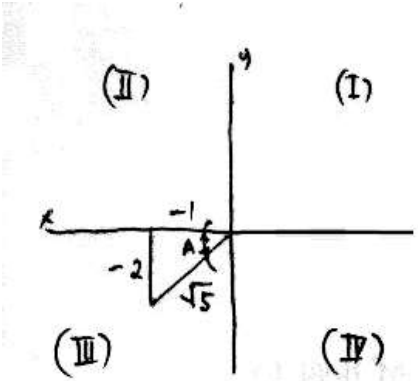
Answer Key

ENGINEERING MATHEMATICS

Refresher 03

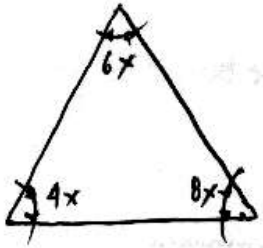


$$\cos A = \frac{1}{\sec A} = \frac{\text{adjacent}}{\text{hypotheneus}}$$

$$\sec A = \frac{\sqrt{5}}{-1}$$

$$\sec A = -\sqrt{5}$$

2



$4x + 6x + 8x = 180°$

$x = 10°$

Note: 1 rev = 360° = 6400 mils

Smallest angle:

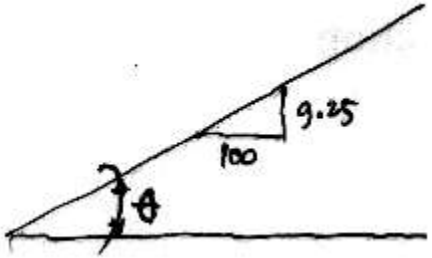
$$4x = (40°)\left(\frac{6400 \text{ mils}}{360°}\right)$$

Smallest Angle = 711.1111 mils

3

Percentage

4



$$\tan\theta = \frac{9.25}{100}$$

$$\theta = 5.2848^\circ$$

5

$A_1 - A_2 = 8\ ft^2$ $\qquad$ $P_1 - P_2 = 5\ ft$

for square: $b_1 = b_2$

$b_1^2 - b_2^2 = 8\ ft^2 \longrightarrow (1)$ $\qquad$ $4b_1 - 4b_2 = 5\ ft$

$$b_1 = \frac{5 + 4b_2}{4} \longrightarrow (2)$$

Subst. (2) to (1)

$$\left(\frac{5 + 4b_2}{4}\right)^2 - b_2^2 = 8\ ft^2$$

$b_2 = 2.575\ ft$

$b_1 = 3.825\ ft$

Hence; sum of areas:

$$A_1 + A_2 = (3.825\ ft)^2 + (2.575\ ft)^2$$

$$A_1 + A_2 = 21.26125\ ft^2$$

6

180 deg

7

Sector

8

Axis

9

M_L = male population literate

F_L = female population literate

$F + M = 1500$

$F = 1500 - M$ ← (1)

$F_L + M_L = (0.55)(1500)$ "literate

$F_L + M_L = 825$ ← (2)

$F_L = 0.75F$

$M_L = 0.60M$

Hence;

$0.75F + 0.60M = 825$

$0.75(1500 - M) + 0.60M = 825$

$\boxed{M = 2000}$

10

$$CC = C_o + P_{o/m} + \frac{C_o - C_L}{(1+i)^n - 1}$$

$$= ₱300{,}000 + \frac{₱8{,}000}{0.08}$$

$$CC = ₱400{,}000$$

11

Algebra

12

Helix

13

Corrosion

14

$$ei_{Annually} = ei_{semi\text{-}annually}$$

$$(1+i)^1 = \left(1 + \frac{0.06}{2}\right)^2$$

$$i = 6.09\%$$

$$P = \frac{A}{i}$$

$$₱30{,}000 = \frac{A}{0.0609}$$

$$A = ₱1{,}827$$

15

$$e_{i_{monthly}} = e_{i_{annually}}$$

$$(1+i)^{12} = (1+0.05)^{1}$$

$$i = 4.0741 \times 10^{-3}$$

$$i = 0.40741\%$$

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$\$120{,}000 = A\left[\frac{1-(1.004074)^{-(12)(9)}}{4.0741 \times 10^{-3}}\right]$$

