SUGGESTED SOLUTION

CA FINAL MAY 2017 EXAM

ADVANCED MANAGEMENT ACCOUNTING

Test Code - F M J 4 0 1 6

BRANCH - (MULTIPLE) (Date : 11.02.2017)

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Answer-1 (a) :

Let x units of product A and y units of product B are purchased.

Required mathematical formulation of L.P. problem is as given below:

Minimize

$Z = 20x + 40y$

Subject to the Constraints:

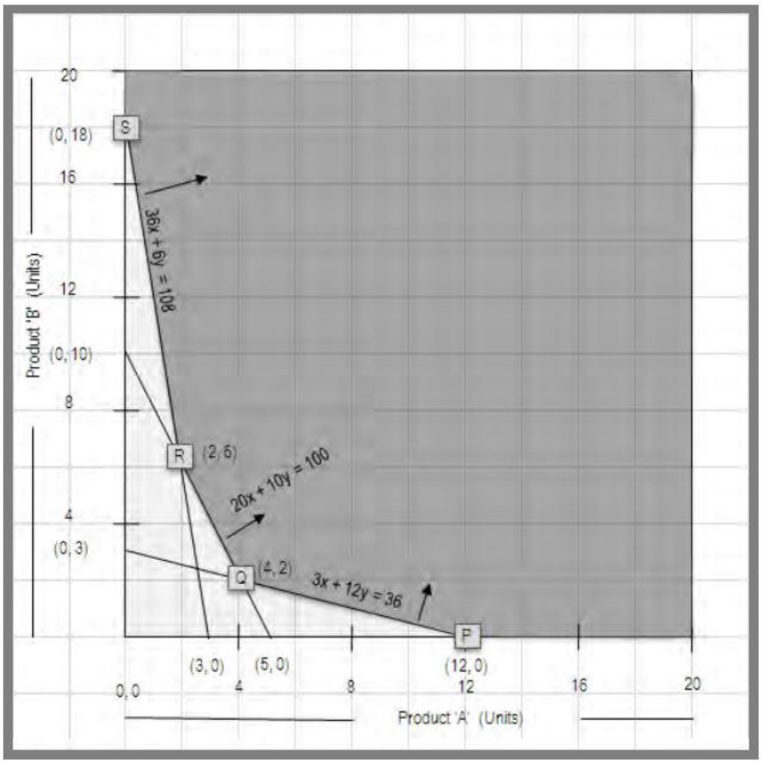
$36x + 6y \geq 108$

$3x + 12y \geq 36$

$20x + 10y \geq 100$ and

$x, y \geq 0$ **(2 Marks)**

The problem is solved graphically below:



(2 Marks)

For solving the above problem graphically, consider a set of rectangular axis x, y in the plane. As each point has the coordinates of type (x, y), any point satisfying the conditions $x \geq 0$ and $y \geq 0$ lies in the first quadrant only.

The constraints of the given problem as described earlier are plotted by treating them as equations:

$36x + 6y = 108$

$3x + 12y = 36$

$20x + 10y = 100$

(1 Mark)

The area beyond these lines represents the feasible region in respect of these constraints; any point on the straight lines or in the region above these lines would satisfy the constraints.

Intersection Points:

The point of intersection for the lines

$36x + 6y = 108$ and

$20x + 10y = 100$ is given by Intersection Point R (2, 6)

The point of intersection for the lines

$20x + 10y = 100$ and

$3x + 12y = 36$ is given by Intersection Point Q (4, 2)

(2 Marks)

The coordinates of the extreme points of the feasible region are given by

S = (0, 18)

R = (2, 6)

Q = (4, 2) and

P = (12, 0)

(1 Mark)

The value of the objective function at each of these points can be evaluated as follows:

Extreme Point	Co-Ordinates of the corner points of the feasible region (value of x and y)	Value of the objective function Z = 20x + 40y
S	(0,18)	Rs.720
R	(2,6)	Rs.280
Q	(4,2)	Rs.160
P	(12,0)	Rs.240

The value of the objective function is minimum at the point Q (4, 2). Hence, the optimum solution in to purchase 4 units of product A and 2 units of product B in order to have minimum cost of Rs.160.

