Question 1 (algorithmic, number set may not match your exact assignment):

1. BE units = $\frac{F + \pi_B}{(p - v)} = \frac{\$75{,}000 + 0}{(\$10 - \$6)/\text{unit}} =$ **18,750 units**

2. BE dollars = $\frac{F + \pi_B}{\frac{(p - v)}{p}} = \frac{\$75{,}000 + 0}{\frac{\$10 - \$6}{\$10}} = \frac{\$75{,}000}{0.40} =$ **$187,500**

   Or: BE units × selling price per unit
   = 18,750 units × $10 = **$187,500**

3. $Q = \frac{F + \pi_B}{(p - v)} = \frac{\$75{,}000 + \$40{,}000}{(\$10 - \$6)} =$ **28,750 units**

4. $pQ = \frac{F + \pi_B}{\frac{(p - v)}{p}} = \frac{\$75{,}000 + \$35{,}000}{\frac{\$10 - \$6}{\$10}} = \frac{\$110{,}000}{0.40} =$ **$275,000**

5. $Q = \frac{F + \pi_B}{(p - v)} = \frac{F + \pi_A/(1 - t)}{(p - v)}$

   $= \frac{\$75{,}000 + \$25{,}000/(1 - 0.3)}{(\$10 - \$6)/\text{unit}} = \frac{\$75{,}000 + \$35{,}714}{\$4/\text{unit}}$

   = **27,679 units** (rounded up to the nearest whole unit)

   Using the contribution margin ratio (CMR):

$pQ = \frac{F + \pi_A/(1 - t)}{\frac{p - v}{p}} = \frac{\$75{,}000 + \$35{,}714}{\frac{\$10 - \$6}{\$10}} = \frac{\$110{,}714}{0.40} =$ **$276,786**

It is not possible to sell a fraction of a unit, so we need to round up.
27,679 units × $10/unit = **$276,790 (rounding difference is $4.00)**

Question 2 (algorithmic, number set may not match your exact assignment):

1. Contribution margin ratio (CMR) = Contribution margin / Sales

   Thus, CMR = ($46,000,000 − $32,200,000) / $46,000,000

   = $13,800,000 / $46,000,000 = 0.30

   BE in dollars = Fixed costs (F) / CMR

   = $7,500,000 / 0.30 = **$25,000,000**

2. $\frac{F + \pi_B}{CMR} = \frac{\$7,500,000 + \$8,000,000}{0.30} =$ **$51,666,667**

1. Variable cost ratio = Total variable costs / Sales ($)

   = (Original variable costs × 1.12) / Sales ($)

   = ($32,200,000 × 1.12) / $46,000,000

   = $36,064,000 / $46,000,000 = **0.784**

   CMR = 1 – Variable cost ratio

   = 1 − 0.784 = 0.216

   BE ($) = Fixed costs / CMR

   = $7,500,000 / 0.216

   = **$34,722,222**

Question 3 (algorithmic, number set may not match your exact assignment):

1. First, calculate the breakeven point, using the contribution margin ratio (CMR), as follows:

   CMR = Contribution Margin / Sales = $227,500 / $650,000 = 0.35

Breakeven in dollars = Fixed Costs / CMR = $105,000 / 0.35 = $300,000

Therefore:

MOS, in dollars = Budgeted sales – Breakeven sales dollars
= $650,000 – $300,000 = **$350,000**

MOS ratio = MOS / Budgeted sales (in dollars)
= $350,000 / $650,000 = **53.85%**

2. The MOS and related MOS ratio or percentage are rough measures of *operating risk*. They indicate the amount by which sales could fall—either in absolute dollars or in percentage terms—before losses are incurred.