$$A = \$1{,}375.6515$$

16

$$F = P(1+i)^N$$

$$= ₱9{,}000\left(1+\frac{0.17}{12}\right)^{(12)(9/12)}$$

$$F = ₱9{,}931.3396$$

17

Pitching

18

4 deg C

19

It needs 0.42 calorie to warm it by 1 deg

20

$e_i = 27.54\%$ compounded monthly

$$e_{i\,monthly} = e_{i\,quarterly}$$

$$0.2754 = \left(1 + \frac{i_n}{m}\right)^q - 1$$

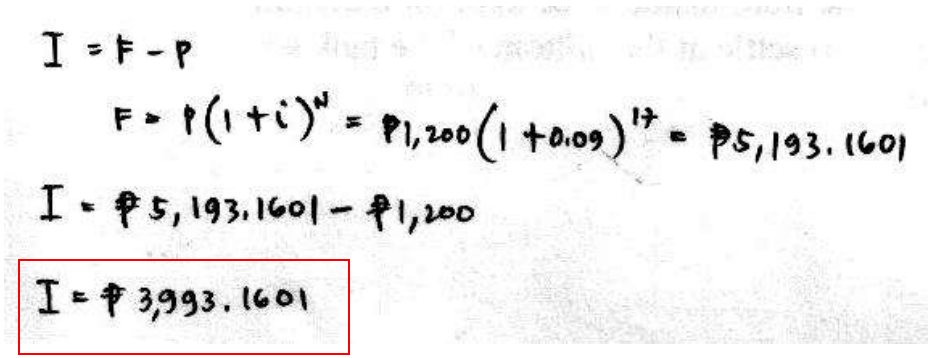
$$i = \frac{i_n}{m} = 0.06270 \quad \text{quarterly}$$

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$P = ₱26{,}000\left[\frac{1-(1.06270)^{-(12)(5)}}{0.06270}\right]$$

$$\boxed{P = ₱403{,}881.9648}$$

21



$$I = F - P$$

$$F = P(1+i)^N = ₱1,200(1+0.09)^{17} = ₱5,193.1601$$

$$I = ₱5,193.1601 - ₱1,200$$

$$I = ₱3,993.1601$$

22

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$= ₱530.22\left[\frac{1-(1.01142)^{-360}}{0.01142}\right]$$

$$P = ₱45,650.2527$$

23

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$= ₱12{,}000\left[\frac{1-(1.083)^{-18}}{0.083}\right]$$

$$P = ₱110{,}159.8929$$

24

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$₱632,000 = A\left[\frac{1-(1.0095)^{-36}}{0.0095}\right]$$

$$A = ₱20,810.7914$$

25

Pascal's Principle

26

Ethical and legal are the same action

27

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$₱20{,}000 = ₱1{,}300\left[\frac{(1.11)^N - 1}{0.11}\right]$$

$$N = 9.4902 \text{ years}$$

$$N \approx 9.5 \text{ years}$$

28

$$I = 0.06P$$

$$F = P + I = P + 0.06P$$

$$F = P(1.06)$$

from:

$$F = P(1+i)^N$$

$$P(1.06) = P(1+i)^{(12)(\frac{1}{2})}$$

$$\boxed{i = 0.9759\%}$$

29

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$₱700{,}000 = A\left[\frac{(1+0.0096)^{(6)(12)} - 1}{0.0096}\right]$$

$$A = ₱6{,}297.7648$$

30

$C_0 = ₱1,200,000$

$L = 7$ years

$C_L = ₱110,000$

Find; C_5

$$d = \frac{C_0 - C_L}{L} = \frac{₱1,200,000 - ₱110,000}{7}$$

$d = ₱155,714.2857$

then;

