Fifth Edition

CMA

Preparatory Program

Part 1

Financial Planning, Performance and Control

Manufacturing Input Variances Sample

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Published January 2010

Acknowledgements

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Thanks

The authors would like to thank the following people for their assistance in the production of this material:

- All of the staff of HOCK Training and HOCK *international* for their patience in the multiple revisions of the material,
- The students of HOCK Training in all of our classrooms and the students of HOCK *international* in our Distance Learning Program who have made suggestions, comments and recommendations for the material,
- Most importantly, to our families and spouses, for their patience in the long hours and travel that have gone into these materials.

Editorial Notes

Throughout these materials, we have chosen particular language, spellings, structures and grammar in order to be consistent and comprehensible for all readers. HOCK study materials are used by candidates from countries throughout the world, and for many, English is a second language. We are aware that our choices may not always adhere to “formal” standards, but our efforts are focused on making the study process easy for all of our candidates. Nonetheless, we continue to welcome your meaningful corrections and ideas for creating better materials.

This material is designed exclusively to assist people in their exam preparation. No information in the material should be construed as authoritative business, accounting or consulting advice. Appropriate professionals should be consulted for such advice and consulting.

Note: On the Exam, you may be asked a question about a variance of any component of a budget. For example, you may be asked to calculate the variable costs flexible budget variance. You simply calculate the difference between the actual and the flexible budget amounts of variable costs and determine whether the variance is favorable or unfavorable.

If a question does not say what line to use, use either the contribution margin line or the operating income line. If the question is asking for the volume variance, the variances on the contribution margin line and the operating income lines will be exactly the same, so it does not matter which line you use. The reason the variances on these two lines are the same is that the volume variance is the difference between the static budget amount and the flexible budget amount. The only difference between the contribution margin line and the operating income line is fixed costs; and fixed costs are exactly the same in the flexible budget as they are in the static budget. Therefore, the volume variance for the contribution margin line will be exactly the same as the volume variance for the operating income line.

As shown on the following pages, we are really most interested in the flexible budget and the flexible budget variances. This is because the sales volume variances are explained simply, by the fact that the actual level of sales was different from the budgeted level of sales. The flexible budget variances, on the other hand, identify variances that are not the result of different-than-expected sales.

In fact, a flexible budget variance for a revenue item is called a **selling price variance**, because it is caused exclusively by differences between the actual selling price and the budgeted selling price.

Types of Variances

Before looking at the different individual variances in greater detail, we will simply list the different variances that we will study. You need to know how to calculate each of these and understand what they tell us when calculated. Additionally, you also must be able to identify what may cause the different variances. The variances that we will look at are:

Manufacturing Input Variances:

Direct Materials Variances

1) Price variance
2) Quantity or efficiency variance
- **2a) Mix variance***
- **2b) Yield variance***

Direct Labor Variance

3) Rate (price) variance
4) Efficiency (quantity) variance
- **4a) Mix variance***
- **4b) Yield variance***

Factory Overhead Variances

5) Total Variable overhead variance
- **5a) Variable overhead spending variance**
- **5b) Variable overhead efficiency variance**

6) Total Fixed overhead variance
- **6a) Fixed overhead spending or budget variance**
- **6b) Fixed overhead production-volume variance**

Sales Variances:

7) Sales price variance
8) Sales volume variance
8a) Quantity variance**
8b) Mix variance**

* These specific manufacturing variances are calculated only when there is more than one input (either classes of labor or types of material) into the final product.
** These specific sales variances are calculated when the company sells more than one product.

Manufacturing Input Variances

Manufacturing input variances are a special class of variances, including direct materials, direct labor, and manufacturing overhead used in production. These variances are concerned with **inputs** to the manufacturing process and whether the amount of inputs used per unit manufactured was over or under the standard or whether they cost more or less per unit than the standard, and what the cost impact was of each type of variance. Manufacturing input variances are used in controlling production.

In the accounting system, manufacturing input variances are closed out at the end of each period to cost of sales or, if material, they are prorated among cost of sales and inventories. A variance report like the one you see above will not reflect the exact manufacturing input variances, because the variance report above reflects **sold** units, not manufactured units. The input cost variances for the **sold** units **are** included in the flexible budget variance amount on the above report, because they are included in the Actual Results column which is compared with the Flexible Budget column to calculate a Flexible Budget variance. However, the detail is not there, and they should not be expected to reconcile with a production variance report. A production variance report includes all units produced, whether they were sold or whether they remained in inventory as unsold units at the end of the period.

Before getting into the specific manufacturing input variances, let us think for a moment about the possible reasons for an actual input cost to be different from the standard (i.e., expected or budgeted) cost. The standard cost is determined using an **estimated cost and an estimated level of usage**. It is obvious that if the company either pays a different price than had been budgeted, or uses a different amount than was budgeted for the actual output, the actual cost for the actual output will be different from the budgeted cost for the actual output.

The simple fact that the actual cost is different from the budgeted amount is not, by itself, useful enough for management. Management needs to know **why** the actual cost is different. Is it because **a different amount of raw materials or labor was used than should have been used for the actual output,** or was it because **a different price was paid for the raw materials or labor? Or was it both?** The process of variance analysis will enable management to separate out the specific reason(s) for the variance and then focus its efforts on the areas that have a negative impact on the business – identified by unfavorable variances.

In variance analysis, we subdivide input cost variances into

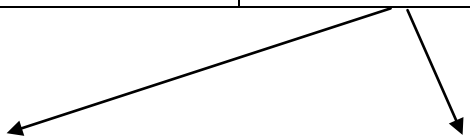
1) a **price variance** that reflects the difference between actual and budgeted input **prices** and
2) a **quantity variance**, called an **efficiency variance**, that reflects the difference between actual and budgeted input **quantities** used.

If you are able to keep this simple, conceptual understanding of how variances occur, you should find variance analysis questions a little easier.

Summary of Manufacturing Input Variances

The following table summarizes the calculations that we make and the different terms that we use in variance analysis. We will look at all of these in more detail later, and this table is again presented at the end of the section on variances. We have simply included this table at the beginning to help you see what will be covered.

Prime Costs	**Price Variance** **(AP – SP) × AQ**	**Quantity Variance** **(AQ – SQ) × SP**
Materials	**Price** Variance	**Quantity** Variance
Labor	**Rate** Variance	**Efficiency** Variance



Multiple Inputs (both Material and Labor)	**Mix** Variance (WASPAM – WASPSM) × AQ	**Yield** Variance (AQ – SQ) × WASPSM

Variable Overhead	**Spending** Variance (AP – SP) × AQ	**Efficiency** Variance (AQ – SQ) × SP
Fixed Overhead	**Spending** (Budget) Variance Actual OH – Budgeted OH	**Production Volume** Variance Budgeted OH – Applied OH

Direct Materials Variances

We will start by looking at the variances related to direct materials and their usage.

