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Industrial Engineering

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CLASS TEST 2019-2020

MECHANICAL ENGINEERING

Industrial Engineering

Date of Test : 25/05/2019

Answer Key

1.	(c)	7.	(a)	13.	(c)	19.	(b)	25.	(c)
2.	(d)	8.	(c)	14.	(a)	20.	(a)	26.	(c)
3.	(b)	9.	(a)	15.	(b)	21.	(c)	27.	(c)
4.	(a)	10.	(b)	16.	(b)	22.	(b)	28.	(a)
5.	(d)	11.	(a)	17.	(d)	23.	(c)	29.	(b)
6.	(c)	12.	(d)	18.	(d)	24.	(b)	30.	(b)

DETAILED EXPLANATIONS

1. (c)

At breakeven point : Selling price = fixed cost + variable cost

$$50000 \times SP = 200000 + 50000 \times 20$$

$$SP = 4 + 20$$

$$= ₹24 \text{ per unit}$$

2. (d)

Processing time for one job (one unit) = 6 + 11 + 13 + 4 + 16 = 50 seconds

Total available working time in a week = $7 \times 3600 \times 5 = 126{,}000$ seconds

$$\text{No. of units produced on single workstation} = \frac{126{,}000}{50} = 2520 \text{ units}$$

$$\text{Minimum no. of workstations required} = \frac{9000}{2520} = 3.6 \approx 4$$

5. (d)

For 6σ level $\rightarrow$ Defects per million is limited to 3.4

We have 100 lakhs component, which means 10 million.

For *P*, defects per million is 2.8 $\Leftarrow$ falls in $6 - \sigma$ level confromance

For *Q*, defects per million is 4.0

For *R*, defects per million is 4.9

6. (c)

As per *SPT* rule, optional sequence is : 2 – 3 – 1

Completion times of the jobs are : 8, 19 and 39 minutes respectively

$$\text{Mean flow time} = \frac{8+19+39}{3} = 22 \text{ minutes}$$

8. (c)

Balance delay is the measure of line inefficiency due to imbalances in station times

$$d = \frac{nT_C - T_{WC}}{nT_C}$$

$$= \frac{5\times10-(10+8+6+9+10)}{5\times10} = \frac{50-43}{50} = \frac{7}{50} = 0.14 \text{ or } 14\%$$

10. (b)

$$EOQ = \sqrt{\frac{2AD}{H}}$$

$$D = \frac{(EOQ)^2 \times H}{2A} = \frac{(385)^2 \times 0.30}{2\times6} = 3705.625 \approx 3706 \text{ units}$$

11. (a)

Option (a) pertains to loading and scheduling.

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14. (a)

$$\text{Standard time} = \text{Set up time + time per piece} \times \text{nos. of pieces produced}$$
$$= 35 + 8 \times 50 = 435 \text{ minutes} = 7 \text{ hours and } 15 \text{ minutes}$$
$$\text{Efficiency of operator} = \frac{\text{Standard time} \times 100}{\text{Actual time}} = \frac{435 \times 100}{(6 \times 60 + 30)} = \frac{435}{390} \times 100 = 111.5\%$$

15. (b)

$$\text{Arrival rate, } \lambda = \frac{10}{8} \text{ per hours}$$
$$\text{Service rate, } \mu = \frac{60}{30} = 2 \text{ per hour}$$
$$\text{Probability that the service is free} = 1 - \frac{\lambda}{\mu} = 1 - \frac{10}{8 \times 2} = \frac{6}{16}$$
$$\text{Expected idle time per day} = \frac{6 \times 18}{16} = 3 \text{ hours}$$
$$\text{Length in the system, } L_S = \frac{\lambda}{\mu(\mu - \lambda)} = \frac{10/8}{2 - (10/8)} = 1.67 \text{ sets} \approx 2 \text{ sets}$$

16. (b)

$\lambda = 12$ trucks per hour, $\mu = 20$ trucks per hour

The probability that a truck has to wait is given by the probability that the service is busy.

$$\text{Probability that service is busy} = \frac{\lambda}{\mu} = \frac{12}{20} = 0.6$$
$$\text{Expected waiting time for a truck} = \frac{\lambda}{\mu(\mu - \lambda)} = \frac{12}{20(20 - 12)} = \frac{3}{40} \text{ hours or } 4.5 \text{ minutes}$$

The number of trucks arriving in a day (24 hours) is $24 \times 12 = 288$

As given, 50% belong tot he contractor, i.e. 144 trucks.