$C_5 = C_0 - 5(d)$

$C_5 = ₱1,200,000 - 5(₱155,714.2857)$

$C_5 = ₱421,428.5714$

31

1997 C_o = ₱900,000

L = 5 years

C_L = ₱92,400

USING: SYDM

$$d_n = \frac{\text{Reversed Digit}}{\text{Sum of Digit}} (C_o - C_L)$$

1997	1	5
1998	2	4
1999	3	3
2000	4	2
2001	5	1

Reversed Digit = 3

or using: Reversed Digit = $L - n + 1$

$$\text{Sum of Digit} = \frac{L}{2}(L+1) = \frac{5}{2}(5+1) = 15$$

$$d_3 = \frac{3}{15}(₱900{,}000 - ₱92{,}400)$$

$$d_3 = ₱161{,}520$$

32

$L = 5$ years

$C_o = ₱550{,}000$

$C_L = (0.35)(₱550{,}000) = ₱192{,}500$

Inflation $= i_f = 12\%$

Appreciation $= i_a = 12\%$

Due to inflation

$$C_o' = C_o(1 + i_f)^n$$

$$= ₱550{,}000(1.12)^5$$

$$C_o' = ₱969{,}287.9258$$

Due to appreciation

$$C_L' = C_L(1 + i_a)^n$$

$$= ₱192{,}500(1.12)^5$$

$$C_L' = ₱339{,}250.774$$

Replacement cost $= C_o' - C_L'$

$= ₱969{,}287.9258 - ₱339{,}250.774$

Replacement cost $= ₱630{,}037.1518$

33

RATE of return earned

$$F = P(1+i)^N$$

$$₱500,000 = ₱290,000(1+i)^5$$

$$\boxed{i = 11.51\%}$$

34

Feb 12, 1998

35

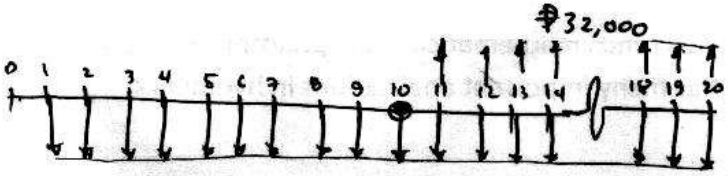
Schedule expenses

36

4

Examination, registration and license

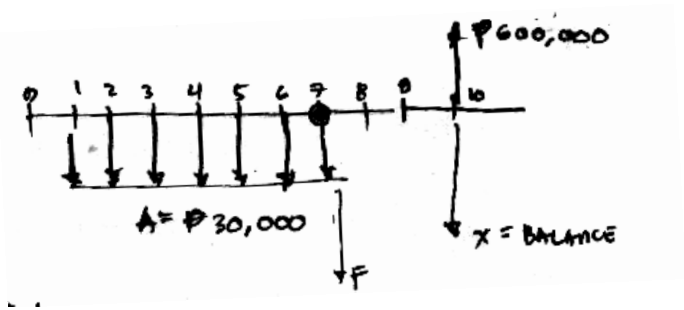
38



$$A\left[\frac{(1.045)^{10}-1}{0.045}\right]+A\left[\frac{1-(1.045)^{-10}}{0.045}\right]=₱32000\left[\frac{1-(1.045)^{-10}}{0.045}\right]$$

$$A=₱12,534.4235$$

39



$$₱450{,}000 = F(1.07)^4 + X$$

$$₱600{,}000 = ₱30{,}000\left[\frac{(1.07)^7 - 1}{0.07}\right](1.07)^4 + X$$

$$X = ₱259{,}690.3104$$

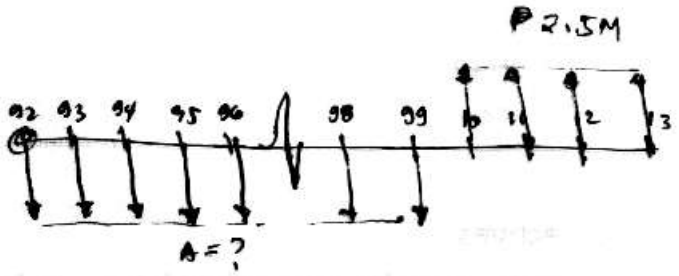
40

1793 and 9806

41

The total resistance is the sum of the individual resistors

42



$$A\left[\frac{(1.04)^{17}-1}{0.04}\right] = ₱2.5M\left[\frac{1-(1.04)^{-4}}{0.04}\right]$$