The **total material variance (also called the flexible budget variance)** is an easy one to calculate. It is the difference between the actual direct materials costs for the period and the standard costs for the standard amount of materials at the standard price per unit **for the level of output actually produced** (the flexible budget).

Example: Paterno Co. produces footballs. Each football requires a standard of 1 square meter of leather that has a standard cost of $5. During the period, Paterno produced 250 footballs and used 290 meters of leather. The cost of the leather was $4.50 per meter.

Therefore, the actual total cost of the leather was $1,305. However, given the actual output of 250 footballs, Paterno should have used only 250 meters. And since each meter should have cost $5, Paterno should have spent $1,250 on leather in order to produce 250 footballs.

The total materials variance is:

Actual cost – 290 meters × $4.50	$ 1,305	
Standard cost – 250 meters × $5	$ 1,250	
Total variance	$ 55	U

In total, we can see that Paterno spent more money than it should have for the leather to make the footballs. If a manager simply looks at this total variance, the conclusion may be that things are acceptable (it is an unfavorable variance, but it is not that large) and don't require any significant attention. But, when we look in more depth at this example, it is obvious to us that the company used more materials than it should have, but paid less for each square meter of leather than expected. Management will most certainly look at the production process to find out why so much leather was required to make the 250 footballs.

Even though Paterno's total actual cost came close to the total standard cost, there is a significant problem with production. The company either has a very inefficient process that wastes too much leather, or perhaps it has new workers that are not as experienced as they will be in the future. In either case, despite the fact that the total variance cost was close, Paterno needs to investigate further its usage of leather.

Because of the need to have this more useful analysis, the total materials variance is divided into two components – price and quantity. The **price variance** measures how much of the total variance was caused by paying a different amount for the material than had been budgeted, and the **quantity variance (also called the efficiency or usage variance)** measures how much of the variance is due to using more or less of the material than budgeted.

The Quantity Variance

The quantity variance **(also called the efficiency or usage variance)** is calculated as:

(Actual Quantity − Standard Quantity for Actual Output) × Standard Price

or

(AQ – SQ) × SP

This is simply the difference between the actual material usage and the standard usage for this level of output, multiplied by the standard price. We use the standard price because we are trying to determine what the variance actually is, because we used either too much or too little material, not how much we paid for it. A positive variance is an unfavorable variance, while a negative variance is a favorable variance.

In the example above, the **quantity variance** is calculated as:

(290 – 250) × $5 = $200

This is an **unfavorable variance** because if the actual price had been the same as the standard price, Paterno would have had to pay $200 more for the materials it used than it should have, given the number of footballs produced, because it used too much material. The fact that it is unfavorable is indicated by the fact that the number we have calculated is positive. A positive variance for a cost indicates an unfavorable variance, while a negative variance for a cost indicates a favorable variance.

The Price Variance

The price variance is calculated as:

(Actual Price – Standard Price) × Actual Quantity

or

(AP – SP) × AQ

This measures how much of the variance was due to a difference in the price between what we expected it to be per unit and what it the price paid actually was.

In the example above, the price variance is calculated as:

($4.50 – $5) × 290 = $(145)

This means that we saved $145 because the price of the leather was lower than expected. This is a **favorable variance**. Remember that a negative variance for a cost is a favorable variance because it means that actual cost was lower than budgeted cost. So even though Paterno used more leather than it should have for each football it manufactured, it saved $.50 per meter because the price was lower than expected.

If we take these two variances and add them together, we will have the total materials variance that we first calculated.

Quantity variance	$ 200	U
Price variance	(145)	F
Total Variance	$ 55	U

In total, Paterno had a positive variance of $55, which is unfavorable, because the cost for the extra leather that was used was more than the savings on each meter of leather.

Purchase Price Variance

If an Exam question asks for the **purchase** price variance, you calculate this using **all of the units purchased,** not just the units that are put into production. You need to be certain to notice this word if it is used, since it changes your calculation.

One way of looking at these two price variances is as follows: the price variance is calculated at the time of usage, while the **purchase** price variance is calculated at the time of purchase.

Likewise, if a question says that the company recognizes variances **as early as possible**, you would use the **quantity purchased** instead of the quantity used. Most questions ask for the price variance as calculated above, using the units placed into production. But be aware of these possible variations.

Note: On the Exam, you will need to identify possible reasons why a particular variance is favorable or unfavorable. You should usually be able to do this by common sense. For example, an unfavorable quantity variance may be caused by the purchasing department because it bought an inferior product that was damaged or broken, or because of new employees or poor techniques.

In the example above, the variances could be due to the purchasing department getting a good price on inferior leather that was damaged in the production process, or was not always of an acceptable quality.

Accounting for Direct Materials Variances in a Standard Cost System

Standard costing systems use actual variance accounts to record the variances from the standard costs as they occur. At the end of the period, the variances are closed out to cost of goods sold or, if material, prorated among cost of goods sold and inventories.

Purchases of direct materials are recorded as debits to the Materials Inventory account at their **standard cost**. If the company recognizes price variances at the time of purchase, any difference in price from the standard is recorded in a Direct Materials Purchase Price Variance account (a debit if the price is higher than the standard price and a credit if the price is lower than the standard price). The company will probably have a separate variance account for each material used. The credit is to Accounts Payable.

When direct materials are requisitioned from materials inventory for use in the production process, the debit to Work-In-Process Inventory is for the **standard quantity** of materials that should have been used for manufacturing the units manufactured, at their **standard cost**. The credit to the Materials Inventory account is for the **total amount of materials actually used**, at their **standard cost**. The difference is the direct materials quantity variance, and it is recorded in the Direct Materials Quantity (or Usage) Variance account (a debit for an unfavorable variance and a credit for a favorable variance).

This isolates the variances so they can be analyzed. It also maintains standard costs in the Work-In-Process Inventory accounts during the production process.

At the end of the period, the variances are closed out, either to Cost of Goods Sold or, if they are material, they are usually prorated among Work-In-Process Inventory, Finished Goods Inventory, and Cost of Goods Sold.

Question 46: Under a standard cost system, the materials efficiency variances are the responsibility of:

a) Production and industrial engineering.

b) Purchasing and industrial engineering.

c) Purchasing and sales.

d) Sales and industrial engineering.

(CMA Adapted)

Question 47: A favorable materials price variance coupled with an unfavorable materials usage variance would most likely result from:

a) Machine efficiency problems.

b) Product mix production changes.

c) The purchase and use of higher than standard quality materials.

d) The purchase of lower than standard quality materials.

(CMA Adapted)

Question 48: Garland Company uses a standard cost system. The standard for each finished unit of product allows for 3 pounds of plastic at $0.72 per pound. During December, Garland bought 4,500 pounds of plastic at $0.75 per pound, and used 4,100 pounds in the production of 1,300 finished units of product. What is the materials price variance for the month of December?

a) $117 unfavorable.

b) $123 unfavorable.

c) $135 unfavorable.

d) $150 unfavorable.

