

17. A company can manufacture a product using hand tools. Tools will cost \$1,000, and the manufacturing cost per unit will be \$1.50. As an alternative, an automated system will cost \$15,000 with a manufacturing cost per unit of \$0.50. The anticipated annual volume is 5,000 units. If interest is neglected, the breakeven point (years) is most nearly:
- A. 2.8
  - B. 3.6
  - C. 15.0
  - D. never

17. Refer to the Breakeven Analysis section in the Engineering Economics chapter of the *FE Reference Handbook*.

$$\text{Tool manufacturing costs} = \$1.50 (5,000) = \$7,500$$

$$\text{Automated tool manufacturing costs} = \$0.50 (5,000) = \$2,500$$

$$\text{Annual manufacturing savings} = \$7,500 - \$2,500 = \$5,000$$

$$\text{Additional investment for automation} = \$15,000 - \$1,000 = \$14,000$$

$$\text{Payback} = \$14,000 / \$5,000 = 2.8 \text{ years}$$

**THE CORRECT ANSWER IS: A**

Ev

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16. The relationship between the purchase price ( $P$ ) per unit, in \$, and consumer demand ( $D$ ), in units sold, for a certain component is defined by the equation  $P = 220 - 0.025D$ .

The fixed costs for the production of this unit are \$75,000 per month, and the variable cost is \$82 per unit. If 1,200 units per month are produced and sold to consumers, the resulting monthly profit is \$\_\_\_\_\_.

Enter your response in the blank.

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16. Refer to the cash flow equations table in the Engineering Economics chapter of the *FE Reference Handbook*.

Given that demand  $D = 1,200$  units/month

So purchase price per unit:  $P = 220 - 0.025 \times 1,200 = 220 - 30 = \$190$

Thus the monthly revenue =  $P \times D = \$190 \times 1,200 = \$228,000$  per month

Given that fixed cost = \$75,000 per month

The variable cost per unit = \$82, so the monthly variable costs =  $\$82 \times 1,200 = \$98,400$  per month

Total costs per month = fixed cost + variable costs =  $\$75,000 + \$98,400 = \$173,400$  per month

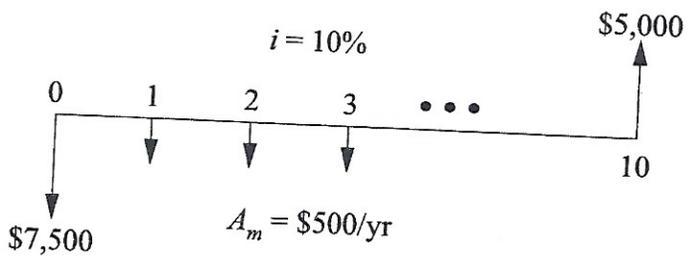
Profit = revenue - total costs =  $\$228,000 - \$173,400 = \$54,600$  per month

**THE CORRECT ANSWER IS: \$54,600**

15. A tractor costs \$7,500. After 10 years it has a salvage value of \$5,000. Maintenance costs are \$500 per year. If the interest rate is 10%, the equivalent uniform annual cost is most nearly:

- A. \$500  
 ○ B. \$750  
 ○ C. \$1,400  
 ○ D. \$2,000

15. Refer to the cash flow equations table in the Engineering Economics chapter of the *FE Reference Handbook*.



$$\begin{aligned}
 A &= A_m + P \left( \frac{A}{P}, i, n \right) - SV \left( \frac{A}{F}, i, n \right) \\
 &= 500 + 7,500 \left( \frac{A}{P}, 10\%, 10 \right) - 5,000 \left( \frac{A}{F}, 10\%, 10 \right) \\
 &= 500 + 7,500(0.16275) - 5,000(0.06275) \\
 &= \$1,407 \text{ per year}
 \end{aligned}$$

**THE CORRECT ANSWER IS: C**

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12. A lien is a:

- A. claim on property for payment of a debt
- B. requirement that a contractor secure a performance bond for a project
- C. requirement that a contractor secure a payment bond for a project
- D. claim for damages for lack of specific performance

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12. *Black's Law Dictionary* defines *lien* as a claim on property for payment of debt. Examinees are expected to be familiar with liens.

**THE CORRECT ANSWER IS: A**

E

15. An engineer has been asked to evaluate several projects for planning the following fiscal year. The probability of success and the payoff of the project, if successful, are shown. Given these values, rank the projects from lowest to highest expected payoff.

