WORKSHOP CALCULATION & SCIENCE

(NSQF)

2nd YEAR

(As per Revised Syllabus July 2022)

ELECTROPLATER

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENTOF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Workshop Calculation & Science

Electroplater - 2nd Year NSQF

As per Revised Syllabus July 2022

Developed & Published by

National Instructional Media Institute
Post Box No.3142
Guindy, Chennai - 600032
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

First Edition : December 2023 Copies: 1000

Rs. 85/-

FOREWORD

The Government of India has set an ambitious target of imparting skills one out of every four Indians, to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Workshop Calculation & Science - Electroplater 2nd Year** NSQF (Revised 2022) under CTS will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Director General of Training, Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

ATUL KUMAR TIWARI, *I.A.S.*
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

December 2023
New Delhi - 110 001

PREFACE

The National Instructional Media Institute(NIMI) was set up at Chennai, by the Directorate General of Training, Ministry of skill Development and Entrepreneurship, Government of India, with the technical assistance from the Govt of the Federal Republic of Germany with the prime objective of developing and disseminating instructional Material for various trades as per prescribed syllabus and Craftsman Training Programme(CTS) under NSQF levels.

The Instructional materials are developed and produced in the form of Instructional Media Packages (IMPs), consisting of Trade Theory, Trade Practical, Test and Assignment Book, Instructor Guide and Wall charts. The above material will enable to achieve overall improvement in the standard of training in ITIs.

A national multi-skill programme called SKILL INDIA, was launched by the Government of India, through a Gazette Notification from the Ministry of Finance (Dept of Economic Affairs), Govt of India, dated 27th December 2013, with a view to create opportunities, space and scope for the development of talents of Indian Youth, and to develop those sectors under Skill Development.

The emphasis is to skill the Youth in such a manner to enable them to get employment and also improve Entrepreneurship by providing training, support and guidance for all occupation that were of traditional types. The training programme would be in the lines of International level, so that youths of our Country can get employed within the Country or Overseas employment. The **National Skill Qualification Framework (NSQF)**, anchored at the National Skill Development Agency(NSDA), is a Nationally Integrated Education and competency-based framework, to organize all qualifications according to a series of **levels of Knowledge, Skill and Aptitude.** Under NSQF the learner can acquire the Certification for Competency needed at any level through formal, non-formal or informal learning.

The **Workshop Calculation & Science -** Electroplater 2nd Year NSQF (Revised 2022) under CTS is one of the book developed by the core group members as per the NSQF syllabus.

The **Workshop Calculation & Science -** Electroplater 2nd Year NSQF (Revised 2022) under CTS as per NSQF is the outcome of the collective efforts of experts from Field Institutes of DGT, Champion ITI's for each of the Sectors, and also Media Development Committee **(MDC)** members and Staff of **NIMI.** NIMI wishes that the above material will fulfill to satisfy the long needs of the trainees and instructors and shall help the trainees for their Employability in Vocational Training.

NIMI would like to take this opportunity to convey sincere thanks to all the Members and Media Development Committee (MDC) members.

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

The National Instructional Media Institute (NIMI) sincerely acknowledge with thanks the co-operation and contribution of the following Media Developers to bring this IMP for **Workshop Calculation & Science - Electroplater 2nd Year** as per NSQF Revised 2022.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. M. Sangara pandian	-	Training Officer (Retd.) CTI, Govt. of India, Guindy, Chennai - 32.
Shri. G. Sathiamoorthy	-	Jr.Training Officer - SG (Retd.) Govt I.T.I, Trichy, DET - Tamilnadu.
Smt. P. J. Philomina Jeffy Jennifar	-	Principal (Retd.) Govt. I.T.I, Kuttikol, Kasaragod District, Kerala - 671541.

NIMI CO-ORDINATORS

Shri. Nirmalya Nath	-	Deputy General Manager, NIMI, Chennai - 32.
Shri. G. Michael Johny	-	Manager, NIMI, Chennai - 32.

NIMI records its appreciation of the **Data Entry, CAD, DTP Operators** for their excellent and devoted services in the process of development of this IMP.

NIMI also acknowledges with thanks, the efforts rendered by all other staff who have contributed for the development of this book.

INTRODUCTION

The material has been divided into independent learning units, each consisting of a summary of the topic and an assignment part. The summary explains in a clear and easily understandable fashion the essence of the mathematical and scientific principles. This must not be treated as a replacment for the instructor's explanatory information to be imparted to the trainees in the classroom, which certainly will be more elaborate. The book should enable the trainees in grasping the essentials from the elaboration made by the instructor and will help them to solve independently the assignments of the respective chapters. It will also help them to solve the various problems, they may come across on the shop floor while doing their practical exercises.

The assignments are presented through 'Graphics' to ensure communications amongst the trainees. It also assists the trainees to determine the right approach to solve the problems. The required relevent data to solve the problems are provided adjacent to the graphics either by means of symbols or by means of words. The description of the symbols indicated in the problems has its reference in the relevant summaries.

At the end of the exercise wherever necessary assignments, problems are included for further practice.

Time allotment - 2nd Year : 22 Hrs

Time allotment for each title of exercises has been given below. **Workshop Calculation & Science - Electroplater** 2nd Year NSQF Revised Syllabus 2022.

S.No	Title	Exercise No.	Time in Hrs
1	Area of cut out regular surfaces and area of irregular surfaces	2.1.01 - 2.1.03	8
2	Profit and Loss	2.2.04 & 2.2.05	4
3	Estimation and Costing	2.3.06 & 2.3.07	10
		Total	**22 Hrs**

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Demonstrate basic mathematical concept and principles to perform practical operations.**
- **Understand and explain basic science in the field of study.**

CONTENTS

Exercise No.	Title of the Exercise	Page No.
	Area of cut-out regular surfaces and area of irregular surfaces	
2.1.01	Area of cut-out regular surfaces - circle, segment and sector of circle	1
2.1.02	Related problems of area of cut-out regular surfaces - circle, segment and sector of circle	4
2.1.03	Area of irregular surfaces and application related to shop problems	6
	Profit and Loss	
2.2.04	Profit and loss - Simple problems on profit & loss	9
2.2.05	Profit and loss - Simple and compound interest	15
	Estimation and Costing	
2.3.06	Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade	26
2.3.07	Estimation and costing - Problems on estimation and costing	34

SYLLABUS

2nd Year

Workshop Calculation & Science - Electroplater
Revised syllabus July 2022 under CTS

S.no.	Syllabus	Time in Hrs
I	**Area of cut out regular surfaces and area of irregular surfaces** 1 Area of cut out regular surfaces – circle, segment and sector of circle 2 Related problems of area of cut – out regular surfaces – circle, segment and sector of circle 3 Area of irregular surfaces and application related to shop problems	**8**
II	**Profit and Loss** 1 Simple problems on profit & loss 2 Simple and compound interest	**4**
III	**Estimation and Costing** 1 Simple estimation of the requirement of material etc., as applicable to the trade 2 Problems on estimation and costing	**10**
	Total	**22**

Area of cut-out regular surfaces - Circle, segment and sector of circle

Circle (Fig 1)

It is the path of a point which is always equal from its centre is called a circle.

r = radius of the circle

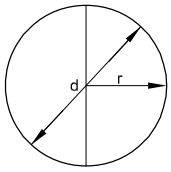
d = diametre of the circle

Area of the circle = πr^2

(or) = $\frac{\pi}{4} d^2$ unit^2

Circumference of the circle = $2\pi r$ (or) πd unit

Fig 1



PROPERTIES OF CIRCLE

WSNEP210111

Sector of a circle (Fig 2)

The area bounded by an arc and two side radius is called the sector of a circle. In the figure given ABC is the sector of a circle.

r = radius of the circle

θ = Angle of sector in degrees

Area of sector ABC

$$= \frac{\pi r^2 \times \theta}{360^0} \text{ unit}^2$$

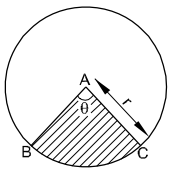
$$\text{Area of sector} = \frac{\text{Length of arc of sector} \times \text{radius}}{2} \text{ unit}^2$$

$$\text{Length of the arc } \ell = 2\pi r \times \frac{\theta}{360^0} \text{ unit}$$

Perimeter of the sector = $\ell + 2r$ unit

r = radius

Fig 2



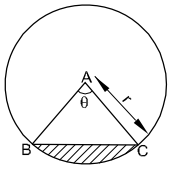
SECTOR OF A CIRCLE

WSNEP210112

Segment of a circle (Fig 3)

When a circle is divided into two by drawing a line, the bigger part is called segment of the circle and the smaller part is also called segment of the circle.

Fig 3



SEGMENT OF A CIRCLE

WSNEP210113

Area of the smaller segment

= Area of the sector - Area of Δ ABC

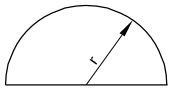
Area of the greater segment

= Area of the circle - Area of smaller segment

Semi Circle (Fig 4)

- A semi circle is a sector whose central angle is 180°.

Fig 4



SEMI CIRCLE

WSNEP210114

- Length of arc of semi circle

$$\ell = 2\pi r \times \frac{180^\circ}{360^\circ} = 2\pi r \times \frac{1}{2} \text{ unit}$$

$$= \pi r \text{ unit}$$

$$\text{Area of semi circle} = \frac{\pi r^2}{2} \text{ unit}^2$$

$$\text{Perimeter of a semi circle} = \frac{2\pi r}{2} + 2r$$

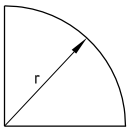
$$= \pi r + 2r$$

$$= r(\pi + 2) \text{ unit}$$

Quadrant of a circle (Fig 5)

- A quadrant of a circle is a sector whose central angle is 90°.

Fig 5



QUADRANT CIRCLE

WSNEP210115

- Length of arc of quadrant of a circle

$$\ell = 2\pi r \times \frac{90^\circ}{360^\circ}$$

$$= 2\pi r \times \frac{1}{4}$$

$$= \frac{\pi r}{2}$$

Area of quadrant of a circle = $\frac{\pi r^2}{4}$ unit^2

Perimeter of a quadrant = $\frac{2\pi r}{4} + 2r$

$$= \frac{\pi r}{2} + 2r$$

$$= r\left(\frac{\pi}{2} + 2\right) \text{ unit}$$

Examples :

1 Find the area of a sector of a circle whose radius is 14 cm and the length of the arc of the sector is 28 cm.

Radius of sector r = 14 cm

Length of arc of sector = 28 cm

Length of arc of sector (ℓ) = $\frac{\theta}{360^\circ}$ x 2πr unit

28 = $\frac{\theta}{360^\circ}$ x 2 x $\frac{22}{7}$ x 14 unit

$\theta = \frac{28 \times 360^\circ \times 7}{2 \times 22 \times 14} = 114.55^0$

∴ Angle of sector $\theta = 114.55^0$

∴ Area of sector = $\frac{\theta}{360^\circ}$ x πr^2 unit^2

= $\frac{114.55}{360^\circ}$ x $\frac{22}{7}$ x 14 x 14 cm^2

= 196 cm^2

Area of sector = 196 cm^2

2 If the circumference of a circle is 44 cm, find its area. (Take $\pi = \frac{22}{7}$)

Solution

∴ Let (d) = diameter of circle

∴ Circumference of circle = πd

∴ 44 = π . d

$d = \frac{44}{\pi} = 44 \div \pi$

$= 44 \div \frac{22}{7}$

$= 44 \times \frac{7}{22}$

= 14 cm

∴ Diameter of circle (d) = 14 cm

∴ Area of circle $= \frac{\pi}{4} d^2$ unit^2

$= \pi \times \frac{1}{4} d^2$

$= \frac{22}{7} \times \frac{1}{4} \times 14 \times 14$

= 154 cm^2

Area of circle = 154 cm^2

3 Find the remaining area of circle of 10 cm dia after inscribing triangle of 5 cm base and 10 cm height.

Solution

(i) Area of the circle $= \frac{\pi}{4} d^2$

$= \frac{22 \times 10 \times 10}{7 \times 4}$ Unit^2

$= \frac{550}{7}$ = 78.57 cm^2

(ii) Area of the triangle inscribed in this circle

$= \frac{1}{2} \times \text{base} \times \text{height}$

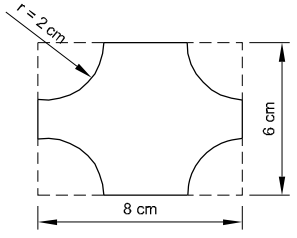
$= \frac{10 \times 5}{2} = 25 \text{ sq.cm}$

Remaining area = 78.57 - 25

Remaining area of circle = 53.57 cm^2

4 A rectangular sheet of metal measures 8 cm and 6 cm. Four quadrants of circles each of radius 2 cm are cut away at corners. Find the area of the remaining portion.

Fig 1



Area of rectangular sheet = 8 x 6

= 48 cm^2

There are four quadrants of a circle, each of radius 2 cm cut away at the corners. Quadrant of circle means 1/4th of circle.

4 quadrant of circles = 4 x $\frac{1}{4}$ of circle = 1 circle

Area of 4 quadrant circles = Area of one circle

= πr^2

= $\frac{22}{7} \times 2 \times 2$

= 12.57 cm^2

Area of remaining portion = Area of rectangular sheet – Area of four quadrant circles cut at corners.

= 48 - 12.57

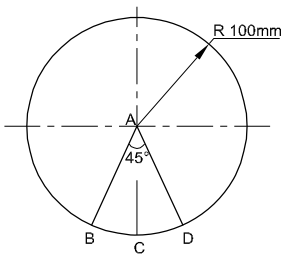
= 35.428 cm^2

= say 35.43 cm^2

Area of remaining portion = 35.43 cm^2

5 Find the perimeter of the given circular disc.

Fig 2



Sector :

r = 100 mm

θ = 360° - 45° = 315°

$$\ell = \frac{\theta}{360} \times 2\pi r \text{ unit}$$

$$= \frac{315}{360} \times 2 \times \pi \times 100\text{mm}$$

ℓ = 550 mm

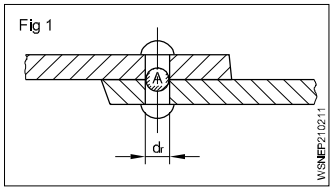
Perimeter of the given circular Disc = ℓ + 2r

= 550 + 200 = 750 mm

Perimeter of the given circular Disc = 750 mm

Related problems of area of cut-out regular surfaces - circle, segment and sector of circle

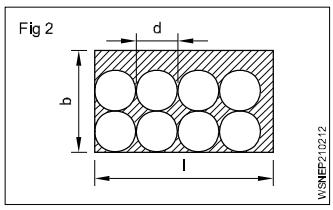
1



d_t = 21 mm

A_t = _____ mm²

2



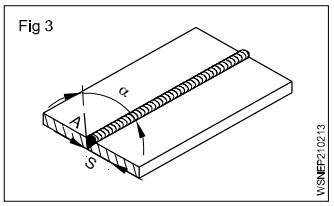
l = 750 mm

b = 400 mm

d = 180 mm

Area of sheet = _____

3

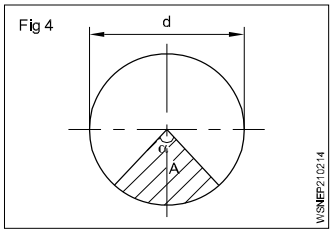


α = 60°

s = 9.2 mm

A of sector = _____ mm²

4

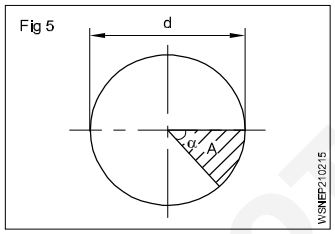


A = Area of sector = 140 mm²

d of the circle = 30 mm

α = _____ °

5



d = 380 mm

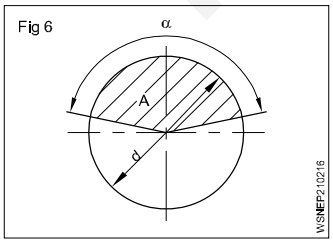
No. of sectors of equal area = 8

Area of each sector = _____ mm²

α = _____ °

length of arc of each sector = _____ mm

6

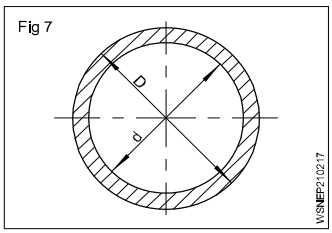


α = 160°

A = 0.893 m²

d = _____ mm

7

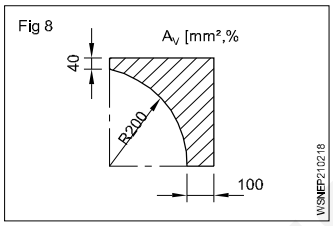


D = 38 mm

d = 32 mm

Cross sectional area = _____ mm²

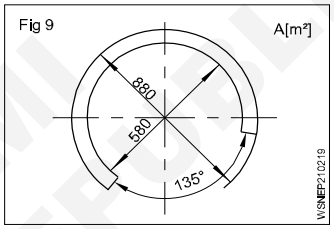
8



Av (Area of shaded part) = _____ mm²

Av = % of (Area of rectangle) A_1

9



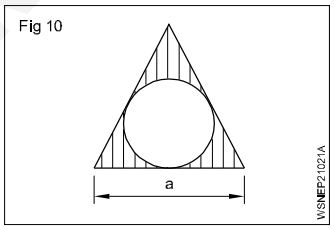
D = 880 mm

d = 580 mm

Angle of cut off sector = 135°

Area of the remaining portion, A = _____ mm²

10

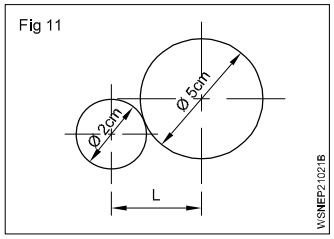


Equilateral triangle of side a = 6 cm

Radius of circle = 1.732 cm

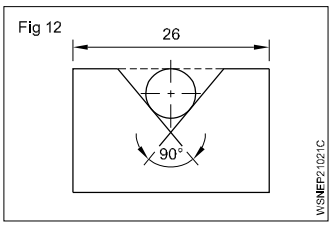
Shaded area = _____

11

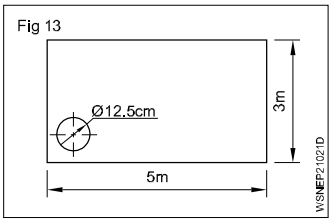


Two plugs having diameters 2 cm and 5 cm are placed on a surface plate touching each other. calculate the distance 'L' in the figure.