(2 Marks)

Answer-1 (b) :

We shall prepare the simplex tableau as follows:

SIMPLEX TABLEAU-I

$C_j \rightarrow$			40	60	0	0	0	Min. Ratio
C_B	Basic Variable (B)	Value of Basic Variables b(=X_B)	x_1	x_2	s_1	s_2	s_3	
0	s_1	36	3	3	1	0	0	12
0	s_2	60	5	2	0	1	0	30
0	s_3	60	2	**6**	0	0	1	←10
		$Z_j = \sum C_{Bi}X_j$	0	0	0	0	0	
		$C_j - Z_j$	40	60↑	0	0	0	

(3 Marks)

SIMPLEX TABLEAU-II

$C_j \rightarrow$			40	60	0	0	0	Min. Ratio
C_B	Basic Variable (B)	Value of Basic Variables b(=X_B)	x_1	x_2	s_1	s_2	s_3	
0	s_1	6	**2**	0	1	0	$-\frac{1}{2}$	←3
0	s_2	40	$\frac{13}{3}$	0	0	1	$-\frac{1}{3}$	$\frac{120}{13}$
60	x_2	10	$\frac{1}{3}$	1	0	0	$\frac{1}{6}$	30
		$Z_j = \sum C_{Bi}X_j$	20	60	0	0	10	
		$C_j - Z_j$	20↑	0	0	0	−10	

SIMPLEX TABLEAU-III

$C_j \rightarrow$			40	60	0	0	0
C_B	Basic Variable (B)	Value of Basic Variables b(=X_B)	x_1	x_2	s_1	s_2	s_3
40	x_1	3	1	0	$\frac{1}{2}$	0	$-\frac{1}{4}$
0	s_2	27	0	0	$-\frac{13}{6}$	1	$\frac{3}{4}$
60	x_2	9	0	1	$-\frac{1}{6}$	0	$\frac{1}{4}$
		$Z_j = \sum C_{Bi}X_j$	40	60	10	0	5
		$C_j - Z_j$	0	0	−10	0	− 5

Since all $C_j - Z_j$ are negative or zero, this is the optimum solution with, x_1 =3 & x_2 =9 and optimum Z = ₹660.

(5 Marks)

Answer-2 (a) :

The given information can be tabulated in following transportation problem-

Manager	Assignment			Time Available (Hours)
	Transfer Pricing (₹)	Corporate Valuation (₹)	Statutory Audit (₹)	
S	1,800	2,250	2,850	176
D	2,100	1,950	1,800	176
K	2,400	2,100	2,250	176
Time Required (Hours)	143	154	176	

(2 Marks)

The given problem is an unbalanced transportation problem. Introducing a dummy assignment to balance it, we get-

Manager	Assignment				Time Available (Hours)
	Transfer Pricing (₹)	Corporate Valuation (₹)	Statutory Audit (₹)	Dummy (₹)	
S	1,800	2,250	2,850	0	176
D	2,100	1,950	1,800	0	176
K	2,400	2,100	2,250	0	176
Time Required (Hours)	143	154	176	55	528

(2 Marks)

The objective here is to maximize total billing amount of the auditors. For achieving this objective, let us convert this maximization problem into a minimization problem by subtracting all the elements of the above payoff matrix from the highest payoff i.e. Rs.2,850.

Manager	Assignment				Time Available (Hours)
	Transfer Pricing (₹)	Corporate Valuation (₹)	Statutory Audit (₹)	Dummy (₹)	
S	1,050	600	0	2,850	176
D	750	900	1,050	2,850	176
K	450	750	600	2,850	176
Time Required (Hours)	143	154	176	55	528

(2 Marks)

Now, let us apply VAM method to the above matrix for finding the initial feasible solution.

Manager	Assignment				Time Avail. (Hours)	Difference
	Transfer Pricing (₹)	Corp. Valuation (₹)	Stat. Audit (₹)	Dummy (₹)		
S	1,050	600	0 [176]	2,850	176/0	600 - -
D	750	900 [121]	1,050	2,850 [55]	176/55/0	150, 150 1,950
K	450 [143]	750 [33]	600	2,850	176/33/0	150, 300, 2,100
Time Required	143/0	154/121/0	176/0	55/0	528	
Difference	300 300 -	150 150 150	600 -- -	0 0 0		

(2 Marks)

The initial solution is given below. It can be seen that it is a degenerate solution since the number of allocation is 5. In order to apply optimality test, the total number of allocations should be 6 (m + n -1). To make the initial solution a non-degenerate, we introduce a very small quantity in the least cost independent cell which is cell of K, Statutory Audit.

