**CHAPTER TWELVE**

**CHANGE OF SUBJECT**

**Introduction:**

To make a letter the subject of a given equation is to let it stand alone, on one side of the equal to symbol.

Q1. Given that c = 2πr,

1. make r the subject.
2. calculate r when c = 20 and π = 3.14 .

Soln.

c = 2πr

Divide through using 2π ⇒⇒⇒ r =

When c = 20 and π = 3.14

⇒ r =

= 3.2 ⇒ r = 3.2.

Q2. Given that M = RVL,

1. make V the subject.
2. Calculate V when M = 50, R = 20 and L = 10.

Soln.

1. M = RVL

Divide through using RL ⇒⇒⇒ V = .

1. When M = 50, R = 20 and L = 10 ⇒ V =

= .

Q3. You are given the formula 2R = mg.

1. Make R the subject.
2. Calculate R when V = 3, M = 5 and g = 2.

Soln.

1. 2R.

Divide through using 2⇒R =

1. If V = 3, m = 5 and g = 2

⇒ R = ⇒ R = 0.55 .

Q4. If 5

Soln.

5⇒

⇒ v = .

Q5. Given that a + b = 2R,

1. make a the subject.
2. calculate a, when b = 3 and R = 10.
3. make R the subject.
4. calculate R when a = 3 and b = 5.

Soln.

1. a + b = 2R ⇒ a = 2R – b
2. When b = 3 and R = 10 ⇒ a = 2R – b, ⇒ a = 2(10) – 3

= 20 – 3 = 17.

1. To make R the subject, a + b = 2R. Divide through using 2 ⇒

⇒ R =

When a = 3 and b = 5

⇒ R =

Q6. Given that 2V + 3R = 4b,

1. make V the subject.
2. calculate V when R = 3 and b = 1.

Soln.

1. 2V + 3R = 4b ⇒ 2V = 4b – 3R

Divide through using 2 ⇒

ii) When R = 3 and b = 1

⇒ V = .

Q7. You are given the formula 2V + 3R = 4b,

(i) make R the subject.

(ii) make b the subject.

Soln.

(i) 2V + 3R = 4b

⇒ 3R = 4b – 2V

Divide through using 3

⇒

(ii) 2V + 3R = 4b .

Divide through using 4

⇒

⇒ b =

Q8. Given that the three quantities V, u and t are connected by the formula V = 3u + a, calculate a when V = 10, t = 1 and u = 3.

N/B: Before you can calculate a, you must first make a the subject.

Soln.

V = 3u + a

Divide through using

⇒ a = .

When V = 10, t = 1 and u = 3

⇒ a =

= 1 .

N/B: If .

If .

Q9. If 2V = u – g

(i) make a the subject.

(ii) calculate a when V = 3, u = 30 and g = 1.

Soln.

(i) 2V = u – g

⇒ g

Divide through using g

⇒

(ii) When V = 3, u = 30 and g = 1

⇒ a =

⇒ a = ⇒

Q10. If 2R

Soln.

2R

Dividing through using 2R ⇒

⇒ V = .

When m = 50, g = 4 and R = 1

⇒ V =

⇒ V = 10.

Q11. The movement of a particle is such that its final velocity V, its initial velocity u, its acceleration a and its time t, are connected by the formula V = 3u + a

Soln.

V = 3u + a

Divide through using a ⇒,

⇒

But V = 115, u = 5 and a = 4

⇒ t =

= 5 ⇒ t = 5seconds.

N/B: If the letter we are required to make the subject appears twice, then we must factorize it by bringing it outside the bracket.

Q12. The variables b and v are connected by the formula 5b - = vb + 2. Make b the subject.

Soln.

5b –

⇒ b = .

Q13. Given that a

Soln.

a

⇒ a

⇒

⇒,

Divide through using a – 2.

⇒

⇒

N/B: (1) If

(2) If

(3) If

(4) If

Q14. Given that 5

(i) make b the subject

(ii) calculate b when v = 10.

Soln.

5

⇒

⇒ b =

= .

Q15. Given that 2

Soln.

2,

If T = 30 ⇒ b =

= 2.6 approx.

Q16. If

Soln.

⇒⇒⇒ b =3

**Change of subject which involves cross multiplication:**

There may arise certain questions whose solutions may require cross multiplication.

Q1. Given that

(i) make V the subject.

(ii) calculate v when T = -2 and b = 8.

Soln. (i) .

We now cross multiply .

Divide through using 2

.

(ii) If T = -2 and b = 8

⇒ V = - 8 .

Q2. Given that

(i) make T the subject .

(ii) find T when M = 9.

Soln.

(i) make V the subject.

(ii) calculate V when T = 2 and x = 3.

Soln.

(i) 5x = ,

(ii) If T = 2 and x = 3

N/B: When cross multiplying, and there is a minus or a plus sign between a letter and a number, or between two letters, they must be placed inside a bracket.

Q4. Given that T – 1 =

Soln.

T – 1 =.

Cross multiply,

When V = 8 and a = 4

T =

Q5. Given that

make a the subject.

Soln.

⇒ T(a+b) = 2b ⇒ Ta + Tb = 2bv ⇒ Ta = 2bv – Tb.

Divide through using T ⇒⇒ a =

**Change of subject involving fractions:**

N/B: When fractions are available, they must be removed by multiplying through the given formula with a number which can remove them.

Q1. Given that

1. s the subject. (b) V the subject

Soln.

⇒ 2

Divide through using a

.

(b)From at = 10V

Divide through using 10

Q2. Given that

Soln.

