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CMA

Preparatory Program

Part 1

Financial Reporting, Planning, Performance, and Control

Manufacturing Input Variances Sample

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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.

volume variance can be caused by the state of the economy, actions of competitors, production problems at the plant that prevented the company from manufacturing enough product to meet the demand, or any number of other things.

Flexible budget variances identify variances that are caused by something other than the different-from-expected sales volume. Flexible budget variances can be caused by multiple factors, and it is important to investigate the factors that caused the variances in order to determine what changes need to be made. Additional variance detail can be calculated to assist in this determination.

Level 3 Variances: Manufacturing Input and Sales Quantity and Sales Mix Variances

Level 3 variances also include manufacturing input variances. Below are the different variances that will be discussed in the following topic. Candidates need to know how to calculate each of these variances, need to understand what the variances mean, and need to be able to identify possible causes of the variances. Manufacturing input variances will be covered first, followed by sales variances, sales quantity, and sales mix variances.

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) **Flexible budget variance**   } **Level 2 variances**
> 8) **Sales volume variance**
> > 8a) **Quantity variance****   } **Level 3 variances**
> > 8b) **Mix variance****

*   These specific manufacturing variances are calculated only when more than one input (either classes of labor or types of material) is used in the production process.

** These specific sales variances are calculated only when the company sells more than one product.

> **Note**: The preceding list contains a lot of variances. However, the number of variances should not be a cause for discouragement. A number of these variances are simply variations on a theme. The formulas are the same, so it is not necessary to memorize a separate formula for each variance.

Manufacturing Input Variances

Manufacturing input variances are a special class of variances. Manufacturing inputs are the direct materials, direct labor, and manufacturing overhead **used in production**. Manufacturing input variances are concerned with **inputs** to the manufacturing process, as follows:

- Whether the amount of inputs used per unit manufactured was over or under the standard (a quantity, or efficiency, variance),

- Whether the inputs used cost more or less per unit of the input than the standard (a price variance), and

- What the monetary impact was of each type of variance.

Manufacturing input variances are used in controlling production. Manufacturing input variances are also called flexible budget variances, and the flexible budget amounts used are based on the price and quantity of the **input allowed for the actual production**. Manufacturing input variances are reported on a production variance report, not on a report in the form of an income statement, because they report on units produced, not on units sold.

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, finished goods inventory, work in process inventory and—for direct material variances only—direct materials inventory.

The Difference Between Sales Variances and Production Variances

The variance reports seen so far have been sales variance reports, and they present only the results of units sold. Sales variances are Level 2 variances. In its variable manufacturing costs section, a Level 2 sales variance report presents the **total** flexible budget variance for variable manufacturing costs for units **sold**. This total flexible budget variance includes both the manufacturing input price and the manufacturing input quantity variances for sold units. The price and quantity input variances for the sold units are presented on the report as one combined variance.

A production variance report, which is a Level 3 report, is required to present the detail behind the total flexible budget variance. However, a production variance report includes all units **produced**, whether they were sold or remained in inventory as unsold units at the end of the period.

Because a Level 2 sales variance report presents information on units sold and a Level 3 production variance report presents information on units produced, the two cannot be reconciled for a given reporting period unless the units that were sold are the same units as the units that were produced during the period. Thus, Level 2 variances based on revenue and costs of units sold should not be expected to reconcile with the detail variances on a production variance report covering the same reporting period unless an exam question gives information that can be interpreted to mean that **the same units that were produced were the same units that were sold.**

For example, an exam question might say that the company is a new manufacturing company that just started in business (thus beginning inventories were all zero), and it sold all of its first period's production during its first period of operation. In that case, the company sold the same units as it produced. But if the information given does not enable reconciliation, do not try to reconcile them, because it will not work.

Furthermore, the total flexible budget variances for variable manufacturing costs on the Level 2 report cannot be broken down between manufacturing input price and quantity variances the way production variances are because the information needed to do that is not available. Information given in the problem might make it possible to reconcile the sum of the manufacturing input quantity and price variances on the production variance report to the total flexible budget variance on a sales variance report (if the units produced were the same units sold), but the breakdown between price and quantity variances cannot be seen on the sales variance report.

What Causes Manufacturing Input Variances?

Before getting into the specific manufacturing input variances, consider the possible reasons for an actual input cost to be different from the standard, expected, or budgeted input cost. The standard cost is determined using an **estimated cost** and an **estimated level of usage**. Obviously, if a company either pays a different price for an input than had been budgeted or uses a different amount of the input than was budgeted for the actual level of output, or both, then the actual cost for the actual level of output will be different from the budgeted cost for the actual level of output.

The simple fact that the actual cost was different from the budgeted amount is not, by itself, very useful information to management. Management needs to know **why** the actual cost was different from the budgeted amount.

- Was it because a different amount of raw materials or labor was used than should have been used for the actual output?

- Was it because a different price per unit was paid for the raw materials or labor?

- Was it because of differences in both, the most likely scenario?

Variance analysis enables management to investigate the specific reason or reasons for the variance, and then the company can focus its efforts on the areas that have a negative impact on the business.

Input cost variances are sub-divided into their two causes:

1) A **price variance** that reflects the difference between actual and budgeted input **prices**.

2) A **quantity variance**, also called an **efficiency variance**, that reflects the difference between actual and budgeted input **quantities** used.

Mastering a conceptual understanding of these two basic causes of variances will make variance analysis exam questions much easier.

Summary of Manufacturing Input Variances

The following table summarizes the formulas and the terms used in variance analysis, and it is presented here as an overview of the material that will be covered in detail later. This table will appear again at the end of the topic of variances.

Prime Costs	**Price Variance** $(AP - SP) \times AQ$	**Quantity Variance** $(AQ - SQ) \times SP$
Materials	**Price** Variance	**Quantity** Variance
Labor	**Rate** Variance	**Efficiency** Variance

Multiple Inputs (both Material and Labor)	**Mix** Variance $(waspAM - waspSM) \times AQ$	**Yield** Variance $(AQ - SQ) \times waspSM$

Variable Overhead	**Spending** Variance $(AP - SP) \times AQ$	**Efficiency** Variance $(AQ - SQ) \times SP$
Fixed Overhead	**Spending** (Flexible Budget) Variance Actual OH − Budgeted OH	**Production Volume** Variance Budgeted OH − Applied OH

Direct Materials Variances

The total direct materials variance is also the **flexible budget variance** for direct materials. The total direct materials variance is the difference between the actual direct materials costs for the period and the standard costs for the standard amount of materials **allowed** for the actual output at the standard price per unit of direct materials (the flexible budget).

> **Actual total direct materials costs incurred (money spent)**   (AP x AQ)
>
> **− Standard amount of direct materials allowed for the actual**
>   **output at the standard price per unit of direct materials**   (SP x SQ)
> **= Total direct materials variance**

Example: Medina Co. produces footballs. Each football requires a standard of 1 square meter of leather that has a standard cost of $5.00. During the period, Medina produced 250 footballs and used 290 square meters of leather. The actual cost of the leather was $4.50 per square meter.

The total actual cost of the leather used was $1,305 (290 × $4.50). However, given the actual output of 250 footballs, Medina should have used only 250 square meters of leather. Since each square meter should have cost $5, Medina should have spent $1,250 on leather in order to produce 250 footballs (250 × $5).

The total direct materials variance is:

Actual cost for 250 units – $4.50 × 290 sq. meters used	$ 1,305
Standard cost allowed for 250 units – $5.00 × 250 sq. meters	$ 1,250
Total variance	**$ 55 U**

Medina spent $55 more than it should have spent for the leather to make 250 footballs. A manager might conclude that this situation is acceptable and does not require any significant attention because even though the variance is unfavorable, it is not large. However, a more in-depth examination will reveal that the company used a greater quantity of materials than it should have, though the financial impact of that variance was mitigated by the fact that it paid less than expected for each square meter of leather used.

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

The **quantity variance** plus the **price variance** equals the **total variance**, which is also the **flexible budget variance**.

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 = Quantity Variance**

The above formula is actually a shorter way of expressing the following:

> **Actual Quantity × Standard Price**
> **− Standard Quantity × Standard Price**
> **= Quantity Variance**

The quantity variance represents the difference in cost between the actual material used at the standard price and the standard usage allowed for the level of actual output at the standard price.

The quantity variance formula is used to calculate the portion of the total variance that was caused by either too much or too little direct materials having been used, without any reference to the amount of the variance that was caused by a difference between the actual and the standard price per unit of the material used. Both the actual quantity and the standard quantity for the actual output are multiplied by the standard price in order to remove any effect of the price variance from the result.

Because the quantity variance measures a cost variance, a positive result is an unfavorable variance because costs were higher than expected, while a negative result is a favorable variance because costs were lower than expected.

Example: In the example of Medina Co., where each football requires a standard quantity of 1 square meter of leather that has a standard cost of $5 and Medina produced 250 footballs using 290 square meters of leather, the amounts used in calculating the quantity variance are as follows:

Actual Quantity = 290 meters used
Standard Quantity = 1 meter allowed per football × 250 footballs produced, which equals 250 meters
Standard Price = $5 per meter

The **quantity variance** is **(AQ − SQ) × SP** and is calculated as:

> **(290 − 250) × $5 = $200 Unfavorable**

The variance is **unfavorable** because it is a positive variance for a cost. The $200 variance means that Medina had to pay $200 more than it should have paid for the materials used to produce 250 footballs because it used too much material. Any variance caused by a difference between the actual price paid per meter and the standard price per meter is not reflected in the unfavorable quantity variance.

Thus, if the actual price per meter of direct materials actually used had been the same as the standard price per meter actually used (in other words, if there had been no price variance), the total direct materials variance would have been $200 Unfavorable, all due to having used too much direct materials in production.

The Price Variance

Though it is commonly called the "price variance" for materials, the more complete name for this variance is the "price usage variance." The variance is called the "price usage variance" to distinguish it from the "purchase price variance," which will be covered next. For the sake of brevity, from this point onward "price variance" will be used to mean the "price usage variance."

The price variance is calculated as:

> **(Actual Price − Standard Price) × Actual Quantity**
> **or**
> **(AP − SP) × AQ = Price Variance**

The above formula is actually a shorter way of expressing the following:

> **Actual Price × Actual Quantity**
> **− Standard Price × Actual Quantity**
> **= Price Variance**

The price variance represents the difference between the actual material usage at the actual price and the actual material usage at the standard price.

The price variance formula is used to calculate the portion of the total variance that was due to a difference between what was actually paid (the actual price) per unit of direct materials used and the amount allowed (the standard or budgeted price) per unit of direct materials actually used. Both the actual price and the standard price are multiplied by the actual quantity used in order to remove any effect of the quantity variance from the result.

Because the materials price variance measures a cost variance, a positive result is an unfavorable variance because costs were higher than expected, while a negative result is a favorable variance because costs were lower than expected.

Example: In the Medina Co. example, where the actual cost paid per meter of leather was $4.50, the standard price was $5.00, and 290 meters were actually used in production, the amounts used in calculating the price variance are as follows:

Actual Price = $4.50 per meter

Standard Price = $5.00 per meter

Actual Quantity = 290 meters

The **price variance** is **(AP − SP) × AQ and** is calculated as:

($4.50 − $5.00) × 290 = $(145) Favorable

Medina saved $145 because the price per unit of the leather that was actually used in production was lower than expected, a **favorable variance**. A negative variance for a cost is a favorable variance because it means the actual cost per unit used was lower than the budgeted cost per unit. Even though Medina used more leather than it should have for each football it manufactured, it saved $0.50 on each square meter of leather actually used.

The variance of $(145) means that, because the price per square meter was $0.50 lower than expected, the company's cost for the 290 square meters of direct materials used was $145 lower than the standard cost allowed for that quantity of materials.

The Quantity Variance Plus the Price Variance Equals the Total Variance

Assuming the total, price, and quantity variances have been calculated accurately, the quantity variance plus the price variance will equal the total variance.

> **Example**: The total materials variance for Medina Co. is the sum of the quantity variance and the price variance.
>
> | | | |
> |---|---:|---|
> | Quantity variance | $ 200 | U |
> | Price variance | (145) | F |
> | **Total Variance** | **$ 55** | **U** |
>
> In total, Medina 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 square meter of leather used.
>
> Even though Medina's total actual cost came close to the total standard cost, the company has significant production problems, revealed by the large unfavorable quantity variance and the almost equally large price variance. Management will most certainly look at the production process to find out why so much leather was required to make 250 footballs. The company may have a very inefficient process that wastes too much leather, or perhaps it has new workers who are not as experienced as they will be in the future. Perhaps the less expensive leather was more difficult to work with and therefore an excessive amount was spoiled in the production process. In any case, despite the total cost variance being small, Medina needs to investigate further the cause of the variance in its leather usage.

Investigation of a variance is an example of **management by exception**.[40] All significant variances need to be investigated, whether they are favorable or unfavorable.

- Investigation of an unfavorable variance is needed to find out what went wrong so it can be corrected.

- Investigation of a favorable variance may reveal a positive change in a process that can be duplicated throughout the organization.

> **Note**: On the exam, candidates need to be able to identify possible reasons **why** a particular variance is favorable or unfavorable. Most of these reasons can be identified by using common sense. For example, an unfavorable quantity variance may be caused by the purchasing department having bought an inferior, defective product, or it may be caused by new, untrained employees or poor techniques.
>
> In the Medina Co. example, the variances could be due to the purchasing department's having gotten a cheap price on inferior leather that was damaged in the production process or was not consistently of an acceptable quality.

Materials Purchase Price Variance

The materials price variance may be calculated at the time of purchase instead of at the time of use. A materials price variance computed at the time of purchase is a variation on the materials price usage variance and is called a **materials purchase price variance**. The materials purchase price variance is calculated in exactly the same way as the materials price usage variance, except the AP (Actual Price) in the formula is the price paid for the materials during the period and the AQ (Actual Quantity) in the formula is the quantity of direct materials **purchased**, not the quantity of direct materials **used**.

