CHAPTER 16
COST ALLOCATION: JOINT PRODUCTS AND BYPRODUCTS

16-1 Exhibit 16-1 presents many examples of joint products from four different general industries. These include:

Industry	*Separable Products at the Splitoff Point*
Food Processing:	
• Lamb	• Lamb cuts, tripe, hides, bones, fat
• Turkey	• Breasts, wings, thighs, poultry meal
Extractive:	
• Petroleum	• Crude oil, natural gas

16-2 True. Joint costs are inevitable, they appear if you want it or not. They are a technical necessity. Whatever you do with the joint products after the split-off point is determined by the selling price and the costs to further process the joint products (separable costs). And of course, sunk costs don't have to be joint costs.

16-3 The distinction between a joint product and a byproduct is based on relative sales value. A *joint product* is a product from a joint production process (a process that yields two or more products) that has a relatively high total sales value. A *byproduct* is a product that has a relatively low total sales value compared to the total sales value of the joint (or main) products.

16-4 A *product* is any output that has a positive sales value (or an output that enables a company to avoid incurring costs). In some joint-cost settings, outputs can occur that do not have a positive sales value. The offshore processing of hydrocarbons yields water that is recycled back into the ocean as well as yielding oil and gas. The processing of mineral ore to yield gold and silver also yields dirt as an output, which is recycled back into the ground.

16-5 True. There is no causal relationship between the joint costs and the products that come out of a joint process. That's why joint costs cannot be allocated, but only divided by some "arbitrary" method. These methods are equally good or bad. They do not indicate the profitability of products, but the "valuation" can be used for inventory or tax purposes. Indirect costs (overhead) on the other hand can be allocated; you choose an allocation method that comes close to the causal relationship between the overhead and the products.

16-6 The joint production process yields individual products that are either sold this period or held as inventory to be sold in subsequent periods. Hence, the joint costs need to be allocated between total production rather than just those sold this period.

16-7 This situation can occur when a production process yields separable outputs at the splitoff point that do not have selling prices available until further processing. The result is that selling prices are not available at the splitoff point to use the sales value at splitoff method. Examples include processing in integrated pulp and paper companies and in petro-chemical operations.

16-8 True, see 16-5.

16-9 True, see 16-2

16-10 The NRV method can be simplified by assuming (a) a standard set of post-splitoff point processing steps and (b) a standard set of selling prices. The use of (a) and (b) achieves the same benefits that the use of standard costs does in costing systems.

16-11 The constant gross-margin percentage NRV method takes account of the post-splitoff point "profit" contribution earned on individual products, as well as joint costs, when making cost assignments to joint products. In contrast, the sales value at splitoff point and the NRV methods allocate only the joint costs to the individual products.

16-12 No. Any method used to allocate joint costs to individual products that is applicable to the problem of joint product-cost allocation should not be used for management decisions regarding whether a product should be sold or processed further. When a product is an inherent result of a joint process, the decision to process further should not be influenced by either the size of the total joint costs or by the portion of the joint costs assigned to particular products. Joint costs are irrelevant for these decisions. The only relevant items for these decisions are the incremental revenue and the incremental costs beyond the splitoff point.

16-13 No. The only relevant items are incremental revenues and incremental costs when making decisions about selling products at the splitoff point or processing them further. Separable costs are not always identical to incremental costs. Separable costs are costs incurred beyond the splitoff point that are assignable to individual products. Some separable costs may not be incremental costs in a specific setting (e.g., allocated manufacturing overhead for post-splitoff processing that includes depreciation).

16-14 True. It is one method to deal with the joint costs. In this case, the revenue of the by product is subtracted from the joint costs of the production process before they are divided among the products. It is up to the manager to decide which products are to be considered by-products.

16-15 The sales byproduct method enables a manager to time the sale of byproducts to affect reported operating income. A manager who was below the targeted operating income could adopt a "fire-sale" approach to selling byproducts so that the reported operating income exceeds the target. This illustrates one dysfunctional aspect of the sales method for byproducts.

16-16 (20-30 min.) **Joint-cost allocation, insurance settlement.**

1. (a) Sales value at splitoff method:

	Pounds of Product	Wholesale Selling Price per Pound	Sales Value at Splitoff	Weighting: Sales Value at Splitoff	Joint Costs Allocated	Allocated Costs per Pound

Breasts	100	$0.55	$55.00	0.675	$33.75	0.3375
Wings	20	0.20	4.00	0.049	2.45	0.1225
Thighs	40	0.35	14.00	0.172	8.60	0.2150
Bones	80	0.10	8.00	0.098	4.90	0.0613
Feathers	10	0.05	0.50	0.006	0.30	0.0300
	250		$81.50	1.000	$50.00	

Costs of Destroyed Product

Breasts: $0.3375 per pound × 40 pounds =	$13.50
Wings: $0.1225 per pound × 15 pounds =	1.84
	$15.34

b. Physical measure method:

	Pounds of Product	Weighting: Physical Measures	Joint Costs Allocated	Allocated Costs per Pound
Breasts	100	0.400	$20.00	$0.200
Wings	20	0.080	4.00	0.200
Thighs	40	0.160	8.00	0.200
Bones	80	0.320	16.00	0.200
Feathers	10	0.040	2.00	0.200
	250	1.000	$50.00	

Costs of Destroyed Product

Breast: $0.20 per pound × 40 pounds =	$ 8
Wings: $0.20 per pound × 15 pounds =	3
	$11

Note: Although not required, it is useful to highlight the individual product profitability figures:

		Sales Value at Splitoff Method		Physical Measures Method	
Product	Sales Value	Joint Costs Allocated	Gross Income	Joint Costs Allocated	Gross Income
Breasts	$55.00	$33.75	$21.25	$20.00	$35.00
Wings	4.00	2.45	1.55	4.00	0.00
Thighs	14.00	8.60	5.40	8.00	6.00
Bones	8.00	4.90	3.10	16.00	(8.00)
Feathers	0.50	0.30	0.20	2.00	(1.50)

2. The sales value at splitoff method captures the benefits-received criterion of cost allocation and is the preferred method. The costs of processing a chicken are allocated to products in proportion to the ability to contribute revenue. Quality Chicken's decision to process chicken is heavily influenced by the revenues from breasts and thighs. The bones provide relatively few benefits to Quality Chicken despite their high physical volume.

The physical measures method shows profits on breasts and thighs and losses on bones and feathers. Given that Quality Chicken has to jointly process all the chicken products, it is non-intuitive to single out individual products that are being processed simultaneously as making losses while the overall operations make a profit. Quality Chicken is processing chicken mainly for breasts and thighs and not for wings, bones, and feathers, while the physical measure method allocates a disproportionate amount of costs to wings, bones, and feathers.

16-17 (10 min.) **Joint products and byproducts (continuation of 16-16).**

1. Ending inventory:

Breasts	15	×	$0.3375	=	$5.06
Wings	4	×	0.1225	=	0.49
Thighs	6	×	0.2150	=	1.29
Bones	5	×	0.0613	=	0.31
Feathers	2	×	0.0300	=	0.06
					$7.21

2.

Joint products	**Byproducts**	Net Realizable Values of byproducts:	
Breasts	Wings	Wings	$ 4.00
Thighs	Bones	Bones	8.00
	Feathers	Feathers	0.50
			$12.50

Joint costs to be allocated:

Joint Costs – Net Realizable Values of Byproducts = $50 – $12.50 = $37.50

	Pounds of Product	**Wholesale Selling Price per Pound**	**Sales Value at Splitoff**	**Weighting: Sales Value at Splitoff**	**Joint Costs Allocated**	**Allocated Costs Per Pound**
Breast	100	$0.55	$55	55 ÷ 69	$29.89	$0.2989
Thighs	40	0.35	14	14 ÷ 69	7.61	0.1903
			$69		$37.50	

Ending inventory:

Breasts 15 × $0.2989	$4.48
Thighs 6 × 0.1903	1.14
	$5.62

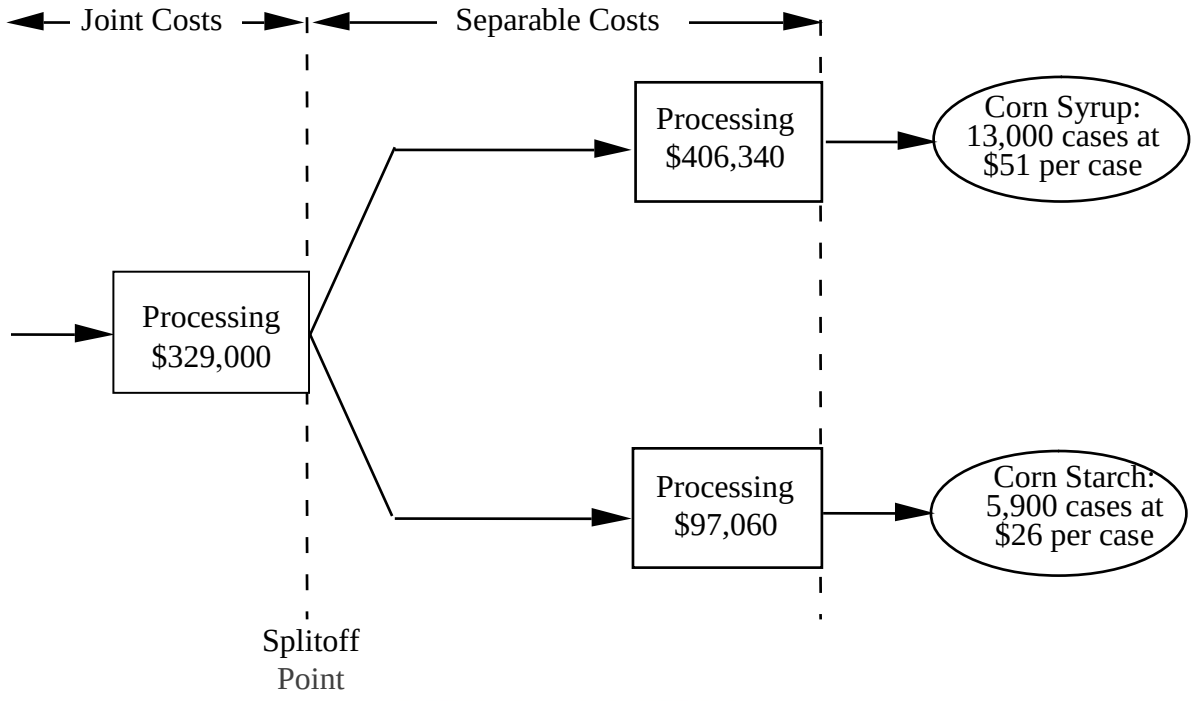
3. Treating all products as joint products does not require judgments as to whether a product is a joint product or a byproduct. Joint costs are allocated in a consistent manner to all products for the purpose of costing and inventory valuation. In contrast, the approach in requirement 2 lowers the joint cost by the amount of byproduct net realizable values and results in inventory values being shown for only two of the five products, the ones (perhaps arbitrarily) designated as being joint products.