(CMA Adapted)

The following information is for the next three Questions: ChemKing uses a standard costing system in the manufacture of its single product. The 35,000 units of raw material in inventory were purchased for $105,000, and 2 units of raw materials are required to produce 1 unit of final product. In November, the company produced 12,000 units of product, which was as budgeted. The standard allowed for material was $60,000, and there was an unfavorable quantity variance of $2,500.

Question 49: ChemKing's standard price for one unit of material is:

a) $2.00

b) $2.50

c) $3.00

d) $5.00

Question 50: The units of material used to produce November output totaled:

a) 12,000 units.

b) 12,500 units.

c) 23,000 units.

d) 25,000 units.

Question 51: The materials price variance for the units used in November was:

a) $2,500 unfavorable.

b) $11,000 unfavorable.

c) $12,500 unfavorable.

d) $3,500 unfavorable.

(CMA Adapted)

Direct Labor Variances

As with the materials variance, the **total labor variance (also called the flexible budget variance)** is the difference between the standard labor costs for the actual level of output (the flexible budget) and the actual costs incurred by the company. Also similar to the materials variance, this total variance is attributable to variances in both labor rates and labor usage. This means that the company either paid a different wage rate than standard or used a different number of labor hours than standard for this level of output, or both.

Because this is so similar to variance analysis for materials, we will not cover it in detail again, but the total labor variance can be broken down into the labor rate variance (a price variance) and the labor efficiency variance (a quantity variance). These are calculated in the exact same manner as the direct material cost and usage variances, but simply have different names.

The Labor Rate Variance

The labor rate variance is calculated as the direct materials price variance was calculated:

$$(\text{Actual Rate} - \text{Standard Rate}) \times \text{Actual Hours}$$

or

$$\mathbf{(AP - SP) \times AQ}$$

The Labor Efficiency Variance

The labor efficiency variance is calculated the same way as the direct materials quantity variance was calculated:

$$(\text{Actual Hours} - \text{Standard Hours for Actual Output}) \times \text{Standard Rate}$$

or

$$\mathbf{(AQ - SQ) \times SP}$$

Note: On the Exam, you need to be able to use these formulas not only to solve for the variance itself, but also to solve for any of the individual variables in these equations. In this second case, you will be given the variance and asked to solve for one of the quantity or price numbers, either actual or standard. This is simply using the same formulas, but solving for a different variable.

Accounting for Direct Labor Variances in a Standard Cost System

The production payroll is recorded by debiting Work-In-Process Inventory for the total number of **standard hours for the units manufactured** at the **standard hourly rate**. The credit is to accrued payroll at the **total number of hours actually spent** and at the **actual hourly rate**. The difference is recorded in the Direct Labor Rate Variance (the price variance) and the Direct Labor Efficiency Variance (the quantity variance) accounts. Unfavorable variances are debits, and favorable variances are credits.

As with direct materials variances, the variances are closed out at the end of the period, either to Cost of Goods Sold or, if they are material, prorated among Work-In-Process Inventory, Finished Goods Inventory, and Cost of Goods Sold.

Note: The company must also choose how the costs of employee related costs such as employee benefits and payroll taxes will be treated. They may be included in the cost of direct labor or treated as an overhead and allocated to the units produced. In some cases, these costs may be treated as a period cost. The method in which these costs are treated may have a small effect on cost of goods sold, income or inventory. Only in cases where direct labor is a large portion of the total expenses will this difference be significant.

Question 52: An unfavorable direct labor efficiency variance could be caused by a(n):

a) Unfavorable variable overhead spending variance.

b) Unfavorable materials usage variance.

c) Unfavorable fixed overhead volume variance.

d) Favorable variable overhead spending variance.

(CMA Adapted)

Question 53: Under a standard cost system, labor price variances are usually not attributable to:

a) Labor rate predictions.

b) The use of a single average standard rate.

c) Union contracts approved before the budgeting cycle.

d) The assignment of different skill levels of workers than planned.

(CMA Adapted)

Question 54: Price variances and efficiency variances can be key to the performance measurement within a company. In evaluating performance, all of the following can cause a materials efficiency variance except the:

a) Performance of the workers using the material.

b) Actions of the purchasing department.

c) Design of the product.

d) Sales volume of the product.

(CMA Adapted)

Question 55: A company set the total budgeted direct labor cost at $75,000 for the month for producing 5,000 units. The following standard cost, stated in terms of direct labor hours (DLH), was used to develop the budget for direct labor cost:

1.25 DLH x $12.00/DLH = $15.00/unit produced

The actual operating results for the month were as follows:

Actual units produced	5,200
Actual direct labor hours worked	6,600
Actual direct labor cost	$77,220

The direct labor efficiency variance for the month would be:

a) $4,200 unfavorable.

b) $3,000 unfavorable.

c) $2,220 unfavorable.

d) $1,200 unfavorable.

(CIA Adapted)

The following information is for the next three Questions: Jackson Industries employs a standard cost system that carries direct materials inventory at standard cost. Jackson has established the following standards for the prime costs of one unit of product:

	Standard Quantity	Standard Price	Standard Cost
Direct Materials	5 pounds	$3.60 per pound	$18.00
Direct Labor	1.25 hours	$12.00 per hour	$15.00
			$33.00

During May, Jackson purchased 125,000 pounds of direct material at a total cost of $475,000. The total factory wages for May were $364,000, 90% of which were direct labor. Jackson manufactured 22,000 units of product during May, using 108,000 pounds of direct materials and 28,000 direct labor hours.

Question 56: The direct materials usage (quantity) variance for May is:

a) $7,200 unfavorable.

b) $7,600 favorable.

c) $5,850 unfavorable.

d) $7,200 favorable.

Question 57: The direct labor price (rate) variance for May is:

a) $8,400 favorable.

b) $7,200 unfavorable.

c) $8,400 unfavorable.

d) $6,000 unfavorable.

Question 58: The direct labor usage (efficiency) variance for May is:

a) $5,850 favorable.

b) $6,000 unfavorable.

c) $5,850 unfavorable.

d) $6,000 favorable.

(CMA Adapted)

More than One Material Input or One Labor Class

What has been outlined above is the variance analysis process when we have only one material input into the product or only one class of labor (a class of labor is nothing more than a different wage rate).

In situations where there is a **mix of materials (or labor)** that goes into the product (such as for dog food or cereal), there will be a total variance, a price variance, and a quantity variance. In addition, the quantity variance is subdivided into a **mix variance** and a **yield variance**. The **mix variance** tells us how much of the quantity variance was caused by the fact that the actual **mix** that was used was different from the standard mix (i.e., more of one ingredient was used and less of another ingredient was used). The **yield variance** tell us how much of the quantity variance was caused by the fact that the **total** actual amount of all ingredients used was different from the **total** standard amount.

The price variance of a weighted mix is not broken down the way the quantity variance is.

The mix of ingredients is called a **weighted mix**.

Total Variance of a Weighted Mix

The **total variance** of a weighted mix is the **Total Actual Cost** minus the **Total Standard Cost**.

This and the following variance calculations will be illustrated in an example that follows this discussion.