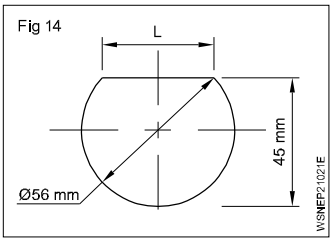
12



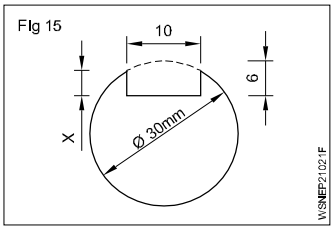
90° vee block is 26 mm wide at the top of the vee block. What dia. of shaft when laid in the vee block will have its top surface just level with the top of the vee block.

13 

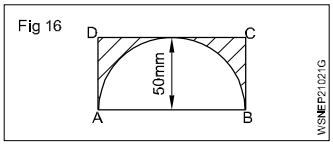
From a sheet of 5m × 3m how many circular pieces of 12.5 cm dia can be cut.

14 

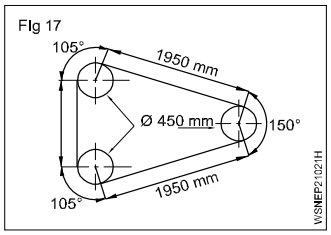
Find out 'L' from the given sketch.

15 

Find the value of 'x' in the fig.

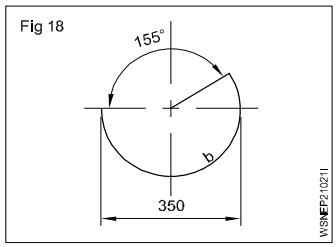
16 

Area of the shaded portion
= _____mm^2.

17 

The arrangement of a band saw blade is shown in the figure given below. Find out the length of the saw blade.

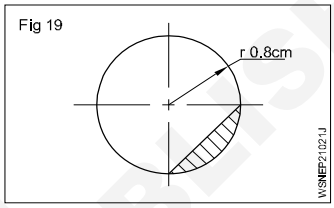
18 Calculate the area covered by 3 equal circles of radius 2.8 cm touches one another.

19 

α = 155°

d = 350 mm

b = ____mm

20 

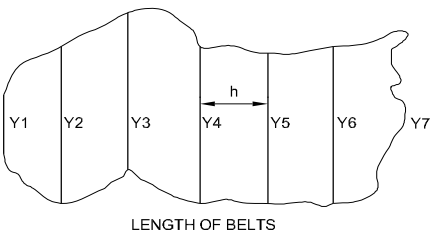
Find the area of shaded portion.

Area of irregular surfaces and application related to shop problems

Area of irregular surface

Surface area of irregular figures can be obtained by applying either, simpson's rule or trapezoidal rule. Area found by simpson's rule is more accurate than trapezoidal rule. However accurate area can be obtained if the number of ordinates are more i.e interval between ordinates is so small as possible. (Fig 1)

Fig 1



i Area as per simpson's rule

$$\text{Area} = \frac{h}{3}[(y_1 + y_7) + 4(y_2 + y_4 + y_6) + 2(y_3 + y_5)]$$

where

h = interval between ordinates

ii Area as per trapezoidal rule

$$\text{Area} = \frac{h}{2}[(y_1 + y_7) + 2(y_2 + y_3 + y_4 + y_5 + y_6)]$$

where

h = interval between ordinates

Calculate the area enclosed between the chain line, the edge and the end offsets by

The offsets were taken from a chain line to a edge.

Distance (M)	0	5	10	15	20	25	30	35
Off set (M)	4	3	2	5	1	2	3	5

(a) Simpson's rule **(b) Trapezoidal rule**

(a) Simpson's rule

$$A = \frac{h}{3}[(y_1 + y_8) + 4(y_2 + y_4 + y_6) + 2(y_3 + y_{5+} Y_7)] \text{ unit}^2$$

$$A = \frac{5}{3}[(4 + 5) + 4(3 + 5 + 2) + 2(2 + 1 + 3)] \text{ m}^2$$

$$= \frac{5}{3}[9 + 4(10) + 2(6)]$$

$$= \frac{5}{3}[9 + 40 + 12]$$

$$= \frac{5}{3} \times 61 = \mathbf{101.66}$$

= 101.7 m²

(b) Trapezoidal rule

$$A = \frac{h}{2}[(y_1 + y_8) + 2(y_2 + y_3 + y_4 + y_5 + y_{6+} Y_7)] \text{ unit}^2$$

$$A = \frac{5}{2}[(4 + 5) + 2(3 + 2 + 5 + 1 + 2 + 3)] \text{ m}^2$$

$$= \frac{5}{2}[9 + 2(16)] \text{ m}^2$$

$$= \frac{5}{2}[9 + 32] \text{ m}^2$$

$$A = \frac{5}{2} \times 41 \text{ m}^2$$

= 102.5 m²

Calculation of the area of an irregular surface

In this Calculation the area of an irregular surface may be determined as follows.

In this method of calculation a chain line known as base line to be laid through the centre of the area of the surface.

The offset are taken to the boundary points in the order of their chainages on both the sides of the base line.

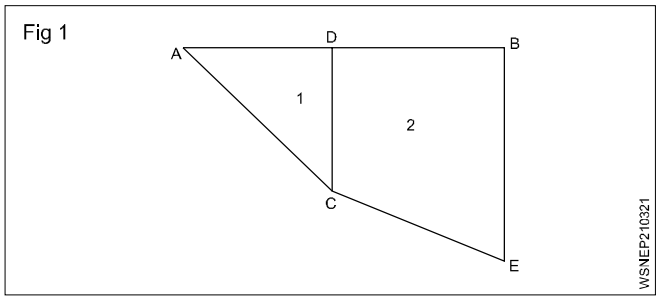
The chain line and offsets are noted down.

With reference to the notes the boundary points are plotted and the area to be divided into number of triangles and trapezium according to the shape.

Example

Now apply the geometrical formulae for calculation according to the shape of the figure. (Fig 1)

Fig 1



Chainline = AB

Offsets = C,E

1 Area of triangle

½ x base x height

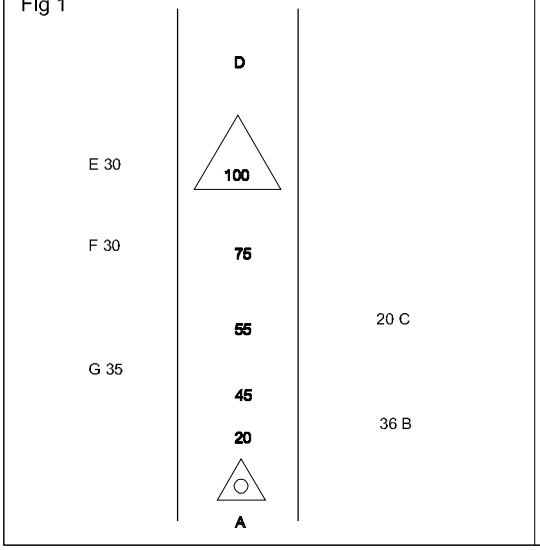
2 Area of trapezium

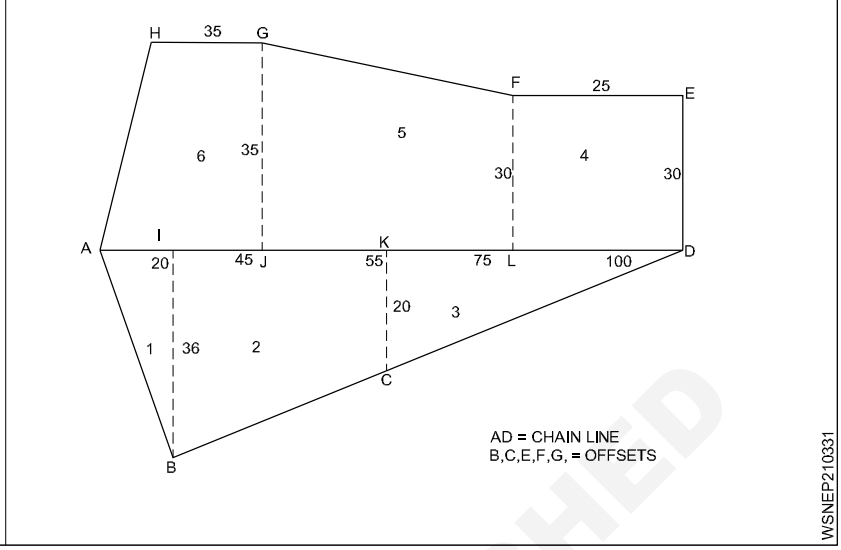
$$\frac{\text{base}\,(a + b)}{2} \times \text{height}$$

Example

Plot the following details of a field and calculate its area (all measurements are in metres) (Fig 1)

Fig 1





Serial No. 1 In ΔAB

Chainage in metres 0 and 20m.

Offsets in metres 0 and 36m.

In Δ ABI

Area = ½ x base x height

=1/2 x 20 x 36

=360 sq.m

Sl. No. 2

Area of trapezium IBCK

Chainage in metres = 20m and 55m = 35m

Offsets in metres 36m and 20m = 28m

$$= \frac{(a+b)}{2} \times \text{height} = \left[\frac{36+20}{2} \times 35\right]$$

= 28 x 35 = 980 sq.m

Sl. No. 3

Area of triangle KCD $= \frac{1}{2}$ x b x h $= \frac{1}{2} \times 20 \times 45$

= 45m x 10m = 450 Sq.m

Sl. No. 4

Area of rectangle DEFL = 25 x 30 = 750 sq.m

Sl. No. 5 (LFGJ)

$$\text{Area of Trapezium LFGJ} = \frac{(a+b)}{2} \times \text{height} = \left[\frac{30+35}{2} \times 30\right]$$

= 32.5m x 30m = 975 sq.m

Sl. No. 6

$$\text{Area of trapezium AJGH} = \frac{35+45}{2} \times 35 = \frac{80}{2} \times 35$$

= 40 x 35 = 1400 sq.m

S. No.	Figure	Chainline in metres	Base in Metres	Offsets in metres	Mean offsets in metres	Area in square Metres		Remarks
						+ve	-ve	
1	2	3	4	5	6	7	8	9
1	ΔABI	0 and 20	20	0 and 36	18	360	--	
2	Trapezium IBCK	20 and 55	35	36 and 20	28	980	--	
3	ΔKCD	55 and 100	45	0 and 20	10	450	--	
4	Rectangle DEFL	100 and 75	25	0 and 30	15	750	--	
5	Trapezium LFGJ	75 and 45	30	30 and 35	32.50	975	--	
6	Trapezium JGHA	45 and 0	45	45 and 35	40	1400	--	
					Total	4915		

Assignment

Calculate the area of the irregular surfaces given below.

Fig 1

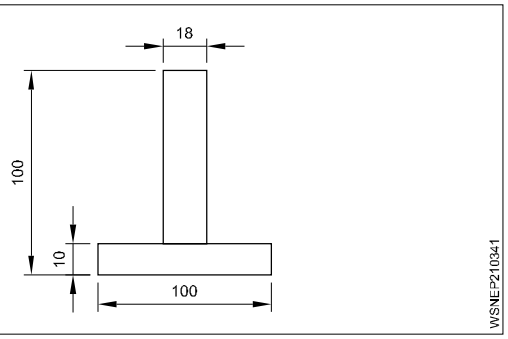


Fig 2

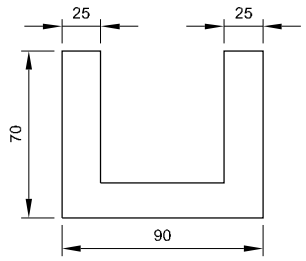


Fig 3

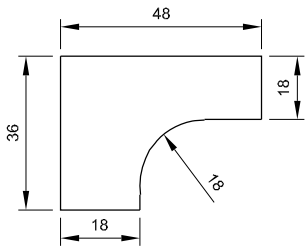


Fig 4

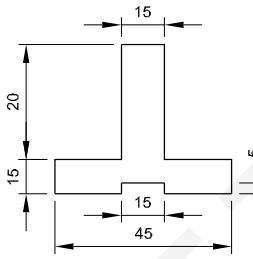


Fig 5

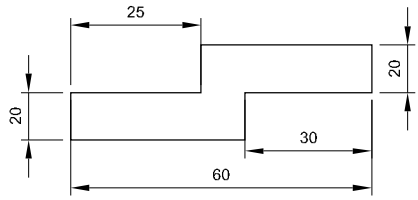


Fig 6

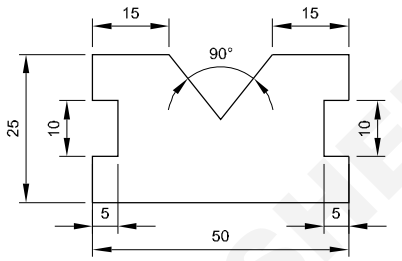


Fig 7

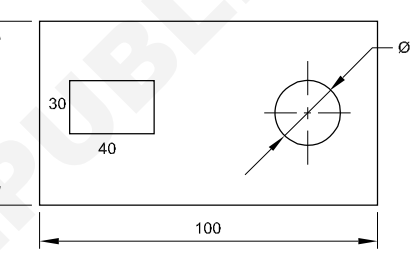
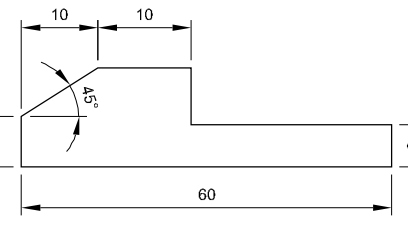


Fig 8



Note : All dimension are in mm.

Profit and loss - Simple problems on profit & loss

Definition of 'profit and loss statement (P&L)

A profit and loss statement (P&L) is a financial statement that summarizes the revenues, costs and expenses incurred during a specific period of time, usually a year. These records provide information about a company's ability - to generate profit by increasing revenue, reducing costs, or both. The P&L statement is also referred to as "statement of profit and loss", "income statement", "statement of operations", "statement of financial results" and "income and expenditure statement".