16-18 (10 min.) **Net realizable value method.**

A diagram of the situation is in Solution Exhibit 16-18.

	Corn Syrup	Corn Starch	Total
Final sales value of total production, 13,000 × $51; 5,900 × $26	$663,000	$153,400	$816,400
Deduct separable costs	406,340	97,060	503,400
Net realizable value at splitoff point	$256,660	$ 56,340	$313,000
Weighting, $256,660; $56,340 ÷ $313,000	0.82	0.18	1.00
Joint costs allocated, 0.82; 0.18 × $329,000	$269,780	$ 59,220	$329,000

SOLUTION EXHIBIT 16-18 (all numbers are in thousands)



16-19 (40 min.) **Alternative joint-cost-allocation methods, further-process decision.**

A diagram of the situation is in Solution Exhibit 16-19.

1.

	Methanol	Turpentine	Total
Physical measure of total production (gallons)	2,500	7,500	10,000
Weighting, 2,500; 7,500 ÷ 10,000	0.25	0.75	
Joint costs allocated, 0.25; 0.75 × $120,000	$ 30,000	$ 90,000	$120,000

2.

	Methanol	Turpentine	Total
Final sales value of total production, 2,500 × $21.00; 7,500 × $14.00	$ 52,500	$105,000	$157,500
Deduct separable costs, 2,500 × $3.00; 7,500 × $2.00	7,500	15,000	22,500
Net realizable value at splitoff point	$ 45,000	$ 90,000	$135,000
Weighting, $45,000; $90,000 ÷ $135,000	1/3	2/3	
Joint costs allocated, 1/3; 2/3 × $120,000	$ 40,000	$ 80,000	$120,000

3. a. Physical-measure (gallons) method:

	Methanol	Turpentine	Total
Revenues	$52,500	$105,000	$157,500
Cost of goods sold:			
Joint costs	30,000	90,000	120,000
Separable costs	7,500	15,000	22,500
Total cost of goods sold	37,500	105,000	142,500
Gross margin	$15,000	$ 0	$ 15,000

b. Estimated net realizable value method:

	Methanol	Turpentine	Total
Revenues	$52,500	$105,000	$157,500
Cost of goods sold:			
Joint costs	40,000	80,000	120,000
Separable costs	7,500	15,000	22,500
Total cost of goods sold	47,500	95,000	142,500
Gross margin	$ 5,000	$ 10,000	$ 15,000

4.

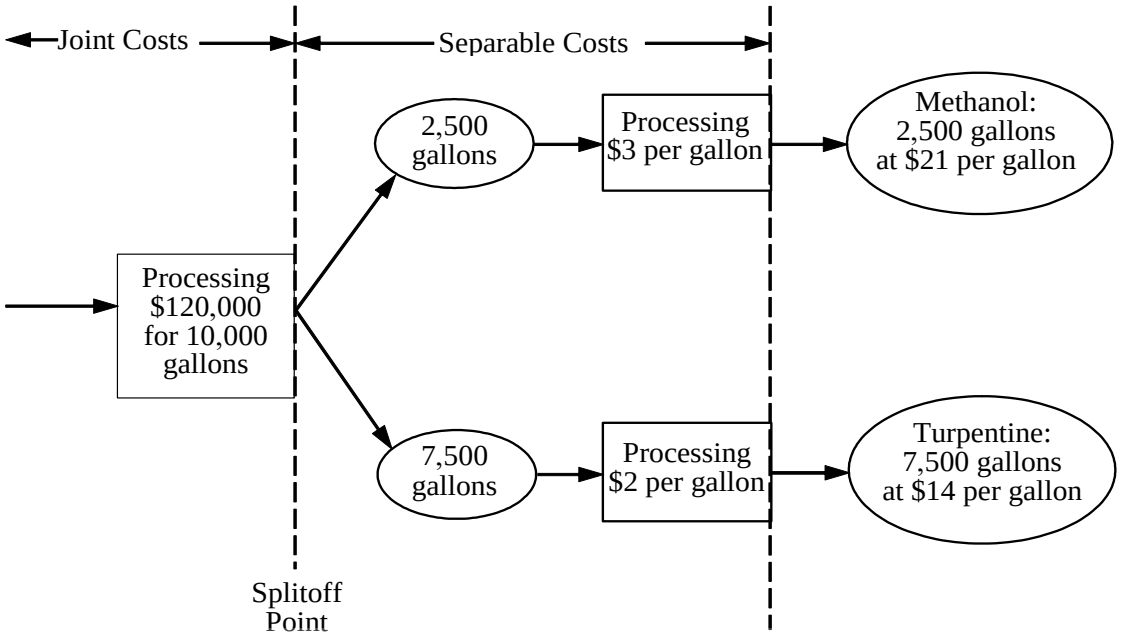
	Alcohol Bev.	Turpentine	Total
Final sales value of total production, 2,500 × $60.00; 7,500 × $14.00	$150,000	$105,000	$255,000
Deduct separable costs, (2,500 × $12.00) + (0.20 × $150,000); 7,500 × $2.00	60,000	15,000	75,000
Net realizable value at splitoff point	$ 90,000	$ 90,000	$180,000
Weighting, $90,000; $90,000 ÷ $180,000	0.50	0.50	
Joint costs allocated, 0.5; 0.5 × $120,000	$ 60,000	$ 60,000	$120,000

An incremental approach demonstrates that the company should use the new process:

Incremental revenue, ($60.00 – $21.00) × 2,500		$ 97,500
Incremental costs:		
Added processing, $9.00 × 2,500	$22,500	
Taxes, (0.20 × $60.00) × 2,500	30,000	(52,500)
Incremental operating income from further processing		$ 45,000

Proof:	Total sales of both products	$255,000
	Joint costs	120,000
	Separable costs	75,000
	Cost of goods sold	195,000
	New gross margin	60,000
	Old gross margin	15,000
	Difference in gross margin	$ 45,000

SOLUTION EXHIBIT 16-19



16-20 (40 min.) **Alternative methods of joint-cost allocation, ending inventories.**

Total production for the year was:

	Sold	Ending Inventories	Total Production
X	68	132	200
Y	480	120	600
Z	672	28	700

A diagram of the situation is in Solution Exhibit 16-20.

1. a. Net realizable value (NRV) method:

	X	Y	Z	Total
Final sales value of total production, 200 × $1,200; 600 × $900; 700 × $600	$240,000	$540,000	$420,000	$1,200,000
Deduct separable costs	—	—	200,000	200,000
Net realizable value at splitoff point	$240,000	$540,000	$220,000	$1,000,000
Weighting, $240; $540; $220 ÷ $1,000	0.24	0.54	0.22	
Joint costs allocated, 0.24, 0.54, 0.22 × $580,000	$139,200	$313,200	$ 127,600	$ 580,000

Ending Inventory Percentages:

	X	Y	Z
Ending inventory	132	120	28
Total production	200	600	700
Ending inventory percentage	66%	20%	4%

Income Statement

	X	Y	Z	Total
Revenues, 68 × $1,200; 480 × $900; 672 × $600	$81,600	$432,000	$403,200	$916,800
Cost of goods sold:				
Joint costs allocated	139,200	313,200	127,600	580,000
Separable costs	—	—	200,000	200,000
Production costs	139,200	313,200	327,600	780,000
Deduct ending inventory, 66%; 20%; 4% of production costs	91,872	62,640	13,104	167,616
Cost of goods sold	47,328	250,560	314,496	612,384
Gross margin	$ 34,272	$181,440	$ 88,704	$304,416
Gross-margin percentage	42%	42%	22%	

b. Constant gross-margin percentage NRV method:

Step 1:

Final sales value of prodn., (200 × $1,200) + (600 × $900) + (700 × $600)	$1,200,000
Deduct joint and separable costs, $580,000 + $200,000	780,000
Gross margin	$ 420,000
Gross-margin percentage, $420,000 ÷ $1,200,000	35%

Step 2:

	X	Y	Z	Total
Final sales value of total production, 250 × $1,800; 300 × $1,300; 350 × $800	$240,000	$540,000	$420,000	$1,200,000
Deduct gross margin, using overall Gross-margin percentage of sales, 35%	84,000	189,000	147,000	420,000
Total production costs	156,000	351,000	273,000	780,000
Step 3: Deduct separable costs	—	—	200,000	200,000
Joint costs allocated	$156,000	$351,000	$ 73,000	$ 580,000