3. If sales fall to $500,000, the breakeven point will remain the same, but the MOS will change:

MOS, in dollars = Budgeted sales – Breakeven sales
= $500,000 – $300,000 = **$200,000**

Operating profit:

Contribution margin = Sales $ × CMR		
	= $500,000 × 0.35 =	$175,000
Less fixed costs		105,000
Operating profit	=	**$ 70,000**

Or, using the relationship between the MOS and operating profit:

Operating profit = MOS × CMR
$70,000 = $200,000 × 0.35

Why this works:

Operating profit = MOS × CMR
= (Expected Sales − Breakeven) × CMR
= (Expected Sales × CMR) − (Breakeven sales × CMR)
= Contribution Margin − Fixed costs (F) = Operating profit

(**Note**: By definition, Breakeven in sales dollars × CMR = Fixed costs; at the breakeven point there is just enough contribution margin generated to cover total fixed costs, F)

Question 4 (algorithmic, number set may not match your exact assignment):

1. Breakeven volumes (total external costs/year = $2*Q*):

For Machine A	**For Machine B**
$2*Q* = $0.65*Q* + $135,000	$2*Q* = $0.3*Q* + $204,000
Q = **100,000**	*Q* = **120,000**

2. Cost indifference point, *Q*:

Cost using Machine A	=	Cost using Machine B
$0.65*Q* + $135,000	=	$0.30*Q* + $204,000
$0.35*Q*	=	$69,000
Q	=	**197,143 units**

When 197,143 switches are needed, the Vista Company is indifferent as to which machine to use; the total cost under each of the two decision alternatives is the same at this volume.

An alternative way to determine the indifference point is:

$$\frac{\text{Fixed costs of Machine B} - \text{Fixed costs of Machine A}}{\text{Unit variable costs of A} - \text{Unit variable costs of B}}$$

$$\frac{\$204,000 - \$135,000}{(\$0.65 - \$0.30)/\text{unit}}$$

= $69,000 / $0.35/unit = **197,143 units**

Summary of (1) and (2): If output is less than 100,000, buy the switches; if output is less than 197,143 units but greater than 100,000, buy and use machine A; if output is greater than 197,143 units, then buy and use machine B.

2. Total costs if volume = 200,000 units/year:

Costs when purchasing from outside supplier:
$2/unit × 200,000 units = $400,000

Costs when using machine A:
$135,000 + ($0.65/unit × 200,000 units) = **$265,000**

Costs when using machine B:
$204,000 + ($0.30 ×200,000) = **$264,000**

When 200,000 switches are needed, it is most profitable to produce them with machine B, though the difference is only $1,000.

4. Recommendation to management:

Considerations regarding outsourcing (rather than making internally): What is the reliability of the existing supplier? What are likely price increases in the future from this supplier? What is the reliability of the external supplier (delivery time, etc.)? As we've seen with supply disruptions in Japan subsequent to the 2011 tsunami/earthquake in Japan, it may make sense to diversify and spread production/supply over multiple geographical areas to minimize production shut-downs attributable to such disruptions.

Considerations regarding insourcing (rather than purchasing externally from the current supplier): Is sufficient capital (to purchase and install machinery) available? Are there any training-related costs to be borne? The decision to insource increases the operating leverage of the company, which in turn increases the business (or operating) risk of the company. Therefore, what is the long-term upside potential for increases in sales--if large, then perhaps a move to a greater level of fixed costs makes sense. What are anticipated year-to-year fluctuations in sales/demand for the component in question? If these are significant, then perhaps lower operating leverage is more advantageous. Finally, by locking the company into a certain technology, does this decrease flexibility (for future investments in alternative technologies, as an example)?

The basic point to make to students is that choice of cost structure both reflects and influences a company's strategy. This elevates the discussion beyond the more procedural aspect of CVP analysis

(calculating degree of operating leverage (DOL), margin of safety ratios, breakeven points, etc.)

Question 5 (algorithmic, number set may not match your exact assignment):

1. BE units = $F \div (p - v)$ = \$500,000 ÷ (\$80 − \$55) per unit = **20,000 units**

BE (\$) = $F \div$ CMR = $F \div [(p - v) / p]$

= \$500,000 ÷ [(\$80 − \$55) / \$80]

= \$500,000 / 0.3125 = **\$1,600,000**
Or: 20,000 hats × \$80 = \$1,600,000

2.