Determining materials price variances as soon as the materials are received instead of when the materials are put into production leads to better control. If the variance is not computed until the materials are requisi-

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[40] "Management by Exception" refers to a system whereby only significant variances between actual results and the budget or plan are brought to the attention of management. Management by exception focuses management on the things that have the highest priority, defined as the greatest variances.

tioned for production, corrective action will be more difficult because more time will have elapsed from the date of purchase.

If an exam question is about the purchase price variance, the information given in the question will make it clear that the question is asking for the purchase price variance. Be sure to notice the word "purchase" if it is used since it changes the way the variance is calculated.

However, a question may not call the variance by its name of "purchase price variance." Instead, a question may **describe** the materials purchase price variance, to test whether candidates know what the materials purchase price variance is. For example, the question may say that a company recognizes materials variances as early as possible. That is an indication the question is asking for the purchase price variance.

If the **purchase price variance** is required, calculate it using **all of the units purchased** as the Actual Quantity, not just the units that were put into production.

Exam Tip:

- If a question asks for the **materials price variance** (or **materials price usage variance**), use the units **used** as the Actual Quantity in the variance formula, not the units purchased.

- If a question asks for the **materials purchase price variance**, or if the question says that **the company recognizes materials variances as early as possible** (or some other description of the materials purchase price variance), use the **quantity purchased** as the Actual Quantity in the variance formula instead of the quantity used.

Most questions ask for the materials price usage variance, using the units placed into production. However, a question could be about the materials purchase price variance instead. Therefore, be aware of this potential variation.

Note: The materials price variance (or materials price **usage** variance) is calculated at the time of **usage**, while the materials **purchase** price variance is calculated at the time of **purchase**.

Exam Tip: For the exam, candidates need to be able to use the variance formulas to solve for the variance itself and also to solve for any of the individual variables in the formulas.

For example, each variance uses three amounts to calculate the variance. In a straightforward question, the variance is the unknown. The amounts for the formula (AP, SP, AQ, or SQ) are on the left side of the equals sign and the calculated variance is on the right.

Instead, an exam question may give the variance and two of the amounts for the formula (or may give enough information to determine what the two amounts are). The question may ask for the third amount on the left side of the "equals" sign—the AP, SP, AQ, or SQ—so that amount will be the unknown. To do the calculation, simply use the same formulas but use algebra to solve for a different unknown.

Question 88: 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)

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. The standard cost for material allowed for the output was $60,000, and there was an unfavorable quantity variance of $2,500.

Question 89: ChemKing's standard price for one unit of material is:

a) $2.00

b) $2.50

c) $3.00

d) $5.00

Question 90: 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 91: 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)

Question 92: 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)

Direct Labor Variances

As with the materials variance, the **total labor variance** (also called the **flexible budget variance** for direct labor) is the difference between the actual labor costs incurred by the company for the period and the standard labor costs for the standard amount of direct labor **allowed** for the actual level of output at the standard wage rate per hour (the flexible budget). Similar to the total direct materials variance, the total direct labor variance is attributable to variances in both labor rates and labor usage, meaning that the company either paid a wage rate that was different from the standard rate, used a different number of labor hours than the standard number of hours allowed for the actual level of output, or both.

> **Actual total direct labor costs incurred (money spent)**   (AP x AQ)
>
> **−**   **Standard amount of direct labor allowed for the actual**
>   **output at the standard wage rate per hour**   (SP x SQ)
>
> **=**   **Total direct labor variance**

Because the direct labor variances are so similar to variance analysis for materials, direct labor variances will not be covered in detail. Briefly, the total labor variance can be broken down into the labor rate variance (a price variance) and the labor efficiency variance (a quantity variance). Direct labor price and quantity variances are calculated in the same manner as the direct material price and quantity variances; but, when direct labor is analyzed, different names are used for the price and quantity variances.

The Direct Labor Rate Variance

The direct labor rate variance is calculated in the same manner as the direct materials price variance:

> **(Actual Rate − Standard Rate) × Actual Hours**
>
> **or**
>
> **(AP − SP) × AQ = Labor Rate Variance**

The above formula is actually a shorter way of expressing:

> **Actual Rate × Actual Quantity**
>
> **−**   **Standard Rate × Actual Quantity**
>
> **=**   **Labor Rate Variance**

The labor rate variance represents the difference between the cost of the actual labor used at the actual rate and the cost of the actual labor used if it had been paid at the standard rate.

The labor rate variance formula results in the portion of the total direct labor variance that was due to a difference between what was paid per hour (the actual rate) and the amount budgeted to be paid per hour (the standard rate) for direct labor actually used. Both the actual rate and the standard rate are multiplied by the actual quantity used in order to remove any effect of the quantity variance (called the efficiency variance) from the result.

Because the labor rate variance measures a cost variance, a positive result is an unfavorable variance because costs were higher than expected, while a negative result is a favorable variance because costs were lower than expected.

The Direct Labor Efficiency Variance

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

> **(Actual Hours − Standard Hours for Actual Output) × Standard Rate**
>
> **or**
>
> **(AQ − SQ) × SP = Direct Labor Efficiency Variance**

The above formula is actually a shorter way of expressing:

> **Actual Hours × Standard Rate**
>
> **−** **Standard Hours × Standard Rate**
>
> **=** **Direct Labor Efficiency Variance**

The direct labor efficiency variance represents the difference in cost between the actual direct labor hours used if those hours had been paid at the standard hourly rate and the standard direct labor hours allowed for the level of actual output paid at the standard direct labor hourly rate.

The direct labor efficiency variance formula is used to calculate the portion of the total variance that was caused by either too much or too little direct labor having been used, without any reference to the amount of the variance that was caused by a difference between the actual rate and the standard rate per hour of the direct labor used. Both the actual hours and the standard hours allowed for the actual output are multiplied by the standard rate per hour in order to remove any effect of the labor rate variance from the result.

Because the labor efficiency variance measures a cost variance, a positive result is an unfavorable variance because costs were higher than expected, while a negative result is a favorable variance because costs were lower than expected.

> **Exam Tip**: As with direct material variances, for the exam candidates need to be able to use the variance formulas to solve for the variance itself and also to solve for any of the individual variables in the formulas.

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 allowed for the units manufactured** at the **standard hourly rate**. The credit is to accrued payroll at the **total number of hours actually used** and at the **actual hourly rate**. The difference between the two is recorded in the Direct Labor Rate Variance (the price variance) and the Direct Labor Efficiency Variance (the quantity variance) general ledger accounts. For both the rate variance and the efficiency variance, unfavorable variances are recorded as debits and favorable variances are recorded as credits.

As with direct materials variances, direct labor variances are closed out at the end of the period, either to cost of goods sold or, if they are material, they are prorated among work-in-process inventory, finished goods inventory, and cost of goods sold.

However, note that direct materials inventory is not included in the proration of direct labor variances. In addition, note that direct labor has no equivalent variance to the direct materials **purchase** price variance. Labor rate variances are always rate variances for direct labor **used**. Both of these differences between the

handling of direct materials variances and direct labor variances are caused by the fact that labor cannot be bought and stored until used the way direct materials can be.

> **Note**: A company must decide how employee-related costs, such as employee benefits and payroll taxes, will be treated. These costs may be included in the cost of direct labor or treated as an overhead cost and allocated to the units produced as part of overhead. 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.

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 93: 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 94: 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 95: 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)

Question 96: 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)

More Than One Material Input or One Labor Class

So far, the variances covered have involved only one material input into the product or only one class, or wage rate, of labor.

A total variance, a price variance, and a quantity variance are also calculated in situations where more than one direct material input or more than one class of labor is used in producing the product. However, when multiple inputs are used—called a mix of inputs—the quantity variance is broken down into two sub-variances: the **mix variance** and the **yield variance**.

The **mix variance** shows the portion of the quantity variance that was caused by the actual **mix used** having been different from the standard mix (that is, more of one ingredient was used and less of another ingredient was used). The **yield variance** shows the portion of the quantity variance that was caused by the **total** actual amount of all ingredients used having been different from the **total** standard amount.

In a situation with multiple inputs, the price variance is not broken down the way the quantity variance is.

Note: The mix of inputs (labor or materials) is called a **weighted mix**. To calculate the mix and yield variances for a given amount of output, the weighted average **standard price of the actual mix** used in the batch and the weighted average **standard price of the standard mix** for the batch need to be calculated.

Total Variance of a Weighted Mix

Variances of a weighted mix are calculated individually for materials and labor. The **total variance** of a weighted mix for either materials or labor is the **actual total cost** minus the **standard total cost allowed for the actual output**.

	Actual total cost incurred for labor or materials	(AP x AQ)
−	**Standard total quantity allowed of labor or materials for the actual output at the standard rate or price**	(SP x SQ)
=	**Total direct labor or materials variance**	

Example: The Good Dog Food Company produces Beef Mix dog food consisting of three different ingredients: beef, spinach, and pumpkin. The standard prices and the standard quantities of the ingredients **allowed** for the **actual output** during February are as follows.

	Standard Price/Lb.	Standard Lbs. Allowed for Output	Standard Cost
Beef	$2.00	2,700	$ 5,400.00
Spinach	$1.00	1,485	1,485.00
Pumpkin	$0.20	1,065	213.00
		5,250	$ 7,098.00

Prices for all the ingredients increased during January due to inclement weather. The actual prices and quantities used for the February production were as follows.

	Actual Price/Lb.	Actual Lbs. Used	Actual Cost
Beef	$3.00	2,547	$ 7,641.00
Spinach	$1.20	1,725	2,070.00
Pumpkin	$0.30	1,200	360.00
		5,472	$10,071.00

The total variance of the weighted mix is $10,071.00 − $7,098.00, or   **$2,973.00 Unfavorable**.

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.

Example: Below are the facts again for the Good Dog Food Company's Beef Mix dog food for the month of February.

	Standard Price/Lb.	Standard Lbs. Allowed for Output	Standard Cost
Beef	$2.00	2,700	$ 5,400.00
Spinach	$1.00	1,485	1,485.00
Pumpkin	$0.20	1,065	213.00
		5,250	$ 7,098.00

The actual prices and quantities used during February were as follows:

	Actual Price/Lb.	Actual Lbs. Used	Actual Cost
Beef	$3.00	2,547	$ 7,641.00
Spinach	$1.20	1,725	2,070.00
Pumpkin	$0.30	1,200	360.00
		5,472	$10,071.00

The materials price variance is the sum of the price variances for each of the three inputs. The formula is (AP − SP) × AQ for each price variance. The three price variances and the total materials price variance are:

Beef	($3.00 – $2.00)	×	2,547	=	$ 2,547.00
Spinach	($1.20 – $1.00)	×	1,725	=	345.00
Pumpkin	($0.30 – $0.20)	×	1,200	=	120.00
Total materials price variance					**$3,012.00 Unfavorable**

Total Materials Quantity or Labor Efficiency Variance of a Weighted Mix

The **total** materials quantity or labor efficiency variance of a weighted mix is the sum of the quantity variances for each component of the mix. The formula (AQ − SQ) × SP is used to calculate the quantity variance for each component of the mix separately. The individual quantity variances are then summed to calculate the total quantity variance.

> **Example**: Continuing the variances for Good Dog Food Company's Beef Mix dog food for the month of February, the total materials quantity variance is calculated for each of the inputs individually with the usage formula (AQ − SQ) × SP and then the results are summed.
>
> | | | | | | | |
> |---|---|---|---|---|---|---|
> | Beef | (2,547 − 2,700) | × | $2.00 | = | $ | (306.00) |
> | Spinach | (1,725 − 1,485) | × | $1.00 | = | | 240.00 |
> | Pumpkin | (1,200 − 1,065) | × | $0.20 | = | | 27.00 |
> | | Total materials quantity variance | | | | **$ (39.00)** | **Favorable** |
>
> Even though a greater quantity in total (5,472 lbs.) was used than the total standard quantity allowed for the output (5,250 lbs.), the total materials quantity variance, or the total variance in cost because of variances in the ingredients used, is favorable. The mix and yield variances will provide an explanation for that.

Because more than one material is used in the production process, the total materials quantity variance cannot be used to determine exactly why the total materials quantity variance occurred. The variance may have occurred simply because a different total volume of materials was used in production even though the individual materials were used in the correct ratio. Alternatively, it may have occurred because a different mix of materials was used, even though the total volume of the materials used may have been equal to the standard. Of course, the variance could have also been caused by differences from the standards for both the total volume and the mix, which is the case with Good Dog Food Company.

"A different mix" means that the actual ratio of the inputs into the product was different from the standard ratio of inputs for the product. In the example used here, instead of the input mix for dog food consisting of the standard 51.4% beef, 28.3% spinach, and 20.3% pumpkin, it turned out to be 46.6% beef, 31.5% spinach, and 21.9% pumpkin. The total volume of beef, spinach, and pumpkin used a little more than the total standard volume of 5,250 lbs. allowed for February's production. Because of that and because the **ratio** of the inputs used was different from the standard ratio of inputs, a total materials quantity variance arose.

Breaking down the total materials quantity or labor efficiency variance into two sub-variances (the **mix** and the **yield** variances) reveals how much each of these factors contributed to the total quantity variance. The same process for calculating the mix and yield variances is used for both labor and materials.

1) The Mix Variance (Materials or Labor)

> **Note**: This is the first of the two sub-variances of the total quantity variance.

The mix variance is the portion of the quantity variance that was caused by the actual mix of materials used or the actual mix of the labor used having been different from the standard mix. Returning to the dog food example, the cause of a mix variance would be including higher percentages of spinach and pumpkin and a lower percentage of beef in the dog food than the standard.