Income Statement

	X	Y	Z	Total
Revenues, 68 × $1,200; 480 × $900; 672 × $600	$81,600	$432,000	$403,200	$916,800
Cost of goods sold:				
Joint costs allocated	156,000	351,000	73,000	580,000
Separable costs	—	—	200,000	200,000
Production costs	156,000	351,000	273,000	780,000
Deduct ending inventory, 66%; 20%; 4% of production costs	102,960	70,200	10,920	184,080
Cost of goods sold	53,040	280,800	262,080	595,920
Gross margin	$ 28,560	$151,200	$141,200	$320,880
Gross-margin percentage	35%	35%	35%	35%

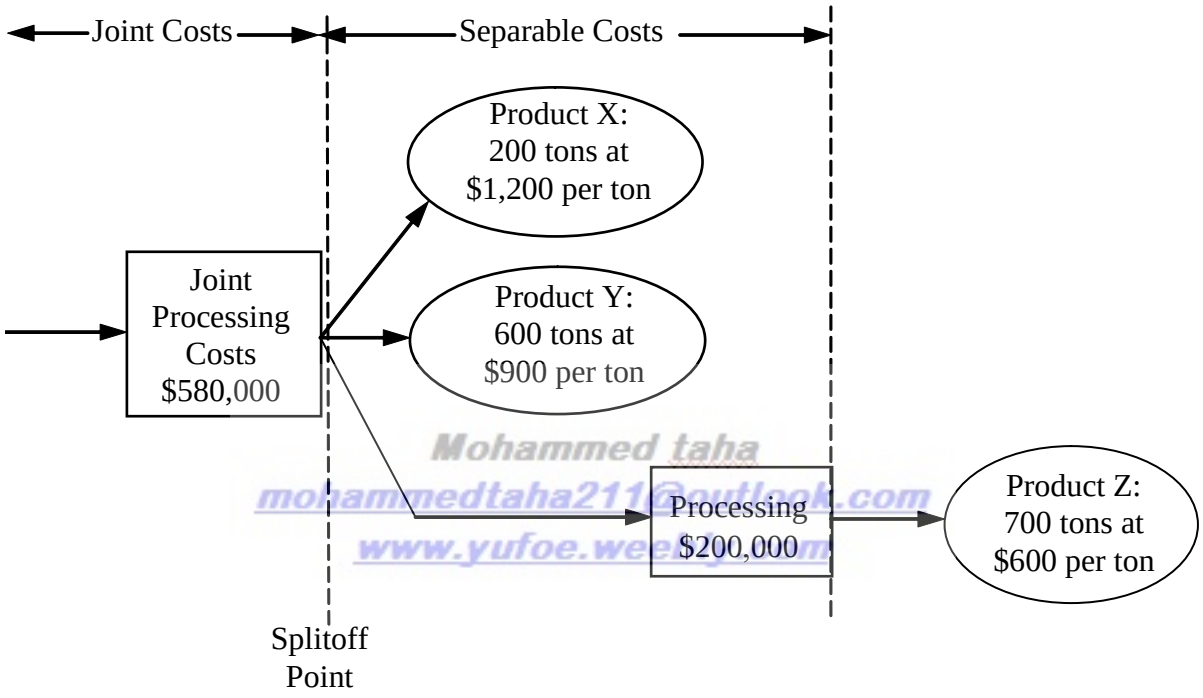
Summary

	X	Y	Z	Total
a. NRV method:				
Inventories on balance sheet	$91,872	$ 62,640	$ 13,104	$167,616
Cost of goods sold on income statement	47,328	250,560	314,496	612,384
				$780,000
b. Constant gross-margin percentage NRV method				
Inventories on balance sheet	$102,960	$ 70,200	$ 10,920	$184,080
Cost of goods sold on income statement	53,040	280,800	262,080	595,920
				$780,000

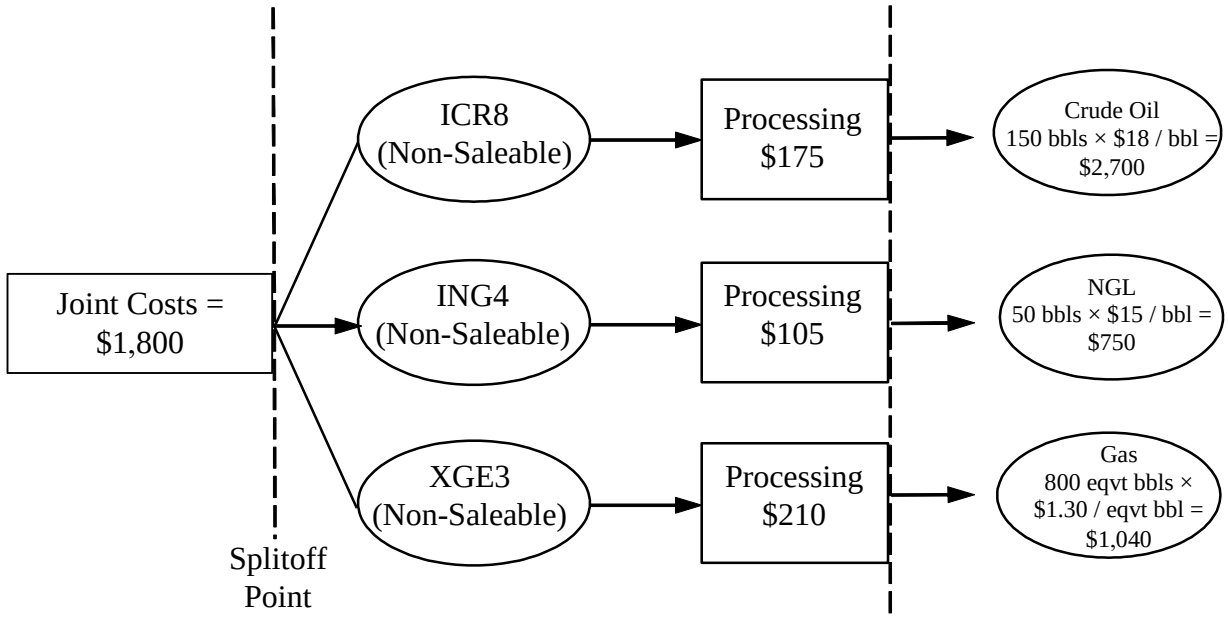
2. Gross-margin percentages:

	X	Y	Z
NRV method	42%	42%	22%
Constant gross-margin percentage NRV	35.0%	35.0%	35.0%

SOLUTION EXHIBIT 16-20



16-21 (30 min.) **Joint-cost allocation, process further.**



1a. Physical Measure Method

	Crude Oil	NGL	Gas	Total
1. Physical measure of total prodn.	150	50	800	1,000
2. Weighting (150; 50; 800 ÷ 1,000)	0.15	0.05	0.80	1.00
3. Joint costs allocated (Weights × $1,800)	$270	$90	$1,440	$1,800

1b. NRV Method

	Crude Oil	NGL	Gas	Total
1. Final sales value of total production	$2,700	$750	$1,040	$4,490
2. Deduct separable costs	175	105	210	490
3. NRV at splitoff	$2,525	$645	$ 830	$4,000
4. Weighting (2,525; 645; 830 ÷ 4,000)	0.63125	0.16125	0.20750	
5. Joint costs allocated (Weights × $1,800)	$1,136.25	$290.25	$373.50	$1,800

2. The operating-income amounts for each product using each method is:

(a) Physical Measure Method

	Crude Oil	NGL	Gas	Total
Revenues	$2,700	$750	$1,040	$4,490
Cost of goods sold				
Joint costs	270	90	1,440	1,800
Separable costs	175	105	210	490
Total cost of goods sold	445	195	1,650	2,290
Gross margin	$2,255	$555	$ (610)	$2,200

(b) NRV Method

	Crude Oil	NGL	Gas	Total
Revenues	$2,700.00	$750.00	$1,040.00	$4,490.00
Cost of goods sold				
Joint costs	1,136.25	290.25	373.50	1,800.00
Separable costs	175.00	105.00	210.00	490.00
Total cost of goods sold	1,311.25	395.25	583.50	2,290.00
Gross margin	$1,388.75	$354.75	$ 456.50	$2,200.00

3. Neither method should be used for product emphasis decisions. It is inappropriate to use joint-cost-allocated data to make decisions regarding dropping individual products, or pushing individual products, as they are joint by definition. Product-emphasis decisions should be made based on relevant revenues and relevant costs. Each method can lead to product emphasis decisions that do not lead to maximization of operating income.

4. Because crude oil is the only product subject to taxation, it is clearly in Sinclair's best interest to use the NRV method because it leads to a lower profit for crude oil and, consequently, a smaller tax burden. A letter to the taxation authorities could stress the conceptual superiority of the NRV method. Chapter 16 argues that, using a benefits-received cost allocation criterion, market-based joint cost allocation methods are preferable to physical-measure methods. A meaningful common denominator (revenues) is available when the sales value at splitoff point method or NRV method is used. The physical-measures method requires nonhomogeneous products (liquids and gases) to be converted to a common denominator.

16-22 (30 min.) **Joint-cost allocation, sales value, physical measure, NRV methods.**
1a.

PANEL A: Allocation of Joint Costs using Sales Value at Splitoff Method	Special B/ Beef Ramen	Special S/ Shrimp Ramen	Total
Sales value of total production at splitoff point (20,000 tons × $5 per ton; 28,000 × $20 per ton)	$100,000	$560,000	$660,000
Weighting ($100,000; $560,000 ÷ $660,000)	0.15	0.85	
Joint costs allocated (0.15; 0.85 × $400,000)	$60,000	$340,000	$400,000

PANEL B: Product-Line Income Statement for June 2014	Special B	Special S	Total
Revenues (25,000 tons × $17 per ton; 34,000 × $33 per ton)	$425,000	$1,122,000	$1,547,000
Deduct joint costs allocated (from Panel A)	60,000	340,000	400,000
Deduct separable costs	100,000	238,000	338,000
Gross margin	$265,000	$544,000	$809,000
Gross margin percentage	62%	48%	52%

1b.