Materials Price Variance or Labor Rate Variance of a Weighted Mix

The price variance of a weighted mix is the sum of the price variances for each component of the mix, each one calculated individually, using the formula (AP – SP) × AQ.

So if the product manufactured has more than one material input or more than one labor rate, a price variance is calculated for each separate input, and the individual price variances are added together to calculate the total price variance.

Total Material Quantity or Labor Efficiency Variance of a Weighted Mix

The **total** material quantity or labor efficiency variance of a weighted mix is the sum of the quantity variances for each component of the mix, each one calculated individually.

The formula (AQ – SQ) × SP is used to calculate the quantity variance for each component of the mix separately, and then the individual quantity variances are added together to calculate the total quantity variance.

We then break down this total material quantity or labor efficiency variance into two subvariances – the **mix** and the **yield variances**.

The Mix Variance (Materials or Labor)

The mix variance is the part of the quantity variance that results because the mix of materials actually used or the mix of the labor used was different from the mix that should have been used (i.e., the standard). An example would be including more corn and less wheat in the cereal than the standard calls for.

This can occur if there is not enough of a specific input and substitutes were required, or if the wrong proportions were accidentally used in the product.

The formula used to calculate the mix variance is a variation of the **price variance** formula: (AP – SP) × AQ. But instead of using the actual and standard prices for the input, we use **weighted average standard prices.** We use:

1) The **weighted average standard price of the *actual* mix**. We calculate this as the **actual quantity used for each input** multiplied by the **standard cost** for each input, and then adding the results; and

2) The **weighted average standard price of the *standard* mix**. This is calculated as the **standard quantity of each input *for the actual output*** multiplied by the **standard cost** for each input, and then adding the results.

This is demonstrated with numbers in the example following the explanations of these subvariances. (It is not as bad as it sounds.)

The mix variance is calculated as follows:

Weighted Average Standard Price of the *Actual* Mix – Weighted Average Standard Price of the *Standard* Mix (both calculated using the **Standard Costs**) × **Actual Quantity of all material or labor inputs**

or

(WASPAM – WASPSM) × AQ

Note: When looking at any mix variances, it is essential that responsibility be given to an individual only if the person actually has control over the mix, or the substitutions, used.

The Yield Variance (Material or Labor)

The yield variance results from the difference between the **total actual quantity** of the inputs that were actually used to produce the actual output and the **total standard quantity** that should have been used to produce the actual output.

The formula to calculate the yield variance is a variation of the **quantity variance** of the mix, or (AQ – SQ) × SP. Instead of using the standard price of a single input, we use the **weighted average standard price of the standard mix.**

The yield variance is calculated as follows:

Actual Total Quantity of *All* Inputs – Standard Total Quantity of *All* Inputs × **Weighted Average Standard Price of Standard Mix of All Inputs**

or

(AQ – SQ) × WASPSM[b]

Note: In the formula above, the actual quantity of input to the product (AQ) is equal to the **total** number of all of the pounds or hours (or whatever else) that **actually was used** to produce the actual level of output.

The standard quantity of input to the product (SQ) is equal to the **total** number of all of the pounds or hours (or whatever else) that **should have been used** to produce the actual level of output.

Note: Remember, if there is only one input to the product, there is no need to calculate these two additional variances.

On the following two pages is a full example of the calculation of the total variance, the price variance, the quantity variance, and the materials mix and yield variances of a weighted mix.

[b] This is the same WASPSM as was used in the calculation of the mix variance.

Example: Using the following information, calculate the material price and quantity variances, and also the material mix and yield subvariances.

A company produces cereal made up of different grains. The material prices in effect for the fiscal year ending June 30 and the standard kg allowed for the output of April are:

	Standard Price/Kg	Standard Kg for Output	Standard Cost
Corn	$10.00	250	$2,500.00
Wheat	$ 8.00	250	2,000.00
Rice	$ 3.00	250	750.00
		750	$5,250.00

Due to various natural disasters around the world, the price for each input increased on January 1. The standard prices were not revised, and the actual output in April was the same as planned.

The actual material prices and the actual usage for April were as follows:

	Actual Price	Actual Usage	Actual Cost
Corn	$12.00	375	$4,500.00
Wheat	$ 8.50	200	1,700.00
Rice	$ 5.50	325	1,787.50
		900	$7,987.50

Total Variance

The total variance is the difference between the **standard cost for the actual level of output** and the **actual cost**. The standard cost for April was $5,250. The actual cost for April was $7,987.50. This gives a **total unfavorable variance of $2,737.50**, which is broken down into the price and the quantity variances as below.

Materials Price Variance

This is calculated by determining the price variance for each of the three products individually and adding them together. The formula (AP – SP) × AQ and the 3 calculations are:

Corn	($12 – $10) × 375	=	$ 750.00
Wheat	($8.50 – $8) × 200	=	100.00
Rice	($5.50 – $3) × 325	=	812.50
Total Materials Price Variance			**$1,662.50**

Total Materials Quantity Variance

The total materials quantity variance is calculated by using the usage formula (AQ – SQ) × SP for each of the classes individually and then adding them all together:

Corn	(375 – 250) × $10	=	$ 1,250.00
Wheat	(200 – 250) × $8	=	(400.00)
Rice	(325 – 250) × $3	=	225.00
Total Materials Quantity Variance			**$1,075.00**

At this point, we can do a simple test of the two main variances. The price variance added together with the quantity variance should equal the total variance. In this case, that is true:($1,662.50 + $1,075.00 = $2,737.50.

From this point, we need to calculate the mix variance and the yield variance, and when those two items are added together, they must equal $1,075, the total material quantity variance.

Mix Variance

We will start with the **Mix Variance**. What we are calculating here is how much of the material quantity variance was a result of the actual mix that was used being different from the standard mix. We do this by comparing the weighted average standard prices of the actual and standard quantities of each material input, using the standard price for each input. We then multiply this difference by the actual total quantity of all inputs used. The formula for this is:

(WASPAM – WASPSM) × AQ

The **Weighted Average Standard Price of the Standard Mix (WASPSM)** is calculated as follows:

Total Standard Cost ÷ Total Standard Kgs

The total standard kilograms is 750 and the total standard cost is calculated as follows:

Corn	250 × $10	=	$2,500
Wheat	250 × $ 8	=	2,000
Rice	250 × $ 3	=	750
Total Standard Cost	**750 kg**		**$5,250**

This will make the **Weighted Average Standard Price of the Standard Mix (WASPSM) $7.00 per kg** ($5,250 ÷ 750).

The **Weighted Average Standard Price of the Actual Mix (WASPAM)** is calculated as follows:

Total Cost using Actual Kg and Standard Price ÷ Total Actual Kg.

The total actual kg was 900 and the total standard cost of the actual mix is calculated as follows:

Corn	375 × $10	=	$3,750
Wheat	200 × $ 8	=	1,600
Rice	325 × $ 3	=	975
Total Cost at Standard Rate	**900 kg**		**$6,325**

This will make the **Weighted Average Standard Price of the Actual Mix (WASPAM) $7.0277 per kg** ($6,325 ÷ 900).