Such a mix variance could occur if the company deliberately substitutes spinach and pumpkin for a portion of the beef required. A mix variance could also occur accidentally if, for example, the wrong proportions are used when the materials are added to the production process.

> **Note**: Variances are calculated in order to determine the cause or causes of variances from the standard, or planned, amounts. Once the variances have been calculated, the person who made the decisions that resulted in each variance should be responsible for explaining why the variance occurred. Responsibility for explaining a mix variance should usually be given to an individual only if that person actually had control over the mix and over substitutions made in the mix during the reporting period when the variance arose.
>
> In some cases, however, someone who does not have control over decisions may be in the best position to explain the variances because he or she was closer to the situation and has knowledge that can be of assistance in an investigation. That person may be made responsible for reporting on the causes of the variance while the decision-maker remains responsible for the variance.

The formula used to calculate the mix variance is a variation of the **price variance** formula: $(AP - SP) \times AQ$. Instead of using the actual and standard prices for the input, **weighted average standard prices** are used. The weighted average standard price of the **actual** mix and the weighted average standard price of the **standard** mix are calculated, as follows:

1) The **weighted average standard price of the *actual* mix**: the actual quantity used for each input is multiplied by the standard cost for that input, the products are summed, and the sum is divided by the total volume of all inputs used. The result is the weighted average standard price of one unit of the actual mix.

   The weighted average standard price of the actual mix is how much one standard input **should** have cost, based on the actual mix used. In the example of dog food, the actual mix used in the production of dog food during February is determined. The next step is to calculate how much one pound of the actual mix of ingredients (46.6% beef, 31.5% spinach, and 21.9% pumpkin) **should** have cost, using the standard price for each input.

   The weighted average standard price of the actual mix cannot be calculated until after the end of the reporting period, because the actual inputs used during the period cannot be known until that time.

2) The **weighted average standard price of the *standard* mix**: The standard quantity of each input **allowed for the actual output** is multiplied by the standard cost for each input, the results are summed, and the sum is divided by the total volume of all inputs allowed for the actual output.

   The weighted average standard price of the standard mix for the actual output that results from this calculation is how much one standard unit of the mix **should** have cost, based on the standard mix allowed for the actual output. In the example of dog food, the weighted average standard price for the standard output is how much one pound of the standard mix allowed for the actual output (51.4% beef, 28.3% spinach, and 20.2% pumpkin) **should** have cost.

   The weighted average standard price of the standard mix can be calculated at the beginning of the period even though the actual output is not known at that point. The weighted average standard price of the standard mix will be the same regardless of the volumes actually used for each input in the calculation, as long as the standard cost per pound of each input and the standard ratio of the inputs to one another are used in the calculation.

Calculations of the weighted average standard price of the actual mix and the weighted average standard price of the standard mix will be demonstrated in the examples that follow each part of the following explanation. (It is not as bad as it sounds.)

The mix variance is calculated as follows:

$$\left.\begin{array}{c}\text{Weighted Average Standard Price of the Actual Mix} - \\ \text{Weighted Average Standard Price of the Standard Mix} \\ \text{(both calculated using the Standard Price)}\end{array}\right\} \times \begin{array}{c}\text{Actual Quantity of all} \\ \text{material or labor inputs}\end{array}$$

or
(waspAM − waspSM) × AQ = Mix Variance

Note: "waspAM" and "waspSM" are abbreviations that were developed by HOCK, as is the method presented here for calculating the mix and yield variances. The method as it is explained here is simpler than the way it is taught in most cost accounting textbooks, and it results in the correct variances. Candidates who use these abbreviations in an answer to an exam essay question should explain what they stand for so that the grader can understand what is being calculated.

Note: The way the mix variance is calculated is similar to the way a price variance is calculated, because a price variance is calculated as (AP − SP) × AQ. However, **the mix variance is not a price variance**. The mix variance formula uses the weighted average **standard** prices of both the actual mix and the standard mix.

To calculate the amount of any variance caused by a difference between the actual and the standard values of one variable, isolate the actual and the standard for that variable within the parentheses. In the mix variance, the amount of variance caused by a difference between the actual mix and the standard mix is being calculated, so the mix is the item that must vary within the parentheses.

To isolate the difference between the actual mix and the standard mix, the same price must be used for both mixes. Therefore, the "weighted average standard price" is used for both mixes, and the variable that differs is the mix: actual mix (AM) versus standard mix (SM).

An example of the calculation of the mix variance follows.

Example: Below are the facts again for the Good Dog Food Company's Meat Mix dog food production for the month of February.

The standards were as follows:

	Standard Price/Lb.	Standard Lbs. Allowed for Output	Standard Cost
Beef	$2.00	2,700	$ 5,400.00
Spinach	$1.00	1,485	1,485.00
Pumpkin	$0.20	1,065	213.00
		5,250	$ 7,098.00

The actual prices and quantities used during February were as follows:

	Actual Price/Lb.	Actual Lbs. Used	Actual Cost
Beef	$3.00	2,547	$ 7,641.00
Spinach	$1.20	1,725	2,070.00
Pumpkin	$0.30	1,200	360.00
		5,472	$10,071.00

The first step in calculating the mix variance is to calculate waspAM and waspSM.

The **weighted average standard price of the actual mix** (waspAM) is the sum of the individual standard costs multiplied by the **actual** quantity of each input used, then the sum is divided by the total actual quantity of all the inputs used.

The actual lbs. used totaled 5,472 and the total standard cost of the actual mix is calculated as follows:

Beef	$2.00 × 2,547 lb.	=	$ 5,094.00
Spinach	$1.00 × 1,725 lb.	=	1,725.00
Pumpkin	$0.20 × 1,200 lb.	=	240.00
Totals, Actual Mix at Standard Price	**5,472 lb.**		**$7,059.00**

The waspAM is $7,059.00 ÷ 5,472 =   **$1.29 per lb**.

The **weighted average standard price of the standard mix** (waspSM) is the sum of the individual standard costs multiplied by the **standard** quantity of each input allowed for the actual output, then the sum is divided by the total standard quantity of all the inputs allowed for the actual output.

Beef	$2.00 × 2,700 lb.	=	$ 5,400.00
Spinach	$1.00 × 1,485 lb.	=	1,485.00
Pumpkin	$0.20 × 1,065 lb.	=	213.00
Totals, Actual Mix at Standard Price	**5,250 lb.**		**$7,098.00**

The waspSM is $7,098.00 ÷ 5,250 =   **$1.352 per lb**.

The mix variance is the portion of the total material quantity variance that was caused by the actual mix having been different from the standard mix. The mix variance is the difference between the weighted average standard prices of the actual and the standard mix multiplied by the actual total quantity used of all inputs. The formula is:

$$\text{Mix Variance} = (\text{waspAM} - \text{waspSM}) \times \text{AQ}$$

The actual quantity is 5,472, waspAM is $1.29, and waspSM is $1.352. The materials mix variance is:

$$\text{Mix Variance} = (\$1.29 - \$1.352) \times 5,472 = \underline{\$(339.00)} \text{ Favorable}$$

Therefore, the $(39.00) favorable materials quantity variance, which is made up of the mix and the yield variances, included $(339.00) of a favorable mix variance, caused by a different mix of ingredients than had been planned.

Since the quantity variance is the mix variance plus the yield variance and the favorable mix variance is greater than the favorable quantity variance, the yield variance must be unfavorable.

2) The Yield Variance (Material or Labor)

> **Note**: This is the second of the two sub-variances of the total quantity variance.

The yield variance results from a difference between the **total actual quantity** of the inputs that were used to produce the actual output and the **total standard quantity** of inputs 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: (AQ – SQ) × SP. Instead of using the standard price of a single input, however, the **weighted average standard price of the standard mix, or waspSM**, is used. (This is the same waspSM as was used in the calculation of the mix variance above.)

The yield variance is calculated as follows:

$$\left(\text{Actual Total Quantity of } \textit{All} \text{ Inputs} - \text{Standard Total Quantity of } \textit{All} \text{ Inputs}\right) \times \text{Weighted Average Standard Price of Standard Mix of All Inputs}$$

Or

(AQ – SQ) × waspSM = Yield Variance

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

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

> **Note**: Remember, if a product has only one direct materials or direct labor input class, the mix and yield variances are not calculated.

An example of the calculation of the yield variance follows.

Example: Below are the facts again for the Good Dog Food Company's Meat Mix dog food production for the month of February.

The standards were as follows:

	Standard Price/Lb.	Standard Lbs. Allowed for Output	Standard Cost
Beef	$2.00	2,700	$ 5,400.00
Spinach	$1.00	1,485	1,485.00
Pumpkin	$0.20	1,065	213.00
		5,250	$ 7,098.00

The actual prices and quantities used during February were as follows:

	Actual Price/Lb.	Actual Lbs. Used	Actual Cost
Beef	$3.00	2,547	$ 7,641.00
Spinach	$1.20	1,725	2,070.00
Pumpkin	$0.30	1,200	360.00
		5,472	$10,071.00

(Continued)

The yield variance is the portion of the quantity variance that occurred as a result of having used more or fewer total inputs than the standard total inputs. Good Dog used a greater quantity of inputs than the standard, so the yield variance must be unfavorable. The formula is:

Yield Variance = (AQ − SQ) × waspSM

The actual quantity is 5,472 lbs., and the standard quantity is 5,250 lbs.

The weighted average standard price of the standard mix (waspSM) was calculated as $1.352 in the previous example.

Therefore, the materials yield variance is:

Yield Variance = (5,472 − 5,250) × $1.352 = <u>$300.00</u> Unfavorable

Therefore, an unfavorable quantity variance of $300.00 occurred because in total the company used more material input than it should have for the amount of output.

Example: Reconciliation and interpretation

Good Dog's quantity variance is $(39.00) favorable. The quantity variance is broken down into the mix variance and the yield variance. The mix variance is $339.00 favorable. The yield variance is $300.00 unfavorable. The mix and yield variances should sum to the quantity variance, and they do:

Mix variance	$ (339.00) Favorable
Yield variance	<u> 300.00</u> Unfavorable
Quantity variance	<u>$ (39.00)</u> Favorable

Furthermore, the price variance and the quantity variance should sum to the total variance, and they do. The total variance is $2,973.00 unfavorable, the price variance is $3,012.00 unfavorable, and the quantity variance is $(39.00) favorable.

Price variance	$ 3,012.00 Unfavorable
Quantity variance	<u>(39.00)</u> Favorable
Total variance	<u>$ 2,973.00</u> Unfavorable

It is clear that the largest component of the $2,973.00 unfavorable total materials variance was the price variance. The price variance was caused by price increases. If the price increases persist, the standard prices in the system should be adjusted to reflect reality.

However, the price increase was mitigated somewhat by the $(339.00) favorable mix variance. Although prices of all the ingredients increased, the effect of the beef increase was more significant because beef accounts for 51.4% of the standard mix. During February, the proportion of beef used was reduced so that beef accounted for 46.6% of the actual mix instead, so the mix variance was slightly favorable.

Another comprehensive example appears on the following pages.

Comprehensive example: The Sunny Grains Cereal Company produces cereal made up of different grains. The material prices in effect for the fiscal year ending June 30 and the standard kilograms (kg) allowed for each input for the April output of Sunny Morning cereal 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 several natural disasters around the world, the price for each input increased on January 1. The actual material prices and the actual usage for April were as follows:

	Actual Price/Kg	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

The following variances and variance components will be calculated:

1)   Total variance

2)   Materials price variance

3)   Materials quantity variance

4)   Weighted average standard price of the standard mix (waspSM)

5)   Weighted average standard price of the actual mix (waspAM)

6)   Mix variance

7)   Yield variance

1) Total Materials Variance

The total materials variance is the difference between the **actual cost** and the **standard cost allowed for the actual output**. The actual cost for April was $7,987.50. The standard cost for April was $5,250.00 The total materials variance was an **unfavorable variance of $2,737.50**, which is broken down into the price and the quantity variances as follows.

2) Materials Price Variance

The materials price variance is calculated by determining the price variance for each of the three inputs individually and summing them. The formula is $(AP - SP) \times AQ$ and the 3 calculations are:

Corn	($12.00 – $10.00)	× 375	= $	750.00
Wheat	($8.50 – $8)	× 200	=	100.00
Rice	($5.50 – $3)	× 325	=	812.50

Total materials price variance   **$ 1,662.50   Unfavorable**

3) Materials Quantity Variance

The total materials quantity variance is calculated by using the usage formula $(AQ - SQ) \times SP$ for each of the classes individually and then summing them:

Corn	(375 – 250)	×	$ 10.00	=	$ 1,250.00
Wheat	(200 – 250)	×	$ 8.00	=	(400.00)
Rice	(325 – 250)	×	$ 3.00	=	225.00

Total materials quantity variance   **$ 1,075.00   Unfavorable**

At this point, a simple reconciliation should be done to test the two main variances. The price variance plus the quantity variance should equal the total variance, and it does: $1,662.50 + $1,075.00 = **$2,737.50**.

(Continued)

Calculation of Mix and Yield Variances

After the materials quantity variance has been calculated, the next step is to calculate the mix variance and the yield variance. When those two variances are summed they must equal $1,075, the total material quantity variance.

The first step in calculating the mix variance and yield variance is to calculate waspAM and waspSM. The information about the actual and standard prices and quantities is repeated below with the addition of some labels to clarify the information. The unused information has been made lighter and the boxes have been clearly labeled.

	Standard Price **SP** Standard Price/Kg	Standard Quantity **SM** 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

	NOT USED Actual Price	Actual Quantity **AM** 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

The first step in calculating the mix and yield variances is to calculate waspAM and waspSM. Since the mix and yield variances are subdivisions of the total quantity variance, the actual price **is not used**. The actual price is used in calculating the price variance, but it is not used for quantity variances such as are being calculated here.

Note that arrows have been added to show the sources of the values used in the calculations of waspAM and waspSM.