PANEL A: Allocation of Joint Costs using Physical-Measure Method	Special B/ Beef Ramen	Special S/ Shrimp Ramen	Total
Physical measure of total production (tons)	20,000	28,000	48,000
Weighting (20,000 tons; 28,000 tons ÷ 48,000 tons)	42%	58%	
Joint costs allocated (0.42; 0.58 × $400,000)	$168,000	$232,000	$400,000

PANEL B: Product-Line Income Statement for June 2014	Special B	Special S	Total
Revenues (25,000 tons × $17 per ton; 34,000 × $33 per ton)	$425,000	$1,122,000	$1,547,000
Deduct joint costs allocated (from Panel A)	168,000	232,000	400,000
Deduct separable costs	100,000	238,000	338,000
Gross margin	$ 157,000	$652,000	$809,000
Gross margin percentage	37%	58%	52%

1c.

PANEL A: Allocation of Joint Costs using Net Realizable Value Method	Special B	Special S	Total
Final sales value of total production during accounting period (25,000 tons × $17 per ton; 34,000 × $33 per ton)	$425,000	$1,122,000	$1,547,000
Deduct separable costs	100,000	238,000	338,000
Net realizable value at splitoff point	$325,000	$884,000	$1,209,000
Weighting ($325,000; $884,000 ÷ $1,209,000)	27%	73%	
Joint costs allocated (0.27; 0.73 × $240,000)	$108,000	$292,000	$400,000

PANEL B: Product-Line Income Statement for June 2014	Special B	Special S	Total
Revenues (25,000 tons × $17 per ton; 34,000 × $33 per ton)	$425,000	$1,122,000	$1,547,000
Deduct joint costs allocated (from Panel A)	108,000	292,000	400,000
Deduct separable costs	100,000	238,000	338,000
Gross margin	$217,000	$592,000	$809,000
Gross margin percentage	51%	53%	52%

2. Sandra Dashel probably performed the analysis shown below to arrive at the net loss of $2,435 from marketing the stock:

PANEL A: Allocation of Joint Costs using Sales Value at Splitoff	Special B/ Beef Ramen	Special S/ Shrimp Ramen	Stock	Total
Sales value of total production at splitoff point (20,000 tons × $5 per ton; 28,000 × $20 per ton; 6,000 × $4 per ton)	$100,000	$560,000	$24,000	$684,000
Weighting ($100,000; $560,000; $24,000 ÷ $684,000)	14.6199%	81.8713%	3.5088%	100%
Joint costs allocated (0.146199; 0.818713; 0.035088 × $400,000)	$58,480	$327,485	$14,035	$400,000

PANEL B: Product-Line Income Statement for June 2014	Special B	Special S	Stock	Total
Revenues (25,000 tons × $17 per ton; 34,000 × $33 per ton; 6,000 × $4 per ton)	$425,000	$1,122,000	$24,000	$1,571,000
Separable processing costs	100,000	238,000	0	338,000
Joint costs allocated (from Panel A)	58,480	327,485	14,035	400,000
Gross margin	$266,520	$556,515	$9,965	$833,000
Deduct marketing costs			12,400	12,400
Operating income			$ (2,435)	$820,600

In this (misleading) analysis, the $400,000 of joint costs are reallocated between Special B, Special S, and the stock. Irrespective of the method of allocation, this analysis is wrong. Joint costs are always irrelevant in a process-further decision. Only incremental costs and revenues past the splitoff point are relevant. In this case, the correct analysis is much simpler: The incremental revenues from selling the stock are $24,000, and the incremental costs are the marketing costs of $12,400. So, Fancy Foods should sell the stock—this will increase its operating income by $11,600 ($24,000 – $12,400).

16-23 (20 min.) **Joint cost allocation: sell immediately or process further.**

1.

a. Sales value at splitoff method:

	Cookies/ Soymeal	Soyola/ Soy Oil	Total
Sales value of total production at splitoff, 575 lbs × $1.24; 160 gallons × $4.25	$713	$680	$1,393
Weighting, $713; $680 ÷ $1,393	0.512	0.488	
Joint costs allocated, 0.512; 0.488 × $530	$271	$259	$530

b. Net realizable value method:

	Cookies	Soyola	Total
Final sales value of total production, 725 lbs × $2.24; 640 qts × $1.35	$1,624	$864	$2,488
Deduct separable costs	380	240	620
Net realizable value	$ 1,244	$624	$1,868
Weighting, $1,244; $624 ÷ $1,868	0.666	0.334	
Joint costs allocated, 0.666; 0.334 × $530	$ 353	$177	$ 530

2.

	Cookies/Soy Meal	Soyola/Soy Oil
Revenue if sold at splitoff	$713[a]	$ 680[b]
Process further NRV	1,244[c]	624[d]
Profit (Loss) from processing further	$531	$(56)

[a] 575 lbs × $1.24 = $713
[b] 160 gal × $4.25 = $680
[c] 725 lbs × $2.24 – $380 = $1,244
[d] 640 qts × $1.35 – $240 = $624

ISP should process the soy meal into cookies because that increases profit by $531 ($1,244 – $713). However, ISP should sell the soy oil as is, without processing it into the form of Soyola, because profit will be $56 ($680 – $624) higher if they do. Because the total joint cost is the same under both allocation methods, it is not a relevant cost to the decision to sell at splitoff or process further.

16-24 (30 min.) **Accounting for a main product and a byproduct.**

		Production Method	Sales Method
1.	Revenues		
	Main product	$682,240[a]	$682,240
	Byproduct	—	65,000[d]
	Total revenues	682,240	747,240
	Cost of goods sold		
	Total manufacturing costs	500,000	500,000
	Deduct value of byproduct production	85,000[b]	0
	Net manufacturing costs	415,000	500,000
	Deduct main product inventory	74,700[c]	90,000[e]
	Cost of goods sold	340,300	410,000
	Gross margin	$341,940	$337,240

[a] 42,640 × $16.00
[b] 8,500 × $10.00
[c] Inventory = 52,000 – 42,640 = 9,360 lbs;
(9,360/52,000) × $415,000 = $74,700
[d] 6,500 × $10.00
[e] (9,360/52,000) × $500,000 = $90,000

		Production Method	Sales Method
2.	Main Product	$74,700	$90,000
	Byproduct	20,000[a]	0

[a] Ending inventory shown at unrealized selling price.
BI + Production – Sales = EI
0 + 8,500 – 6,500 = 2,000 pounds
Ending inventory = 2,000 pounds × $10 per pound = $20,000

16-25 (20 min.) **Joint costs and decision making.**

1. For analyzing the incremental value generated by rattles as a product line, the allocation of the cost of the snake (which is a joint cost) is irrelevant because it is sunk. The allocated overhead charge is also irrelevant because it represents Jack's living expenses, which would be incurred regardless of the decision to sell (or not sell) rattles. So, the only relevant information in the financial results for rattles are the sales revenues of $2,200 and the traced processing expenses of $660. The incremental profit from selling rattles is given by:

Sales Revenues, $2,200 – Processing Expenses, $660 = $1,540.

Jack should therefore continue to sell rattles as dropping that product line would reduce his overall income by $1,540.

2. Jack purchases snakes at a unit cost of $11. Given the total snake cost of $26,400, this implies that Jack purchased a total of $26,400/$11 = 2,400 snakes this season. Jack's incremental profit per rattle (given one rattle per snake and the incremental profit calculated in requirement 1 above) is therefore:

$1,540/2,400 = $0.64 per rattle

Because the miner is offering just $0.60 per rattle, Jack is better off processing and selling the rattles on his own.

16-26 (35-45 min.) **Joint costs and byproducts.**

1. Computing byproduct deduction to joint costs:

Revenues from C, 16,000 × $6	$ 96,000
Deduct:	
Gross margin, 10% of revenues	9,600
Marketing costs, 20% of revenues	19,200
Peanut Butter Department separable costs	12,000
Net realizable value (less gross margin) of C	$ 55,200
Joint costs	$180,000
Deduct byproduct contribution	55,200
Net joint costs to be allocated	$124,800

	Quantity	Unit Sales Price	Final Sales Value	Deduct Separable Processing Cost	Net Realizable Value at Splitoff	Weighting	Allocation of $124,800 Joint Costs
A	12,000	$12	$144,000	$27,000	$117,000	37.5%	$ 46,800
B	65,000	3	195,000	—	195,000	62.5%	78,000
Totals			$339,000	$27,000	$312,000		$124,800

	Joint Costs Allocation	Add Separable Processing Costs	Total Costs	Units	Unit Cost
A	$ 46,800	$27,000	$ 73,800	12,000	$6.15
B	78,000	—	78,000	65,000	1.20
Totals	$124,800	$27,000	$151,800	77,000	

Unit cost for C: $3.45 ($55,200 ÷ 16,000) + $0.75 ($12,000 ÷ 16,000) = $4.20,
or $6.00 – $0.60 (10% × $6) – $1.20 (20% × $6) = $4.20.

2. If all three products are treated as joint products:

	Quantity	Unit Sales Price	Final Sales Value	Deduct Separable Processing Cost	Net Realizable Value at Splitoff	Weighting	Allocation of $180,000 Joint Costs
A	12,000	$12	$144,000	$27,000	$117,000	117 ÷ 376.8	$ 55,892
B	65,000	3	195,000	—	195,000	195 ÷ 376.8	93,153
C	16,000	6	96,000	31,200	64,800	64.8 ÷ 376.8	30,955
Totals			$435,000	$58,200	$376,800		$180,000

	Joint Costs Allocation	Add Separable Processing Costs	Total Costs	Units	Unit Cost
A	$ 55,892	$27,000	$ 82,892	12,000	$6.91
B	93,153	—	93,153	65,000	1.43
C	30,955	12,000	42,955	16,000	2.68
Totals	$180,000	$39,000	$219,000	93,000	

Call the attention of students to the different unit "costs" resulting from the two assumptions about the relative importance of Product C. The point is that costs of individual products depend heavily on which assumptions are made and which accounting methods and techniques are used.