Profit and loss

Important facts

Cost price

The price, at which an article is purchased is called its cost price, abbreviated as C.P.

Selling price

The price at which an article is sold, is called its selling prices, abbreviated as S.P.

Profit or gain

If S.P. is greater than C.P., the seller is said to have a profit or gain.

Loss

If S.P. is less than C.P., the seller is said to have incurred a loss.

Discount

The reduction given to the selling price of a product is the discount.

Important formulae

1 Profit or Gain=(S.P)-(C.P)

2 Loss=(C.P)-(S.P)

3 Loss or gain always depends on C.P.

4 Profit/gain is always expressed in %.

$$\text{Gain\%} = \left(\frac{\text{Gain x 100}}{\text{C.P.}}\right)$$

5 Loss percentage: (Loss %)

$$\text{Loss \%} = \left(\frac{\text{Loss x 100}}{\text{C.P.}}\right)$$

6 Selling price: (S.P)

$$\text{SP} = \left(\frac{100 + \text{Gain\%}}{100} \text{x C.P}\right)$$

7 Selling price: (S.P)

$$\text{SP} = \left(\frac{(100 - \text{loss \%})}{100} \text{x C.P}\right)$$

8 Cost price: (C.P)

$$\text{C.P} = \left(\frac{100}{(100 + \text{Gain \%})} \text{x S.P}\right)$$

9 Cost price: (C.P)

$$\text{C.P} = \left(\frac{100}{(100 - \text{Loss \%})} \text{x S.P}\right)$$

10 If an article is sold at a gain of say 35%, then S.P.=135% of C.P.

11 If an article is sold at a loss of say, 35% then S.P=65% of C.P.

Example

1 A dealer bought a television set for Rs.10,000 and sold it for Rs.12,000. Find the profit made by him for 1 television set. If he had sold 5 television sets, find the total profit?

Solution

Selling price of the television set = Rs.12,000

Cost price of the television set = Rs.10,000

S.P. > C.P., there is a profit

Profit = S.P. - C.P

= 12000-10000

Profit = Rs.2,000

Profit on 1 television set = Rs.2000

Profit on 5 television sets = 2000 x 5

= Rs.10,000

2 Sanjay bought a bicycle for Rs.5000. He sold it for Rs.600 less after two years. Find the selling price and the loss percent?

Solution

Cost price of the bicycle = Rs.5000

Loss = Rs.600

Selling price = Cost price - loss

= 5000 - 600

Selling price of the bicycle = Rs.4400

Loss % = $\frac{\text{Loss}}{\text{C.P.}}$ x 100

= $\frac{600}{5000}$ x 100

Loss = 12%

3 A man bought an old bicycle for Rs.1250. he spent Rs.250 on its repairs. He then sold it for Rs.1400. Find his loss %?

Solution

Cost price of the bicycle = Rs.1250

Repair Charges = Rs.250

Total cost price = 1250+250 = Rs.1500

Selling price = Rs.1400

C.P > S.P, there is a loss

Loss = Cost price - Selling price

1500 - 1400 = 100

Loss = Rs.100

$$\text{Loss \%} = \frac{\text{Loss}}{\text{C.P.}} \times 100$$

$$= \frac{100}{1500} \times 100$$

$$= \frac{20}{3} = 6\frac{2}{3}\% \text{ (or) } 6.67\%$$

Loss = 6.67%

Profit percentage or loss percentage is always calculated on the cost price of the article.

4 A fruit seller bought 8 boxes of grapes at Rs.150 each. One box was damaged. He sold the remaining boxes at Rs.190 each. Find the profit percent?

Solution

Cost price of 1 box of grapes = Rs.150

Cost price of 8 boxes of grapes = 150 x 8

= Rs.1200

Number of boxes damaged = 1

Number of boxes sold = 8 - 1 = 7

Selling price of 1 box of grapes = Rs.190

Selling price of 7 boxes of grapes = 190 x 7

= Rs.1330

S.P.>C.P, there is a profit

Profit = Selling price - Cost price

= 1330-1200

= 130

Profit = Rs.130

$$\text{Percentage of profit} = \frac{\text{Profit}}{\text{C.P}} \times 100$$

$$= \frac{130}{1200} \times 100$$

= 10.83

Profit = 10.83%

5 Ram, the shopkeeper bought a pen for Rs.50 and then sold it at a loss of Rs.5. Find his selling price.

Solution

Cost price of the pen = Rs.50

Loss = Rs.5

S.P. = C.P. - Loss

= 50 - 5 = 45

Selling price of the pen = Rs.45

6 Find the initial amount if 12% of the total amount it is ₹ 1080

Let the initial amount be 'x '

Given: 12% of the total amount = Rs.1080

$$\frac{12}{100} \times x = 1080$$

$$x = \frac{1080 \times 100}{12}$$

= ₹ 9000

∴ The initial amount = Rs.9000

Applications of profit and loss

In this section, we learn to solve problems on applications of profit and loss.

i Illustration of the formula for S.P.

Consider the following situation

Rajesh buys a pen for Rs.80 and sells it to his friend.

If he wants to make a profit of 5%, can you say the price for which he would have sold?

(Rajesh bought the pen for Rs.80 which is the cost price (C.P.). When he sold, he makes a profit of 5% which is calculated on the C.P.)

$$\therefore \text{Profit} = 5\% \text{ of C.P.} = \frac{5}{100} \times 80 = \text{Rs.}4$$

Since there is a profit, S.P > C.P.

S.P. = C.P. + Profit

= 80 + 4 = Rs.84

∴ The price for which Rajesh would have sold = Rs.84

The same problem can be done using the formula.

$$\text{Selling price (S.P)} = \frac{(100 + \text{Profit \%})}{100} \times \text{C.P}$$

$$= \frac{(100 + 5)}{100} \times 80$$

$$= \frac{105}{100} \times 80 = \text{Rs. } 84$$

ii Illustration of the formula for C.P

Consider the following situation

Suppose a shopkeeper sells a wrist watch for Rs. 540 making a profit of 5%, then what would have been the cost of the watch?

(The shopkeeper had sold the watch at a profit of 5% on the C.P. Since C.P. is not known, let us take it as Rs. 100)

Profit of 5% is made on the C.P.

$\therefore$ Profit = 5% of C.P.

$= \frac{5}{100} \times 100 = \text{Rs. } 5$

We know S.P. = C.P + Profit

= 100 + 5

= Rs. 105

Here, if S.P. is Rs.105, then C.P. is Rs. 100

When S.P. of the watch is Rs. 540, C.P $= \frac{540 \times 100}{105}$

= Rs. 514.29

$\therefore$ The watch would have cost Rs. 514.29 for the shopkeeper.

The above problem can also be solved by using the formula method.

$$\text{C.P.} = \left(\frac{100}{100 + \text{Profit \%}}\right) \times \text{S.P}$$

$$= \left(\frac{100}{100+5} \times 540\right)$$

$$= \frac{100}{105} \times 540 = \text{Rs. } 514.29$$

We now summarize the formulae to calculate S.P. and C.P. as follows.

1 When there is a profit $\textbf{C.P} = \left(\frac{\textbf{100}}{\textbf{100} + \textbf{Profit\%}}\right) \textbf{x S.P.}$	**1 When there is a loss** $\textbf{C.P} = \left(\frac{\textbf{100}}{\textbf{100} - \textbf{Loss\%}}\right) \textbf{X S.P.}$
2 When there is a profit $\textbf{S.P} = \left(\frac{\textbf{100} + \textbf{Profit\%}}{\textbf{100}}\right) \textbf{x C.P.}$	**2 When there is a loss** $\textbf{S.P} = \left(\frac{\textbf{100} - \textbf{Loss\%}}{\textbf{100}}\right) \textbf{X C.P.}$

Example

1 Hameed buys a colour T.V. set for Rs. 15,200 and sells it at a loss of 20%. What is the selling price of the T.V. set?

Solution

Method - I

Loss is 20% of the C.P.

$\frac{20}{100} \times 15200 = \text{Rs. } 3040$

S.P = C.P - Loss

15200 - 3040 = Rs.12160

Method - II

C.P = Rs 15,200

Loss = 20%

$\text{S.P} = \frac{100 - \text{Loss\%}}{100} \times \text{C.P.}$

$= \frac{100-20}{100} \times 15200$

$= \frac{80}{100} \times 15200$

= Rs. 12,160

2 A scooty is sold for Rs. 13600 and fetches a loss of 15%. Find the cost price of the scooty.

Method - I

Loss of 15% means,

If C.P. is Rs. 100, Loss = Rs. 15

Therefore, S.P. would be

(100-15) = Rs. 85

If S.P. is Rs. 85, C.P. is Rs. 100

When S.P is Rs. 13600 then

$\text{C.P} = \frac{100 \times 13600}{85} = \text{Rs. } 16000$

Method - II

Loss = 15%

S.P. = Rs. 13600

$\text{C.P.} = \left(\frac{100}{100 - \text{Loss\%}}\right) \times \text{S.P}$

$$= \frac{100}{100-15} \times 13600$$

$$= \frac{100}{85} \times 13600$$

= Rs. 16000

Hence the cost price of the scotty is Rs. 16000

Discount

Discount is the reduction in value on the marked price or list price of the article.

The market price of a product is Rs.550

Amount paid by pooja to the shop keeper is Rs. 440

Discount = Rs. 550 - Rs. 440

= Rs. 110

= Marked price - Selling price

Hence we conclude the following

Discount	= Marked price - Selling price
Selling price	= Marked price - Discount
Marked price	= Selling price + Discount

Example

1 A bicycle marked at Rs. 1500 is sold for Rs. 1350. What is the percentage of discount?

Marked price = Rs. 1500

Selling price = Rs. 1350

Amount of discount = Marked price - Selling price

= 1500 - 1350

= Rs. 150

Discount for Rs. 1500 = Rs. 150

Discount for Rs. 100 $= \frac{150}{1500} \times 100$

Percentage of discount = 10%

2 The list price of a Frock is Rs.220. A discount of 20% on sales is announced. What is the amount of discount on it and its selling price?

Amount of discount $= \frac{\text{Discount}}{100\%} \times \text{M.P.}$

Amount of discount $= \frac{20}{100} \times 220 = \text{Rs. } 44$

Selling price of the frock = Marked price - Discount

220 - 44 = Rs. 176

3 An almirah is sold at Rs. 5225 after allowing a discount of 5%. Find its marked price.

Solution

Method - I

The discount is given in percentage

Hence, the M.P. is taken as Rs. 100

Rate of discount = 5%

Amount of discount $= \frac{5}{100} \times 100$

Selling price = M.P - Discount

= 100 - 5 = Rs. 95

If S.P. is Rs. 95, then M.P. is Rs.100

When S.P. is Rs. 5225

M.P. $= \frac{100}{95} \times 5225$

M.P of the almirah = Rs. 5500

Method - II

S.P = Rs. 5225

Discount = 5%

M.P = ?

M.P $= \left(\frac{100}{100 - \text{Discount\%}}\right) \times \text{S.P.}$

$= \left(\frac{100}{100-5}\right) \times 5225$

= Rs. 5500

4 A shopkeeper allows a discount of 10% to his customers and still gains 20%. Find the marked price of an article which costs Rs.450 to the shopkeeper.

Solution

Method - I

Let M.P be Rs. 100

Discount = 10% of M.P

$= \frac{10}{100}$ of M.P $= \frac{10}{100} \times 100$

= Rs. 10

S.P = M.P - Discount

= 100 - 10

= Rs. 90

Gain = 20% of C.P.

$= \frac{20}{100} \times 450 = \text{Rs. } 90$

S.P = C.P + Gain

= 450 + 90 = Rs. 540

If S.P. is Rs. 90, then M.P is Rs. 100

$$\text{M.P.} = \frac{540 \times 100}{90} = \text{Rs. } 600$$

The M.P. of an article = Rs. 600

Method - II

Discount = 10%, Gain = 20%

C.P. = Rs. 450 , M.P. = ?

$$\text{M.P} = \frac{100 + \text{Gain}\%}{100 - \text{Discount}\%} \times \text{C.P}$$

$$= \frac{(100 + 20)}{(100 - 10)} \times 450$$

$$= \frac{120}{90} \times 450$$

$$= \text{Rs. } 600$$

5 A dealer allows a discount of 10% and still gains 10%. What is the cost price of the book which is marked at Rs. 220?

Solution

Method - I

M.P = Rs.220

Discount = 10% of M.P

$$= \frac{10}{100} \times 220$$

$$= \text{Rs. } 22$$

S.P = M.P - Discount

= 220 - 22

= Rs. 198

Let, C.P. be Rs. 100

Gain = 10% of C.P.

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

$$= \text{Rs. } 10$$

S.P. = C.P + Gain

= 100 + 10

= Rs. 110

If S.P. is Rs. 110, then C.P is Rs. 100

When S.P. is Rs. 198,

$$= \frac{198 \times 100}{110}$$

$$= \text{Rs. } 180$$

Method - II

Discount = 10%

Gain = 10%

M.P. = Rs. 220

$$\text{C.P.} = \frac{100 - \text{Discount}\%}{100 + \text{Gain}\%} \times \text{M.P}$$

$$= \frac{100 - 10}{100 + 10} \times 220$$

$$= \frac{90}{110} \times 220$$

$$= \text{Rs. } 180$$

6 A trader buys an article for Rs. 1200 and marks it 30% above the C.P. He then sells it after allowing a discount of 20%. Find the S.P. and profit percent.

Solution

Let C.P. of the article be Rs. 100

M.P. =30% above C.P. = Rs. 130

If C.P is Rs. 100, then M.P. is Rs. 130

When C.P. is Rs. 1200,

$$\text{M.P.} = \frac{1200 \times 130}{100} = \text{Rs. } 1560$$

$$\text{Discount} = 20\% \text{ of } 1560 = \frac{20}{100} \times 1560$$

$$\text{Discount} = 20\% \text{ of } 1560 = \frac{20}{100} \times 1560$$

$$= \text{Rs. } 312$$

S.P = M.P. - Discount

= 1560 - 312

= Rs. 1248

Profit = S.P - C.P

= 1248 - 1200

= Rs. 48

$$\text{Profit}\% = \frac{\text{Profit}}{\text{C.P.}} \times 100$$

$$= \frac{48}{1200} \times 100$$

$$= 4\%$$

Summary

Percent means per hundred. A fraction with its denominator 100 is called a percent.

In case of profit, we have Profit = S.P - C.P.

$$\text{Profit \%} = \frac{\text{Profit}}{\text{C.P.}} \times 100$$

$$\text{S.P} = \left(\frac{100 + \text{Profit\%}}{100}\right) \times \text{C.P.}$$

$$\text{C.P} = \left(\frac{100}{100 + \text{Profit\%}}\right) \times \text{S.P.}$$

In case of loss, we have Loss = C.P - S.P.

$$\text{Loss \%} = \frac{\text{Loss}}{\text{C.P.}} \times 100$$

$$\text{S.P} = \left(\frac{100 - \text{Loss\%}}{100}\right) \times \text{C.P.}$$

$$\text{C.P} = \left(\frac{100}{100 - \text{Loss\%}}\right) \times \text{S.P.}$$

$$\text{M.P.} = \frac{100}{100 - \text{Discount \%}} \times \text{S.P}$$

$$\text{S.P.} = \frac{100 - \text{Discount \%}}{100} \times \text{M.P}$$

$$\text{C.P.} = \frac{100 - \text{Discount \%}}{100 + \text{Profit \%}} \times \text{M.P}$$

$$\text{M.P.} = \frac{100 + \text{Profit \%}}{100 - \text{Discount \%}} \times \text{C.P}$$

$$\text{Discount percent} = \frac{\text{Discount}}{\text{M.P.}} \times 100$$

Discount is the reduction given on the Marked price.

Selling price is the price payable after reducing the discount from the marked price.

Discount = M.P. - S.P.