Project	Probability of Success	Payoff	Ranking (lowest to highest)
Project A	40%	\$3,500,000	
Project B	65%	\$1,250,000	
Project C	75%	\$2,750,000	

Expected value of Project B =  $(0.65)(\$1,250,000) = \$812,500$  (lowest payoff)

Expected value of Project A =  $(0.4)(\$3,500,000) = \$1,400,000$

Expected value of Project C =  $(0.75)(\$2,750,000) = \$2,062,500$  (highest payoff)

**THE CORRECT ANSWERS ARE SHOWN ABOVE.**

16. A factory can buy and install energy-saving equipment at a cost of \$450,000. The equipment will save \$65,000 in energy costs each year for 10 years. The equipment's salvage value at that time will be \$50,000. The firm evaluates energy-saving projects at an interest rate of 6%. The present worth of this equipment to the nearest \$100 is \_\_\_\_\_.

Enter your response in the blank.

16. Refer to the table of cash flow formulas in the Engineering Economics chapter of the *FE Reference Handbook*.

$$PW = -450,000 + 65,000 (P/A, 6\%, 10) + 50,000 (P/F, 6\%, 10)$$

$$PW = -450,000 + 65,000 (7.3601) + 50,000 (0.5584)$$

$$= -450,000 + 478,406.5 + 27,920$$

$$= \$56,326.50 \text{ to the nearest } \$100$$

$$= \$56,300$$

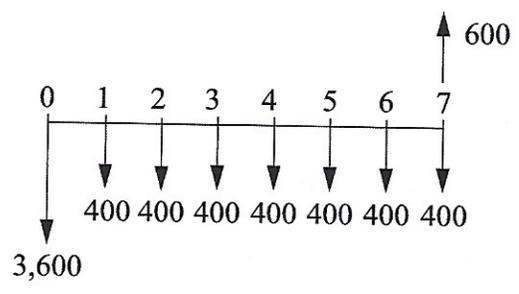
**THE CORRECT ANSWER IS: \$56,300**

15. A new sander costs \$3,600 and has an annual maintenance cost of \$400. Salvage value after 7 years is \$600. If the interest rate is 10%, the present worth is most nearly:

- A. -\$1,640
- B. -\$3,290
- C. -\$3,600
- D. -\$5,240

15. Refer to the table of cash flow formulas in the Engineering Economics chapter of the *FE Reference Handbook*.

$$\begin{aligned} PW &= -3,600 - 400 (P/A, 10\%, 7) + 600 (P/F, 10\%, 7) \\ &= -3,600 - 400 (4.8684) + 600 (0.5132) \\ &= -5,239.4 \end{aligned}$$



**THE CORRECT ANSWER IS: D**

M

16. Economic analysis will be used to compute an equivalent value today for an estimated constant monthly expense that is projected to occur each month over the next three years.

Select the column in the factor table that contains the value that could be used for the analysis.

Factor Table  $-i = 2.00\%$

$n$	$P/F$	$P/A$	$P/G$	$F/P$	$F/A$	$A/P$	$A/F$	$A/G$
1	0.9804	0.9804	0.0000	1.0200	1.0000	1.0200	1.0000	0.0000
2	0.9612	1.9416	0.9612	1.0404	2.0200	0.5150	0.4950	0.4950
3	0.9423	2.8839	2.8458	1.0612	3.0604	0.3468	0.3268	0.9868
4	0.9238	3.8077	5.6173	1.0824	4.1216	0.2626	0.2426	1.4752
<b>5</b>	<b>0.9057</b>	<b>4.7135</b>	<b>9.2403</b>	<b>1.1041</b>	<b>5.2040</b>	<b>0.2122</b>	<b>0.1922</b>	<b>1.9604</b>
6	0.8880	5.6014	13.6801	1.1262	6.3081	0.1785	0.1585	2.4423
7	0.8706	6.4720	18.9035	1.1487	7.4343	0.1545	0.1345	2.9208
8	0.8535	7.3255	24.8779	1.1717	8.5830	0.1365	0.1165	3.3961
9	0.8368	8.1622	31.5720	1.1951	9.7546	0.1225	0.1025	3.8681
<b>10</b>	<b>0.8203</b>	<b>8.9826</b>	<b>38.9551</b>	<b>1.2190</b>	<b>10.9497</b>	<b>0.1113</b>	<b>0.0913</b>	<b>4.3367</b>
11	0.8043	9.7868	46.9977	1.2434	12.1687	0.1022	0.0822	4.8021
12	0.7885	10.5753	55.6712	1.2682	13.4121	0.0946	0.0746	5.2642
13	0.7730	11.3484	64.9475	1.2936	14.6803	0.0881	0.0681	5.7231
14	0.7579	12.1062	74.7999	1.3195	15.9739	0.0826	0.0626	6.1786
<b>15</b>	<b>0.7430</b>	<b>12.8493</b>	<b>85.2021</b>	<b>1.3459</b>	<b>17.2934</b>	<b>0.0778</b>	<b>0.0578</b>	<b>6.6309</b>
16	0.7284	13.5777	96.1288	1.3728	18.6393	0.0737	0.0537	7.0799
17	0.7142	14.2919	107.5554	1.4002	20.0121	0.0700	0.0500	7.5256
18	0.7002	14.9920	119.4581	1.4282	21.4123	0.0677	0.0467	7.9681
19	0.6864	15.6785	131.8139	1.4568	22.8406	0.0638	0.0438	8.4073
<b>20</b>	<b>0.6730</b>	<b>16.3514</b>	<b>144.6003</b>	<b>1.4859</b>	<b>24.2974</b>	<b>0.0612</b>	<b>0.0412</b>	<b>8.8433</b>
21	0.6598	17.0112	157.7959	1.5157	25.7833	0.0588	0.0388	9.2760
22	0.6468	17.6580	171.3795	1.5460	27.2990	0.0566	0.0366	9.7055
23	0.6342	18.2922	185.3309	1.5769	28.8450	0.0547	0.0347	10.1317
24	0.6217	18.9139	199.6305	1.6084	30.4219	0.0529	0.0329	10.5547
<b>25</b>	<b>0.6095</b>	<b>19.5235</b>	<b>214.2592</b>	<b>1.6406</b>	<b>32.0303</b>	<b>0.0512</b>	<b>0.0312</b>	<b>10.9745</b>
30	0.5521	22.3965	291.7164	1.8114	40.5681	0.0446	0.0246	13.0251
40	0.4529	27.3555	461.9931	2.2080	60.4020	0.0366	0.0166	16.8885
50	0.3715	31.4236	642.3606	2.6916	84.5794	0.0318	0.0118	20.4420
60	0.3048	34.7609	823.6975	3.2810	114.0515	0.0288	0.0088	23.6961
<b>100</b>	<b>0.1380</b>	<b>43.0984</b>	<b>1,464.7527</b>	<b>7.2446</b>	<b>312.2323</b>	<b>0.0232</b>	<b>0.0032</b>	<b>33.9863</b>