This tells us that because the mix was wrong, the standard price of each kilogram of actual input used was $.0277 more than it should have been.

Putting all of these numbers into the formula (WASPAM – WASPSM) × AQ we get the following:

($7.0277 – $7.00) × 900 = **$25 Unfavorable Materials Mix Variance**

$25 of the unfavorable quantity variance arose because the mix that was used was not the correct mix.

Yield Variance

We now need to calculate the **Materials Yield Variance**, which calculates how much of the quantity variance occurred as a result of using more or less total input than the standard total input. In this calculation, we are not worried about the mix of the inputs, just the total quantity of inputs used. The formula for this is:

(AQ – SQ) × WASPSM

We already know the WASPSM was $7 per kg from the previous calculations, the Actual Quantity was 900 kg, and the Standard Quantity was 750 kg.

Putting all of this into the formula we get the following:

(900 – 750) × $7 = **$1,050 Unfavorable Materials Yield Variance**

This means that $1,050 of the unfavorable quantity variance was caused by the fact that we used more material input than we should have for the amount of output. From these calculations, we see that it was not so much the change in the mix that caused the variance, but rather a general inefficiency in the use of the material inputs.

To prove all of the calculations, we can do a simple check comparing the two subvariances to the total quantity variance:

	Materials Mix Variance	$ 25 U
+	Materials Yield Variance	1,050 U
=	**Total Materials Quantity Variance**	**$1,075 U**

The following information is for the next two Questions: Azat Corporation produces ketchup. Azat mixes two varieties of tomatoes: a locally grown variety to provide excellent taste and an imported variety to provide a richer color. The standard costs and inputs for a 200-kg batch of ketchup are as follows:

Tomato Type	Standard Quantity in Kg.	Standard Cost per Kg	Total Cost
Local	200	.75	$150
Imported	100	.90	90
Total	300		$240

A total of 110 batches were produced during the current period. The quantities actually purchased and used during the current period as well as the prices paid are shown below:

Tomato Type	Quantity in Kg.	Actual Cost per Kg	Total Cost
Local	21,000	.65	$13,650
Imported	14,000	.95	13,300
Total	35,000		$26,950

Question 59: What is the materials mix variance for the current period?

a) $1,050 favorable

b) $350 favorable.

c) $1,050 unfavorable.

d) $350 unfavorable.

Question 60: What is the materials yield variance for the current period?

a) $1,600 favorable.

b) $1,600 unfavorable.

c) $1,620 unfavorable.

d) $1,620 favorable.

(HOCK)

Factory Overhead Variances

In this section we are looking at the calculation of the variances related to factory overhead. Unfortunately, these are a little more difficult for most people to logically "see" what is happening. If this is the case for you, simply memorize the formulas for these calculations. They are very similar to the formulas used for labor and material variances.

There are both variable and fixed overhead variances. We will look first at the variable overhead variances and then at the fixed overhead variances. Both of these two general variances can be broken down into two variances, as we did for the material and labor variances.

As such, there are actually four total variances that are calculated for overhead.

These four variances are then combined into what are known as four-way, three-way and two-way analysis. The different methods are simply different combinations of the same four variances. We will start by looking at the four variances individually, and then look at the different combinations.

Variable Overhead Variances

Total Variable Overhead Variance (or Variable Overhead Flexible Budget Variance)

Variable overheads are overhead costs that change as the level of production changes. Examples are plant electricity, equipment maintenance, utilities, etc. They cannot be traced to specific units manufactured, and for that reason they are called overhead costs. However, since they do increase when production increases and decrease when production decreases, they are variable costs.

The total variable overhead variance is equal to the difference between the actual variable overhead incurred and the standard variable overhead applied. The standard variable overhead applied is based on the standard usage (given the actual output) of the overhead allocation base (machine hours, direct labor hours, etc). This is also called the **variable overhead flexible budget variance**.

Actual Total Variable Overhead Incurred **(money spent on these items)**
– Flexible Budget Amount[c]
= Total Variable Overhead Variance[d]

This total variance may be broken down into the spending and efficiency variances.

Variable Overhead Spending Variance

This is essentially the price variance and this variance is related to the difference between the actual variable overhead cost per unit (this is calculated as the actual overhead costs ÷ the actual usage of the allocation base) and the standard application rate. The variable overhead spending variance is calculated as follows:

(Actual VOH Cost Per Unit of Allocation Base Actually Used – Standard VOH Cost Per Unit of Allocation Base [i.e., Standard Application Rate]) × Actual Quantity of VOH Allocation Base Used for Actual Output

or

$$(AP - SP^{e}) \times AQ$$

[c] This is calculated as (Standard Rate × Standard Quantity for the Actual Production Level).
[d] Note that this is the same as the amount of over- or underapplied variable overhead.
[e] Note that this is really not a price, but rather a rate. We use the letter P in this formula to keep it the same as in the materials and labor variances since the formulas are essentially the same.

This variance is also the difference between the **actual amount of variable overhead incurred** and the **standard amount of variable overhead allowed for the actual quantity of the VOH allocation base used for the actual output produced.**

Variable Overhead Efficiency Variance

This is essentially the quantity variance, and it determines the amount of the total variance caused by a different usage of the allocation base than was expected (i.e., the standard hours for the actual output).

The variable overhead efficiency variance is calculated as follows:

(Actual Activity Level of VOH Allocation Base Used for Actual Output – Standard Activity Level of VOH Allocation Base Allowed for Actual Output) × Standard Application Rate

or, what is essentially

(AQ – SQ) × SP

Note: If overhead is applied based on amount of the allocation base used for the actual units of output rather than a standard amount allowed, there will be no variable overhead efficiency variance.

Question 61: The following information pertains to Roe Co.'s June operations:

Standard direct labor hours per unit	2
Actual direct labor hours	10,500
Number of units produced	5,000
Standard variable overhead per standard direct labor hour	$3
Actual variable overhead	$28,000

Roe's June unfavorable variable overhead efficiency variance was:

a) $0

b) $1,500

c) $2,000

d) $3,500

(CPA Adapted)

Fixed Overhead Variances

Total Fixed Overhead Variance

The total fixed overhead variance analysis is the difference between the actual fixed overhead and the amount that was applied using the standard rate and the standard usage for the actual level of output.

Actual Fixed Overhead Incurred (money actually spent)
– **Applied Fixed Overheads** (standard rate × standard for actual output)[f]
= Total Fixed Overhead Variance[g]

As with the variable overhead variance, this total fixed overhead variance can be broken down into two other variances – spending (or budget) variance and volume variance.

Fixed Overhead Spending (or Fixed Overhead Budget) Variance

The fixed overhead budget/spending variance is simply the difference between the actual fixed overhead costs and the budgeted fixed overhead amount.