16-27 (25 min.) **Methods of joint-cost allocation, ending inventory.**

1. Net realizable value of human product:

$$(2{,}000 \text{ gallons} \times \$585) - \$120{,}000 = \$1{,}050{,}000$$

Net realizable value of veterinarian product:

$$500 \text{ gallons} \times (\$410 - \$10) = \$200{,}000$$

Joint costs: $60,000 + $90,000 = $150,000

Joint costs charged to human product: $\frac{1{,}050{,}000}{1{,}250{,}000} \times \$150{,}000 = \$126{,}000$

Joint costs charged to veterinarian product: $\frac{200{,}000}{1{,}250{,}000} \times \$150{,}000 = \$24{,}000$

2.

	Human Product	Vet Product	Total
Separable costs, $120,000; 500 × $10	$120,000	$ 5,000	$125,000
Joint costs (from above)	126,000	24,000	150,000
Total costs	$246,000	$29,000	$275,000
Units produced (gallons)	2,000	500	2,500
Cost per gallon $246,000 ÷ 2,000; $29,000 ÷ 500	$123	$58	$110
Units in ending inventory (gallons)	300	200	500
Cost of ending inventory $123 × 300; $58 × 200	$36,900	$11,600	$48,500

3. Final gross margin: NRV (Human) + NRV (Vet) – Joint costs
= $1,050,000 + $200,000 – $150,000 = $1,100,000

Final sales revenues: (2,000 × $585) + (500 × $410) = $1,375,000

Final gross margin percentage: $\frac{\$1,100,000}{\$1,375,000} = 80\%$

By applying this constant gross margin percentage of 80% to both products, we can identify the amount of joint costs allocated to each product, as shown below.

Constant gross-margin percentage NRV method	**Human Product**	**Vet Product**	**Total**
Final sales value of production			
$2,000 × 585; $410 × 500	$1,170,000	$205,000	$1,375,000
Gross Margin (80%)	936,000	164,000	1,100,000
Total costs	$ 234,000	$ 41,000	$ 275,000
Separable costs	120,000	5,000	125,000
Joint costs	$ 114,000	$ 36,000	$ 150,000

4. In March, Tivoli sold 1,700 gallons for human use for a sales revenue of:

1,700 × $585 = $994,500

Under the constant gross-margin percentage NRV method, each product is provided a gross margin of 80%. Therefore, the gross margin for the sale of human product in March is:

$994,500 × 80% = $795,600

5.

Revenue from accepting the offer:	$6,000
Cost of modification (300 pints × $30):	9,000
Net Inflow:	($3,000)
Add: Cost saving from not having to dispose of toxic byproduct	5,000
Total benefit from offer:	$2,000

Tivoli should therefore accept the offer because its net income will increase by $2,000 as a result.

16-28 (40 min.) **Joint cost allocation**

1. A diagram of the situation is in Solution Exhibit 16-28.

Charme $ 750 + 1/5 * $ 2,700 = $ 1,290. Cost per liter $ 12.90
Romance $ 450 + 4/5 * $ 2,700 = $ 2,610. Cost per liter $ 6.525

2. Total revenues $ 2,250 + $ 2,400 =
$ 4,550
Total costs $ 2,700 + $ 750 + $ 450 = $ 3,900
Total profit
$ 750

This can be divided into
Charme $ 2,250 -/-$ 1,290 = $ 960
Romance $ 2,400 -/- $ 2,610 = - $ 210

3. No ending because the incremental revenues after the split-off point exceeds the incremental costs after de split-off point, for both charme and romance. So the npv is positive for both proucts.

4.

a.

NRV Charme $ 2,250 -/- $ 750 = $ 1,500 (43,5%)
NRV Romance $ 2,400 -/- $ 450 = $ 1,950 (56,5%)

Total profit: see 2)

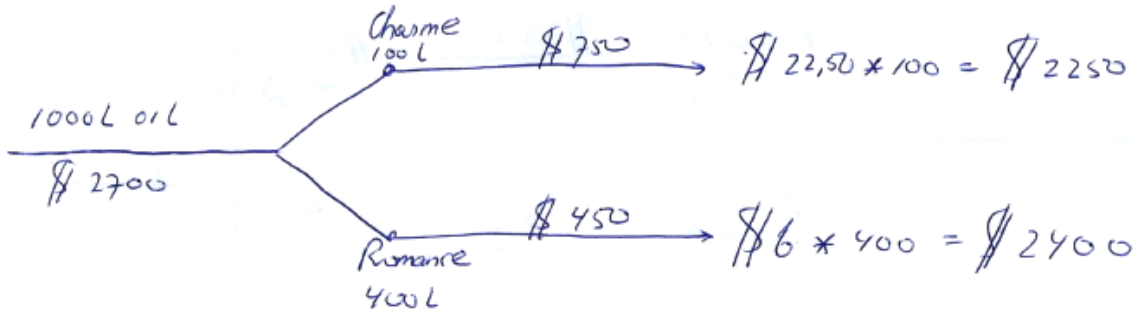
Costs Charme $ 750 + 43.5% * $ 2,700 = $ 1,924.
Costs Romance $ 450 + 56.5% * $ 2,700 = $ 1,976.

Profit Charme $ 2,250 -/- $ 1,924 = $ 326
Profit Romance $ 2,400 -/- 1,976 = $ 424

b.

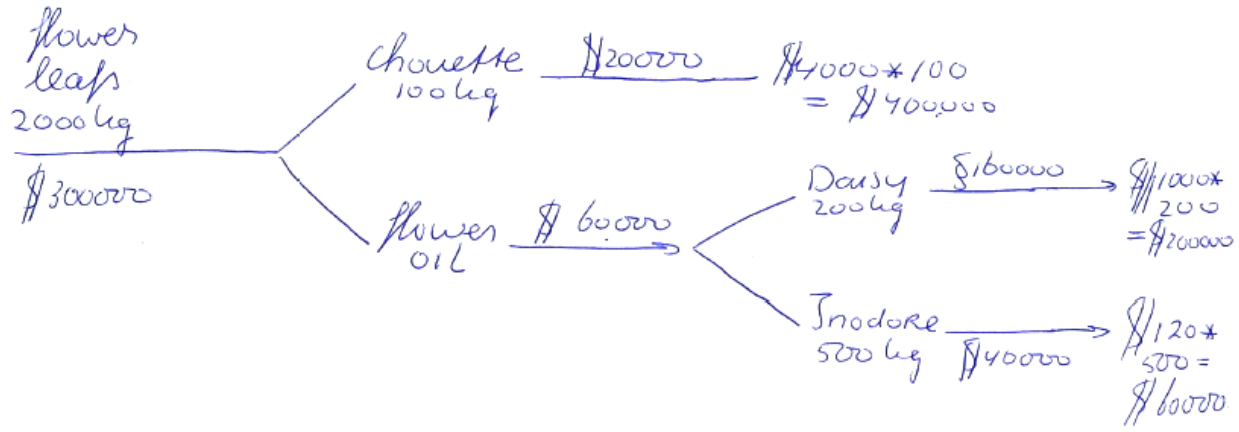
The same. The NRV is positive for both products

SOLUTION EXHIBIT 16-28



16-29 (40–60 min.) **Further-processing decision (Continuation of 16-28)**

1.



NRV Chouette $ 400,000 -/- $ 20,000 = $ 380,000 (86.4%)
NRV Daisy $ 200,000 -/- $ 160,000 = $ 40,000 (9.1%)
NRV Inodore $ 60,000 -/- $ 40,000 = $ 20,000 ((4.5%)

Joint costs Chouette 86.4% * $ 300,000 = $ 259,200
Joint costs Daisy 9.1% * $ 300,000 + 2/3 * $ 60,000 = $ 67,300
Joint costs Inodore 4.5% * $ 300,000 + 1/3 * $ 60,000 = $ 33,500

2.
Chouette: ($ 20,000 + $ 259,200) / 100 = $ 2,729
Daisy: ($ 160,000 + $ 67,300) / 200 = $ 1,136.50
Inodore: (40,000 + $ 33,500) / 500 = $ 147

3.

Total revenues $ 400,000 + $ 200,000 + $ 60,000 =	$ 660,000	
Total costs $ 300,000 + $ 20,000 + $ 60,000 +		
$ 160,000 + $ 40,000 =		$ 580,000
Total profit		$ 80,000

This can be divided into
Chouette $ 400,000 -/- $ 279,200 = $ 120,800
Daisy $ 200,000 -/- $ 227,300 = - $ 27,300
Inodore $ 60,000 -/- $ 73,500 = - $ 13,500

4.
After the first split off point, the incremental revenues of Daisy and Inodore are equal to the incremental costs (both $ 260,000). So from this point of view, and also the distribution point of view, these products can be eliminated. They add no value.
On the other hand, if exclusivity is the main target, than Daisy and Inodore can stay in the assortment, and maybe the indirect costs of $ 20,000 as part of the joint costs can be re-allocated.

16-30 (30 min.) **Joint-cost allocation, process further or sell.**

A diagram of the situation is in Solution Exhibit 16-30.

1.

a. Sales value at splitoff method.