16. Compute  $P$  (present value) given  $A$  (the periodic value) for  $P/A$ . Uniform series present worth factors are described in the Engineering Economics chapter of the *FE Reference Handbook*.

Factor Table  $-i = 2.00\%$

$n$	$P/F$	$P/A$	$P/G$	$F/P$	$F/A$	$A/P$	$A/F$	$A/G$
1	0.9804	0.9804	0.0000	1.0200	1.0000	1.0200	1.0000	0.0000
2	0.9612	1.9416	0.9612	1.0404	2.0200	0.5150	0.4950	0.4950
3	0.9423	2.8839	2.8458	1.0612	3.0604	0.3468	0.3268	0.9868
4	0.9238	3.8077	5.6173	1.0824	4.1216	0.2626	0.2426	1.4752

ME

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15. A printer costs \$900. Its salvage value after 5 years is \$300. Annual maintenance is \$50. If the interest rate is 8%, the equivalent uniform annual cost is \_\_\_\_\_.

Enter your response in the blank. Answer to the nearest integer.

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15. Refer to the Engineering Economics chapter of the FE Reference Handbook.

$$\begin{aligned} \text{Annual cost:} &= \text{cost} + \text{maintenance} - \text{salvage} \\ \text{Annual cost:} &= \$900(A/P, 8\%, 5) + \$50 - \$300(A/F, 8\%, 5) \\ &= \$900(0.2505) + \$50 - \$300(0.1705) \\ &= \$225.45 + \$50 - \$51.15 \\ &= \$224.30 \end{aligned}$$

**THE CORRECT ANSWER IS: 224 OR 225**

17. A business owner wants to build a reserve fund. To have \$50,000 in the fund at the end of 10 years, the amount the owner will need to invest annually, assuming an annual return of 5%, is most nearly:

- A. \$951
- B. \$1,535
- C. \$2,500
- D. \$3,975

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$$A = \$50,000 \cdot \frac{0.05}{(1+0.05)^{10} - 1}$$

$$A = \$3,975$$

**THE CORRECT ANSWER IS: D**

**FE INDUSTRIAL AND SYSTEMS PRACTICE EXAM**

17. Match each of the costs below with its correct category.

**Variable Costs**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Fixed Costs**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Costs**

Building  
Depreciation

Consumables

Direct Labor

Property Tax

Raw Materials

Salaries

17. Variable costs are costs that vary with output. Fixed costs do not vary with the volume of production. Examinees should be familiar with these concepts.

**Variable Costs**

Direct Labor

Consumables

Raw Materials

**Fixed Costs**

Property Tax

Salaries

Building  
Depreciation

**THE CORRECTLY SORTED COSTS ARE SHOWN ABOVE.**