Actual Fixed Overhead Incurred
– Budgeted Fixed Overheads (the static budget amount)
= Fixed Overhead Budget/Spending Variance

Fixed Overhead Production-Volume Variance

The fixed overhead volume variance is the difference between the budgeted amount of fixed overhead and the amount of fixed overhead applied (standard rate × **standard input for the actual level of output**). The Fixed Overhead Production-Volume Variance is caused by the actual production level being different from the production level used to calculate the budgeted fixed overhead rate. This is done mathematically as follows:

Budgeted Fixed Overheads (the static budget amount)
– Applied amount of Fixed Overhead (standard rate × standard input for actual output)
= Fixed Overhead Production-Volume Variance

Note: This is the only time for an expense variance calculation that a budgeted cost amount comes before an actual cost amount, and yet a negative amount is Favorable. This variance is different because it does not measure a difference between an actual incurred cost and a budgeted cost. A negative amount is Favorable because it indicates that **actual production has exceeded the budgeted production level**. A positive amount is Unfavorable because it indicates that **actual production has been lower than the budgeted production level**.

As we can see, the Total Fixed Overhead Variance is equal to the Fixed Overhead Budget/Spending Variance plus the Fixed Overhead Production-Volume Variance.

Note: There is no fixed overhead efficiency variance because these costs do not relate to levels of output and therefore cannot be used efficiently or inefficiently.

Following is an example of variable, fixed, and total overhead variance calculations. In addition to this example, you will find a comprehensive example of accounting for fixed overhead and fixed overhead variances in Section C of this textbook under the topic of "The Process of Accounting for Factory Overhead." The example in the next section will highlight fixed overhead and show how the fixed overhead variances

[f] Overhead is applied to individual products produced, usually on the basis of either direct labor hours, machine hours, materials costs, units of production, weight of production, or some other similar measure. This will be covered in depth in Section C, Cost Management. The "standard for actual output" in the formula is the **standard amount of the application base allowed for the actual output**.
[g] This amount is the same as the over- or under-applied fixed factory overhead.

arise in the accounting system and how they are cleared out. The fixed overhead example in Section C will use the same amounts as this example does for fixed overhead, so it will maintain continuity.

Example: Overhead is applied to production based on machine hours. Before 2010 begins, the company budgets the following for the year 2010:

Standard for number of machine hours used/unit produced	5 MH/unit
Budgeted activity level	1,000,000 units
Budgeted fixed overhead	$10,000,000
Budgeted fixed overhead application rate	
$10,000,000 ÷ (5 MH/unit × 1,000,000 units)	$2/MH
Budgeted variable overhead for budgeted activity level	$5,000,000
Budgeted variable overhead application rate	
$5,000,000 ÷ (5 MH/unit × 1,000,000 units)	$1/MH

Actual production during 2010 is 1,200,000 units. The **standard** number of machine hours (the machine hours **allowed** for the actual production) is 1,200,000 units × 5 MH per unit, or 6,000,000 machine hours. The **actual** number of machine hours used during 2010 for the actual production is 6,300,000 hours.

During 2010, fixed and variable overhead is applied to production at the predetermined rates of $2 per machine hour **allowed** for fixed overhead and $1 per machine hour **allowed** for variable overhead, for a total of $3 per machine hour allowed. Since 6,000,000 machine hours were allowed for the actual production of 1,200,000 units, the total amount of fixed overhead applied is $2 × 6,000,000, or $12,000,000; and the total amount of variable overhead applied is $1 × 6,000,000, or $6,000,000. Total fixed and variable overhead applied is $12,000,000 + $6,000,000, or $18,000,000.

Actual overhead incurred during 2010:	
Fixed overhead	$11,000,000
Variable overhead	5,670,000
Total actual overhead incurred	$16,670,000

Budgeted overhead for 2010:		
Fixed overhead	$10,000,000	
Variable overhead ($1/MH × 5MH/unit × 1,200,000 units produced)	6,000,000	
Total budgeted overhead, fixed and variable	$16,000,000	
Total overhead variance (Total actual OH – Total budgeted OH)	$ 670,000	Unfavorable

Variable Overhead Variances

Total Variable OH Variance:

	Actual Total Variable OH incurred	$5,670,000
Minus:	VOH Applied: standard rate × standard qty. of application base (machine hours) allowed for actual output ($1 × 5 × 1,200,000)	6,000,000
	Total Variable Overhead Variance	**$(330,000)** **Favorable**

The total variable overhead variance is broken down into the **variable overhead spending variance** and the **variable overhead efficiency variance.**

(continued)

Variable Overhead Spending Variance:

(Actual VOH cost/unit of allocation base actually used − Minus standard VOH application rate/unit of allocation base) × Actual Qty. of VOH application base used for actual output

OR (AP – SP) × AQ

[($5,670,000 ÷ 6,300,000) − $1] × 6,300,000 = (.90 – 1.00) × 6,300,000 = **$(630,000) Favorable**

Variable Overhead Efficiency Variance:

(Actual activity level of VOH application base **actually used** − Minus standard activity level of application base **allowed**) × Standard Application Rate

OR (AQ – SQ) × SP

[6,300,000 – (1,200,000 × 5)] × $1 = (6,300,000 – 6,000,000) × $1 = **$300,000 Unfavorable**

The Variable Overhead Spending Variance of $(630,000) Favorable plus the Variable Overhead Efficiency Variance of $300,000 Unfavorable equals the Total Variable Overhead Variance of $(330,000) Favorable.

The variance analysis tells us that the actual variable overhead cost per unit of the allocation base (machine hours) incurred was lower than budgeted for the amount actually produced ($630,000 Favorable); but the number of units of the allocation base (machine hours) actually used was higher than budgeted ($300,000 Unfavorable).

Fixed Overhead Variances

Total Fixed Overhead Variance:

	Actual fixed overhead incurred	$11,000,000	
Minus:	Applied fixed overhead (standard rate × standard quantity of applic. base for actual output, or $2 × 6,000,000 MH)	12,000,000	
	Total fixed overhead variance	**$(1,000,000)**	**Favorable**

The total fixed overhead variance is broken down into the **fixed overhead spending variance** and the **fixed overhead production-volume variance**.

Fixed Overhead Spending Variance:

	Actual fixed overhead incurred	$11,000,000	
Minus:	Budgeted Fixed Overhead	10,000,000	
	Total fixed overhead variance	**$1,000,000**	**Unfavorable**

Fixed Overhead Production-Volume Variance:

	Budgeted Fixed Overhead	$10,000,000	
Minus:	Applied fixed overhead (standard rate × standard quantity of applic. base for actual output, or $2 × 6,000,000 MH)	12,000,000	
	Fixed overhead production-volume variance	**$(2,000,000)**	**Favorable**

The Total Fixed Overhead Variance is the $1,000,000 Unfavorable spending variance plus the $2,000,000 Favorable production-volume variance, or $1,000,000 Favorable. The unfavorable spending variance means more fixed overhead was actually incurred than was budgeted. The favorable production-volume variance means that actual production exceeded the budgeted production level.