4) 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	$10.00 × 250 kg =	$ 2,500.00
Wheat	$ 8.00 × 250 kg =	2,000.00
Rice	$ 3.00 × 250 kg =	750.00

Total Standard Cost   **750 kg**   **$5,250.00**

The **waspSM is $7.00 per kg** ($5,250 ÷ 750).

5) 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	$10.00 × 375 kg =	$ 3,750.00
Wheat	$ 8.00 × 200 kg =	1,600.00
Rice	$ 3.00 × 325 kg =	975.00

Total Cost at Standard Price   **900 kg**   **$6,325.00**

The **waspAM is $7.0277 per kg** ($6,325 ÷ 900).

(Continued)

Because the mix was wrong, the weighted average standard price of each kilogram of actual input used was $0.0277 more than it should have been.

6) Mix Variance

The mix variance is the portion of the total material quantity variance that was caused by the actual mix having been different from the standard mix. The mix variance is the difference between the weighted average standard prices of the actual and the standard mix multiplied by the actual total quantity used of all inputs. The formula is:

Mix Variance = (waspAM − waspSM) × AQ

Putting the calculated amounts into the formula (waspAM − waspSM) × AQ results in the following:

Mix Variance = ($7.0277 − $7.00) × 900 = $25.00 Unfavorable

Therefore, $25.00 of the $1,075.00 unfavorable quantity variance arose because the actual mix of grains was not the same as the standard mix of grains.

7) Yield Variance

The yield variance is the portion of the quantity variance that occurred as a result of having used more or fewer total inputs than the standard total inputs. The **mix** of the inputs is not needed to calculate the yield variance--only the total quantity of inputs used. The formula is:

Yield Variance = (AQ − SQ) × waspSM

The waspSM was $7.00 per kilogram as calculated in the previous calculations, the Actual Quantity was 900 kilograms, and the Standard Quantity was 750 kilograms.

Putting all of the variables into the formula results in the following:

Yield Variance = (900 − 750) × $7.00 = $1,050.00 Unfavorable

Therefore, $1,050.00 of the $1,075.00 unfavorable quantity variance occurred because the company used more material input than it should have for the amount of output.
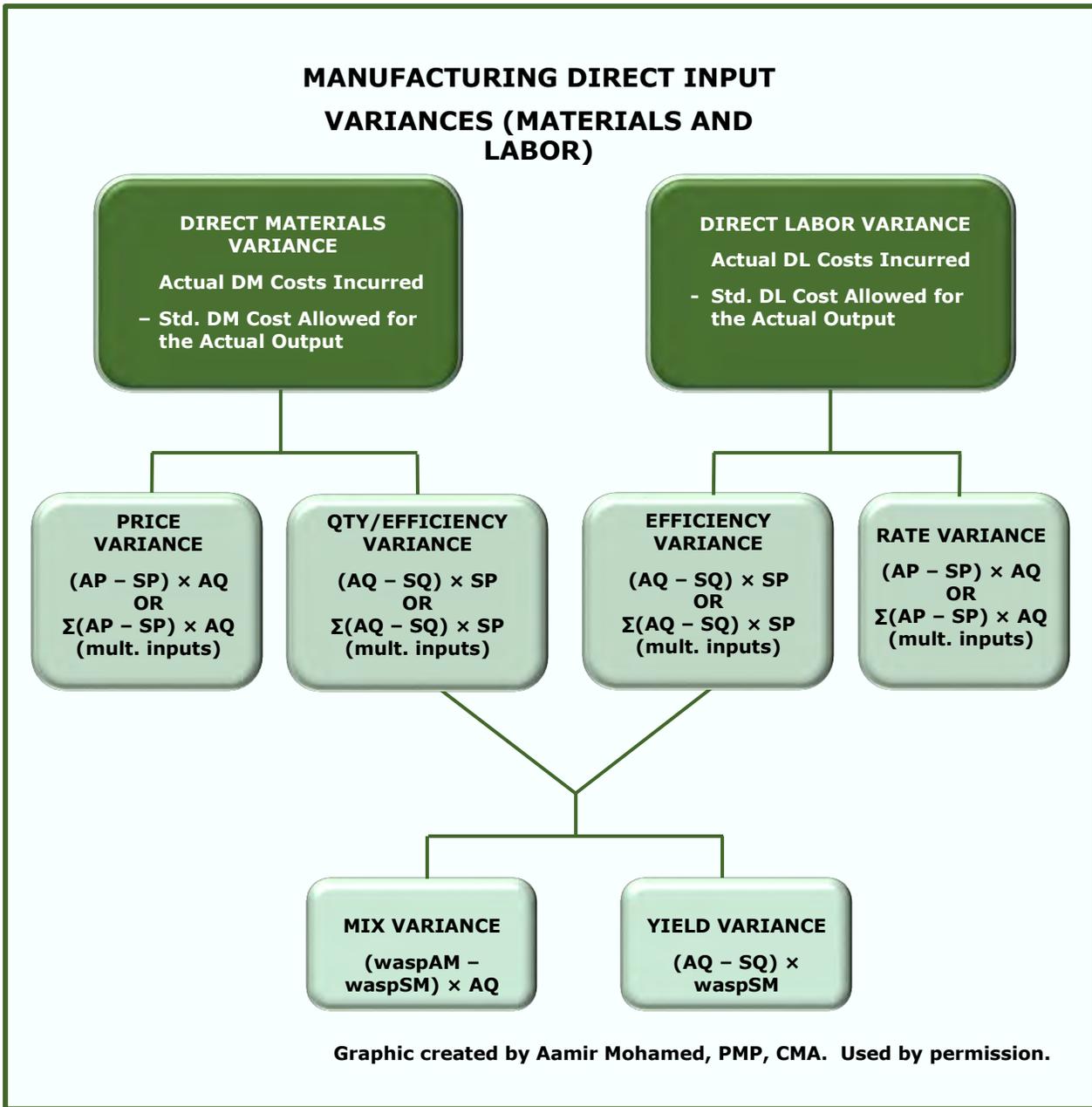
Summary, Reconciliation, and Interpretation

The variance in the mix was not a material cause of the $1,075.00 Unfavorable quantity variance, since it was responsible for only $25.00 of the unfavorable variance. Rather, the unfavorable quantity variance was primarily caused by a general inefficiency in the use of the material inputs.

To prove all of the calculations, the sum of the two sub-variances should be reconciled to the total quantity variance:

	Materials mix variance	$	25.00 U
+	Materials yield variance		1,050.00 U
=	**Total materials quantity variance**		**$1,075.00** U

Manufacturing Input Variances Graphic

The graphic on the following page was created by a CMA who used these study materials to prepare for his CMA exams and graciously offered it for the assistance of other students. Many thanks to Aamir Mohamed.

MANUFACTURING DIRECT INPUT
VARIANCES (MATERIALS AND
LABOR)

DIRECT MATERIALS VARIANCE

Actual DM Costs Incurred

– Std. DM Cost Allowed for the Actual Output

DIRECT LABOR VARIANCE

Actual DL Costs Incurred

- Std. DL Cost Allowed for the Actual Output

PRICE VARIANCE

$(AP - SP) \times AQ$
OR
$\Sigma(AP - SP) \times AQ$
(mult. inputs)

QTY/EFFICIENCY VARIANCE

$(AQ - SQ) \times SP$
OR
$\Sigma(AQ - SQ) \times SP$
(mult. inputs)

EFFICIENCY VARIANCE

$(AQ - SQ) \times SP$
OR
$\Sigma(AQ - SQ) \times SP$
(mult. inputs)

RATE VARIANCE

$(AP - SP) \times AQ$
OR
$\Sigma(AP - SP) \times AQ$
(mult. inputs)

MIX VARIANCE

$(waspAM - waspSM) \times AQ$

YIELD VARIANCE

$(AQ - SQ) \times waspSM$

Graphic created by Aamir Mohamed, PMP, CMA. Used by permission.

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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	$0.75	$150
Imported	100	$0.90	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	$0.65	$13,650
Imported	14,000	$0.95	13,300
Total	35,000		$26,950

Question 97: 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 98: 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

Overhead costs are production and operation costs that a company cannot trace to any specific product or unit of a product. Because these costs are incurred and paid for by the company and are necessary for the production process, the company needs to know what the costs are and needs to allocate them to the various products that are produced. This allocation must occur so that the full costs of production and operation are known in order to set the selling prices for the different products. If a company does not take overhead costs into account when it determines the selling price for a product, significant risk exists that the company will price the product so that it covers the direct costs of production but not all of the indirect costs of production. As a result, the company may sell the product at a loss.

Furthermore, generally accepted accounting principles require the use of absorption costing for external financial reporting. In absorption costing, all overhead costs associated with manufacturing a product become a part of the product's cost basis along with the direct costs. Along with the direct costs, the overhead costs flow to the income statement as cost of goods sold when the units they are attached to are sold. Therefore, all manufacturing overhead costs must be allocated to the units produced.

Factory overhead costs are segregated into variable overheads that **increase or decrease in total** with increased or decreased production and fixed overheads that ordinarily **do not change in total** as a result of changes in the production level.[41] Thus, factory overhead variances are also segregated into variable overhead variances and fixed overhead variances.

Factory overhead costs are incurred as production takes place, and an estimated amount is applied to each unit as manufacturing takes place. The amount of overhead costs to be applied to each unit produced is usually based on the standard usage allowed per unit of a **cost allocation base**[42]. The standard usage allowed for a reporting period is the usage of the allocation base allowed for the actual production level achieved[43] during the period.

The overhead allocation rate is predetermined[44] at the beginning of the period by dividing the total budgeted overhead cost by the budgeted usage of the allocation base or by the budgeted production level in units. As with other manufacturing costs, overhead costs are applied to production as production takes place using the predetermined or standard rate instead of an actual incurred rate, because the actual rate is not known until after the end of the period.

Common cost allocation bases used to allocate overhead to products are direct labor hours and machine hours allowed for the actual production of one unit of product.

> **Example**: Budgeted variable overhead for the year is $10,000,000, and 800,000 units are budgeted to be produced. Variable overhead is applied on the basis of direct labor hours, and the direct labor standard is that 1.25 hours of direct labor are allowed for each unit produced. Therefore, the variable overhead application rate (called the **predetermined rate**) is $10,000,000 budgeted costs ÷ (800,000 budgeted units × 1.25 DL per unit), or $10 per direct labor hour allowed for the actual production. Since 1.25 direct labor hours are allowed for each unit, the amount of variable overhead applied to each unit actually produced will be $10 × 1.25, or $12.50. The difference between the actual variable overhead incurred and the amount of variable overhead applied is a variance.

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[41] Fixed factory overhead costs are fixed as long as production activity remains within a given range, called the **relevant range**. If production drops below the relevant range or increases above the relevant range, fixed overhead will change, and then it will again be fixed as long as production remains within the new relevant range.

[42] A cost allocation base is a measure of activity that is used to assign costs to cost objects. Direct labor hours and machine hours are commonly used as cost allocation bases for factory overhead. A cost object is anything for which cost information is desired.

[43] This discussion assumes that standard costing and flexible budgeting are being used.

[44] Determination of the predetermined overhead allocation rate is explained in Section B of this text, in the topic *Setting Standard Costs*.

Thus, the incurring of factory overhead costs is separate from the application of those costs to the products manufactured. Differences between the overhead costs incurred and the overhead costs applied account for the majority of factory overhead variances.

This discussion will begin with the total overhead variance, move on to variable overhead variances, and conclude with the fixed overhead variances. Both the total variable overhead variance and the total fixed overhead variance can be broken down into two sub-variances, similar to the way the direct material and direct labor variances were broken down. Therefore, candidates need to know four individual variances that are calculated for factory overhead.

The four individual overhead variances are:

1) Variable overhead spending variance.

2) Variable overhead efficiency variance.

3) Fixed overhead spending variance.

4) Fixed overhead production-volume variance.

The four overhead variances can be combined in various ways, such as four-way, three-way, and two-way analyses. The different methods are simply different combinations of the same four variances. The four variances will each be explained individually first, and then the various possible combinations of the individual variances will be presented.

Overview of Total Manufacturing Overhead Variances

The total overhead variance is the most general overhead variance. It includes both the variable and the fixed overhead variances:

> **Actual total variable and fixed overhead incurred** (money actually spent on these items)
>
> − **Total variable and fixed overhead applied to production using predetermined rates**
>
> = **Total overhead variance**

As with all cost variances, a positive variance is unfavorable and a negative variance is favorable.

The total overhead variance is the same as the amount of over- or under-applied factory overhead. Over- and under-applied overhead is calculated as actual overhead incurred minus applied overhead. The formula above is the same formula as the formula for over- and under-applied overhead.

The total overhead variance is **not** the difference between actual overhead incurred and budgeted overhead. Rather, it is the difference between the actual overhead incurred and the **overhead applied to production**. (This subject will be covered in more detail later.)

The total overhead variance is divided into the total variable overhead variance and the total fixed overhead variance. The total variable and total fixed overhead variances are calculated the same way as the total overhead variance: actual overhead incurred minus overhead applied to production. (The calculation is explained below.)

The total variable and total fixed overhead variances are both subdivided into two other sub-variances:

Variable overhead *spending* variance	Fixed overhead *spending* variance
+ Variable overhead *efficiency* variance	+ Fixed overhead *production-volume* variance
= *Total* variable overhead variance	= *Total* fixed overhead variance

Variable Overhead (VOH) Variances

Variable overheads are overhead costs that change in total as the level of production changes. Examples of variable overheads are plant electricity, equipment maintenance, other utilities, and so forth. Overhead costs are called overhead costs because they cannot be traced to specific units manufactured. However, since they do increase when production increases and decrease when production decreases, they are variable costs.

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

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 allowed of the overhead allocation base (machine hours, direct labor hours, and so forth) for the actual output.