Assignment

1 Find the cost price if the product is sold at Rs. 572 with a profit of Rs. 72.

2 Find the C.P if the product is sold at Rs.1973 with a profit of Rs. 273

3 Find the selling price if the cost price is Rs. 7282 with a profit of Rs. 208

4 Find out the S.P. if the C.P. is Rs. 9684 with a loss of Rs. 684

5 Find out the profit percentage if the C.P is Rs. 320 and S.P is Rs. 384.

6 Find out the profit amount if the C.P. and S.P. are Rs. 2500 and Rs. 2700 respectively.

7 Calculate the percentage of loss if the C.P. and S.P are Rs. 40 and Rs. 38 respectively.

8 A computer table bought at Rs. 1150 with Rs. 50 as a transport charge. Calculate the S.P. if the profit is of 5%

9 By selling a table for Rs. 1320 with a gain of 10%. Find the C.P.

10 The C.P. of 16 bolts is equal to the S.P. of 12 bolts. Find the gain percent.

Profit and loss - Simple and compound interest

Interest

When we borrow (or lent) money we pay (or receive) some additional amount in addition to the original amount. This additional amount that we receive is termed as Interest. It is denoted as 'I'. Money can be borrowed/lent deposited in banks to get Interest. The amount borrowed//lent is called the principal. (P)

The principal added to the Interest is called the Amount(A).

Amount = Principal + Interest

$$A = P + I$$

Interest depends on principal and duration of time. But it also depends on one more factor called the rate of interest. Rate of interest is the amount calculated annually for ₹100. (ie) if rate of interest is 10% per annum, then interest is ₹10 for ₹100 for 1 year.

So,

Interest depends on

Amount deposited or borrowed/lent - Principal - P

Period of time - mostly expressed in years - n

Rate of interest - r

This interest is termed as Simple interest.

When the interest is paid on the principal only, it is called simple interest.

Calculation of interest

If 'r' is the rate of interest, Principal is 100,

The interest for 1 year = $100 \times 1 \times \frac{r}{100}$

for 2 years = $100 \times 2 \times \frac{r}{100}$

for 3 years = $100 \times 3 \times \frac{r}{100}$

for n years = $100 \times n \times \frac{r}{100}$

So,

$$I = \frac{Pnr}{100}$$

$$A = P + I$$

$$A = P + \frac{Pnr}{100}$$

$$A = P\left(1 + \frac{nr}{100}\right)$$

Interest = Amount - Principal

The other formulae derived from

$$I = \frac{Pnr}{100}$$

$$r = \frac{100I}{Pn}$$

$$n = \frac{100I}{Pr}$$

$$P = \frac{100I}{rn}$$

'n' is always calculated in years. When 'n' is given in months or days, convert it into years.

Example :

12 Months = 1 year

6 Months $= \frac{6}{12}$ year $= \frac{1}{2}$ year

3 Months $= \frac{3}{12}$ year $= \frac{1}{4}$ year

146 days $= \frac{146}{365}$ year $= \frac{2}{5}$ year

Example

1 Vimal invested ₹ 3000 for 1 year at 7% per annum. Find the simple interest and the amount received by him at the end of one year.

Solution

Principal (P) = ₹ 3,000

Number of years (n) = 1

Rate of interest (r) = 7%

Interest(I) $= \frac{Pnr}{100}$

$= \frac{3000 \times 1 \times 7}{100}$

$I = 210$

Amount(A) = P + I

= 3000 + 210

Amount received by him (A) = ₹ 3,210

2 Ramani invested ₹ 5000 for 2 years at 11% per annum. Find the simple interest and the amount received by him at the end of 2 years.

Solution

Principal (P) = ₹ 5,000

Number of years (n) = 2 yrs

Rate of interest (r) = 11%

Interest(I) $= \frac{Pnr}{100}$

$$= \frac{5000 \times 2 \times 11}{100}$$

$$= 1100$$

$$I = ₹\ 1100$$

$$\text{Amount(A)} = P + I$$

$$= 5000 + 1100$$

Amount received by him (A) = ₹ 6,100

3 Find the simple interest and the amount due on ₹ 7,500 at 8% per annum for 1 year 6 months.

Solution

$$\text{Principal (P)} = ₹\ 7{,}500$$

$$\text{Number of years (n)} = 1 \text{ yr. } 6 \text{ months}$$

$$= 1\frac{6}{12} \text{ yrs}$$

$$= 1\frac{1}{2} \text{ yrs} = \frac{3}{2} \text{ yrs.}$$

$$r = 8\%$$

$$\text{Interest(I)} = \frac{Pnr}{100}$$

$$= \frac{7500 \times \frac{3}{2} \times 8}{100}$$

$$= \frac{7500 \times 3 \times 8}{2 \times 100}$$

$$= 900$$

$$I = ₹\ 900$$

$$\text{Amount} = P + I$$

$$= 7500 + 900$$

Amount due on = ₹ 8,400

Interest = ₹ 900, Amount = ₹ 8,400

Alternative method

$$\text{Principal (P)} = ₹\ 7{,}500$$

$$\text{Number of years (n)} = \frac{3}{2} \text{ yrs}$$

$$\text{Rate of interest (r)} = 8\%$$

$$A = P\left(1 + \frac{nr}{100}\right)$$

$$= 7500\left(1 + \frac{\frac{3}{2} \times 8}{100}\right)$$

$$= 7500\left(1 + \frac{3 \times 8}{2 \times 100}\right)$$

$$= 7500\left(\frac{28}{25}\right)$$

$$= 300 \times 28$$

$$= 8400$$

$$A = ₹\ 8400$$

$$\text{Interest (I)} = A - P$$

$$= 8400 - 7500$$

Interest(I) = ₹ 900, Amount = ₹ 8,400

4 Find the simple interest and the amount due on ₹ 6,750 for 219 days at 10% per annum.

Solution

$$\text{Principal (P)} = ₹\ 6{,}750$$

$$\text{Number of years (n)} = 219 \text{ days}$$

$$= \frac{219}{365} \text{ year} = \frac{3}{5} \text{ year}$$

$$r = 10\%$$

$$I = \frac{Pnr}{100}$$

$$= \frac{6750 \times 3 \times 10}{5 \times 100}$$

$$= 405$$

$$I = ₹\ 405$$

$$\text{Amount} = P + I$$

$$= 6750 + 405$$

$$\text{Amount due on} = ₹\ 7{,}155$$

Interest(I) = ₹ 405, Amount = ₹ 7,155

5 Ravi borrowed ₹ 4000 on 7th june 2006 and returned it on 19th August 2006. Find the amount he paid, if the interest is calculated at 5% per annum.

Solution

$$\text{Principal (P)} = ₹\ 4{,}000$$

$$r = 5\%$$

$$\text{Number of days, June} = 24(30 - 6)$$

$$\text{July} = 31$$

$$\text{August} = 18$$

$$\text{Total number of days} = 73$$

$$n = 73 \text{ days}$$

$$= \frac{73}{365} \text{ year}$$

$= \frac{1}{5}$ year

Amount $= P\left(1+\frac{nr}{100}\right)$

$= 4000\left(1+\frac{1 \times 5}{5 \times 100}\right)$

$= 4000\left(1+\frac{1}{100}\right)$

$= 4000\left(\frac{101}{100}\right)$

$= 4,040$

Amount = ₹ 4,040

6 Find the rate percent per annum when a principal of ₹ 7,000 earns a S.I. of ₹ 1,680 in 16 months.

Solution

Principal (P) = ₹ 7,000

n = 16 months

$= \frac{16}{12}$ yr $= \frac{4}{3}$ yr

I = ₹ 1,680

r = ?

$r = \frac{100I}{Pn}$

$= \frac{100 \times 1680}{7000 \times \frac{4}{3}}$

$= \frac{100 \times 1680 \times 3}{7000 \times 4}$

$= 18$

Rate of interest (r) = 18%

7 Vijayan invested ₹10,000 at the rate of 5% simple interest per annum. He received ₹ 11,000 after some years. Find the number of years.

Solution

A = ₹ 11,000

P = ₹ 10,000

r = 5%

I = A - P

= 11,000 - 10,000

= 1,000

I = ₹ 1,000

$n = \frac{100I}{Pr}$

$= \frac{100 \times 1000}{10000 \times 5}$

Number of years = 2 years.

Alternative method

$A = P\left(1+\frac{nr}{100}\right)$

$11000 = 10000\left(1+\frac{n \times 5}{100}\right)$

$\frac{11}{10} = \frac{20+n}{20}$

$\frac{11}{10} \times 20 = 20 + n$

$22 = 20 + n$

$22 - 20 = n$

Number of years = 2

8 A sum of money triples itself at 8% per annum over a certain time. Find the number of years.

Solution

Let principal = ₹ P

Amount = triple the principal

= ₹ 3P

Let, P = 100

3P = 3 x 100

r = 8%

n = ?

I = A - P

= 300 - 100

I = ₹ 200

$n = \frac{100I}{Pr} = \frac{100 \times 200}{100 \times 8}$

$n = \frac{200}{8} = 25$

Number of years = 25

9 A certain sum of amounts to ₹ 10,080 in 5 years at 8%. Find the principal.

Solution

A = ₹ 10,080

n = 5 years

r = 8%

P = ?

Amount (A) $= P\left(1+\frac{nr}{100}\right)$

₹ 10080 $= P\left(1+\frac{5 \times 8}{100}\right)$

₹ 10080 $= P\left(1+\frac{5 \times 8}{100}\right)$

₹ 10080 $= P\left(\frac{7}{5}\right)$

₹ 10080 x $\frac{5}{7}$ $= P$

7,200 $= P$

Principal = ₹ 7,200

10 A certain sum of amounts to ₹ 7,920 in 4 years and ₹ 8,880 in 6 years respectively. Find the principal and rate percent.

Solution

Amount at the end of 6 years = Principal + interest for 6 years

$= P + I_6 = 8880$

Amount at the end of 4 years = Principal + interest for 4 years

$= P + I_4 = 7920$

$I_2 = 8880 - 7920$

$= 960$

Interest at the end of 2 years = ₹ 960

Interest at the end of 1st years $= \frac{960}{2}$

$= 480$

Interest at the end of 4 years $= 480 \times 4$

$= 1,920$

$P + I_4 = 7920$

$P + 1920 = 7920$

$P = 7920 - 1920$

$P = 6,000$

Principal = ₹ 6,000

$r = \frac{100I}{Pn}$

$= \frac{100 \times 1920}{6000 \times 4}$

Rate of interest (r) = 8%

Compound Interest

Rajesh borrowed ₹ 50,000 from a bank for a fixed time period of 2 years. at the rate of 4% per annum.

Rajesh has to pay for the first year.

Simple interest = $\frac{P \times n \times r}{100}$

$= \frac{50000 \times 1 \times 4}{100} =$ ₹ 2,000

Suppose he fails to pay the simple interest ₹ 2,000 at the end of first year, then the interest ₹ 2,000 is added to the old principal ₹ 50,000 and now the sum = P + I = ₹ 52,000 becomes the new principal for the second year for which the interest is calculated.

Now in the second year he will have to pay an interest of

Simple interest = $\frac{P \times n \times r}{100}$

$= \frac{52000 \times 1 \times 4}{100} =$ ₹ 2,080

Therefore Rajesh will have to pay more interest for the second year.

This way of calculating interest is called compound Interest.

If the interest is paid on the principal as well as on the accrued interest, it is called compound interest.

Generally in banks, insurance companies, post offices and in other companies which lend money and accept deposits, compound interest is followed to find the interest.

Example

Ram deposited ₹ 8,000 with a finance company for 3 years at an interest of 15% per annum. What is the compound interest that Ram gets after 3 years?

Solution

Step 1 :

Principal for the first year = ₹ 8,000

Interest for the first year $= \frac{P \times n \times r}{100}$

$= \frac{80000 \times 1 \times 15}{100}$

= ₹ 1,200

Amount at the end of first year = P + I

= 8,000 + 1,200

= ₹ 9,200

Step 2 :

Principal for the 2nd year = ₹ 9,200

Interest for the 2nd year $= \frac{P \times n \times r}{100}$

$= \frac{9200 \times 1 \times 15}{100}$

= ₹ 1,380

Amount at the end of 2nd year = P + I

= 9,200 + 1,380

= ₹ 10,580

Step 3 :

Principal for the 3rd year = ₹ 10,580

Interest for the 3rd year $= \frac{P \times n \times r}{100}$

$= \frac{10580 \times 1 \times 15}{100}$

= ₹ 1,587

Amount at the end of 3rd year = P + I

= 10,580 + 1,587

= ₹ 12,167

Hence, the compound interest that Ram gets after 3 years is

A - P = 12,167 - 8,000 = ₹ 4,167

Deduction of formula for compound interest

The above method which we have used for the calculation of compound interest is quite lengthy and cumbersome, especially when the period of time very large. Hence we shall obtain a formula for the computation of amount and compound interest.

Example

If the principal is P, Rate of interest per annum is r% and the period of time or the number of years is n, then we deduce the compound interest formula as follows:

Step 1:

Principal for the first year = P

Interest for the first year $= \frac{P \times n \times r}{100}$

$= \frac{P \times 1 \times r}{100} = \frac{Pr}{100}$

Amount at the end of first year = P + I

$= P + \frac{Pr}{100}$

$= P\left(1+\frac{r}{100}\right)$

Step 2 :

Principal for the 2nd year $= P\left(1+\frac{r}{100}\right)$

Interest for the 2nd year $= P\left(1+\frac{r}{100}\right) \times \frac{1 \times r}{100}$

(using the Simple Interest formula)

$= P\left(1+\frac{r}{100}\right) \times \frac{r}{100}$

Amount at the end of 2nd year = P + I

$= P\left(1+\frac{r}{100}\right) + P\left(1+\frac{r}{100}\right) \times \frac{r}{100}$

$= P\left(1+\frac{r}{100}\right)\left(1+\frac{r}{100}\right)$

$= P\left(1+\frac{r}{100}\right)^2$

Step 3 :

Principal for the 3rd year $= P\left(1+\frac{r}{100}\right)^2$

Interest for the 3rd year $= P\left(1+\frac{r}{100}\right)^2 \times \frac{1 \times r}{100}$

(using the Simple interest formula)

$= P\left(1+\frac{r}{100}\right)^2 \times \frac{r}{100}$

Amount at the end of 3rd year = P + I

$= P\left(1+\frac{r}{100}\right)^2 + P\left(1+\frac{r}{100}\right)^2 \times \frac{r}{100}$

$= P\left(1+\frac{r}{100}\right)^2\left(1+\frac{r}{100}\right)$

$= P\left(1+\frac{r}{100}\right)^3$

Similarly, Amount at the end of n^{th} year is $A = P\left(1+\frac{r}{100}\right)^n$ and C.I. at the end of 'n' years is given by

Compound Interest (C.I) = A – P

(ie.) Compound Interest (C.I) $= P\left(1+\frac{r}{100}\right)^n - P$

To compute compound interest

Case 1 : Compounded Annually

When the interest is added to the principal at the end of each year, we say that the interest is compounded annually.

Here,

$$A = P\left(1+\frac{r}{100}\right)^{n} \text{ and C.I } = A - P$$

Case 2 : Compounded half-yearly (semi-annually)

When the interest is compounded half-yearly, there are two conversion periods in a year each after 6 months. In such situations, the half-yearly rate will be half of the annual rate, that is ().

In this case,

$$A = P\left(1+\frac{1}{2}\left(\frac{r}{100}\right)\right)^{2n} \text{ and C.I } = A - P$$

Case 3 : Compounded quarterly

When the interest is compounded quarterly, there are four conversion periods in a year and the quarterly rate will be one-fourth of the annual rate, that is ().

In this case,

$$A = P\left(1+\frac{1}{4}\left(\frac{r}{100}\right)\right)^{4n} \text{ and C.I } = A - P$$

Case 4 : Compounded when time being fraction of a year

When interest is compounded annually but time being a fraction.

In this case, when interest is compounded annually but time being a fraction of a year, say $5\frac{1}{4}$ years, then amount A is given by

$$A = P\left(1+\frac{r}{100}\right)^{5}\left[1+\frac{1}{4}\left(\frac{r}{100}\right)\right] \text{ and C.I } = A - P$$

for 5 years for $\frac{1}{4}$ years

Example

Find the C.I. on ₹ 15,625 at 8% p.a. for 3 years compounded annually.

Solution

We know,

$$\text{Amount after 3 years} = P\left(1+\frac{r}{100}\right)^{3}$$

$$= 15625\left(1+\frac{8}{100}\right)^{3}$$

$$= 15625\left(1+\frac{2}{25}\right)^{3}$$

$$= 15625\left(\frac{27}{25}\right)$$

$$= 15625 \times \frac{27}{25} \times \frac{27}{25} \times \frac{27}{25}$$

$$= ₹\ 19{,}683$$

Now, compound interest = A - P

$$= 19{,}683 - 15{,}625$$

$$= ₹\ 4{,}058$$

To find the C.I. when the interest is compounded annually or half-yearly.

