These types of questions will test you on your understanding of the meaning of various EVM metrics:

* **Planned Value (PV)** — how much work was scheduled to date
* **Earned Value (EV)** — how much work was completed to date
* **Actual Cost (AC)** — the amount of money spent so far
* **Budget at Completion (BAC)** — the total budget for the project
* **Estimate at Completion (EAC)** — the estimated total amount of money needed to be put into the project based on the information available as today
* **Estimate to Completion (ETC)** — how much more do we need to put into the project to complete it
* **Variance at Completion (VAC)** — the difference between the estimated total cost and the original budget
* **Cost Performance Index (CPI)** — ratio between EV and AC, to reflect whether the project work is under / on / over budget in relative terms
* **Schedule Performance Index (SPI)** — ratio between EV and PV, to reflect whether the project work is ahead of / on / behind schedule in relative terms
* **To Complete Performance Index (TCPI)** — the efficiency needed to finish the project on budget, it is the ratio between budgeted cost of work remaining and money remaining

The following formulas will be used for the following examples.

PV = Planned Completion (%) \* BAC

EV = Actual Completion (%) \* BAC

CPI = EV/AC

SPI = EV/PV

**Earned Value Analysis Example 1**

Suppose you have a budgeted cost of a project at $900,000. The project is to be completed in 9 months. After a month, you have completed 10 percent of the project at a total expense of $100,000. The planned completion should have been 15 percent.

Now, let’s see how healthy the project is by computing the CPI and SPI.

From the scenario, you can extract the following:

* + BAC = $900,000
  + AC = $100,000

The Planned Value (PV) and Earned Value (EV) can then be computed as follows:

* + Planned Value = Planned Completion (%) \* BAC = 15% \* $ 900,000 = $ 135,000
  + Earned Value = Actual Completion (%) \* BAC = 10% \* $ 900,000 = $ 90,000

Compute the earned value variances:

* + **Cost Performance Index (CPI)** = EV / AC = $90,000 / $100,000 = 0.90. This means for every $1 spent, the project is producing only 90 cents in work.
  + **Schedule Performance Index (SPI)** = EV / PV = $90,000 / $135,000 = 0.67. This means for every estimated hour of work, the project team is completing only 0.67 hours (approximately 40 minutes).

**Interpretation**: Since both Cost Performance Index (CPI index) and Schedule Performance Index (SPI index) are less than 1, it means that the project is over budget and behind schedule. This example project is in major trouble and corrective action needs to be taken. [Risks management needs to kick-in](https://www.brighthubpm.com/risk-management/48016-responding-to-negative-risks-in-risk-management-strategies/).

**Earned Value Analysis - Example 2**

Suppose you are managing a software development project. The project is expected to be completed in 8 months at a cost of $10,000 per month. After 2 months, you realize that the project is 30 percent completed at a cost of $40,000. You need to determine whether the project is on-time and on-budget after 2 months.

Step 1: Calculate the Planned Value (PV) and Earned Value (EV)

From the scenario,

* + Budget at Completion (BAC) = $10,000 \* 8 = $80,000
  + Actual Cost (AC) = $40,000
  + Planned Completion = 2/8 = 25%
  + Actual Completion = 30%

Therefore,

* + Planned Value = Planned Completion (%) \* BAC = 25% \* $ 80,000 = $ 20,000
  + Earned Value = Actual Completion (%) \* BAC = 30% \* $ 80,000 = $ 24,000

Step 2: Compute the Cost Performance Index (CPI) and Schedule Performance Index (SPI)

* + **Cost Performance Index (CPI)** = EV / AC = $24,000 / $40,000 = 0.6
  + **Schedule Performance Index (SPI)** = EV / PV = $24,000 / $20,000 = 1.2

**Interpretation**: Since Cost Performance Index (CPI) is less than one, this means the project is over budget. For every dollar spent we are getting 60 cents' worth of performance. Since Schedule Performance Index (SPI) is more than one, the project is ahead of schedule. However, this has come at a cost of going over budget. If work is continued at this rate, the project will be delivered ahead of schedule and over budget. Therefore, corrective action should be taken.

Apart from computing the Cost Performance Index (CPI) and Schedule Performance Index (SPI), you can calculate the earned value [cost and schedule variance](https://www.brighthubpm.com/monitoring-projects/57942-examples-of-cost-variance-cv-and-schedule-variance-sv-in-a-project/). In addition, you can use [earned value forecasting formula](https://www.brighthubpm.com/monitoring-projects/57945-examples-of-using-earned-value-analysis-for-calculating-project-performance/).