Manager	Assignment			
	Transfer Pricing (₹)	Corp. Valuation (₹)	Stat. Audit (₹)	Dummy (₹)
S	1,050	600	0 [176]	2,850
D	750	900 [121]	1,050	2,850 [55]
K	450 [143]	750 [33]	600 [e]	2,850

(1 Mark)

Let us test the above solution for optimality-

($u_i + v_j$) Matrix for Allocated / Unallocated Cells

					u_i
	-150	150	0	2,100	-600
	600	900	750	2,850	150
	450	750	600	2,700	0
v_j	450	750	600	2,700	

(1 Mark)

Now we calculate $\Delta_{ij} = C_{ij} - (u_i + v_j)$ for non basic cells which are given in the table below-

Δ_{ij} Matrix

1,200	450		750
150		300	
			150

Since, all allocations in $\Delta_{ij} = C_{ij} - (u_i+v_j)$are non negative, the allocation is optimal. The allocation of assignments to managers and their billing amount is given below:

(1 Mark)

Manager	Assignment	Billing Amount
S	Statutory Audit	₹5,01,600 (176 hrs. x ₹2,850)
D	Corporate Valuation	₹2,35,950 (121 hrs. x ₹1,950)
K	Transfer Pricing	₹3,43,200 (143 hrs. x ₹2,400)
K	Corporate Valuation	₹69,300 (33 hrs. x ₹2,100)
	Total Billing	₹11,50,050

(1 Mark)

Answer-2 (b) :

The following matrix gives the cost incurred if the typist (i = A, B, C, D, E) executes the job (j = P, Q, R, S, T).

Typist	Job P	Job Q	Job R	Job S	Job T
A	85	75	65	125	75
B	90	78	66	132	78
C	75	66	57	114	69
D	80	72	60	120	72
E	76	64	56	112	68

(1 Mark)

Subtracting the minimum element of each row from all its elements in turn, the above matrix reduces to-

Typist	Job P	Job Q	Job R	Job S	Job T
A	20	10	0	60	10
B	24	12	0	66	12
C	18	9	0	57	12
D	20	12	0	60	12
E	20	8	0	56	12

(1 Mark)

Now subtract the minimum element of each column from all its elements in turn, and draw minimum number of lines horizontal or vertical so as to cover all zeros. All zeros can be covered by four lines as given below-

Typist	Job P	Job Q	Job R	Job S	Job T
A	2	2	0	4	$\boxed{0}$
B	6	4	$\boxed{0}$	10	2
C	$\boxed{0}$	1	0	1	2
D	2	4	0	4	2
E	2	$\boxed{0}$	0	0	2

(1.5 Marks)

Since there are only 4 lines (<5) to cover all zeros, optimal assignment cannot be made. The minimum uncovered element is 1.

We subtract the value 1 from all uncovered elements, add this value to all intersections of two lines values and leave the other elements undisturbed. The revised matrix so obtained is given below-

Typist	Job P	Job Q	Job R	Job S	Job T
A	3	2	1	4	$\boxed{0}$
B	6	3	$\boxed{0}$	9	1
C	$\boxed{0}$	0	0	0	1
D	2	3	0	3	1
E	3	$\boxed{0}$	1	0	2

(1.5 Marks)

Since the minimum no. of lines required to cover all the zeros is only 4 (< 5), optimal assignment cannot be made at this stage also.

The minimum uncovered element is 2. Repeating the usual process again, we get the following matrix-

Typist	Job P	Job Q	Job R	Job S	Job T
A	1	0	1	2	$\boxed{0}$
B	4	1	$\boxed{0}$	7	1
C	0	$\boxed{0}$	2	0	3
D	$\boxed{0}$	1	0	1	1
E	3	0	3	$\boxed{0}$	4

(2 Marks)

Since the minimum number of lines to cover all zeros is equal to 5, this matrix will give optimal solution. The optimal assignment is made in the matrix below-

Typist	Job P	Job Q	Job R	Job S	Job T
A	1	$\cancel{0}$	1	2	$\boxed{0}$
B	4	1	$\boxed{0}$	7	1
C	$\cancel{0}$	$\boxed{0}$	2	$\cancel{0}$	3
D	$\boxed{0}$	1	$\cancel{0}$	1	1
E	3	$\cancel{0}$	3	$\boxed{0}$	4

(2 Marks)