Let us see what happens to ₹100 over a period of one year if an interest is compounded annually or half-yearly.

S. No.	Annually	Half yearly
1	P = ₹ 100 at 10% per annum compounded annually.	P = ₹ 100 at 10% per annum compounded half-yearly.
2	The time period taken is 1 year.	The time period is 6 months or 1/2 year.
3	$I = \frac{100 \times 10 \times 1}{100} = ₹\ 10$	$I = \frac{100 \times 10 \times 1/2}{100} = ₹\ 5$
4	A = 100 + 10 = ₹ 110	A = 100 + 5 = ₹ 105 For the next 6 months, P = ₹ 105 So, $I = \frac{105 \times 10 \times 1/2}{100} = ₹\ 5.25$ and A = 105 + 5.25 = ₹ 110.25
5	A = ₹ 110	A = ₹ 110.25

Thus, if interest is compounded half-yearly, we compute the interest two times and rate is taken as half of the annual rate.

Example

1 Find the compound interest on ₹ 1000 at the rate of 10% per annum for 18 months when interest is compounded half-yearly.

Solution

Here, P = ₹ 1000, r = 10% per annum.

and n = 18 months = $\frac{18}{12}$ years = $\frac{3}{2}$ years = 1½ years

$$\therefore \text{Amount after 18 months} = P\left[1+\frac{1}{2}\left(\frac{r}{100}\right)\right]^{2n}$$

$$= 1000\left[1+\frac{1}{2}\left(\frac{10}{100}\right)\right]^{2x\frac{3}{2}}$$

$$= 1000\left[1+\frac{10}{200}\right]^{3}$$

$$= 1000\left(\frac{21}{20}\right)^{3}$$

$$= 1000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$$

$$= ₹\ 1157.625$$

$$= ₹\ 1157.63$$

$$C.I = A - P$$

$$= 1157.63 - 1000$$

Compound Interest = ₹ 157.63

2 Find the compound interest on ₹ 20,000 at 15% per annum for $2\frac{1}{3}$ years.

Solution

Here, P = ₹ 20,000, r = 15% per annum. and n = $2\frac{1}{3}$ years.

Amount after $2\frac{1}{3}$ years $A = P\left(1+\frac{r}{100}\right)^{2}\left(1+\frac{1}{3}\left(\frac{r}{100}\right)\right)$

$$= 20000\left(1+\frac{15}{100}\right)^{2}\left(1+\frac{1}{3}\left(\frac{15}{100}\right)\right)$$

$$= 20000\left(1+\frac{3}{20}\right)^{2}\left(1+\frac{1}{20}\right)$$

$$= 20000\left(\frac{23}{20}\right)^{2}\left(\frac{21}{20}\right)$$

$$= 20000 \times \frac{23}{20} \times \frac{23}{20} \times \frac{21}{20}$$

$$= ₹\ 27,772.50$$

$$C.I = A - P$$

$$= 27,772.50 - 20,000$$

Compound Interest = ₹ 7,772.50

Inverse problems on compound interest

We have already learnt the formula, $A = P\left(1+\frac{r}{100}\right)^{n}$

Where four variable A, P, r and n are involved. Out of these four variables, if any three variables are known, then we can calculate the fourth variable.

Example

1 At what rate per annum will ₹ 640 amount to ₹ 774.40 in 2 years, interest being compounded annually?

Solution

Given : P = ₹ 640, A = ₹ 774.40, n = 2 years , r = ?

We know,

$$A = P\left(1+\frac{r}{100}\right)^{n}$$

$$774.40 = 640\left(1+\frac{r}{100}\right)^{2}$$

$$\frac{774.40}{640} = \left(1+\frac{r}{100}\right)^{2}$$

$$\frac{77440}{64000} = \left(1+\frac{r}{100}\right)^{2}$$

$$\frac{121}{100} = \left(1+\frac{r}{100}\right)^{2}$$

$$\left(\frac{11}{10}\right)^{2} = \left(1+\frac{r}{100}\right)^{2}$$

(∴ Remove square root on both side)

$$\frac{11}{10} = \frac{100+r}{100}$$

$$\frac{11}{10} \times 100 = 100 + r$$

$$110 = 100 + r$$

$$r = 110 - 100$$

$$r = 10\%$$

Rate r = 10% per annum

2 In how much time will a sum of ₹ 1600 amount to ₹ 1852.20 at 5% per annum compound interest.

Solution

Given : P = ₹1600, A = ₹ 1852.20, r = 5% per annum, n = ?

We know,

$$A = P\left(1+\frac{r}{100}\right)^n$$

$$1852.20 = 1600\left(1+\frac{5}{100}\right)^n$$

$$\frac{1852.20}{1600} = \left(\frac{105}{100}\right)^n$$

$$\frac{185220}{160000} = \left(\frac{21}{20}\right)^n$$

$$\frac{9261}{8000} = \left(\frac{21}{20}\right)^n$$

$$\left(\frac{21}{20}\right)^3 = \left(\frac{21}{20}\right)^n$$

∴ n = 3 years

3 Find the principal that will yield a compound interest of ₹ 1632 in 2 years at 4% rate of interest per annum.

Solution

Given : C.I = ₹ 1632, n = 2 years, r = 4% p.a

P = ?

We know,

Amount - Principal = Compound interest

A - P = C.I

- P = C.I - A

+ P = A - C.I

$$P = P\left(1+\frac{r}{100}\right)^n - C.I$$

$$= P\left(1+\frac{4}{100}\right)^2 - 1632$$

$$= P \times \frac{104}{100} \times \frac{104}{100} - 1632$$

$$P = 1.0816P - 1632$$

$$1P - 1.0816P = -1632$$

$$-0.0816P = -1632$$

$$0.0816P = 1632$$

$$P = \frac{1632}{0.0816}$$

$$= 20,000$$

Principal = ₹ 20,000

Difference between simple interest and compound interest

When P is the Principal, n = 2 years and r is the rate of interest.

Difference between C.I and S.I for 2 years = $P\left(\frac{r}{100}\right)^2$

Example

Find the difference between simple interest and compund interest for a sum of ₹ 8,000 lent at 10% p.a. in 2 years.

Solution

Here, P = ₹ 8000, n = 2 years, r = 10% p.a.

Difference between compound interest and simple interest for 2 years

$$= P\left(\frac{r}{100}\right)^2$$

$$= 8000\left(\frac{10}{100}\right)^2$$

$$= 8000\left(\frac{1}{10}\right)^2$$

$$= 8000 \times \frac{1}{10} \times \frac{1}{10}$$

= ₹ 80

Assignment A

1 If principal = Rs. 5000, Interest = Rs. 500. Find the amount.

2 If principal = Rs. 12500, Amount= Rs. 17500. Find the Interest.

3 If the amount is Rs. 25000, its interest is 6000, calcaulate its principal.

4 If principal = Rs. 8450, Interest is 750. Calculate the amount.

5 If principal = Rs. 12000, Amount= Rs. 15600. Find the Interest.

Assignment B

Convert the following

1 6 Months = _____ year.

2 10 Months = _____ year.

3 259 days into week.

4 22 weeks into days.

5 170 days into year.

6 292 days into year.

7 The month of July and August = ____ days

8 2 year 6 months = ____ years

9 15 years = ____ months

10 144 Months = _____ years.

Assignment C

1 Ramani invested Rs. 1000 for 2 years at 10% per annum. Find the simple interest.

2 Find the S.I. and the amount on ₹ 5,000 at 10% per annum for 5 years.

3 Find the S.I. and the amount on ₹ 1,200 at 12½% per annum for 3 years.

4 Kamesh invested ₹ 10,000 in a bank that pays an interest of 10% per annum. He withdraws the amount after 2 years and 3 months. Find the interest, he receives.

5 Find the amount when ₹ 2,500 is invested for 146 days at 13% per annum.

6 Find the S.I. and the amount on ₹ 12,000 from May 21" 1999 to August 2nd 1999 at 9% per annum.

7 Shanthi deposited ₹ 6,000 in a bank and received 7500 at the end of 5 years. Find the rate of interest.

8 Find the principal that earns ₹ 250 as S.I. in 2½ years at 10% per annum.

9 In how many years will a sum of ₹ 5,000 amount to ₹ 5,800 at the rate of 8% per annum.

10 A sum of money doubles itself in 10 years. Find the rate of interest.

11 A sum of money doubles itself in 12½ per annum over a certain period of time. Find the number of years.

12 A certain sum of money amounts to ₹ 6,372 in 3 years at 6%. Find the principal.

13 A certain sum of money amounts to ₹ 6,500 in 3 years and ₹ 5,750 in 1½ years respectively. Find the principal and the rate percent.

14 Find the S.I. and the amount on ₹ 3,600 at 15% per annum for 3 years and 9 months.

15 Find the principal that earns ₹ 2,080 as S.I. in 3¼ years at 16% p.a.

Assignment D

1 Find the amount and compound interest in the following cases:

Sl. No.	Principal in Rs.	Rate % per annum	Time in years
a	1000	5%	3
b	4000	10%	2
c	18000	10%	2½

2 Sankari borrowed Rs. 8,000 from Alex for 2 years at 12½% per annum. What interest did sankari pay to Alex if the interest is compounded annually.

3 Find the compound interest on Rs. 24000 compounded semi annually (half yearly) for 1½ years at the rate of 10% per annum.

4 Find the amount that Divakar would receive if he invests Rs. 8192 for 18 months at 12½% per annum, the interest being compounded half-yearly.

5 Anbu took a loan of Rs.80,000 from a bank for 1½ years at 10% per annum. What interest did Anbu pay to bank if the interest is compounded annually.

6 Find the amount that Manimegalai would receive if she invests Rs. 80,000 for 18 months at 10% per annum, the interest being compounded half-yearly.

7 Find the compound interest on Rs. 15625 for 9 months at 16% per annum compounded quarterly.

8 Raju took a loan of Rs. 80,000 from a bank. If the rate of interest is 10% p.a. Find the difference in amounts he would be paying after 1½ years if the interest compounded annually is Rs. 92400, compounded half yearly is Rs. 92610.

9 Guna borrowed Rs. 26400 from a bank to buy a scooter at the rate of 15% p.a. compounded yearly. What amount will he pay at the end of 2 years to clear the loan.

10 Find the difference between simple interest and compound interest on ₹ 2400 at 2 years at 5% per annum compounded annually.

11 Find the difference between simple interest and compound interest on ₹ 6400 for 2 years at 6¼% p.a. compounded annually.

Assignment E

I MCQ (Multiple Choise Questions)

1 Reduction from original selling price is called ____

A loss B list price

C profit D marked price

2 A man buys an article for Rs. 27.50 and sells it for Rs. 28.60. Find his gain percent

A 1% B 2%

C 3% D 4%

3 A TV is purchased at Rs.5000 and sold at Rs. 4000, find the lost percent.

A 10% B 20%

C 25% D 28%

4 A person incurs a loss of 5% be selling a watch for Rs. 1140. At what price should the watch be sold to earn 5% profit.

A Rs. 1200 B Rs. 1230

C Rs. 1260 D Rs. 1290

5 A book was sold for Rs. 27.50 with a profit of 10%. If it were sold for Rs.25.75, What would have been percentage of profit and loss?

A 2% profit B 3% profit

C 2% loss D 3% loss

6 Alfred buys an old scooter for Rs. 4700 and spends Rs. 800 on its repairs. If he sells the scooter for Rs. 5800 his gain percent is _____

A 6.19% B 6.17%

C 5.4545% D 3.5111%

7 If the cost price is 25% of selling price. Then what is the profit percent?

A 150% B 200%

C 300% D 350%

8 The cost price of 20 articles is the same as the selling price of x articles. If the profit is 25%, find out the value of x.

A 13 B 14

C 15 D 16

9 A man buys an item at Rs. 1200 and sells it all the loss of 20 percent. Then what is the selling price of that item.

A 660 B 760

C 860 D 960

10 A plot is sold for Rs. 18,700 with a loss of 15%. At what price it should be sold to get profit of 15%.

A Rs. 25300 B Rs. 22300

C Rs. 24300 D Rs. 21300

11 A man gains 20% by selling an article for a certain price. If he sells it at double the price, the percentage of profit will be

A 130% B 140%

C 150% D 160%

12 If the cost price of 12 pens is equal to the selling price of 8 pens, the gain percent is?

A 12% B 30%

C 50% D 60%

13 Ryan buys a clock for Rs. 75 and sells it for Rs. 100. His gain percent is _____

A 25% B $33\frac{1}{3}\%$

C 20% D $37\frac{1}{2}\%$

14 A bat is bought for Rs. 120 and sold for Rs. 105, the loss percent is _____

A $15\frac{1}{3}\%$ B $14\frac{1}{5}\%$

C 15% D $16\frac{2}{3}\%$

15 A man bought apples at the rate of 8 for Rs.34 and sold them at the rate of 12 for Rs. 57. How many apples should be sold to earn a net profit of Rs. 45?

A 90 B 100

C 135 D 150

16 A tradesman sold an article at a loss of 20%. Had he sold it for Rs. 100 more , he should have gained 5%. The cost price of the article was _____

A Rs. 360 B Rs. 400

C Rs. 425 D Rs. 450

17 At what percentage above the cost price must an article be marked so as to gain 33% after allowing a customer a discount of 5%?

A 35% B 38%

C 40% D 42%

18 A shopkeeper earns a profit of 12% on selling a book at 10% discount on the printed price. The ratio of the cost price and the printed price of the book is

A 45:56 B 45:51

C 47:56 D 47:51

19 By selling a bicycle for Rs. 2,850 a shopkeeper gains 14%. If the profit is reduced to 8%, then the selling price will be

A Rs. 2600 B Rs. 2700

C Rs. 2800 D Rs. 3000

20 A person sold a horse at a gain of 15%. Head he bought it for 25% less and sold it for Rs. 600 less, he would have made a profit of 32%. The cost price of the horse was:

A Rs. 3750 B Rs. 3250

C Rs. 2750 D Rs. 2250

21 If a man were to sell his chair for Rs. 720, he would lose 25%. To gain 25% he should sell it for:

A Rs. 1200 B Rs. 1000

C Rs. 960 D Rs. 900

22 If harsh sold a match ticket for Rs. 340 at a profit of 25%, at what price did he purchase the ticket?

A 280 B 255

C 300 D 272

23 Eleven bags are bought for Rs. 1000 and sold at 10 for Rs. 1100. What is the gain or loss in percentage?

A 10% B 21%

C 25% D 20%

24 A man buys an article for Rs. 27.50 and sells it for rs. 28.60. Find its gain percent?

A 1% B 2%

C 3% D 4%

II MCQ

1 Find the simple interest on Rs. 5200 for 2 years at 6% per annum.

A Rs. 450 B Rs. 524

C Rs. 600 D Rs. 624

2 Rs. 1200 is lent out at 5% per annum simple interest for 3 years. Find the amount after 3 years

A Rs. 1380 B Rs. 1290

C Rs. 1470 D Rs. 1200

3 Interest obtained on a sum of Rs. 5000 for 3 years is Rs. 1500. Find the rate percent.

A Rs. 8% B Rs. 9%

C Rs. 10% D Rs. 11%

4 Rs. 2100 is lent at compound interest of 5% per annum for 2 years. Find the amount after two years.

A Rs. 2300 B Rs. 2315.25

C Rs. 2310 D Rs. 2320

5 Find the difference between the simple interest and the compound interest at 5% per annum for 2 years on principal of Rs. 2000?

A Rs. 5 B Rs. 10.5

C Rs. 4.5 D Rs. 5.5

6 A bank offers 5% compound interest calculated on half yearly basis. A customer deposits Rs. 1600 each on 1st January and 1st july of a year. At the end of the year, the amount he would have gained by way of interest is:

A Rs. 120 B Rs. 121

C Rs. 122 D Rs. 123

7 There is 60% increase in an amount in 6 years at simple interest. What will be the compound interest of Rs. 12,000 after 3 years at the same rate?