**Sample PMP Earned Value Questions**

Given a project with the following characteristics, answer the following questions:

* You are the project manager of a project to build fancy birdhouses.
* You are to build two birdhouses a month for 12 months.
* Each birdhouse is planned to cost $100.
* Your project is scheduled to last for 12 months.
* It is the beginning of month 10.
* You have built 20 birdhouses and your CPI is .9091.

1. How is the project performing?

A. Over budget and ahead of schedule  
B. Under budget and ahead of schedule  
C. Over budget and behind schedule  
D. Under budget and behind schedule.

2. What is the actual cost of the project right now?

A. $1800  
B. $2000  
C. $2200  
D. $2400

3. Assuming that the COST variance experienced so far in the project will continue, how much more money will it take to complete the project?

A. $400  
B. $440  
C. $2800  
D. $2840

4. If the variance experienced so far were to stop, what is the project’s estimate at completion?

A. $2400  
B. $2440  
C. $2600  
D. $2800

5. What is the project’s TCPI using the project’s budget at completion?

A. .5  
B. 1  
C. 1.5  
D. 2

6. Senior management wants to the percentage of the project that is complete. What should you report?

A. 75%  
B. 83%  
C. 92%  
D. 95%

7. Imagine if instead of 10 months and costing $2200, the project was in month three and costing $4000. What formula might you use for BAC?

A. [(BAC – EV) / (CPI \* SPI)] + AC  
B. new bottom-up estimate  
C. AC + new ETC  
D. AC + BAC – EV

**Answers:**

1. **A – Over budget & ahead of schedule.** The problem tells you that your CPI is .9091, and we know that CPI = EV/AC. Applying that, a CPI less than 1 means that we aren’t getting enough value for each dollar that we put into our project, so it is over budget. However, the project is ahead of schedule because we have built 20 birdhouses and after 9 months, we had expected to build only 2 birdhouses per month \* 9 months = 18 birdhouses.

2. **C – $2200.** If you weren’t quite sure whether the project was over budget in the last question, you can use this problem to strengthen your knowledge. In this problem, we need to determine the AC. In the body of the problem, you are given the CPI and can determine the EV, so you can use the CPI formula to back out the AC. EV = 20 birdhouse & $100 per birdhouse = $2000.

* CPI = EV/AC
* .9091 = 2000/AC, so multiply both sides by AC
* AC(.9091) = 2000, so divide both side by .9091
* AC = 2200

3. **B – $440.** First, use the context of the problem to determine that you need the ETC when a variance exists and it is continuing. Based on that information, we know to use ETC = BAC/CPI – AC. We already know the CPI from the problem and AC from the solution to #2, so let’s find BAC.

* BAC = 2 birdhouses per month \* 12 months \* $100 per birdhouse
* BAC = $2400
* ETC = BAC/CPI – AC
* ETC = 2400/.9091 – 2200
* ETC = 440

4. **C – $2600.** A few of the EMV questions you encounter on the PMP exam will be fairly straightforward. This question is asking you for the EAC if a variance that was encountered on a project is expected to stop, so use EAC = AC + BAC – EV.

* EAC = 2200 + 2400 – 2000
* EAC = $2600

I should take a moment to point out that this problem wouldn’t be so straightforward if it were standing on its own. Based on our answers to the previous three questions, we already knew AC, BAC, and EV. The real PMP doesn’t have answers that build upon each other, so your steps to solving this problem on its on would be less straightforward. Instead you would first determine which equation to use, then calculate AC using the CPI (as in question #2), then BAC as in question #3, then EV as in question #2.

5. **D – 2.** Fortunately, PMI has to tell you which TCPI formula to use. This one says use BAC, so TCPI = (BAC – EV)/(BAC – AC) = (2400 – 2000) / (2400 – 2200) = 400/200 = 2.

6. **B – 83%.** If you have the percent complete formula in front of you, then this problem is really easy. Just plug EV & BAC into (EV/BAC)\*100%, and you’re all set. If you got this problem wrong, then [review this article on EV, PV, and AC](https://magoosh.com/pmp/pmp-topics-ev-pv-ac/).

7. **C – AC + new ETC.** It may be tempting to pick A, but remember that the EAC formula is for when a project is past due. If you find that your estimates are wildly wrong at the beginning of a project, it is best to develop a bottom-up estimate to complete and then add that to your actual costs.