Each truck wait for an average of 4.5 minutes

$$\text{Total waiting time for the contractor's truck} = \frac{144 \times 4.5}{60} = 10.8 \text{ hours}$$

17. (d)

λ = arrival rate = 5 jobs/minute

μ = service rate = 8 jobs/minute

The mean steady state numbers of jobs in the system,

$$L_S = \frac{\lambda}{\mu - \lambda} = \frac{5}{8 - 5} = \frac{5}{3} = 1.67$$

19. (b)

$$\text{Selling price, } S = ₹16$$
$$\text{Variable cost, } V = ₹12$$
$$\text{Fixed cost, FC} = ₹1,20,000$$
$$\text{Break even point (units)} = \frac{FC}{S - V} = \frac{1,20,000}{16 - 12} = 30,000 \text{ units}$$
$$\text{BEP as a percentage of capacity} = \frac{\text{Break-even sales}}{\text{Capacity sales}} = \frac{30,000}{50,000} = 60\%$$

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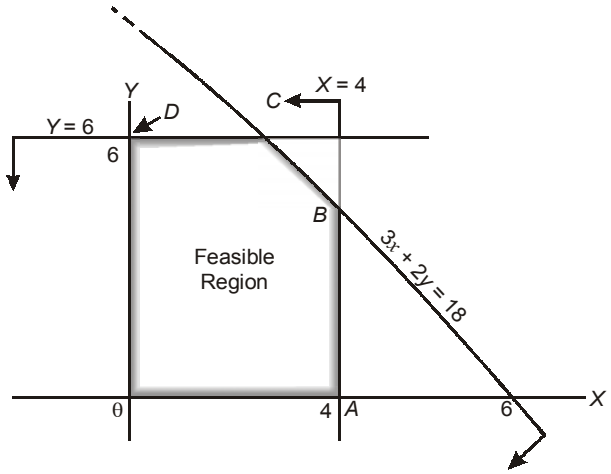
20. (a)

$$F_{t+1} = F_t + \alpha (D_{\text{April 2018}} - F_{\text{April 2018}})$$
$$= 850 + 0.4\,(900 - 850) = 850 + 0.4 \times 50 = 870 \text{ units}$$
$$F_{\text{June 2018}} = 870 + \propto (1030 - 870)$$
$$= 870 + 0.4 \times 160 = 934 \text{ units}$$

22. (b)



$$A \equiv (4, 0)$$
$$B \equiv (4, 3)$$
$$C \equiv (2, 6)$$
$$D \equiv (0, 6)$$
$$Z_A = 6 \times 4 + 10 \times 0 = 24$$
$$Z_B = 6 \times 4 + 10 \times 3 = 54$$
$$Z_C = 6 \times 2 + 10 \times 6 = 72$$
$$Z_D = 6 \times 0 + 10 \times 6 = 60$$
$$Z_C = Z_{max} = 72$$

23. (c)

Product	Release Time	Processing Time	Start Time	Finish Time	Due Date	Tardiness
R	0	2	1	2	15	0
P	0	3	2	5	10	0
S	1	5	5	10	11	0
T	1	1	10	11	13	0
Q	2	4	11	15	9	6

Total tardiness = 6

24. (b)

$$\text{Supply rate, } R = \frac{12000}{12} = 1000 \text{ units/month}$$
$$\text{Holding cost, } C_1 = ₹0.20 \text{ per unit per month}$$

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Ordering cost, C_3 = ₹350 per order

$$EOQ = \sqrt{\frac{2C_3R}{C_1}} = \sqrt{\frac{2\times350\times1000}{0.2}} = 1870 \text{ units / order}$$

25. (c)