	Monthly Unit Output	Selling Price Per Unit	Sales Value of Total Prodn. at Splitoff	Weighting	Joint Costs Allocated
Studs (Building)	82,000	$ 6	$492,000	53.48%	$545,496
Decorative Pieces	2,000	70	140,000	15.22	$155,244
Posts	18,000	16	288,000	31.30	$319,260
Totals			$920,000	100.00%	$1,020,000

b. Physical measure method.

	Physical Measure of Total Prodn.	Weighting	Joint Costs Allocated
Studs (Building)	82,000	80.39%	$ 819,978
Decorative Pieces	2,000	1.96	19,992
Posts	18,000	17.65	180,030
Totals	102,000	100.00%	$1,020,000

c. Net realizable value method.

	Monthly Units of Total Prodn.	Fully Processed Selling Price per Unit	Net Realizable Value at Splitoff	Weighting	Joint Costs Allocated
Studs (Building)	82,000	$ 6	$492,000	56.68%	$ 578,136
Decorative Pieces	1,800[a]	110	88,000[b]	10.14	103,428
Posts	18,000	16	288,000	33.18	338,436
Totals			$868,000	100.00%	$1,020,000

[a] 2,000 monthly units of output – 10% normal spoilage = 1,800 good units.

[b] 1,800 good units × $110 = $198,000 – Further processing costs of $110,000 = $88,000

2. Presented below is an analysis for Doughty Sawmill, Inc., comparing the processing of decorative pieces further versus selling the rough-cut product immediately at splitoff:

	Units	Dollars
Monthly unit output	2,000	
Less: Normal further processing shrinkage	200	
Units available for sale	1,800	
Final sales value (1,800 units × $110 per unit)		$198,000
Less: Sales value at splitoff		(140,000)
Incremental revenue		58,000
Less: Further processing costs		(110,000)
Additional contribution from further processing		$ (52,000)

3. Assuming Doughty Sawmill announces that in six months it will sell the rough-cut product at splitoff due to increasing competitive pressure, behavior that may be demonstrated by the skilled labor in the planning-and-sizing process include the following:

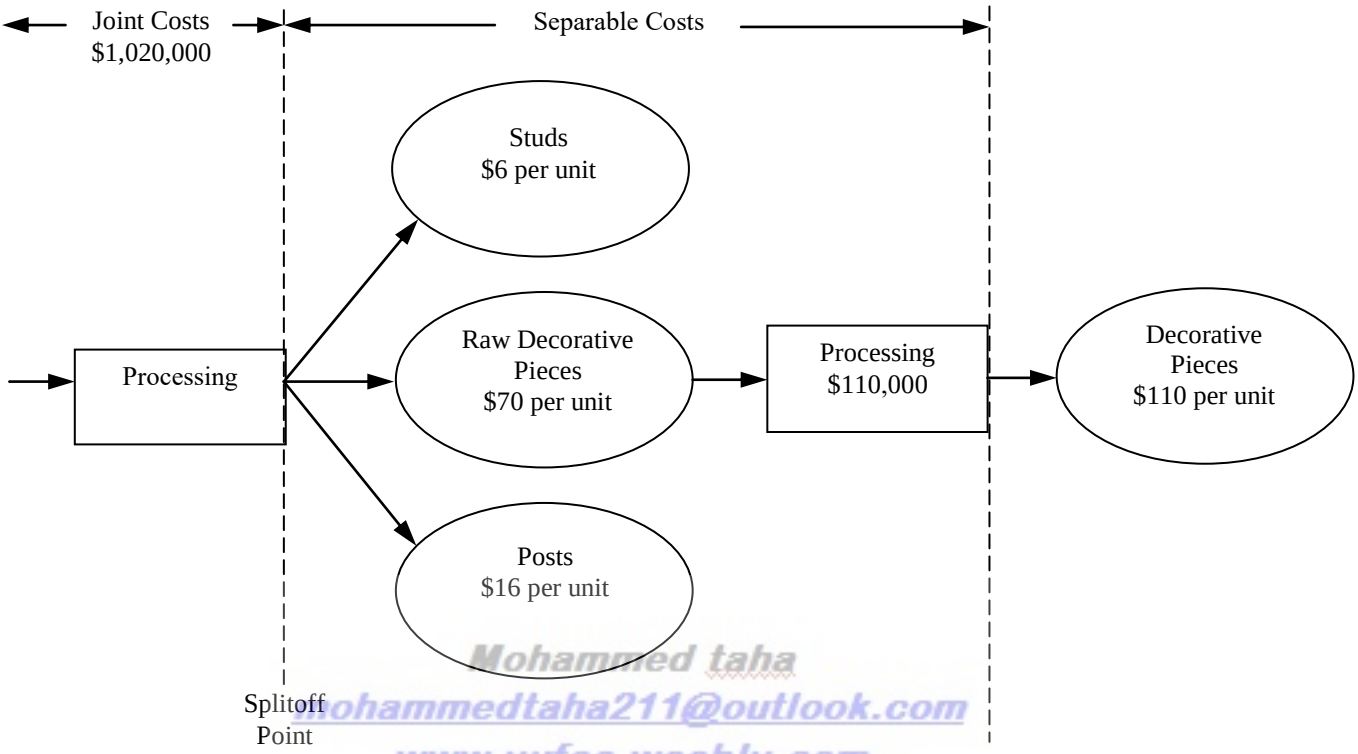
- Lower quality
- Reduced motivation and morale
- Job insecurity, leading to nonproductive employee time looking for jobs elsewhere.

Management actions that could improve this behavior include the following:

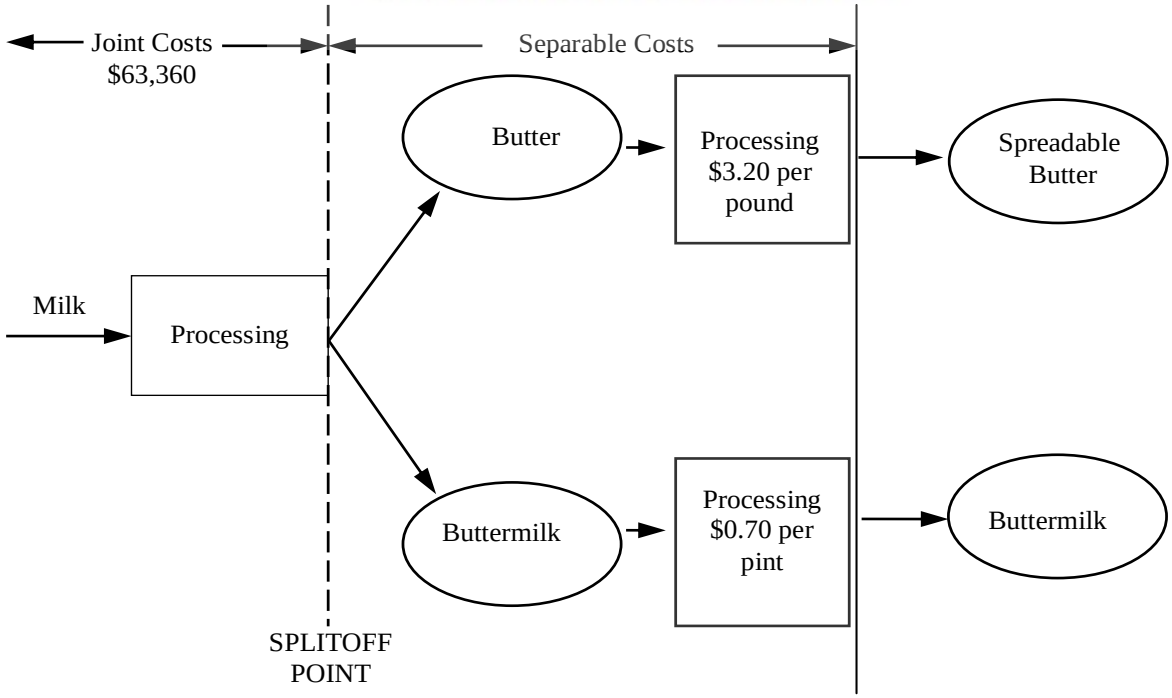
- Improve communication by giving the workers a more comprehensive explanation as to the reason for the change (and in particular the analysis in requirement 2 above) so they can better understand the situation and bring out a plan for future operation of the rest of the plant.
- The company can offer incentive bonuses to maintain quality and production and align rewards with goals and also share some of the savings from not processing the unfinished decorative pieces.
- The company could provide job relocation and internal job transfers.

SOLUTION EXHIBIT 16-30

16-31 (40 min.) **Joint-cost allocation.**



1.



a.
Physical-measure method:

	Butter	Buttermilk	Total
Physical measure of total production (12,000 gal × 3; 12,000 gal × 9)	36,000 cups	108,000 cups	144,000 cups
Weighting, 36,000; 108,000 ÷ 144,000	0.25	0.75	
Joint costs allocated, 0.25; 0.75 × $63,360	$15,840	$47,520	$63,360

b. Sales value at splitoff method:

	Butter	Buttermilk	Total
Sales value of total production at splitoff, 18,000 lbs × $4.40; 27,000 quarts × $2.40	$79,200	$64,800	$144,000
Weighting, $79,200; $64,800 ÷ $144,000	0.55	0.45	
Joint costs allocated, 0.55; 0.45 × $63,360	$34,848	$28,512	$63,360

c. Net realizable value method:

	Butter	Buttermilk	Total
Final sales value of total production, 36,000 tubs × $4.60; 27,000 quarts × $2.40	$165,600	$64,800	$230,400
Deduct separable costs	57,600	0	57,600
Net realizable value	$108,000	$64,800	$172,800
Weighting, $108,000; $64,800 ÷ $172,800	0.625	0.375	
Joint costs allocated, 0.625; 0.375 × $63,360	$39,600	$23,760	$63,360

d. Constant gross-margin percentage NRV method:

Step 1:

Final sales value of total production (see 1c.)	$230,400
Deduct joint and separable costs ($63,360 + $57,600)	120,960
Gross margin	$109,440
Gross-margin percentage ($109,440 ÷ $230,400)	47.50%

Step 2:

	Butter	Buttermilk	Total
Final sales value of total production	$165,600	$64,800	$230,400
Deduct gross margin, using overall gross-margin percentage of sales (47.50%)	78,660	30,780	109,440
Total production costs	86,940	34,020	120,960

Step 3:			
Deduct separable costs	57,600	0	57,600
Joint costs allocated	$29,340	$34,020	$63,360

2. Advantages and disadvantages:

- Physical-Measure

Advantage: Low information needs. Only knowledge of joint cost and physical distribution is needed.