(continued)

Although the actual production level exceeded the budgeted production level, the actual fixed overhead cost incurred did not increase because of the increased production, since the cost is fixed. The total fixed cost was spread over a greater number of units, and that is favorable. However, the actual fixed overhead cost incurred **was** higher than had been budgeted (though not due to the increased production), and that was unfavorable.

The total variable overhead variance of $(330,000) Favorable plus the total fixed overhead variance of $1,000,000 Unfavorable is equal to the total overhead variance we calculated at the beginning of this example of $670,000 Unfavorable.

Question 62: The total fixed overhead variance is the:

a) Measure of the lost profits from the lack of sales volume.

b) Amount of the underapplied or overapplied fixed overhead costs.

c) Potential cost reduction that can be achieved from better cost control.

d) Measure of production inefficiency.

(CMA Adapted)

Question 63: Variable overhead is applied on the basis of standard direct labor hours. If the direct labor efficiency variance is unfavorable, the variable overhead efficiency variance will be:

a) Favorable.

b) Unfavorable.

c) The same amount as the labor efficiency variance.

d) Indeterminable because it is not related to the labor efficiency variance.

(CMA Adapted)

Two-Way, Three-Way and Four-Way Analysis

What we have covered above is the analysis of overheads (fixed and variable) in the four-way method. There are four variances and each is calculated separately. There are also three-way and two-way methods of analyzing overheads, which we do by simply combining some of the four-way analysis variances that we calculated.

In **Three-way Analysis**, the three variances are the volume, efficiency and spending variances.

1) The **volume variance** is equal to the volume variance as calculated for fixed overhead.
2) The **efficiency variance** is equal to the variable overhead efficiency variance.
3) The **spending variance** is equal to the variable overhead spending variance **plus** the fixed overhead spending (budget) variance.

Two-way Analysis uses the same information as calculated for four-way analysis, but we are going to combine it in a slightly different manner. The two variances are called the volume variance and the controllable (or budget) variance.

1) The **volume variance** is equal to the volume variance for fixed overhead.
2) The **controllable variance** is equal to the sum of the remaining three variances, which are variable spending variance, variable efficiency variance and fixed spending (budget) variance.

The following table illustrates the way the four variances are combined for three-way and two-way analysis.

<table>
<tr><th colspan="2">Variable Overhead Variance Analysis</th><th colspan="2">Fixed Overhead Variance Analysis</th></tr>
<tr><td>Efficiency
Variance
(AQ − SQ) × SP</td><td>Spending
Variance
(AP − SP) × AQ</td><td>Spending (Budget)
Variance
Actual − Budgeted</td><td>Production Volume
Variance
Budgeted – Applied</td></tr>
<tr><td>Efficiency Variance</td><td colspan="2">Spending Variance</td><td>Volume Variance</td></tr>
<tr><td colspan="3">Controllable Variance</td><td>Volume Variance</td></tr>
</table>

Question 64: Which of these variances is least significant for cost control?

a) Labor price variance.

b) Materials quantity variance.

c) Fixed O/H volume variance.

d) Variable O/H spending variance.

(CMA Adapted)

The following information is for the next six Questions: Franklin Glass Works' production budget for the year ended November 30 was based on 200,000 units. Each unit required two standard hours of labor for completion. Total overhead was budgeted at $900,000 for the year, and the fixed overhead rate was estimated at $3.00 per unit. Both fixed and variable overhead are assigned to the product on the basis of direct labor hours. The actual data for the year ended November 30 is presented as follows.

Actual production in units	198,000
Actual direct labor hours	440,000
Actual variable overhead	$352,000
Actual fixed overhead	$575,000

Question 65: The standard hours allowed for actual production for the year ended November 30 total:

a) 247,500

b) 396,000

c) 400,000

d) 495,000

Question 66: Franklin's variable overhead efficiency variance for the year is:

a) $33,000 unfavorable.

b) $35,520 favorable.

c) $66,000 unfavorable.

d) $33,000 favorable.

Question 67: Franklin's variable overhead spending variance for the year is:

a) $20,000 unfavorable.

b) $19,800 favorable.

c) $22,000 unfavorable.

d) $20,000 favorable.

Question 68: Franklin's fixed overhead spending variance for the year is:

a) $19,000 favorable.

b) $25,000 favorable.

c) $5,750 favorable.

d) $25,000 unfavorable.

Question 69: The fixed overhead applied to Franklin's production for the year is:

a) $484,200.

b) $575,000.

c) $594,000.

d) $600,000.

Question 70: Franklin's fixed overhead volume variance for the year is:

a) $6,000 unfavorable.

b) $19,000 favorable.

c) $25,000 favorable.

d) $55,000 unfavorable.

(CMA Adapted)

Summary Table of Variance Calculations

The following table summarizes the calculations that are made and the different terms used in variance analysis.

Prime Costs	**Price Variance** **(AP – SP) × AQ**	**Quantity Variance** **(AQ – SQ) × SP**
Materials	**Price** Variance	**Quantity** Variance
Labor	**Rate** Variance	**Efficiency** Variance

Multiple Inputs[h] (both Material and Labor)	**Mix** Variance (WASPAM – WASPSM) × AQ	**Yield** Variance (AQ – SQ) × WASPSM

Variable Overhead[i]	**Spending** Variance (AP – SP) × AQ	**Efficiency** Variance (AQ – SQ) × SP
Fixed Overhead	**Spending** (Budget) Variance Actual OH – Budgeted OH	**Production Volume** Variance Budgeted OH – Applied OH

[h] The sum of the mix and yield variance is equal to the total of the quantity or efficiency variance for each of the inputs calculated separately, and then added together.

[i] For overhead variances, we use the standard and actual application rate rather than price. The standard rate is the rate that is calculated at the beginning of the year and used to allocate overhead, and the actual rate is calculated as Actual Costs / Actual Level of Usage.

46 a – The efficiency variance measures the actual usage of the materials against the standard that should have been used. This usage is mostly under the control of the production department and industrial engineering.

47 d – If the company buys lower quality materials, there will be a favorable price variance. However, because the input materials are of a lower quality, it is very possible that a higher than normal quantity will need to be used because the lower quality materials may break or be damaged or unusable in some cases because of the lower quality.

48 b – The price variance formula is (AP – SP) × AQ. Putting the numbers from the question into the formula, we get (.75 – .72) × 4,100. (Remember that in the price variance we use the number of units **used** in production, unless the problem asks for the **purchase** price variance.) This gives us an unfavorable variance of $123.

49 b – The standard price is calculated using budgeted amounts. ChemKing expected to make 12,000 units, which would require 24,000 units of raw material. Since the budgeted cost of these raw material units was $60,000, the standard cost per unit is $2.50 ($60,000 ÷ 24,000).