$$A = ₱382,940.5345$$

43

i_n = 9% compounded semi-annualy

$i = \frac{i_n}{m} = \frac{9\%}{2} = 4.5\%$ per 6 months

$$P = A\left[\frac{1-(1+i)^{-N}}{i}\right]$$

$$₱180{,}000 = A\left[\frac{1-(1.045)^{-10}}{0.045}\right]$$

$$A = ₱22{,}748.1879$$

Hence;

$$P = ₱22{,}748.1879\left[\frac{1-(1.045)^{-6}}{0.045}\right]$$

$$P = ₱117{,}332.2525$$

44

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$₱6{,}432{,}000 = A\left[\frac{(1+0.09)^5 - 1}{0.09}\right]$$

$$A = ₱1{,}074{,}738.683$$

45

Portable boiler

46

Asbestos

47

Splash system

48

300 kW

49

35

50

Balance sheet and the profit and loss statements

51

C_o = ₱22,000
C_L = ₱1,800
L = 8 years
i_f = 7%
i_i = 8%
N = 8

Due to inflation

$$C_o' = C_o(1+i_f)^N = ₱22,000\,(1+0.07)^8$$

$$C_o' = ₱37,800.0959$$

Replacement cost = $C_o' - C_L$ = ₱37,800.0959 − ₱1,800

Replacement cost = ₱36,000.0959

Hence;

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$₱36,000.0959 = A\left[\frac{(1+0.08)^8 - 1}{0.08}\right]$$

$$A = ₱3,384.5404$$

52

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$₱130{,}000 = A\left[\frac{(1.025)^{10} - 1}{0.025}\right]$$

$$A = ₱11{,}603.6392$$

53

Labor cost

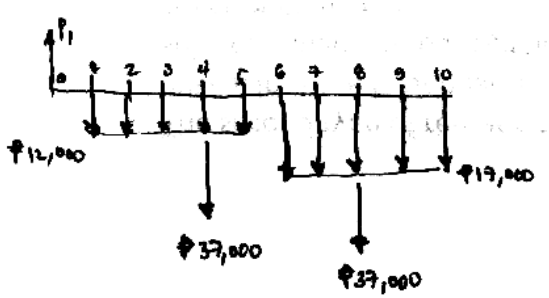
54

The acceleration of the gases through the engine

55

pH 10 to pH 11

56



$$P_1 = ₱12{,}000\left[\frac{1-(1.07)^{-5}}{0.07}\right] + ₱37{,}000(1.07)^{-4} + ₱17{,}000\left[\frac{1-1.07)^{-5}}{0.07}\right](1.07)^{-5} + ₱37{,}000(1.07)^{-8}$$

$$P_1 = ₱148{,}661.3587$$

then;

$$₱148{,}661.3587 = P_2 = A\left[\frac{1-(1.07)^{-10}}{0.07}\right]$$

$$A = ₱21{,}166.0330$$

57

$$P = ₱65{,}000\left[\frac{1-(1.10)^{-10}}{0.10}\right] + ₱40{,}000\left[\frac{1-(1.10)^{-90}}{0.10}\right](1.10)^{-10}$$