= [*22000* × (Contribution margin per unit)] − *F*

= [22,000 units × (\$80 − \$55)/unit] − \$500,000

= \$550,000 − \$500,000 = **\$50,000**

Contribution Income Statement:

Sales (22,000 units × \$80.00/unit)	\$1,760,000
Less: Variable costs (20,000 units × \$52.00/unit)	\$1,210,000
Contribution Margin	\$550,000
Less: Fixed costs	\$500,000
Operating income	**\$50,000**

3. Margin of safety (MOS) = Budgeted sales volume – BE sales volume
= 32,000 – 20,000 = **12,000 hats**
Or: \$2,560,000 - \$1,600,000 = **\$960,000**

MOS ratio = MOS / Budgeted sales volume

= 12,000 / 32,000 = **37.5%**

= $960,000 / $2,560,000 = **37.50%**

Both the MOS and the MOS ratio refer to the extent to which sales could fall before losses are realized. In this sense, they are rough measures of *operating risk* and are therefore helpful in addressing inherent uncertainty in the profit-planning process.

4. BE units = *F* / Contribution margin per unit

= ($500,000 + $157,000) / ($80.00 − $43.50) per unit

= $657,000 / $36.50/unit = **18,000 units**

π_B= Sales − variable costs − fixed costs

= [*Q* × (Unit contribution margin)] − *F*

= [22,000 units × ($80.00 − $43.50*)/unit] − ($500,000 + $157,000)

= $803,000 − $657,000 = **$146,000**

* New variable cost per unit equals just the purchase cost of $43.50.

5. A key strategic issue is that Bubba's sales staff is a critical success factor for the business. His knowledgeable and courteous staff help to bring in and retain customers. If the salary and commissions plan would alienate his sales staff, the plan could be a big mistake. Bubba should therefore proceed with caution and be sure that his sales staff will be as highly motivated under the salary plan as they were under the commissions plan. The decision can also be viewed as an ethical issue: what responsibility does Bubba have to his staff? Is he properly

considering what is owed to the for their loyalty in prior years, and how the decision will affect their families, for better or worse?

Finally, there is the issue of *operating risk* associated with moving to a cost structure characterized by relatively higher fixed costs (traded off against lower variable costs).

Possible benefits:

- If variable costs (such as variable labor costs) are high, this strategy may minimize total costs.
- Upside potential: once the breakeven point is reached, percentage changes in sales volumes are magnified in terms of their effect on operating income.

Possible costs/disadvantages:

- Increased operating (business) risk (e.g., generally speaking, there will be a higher breakeven point).
- If sales volume declines, these reductions are magnified in terms of decreasing operating income (that is, there will likely be greater losses when times are not so good).
- In combination with a high level of financial leverage, total (combined or composite) leverage, and therefore total risk, can be magnified.
- Locking into a high level of fixed costs (e.g., a certain technology) may reduce future flexibility (e.g., ability to embrace new technologies or ability to react to short-term fluctuations in demand).
- Increased fixed costs on top of an existing high level of fixed costs can dramatically increase operating risk.

- Increased fixed costs (e.g., those associated with insourcing) may expose the company to increased risk or exposure to production slow-downs or stoppages, as experienced in 2011 in Japan as a consequence of the earthquake and tsunami that hit the country).
-

There is an additional point worth making:

1. Ultimately, the decision to increase operating leverage is affected by some of the following considerations: year-to-year fluctuations in sales—that is, uncertainty (the greater the uncertainty, the greater the attractiveness of lower operating leverage, due to the increased flexibility and decreased risk associated with this strategy); long-term trend in sales (if sales over time are expected to increase, then perhaps a higher degree of operating leverage is warranted); and, the decision maker's/owner's attitude toward risk.

Question 6 (algorithmic, number set may not match your exact assignment):

1. If operating profit is to increase, the contribution margin (i.e., revenue less variable costs) of the new business must exceed any incremental fixed costs.