A Rs. 2160 B Rs. 3120

C Rs. 3972 D Rs. 6240

8 What is the difference between the compound interest on Rs. 5000 for $1\frac{1}{2}$ years at 4% per annum compounded yearly and half-yearly?

A Rs. 2.04 B Rs. 3.06

C Rs. 4.80 D Rs. 8.30

9 The compound interest on Rs. 30,000 at 7% per annum is Rs. 4347. Their period (in years) is

A Rs.2 B Rs.$2\frac{1}{2}$

C Rs.3 D Rs.4

10 What will be the compound interest on a sum of Rs. 25000 after 3 years at the rate of 12 p.c.p.a?

A Rs. 9000.30 B Rs. 9720

C Rs. 10123.20 D Rs. 10483.20

11 At what rate of compound interest per annum will a sum of Rs. 1200 become Rs. 1348.32 in 2 years?

A 6% B 6.5%

C 7% D 7.5%

12 Albert invested an amount of Rs. 8000 in a fixed deposit scheme for 2 years at compound interest rate 5 P.C.P.A. How much amount will Albert get on maturity of the fixed deposit?

A Rs. 8600 B Rs. 8620

C Rs. 8820 D Rs. 8940

Estimation and Costing - Simple estimation of the requirement of material etc., as applicable to the trade

Introduction

Estimation is the method of calculating the various quantities and the expenditure to be incurred on a particular job or process.

Estimate is the method used to measure or quantify the different quantities and the expected expenditure to be incurred on a particular work or project.

We know that the estimation is a long procedure, and it is totally depends upon the projects,

In case the funds available are less than the estimated cost the work is done in part or by reducing it or specifications are altered,

The following essential details are required for preparing an estimate.

Drawings like plan, elevation and sections of important parts.

Detailed specifications about workmanship & properties of materials, etc.

Standard schedule of rates of the current year.

Estimating is the process of preparing an approximation of quantities which is a value used as input data and it is derived from the best information available.

An estimate that turns out to be incorrect will be an overestimate if the estimate exceeded the actual result, and an underestimate if the estimate fell short of the actual result.

A cost estimate contains approximate cost of a product process or operation. The cost estimate has a single total value and it is inclusive of identifiable component values.

Purpose of Estimating and Costing

1 Estimates provide a rough idea of the cost of the job and therefore its feasibility can be calculated, i.e. whether or not the project would be included in the funds available.

2 Estimate gives an idea of the time needed to complete the work.

3 Estimates are required to invite tenders and quotations and to arrange the contracts.

4 Estimates are also required to control expenditure during the execution of the work.

5 Estimates decide whether or not proposed plan matches the funds available.

Estimation Methods

Estimate involves the following operations

- Preparing detailed Estimate.
- Calculating the rate of each unit of work.
- Preparing abstract of estimate.

Estimation is the process of calculating or evaluating a quantity by estimation, that is, without reference to specific measurements. Estimating is a fundamental process in all engineering.

This is usually done before purchase or construction begins or during preliminary planning stages. Estimating is usually more accurate, but there are a few limitations - namely that if your estimate relies on labour costs, you'll need to know how many man-hours will take to complete the project.

Estimates are developed from observations and knowledge of past experience. The accuracy of an estimate often depends on the level of detail available and the amount of time for which data are available for analysis.

Costing is the process of estimating the cost of a project before it's completed. It can be done with an itemized list, or through estimation using a construction cost calculator.

Costing includes three steps: estimating, bidding, and finalizing. It helps predict how much money will be required to construct the project.

A "costing" typically refers to how much it will cost someone to produce a single unit.

There are two types of costings

Independent costing - this is the cost of direct material and labour costs. This type of costing only takes into account the cost of a single-phase, so it's not representative of the overall project cost.

Cumulative Costing - this type of costing looks at the total cost for all phases of work, but it can be difficult to ensure that estimates are accurate.

Exercise:

1 Electroplating gold on mild steel article. Estimate the required tools/instruments and materials for the same and also calculate the cost of the items for the work. (Fig 1)

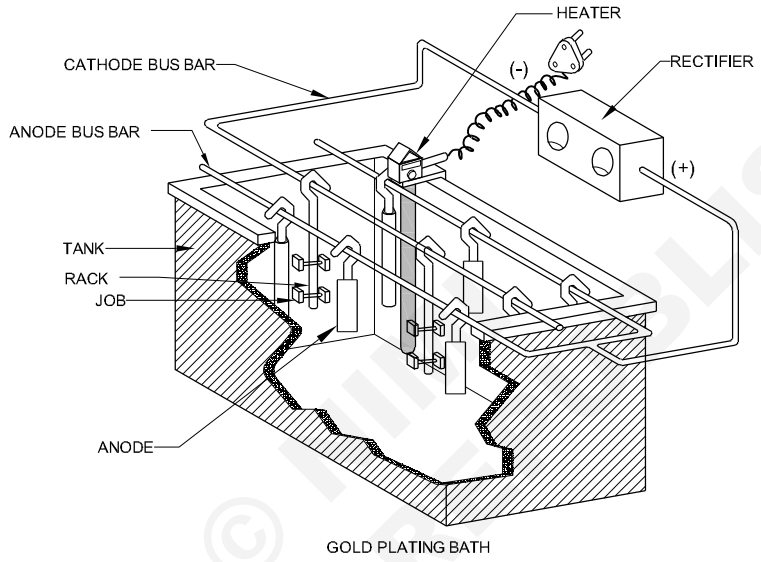
Tools/Instruments - Service persons owns

1 Tool kit - 1 No.
2 Acid dipping bath - 1 No.
3 Cyanide dipping bath - 1 No.
4 Swilling bath - 6 Nos.
5 Hot water bath - 1 No.
6 Drag out bath - 1 No.
7 Gold plating tank - 1 No.
8 Centrifugal dryer - 1 No.

Materials

9 Copper article - 1 No.
10 Plating jig (copper) - 1 No.
11 Sodium cyanide
12 Sulphuric acid

Fig 1



Estimation of Items

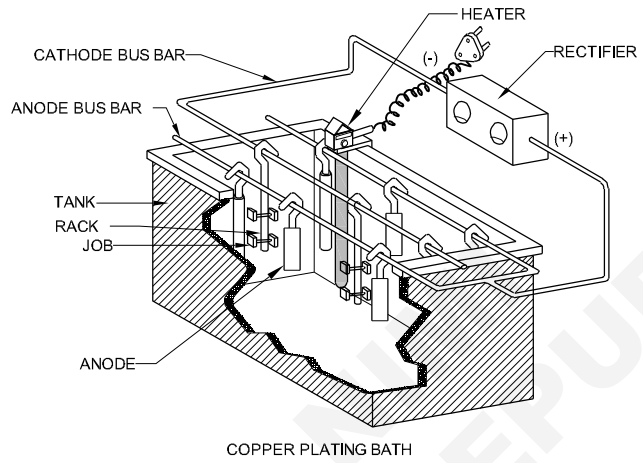
1	Tool kit	=	Rs. 500
2	Rectifier	=	Rs. 8500
3	Centrifugal dryer	=	Rs. 1,000
4	Acid dipping bath	=	Rs. 1,000
5	Cyanide dipping bath	=	Rs. 500
6	Swilling bath	=	Rs. 1500
7	Gold plating tank	=	Rs. 20,000
8	Drag out bath	=	Rs. 1,500
9	Hot water bath	=	Rs. 1,500
10	Copper article	=	Rs. 600
11	Plating jig	=	Rs. 1000
12	Sodium cyanide	=	Rs. 500
13	Sulphuric acid	=	Rs. 400
	Total items cost	**=**	**Rs. 38,500**

2 Estimate the required tools/instruments and materials for electroplating gold on given aluminium article. Also calculate the cost of the items required for the work. (Fig 2)

Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.	10	Zincate bath	- 1 No.
2	Acid dipping bath	- 2 Nos.	11	Vapour degreaser	- 1 No.
3	Cyanide dipping bath	- 1 No.	12	Centrifugal dryer	- 1 No.
4	Swilling bath	- 6 Nos.	**Materials**		
5	Hot water bath	- 1 No.	13	Aluminium article	- 1 No.
6	Drag out bath	- 1 No.	14	Plating jig	- 1 No.
7	Alkaline gold plating alkali bath	- 1 No.	15	Sodium cyanide	
8	Chrome pickling bath	- 1 No.	16	Sulphuric acid	
9	Hydrofluoric nitric pickling bath	- 1 No.	17	Nitric acid	

Fig 2



Estimation of Items

1	Tool kit	=	Rs. 500
2	Hydrofluoric nitric pickling bath	=	Rs. 1280
3	Zincate bath	=	Rs. 1000
4	Vapour degreaser	=	Rs. 2080
5	Centrifugal dryer	=	Rs. 1,000
6	Acid dipping bath	=	Rs. 1,000
7	Cyanide dipping bath	=	Rs. 500
8	Swilling bath	=	Rs. 1,500
9	Hot water bath	=	Rs. 1,500
10	Drag out bath	=	Rs. 1,500
11	Gold plating bath	=	Rs. 20,000
12	Chrome pickling bath	=	Rs. 1,800
13	Aluminium article	=	Rs. 600
14	Plating jig	=	Rs. 1000
15	Sodium cyanide	=	Rs. 500
16	Sulphuric acid	=	Rs. 400
17	Nitric acid	=	Rs. 400
	Total items cost	=	**Rs. 36,560**

3 Estimate the required tools/instruments and materials for electroplater brass on small article (mild steel). Also calculate the cost of the items required for the work. (Fig 3)

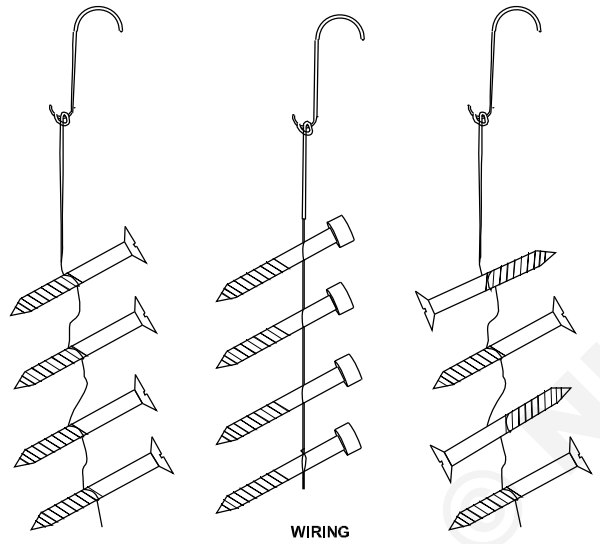
Tools/Instruments - Service persons owns

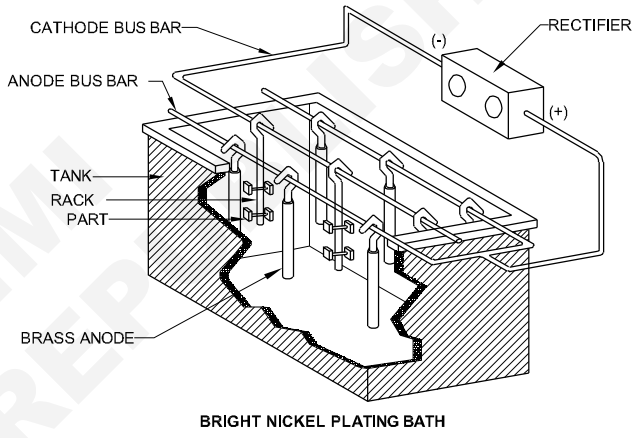
1 Tool kit - 1 No.
2 Acid dipping bath - 1 No.
3 Cyanide dipping bath - 1 No.
4 Swilling bath - 1 No.
5 Hot water bath - 1 No.
6 Drag out bath - 1 No.
7 Brass plating bath setup - 1 No.
8 Vapour degreaser - 1 No.
9 Centrifugal dryer - 1 No.

Materials

10 Small mild steel articles
11 Copper wire
12 Copper cyanide
13 Zinc cyanide
14 Free cyanide
15 Sodium cyanide
16 Ammonium hydroxide

Fig 3





Estimation of Items

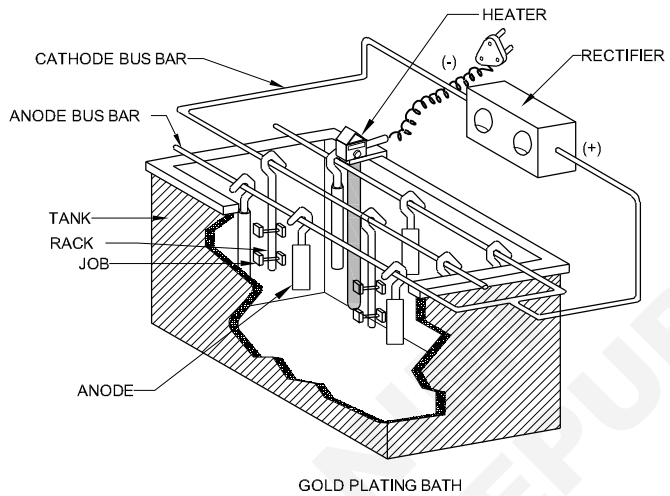
1	Tool kit	=	Rs. 500
2	Vapour degreaser	=	Rs. 2080
3	Centrifugal dryer	=	Rs. 1,000
4	Acid dipping bath	=	Rs. 1,000
5	Cyanide dipping bath	=	Rs. 500
6	Swilling bath	=	Rs. 1500
7	Hot water bath	=	Rs. 1,500
8	Drag out bath	=	Rs. 1,500
6	Brass plating bath setup	=	Rs. 2,600
7	Small mild steel articles	=	Rs. 700
8	Copper wire	=	Rs. 100
9	Copper cyanide	=	Rs. 200
10	Zinc cyanide	=	Rs. 180
11	Free cyanide	=	Rs. 50
12	Sodium cyanide	=	Rs. 40
13	Ammonium hydroxide	=	Rs. 30
	Total items cost	=	**Rs. 13,480**

4 Estimate the required tools/instruments and materials for electroplating gold on copper article, and also calculate the cost of the items required for the work. (Fig 4)

Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.	8	Vapour degreaser	- 1 No.
2	Acid dipping bath	- 1 No.	9	Centrifugal dryer	- 1 No.
3	Cyanide dipping bath	- 1 No.	**Materials**		
4	Swilling bath	- 1 No.	10	Copper article	- 1 No.
5	Hot water bath	- 1 No.	11	Plating jig (copper)	- 1 No.
6	Drag out bath	- 1 No.	12	Sodium cyanide	
7	Gold plating tank with complete setup	- 1 No.	13	Sulphuric acid	

Fig 4



Estimation of Items

1	Tool kit	=	Rs. 500
2	Vapour degreaser	=	Rs. 2080
3	Centrifugal dryer	=	Rs. 1,000
4	Acid dipping bath	=	Rs. 1,000
5	Cyanide dipping bath	=	Rs. 500
6	Swilling bath	=	Rs. 1500
7	Hot water bath	=	Rs. 1,500
8	Drag out bath	=	Rs. 1,500
6	Gold plating tank with complete setup	=	Rs. 15,000
7	Copper article	=	Rs. 1,000
8	Plating jig (copper)	=	Rs. 1,000
12	Sodium cyanide	=	Rs. 500
13	Sulphuric acid	=	Rs. 400
	Total items cost	=	**Rs. 27,480**

5 Estimate the required tools/instruments and materials for electroplating silver on copper and also calculate the cost of the items required for the work. (Fig 5)

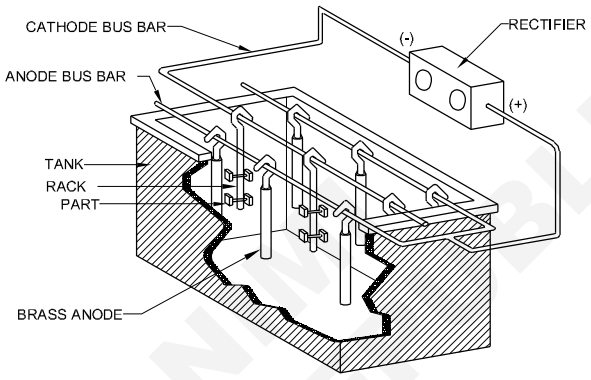
Tools/Instruments- Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 1 No.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 1 No.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Bright nickel plating bath with complete setup	- 1 No.
8	Bright silver plating bath with complete setup	- 1 No.
9	Vapour degreaser	- 1 No.
10	Centrifugal dryer	- 1 No.