> **Actual total variable overhead incurred** (money spent on these items) (AP x AQ)
> − **Variable overhead applied to production using predetermined rate**[*] (SP x SQ)
> = **Total variable overhead variance**
>
> *Overhead is applied to individual products produced, usually on a basis such as direct labor hours or machine hours. Materials costs, units of production, and other similar measures are sometimes used, as well. Overhead is covered in depth in Section D, *Cost Management*. The "variable overhead applied to production" is calculated as Standard Overhead Rate × Standard Quantity of the Application Base Allowed for the Actual Production Level.

The interpretation of the variable overhead variance is the same as for other cost variances:

- A **positive** variance is an **unfavorable** variance because actual costs were **greater than** costs applied, and

- A **negative** variance is a **favorable** variance because actual costs were **less than** the amount of cost applied.

> **Note**: The difference between the actual total variable overhead incurred and the variable overhead applied to production using a predetermined rate is also referred to as the amount of variable overhead that was over- or under-applied.

Note: In a standard cost system, the following three items are all exactly the same—they are just called by different names:

1) Variable overhead allowed for production.

2) Variable overhead applied to production.

3) Variable overhead flexible budget.

In a standard cost system, the amount of variable overhead **allowed** for the actual production is the amount of variable overhead that is **applied** to the production. It is also the variable overhead flexible budget amount.

All of the three items are calculated by multiplying the predetermined overhead rate (the rate per unit allowed of whatever is used as the overhead allocation base) by the number of units of the allocation base **allowed** for the **actual** output.

The predetermined overhead rate is total budgeted variable overhead divided by the number of units of the allocation base allowed for the **budgeted** output.

Example: ABC Industries uses a standard cost system and allocates (applies) variable overhead to production on the basis of machine hours. ABC's budget for 20X8 included production of 250,000 units, and 2 machine hours were allowed per unit. Thus 500,000 total machine hours were allowed for the 20X8 budgeted output. ABC Industries also budgeted total variable overhead of $180,000 for the period. The predetermined variable overhead rate for 20X8 is $180,000 ÷ 500,000 machine hours, or $0.36 per machine hour.

ABC Industries actually produced 270,000 units during 20X8 using 567,000 actual machine hours.

The standard variable overhead allowed for production, the variable overhead applied to production, and the variable overhead flexible budget amounts are all calculated as follows.

$$\$0.36 \times (270,000 \times 2) = \$194,400$$

Note that the actual amount of machine hours used in producing the 270,000 units (567,000) is not a part of the calculation of the variable overhead allowed and applied to production and the variable overhead flexible budget amounts. Instead, the amount of machine hours **allowed for the actual production** (270,000 × 2) is used. The 567,000 actual machine hours used **will be used** to break down the total variable overhead variance into the variable overhead spending and the variable overhead efficiency variances, however (see the following topics).

ABC actually incurred $198,450 in variable overhead during 20X8. ABC's **total variable overhead variance** is

$$\$198,450 - \$194,400 = \underline{\$4,050 \text{ Unfavorable}}$$

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

1) Variable Overhead Spending Variance

The variable overhead spending variance is 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 quantity produced.

The variable overhead spending variance is essentially a price variance. It is caused by a difference between the actual variable overhead cost per unit of the allocation base used (calculated as the actual overhead costs ÷ the actual usage of the allocation base) and the standard application rate per unit of the application base. The variable overhead spending variance is calculated as follows:

> **Actual total variable overhead incurred** (money actually spent)   (AP x AQ)
> − **Budgeted variable overhead based on inputs actually used**   (SP x AQ)
> = **Variable overhead spending variance**

The interpretation of the variable overhead spending variance is the same as for other cost variances:

- A **positive** variance is an **unfavorable** variance because actual costs were **greater than** budgeted costs, and

- A **negative** variance is a **favorable** variance because actual costs were **less than** budgeted costs.

> **Note**: The first line of the variable overhead spending variance formula is the same as the first line of the total variable overhead formula.

The budgeted variable overhead, based on inputs actually used, is the standard (budgeted) variable overhead rate per hour (machine hour or direct labor hour, as appropriate) multiplied by the number of hours **actually used** to produce the actual output.

> **Example**: ABC Industries uses a standard cost system and allocates (applies) variable overhead to production on the basis of machine hours. ABC's budget for 20X8 included production of 250,000 units, and 2 machine hours were allowed per unit. Thus 500,000 total machine hours were allowed for the 20X8 budgeted output. ABC Industries also budgeted total variable overhead of $180,000 for the period. The predetermined variable overhead rate for 20X8 is $180,000 ÷ 500,000, or $0.36 per machine hour. ABC Industries actually produced 270,000 units during 20X8 using 567,000 actual machine hours. ABC actually incurred $198,450 in variable overhead during 20X8.
>
> The variable overhead spending variance is calculated as follows:
>
> **Actual total variable overhead incurred** (money actually spent)   (AP x AQ)
>
> − **Budgeted variable overhead based on inputs actually used**   (SP x AQ)
>
> = **Variable overhead spending variance**
>
> ABC's variable overhead spending variance is
>
> **$198,450 − ($0.36 × 567,000) = $(5,670) Favorable**

The variable overhead spending variance can also be calculated as follows:

> **Actual VOH Cost Per Unit of Allocation Base Actually Used − Standard VOH Cost Per Unit of Allocation Base [Standard Application Rate]**   ×   **Actual Quantity of VOH Allocation Base Used for Actual Output**
>
> **or**
>
> **(AP − SP) × AQ = Variable Overhead Spending Variance**

> **Note**: The "P" in the preceding formula, (AP − SP) × AQ, represents a rate, not a price. It refers to the standard predetermined overhead application rate. The letter "P" is used in the formula to be consistent with the materials and labor variances, since the formulas are essentially the same.

Example: ABC Industries' variable overhead spending variance calculated the second way is

(AP − SP) × AQ

AP = $198,450 ÷ 567,000, which equals $0.35.

SP = $180,000 ÷ 500,000, which equals $0.36.

AQ = 567,000.

Therefore, ABC Industries' variable overhead spending variance is

($0.35 − $0.36) × 567,000 = $(5,670) Favorable

---

2) Variable Overhead Efficiency Variance

The variable overhead efficiency variance is essentially a quantity variance, and it determines the amount of the total variance caused by a different usage of the allocation base than was expected (that is, the standard number of hours allowed for the actual output). It measures the effect on variable factory overhead cost of efficient or inefficient use of the allocation base used to apply the variable overhead. The variable overhead efficiency variance is calculated as follows.

	Budgeted variable overhead based on inputs actually used	(AQ x SP)
−	**Standard variable overhead allowed for production/applied to production**	(SQ x SP)
=	**Variable overhead efficiency variance**	

The variable overhead efficiency variance is closely related to efficiency or inefficiency in the use of whatever allocation base is used to apply the variable overhead. For example, if variable overhead is applied on the basis of direct labor hours, the variable overhead efficiency variance will be unfavorable when the direct labor efficiency variance is unfavorable and vice versa.

The variable overhead efficiency variance calculation begins with budgeted variable overhead instead of actual variable overhead, but the budgeted cost per unit of input (SP) is multiplied by the amount of inputs (direct labor hours, machine hours, and so forth) **actually used** (AQ). Therefore, the interpretation of the variable overhead efficiency variance is the same as for other cost variances:

- A **positive** variance is an **unfavorable** variance because actual usage of the allocation base was **greater than** the amount allowed for the production that took place, and

- A **negative** variance is a **favorable** variance because actual usage of the allocation base was **less than** the amount allowed for the production that took place.

> **Note**: The second line of the variable overhead efficiency variance formula is the same as the second line of the total variable overhead formula. Also, the first line of the variable overhead efficiency variance formula is the same as the second line of the variable overhead spending variance formula. This equivalence between the second line of the VOH efficiency variance and the first line of the VOH efficiency variance illustrates the split of the total variance into the two sub-variances: variable overhead spending and variable overhead efficiency.

Example: ABC Industries uses a standard cost system and allocates (applies) variable overhead to production on the basis of machine hours. ABC's budget for 20X8 included production of 250,000 units, and 2 machine hours were allowed per unit. Thus 500,000 total machine hours were allowed for the 20X8 budgeted output. ABC Industries also budgeted total variable overhead of $180,000 for the period. The predetermined variable overhead rate for 20X8 is $180,000 ÷ 500,000, or $0.36 per machine hour. ABC Industries actually produced 270,000 units during 20X8 using 567,000 actual machine hours.

The variable overhead efficiency variance is calculated as follows:

> **Budgeted variable overhead based on inputs actually used**   (AQ x SP)
>
> − **Standard variable overhead allowed for production/applied to production**   (SQ x SP)
>
> = **Variable overhead efficiency variance**

ABC's variable overhead efficiency variance is

> **($0.36 × 567,000) – ($0.36 × [270,000 × 2]), which equals $9,720 Unfavorable**

The variable overhead efficiency variance is also calculated as follows:

Actual Quantity of VOH Allocation Base Used for Actual Output – Standard Quantity of VOH Allocation Base Allowed for Actual Output   ×   **Standard Application Rate**

or

(AQ – SQ) × SP = Variable Overhead Efficiency Variance

Example: ABC Industries' variable overhead efficiency variance calculated the second way is

(AQ – SQ) × SP

AQ = 567,000.

SQ = 270,000 × 2, or 540,000.

SP = $180,000 ÷ 500,000, which equals $0.36.

Therefore, ABC Industries' variable overhead efficiency variance is

(567,000 – 540,000) × $0.36, which equals $9,720 Unfavorable

Because the variable overhead efficiency variance is related so closely to the usage of whatever activity measure is used to allocate variable overhead to production, management should carefully select the allocation base to be used. If variable overhead is applied using an activity measure that is not well correlated with the incurrence of variable manufacturing costs, the variable overhead efficiency variance will not provide useful information to management.

Furthermore, the person who is responsible for controlling the activity used to allocate the variable overhead (direct labor hours, machine hours, and so forth) should also be responsible for reporting on the variable overhead efficiency variance.

VOH Spending Variance + VOH Efficiency Variance = VOH Total Variance

The variable overhead spending variance combined with the variable overhead efficiency variance should equal the total variable overhead variance, if all have been calculated correctly.

> **Example**: The variable overhead spending variance plus the variable overhead efficiency variance for ABC Industries equals $4,050 Unfavorable, which is the same as the calculated total variable overhead variance.
>
> | | | |
> |---|---:|---|
> | Variable overhead spending variance | $(5,670) | Favorable |
> | Variable overhead efficiency variance | 9,720 | Unfavorable |
> | Total variable overhead variance | **$4,050** | **Unfavorable** |

> **Note**: This discussion of overhead variances is focused on standard costing. Under standard costing, overhead is applied to production on the basis of the amount of the allocation base **allowed** for the actual production. Under standard costing, a company will probably have both a variable overhead spending variance and a variable overhead efficiency variance.
>
> However, if normal costing is being used instead of standard costing, overhead would be applied based on the amount of the allocation base **actually used** for the actual units of output rather than on the standard amount allowed. Thus, if normal costing is being used, the Actual Quantity (AQ) would be used for **both** the AQ and the SQ in the formula above. Thus, the variable overhead efficiency variance formula under normal costing would become (AQ – AQ) × SP, which would be zero. Therefore, if overhead is applied based on the amount of the allocation base **actually used** for the actual units of output rather than on the standard amount allowed, there will be no variable overhead efficiency variance.
>
> Normal costing is explained in Section D of these study materials.

Fixed Overhead Variances

Fixed overhead costs are overhead costs that do not change in total as the level of production changes, as long as the production level remains within the relevant range. The best example of fixed overhead is factory rent, which cannot be traced to specific units manufactured and therefore is classified as an overhead cost. Because the rent payment is the same regardless of the factory's production level as long as the production level remains within the relevant range—which for rent is the maximum volume that can be produced on the premises—rent is a fixed cost.

> **Note**: Fixed manufacturing overhead is unique. Even though fixed overhead does not change in total as the level of production changes, **fixed overhead is applied to production as if it were a variable cost that *does* change in total as the level of production changes**.

Because fixed overhead is applied to production as if it were a variable cost but it is incurred and budgeted for as a fixed cost, fixed overhead variances are different from other types of variances. For direct materials, direct labor, and variable overhead, the amount of cost applied to production is the same as the flexible budget amount of cost allowed for the actual production. Therefore, the total direct materials, direct labor, and variable overhead variances are all their respective differences between actual cost incurred and the flexible budget/applied cost amount.

However, the amount of fixed overhead cost applied to production is **not** the same as the flexible budget amount of fixed overhead cost allowed for the actual production. The flexible budget amount of fixed overhead cost is the same as the static budget amount of fixed overhead cost because the amount of budgeted fixed cost does not change with changes in production level as long as the activity remains within the relevant range. The total fixed overhead variance is the difference between actual fixed overhead incurred

and the amount of fixed overhead applied to production, the same as the other total variances—but the amount of fixed overhead applied to production is not the flexible budget fixed overhead amount.

Therefore, the total fixed overhead variance is **not** the difference between actual fixed overhead incurred and the flexible budget fixed overhead amount. The difference between the actual fixed overhead incurred and the flexible budget fixed overhead amount is called the fixed overhead spending variance, and it is a sub-variance of the total fixed overhead variance.

The fixed overhead production-volume variance, another sub-variance of the total fixed overhead variance, records the difference between the flexible budget fixed overhead amount (which is the same as the static budget amount) and the amount of fixed overhead applied to production.

These two fixed overhead sub-variances will be described in more detail in the following discussion of fixed overhead variances.

Total Fixed Overhead Variance

Fixed overhead costs are allocated to units produced using the predetermined fixed overhead rate. Therefore, the total fixed overhead variance is the difference between the actual fixed overhead incurred and the amount that was applied using the standard rate and the standard usage of the application base for the actual level of output.