   For a breakeven situation, incremental revenue (billings, both from the county audits and from any new business) must equal incremental costs (both variable and fixed).

   Let Y = the minimum revenue that must be earned from the county work in order to insure that operating profit of the firm does not decrease. Thus, looking at this new business proposal in its entirety:

Incremental profits = Incremental revenue – Incremental variable costs – Incremental fixed costs

At breakeven, incremental profit = 0 (by definition). Thus,

0 = [Y + Revenue from new business] − Variable costs – Fixed costs

= [Y + ($90 per hour × 750 hours)] − [$35 per hour × (750 + 950) hours] − $52,000

= Y + $67,500 − $59,500 − $52,000

Y = **$44,000**

The average billing rate at the breakeven bid of $44,000 would be $44,000 / 950 billable hours = **$46.32 per hour**

Clearly, the key to the bidding strategy is the desirability of bringing in 750 hours of new business at the going billing rate of $90 per hour.

2. At the breakeven point for the total new business (county audit jobs + additional new business), incremental revenue (billings) in total would equal incremental costs (both variable and fixed).

   Incremental profit = Incremental revenues (billings) − Incremental variable costs − Incremental fixed costs.

   Alternatively, at breakeven:

   Incremental revenues (billings) = Incremental costs (variable + fixed)

   Let X equal the minimum number of hours of *additional new business* required to breakeven. At breakeven, we have:

$$\$44{,}000 + \$90X = [\$35 \text{ per hour} \times (950 + X) \text{ hours}] + \$52{,}000$$

$$\$90X - \$35X = \$33{,}250 + \$52{,}000 - \$44{,}000$$

$$\$55X = \$41{,}250$$

X = 750 hours

Note that the managing partner's estimate of 750 hours of new business leaves a margin of safety of zero hours, i.e., MOS = 750 hours − 750 hours = 0.

Question 7 (algorithmic, number set may not match your exact assignment):

1. Breakeven dollars (dollars in thousands), Y:

Y = Total fixed costs / Contribution margin ratio
Y = ($6,450 + $1,890) / (1 – VCGS rate − Commissions rate)
Y = $8,340 / (1 − 0.45 − 0.10)
Y = $8,340 / 0.45
Y = **$18,533**

Supporting Calculations

Variable cost of goods sold (VCGS) rate (dollars in thousands):

$12,825 / $28,500 = 45.00%

Current fixed costs ($ thousands):	
Fixed cost of goods sold	$3,500
Fixed advertising cost	800
Fixed administrative cost	2,150
Total	$6,450
Incremental fixed costs ($ thousands):	
Sales people (8 × $80)	$ 640
Travel & entertainment	600
Manager/secretary	150
Additional advertising	500
Total	$1,890

Note: Fixed interest charges are not part of the calculation of operating income

Check:

Sales		$18,533
Variable costs:		
Cost of goods sold	$8,340	
Sales commissions	$1,853	$10,193
Contribution margin		$8,340
Fixed Costs:		
Exisiting	$6,450	
Incremental	$1,890	$8,340
Operating income (before intest and taxes)		$0

2. Required sales (to maintain current level of operating income, $4,095, while paying the requested increase in commission):

Let Y = required sales level:

$4,095 = Total sales − total variable costs − total fixed costs

$4,095 = (Y − (0.4500Y + 0.23Y)) − $6,450

$10,545 = 0.3200Y

Y = $10545 / 0.3200 = **$32,953**

This is $ 4,453 ($32,935 − $28,500) greater than budgeted sales

3. The general assumptions underlying breakeven analysis that may limit its usefulness include the following:

- All costs can be divided into fixed and variable elements.
- Variable costs vary proportionally to volume (thus, the variable cost function is linear)—there are no efficiency changes as output changes.
- Selling prices remain unchanged (thus, the total revenue function is linear).
- The analysis is done within the relevant range of the cost and revenue variables.
- The underlying model is deterministic; as such, the inherent

assumption is that the inputs to the CVP model are known with certainty.