Materials

11	Copper article	- 1 No.
12	Plating jig (copper)	- 1 No.
13	Silver anode	
14	Nickels anodes	
15	Silver salt	
16	Nickel salt	
17	Brighteners	
18	Inhabitors	

Fig 5



BRIGHT NICKEL PLATING BATH

Estimation of Items

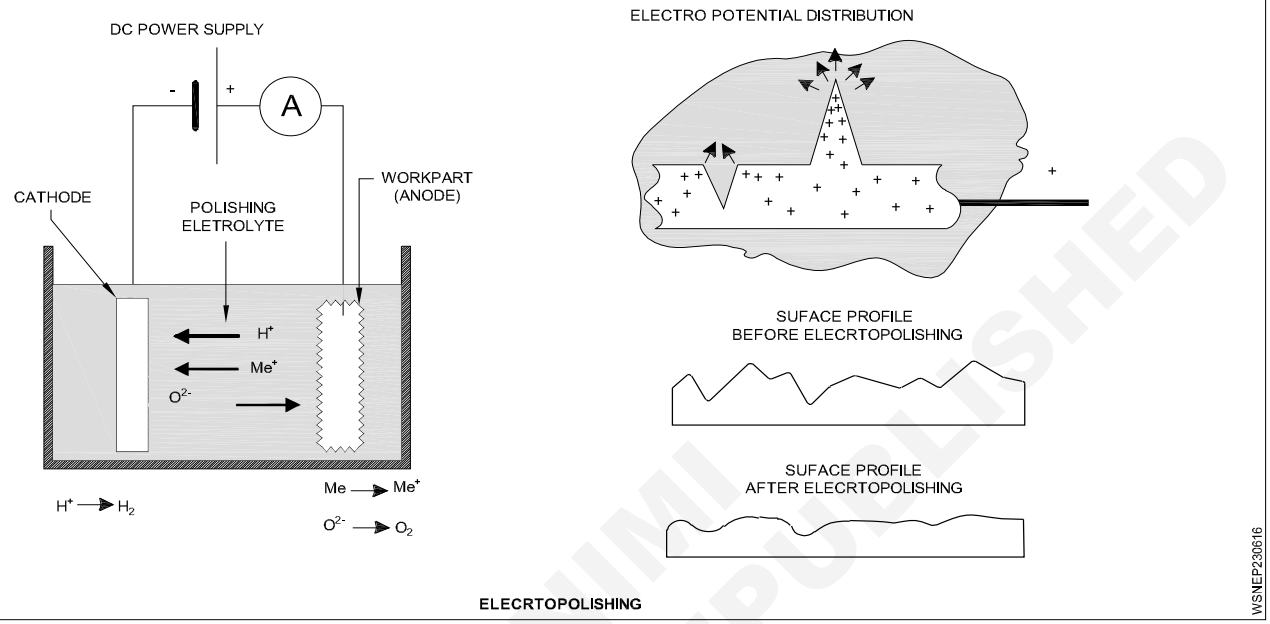
1	Tool kit	=	Rs. 500
2	Vapour degreaser	=	Rs. 2080
3	Centrifugal dryer	=	Rs. 1,000
4	Acid dipping bath	=	Rs. 1,000
5	Cyanide dipping bath	=	Rs. 500
6	Swilling bath	=	Rs. 1500
7	Hot water bath	=	Rs. 1,500
8	Drag out bath	=	Rs. 1,500
6	Bright Nickel plating bath with complete setup	=	Rs. 10,000
7	Bright Silver plating bath with complete setup	=	Rs. 15,000
7	Copper article	=	Rs. 1,000
8	Plating jig (copper)	=	Rs. 1,000
12	Silver salt	=	Rs. 100
13	Nickel salt	=	Rs. 30
14	Brightners	=	Rs. 80
15	Inhabitors	=	Rs. 50
	Total items cost	=	**Rs. 36,840**

6 Estimate the components required for (The process of electro polshing by electroplating) and to calculate the amount of cost of the items required for the work. (Fig 6)

Tools/Instruments - Service persons owns

1	Electropolishing tank (Double welded outside and inside)	- 1 No.	4	Electrolyte (Sulphuric acid & phosphoric acid)	- 1 No.
2	Stainless steel rod 0.25m (Cathode)	- 1 No.	5	Rectifier (D.C supply) source	- 1 No.
3	Workpiece	- 1 No.	6	Ammeter	- 1 No.

Fig 6



ELECRTOPOLISHING

Estimation of Items

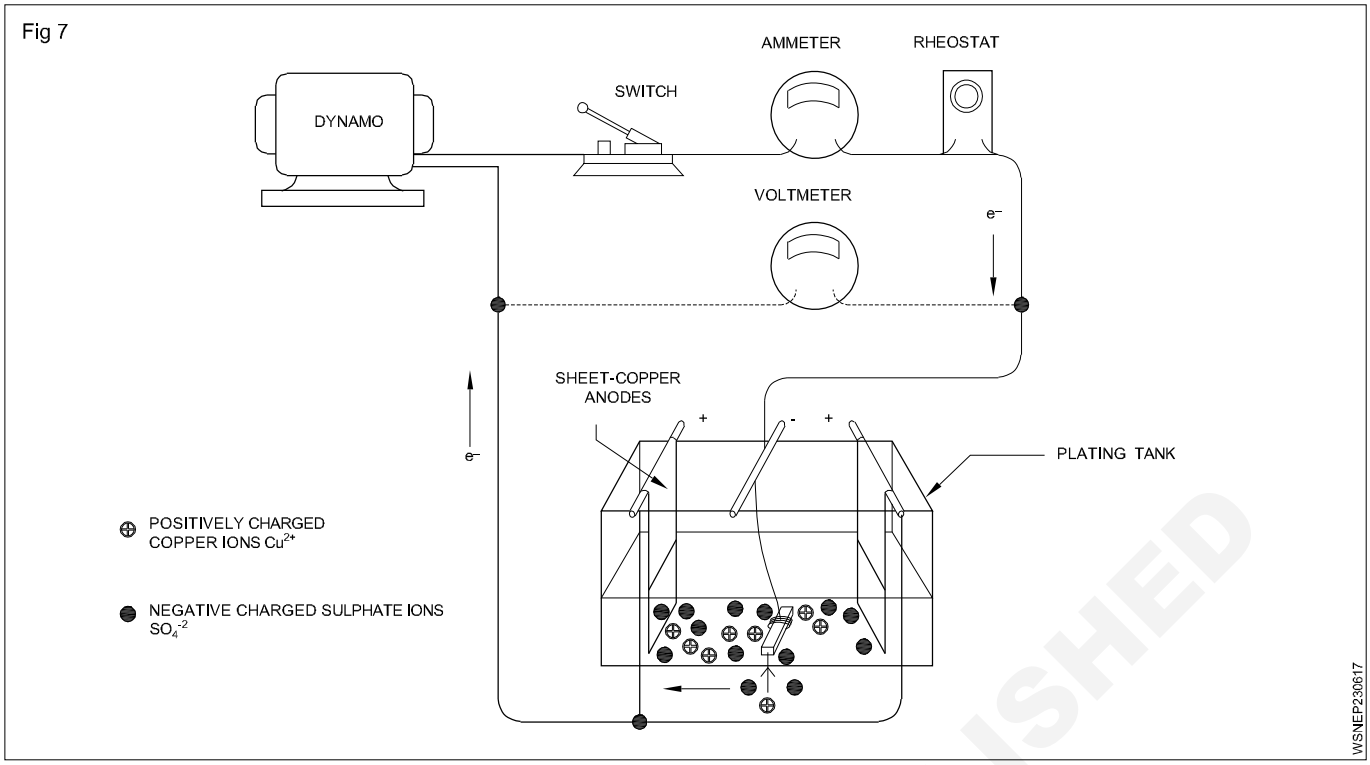
1	Electro polishing tank	=	Rs. 1,500
2	Stainless steel rod	=	Rs. 1200
3	Workpiece	=	Rs. 300
4	Electrolyte	=	Rs. 200
5	DC supply rectifier	=	Rs. 1,200
6	Ammeter	=	Rs. 350
	Total items cost	=	**Rs. 4,750**

7 Estimate the items required for (To perform electroforming for jewellary) and also calculate the cost required for the work. (Fig 7)

Tools/Instruments - Service persons owns

1	Base form (like a gem)	- 1 piece.	9	Copper metalic paint	- 2 gm.
2	Eye protection	- 1 No.	10	1000ml beaker	- 1 No.
3	Rubber gloves	- 2 Nos.	11	Tweezers	- 2 Nos.
4	Copper anode	- 1 Rod	12	Magic sculpt	
5	Copper electroforming solution	- 1 litre	13	Switch	- 1 No.
6	Copper wire	- $^1/_2$ mt.	14	Ammeter	- 1 No.
7	3 Amp rectifier	- 1 No.	15	Voltmeter	- 1 No.
8	Lacauer (paint)	- 1 litre.	16	Rheostat	- 1 No.

Fig 7



Estimation of Items

1	Base form (like a gem)	=	Rs. 150
2	Eye protection	=	Rs. 60
3	Rubber gloves	=	Rs. 148
4	Copper anode	=	Rs. 775
5	Copper electroforming solution	=	Rs. 400
6	Copper wire	=	Rs. 200
7	3 Amp rectifier	=	Rs. 500
8	Lacauer (paint)	=	Rs. 180
9	Copper metalic paint	=	Rs. 315
10	1000ml beaker	=	Rs. 400
11	Tweezers	=	Rs. 150
12	Magic sculpt	=	Rs. 1,000
13	Switch	=	Rs. 390
14	Ammeter	=	Rs. 370
15	Voltmeter	=	Rs. 400
16	Rheostat	=	Rs. 592
	Total items cost	**=**	**Rs. 6,030**

Estimation and Costing - Problems on estimation and costing

1 Electroplating gold on mild steel article. Estimate the required tools/instruments and materials for the same and also calculate the total cost for the work. (Fig 1)

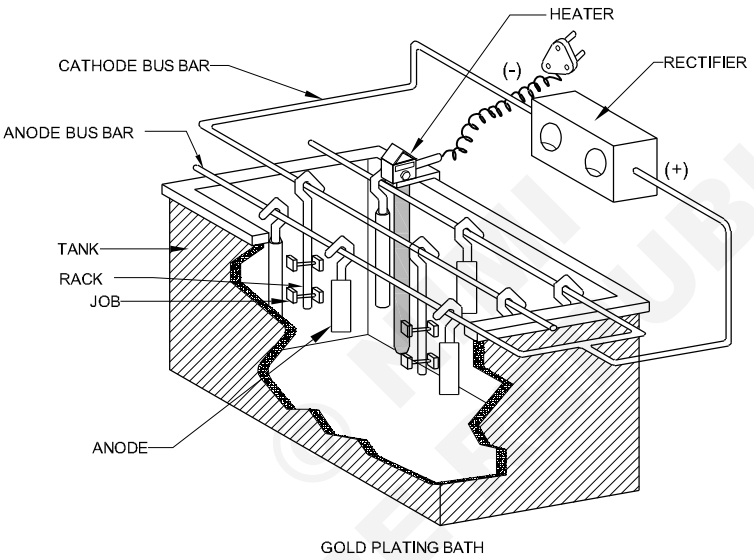
Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 1 No.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 6 Nos.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Gold plating tank	- 1 No.
8	Centrifugal dryer	- 1 No.

Materials

9	Copper article	- 1 No.
10	Plating jig (copper)	- 1 No.
11	Sodium cyanide	
12	Sulphuric acid	

Fig 1



1 Dip the article in acid dipping bath.
2 Swill twice the article in swilling bath.
3 Dip the article in cyanide dipping bath.
4 Swill twice the article in swiling bath.
5 Suspend the article in the cathode rod of the gold plating bath.
6 calculate the required current for plating.
7 Set the required current from the rectifier for 15 minutes and switch OFF.
8 Takeout the article along with the jig and drag out.
9 Swill the article in swilling bath.

Calculation

1 Total items cost = Rs.38,500
2 Labour charge = Rs.700
Total cost = Material cost + Labour charge
= Rs.38,500 + Rs.700
Total cost = Rs.39,200

2 Estimate the required tools/instruments and materials for electroplating gold on given aluminium article. Also calculate the total cost required for the work. (Fig 2)

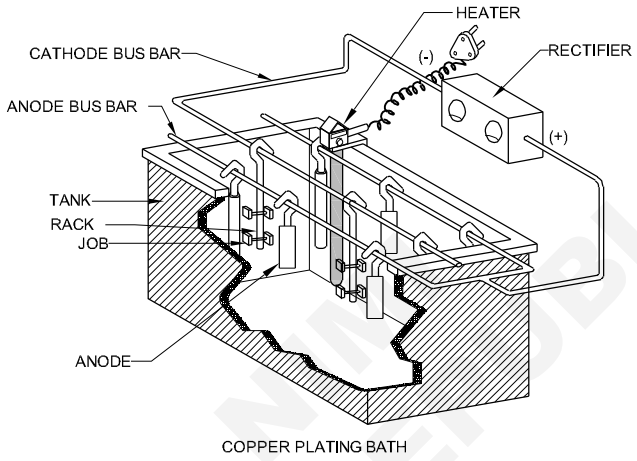
Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 2 Nos.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 6 Nos.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Alkaline gold plating alkali bath	- 1 No.
8	Chrome pickling bath	- 1 No.
9	Hydrofluoric nitric pickling bath	- 1 No.
10	Zincate bath	- 1 No.
11	Vapour degreaser	- 1 No.
12	Centrifugal dryer	- 1 No.

Materials

13	Aluminium article	- 1 No.
14	Plating jig	- 1 No.
15	Sodium cyanide	
16	Sulphuric acid	
17	Nitric acid	

Fig 2



1 Suspend the article in the cathode rod of the gold plating bath.

2 calculate the required current for plating.

3 Set the required current from the rectifier for 15 minutes and switch OFF.

4 Takeout the article along with the jig and dragout.

5 Swill the article in swilling bath.

6 Dip the article in hot water bath.

7 Dry the article using centrifugal dryer.

8 Remove the plated article from the jig.

Calculation

1	Total item cost	=	Rs.36,560
2	Labour charge	=	Rs.1000
	Total cost	=	Material cost + Labour charge
		=	Rs.36,560 + Rs.1000
	Total cost	**=**	**Rs.37,560**

3 Estimate the required tools/instruments and materials for electroplater brass on small article (mild steel). Also calculate the total cost required for the work. (Fig 3)

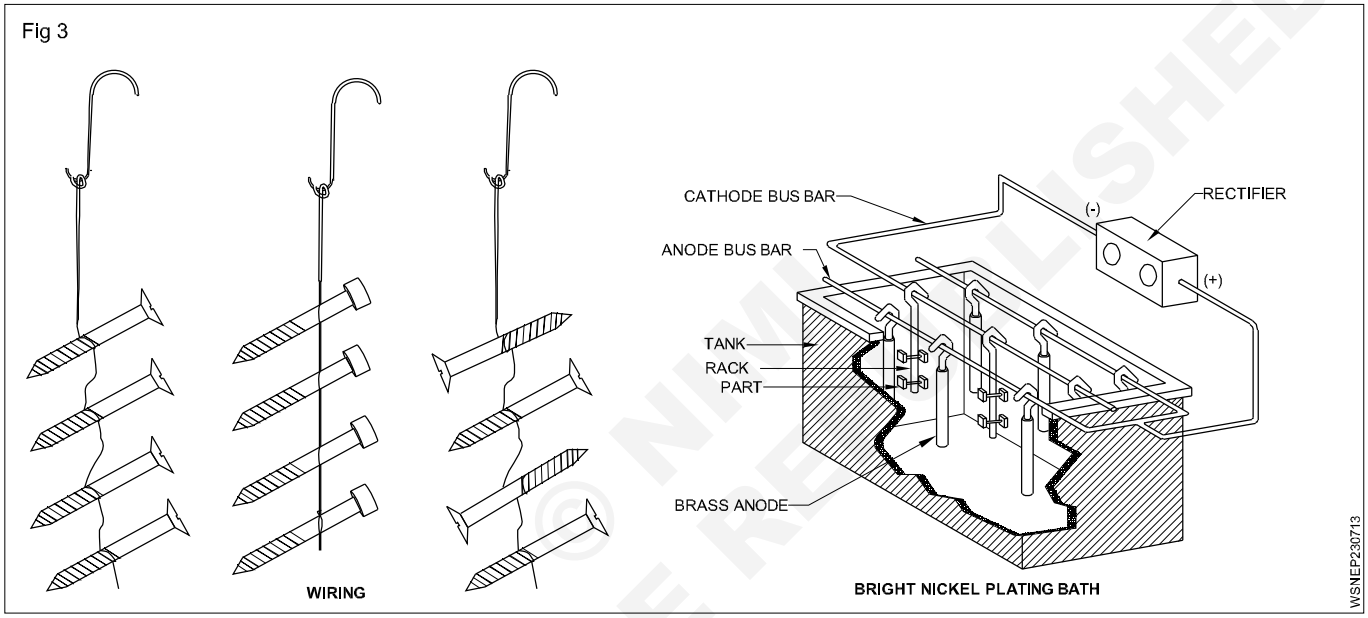
Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 1 No.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 1 No.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Brass plating bath setup	- 1 No.
8	Vapour degreaser	- 1 No.
9	Centrifugal dryer	- 1 No.