Holding cost, C_1 = ₹0.08 per unit per day
Ordering cost, C_3 = ₹400 per order
Supply rate, R = 100 units

$$\text{EOQ, } q_0 = \sqrt{\frac{2C_3R}{C_1}} = \sqrt{\frac{2\times400\times100}{0.08}} = 1{,}000 \text{ units}$$

$$\text{Length of cycle, } t_0 = \frac{1000}{100} = 10 \text{ days}$$

As the lead time is 13 days and cycle length is 10 days, reordering should occur when the level of inventory is sufficient to satisfy the demand for 13 – 10 = 3 days

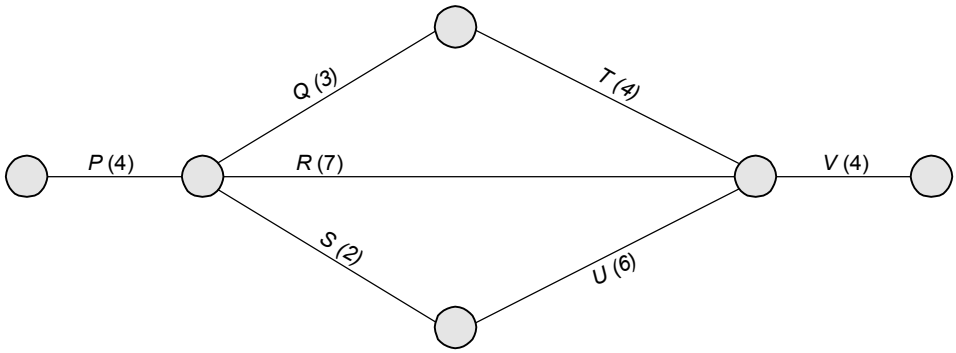
Reorder point = 100 × 3 = 300 units.

26. (c)

15	20	60 700	700
5 1000	40	20 200	1200
30	10 1000	50 100	1100
1000	1000	1000	3000 / 3000

Total cost = 5 × 1000 + 10 × 1000 + 60 × 700 + 20 × 200 + 50 × 100
= 5000 + 10000 + 42000 + 4000 + 5000
= ₹66,000

27. (c)



For path P – R – V, project duration = 15 days
For path P – Q – T – V, project duration = 4 + 3 + 4 + 4 = 15 days
For path P – S – U – V, project duration = 4 + 2 + 6 + 4 = 16 days

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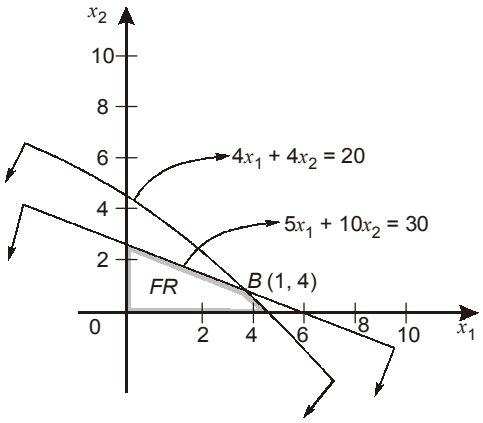
29. (b)



$0 \equiv (0, 0), A \equiv (0, 3)$

$B \equiv (1, 4), C \equiv (5, 0)$

$Z_A = 6 \times 0 - 8 \times 3 = -24$

$Z_B = 6 \times 1 - 8 \times 4 = -26$

$Z_C = 6 \times 5 - 8 \times 0 = 30$

$Z_{min} = 24$ at (0,3)

30. (b)

Step I: (Reducing the matrix by subtracting the minimum element of each row from all the elements of that row)

2	0	1	4
0	1	4	2
3	2	0	1
1	3	0	2

Step II:

	M_1	M_2	M_3	M_4	
J_1	2	[0]	1	3	$J_1 \Rightarrow M_2$
J_2	[0]	1	4	1	$J_2 \Rightarrow M_1$
J_3	3	2		[0]	$J_3 \Rightarrow M_4$
J_4	1	3	[0]	1	$J_4 \Rightarrow M_3$

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