4. Let sales (in 000s) at the indifference point be Y.

Since the two decision alternatives do not affect the selling price per unit, we can define the indifference point as the volume level that results in equal total cost between the two decision alternatives:

Cost under alternative 1 = Cost under alternative 2

$0.4500Y + 0.23Y + \$7,155 = 0.4500Y + \$7,155 + \$1,890 + 0.10Y$

$0.13Y = \$1,890$

Y = $14,538 (rounded and in $000s)

Since the point of indifference, $14,538 is less than current sales of $28,500, the firm would be better off hiring its own agents, because the relatively low variable costs offset the relatively high fixed costs of the new agents when sales are higher than the indifference point.

5. Alan Chen should consider the firm's ethical responsibility to its shareholders, employees, and agents. The new plan would be a savings for the firm and thus would have an upward effect on stock price and benefit the shareholders. However, the plan would be a blow to the sales agents, many of whom may depend on Lionel Corporation for a significant portion (or perhaps all of) their income. The agents are likely to have alternative job prospects if Lionel lets them go, but there will also be a difficult transition time. The company needs to think carefully about the nature and extent of its responsibility to the sales agents as part of its overall responsibility to its constituencies. What is its responsibility to these sales agents who are not its employees? The shareholders are a prime concern, but employees and others such as the sales agents must also be given consideration.

Question 8 (algorithmic, number set may not match your exact assignment):

1. Total variable costs per unit for the current plan are $6 + $12.50 + $25 + $10 = **$53.50**, and $15 + $13.75 + $30 + $10 = **$68.75** under the proposed plan. Thus, the contribution margin per unit and breakeven point (in units) for each of the two plans is as follows:

	Current Plan	Proposed Plan
Contribution margin per unit	$100 − $53.50 = **$46.50**	$100 − $68.75 = **$31.25**
Breakeven*	($6,000,000 + $1,250,000) / $46.50 per unit = **155,914 units**	($3,000,000 + $1,250,000) / $31.25 per unit = **136,000 units**

*Fixed manufacturing overhead costs are determined from the fixed overhead rates:

Current Plan	Proposed Plan
150,000 units × $40 per unit = $6,000,000	150,000 units × $20 per unit = $3,000,000

2. To determine the sales volume (in units) at which CG would be indifferent between the current manufacturing plan and the proposed plan, solve for the point, Q, in which total relevant costs are the same for the two decision alternatives. (Revenue from sales is unaffected by choice of production method. Hence, the point of operating profit indifference is the same as the point of cost indifference between the two alternatives.)

   Relevant variable costs are $43.50 ($53.50 − $10.00) and $58.75 ($68.75 − $10.00) for the current plan and the proposed plan, respectively. Relevant fixed costs (per year) are $6,000,000 and $3,000,000, respectively.

   The indifference point, Q, can be found at the point of cost equality, as follows:

   Total relevant cost, current plan = Total relevant cost, proposed plan

($43.50 × Q) + $6,000,000 = ($58.75 × Q) + $3,000,000
($58.75 − $43.50)/unit × Q = $6,000,000 − $3,000,000
Q = $3,000,000 / $15.25 per unit
Q = **196,722 units**

(The above calculations show that at the current level of 150,000 units, the firm would prefer the low fixed cost strategy, that is, the new plan.)

3. Use **Goal Seek** in Excel to confirm the answer found above in requirement 2:

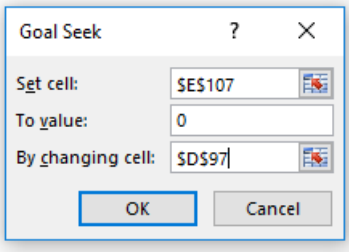
Step #1: Define the Cost-Differential Equation (i.e., Relevant cost of current production plan – Relevant cost of proposed plan)

	B	C	D	E
97	Volume level (units per year) =		-	(exact)
98				
99			**Current**	**Proposed**
100	**Relevant Costs:**			
101	Direct Materials		$6.00	$15.00
102	Direct labor		$12.50	$13.75
103	Variable overhead		$25.00	$30.00
104	Total variable cost per unit		$43.50	$58.75
105	Fixed Cost (Mfg. Ovh.)		$6,000,000	$3,000,000
106				
107	**Difference in relevant Cost =**			**$3,000,000**

