

Efficiency (η) = _____ %
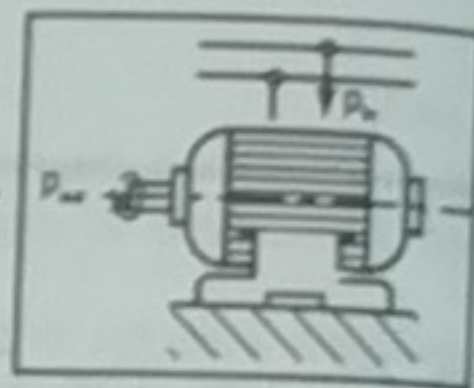
Ans. η = 84.87%.

❑ **State whether 'True' or 'False'**

1. 4% of 25 is equal to 1.

Ans. True

2. $\frac{1}{4}$ th part of 100 is 75.

Ans. False

3. 5% of 660 = 33.

Ans. True

4. 5 is 25% of 50.

Ans. False

❑ **Fill in the Blanks**

1. $\frac{1}{6}$ is equal to _____ %.

Ans. 16.66

2. 10% less of ₹ 75 = _____

Ans. 67.5

3. _____ % is equal to $\frac{3}{8}$.

Ans. 37.5

4. _____ % of 45 is 5.

Ans. 11.11

5. 16% of 550 is _____

Ans. 88

❑ **Answer the Following Questions in Brief**

1. Convert the following into fractions :

(i) 57.4%

(ii) 11%

(iii) 75%

(iv) 0.02%

Ans. (i) $\frac{57.4}{100} = 0.574$

(ii) $\frac{11}{100} = 0.11$

(iii) $\frac{75}{100} = 0.75$

(iv) $\frac{0.02}{100} = 0.0002$

2. Find the percentage:

   (i) 30% of 0.04   (ii) 15% of $\frac{1}{2}$

Ans. (i) 0.012   (ii) 0.075

3. Simplify:

   (i) 16% of what number is 40?

   (ii) 225 is what percent of 1800?

   (iii) 16 is what percent of 1200?

   (iv) 21% of what number is 2025?

Ans. (i) 250   (ii) 12.5%

   (iii) 1.33%   (iv) 9642.857

4. Solve :

   (i) Convert 0.643 into percentage.

   (ii) Convert 112.50% into decimal

   (iii) Find 6.5% of 134.

   (iv) 112.5 is what percent of 75?

   (v) 15% of what number is 12?

Ans. (i) 64.3%   (ii) 1.1250

   (iii) 8.71   (iv) 150%

   (v) 80

5. Convert 0.675 into percentage.

Ans. 67.5%