> **Actual fixed overhead incurred** (money actually spent)
> **−** **Standard fixed overhead _applied_** (standard rate × standard usage for actual output)*
> **=** **Total fixed overhead variance**

- The "standard usage for actual output" in the formula is the **standard amount of the application base allowed for the actual output**.

The total fixed overhead variance is interpreted in the same way as other cost variances:

- A **positive** variance is an **unfavorable** variance because actual fixed costs were **greater than** the amount of fixed costs allowed for the actual output, and
- A **negative** variance is a **favorable** variance because actual fixed costs were **less than** the amount of fixed costs allowed for the actual output.

> **Note**: The total fixed overhead variance is the same as the amount of over- or under-applied fixed overhead.
>
> - If the amount of fixed overhead applied is **less than** the actual fixed overhead incurred, fixed overhead is **under-applied**.
> - If the amount of fixed overhead applied is **greater than** the actual fixed overhead incurred, fixed overhead is **over-applied**.
>
> Over- and under-applied fixed factory overhead are covered in detail in Section D, _Cost Management_, in Vol. 2 of this book.

As with the total variable overhead variance, the total fixed overhead variance can be broken down into two sub-variances: the fixed overhead spending variance and the fixed overhead production-volume variance.

When the fixed overhead spending variance and the fixed overhead production-volume variance are combined, they will equal the total fixed overhead variance and the amount of over- or under-applied fixed overhead.

1) Fixed Overhead Spending (Flexible Budget) Variance

The fixed overhead spending variance, also called the fixed overhead flexible budget variance, is the difference between the actual fixed overhead costs incurred and the budgeted fixed overhead (flexible budget **or** static budget)[45] amount.

> **Actual fixed overhead incurred**
> − **Budgeted fixed overheads** (the flexible budget OR the static budget amount)
> = **Fixed overhead spending/fixed overhead flexible budget variance**

The fixed overhead spending variance is the **actual amount** of fixed overhead incurred minus the **budgeted amount** of fixed overhead. The fixed overhead spending variance arises because actual fixed factory overhead incurred is different from (either greater than or less than) the amount budgeted for it.

The interpretation of the fixed overhead spending/fixed overhead flexible budget variance is the same as for other cost variances:

- A **positive** variance is an **unfavorable** variance because actual costs were **greater than** budgeted costs, and

- A **negative** variance is a **favorable** variance because actual costs were **less than** budgeted costs.

> **Note**: The first line of the fixed overhead spending variance formula is the same as the first line of the total fixed overhead variance formula.
>
> Also, the flexible budget and the static budget amounts for fixed overhead are the same because fixed overhead is fixed and thus does not change with changes in production as long as production remains within the relevant range.

2) Fixed Overhead Production-Volume Variance

The fixed overhead production-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 a difference between the actual production level and the production level used to calculate the budgeted fixed overhead rate.

The fixed overhead production-volume variance has no connection to any actually incurred costs, so it is not a comparison between actual and budgeted costs in the way other variances are. Instead, it is a measure of capacity utilization.

The fixed overhead production-volume variance is calculated as follows:

> **Budgeted fixed overheads** (the flexible budget OR the static budget amount)
> − **Standard fixed overhead *applied*** (standard rate × standard input for actual output)
> = **Fixed overhead production-volume variance**

---

[45] As long as production remains within the relevant range, budgeted fixed costs in the flexible budget will be the same as budgeted fixed costs in the static budget.

Note: The second line of the fixed overhead production-volume variance formula is the same as the second line of the total fixed overhead formula. Also, the **first** line of the fixed overhead production-volume variance formula is the same as the **second** line of the fixed overhead spending/flexible budget variance formula. The following diagram shows how the total fixed overhead variance is split into two variances.

Actual Fixed OH Incurred
− Budgeted Fixed OH   =   **FOH Spending/Flexible Budget Variance**

                                                  +   **= Total FOH Variance**

Budgeted Fixed OH
− FOH Applied   =   **FOH Production-Volume Variance**

The fixed overhead production-volume variance is the **budgeted amount** of fixed overhead minus the **amount of fixed overhead applied**. Interpretation of whether the fixed overhead production-volume variance is favorable or unfavorable is the same as for other cost variances:

- A **negative amount** (applied fixed overhead is greater than budgeted fixed overhead) is **Favorable** because it indicates that actual production has **exceeded** the budgeted production level.

- A **positive amount** (budgeted fixed overhead is greater than applied fixed overhead) is **Unfavorable** because it indicates that actual production has been **lower** than the budgeted production level

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

The Total Overhead *Flexible Budget* Variance

Variances are used for different purposes. The total overhead variance, as calculated at the beginning of this topic is:

> **Actual total variable and fixed overhead incurred** (money actually spent on these items)
> **− Total variable and fixed overhead applied to production using predetermined rates**
> **= Total overhead variance**

The total overhead variance is the sum of the overhead variances (variable and fixed) that arise in the accounting system when production is accounted for. The variances are resolved at the end of the reporting period as part of the closing process. As discussed above, this total variance can be subdivided into four sub-variances.

However, the total overhead variance **does not indicate the difference between the actual variable and fixed overhead incurred and the flexible budget variable and fixed overhead**. For the difference between actual overhead incurred and the flexible budget overhead, the **total overhead *flexible budget* variance** is needed. The total overhead *flexible budget* variance includes the following **three** of the four overhead sub-variances:

1) Variable overhead spending variance.

2) Variable overhead efficiency variance.

3) Fixed overhead spending variance.

The total overhead flexible budget variance **does not** include the fixed overhead production-volume variance because the fixed overhead production-volume variance is not a comparison between actual and flexible budget costs as the other three variances are.

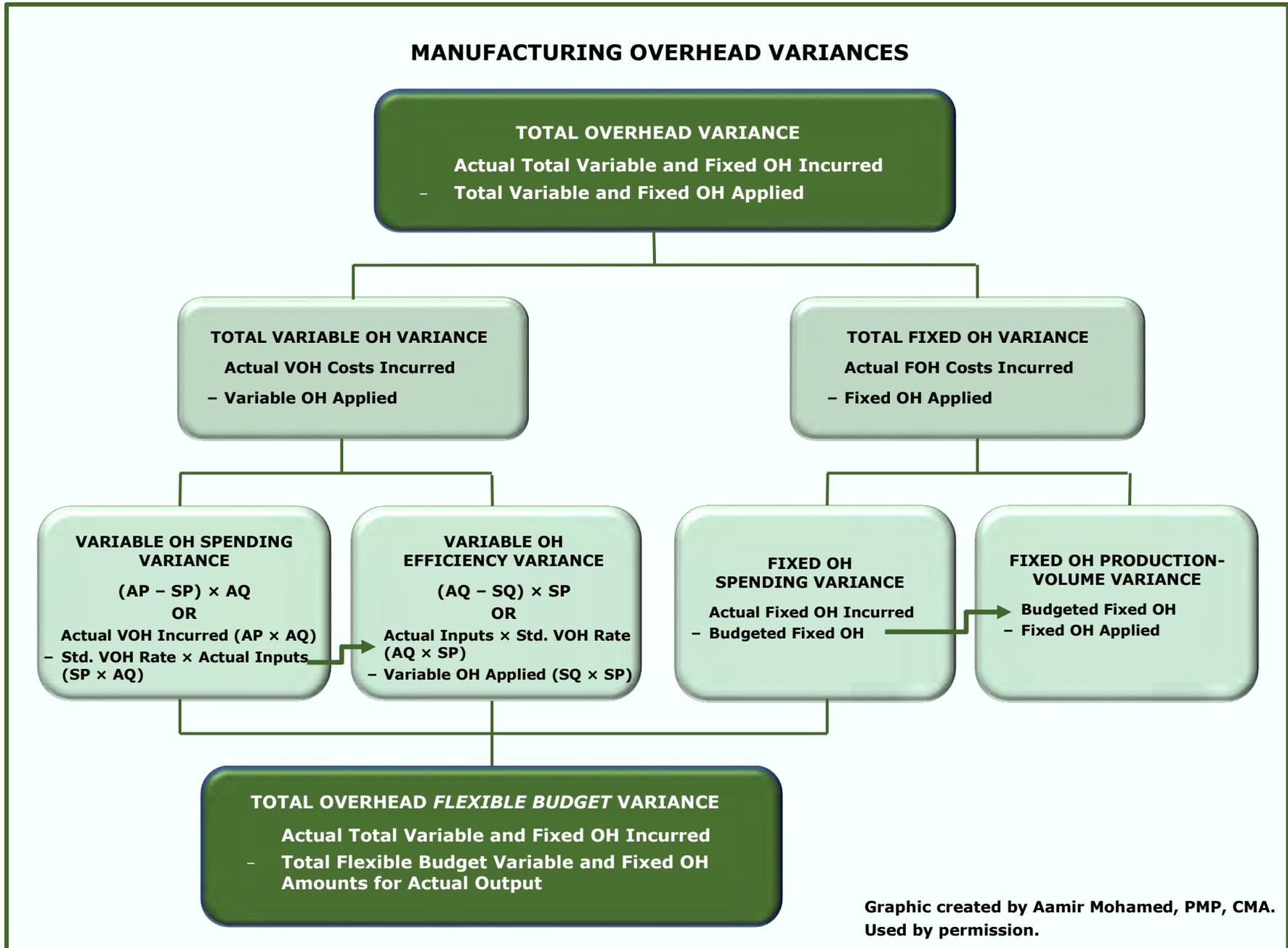The **total overhead *flexible budget* variance** is

> **Actual total variable and fixed overhead incurred** (money spent on these items)
> **−** **Total *flexible budget* variable and fixed overhead amounts for the actual output**
> **=** **Total overhead *flexible budget* variance**

It is important to recognize that the flexible budget amount for **fixed overhead** is exactly the same as the static budget amount for fixed overhead, but the flexible budget amount for **variable** overhead will be an **adjusted amount** because it is the amount **allowed** for the actual output.

The variable overhead spending variance and the variable overhead efficiency variance are both included in the total overhead flexible budget variance. However, of the two fixed overhead variances, only the fixed overhead spending (flexible budget) variance is included in the total overhead flexible budget variance. The fixed overhead production-volume variance (budgeted fixed overhead minus the amount of fixed overhead applied) is omitted from the calculation of the total overhead flexible budget variance. The fixed overhead production-volume variance has no connection to any actually incurred costs, so it is not a comparison between actual and budgeted costs as the other three sub-variances are.

Manufacturing Overhead Variances Graphic

The graphic on the following page was created by a CMA who used these study materials to prepare for his CMA exams and graciously offered it for the assistance of other students. Many thanks to Aamir Mohamed.

MANUFACTURING OVERHEAD VARIANCES

TOTAL OVERHEAD VARIANCE

Actual Total Variable and Fixed OH Incurred

− **Total Variable and Fixed OH Applied**

TOTAL VARIABLE OH VARIANCE

Actual VOH Costs Incurred

− **Variable OH Applied**

TOTAL FIXED OH VARIANCE

Actual FOH Costs Incurred

− **Fixed OH Applied**

VARIABLE OH SPENDING VARIANCE

(AP − SP) × AQ
OR
Actual VOH Incurred (AP × AQ)
− **Std. VOH Rate × Actual Inputs (SP × AQ)**

VARIABLE OH EFFICIENCY VARIANCE

(AQ − SQ) × SP
OR
Actual Inputs × Std. VOH Rate (AQ × SP)
− **Variable OH Applied (SQ × SP)**

FIXED OH SPENDING VARIANCE

Actual Fixed OH Incurred
− **Budgeted Fixed OH**

FIXED OH PRODUCTION-VOLUME VARIANCE

Budgeted Fixed OH
− **Fixed OH Applied**

TOTAL OVERHEAD *FLEXIBLE BUDGET* VARIANCE

Actual Total Variable and Fixed OH Incurred

− **Total Flexible Budget Variable and Fixed OH Amounts for Actual Output**

Graphic created by Aamir Mohamed, PMP, CMA. Used by permission.

Comprehensive Example of Overhead Variances

The following is a comprehensive example of variable, fixed, and total overhead variance calculations. In addition to the following example, a comprehensive example of accounting for fixed overhead and fixed overhead variances is given in Section D of this textbook in the topic *The Process of Accounting for Factory Overhead*. The example in Section D highlights fixed overhead and shows how the fixed overhead variances arise in the accounting system and how they are cleared out. The fixed overhead example in Section D uses the same amounts as the following example uses for fixed overhead.

Example: The following variances will be calculated:

1) Total overhead variance
2) Total variable overhead variance
3) Variable overhead spending variance
4) Variable overhead efficiency variance
5) Total fixed overhead variance
6) Fixed overhead spending variance
7) Fixed overhead production-volume variance
8) Total overhead flexible budget variance

OPQ Company applies overhead to production based on machine hours. Before 20X0 begins, the company budgets the following for the year 20X0:

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 (**also** $10/unit)
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 (**also** $5/unit)

Actual overhead incurred during 20X0 was:

Variable overhead incurred	$ 5,670,000
Fixed overhead incurred	11,000,000
Total overhead incurred	$16,670,000

Actual production during 20X0 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 20X0 for the actual production is 6,300,000 hours.

During 20X0, 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.