Note: Cell C111 contains the formula:

((D105 + (D104 × D97) – (E105 + (E104 × D97))

Step #2: Run Goal Seek, as follows:



Step #3: Generate **results, as follows:**

	B	C	D	E	F
97	Volume level (units per year) =		196,721.31	(exact)	
98					
99			Current	Proposed	
100	**Relevant Costs:**				
101	Direct Materials		$6.00	$15.00	
102	Direct labor		$12.50	$13.75	
103	Variable overhead		$25.00	$30.00	
104	Total variable cost per unit		$43.50	$58.75	
105	Fixed Cost (Mfg. Ovh.)		$6,000,000	$3,000,000	
106					
107	**Difference in relevant Cost =**			$0	

4. CG's strategy is best described as differentiation, since the firm has succeeded by innovation in product design. Further, the firm operates in an industry in which innovation and product design are critical to success. An important element of the firm's strategy is also the fact that the technology, as for many firms in the industry, is not proven. That is, there is a significant level of risk that the firm's product will fail to meet customers' expectations. The overall strategy then must both support the firm's innovative image and also protect against the possibility of loss due to a failure of the technology–that is, simultaneously, the firm must advance and market its technological prowess and develop a plan to deal with the possibility that the technology might fail.

5. The calculations in part 2 above support a decision to go to the new plan; at the current level of 150,000 units, costs are lower for the new plan, and will continue to be lower for the new plan as long as volume stays below 196,722 units.

   Thinking strategically, the new plan is also preferred since it is an appropriate response to the firm's risk, as noted in requirement 3 above. By reducing operating leverage (that is, by reducing manufacturing fixed costs from $6,000,000 to $3,000,000) the firm is less exposed to a possible failure of the innovation and the drop in sales. The reduction in fixed costs also helps the firm to manage cash flows. Thus, the new plan is more consistent with the firm's strategy of developing an innovative

product and also dealing with the risk of potential loss because of a possible failure of the technology in the marketplace.

Also, one could look at the proposal as consistent with the firm's core strength, which appears to be product innovation. There is no evidence that the firm is particularly innovative or cost-effective in manufacturing. Thus, a strategy which focuses less on manufacturing would be consistent with this strategy; more focus should be retained in product design and development.

Sensitivity analysis: Uncertainty is important in this case, CG Graphics should use one or more of the tools discussed in the chapter. Shown below is a calculation of the indifference point and a table of expected profits at various demand levels. Note that the current method looks good if projected demand rises

Sensitivity Analsyis

	Current	Proposed	Difference
Materials and purchased parts	$ 6.00	$ 15.00	
Direct labor	12.50	13.75	
Variable overhead	25.00	30.00	
Total variable cost	$ 53.50	$ 68.75	$ 15.25
Price	100	100	
CM per unit	$ 46.50	$ 31.25	
Total fixed cost per year	$ 7,250,000	$ 4,250,000	$3,000,000
Breakeven	155,914	136,000	
Current level of demand	150,000	150,000	
Operating profit	$ (275,000)	$ 437,500	
Indifference point			196,722

Assumed Levels of Demand	Profit: Current	Profit: Proposed	Iteration
30,000	$ (5,855,000)	$ (3,312,500)	1
60,000	$ (4,460,000)	$ (2,375,000)	2
90,000	$ (3,065,000)	$ (1,437,500)	3
120,000	$ (1,670,000)	$ (500,000)	4
150,000	$ (275,000)	$ 437,500	5
180,000	$ 1,120,000	$ 1,375,000	6
210,000	$ 2,515,000	$ 2,312,500	7
240,000	$ 3,910,000	$ 3,250,000	8
270,000	$ 5,305,000	$ 4,187,500	9
300,000	$ 6,700,000	$ 5,125,000	10