Disadvantage: Allocation is unrelated to the revenue-generating ability of products.

- Sales Value at Splitoff

Advantage: Considers market value of products as basis for allocating joint cost. Relative sales value serves as a proxy for relative benefit received by each product from the joint cost.

Disadvantage: Uses selling price at the time of splitoff even if product is not sold by the firm in that form. Selling price may not exist for product at splitoff.

- Net Realizable Value

Advantages: Allocates joint costs using ultimate net value of each product; applicable when the option to process further exists

Disadvantages: High information needs; Makes assumptions about expected outcomes of future processing decisions

- Constant Gross-Margin percentage method

Advantage: Because it is necessary to produce all joint products, they all look equally profitable.

Disadvantages: High information needs. All products are not necessarily equally profitable; method may lead to negative cost allocations so that unprofitable products are subsidized by profitable ones.

3. When selling prices for all products exist at splitoff, the sales value at splitoff method is the preferred technique. It is a relatively simple technique that depends on a common basis for cost allocation—revenues. It is better than the physical method because it considers the relative market values of the products generated by the joint cost when seeking to allocate it (which is a surrogate for the benefits received by each product from the joint cost). Further, the sales value at splitoff method has advantages over the NRV method and the constant gross margin percentage method because it does not penalize managers by charging more for developing profitable products using the output at splitoff, and it requires no assumptions about future processing activities and selling prices.

16-32 (10 min.) **Further processing decision (continuation of 16-31).**

1.and 2. The decision about which combination of products to produce is not affected by the method of joint cost allocation. For both the sales value at splitoff and physical measure methods, the relevant comparisons are as shown below:

	Butter	Buttermilk
Revenue if sold at splitoff	$ 79,200 [a]	$64,800 [b]
Process further NRV	108,000 [c]	43,200 [d]
Profit (Loss) from processing further	$ 28,800	$(21,600)

[a] 18,000 lbs × $4.40 = $79,200
[b] 27,000 quarts × $2.40 = $64,800
[c] 36,000 tubs × $4.60 – 18,000 lbs × $3.20 = $108,000
[d] 54,000 pints × $1.50 – 54,000 pints × $0.70 = $43,200

To maximize profits, Clover should process butter further into spreadable butter. However, Clover should sell the buttermilk at the splitoff point in quart containers. The extra cost to convert to pint containers ($0.70 per pint × 2 pints per quart = $1.40 per quart) exceeds the increase in selling price ($1.50 per pint × 2 pints per quart = $3.00 per quart – $2.40 original price = $0.60 per quart) and leads to a loss of $21,600.

3. The decision to sell a product at split off or to process it further should have nothing to do with the allocation method chosen. For each product, you need to compare the revenue from selling the product at split off to the NRV from processing the product further. Other things being equal, management should choose the higher alternative. The total joint cost is the same regardless of the alternative chosen and is therefore irrelevant to the decision.

16-33 (20 min.) **Joint-cost allocation with a byproduct.**

1. Sales value at splitoff method: Byproduct recognized at time of production method

	Floor Mats	Car Mats	Rubber Shreds (lbs)
Products manufactured	31,250[a]	93,750[b]	50,000[c]
Products sold	25,000	85,000	43,000
Ending inventory	6,250	8,750	7,000

[a] 25 floor mats/100 tires = 0.25 floor mats per tire × 125,000 tires = 31,250 floor mats
[b] 75 car mats/100 tires = 0.75 car mats per tire × 125,000 tires = 93,750 car mats
[c] (125,000 tires/100) × 40 lbs = 50,000 lbs rubber shreds

Joint cost to be charged to joint products = Joint Cost – NRV of Byproduct
= $600,000 – (50,000 lbs × 0.70 per lb)
= $600,000 – $35,000
= $565,000

	Floor Mats	Car Mats	Total
Sales value of mats at splitoff, 31,250 × $12; 93,750 × $6	$ 375,000	$ 562,500	$937,500
Weighting, $375,000; $562,500 ÷ $937,500	0.40	0.60	
Joint costs allocated, 0.40; 0.60 × $565,000	$226,000	$339,000	$565,000

	Floor Mats	Car Mats	Total
Revenues, 25,000 × $12; 85,000 × $6	$ 300,000	$ 510,000	$ 810,000
Cost of goods sold:			
Joint costs allocated, 0.40; 0.60 × $565,000	$226,000	$339,000	$565,000
Less: Ending inventory	(45,200)[b]	(31,640)[c]	(76,840)
Cost of goods sold	$ 180,800	$ 307,360	$ 488,160
Gross margin	$ 119,200	$ 202,640	$ 321,840

[b] 6,250 × $226,000/31,250 = $45,200
[c] 8,750 × $339,000/93,750 = $31,640

The ending inventory of rubber shreds is reported at its estimated market value of $4,900 (7,000 lbs × $0.70).

2. Sales value at splitoff method: Byproduct recognized at time of sale method

Joint cost to be charged to joint products = Joint Cost = $600,000

	Floor Mats	Car Mats	Total
Sales value of mats at splitoff, 31,250 × $12; 93,750 × $6	$ 375,000	$ 562,500	$937,500
Weighting, $375,000; $562,500 ÷ $937,500	0.40	0.60	
Joint costs allocated, 0.40; 0.60 × $600,000	$240,000	$360,000	$600,000

	Floor Mats	Car Mats	Rubber Shreds	Total
Revenues, 25,000 × $12; 85,000 × $6	$300,000	$510,000	$30,100[d]	$840,100
Cost of goods sold:				
Joint costs allocated, 0.40; 0.60 × $600,000	$240,000	$360,000		$600,000
Less: Ending inventory	(48,000)[e]	(33,600)[f]		(81,600)
Cost of goods sold	$192,000	$326,400		$518,400
Gross margin	$108,000	$183,600	$30,100	$321,700

[d] 43,000 lbs × $0.70 per lb. = $30,100
[e] 6,250 × $240,000/31,250 = $48,000
[f] 8,750 × $360,000/93,750 = $33,600

3. The production method of accounting for the byproduct is only appropriate if The Mat Place is positive they can sell the byproduct at the expected selling price. Moreover, The Mat Place should view the byproduct's contribution to the firm as material enough to find it worthwhile to record and track any inventory that may arise. The sales method is appropriate if either the disposition of the byproduct is unsure or the selling price is unknown, or if the amounts involved are so negligible as to make it economically infeasible for The Mat Place to keep track of byproduct inventories.

16-34 (15 min.) **Byproduct-costing journal entries (continuation of 16-33).**

1. Byproduct—production method journal entries

i) At time of production:

Work-in-process Inventory	600,000	
Accounts Payable, etc.		600,000

<u>For Byproduct</u>:

Finished Goods Inv – Shreds	35,000	
Work-in-process Inventory		35,000

<u>For Joint Products</u>

Finished Goods Inv – Floor	226,000	
Finished Goods Inv – Car	339,000	
Work-in-process Inventory		565,000

ii) At time of sale:

<u>For Byproduct</u>

Cash or A/R	30,100	
Finished Goods Inv – Shreds		30,100

<u>For Joint Products</u>

Cash or A/R	810,000	
Sales Revenue – Floor		300,000
Sales Revenue – Car		510,000

Cost of goods sold – Floor	180,800	
Cost of goods sold – Car	307,360	
Finished Goods Inv – Floor		180,800
Finished Goods Inv – Car		307,360

2. Byproduct—sales method journal entries

i) At time of production:

Work-in-process Inventory	600,000	
Accounts Payable, etc.		600,000

For byproduct:
No entry

For Joint Products

Finished Goods Inv – Floor	240,000	
Finished Goods Inv – Car	360,000	
Work-in-process Inventory		600,000

ii) At time of sale

For byproduct

Cash or A/R	30,100	
Sales Revenue – Shreds		30,100

For Joint Products

Cash or A/R	810,000	
Sales Revenue – Floor		300,000
Sales Revenue – Car		510,000
Cost of goods sold – Floor	192,000	
Cost of goods sold – Car	326,400	
Finished Goods Inv – Floor		192,000
Finished Goods Inv – Car		326,400

16-35 (40 min.) **Process further or sell, byproduct.**

1. The analysis shown below indicates that it would be more profitable for Newcastle Mining Company to continue to sell bulk raw coal without further processing. This analysis ignores any value related to coal fines. It also assumes that the costs of loading and shipping the bulk raw coal on river barges will be the same whether Newcastle sells the bulk raw coal directly or processes it further.

Incremental sales revenues:	
Sales revenue after further processing (8,460,000[a] tons × $34)	$287,640,000
Sales revenue from bulk raw coal (9,000,000 tons × $30)	270,000,000
Incremental sales revenue	17,640,000
Incremental costs:	
Direct labor	790,000
Supervisory personnel	190,000
Heavy equipment costs ($35,000 × 12 months)	420,000
Sizing and cleaning (9,000,000 tons × $3.30)	29,700,000
Outbound rail freight (8,460,000 tons ÷ 600 tons) × $250 per car	3,525,000
Incremental costs	34,625,000
Incremental gain (loss)	$ (16,985,000)

[a] 9,000,000 tons × (1– 0.06)

2. The cost of producing the raw coal is irrelevant to the decision to process further or not. As we see from requirement 1, the cost of producing raw coal does not enter any of the calculations related to either the incremental revenues or the incremental costs of *further* processing. The answer would the same as in requirement 1: Do not process further.