(Continued)

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1)   Total Overhead Variance

Actual overhead incurred during 20X0 was:

Fixed overhead	$11,000,000
Variable overhead	5,670,000
Total actual overhead incurred	$16,670,000

Applied overhead for 20X0:

Fixed overhead ($2/MH × 5MH/unit × 1,200,000 units produced)	$12,000,000
Variable overhead ($1/MH × 5MH/unit × 1,200,000 units produced)	6,000,000
Total flexible budget overhead, fixed and variable	$18,000,000
Total overhead variance (total actual OH – total applied OH)	**$(1,330,000) Favorable**

Variable Overhead Variances

2)   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 ($1 × 5 × 1,200,000)	6,000,000
Equals: Total variable overhead variance	**$(330,000) Favorable**

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

3)   Variable Overhead Spending Variance:

Actual VOH incurred – Budgeted VOH based on actual usage =

$5,670,000 – (6,300,000 × $1) = **$(630,000) Favorable**

OR

⌈ Actual VOH cost/unit of allocation base actually used		Actual qty. of VOH
	×	application base used for
⌊ Minus standard VOH application rate/unit of allocation base ⌋		actual output

OR   (AP – SP) × AQ

[($5,670,000 ÷ 6,300,000) − $1] × 6,300,000 = (0.90 – 1.00) × 6,300,000 = **$(630,000) Favorable**

4)   Variable Overhead Efficiency Variance:

Budgeted VOH based on actual usage – Variable OH applied to production =

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

OR

⌈ Actual activity level of VOH application base **actually used**		
	×	Standard application rate
⌊ Minus standard activity level of application base **allowed** ⌋		

OR   (AQ – SQ) × SP

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

(Continued)

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 reveals 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). The net, or total, variable overhead variance is (630,000) + 300,000 = (330,000) Favorable.

Fixed Overhead Variances

5)   Total Fixed Overhead Variance:

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

6)   Fixed Overhead Spending (Flexible Budget) Variance:

Actual fixed overhead incurred	$11,000,000	
Minus: Flexible & static budget fixed overhead	10,000,000	
Equals: Fixed overhead spending variance	**$1,000,000**	**Unfavorable**

7)   Fixed Overhead Production-Volume Variance:

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

The total fixed overhead variance is the total of 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.

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

8)   Total Overhead *Flexible Budget* Variance

The total overhead variance is the difference between total actual overhead incurred and total overhead applied. The total overhead variance, calculated at the beginning of this example, is $(1,330,000) Favorable.

The total overhead *flexible budget* variance is the difference between total actual overhead incurred and the total flexible budget total overhead. The total overhead flexible budget variance reveals something different from the total overhead variance. The total overhead flexible budget variance is Unfavorable, not Favorable.

(Continued)

Actual overhead incurred during 20X0:

Fixed overhead	$11,000,000
Variable overhead	5,670,000
Total actual overhead incurred	$16,670,000

Budgeted overhead for 20X0 (**flexible** budget):

Budgeted fixed overhead (flexible and static budget amount)	$10,000,000
Flexible budget variable overhead	
($1/MH × 5MH/unit × 1,200,000 units produced)	6,000,000
Total flexible budget overhead, fixed and variable	$16,000,000
Total overhead flexible budget variance (total actual overhead incurred minus total flexible budget overhead)	**$ 670,000 Unfavorable**

The total overhead flexible budget variance consists of the variable overhead spending variance, the variable overhead efficiency variance, and the fixed overhead spending variance, all of which are calculated in this example. They are:

Variable overhead spending variance	$(630,000)	Favorable
Variable overhead efficiency variance	300,000	Unfavorable
Fixed overhead spending variance	1,000,000	Unfavorable
Total overhead flexible budget variance	**$ 670,000**	**Unfavorable**

• The total overhead variance is $(1,330,000) Favorable.

• The total overhead flexible budget variance is $670,000 Unfavorable.

Why are these two total overhead variances so different? The difference is in the fixed overhead production-volume variance, which is included in the total overhead variance and not included in the total overhead flexible budget variance. The fixed overhead production-volume variance was $(2,000,000) Favorable. When the fixed overhead production-volume variance is omitted, the total overhead variance changes from $(1,330,000) Favorable to the total overhead *flexible budget* variance of $670,000 Unfavorable. The fixed overhead production-volume variance was favorable because production exceeded expectations (1,200,000 units produced versus 1,000,000 units budgeted), which generally is a good thing because it means the fixed production facilities were being utilized to a greater degree than the company had expected. When fixed production facilities are used to a greater degree, the fixed cost of each unit produced decreases.

However, total actual fixed costs exceeded the amount budgeted by $1,000,000. Therefore, the amount of fixed cost of each unit may not have decreased after all. Did actual fixed costs increase because production was so great that the fixed cost moved out of the relevant range? That question is something that needs to be investigated, and it may be that the predetermined or standard application rate for fixed costs needs to be adjusted.

Question 99: 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)

Question 100: The JoyT Company manufactures Maxi Dolls for sale in toy stores. In planning for this year, JoyT estimated variable factory overhead of $600,000 and fixed factory overhead of $400,000. JoyT uses a standard costing system, and factory overhead is allocated to units produced on the basis of standard direct labor hours. The denominator level of activity budgeted for this year was 10,000 direct labor hours, and JoyT used 10,300 actual direct labor hours.

Based on the output accomplished during the year, 9,900 standard direct labor hours should have been used. Actual variable factory overhead was $596,000, and actual fixed factory overhead was $410,000 for the year. Based on this information, the volume variance for JoyT for this year is

a) $4,000 unfavorable

b) $6,000 unfavorable

c) $10,000 unfavorable

d) $16,000 unfavorable

(ICMA 2010)

Question 101: The total fixed overhead variance is the:

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

b)   Amount of the under-applied or over-applied fixed overhead costs.

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

d)   Measure of production inefficiency.

(CMA Adapted)

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

The analysis of overheads (fixed and variable) has been covered using the four-way method. In the four-way method, the four overhead variances are each calculated and reported separately.

However, overhead can also be analyzed using a three-way and a two-way method by combining the four-way variances in different ways.

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

    1)   The **volume variance** is equal to the production-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 variance.

Two-way analysis uses the same information as calculated for four-way analysis, but it is combined in a slightly different manner than is done under three-way analysis. The two variances involved are called the volume variance and the controllable (or budget) variance.

    1)   The **volume variance** is equal to the fixed overhead production-volume variance.

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

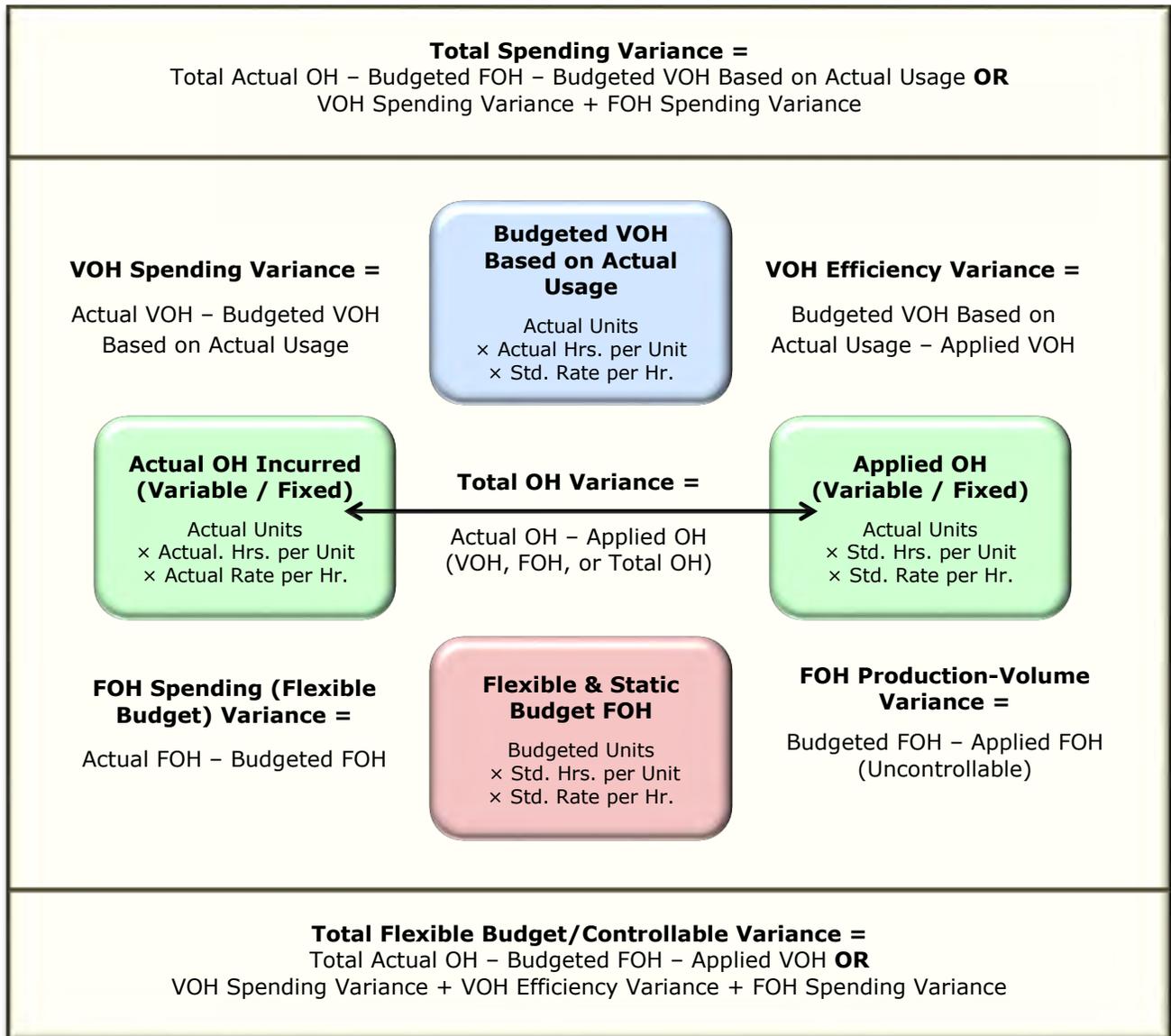> **Note**: The controllable variance is the total overhead flexible budget variance.

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

	Variable Overhead Variance Analysis		Fixed Overhead Variance Analysis	
Four-Way	**Efficiency** Variance $(AQ - SQ) \times SP$	**Spending** Variance $(AP - SP) \times AQ$	**Spending** Variance Actual − Budgeted	**Production-Volume** Variance Budgeted − Applied
Three-Way	**Efficiency** Variance	**Spending** Variance		**Volume** Variance
Two-Way	**Controllable** Variance			**Volume** Variance

The preceding comprehensive example for OPQ Company utilized four-way analysis. However, the controllable variance of two-way analysis was actually calculated when the total overhead flexible budget variance was calculated in that example.

Manufacturing Overhead Variances Graphic

The graphic below was developed by a CMA who used these study materials to prepare for her CMA exams and graciously offered it for the assistance of other students. Many thanks to Laura Zaverdinos.

Total Spending Variance =
Total Actual OH – Budgeted FOH – Budgeted VOH Based on Actual Usage **OR**
VOH Spending Variance + FOH Spending Variance

VOH Spending Variance =

Actual VOH – Budgeted VOH
Based on Actual Usage

Budgeted VOH Based on Actual Usage

Actual Units
× Actual Hrs. per Unit
× Std. Rate per Hr.

VOH Efficiency Variance =

Budgeted VOH Based on
Actual Usage – Applied VOH

Actual OH Incurred (Variable / Fixed)

Actual Units
× Actual. Hrs. per Unit
× Actual Rate per Hr.

Total OH Variance =

Actual OH – Applied OH
(VOH, FOH, or Total OH)

Applied OH (Variable / Fixed)

Actual Units
× Std. Hrs. per Unit
× Std. Rate per Hr.

FOH Spending (Flexible Budget) Variance =

Actual FOH – Budgeted FOH

Flexible & Static Budget FOH

Budgeted Units
× Std. Hrs. per Unit
× Std. Rate per Hr.

FOH Production-Volume Variance =

Budgeted FOH – Applied FOH
(Uncontrollable)

Total Flexible Budget/Controllable Variance =
Total Actual OH – Budgeted FOH – Applied VOH **OR**
VOH Spending Variance + VOH Efficiency Variance + FOH Spending Variance

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Graphic created by Laura Zaverdinos, CPA, CMA, CLU, ChFC. Used by permission.

Two-Way Overhead Variance Analysis

Variance #1: The Controllable Variance

The controllable variance in two-way analysis is the same as the total overhead flexible budget variance that was calculated in the OPQ Company example. In that example, the total overhead flexible budget variance included the variable overhead spending variance, the variable overhead efficiency variance, and the fixed overhead spending variance. The controllable variance is the same number. The controllable variance can be calculated either by summing those other three variances or by calculating it directly as:

> **Total actual overhead incurred**
> **− Budgeted fixed overhead (static and flexible)**
> **− <u>Flexible budget variable overhead (or variable overhead applied to production)</u>**
>
> **= <u>Controllable variance</u>**

For OPQ Company the controllable variance is:

	$16,670,000	Total actual overhead incurred
−	10,000,000	Budgeted fixed overhead (static and flexible)
−	<u>6,000,000</u>	Variable OH applied: $1/MH × 5MH/unit × 1,200,000 units produced
=	**<u>$ 670,000</u>**	**Unfavorable** controllable variance

Note that $670,000 Unfavorable is also the total overhead flexible budget variance that was calculated previously for OPQ Company.

Variance #2: The Fixed Overhead Volume Variance

The fixed overhead volume variance in two-way analysis is the same as the fixed overhead production-volume variance in four-way analysis. For OPQ Company, it is $(2,000,000) Favorable, calculated as:

	Budgeted fixed overhead	$ 10,000,000
Minus:	Applied fixed overhead (standard rate × standard quantity of application base for actual output, or $2 × 6,000,000 MH)	<u>12,000,000</u>
Equals:	Fixed overhead volume variance	**<u>$(2,000,000)</u> Favorable**

Reconciling to the Total Overhead Variance:

Controllable variance	$ 670,000
Fixed overhead volume variance	(2,000,000)
Total overhead variance	**<u>$(1,330,000)</u> Favorable**

Three-Way Overhead Variance Analysis

Variance #1: The Total Spending Variance

In three-way overhead variance analysis, the variable overhead spending variance and the fixed overhead spending variance are combined into a single total spending variance.

