Topic: Systems of equations with subscripts

Question: Use any method to find the unique solution to the system of equations.

$$R_M T_M = 200$$

$$R_P = 5R_M$$

$$R_P T_P = 500$$

$$T_P = 3 - T_M$$

Answer choices:

A $(R_M, T_M) = (100,2)$ $(R_P, T_P) = (500,1)$

B $(R_M, T_M) = (500,3)$ $(R_P, T_P) = (100,1)$

C $(R_M, T_M) = (200,1)$ $(R_P, T_P) = (500,2)$

D $(R_M, T_M) = (200,1)$ $(R_P, T_P) = (100,0)$

Solution: A

Since the second equation ($R_P = 5R_M$) is already solved for R_P, and the fourth equation ($T_P = 3 - T_M$) is already solved for T_P, we can substitute the expressions $5R_M$ and $3 - T_M$ for R_P and T_P, respectively, in the third equation.

$$R_P T_P = 500$$

$$(5R_M)(3 - T_M) = 500$$

$$5R_M(3) - 5R_M(T_M) = 500$$

$$15R_M - 5R_M T_M = 500$$

$$3R_M - R_M T_M = 100$$

$$-R_M T_M = 100 - 3R_M$$

$$R_M T_M = 3R_M - 100$$

The first equation ($R_M T_M = 200$) gives the value of $R_M T_M$ (200). If we substitute 200 for $R_M T_M$ in the equation we just found ($R_M T_M = 3R_M - 100$), we have

$$3R_M - 100 = 200$$

$$3R_M = 300$$

$$R_M = 100$$

Now that we have the value of R_M, we can plug it into the original first and second equations to find the values of T_M and R_P, respectively.

$$R_M T_M = 200$$

$$(100)T_M = 200$$

$$T_M = 2$$

and

$$R_P = 5R_M$$

$$R_P = 5(100)$$

$$R_P = 500$$

Now we'll substitute 500 for R_P in the equation $R_P T_P = 500$ to find the value of T_P.

$$R_P T_P = 500$$

$$(500)T_P = 500$$

$$T_P = 1$$

Collecting all of our results, we get

$$(R_M, T_M) = (100,2)$$

$$(R_P, T_P) = (500,1)$$

Topic: Systems of equations with subscripts

Question: Solve this system for R_b.

$$3R_a - R_b = 15$$

$$2R_a + R_b = 5$$

Answer choices:

A 4

B 3

C -3

D -4

Solution: C

Simply add the two equations from the system

$$3R_a - R_b = 15$$

$$2R_a + R_b = 5$$

to eliminate R_b, and then solve for R_a.

$$3R_a - R_b + (2R_a + R_b) = 15 + (5)$$

$$3R_a - R_b + 2R_a + R_b = 15 + 5$$

$$5R_a - R_b + R_b = 15 + 5$$

$$5R_a = 15 + 5$$

$$5R_a = 20$$

$$R_a = 4$$

Plug $R_a = 4$ into either of the original equations and solve for R_b. Using the first equation:

$$3R_a - R_b = 15$$

$$3(4) - R_b = 15$$

$$12 - R_b = 15$$

$$-R_b = 3$$

$$R_b = -3$$

Topic: Systems of equations with subscripts

Question: Solve this system for C_p.

$$7C_p + 4C_v = 2$$

$$-14C_p - 12C_v = -20$$

Answer choices:

A -4

B -2

C 2

D 4

Solution: B

Multiply both sides of the first equation by 2.

$$7C_p + 4C_v = 2$$

$$2(7C_p + 4C_v) = 2(2)$$

$$2(7C_p) + 2(4C_v) = 2(2)$$

$$14C_p + 8C_v = 4$$

Add this to the second equation to eliminate C_p, and then solve for C_v.

$$14C_p + 8C_v + (-14C_p - 12C_v) = 4 + (-20)$$

$$14C_p + 8C_v - 14C_p - 12C_v = 4 - 20$$

$$8C_v - 12C_v = 4 - 20$$

$$-4C_v = -16$$

$$C_v = 4$$

Plug $C_v = 4$ into either of the original equations to solve for C_p. Using the first equation:

$$7C_p + 4C_v = 2$$

$$7C_p + 4(4) = 2$$

$$7C_p + 16 = 2$$

$$7C_p = -14$$

$$C_p = -2$$