3. The potential revenue from the coal fines byproduct would result in additional revenue ranging between $5,670,000 (at a market price of $14) and $10,125,000 (at a market price of $25).

Coal fines = 75% of 6% of raw bulk tonnage
= 0.75 × (9,000,000 × 0.06)
= 405,000 tons

Potential incremental income from preparing and selling the coal fines:

	Minimum	Maximum
Incremental income per ton (Market price – Incremental costs)	$9 ($14 – $5)	$22 ($25 – $3)
Incremental income ($9; $22 × 405,000)	$3,645,000	$8,910,000

The incremental loss from sizing and cleaning the raw coal is $16,985,000 as calculated in requirement 1. Analysis indicates that relative to selling bulk raw coal, the effect of further processing and selling coal fines is not beneficial at either minimum or maximum incremental income levels. Hence, further processing is still not in Newcastle's interest. In fact, dividing the

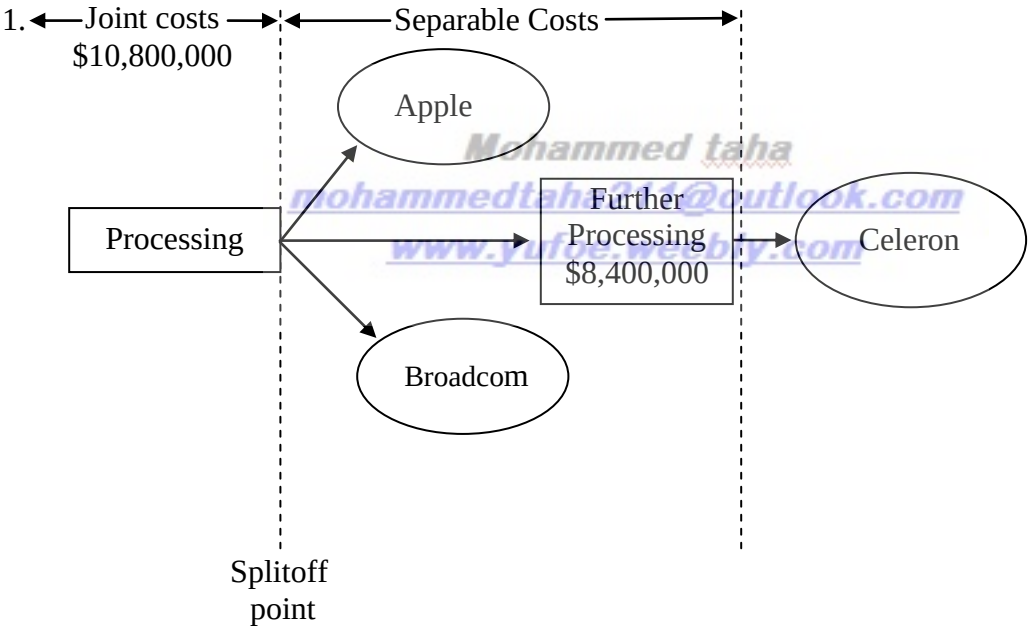
loss of $48,710,000 by the coal fines output of 405,000 tons reveals that the selling price of coal fines would have to increase to create an incremental income of at least $41.94 per ton for further processing to become Newcastle's preferred option.

Note that other than the financial implications, some factors that should be considered in evaluating a sell-or-process-further decision include the following:

- Stability of the current customer market for raw coal and how it compares to the market for sized and cleaned coal
- Storage space needed for the coal fines until they are sold and the handling costs of coal fines
- Reliability of cost (e.g., rail freight rates) and revenue estimates and the risk of depending on these estimates
- Timing of the revenue stream from coal fines and impact on the need for liquidity
- Possible environmental problems, i.e., dumping of waste and smoke from unprocessed coal

16-36 (30 min.) **Joint-cost allocation, process further or sell.**

1.



	Apple	Broadcom	Celeron	Total
Final sales value of total production[a]	$3,570,000	$3,960,000	$15,000,000	$22,530,000
Deduct separable costs	—	—	8,400,000	8,400,000
Net realizable value at splitoff point	$3,570,000	$3,960,000	$ 6,600,000	$14,130,000
Weighting[b]	0.253	0.280	0.467	1.000
Joint costs allocated[c]	$2,732,400	$3,024,000	$5,043,600	$10,800,000

[a] $7 × 510,000; $4 × 990,000; $10 × 1,500,000
[b] $3,570,000; $3,960,000; $6,600,000 ÷ $14,130,000
[c] $10,800,000 × 0.253; $10,800,000 × 0.280; $10,800,000 × 0.467

2.

Further processing Apple	
Incremental revenue	
($11.00 × 455,000) – ($7.00 × 510,000)	$ 1,435,000
Incremental processing cost	1,500,000
Incremental operating income/(loss)	$ (65,000)
Further processing Broadcom	
Incremental revenue	
($5.00 × (990,000 × 1.25)) – ($4 × 990,000)	$2,227,500
Incremental processing cost	2,000,000
Incremental operating income	$ 227,500
Further processing Celeron	
Incremental revenue	
($10.00 × 1,500,000) – ($4.75 × 1,500,000)	$7,875,000
Incremental processing cost	8,400,000
Incremental operating income/(loss)	$ (525,000)

Current Policy

NRV (from requirement 1):	
Sell Apple at splitoff	$3,570,000
Sell Broadcom at splitoff	3,960,000
Process Celeron further	6,600,000
	14,130,000
Joint costs	10,800,000
Operating income	$ 3,330,000

Preferred Options

Sell Apple at splitoff	$3,570,000
Process Broadcom further	
($3,960,000 + $227,500 incremental optg. inc.)	4,187,500
Sell Celeron at splitoff	
($6,600,000 + $525,000 incremental optg. inc.)	7,125,000
	14,882,500
Joint costs	10,800,000
Operating income	$ 4,082,500

Iridium is $752,500 better off by changing two of its current policies—it should process Broadcom further ($227,500 improvement) and sell Celeron at splitoff ($525,000 improvement).

16-37 (60 min.) **Methods of joint-cost allocation, comprehensive.**

1. Joint costs for Kardash include $440,000 in direct materials, $220,000 in direct labor, and $110,000 in overhead costs, for a total of $770,000.

2. At splitoff, the relative weights of the two perfumes are 7,000 ounces of Seduction and 49,000 ounces of Romance (in the form of residue) respectively. Accordingly, the allocation of joint costs under the physical measure method would be in the ratio of 1:7, or as follows:

Seduction: $\left(\frac{1}{8}\right) \times \$770,000 = \$96,250$

Romance: $\left(\frac{7}{8}\right) \times \$770,000 = \$673,750.$

3. The relative sales values of production at splitoff are as follows:

Seduction: 7,000 × $56 per ounce = $ 392,000
Romance: 49,000 × $24 per ounce = $1,176,000

The ratio of the sales values is 392:1176, or 1:3. Accordingly, the joint costs are allocated as:

Seduction: $\left(\frac{1}{4}\right) \times \$770,000 = \$192,500$

Romance: $\left(\frac{3}{4}\right) \times \$770,000 = \$577,500.$

4. Estimated net realizable value per ounce of Seduction perfume:

Selling price per unit:	$109.50
(–) Unit packaging cost: $137,500/5,000 =	27.50
Estimated NRV per ounce:	$ 82.00

Estimated net realizable value per ounce of Romance perfume:

Selling price per unit:	$31.50
(–) Unit packaging cost: $196,000/28,000 =	7.00
(–) Unit processing cost in B: $112,000/28,000 =	4.00
Estimated NRV per ounce:	$20.50

5. The estimated net realizable values of the two perfumes are as follows:

Seduction: 7,000 × $82 per ounce = $ 574,000
Romance: 49,000 × $20.50 per ounce = $1,004,500

The ratio of the ENRVs is 574,000:1,004,500, or 4:7. Accordingly, the joint costs are allocated as:

$$\text{Seduction: } \left(\frac{4}{11}\right) \times \$770,000 = \$280,000$$

$$\text{Romance: } \left(\frac{7}{11}\right) \times \$770,000 = \$490,000.$$

6. The gross margin for Kardash Cosmetics as a whole is the sum of the expected net realizable values from Seduction and Perfume, less the joint costs incurred. From the calculations in requirement 5, this is given by:

ENRV of Seduction ($574,000) + ENRV of Romance ($1,004,500) – Joint Costs ($770,000) = $808,500.

The final sales value of the total production is:

Seduction (7,000 × $109.50) + Romance (49,000 × $31.50) = $2,310,000.

The gross margin percentage for the firm as a whole is therefore:

$$\frac{\$808,500}{\$2,310,000} = 35\%.$$

7. The joint cost allocations to Seduction and Romance under the constant gross-margin percentage NRV method are given as follows:

	Seduction	Romance	Total
Final sales value of production			
7,000 × $109.50; 49,000 × $31.50	$766,500	$1,543,500	$2,310,000
Gross Margin (35%)	268,275	540,225	808,500
Total costs	$498,225	$1,003,275	$1,501,500
Separable costs			
7,000 × $27.50; 49,000 × $11	192,500	539,000	731,500
Joint costs	$305,725	$464,275	$ 770,000

8. No. Selling the residue earns Kardash $24 per ounce. Selling Romance perfume yields (from the calculations in requirement 4) $20.50 per ounce, which is lower. The manager of Kardash Cosmetics could earn an extra $3.50 per ounce by selling residue rather than Romance.