The total spending variance (fixed and variable) can be calculated by combining those two variances, or it can be calculated directly as:

> **Actual total overhead incurred**
> − **Budgeted fixed overhead (static and flexible budget)**
> − **Budgeted variable overhead based on actual usage of the allocation base**
>
> = **Total spending variance**

For OPQ Company, the total spending variance is:

	$16,670,000	(Actual total overhead incurred)
−	10,000,000	(Budgeted fixed overhead)
−	6,300,000	(6,300,000 actual machine hours used × $1/MH)
=	**$ 370,000**	**Unfavorable**

The same variance calculated by combining the variable overhead spending variance and the fixed overhead spending variance for OPQ Company is:

Variable overhead spending variance	$ (630,000)	Favorable
Fixed overhead spending variance	1,000,000	Unfavorable
Total spending variance	**$ 370,000**	**Unfavorable**

Variances #2 and 3: The variable overhead efficiency variance and the fixed overhead volume variance

In three-way overhead analysis, the variable overhead efficiency variance and the fixed overhead volume variance are the same as in four-way analysis. Both of these variances are calculated as they are for four-way variance analysis.

Variance #2: The Variable Overhead Efficiency Variance

For OPQ, the variable overhead efficiency variance is:

Budgeted VOH based on actual usage – Variable OH applied to production =

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

OR

> 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**

(Continued)

Variance #3: The Fixed Overhead Volume Variance

The fixed overhead volume variance is calculated the same way as the fixed overhead production-volume variance is calculated in four-way analysis.

For OPQ, the fixed overhead volume variance is:

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

Reconciliation to the total overhead variance:

	Total spending variance	$ 370,000	Unfavorable
Plus:	Variable overhead efficiency variance	300,000	Unfavorable
Minus:	Fixed overhead volume variance	(2,000,000)	Favorable
Equals:	Total overhead variance	**$(1,330,000)**	**Favorable**

Summary Table of Manufacturing Variance Calculations

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

Prime Costs	Price Variance $(AP - SP) \times AQ$	Quantity Variance $(AQ - SQ) \times SP$
Materials	**Price** Variance	**Quantity** Variance
Labor	**Rate** Variance	**Efficiency** Variance

Multiple Inputs (both Material and Labor)	**Mix** Variance $(waspAM - waspSM) \times AQ$	**Yield** Variance $(AQ - SQ) \times waspSM$

Variable Overhead	**Spending** Variance $(AP - SP) \times AQ$	**Efficiency** Variance $(AQ - SQ) \times SP$
Fixed Overhead	**Spending** (Flexible Budget) Variance Actual OH − Budgeted OH	**Production Volume** Variance Budgeted OH − Applied OH

Question 102: 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)

At the beginning of the month, the company had a cash balance of $107,500. $107,500 minus the $26,000 negative net cash flow during May results in a May ending cash balance before any borrowing of $81,500. However, the company needs to end the month with a cash balance of $100,000; therefore, it is $18,500 short. Since borrowings for cash deficits must be made in $10,000 increments, the company must borrow **$20,000** to cover the $18,500 cash deficit for May and end the month with at least $100,000 in cash. It will thus end the month of May with $101,500 in cash: $107,500 − $26,000 + $20,000 = $101,500.

86 c – Top management would not be likely to be involved in setting budget standards for production because setting budget standards is an activity best done by those more directly involved with budget-related matters.

87 d – Standard costing systems are often and best used together with a flexible budget. By using standard costs, the firm can prepare the flexible budgets that enable better analysis at the end of the period.

88 d – The actual sales volume of the product will not impact the materials efficiency variance. The materials efficiency variance, also called the direct materials quantity variance, is a manufacturing input variance that measures the difference in cost between the actual material used in production at the standard price and the standard usage allowed for the level of actual output at the standard price. It is not affected by the amount of the finished good that is sold.

89 b – The total standard cost allowed for the actual output is $60,000. Two units of raw material are allowed for each unit produced and the company produced 12,000 units. Therefore, the standard quantity allowed for the actual output is 12,000 × 2, or 24,000 units. The standard price for one unit of material is $60,000 ÷ 24,000 units of direct materials, or **$2.50** per unit of direct materials.

90 d – For this question, use the materials quantity variance formula and solve for AQ. The variance formula is (AQ − SQ) × SP. SQ can be calculated because the company produced 12,000 units, and two units of raw materials are required for each unit of output. Therefore, the standard quantity for the actual output is 24,000 units. The standard price per unit of raw material can also be calculated because the standard cost allowed for the actual output is $60,000. Since the standard quantity for the actual output is 24,000 units, the standard price per unit of raw materials is $60,000 ÷ 24,000, or $2.50. The quantity variance is given as $2,500 unfavorable. Therefore, the formula is:

(AQ − 24,000) × $2.50 = $2,500.

Solving for AQ:
2.5AQ − 60,000 = 2,500
2.5AQ = 62,500
AQ = **25,000**

91 c – The formula for calculating the materials price variance is (AP − SP) × AQ. The actual price for raw materials is $105,000 ÷ 35,000 units in inventory, or $3.00 per unit. The standard price is $2.50 per unit of raw materials ($60,000 standard cost for material allowed for the output ÷ [12,000 units actually produced × 2 units of materials per unit produced]). The Actual Quantity in the formula is the actual quantity of the raw materials that were **used** in producing the 12,000 finished units. It is not the actual quantity of product produced, nor is it the standard quantity of materials for the actual quantity produced.

To calculate the price variance, the number of units of raw material actually used in production is needed, but the question does not provide that number. However, the question states that there is an unfavorable quantity variance of 2,500. Therefore, to determine the number of units of materials actually used, use the quantity variance formula and solve for AQ.

The quantity variance formula is (AQ − SQ) × SP. Since the question indicates that the materials standard is 2 units of raw materials for each unit produced, the standard quantity of materials for 12,000 units is 24,000 units. The actual quantity is not yet known. The standard price is $2.50 per unit of raw material ($60,000 standard cost for material allowed for the output ÷ [12,000 units actually produced × 2 units of materials per unit produced]). The quantity variance is 2,500 Unfavorable. The formula is:

(AQ − 24,000) × $2.50 = $2,500

Solving for AQ:
2.5AQ − 60,000 = 2,500
2.5AQ = 62,500
AQ = 25,000

Next, input the actual quantity of materials used into the materials price variance formula and calculate the materials price variance, (AP − SP) × AQ:

($3.00 − $2.50) × 25,000 = **$12,500 Unfavorable**

92 b – The price variance formula is (AP – SP) × AQ. Entering the figures from the question into the formula, results in ($0.75 − $0.72) × 4,100 = **$123** **Unfavorable**. (Remember for the price variance to use the number of units **used** in production, unless the problem asks for the **purchase** price variance.)

93 d – To solve for the direct materials usage variance, use the following formula: (AQ – SQ) × SP. The AQ is the actual quantity of the direct materials used, and the SQ is the standard quantity of direct materials allowed for the actual output. 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). The actual quantity used is 108,000; therefore, the formula is (108,000 – 110,000) × $3.60 = **$(7,200)** **Favorable**.

94 a – To solve for the direct labor rate variance, use the following formula: (AP – SP) × AQ. The actual quantity of labor hours is 28,000 and the standard rate is $12.00 per hour. The actual rate is calculated by dividing the actual cost ($327,600, which is 90% of the total labor cost of $364,000) by the actual hours worked (28,000). The result is an actual labor rate of $11.70 per hour. Inputting these numbers into the formula results in ($11.70 − $12.00) × 28,000 = **$(8,400) Favorable**.

95 b – To solve for the direct labor usage (efficiency) variance, use the following formula: (AQ – SQ) × SP. The AQ is the actual number of direct labor hours used, and the SQ is the standard number of direct labor hours allowed for the actual output. The standard price is $12.00 and the actual number of direct labor hours worked is 28,000. The number of direct labor hours allowed for the actual level of output is 27,500 (22,000 units × 1.25 hours per unit). Putting these numbers into the formula results in (28,000 – 27,500) × $12 = **$6,000 Unfavorable**.

96 b – If the company has an unfavorable materials usage variance, then more materials were used in production than should have been used. An unfavorable materials usage variance may be caused by inferior materials that created the need to discard the unusable materials and start over. Thus, an unfavorable variance in materials usage may in turn cause more labor hours to be used in order to handle and process the additional materials. Therefore, the unfavorable materials usage variance may also cause an unfavorable direct labor efficiency variance.

97 d – The materials mix variance equals the actual total quantity used multiplied by the difference between the weighted average standard price for the actual mix per unit of direct materials, which in this question is kilogram (waspAM) and the weighted average standard price for the standard mix per kilogram (waspSM). The weighted average total standard price for the actual mix is (21,000 × $0.75) + (14,000 × $0.90) = $28,350, and the weighted average standard price per kilogram for the actual mix is $0.81 ($28,350 ÷ 35,000 kg). The weighted average standard price for the standard mix is $0.80 per kilogram ($240 standard total cost per batch ÷ 300 standard total kg per batch). The mix variance is ($0.81 − $0.80) x 35,000 = **$350 Unfavorable**.

98 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 $0.80 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. Therefore, the yield variance is (35,000 – 33,000) x $0.80 = **$1,600 Unfavorable**.

99 b – The variable overhead efficiency variance is essentially a quantity variance, and it determines the amount of the total variance caused by a different usage of the allocation base than was expected. The allocation base used in this question is direct labor hours.

The variable overhead efficiency variance is closely related to efficiency or inefficiency in the use of whatever allocation base is used to apply the variable overhead. For example, if variable overhead is applied on the basis of direct labor hours, the variable overhead efficiency variance will be unfavorable when the direct labor efficiency variance is unfavorable and vice versa.

The variable overhead efficiency variance is:

Budgeted VOH based on actual usage – Variable OH applied to production

Or: (AQ – SQ) × SP

Where: AQ is the actual quantity of the variable overhead allocation base (direct labor hours or direct machine hours) used for the actual output,

SQ is the standard quantity of the variable overhead allocation base allowed for the actual output, and

SP is the standard variable overhead application rate.

The direct labor efficiency variance is:

(AQ – SQ) × SP

Where: AQ is the actual direct labor hours used,

            SQ is the standard direct labor hours allowed for the actual output, and

            SP is the standard direct labor rate.

When variable overhead is applied on the basis of direct labor hours, "AQ" and "SQ" are the same amounts in both the variable overhead efficiency variance and the direct labor efficiency variance. Thus, **when variable overhead is applied on the basis of direct labor hours and the direct labor efficiency variance is unfavorable, the variable overhead efficiency variance will also be unfavorable and vice versa**.

100 a – The production-volume variance (or the volume variance) is the flexible/static budgeted fixed overhead minus the amount of fixed overhead applied. The flexible/static budget fixed overhead amount is given as $400,000.

The predetermined application rate for fixed overhead is $400,000 ÷ 10,000 DLH, or $40 per DLH.

With standard costing, overhead is applied to production on the basis of the amount of the application base that is **allowed** for the actual output. The amount of DLH allowed for the actual output is given as 9,900 hours.

Therefore, the amount of fixed overhead applied to production is $40 per DLH multiplied by the 9,900 DLH allowed for the actual output, or $396,000.

The Volume Variance is $400,000 − $396,000, which equals **$4,000**. Since the amount is positive, the variance is **unfavorable**. It is unfavorable because it means the facilities were not used to the extent planned.

101 b – The total fixed overhead variance is the difference between the actual total fixed overhead cost incurred and the applied fixed overhead. That difference is also the amount of the under-applied or over-applied fixed overhead costs.

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

103 b – Two standard direct labor hours are allowed for each unit. Since Franklin Glass Works produced 198,000 units, **396,000** standard total direct labor hours are allowed for the actual production (198,000 × 2).

104 a – The VOH efficiency variance can be calculated as Budgeted VOH Based on Inputs Actually Used − VOH Applied to Production.

Budgeted VOH based on inputs actually used = VOH allocation rate × DLH actually used.

The VOH allocation rate is budgeted variable overhead divided by the DLH allowed for the budgeted number of units. The **total** budgeted overhead is $900,000 and the **fixed** overhead is $3 per unit. Since 200,000 units are budgeted for production, the budgeted fixed overhead is $600,000 (200,000 × $3). Therefore, the budgeted variable overhead is $300,000 ($900,000 − $600,000). Since 200,000 units were budgeted and 2 direct labor hours are allowed per unit, 400,000 direct labor hours were allowed for the budgeted production. The variable overhead allocation rate is thus $300,000 ÷ 400,000 hours, which equals $0.75 of variable overhead allocated per direct labor hour.

VOH based on inputs actually used = $0.75 VOH allocation rate × 440,000 DLH actually used = $330,000.

VOH applied to production = $0.75 VOH allocation rate × (198,000 actual production × 2 DLH allowed per unit) = $297,000.

The VOH efficiency variance = $330,000 − $297,000 = **$33,000** Unfavorable.

The VOH efficiency variance can also be calculated using the following equation: (AQ − SQ) × SP, where AQ is the actual quantity of the direct labor hours used, SQ is the standard quantity of direct labor hours allowed for the actual output, and SP is the standard variable overhead application rate.

The actual number of direct labor hours is 440,000 and the standard number of direct labor hours allowed for the actual production is 396,000 (198,000 units actually produced multiplied by 2 direct labor hours allowed per unit produced). The standard VOH application rate was calculated above as $0.75 per DLH allowed for the actual output. Therefore, the formula is: (440,000 − 396,000) × $0.75, which equals **$33,000 Unfavorable**.

105 c – The Variable Overhead Spending Variance can be calculated as Actual VOH Incurred − Budgeted VOH Based on Inputs Actually Used.

Actual VOH incurred is given as $352,000.