50 d – In this question, we need to solve for AQ and since we are given the quantity variance in the question, we can use this formula: (AQ – SQ) × SP = Quantity Variance. Or, (AQ – 24,000) × $2.50 = $2,500. Solving for AQ we get 25,000. We also could have solved this in the following manner: because the standard price for each unit of material was $2.50 and ChemKing's quantity variance was $2,500 unfavorable, it must have used 1,000 units of raw materials too many. The standard is 2 units of material for each unit of output, so for 12,000 units of output, the standard would be 24,000 units of material. Thus, the actual units of raw material used were 24,000 + 1,000, or 25,000.

51 c – The formula for the price variance is (AP – SP) × AQ. Using the amounts in the questions, we get ($3.00 – $2.50) × 25,000 = $12,500 Unfavorable. We know that the actual price was $3.00 per unit because the company bought 35,000 units for $105,000.

52 b – If the company has an unfavorable materials usage variance, this will mean that more materials were used than necessary. This in turn may cause more labor hours in order to handle and process the additional materials. Therefore, the unfavorable materials usage variance may also cause an unfavorable labor variance as well.

53 c – If a new labor contract has been signed prior to the budgeting cycle, the new labor rates should have been incorporated into the budget. Therefore, this is not an explanation of a labor price variance.

54 d – The actual sales volume of the product will not impact the materials efficiency variance. The difference between sales and production does not affect the comparison of how much material should have been used in the production and how much actually was used.

55 d – In order to calculate the labor efficiency variance, we need to use the following formula: (AQ – SQ) × SP. The standard price is $12 per direct labor hour. The standard number of hours for the level of production is 6,500 (5,200 units × 1.25 hours per unit). The actual number of hours was 6,600. Putting this into the formula, we get (6,600 – 6,500) × $12 = $1,200. This is a $1,200 unfavorable variance.

56 d – To solve for the direct materials usage variance, we need to solve the following equation: (AQ – SQ) × SP. The standard price is $3.60 per pound and the standard quantity required to produce the actual quantity of output is 110,000 (22,000 units × 5 pounds per unit). We are told that the actual quantity used was 108,000. Therefore, the formula is (108,000 – 110,000) × $3.60 and this gives us a favorable variance of $(7,200).

57 a – To solve for the direct labor rate variance, we need to solve the following equation: (AP – SP) × AQ. The actual quantity of labor hours was 28,000 and the standard rate is $12.00 per hour. The actual rate may be calculated by dividing the actual cost of $327,600 (this is calculated as 90% of the total labor cost) by the actual hours worked of 28,000. This gives an actual labor rate of $11.70. Putting these numbers into the formula, we get ($11.70 – $12.00) × 28,000. This gives us a favorable variance of $(8,400).

58 b – To solve for the labor usage variance, we need to solve the following equation: (AQ – SQ) × SP. The standard price was $12.00 and the actual quantity was 28,000. The standard quantity for the actual level of output is 27,500 (22,000 units × 1.25 hours per unit). Putting these numbers into the formula, we get (28,000 – 27,500) × $12, and this gives us an unfavorable labor usage variance of $6,000.

59 d – The materials mix variance equals the actual total quantity used times the difference between the weighted average standard price for the actual mix per unit and the weighted average standard price for the standard mix per unit. The weighted average standard price for the actual mix was (21,000 × $0.75) + (14,000 × $0.90) = $28,350. So, the weighted average standard price for the actual mix per unit was $.81 ($28,350 ÷ 35,000 kg). The weighted average standard price for the standard mix is $.80 per unit. ($240 standard total cost per batch ÷ 300 standard total kg per batch), and the mix variance was $350 unfavorable: ($.81 – $.80) x 35,000 = $350.

60 b – The materials yield variance equals the weighted average standard price for the standard mix per unit multiplied by the difference between the actual total quantity used and the standard total quantity for the actual output achieved. The weighted average standard price for the standard mix is $.80 per kg. ($240 standard total cost per batch ÷ 300 standard total kg per batch). The actual total quantity used is 35,000. The standard total quantity for the actual output achieved is 300 kg per batch × 110 batches = 33,000 kg. So, the yield variance was $1,600 unfavorable: (35,000 – 33,000) x 0.80 = $1,600.

61 b – The variable overhead efficiency variance is calculated as (AQ – SQ) × SP, where SP is the budgeted application rate. Given that 5,000 units were produced, the standard quantity of DLH would be 10,000. Given that the actual hours was 10,500 and that the standard rate was $3, we get (10,500 – 10,000) × 3 = $1,500, and an unfavorable variance of $1,500.

62 b – By definition, the fixed overhead volume variance is the difference between the budgeted and the applied fixed overhead.

63 b – If overhead is applied based on direct labor hours and the direct labor efficiency variance is unfavorable, the variable overhead efficiency variance will also be unfavorable. This is because the amount applied as overhead is more than was budgeted because the actual hours were more than budgeted.

64 c – The fixed overhead volume variance results from a difference between actual and budgeted production. This does not relate to an expenditure problem in which either too much is paid or too much is used. Therefore, this is the least significant variance for cost control.

65 b – The standard hours for each unit is 2. Since Franklin Glass Works produced 198,000 units, the standard total hours should be 396,000 (198,000 × 2).

66 a – To solve for the variable overhead efficiency variance, we need to solve for the following equation: (SQ – AQ) × SP. In order to calculate the standard variable overhead allocation rate, we need to determine what the total variable overhead was budgeted to be. We are told that the total budgeted overhead is $900,000 and that the fixed overhead is $3 per unit. If there were 200,000 units budgeted, the total budgeted fixed overhead was $600,000. This leaves variable overhead of $300,000. Since 200,000 units were budgeted and there are 2 hours per unit, that gives a total of 400,000 budgeted hours. Calculating the allocation rate now, we get $.75 of variable overhead per direct labor hour ($300,000 ÷ 400,000 hours). The actual number of hours was 440,000 and the standard number of hours was 396,000. Therefore, the formula looks as follows: (440,000 – 396,000) × $.75 and the variance is an unfavorable $33,000.

67 c – To solve for the variable overhead spending variance, we need to solve for the following equation: (AP – SP) × AQ. We know that the standard price was $.75 and that the actual hours were 440,000. The actual price is calculated as the actual variable overhead ÷ actual direct labor hours, or $352,000 ÷ 440,000 = $.80 per hour. We can now put these figures into the equation and get ($.80 – $.75) × 440,000. The variance is an unfavorable $22,000.

68 b – To solve for the fixed overhead spending variance, we must subtract budgeted fixed overheads from the actual fixed overheads. The actual fixed overheads were $575,000 and the budgeted fixed overheads were $600,000 (as calculated for the question above). Therefore, the fixed overhead spending variance is a favorable $25,000.

69 c – The amount of fixed overhead applied is calculated as the application rate ($3 per unit) multiplied by the number of units produced (198,000). This gives us fixed overhead applied of $594,000.

70 a – The fixed overhead volume variance is calculated as the budgeted overhead minus the applied overhead, and a positive amount is unfavorable. The budgeted amount was $600,000 and the applied amount was $594,000, so the volume variance is an unfavorable $6,000.