Materials

10 Small mild steel articles
11 Copper wire
12 Copper cyanide
13 Zinc cyanide
14 Free cyanide
15 Sodium cyanide
16 Ammonium hydroxide

Fig 3



1 Suspend the small mild steel articles serially with copper wire.

2 Degrease the article in acid dipping bath.

3 Dip the article in acid dipping bath.

4 Swill the article in swilling bath.

5 Dip the article in cyanide dipping bath.

6 Swill twice the article in swilling bath.

7 Suspend the article in the cathode rod of the brass plathing bath.

Calculation

1 Total items cost = Rs.13,480

2 Labour charge = Rs.800

Total cost = Material cost + Labour charge

= Rs.13,480 + Rs.800

Total cost = Rs.14,280

4 Estimate the required tools/instruments and materials for electroplating gold on copper article, and also calculate the total cost required for the work. (Fig 4)

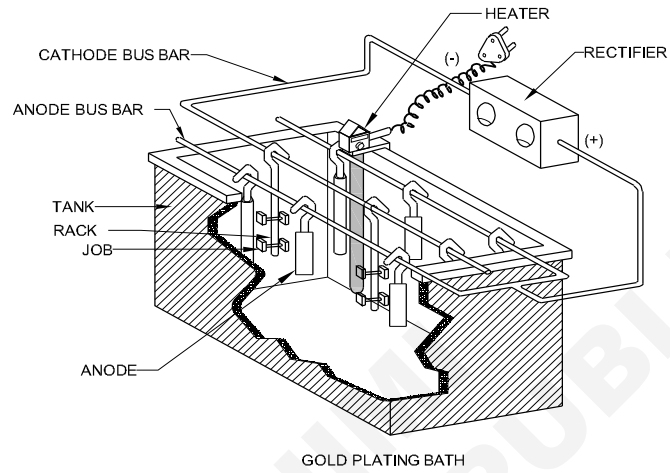
Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 1 No.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 1 No.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Gold plating tank with complete setup	- 1 No.
8	Vapour degreaser	- 1 No.
9	Centrifugal dryer	- 1 No.

Materials

10	Copper article	- 1 No.
11	Plating jig (copper)	- 1 No.
12	Sodium cyanide	
13	Sulphuric acid	

Fig 1



1 Suspend the copper article with copper wire or jig.
2 Degrease the article by vapour degrease.
3 Dip the article in swilling bath.
4 Swill the article in swilling bath.
5 Dip the article in cyanide dipping bath.
6 Swill twice the article in swilling bath.
7 Suspend the article in the cathode rod of the gold plathing bath.
8 Calculate the required current for plating and note down.
9 Set the required current from the rectifier for 15 minutes and switch OFF.
10 Takeout the article along with the jig and drag out.
11 Swill the article in swilling bath.
12 Dip the article in hot water bath.
13 Dry the article using centrifugal dryer.
14 Remove the plated article from the jig.

Calculation

1	Total items cost	=	Rs.27,480
2	Labour charge	=	Rs.800
	Total cost	=	Material cost + Labour charge
		=	Rs.27,480 + Rs.800
	Total cost	**=**	**Rs.28,280**

5 Estimate the required quantity of tools/instruments and materials for electroplater silver on copper and also calculate the total cost required for the work. (Fig 5)

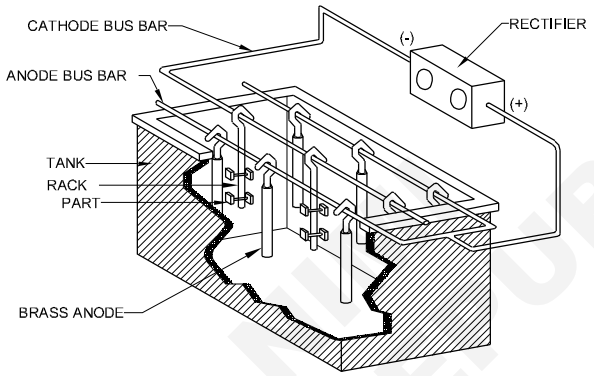
Tools/Instruments - Service persons owns

1	Tool kit	- 1 No.
2	Acid dipping bath	- 1 No.
3	Cyanide dipping bath	- 1 No.
4	Swilling bath	- 1 No.
5	Hot water bath	- 1 No.
6	Drag out bath	- 1 No.
7	Bright nickel plating bath with complete setup	- 1 No.
8	Bright silver plating bath with complete setup	- 1 No.
9	Vapour degreaser	- 1 No.
10	Centrifugal dryer	- 1 No.

Materials

11	Copper article	- 1 No.
12	Plating jig (copper)	- 1 No.
13	Silver anode	
14	Nickels anodes	
15	Silver salt	
16	Nickel salt	
17	Brighteners	
18	Inhabitors	

Fig 5



BRIGHT NICKEL PLATING BATH

1 Suspend the copper article on plating jig or with copper wire.

2 Degrease the article by vapour degrease.

3 Dip the article in acid dipping bath.

4 Swill twice the article in swilling bath.

5 Suspend the article in the cathode rod of the bright nickel plating bath.

6 Calculate the required current for plating and note down.

7 Set the required current from the rectifier for 40 minutes and switch OFF.

8 Takeout the article along with the jig and drag out.

Calculation

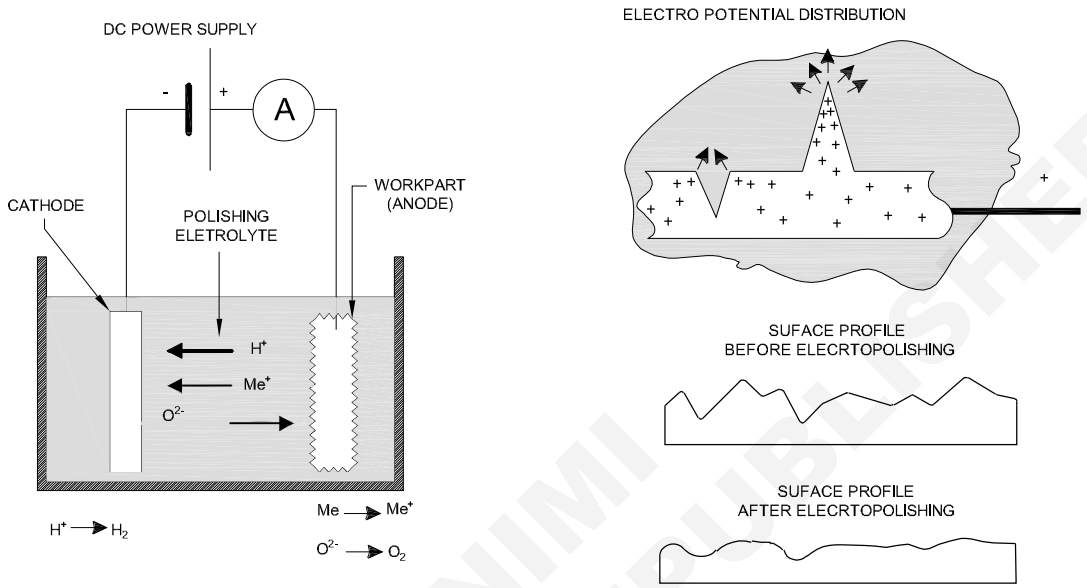
1	Total items cost	=	Rs.36,840
2	Labour charge	=	Rs.800
	Total cost	=	Material cost + Labour charge
		=	Rs.36,840 + Rs.800
	Total cost	**=**	**Rs.37,640**

6 Estimate the components required for (The process of electro polshing by electroplating) and to calculate the amount of total cost required for the work. (Fig 6)

Tools/Instruments/Equipments - Service persons owns

1	Electropolishing tank (Double welded outside and inside)	- 1 No.	4	Electrolyte (Sulphuric acid & phosphoric acid)	- 1 No.
2	Stainless steel rod 0.25m (Cathode)	- 1 No.	5	Rectifier (D.C supply) source	- 1 No.
3	Workpiece	- 1 No.	6	Ammeter	- 1 No.

Fig 6



ELECRTOPOLISHING

1 In electropolishing the metallic work piece dissolves in the electrolyte in contrast to Electroplating where the metallic ions traveling through the electrolyte solution deposit on the work piece surface.

2 The amount of the metal removed from the work piece surface in an electropolishing process varies from 0.1 to 2.5 ml (2.5-64 µm).

3 Brightening is an effect of lower surface roughness produced by electropolishing operation.

4 In contrast to mechanical polishing electropolishing produces a surface free of both mechanical defects and residual stresses.

5 The selective dissolution of prominent point (peaks) on the work surface in the electropolishing process is utilized in deburring operation. Small burrs (up to 0.5 ml/13 µm) produced in some various metalworking operations may be effectively removed by electropolishing.

6 Passivation is a chemical process of a restoration of the corrosion resistance of a contaminated stainless steel part.

7 Tensile stresses concentrated in the part surface reduce its Fatigue.

Calculation

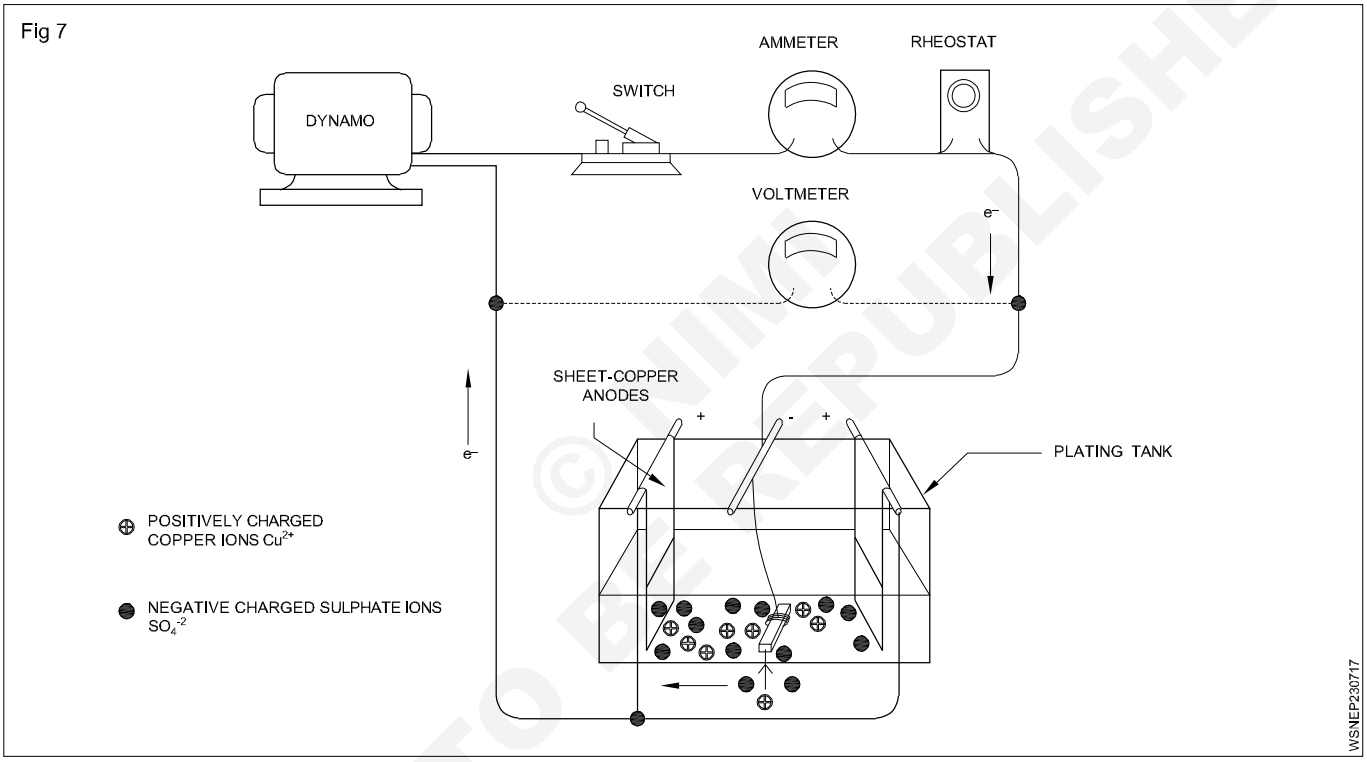
1	Total items cost	=	Rs.4,750
2	Labour charge	=	Rs.1,000
	Total cost	=	Material cost + Labour charge
		=	Rs.4,750 + Rs.1,000
	Total cost	=	**Rs.5,750**

7 Estimate the items required for (To perform electroforming for jewellary) and also calculate the total cost required for the work. (Fig 7)

Tools/Instruments/Equipments - Service persons owns

1	Base form (like a gem)	- 1 piece.	9	Copper metalic paint	- 2 gm.
2	Eye protection	- 1 No.	10	1000ml beaker	- 1 No.
3	Rubber gloves	- 2 Nos.	11	Tweezers	- 2 Nos.
4	Copper anode	- 1 Rod	12	Magic sculpt	
5	Copper electroforming solution	- 1 litre	13	Switch	- 1 No.
6	Copper wire	- $^1/_2$ mt.	14	Ammeter	- 1 No.
7	3 Amp rectifier	- 1 No.	15	Voltmeter	- 1 No.
8	Lacauer (paint)	- 1 litre.	16	Rheostat	- 1 No.

Fig 7



1 Seal your base form - First, seal your gem (or other base form) with lacquer to protect it from acid damage. Let the paint dry thoroughly (~24 hours) before moving forward.

2 Create a base - If you'd like your jewellry piece to have a base, like in a ring or pendant, here's where you'd use the two-part epoxy clay to create it. Combine the resin and hardener according to the product instructions. Create your base and fasten your form item. Leave it for 24 hours until it's completely hard.

3 Apply conductive paint as needed - Apply conductive paint on the area you want to electroform. Make sure it's thoroughly mixed to avoid streaks or uneven application. Let it dry for another day.

The copper-conductive paint areas must be interconnected, otherwise, you'll leave parts of the piece exposed without the copper plate.

4 Suspend your piece into the beaker - Place your (fully dried) painted piece into the empty glass beaker. Wrap it with copper wire to prevent it from falling in, but avoid completely covering the conductive copper paint. Use tongs to wrap the copper wire and slide it into the beaker.

5 Apply the copper anodes - After cleaning your copper anodes (or copper sheets), drill holes into the top two strips and attach them to a new copper wire (not the one wrapped around the base). Then, put them in the beaker.

For context, this new copper wire is what you'll use to connect to the positive power, while the wire around the base deposits the metal ions onto the surface of the base form.

6 Add the electroform solution - Slowly pour the solution into your beaker until the item is completely submerged.

7 Clip the wire leads - With the rectifier turned off, connect the negative (black) wire to the cathode and the red (positive) wire to the anode.

8 Get electric - Set the rectifier at 0.1 to start, which allows for 0.1 voltage per square inch of surface. After 30 minutes, check to see if you need to adjust your amps. Leave it for 10 to 24 hours.

Calculation

1	Total items cost	=	Rs.6,030
2	Labour charge	=	Rs.1,500
	Total cost	=	Material cost + Labour charge
		=	Rs.6,030 + Rs.1,500
	Total cost	**=**	**Rs.7,530**