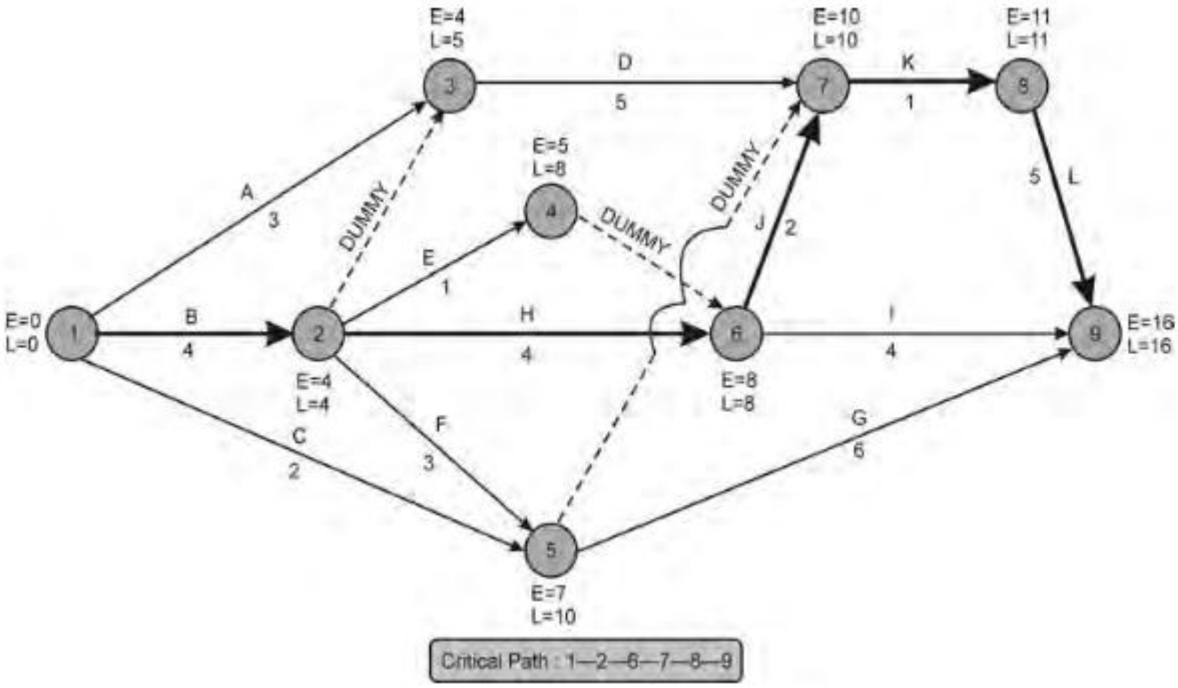
Typist	Job	Cost (₹)
A	T	75
B	R	66
C	Q	66
D	P	80
E	S	112
	Total	399

(1 Mark)

Note : In this case the above solution is not unique. Alternate solution also exists.

Answer-3 (a) :

(i) The Network for the given problem:



(2 Marks)

(ii) The Critical Path is 1–2–6–7–8–9 with Duration 16 Days.

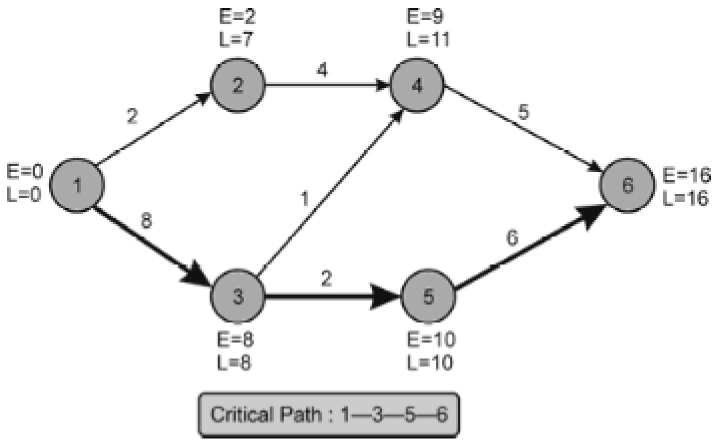
(iii) Calculation of Total Float, Free Float and Independent Float:

Activity	Duration	EST	EFT	LST	LFT	Slack of Tail Event	Slack of Head Event	Total Float	Free Float	Ind. Float
	D_{ij}	E_i	$E_i + D_{ij}$	$L_j - D_{ij}$	L_j	$L_i - E_i$	$L_j - E_j$	LST – EST	Total Float – Slack of Head Event	Free Float – Slack of Tail Event
A (1–3)	3	0	3	2	5	0	1	2	1	1
B (1–2)	4	0	4	0	4	0	0	0	0	0
C (1–5)	2	0	2	8	10	0	3	8	5	5
Dum. (2–3)	0	4	4	5	5	0	1	1	0	0
D (3–7)	5	4	9	5	10	1	0	1	1	0
E (2–4)	1	4	5	7	8	0	3	3	0	0
F (2–5)	3	4	7	7	10	0	3	3	0	0
G (5–9)	6	7	13	10	16	3	0	3	3	0
H (2–6)	4	4	8	4	8	0	0	0	0	0
I (6–9)	4	8	12	12	16	0	0	4	4	4
Dum. (4–6)	0	5	5	8	8	3	0	3	3	0
Dum. (5–7)	0	7	7	10	10	3	0	3	3	0
J (6–7)	2	8	10	8	10	0	0	0	0	0
K (7–8)	1	10	11	10	11	0	0	0	0	0
L (8–9)	5	11	16	11	16	0	0	0	0	0

(8 Marks)

Answer-3 (b) :

The network for the given problem :



(2 Marks)

The Critical Path is 1–3–5–6 with normal duration of 16 weeks. The normal cost of the project is Rs.82,000.

The **Cost Slope** of each activity:-

Activity	Normal		Crash		Cost Slopes		
	Duration (Weeks)	Cost (₹'000)	Duration (Weeks)	Cost (₹'000)	ΔT (Weeks)	ΔC (₹'000)	ΔC/ΔT (₹'000)
1–2	2	10	1	15	1	5	5
1–3	8	15	5	21	3	6	2
2–4	4	20	3	24	1	4	4
3–4	1	7	1	7	0	0	---
3–5	2	8	1	15	1	7	7
4–6	5	10	3	16	2	6	3
5–6	6	12	2	36	4	24	6

(2 Marks)

The **Various Paths** in the network are:

1–3–5–6 with project duration = 16 Weeks

1–3–4–6 with project duration = 14 Weeks

1–2–4–6 with project duration = 11 Weeks

The critical path is 1–3–5–6. The normal length of the project is 16 days.

Crashing steps so that the project completion time reduces to 9 weeks with minimum additional cost:

(1 Mark)

Crashing Step 1:

We will first crash the activities on the critical path.

Activity 1–3 of critical path 1–3–5–6 has minimum costs slope. We can crash activity 1–3 by 3 weeks for additional cost of Rs.6,000 (3Weeks × Rs.2,000). Now the project duration is reduced to 13 weeks.

The various paths in the network with revised duration are:

1–3–5–6 with project duration = 13 Weeks

1–3–4–6 with project duration = 11 Weeks

1–2–4–6 with project duration = 11 Weeks

(1 Mark)

Crashing Step 2:

Crash activity 5–6 by 2 weeks for additional cost of Rs.12,000 (2Weeks × Rs.6,000). Now the project duration is reduced to 11 weeks.

The various paths in the network with revised duration are:

1–3–5–6 with project duration = 11 Weeks

1–3–4–6 with project duration = 11 Weeks

1–2–4–6 with project duration = 11 Weeks **(1 Mark)**

Crashing Step 3:

Now there are three critical paths:

1–3–5–6 with project duration = 11 Weeks

1–3–4–6 with project duration = 11 Weeks

1–2–4–6 with project duration = 11 Weeks

To reduce the project duration further, we crash activity 4–6 by 2 weeks at an additional costs of Rs. 6,000 (2Weeks × Rs.3,000) and activity 5–6 by two weeks at an additional cost of Rs. 12,000 (2Weeks × Rs.6,000).