$$P = ₱550{,}206.7571$$

58

$$d = \frac{C_o - C_L}{L} = \frac{₱520,300 - ₱60,000}{20}$$

$$d = ₱23,015$$

59

Lowest water space

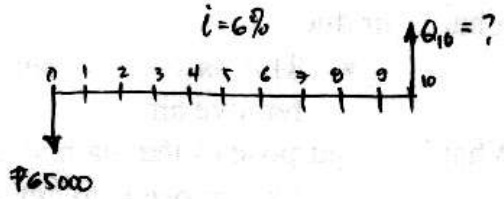
60

Is below the container surface due to cohesion

61

Surface tension

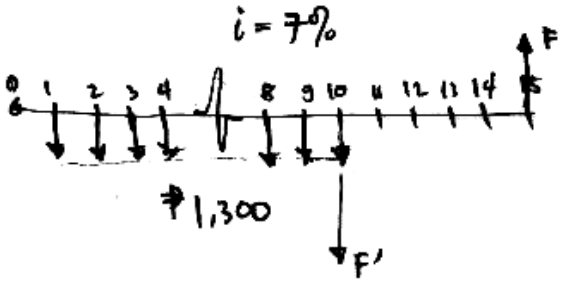
62



$$Q_{10} = ₱65000\,(1.06)^{10}$$

$$Q_{10} = ₱116,405.1003$$

63



$$F = F'(1.07)^5$$

$$F = ₱1{,}300\left[\frac{(1.07)^{10}-1}{0.07}\right](1.07)^5$$

$$F = ₱25{,}191.7679$$

64

$F = 2P$

$F = P(1+i)^N$; $i = \frac{i_n}{m} = 1\%$ per month

$2P = P(1.01)^N$

$2 = 1.01^N$

$\ln 2 = N \ln 1.01$

$N = \frac{\ln 2}{\ln 1.01}$

$N = 69.6607$

$N = 70$ months

65

$C_0 = ₱12{,}000$

$L = 20$ years

$C_L = 0$

REQUIRED: d_{11} using SYDM

$$d_n = \frac{\text{Reversed Digit}}{\text{Sum of Digit}}(C_0 - C_L)$$

$$\text{Reversed Digit} = L - n + 1 = 20 - 11 + 1 = 10$$

$$\text{Sum of Digit} = \frac{L}{2}(L+1) = \frac{20}{2}(20+1) = 210$$

$$d_{11} = \frac{10}{210}(₱12{,}000 - 0)$$

$$\boxed{d_{11} = ₱571.4286}$$

66

$$(₱1,200)(60) = A\left[\frac{(1.05)^{15}-1}{0.05}\right]$$

$$A = ₱3,336.6447$$

Hence;

$$F_{12} = ₱3,336.6447\left[\frac{(1.05)^{12}-1}{0.05}\right]$$

$$F_{12} = ₱53,109.7959$$

67

$$d_n = \frac{\text{Reversed Digit}}{\text{Sum of Digit}} (C_0 - C_L)$$

$$\text{Reversed Digit} = L - n + 1 = 10 - 7 + 1 = 4$$

$$\text{Sum of Digit} = \frac{L}{2}(L+1) = \frac{10}{2}(10+1) = 55$$

Book Value During 7th year

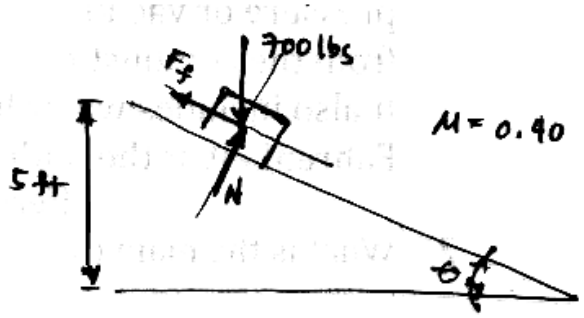
$$C_n = C_0 - D_n$$

$$C_n = C_0 - (d_1 + d_2 + d_3 + \dots + d_n)$$

$$C_7 = ₱8{,}000 - \frac{(₱8{,}000 - ₱1{,}000)}{55}(4+5+6+7+8+9+10)$$

$$C_7 = ₱1{,}763.6364$$

68



Block will START to impede : $\theta = \phi$

$$\tan\theta = \frac{5\text{ ft}}{\sqrt{9^2 + 5^2}\text{ ft}^2}$$

$$\theta = 25.9032^\circ$$

and;

$$\tan\phi = \mu = 0.40$$

$$\phi = 21.8014^\circ$$

since : $\theta > \phi$; then the object will slide

therefore : HOLD BACK

69

nth term:

$$a_n = a_1 + (n-1)d$$

Sum of Arithmetic Progression

$$S = \frac{n}{2}(a_1 + a_n)$$

$$a_{98} = 1.03 + (98-1)(-0.01)$$

$$a_{98} = 0.06$$

Characteristic length, mass flow rate per unit area, and absolute viscosity

Physical inventory

Prime cost

73

2/3 H from the vertex

74

$$PV = mRT$$

$$\rho = \frac{m}{V} = \frac{P}{RT}$$

$$\frac{P_1}{T_1 \rho_1} = \frac{P_2}{T_2 \rho_2}$$

$$\frac{2\ \text{atm}}{(105+460)^\circ\text{R}\left(0.095\ \frac{\text{lb}}{\text{ft}^3}\right)} = \frac{P_2}{(260+460)^\circ\text{R}\left(0.281\ \frac{\text{lb}}{\text{ft}^3}\right)}$$

$$P_2 = 7.5387\ \text{atm}$$

75

$$x^2 + y^2 + z^2 - 3x + 9y + 18z + 68 = 0$$

$$\left(x^2 - 3x + \frac{9}{4}\right) + \left(y^2 + 9y + \frac{81}{4}\right) + \left(z^2 + 18z + 81\right) = -68 + \frac{9}{4} + \frac{81}{4} + 81$$

Thus; $r^2 = \frac{71}{2}$

$r = 5.9582$

76

$N_1 = 1800$ rpm

$Q_1 = 600$ gpm

$H_1 = 250$ ft

Due to change in piping system

$H_2 = 380$ ft

from pump Affinity laws

$$\frac{H_2}{H_1} = \left(\frac{N_2}{N_1}\right)^2$$

$$\frac{380\text{ft}}{250\text{ft}} = \left(\frac{N_2}{1800\text{rpm}}\right)^2$$

$$N_2 = 2219.1890 \text{ rpm}$$

77

$$\tan(2D-3) = \frac{1}{\tan(5D-9)}$$

Find D in degrees

using Calculator or trial and error:

$$D = 14.57°$$

78

0.1

Fusion welding

Lime soda treatment

81

It is valid only for potential flow

82

Assets = liabilities + owner's equity

83

$$J = \frac{\pi D^4}{32} = \frac{\pi (0.003\,m)^4}{32} = 7.9522 \times 10^{-12}\,m^4$$

from; $\tau_s = \frac{Tc}{J}$

$$80000\,kPa = \frac{T\,(1.5 \times 10^{-3}\,m)}{(7.9522 \times 10^{-12}\,m^4)}$$

$$T = 4.2412 \times 10^{-4}\,kN\text{-}m$$

2 complete revolutions:

$$(2)(360^\circ)\left(\frac{\pi}{180^\circ}\right) = 4\pi\ rad$$

Hence; $\theta = \frac{TL}{JG}$

$$4\pi = \frac{(4.2412 \times 10^{-4}\,kN\text{-}m)\,L}{(7.9522 \times 10^{-12}\,m^4)(38 \times 10^6\,kPa)}$$

$$L = 8.9535\,m$$

84

nth term

$$a_n = a_1 + (n-1)d$$

$$a_{10} = 18.1\ ft + (10-1)(32.2)$$

$$\boxed{a_{10} = 307.9\ ft}$$

85

$$P_{\text{at least 2 heads in 4 toss}} = P_{\text{2 heads}} + P_{\text{3 heads}} + P_{\text{4 heads}}$$

$$\text{Use Probability of Repeated trials} = {}_4C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^2 + {}_4C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^1 + {}_4C_4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^0$$

$$\text{Pat least 2 heads in 4 toss} = \frac{11}{16}$$

86

$$F = \frac{A}{i} = \frac{₱11{,}000}{0.12} = ₱91666.6667$$

then;

$$F = P(1+i)^N$$

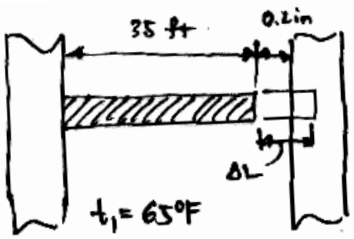
$$₱91666.6667 = ₱63{,}052\,(1.12)^N$$

$$N = 3.3019 \text{ years}$$

$$N = 3.5 \text{ years}$$

There must be an acceptance of the offer

88



$t_1 = 65°F$

$t_2 = 145°F$

$\alpha = 6.8 \times 10^{-6}/°F$

$E = 32 \times 10^6$ psi

From Hooke's Law:

$$S_T = E\epsilon$$

$$S_T = \frac{E\Delta L}{L}; \quad \Delta L = \alpha L \Delta T$$

$$= \left(6.8 \times 10^{-6}/°F\right)(35\,ft)(145 - 65)°F$$

$$\Delta L = (0.01904\,ft)\left(\frac{12\,in}{1\,ft}\right)$$

$$\Delta L = 0.22848\,in$$

Hence;

$$\Delta L' = \Delta L - 0.2\,in$$

$$= 0.22848\,in - 0.2\,in$$

$$\Delta L' = 0.02848\,in$$

$$S_T = (32 \times 10^6\,psi)\left[\frac{0.02848\,in}{(35\,ft)\left(\frac{12\,in}{1\,ft}\right)}\right]$$

$$S_T = 2{,}169.9048\,psi \text{ compressive}$$

89

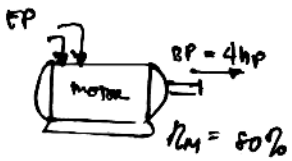
$$P = ₱7,900 + ₱1,200\left[\frac{1-\left(1+\frac{0.07}{12}\right)^{-12}}{\frac{0.07}{12}}\right]$$

$$P = ₱21,768.5442$$

90

Professional Mechanical Engineer (PME)

91



Power cost:

1st	100 kw-hr	₱6.0/kw-hr
2nd	100 kw-hr	₱5.0/kw-hr
Remaining	kw-hr	₱4.0/kw-hr

Running time: 10 days continuous operation

$$\eta_M = \frac{BP}{EP}$$

$$EP = \frac{BP}{\eta_M} = \left(\frac{4\,hp}{0.80}\right)\left(\frac{0.746\,kw}{1\,hp}\right) = 3.73\,kW$$

Energy consumption

$$EP = (3.73\,kw)(10\,days)\left(\frac{24\,hrs}{1\,day}\right)$$

$$EP = 895.2\,kw-hr$$

thus;

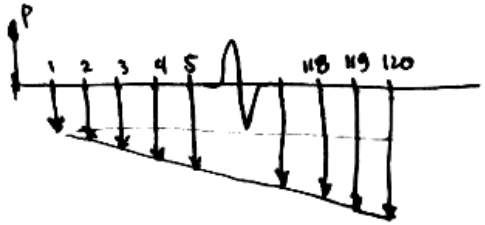
1st 100 kw-hr ⟶ $\frac{₱6.0}{kw-hr}(100\,kw-hr)$ = ₱600

2nd 100 kw-hr ⟶ $\frac{₱5.0}{kw-hr}(100\,kw-hr)$ = ₱500

Remaining kw-hr ⟶ $\frac{₱4.0}{kw-hr}(895.2\,kw-hr)$ = ₱3,580.8

₱4,680.8

92



$i = \frac{10\%}{12} = 0.8333\%$ monthly

Amount of debt;

$$P = P_{ANNUITY} + P_{GRADIENT}$$

$$= ₱6{,}000\left[\frac{1-(1.008333)^{-120}}{0.008333}\right] + \frac{₱1000}{0.008333}\left[\frac{(1.008333)^{120}-1}{0.008333} - 120\right](1.008333)^{-120}$$

$$P = ₱4{,}219{,}995.172$$

93

He must be Certified Plant Mechanic

94

Escalatory clause

95 to 97

TOTAL current ASSET = CASH + A/R + MI + N/R

TCA = ₱60,000 + ₱120,000 + ₱210,000 + ₱150,000

TCA = ₱540,000

TOTAL current LIABILITIES = N/P + A/P + S/P

TCL = ₱70,000 + ₱140,000 + ₱30,000

TCL = ₱240,000

CURRENT RATIO

$$CR = \frac{TCA}{TCL} = \frac{₱540,000}{₱240,000}$$

CR = 2.25

Two speed drive motor

Net income before taxes/net sales

100

Gamma radiation