(1 Mark)

Statement Showing "Additional Crashing Cost"

Normal Project Length (Weeks)	Job Crashed	Crashing Cost (Rs.)
16	—-	—-
13	1–3 by 3 Weeks	6,000
11	5–6 by 2 Weeks	12,000
9	4–6 by 2 Weeks & 5–6 by 2 Weeks	18,000
	Total Additional Cost	36,000

(2 Marks)

Answer-4 (a) :

Random Allocation Table

Time *	Arrival (Probability)	Arrivals Cumulative Probability	Random No. Allocated	Time *	Service (Probability)	Service Cumulative (Probability)	Random No. Allocated
1	0.05	0.05	00 – 04	1	0.10	0.10	00 – 09
2	0.20	0.25	05 – 24	2	0.20	0.30	10 – 29
3	0.35	0.60	25 – 59	3	0.40	0.70	30 – 69
4	0.25	0.85	60 – 84	4	0.20	0.90	70 – 89
5	0.10	0.95	85 – 94	5	0.10	1.00	90 – 99
6	0.05	1.00	95 – 99				

(*) in minutes

(4 Marks)

Simulation of Trails

R. No.	Arrival*	Time	Start	R. No.	Time*	Finish Time	Waiting Time	
							Clerk	Passenger
60	4	9.04	9.04	09	1	9.05	4	---
16	2	9.06	9.06	12	2	9.08	1	---
08	2	9.08	9.08	18	2	9.10	---	---
36	3	9.11	9.11	65	3	9.14	1	---
38	3	9.14	9.14	25	2	9.16	---	---
07	2	9.16	9.16	11	2	9.18	---	---
08	2	9.18	9.18	79	4	9.22	---	---
59	3	9.21	9.22	61	3	9.25	---	1
53	3	9.24	9.25	77	4	9.29	---	1
03	1	9.25	9.29	10	2	9.31	---	4
						Total	6	6

(*) in minutes

In the above ten trial, the clerk was idle for 6 minutes and the passengers had to wait for 6 minutes.

(4 Marks)

Answer-4 (b) :
Workings

Units	Average hrs. /unit
1	2,000
2	1,600
4	1,280
8	1,024

(1 Mark)

Variable Cost excluding Labour:

		Rs.
Material Cost / unit	=	10,000
Variable Overheads	=	2,000
Variable Cost	=	12,000

(1.5 Mark)

Option-I
If both the orders came together, learning rate 80% applies and 8 units can be made, with average time of 1,024 hours per unit.

Cost to AB		Rs.
Variable Cost excluding Labour	=	12,000
Labour Cost (1,024 hrs. × 4Rs./hr)	=	4,096
	=	16,096

(1.5 Marks)

In this case,

Particulars	**Q**	**P**	**Total**
Selling Price p. u. (Rs.)	17,200	16,500	33,700
Variable Cost p. u. (Rs.)	16,096	16,096	32,192
Contribution p. u. (Rs.)	1,104	404	1,508
No. of Units	4	4	
Contribution (Rs.)	4,416	1,616	6,032

(2 Marks)

Option- II
If P Ltd supplies its labour. 80% learning curve will apply to 4 units each of AB & P.
Hence: hrs / u = 1,280

Particulars	**Q**	**P**	**Total**
Selling Price p. u. (Rs.)	17,200	14,000	31,200
Variable Cost p. u. (Rs.)			
(Excluding Labour)	12,000	12,000	24,000
Labour Cost p. u. (Rs.)			
1,280 hrs. × Rs.4	5,120	–	5,120
1,280 hrs. × Rs.1	–	1,280	1,280
Total Variable Cost p. u. (Rs.)	17,120	13,280	30,400
Contribution p. u. (Rs.)	80	720	800
Units	4	4	
Contribution (Rs.)	320	2,880	3,200

(2 Marks)

Decision
AB should not take labour from P Ltd. It should choose Option-I.

Answer-4 (a) :

As the production quantity of a given item is doubled, the cost of the item decreases at a fixed rate. This phenomenon is the basic premise on which the theory of learning curve has been formulated. As the quantity produced doubles, the absolute amount of cost increase will be successively smaller but the rate of decrease will remain fixed.

In the initial stage of a new product or a new process, the learning effect pattern is so regular that the rate of decline established at the outset can be used to predict labour cost well in advance. The effect of experience on cost is summarized in the learning curve ratio or improvement ratio.

(2 Marks)

$$\text{Learning curve ratio} = \frac{\text{Average labour cost of first 2N units}}{\text{Average labour cost of first N units}}$$

(1 Mark)

For example, if the average labour cost for the first 500 units is Rs.25 and the average labour cost for the first 1,000 units is Rs.20, the learning curve ratio is (Rs.20/25) or 80%. Since the average cost per unit of 1,000 units is Rs.20, the average cost per unit of first 2,000 units is likely to be 80% of Rs.20 or Rs.16.

(1 Mark)