Multiply through using 6

Divide through using 3t

When b = 45 and t = 3

.

Q3. The base b, volume v and the radius r of a certain structure, are connected by the formula

= Calculate the volume when the base is 2cm and the radius is 10cm.

Soln.

.

Multiply through using 10

,

,

=> V = .

When b = 2 and r = 10

.

Q4. If .

Soln.

.

Multiply through using R

.

Make V the subject.

Soln.

.

Multiply through using 2R

,

.

Q6. Given that ,

(a) make b the subject.

(b) make V the subject.

Soln. a)

. b)

Multiply through using RV

=>

Divide through using Rb + R ⇒.

Q7. You are given the formula Calculate b when R = 10 and V = 2.

Soln.

Multiply through using

Divide through using

.

If R = 10 and V = 2

=

= .

Q8. Given the formula

Soln.

.

Multiply through using kQ

⇒ C= .

Q9. The variables b, k, w and t are connected by the formula

Soln.

.

Multiply through using kw

⇒ W

,

.

= 0.7

Q10. The quantities a, b and c are such that

Make k the subject.

Soln.

.

Multiply through using abc

.

Divide through using ac

.

Q11. Given that calculate a, when b = 5, k = 2 and v = 100.

Soln.

Multiply through using abv

,

= a.

When b = 5, k = 2 and v = 100

=

.

N/B:(a) (a + b) (c + d) =

= ac + ad + bc + bd

(a + b) (c - d) = a

= ac – ad + bc – bd

(a - b) (c + d) = a

= ac + ad – bc – bd

(a - b) (c - d) = a = ac – ad – bc + bd

Negative Negative = Positive

i.e

(f) Positive egative = Negative

i.e

Q12. Given that u = 1 +

Make t the subject.

Soln.

u = 1 + ,

Cross multiply

⇒ t(

,

N/B:

.

Q13. Given that

Soln.

Divide through using m+n

,

y =

Q14. Given that A = P

Soln.

A = P

,

∴ A = P + which can also be written as ,

,

.

**Change of subject involving the square root sign:**

N/B: (i) (This implies that in other to remove the square root sign, the number, (appropriately referred to as the surd) must be raised to the second power.

Ii) If the letter we want to make the subject of a given equation falls under a root sign, the root sign must be removed first.

Q1. If ,

1. make b the subject.
2. calculate b when w = 6.

N/B: Since the b falls under or is found under the root sign, we must first remove the sign.

Soln.

.

Squaring both sides

.

ii)If w = 6

∴ b = 18 .

Q2. Given that

1. make b the subject.
2. make Q the subject.

Soln. (a)

Square both sides

.

.

Divide through using 2

N/B: In the second case, the Q which we want to make the subject does not fall under the root sign. For this reason, the root sign was not removed.

Q3. Given that

1. b the subject.
2. T the subject.

Soln. a)

Divide through using 5

.b)

Square both sides .

Q4. Given that 2 calculate b when T = 20 and v = 1.

Soln.

2.

Square both sides

2

,

When T = 20 and v =1

Q4. If g = 6.28 and T = 8

Soln

Square both sides

,

= ,

⇒ l =

If g = 6.28, T = 8 and π = 3.14

Q5. You are given the formula 2π

Soln.

2π

Square both sides

(2π

= ,

, .

Q6. If

Soln.

.

Square both sides

(

2b

.

If b = 2, T = 5 and π = 3.14

=

N/B:

Given that (a + b) = 2v, make b the subject. . Soln.

(a + b

Square both sides

(

Q2. If (

Soln.

.

(

,

∴.

= If b = 2 and v = 1

,

T =

N/B: (

(

These given examples indicate that in order to get rid or remove the cube root sign, we only raise the number (the surd) to the third power.

Q3. Given that

Soln.

= 2V.

Raise both sides to the third power .

,

,

When b =2 and V = 3

= 107 .

Q4. If

1. make l the subject.
2. make π the subject.

N/B: The pie (π) is not found under the cube root sign.

Soln. a) .

(

3π

Divide both sides by 3

Q5. Given that 2π, calculate *l* when g = 1 and = 3.14.

Soln.

2π.

Raise both sides to the third power (2π

(,

=,

∴

When π = 3.14 and g = 1,

N/B:

Given that = ab2, make T the subject.

Soln.

Raise both sides to the third power

.

N/B:

(x

Q7. If (2a – b

Soln.

(2a – b

Raise both sides to the third power

,

N/B: - In order to remove the fourth root sign, raise the number (surd) to the fourth power.(

Soln.

.

Raise both sides to the power four.

,

.

When T = 2 and b = 1

Q9. The relationship between three variables v, r and l is shown in the formula (

Determine the value of v when l = 2 and r = 1.

Soln.

(

Raise both sides to the power four

.

When l = 2 and r = 1

N/B: (

This implies that in order to remove the fifth root sign, the number (surd) must be raised to the fifth power.

Q10. Given that

Soln.

.

Raise both sides to the fifth power

,

Q11. If (

Make π the subject.

Soln.

(

Raise both sides to the fifth power

=> ,

Q12. If 2π (, make l the subject.

Soln.

Square both sides

,

,

Q13. Given that π(

Soln.

π(

.

Raise both sides to the third power

,

If π = 3.14 and a = 2

.

Q14. If 2(

Soln.

2(

.

Raise both sides to the fourth power

∴ 8b + 8 =

N/B: If a number is squared or raised the power 2 and we want to remove the power or the exponent, we just find square root of the given number.

Examples:

(

Q1. If (2b + v

Soln.

(2b + v.

Find the square root of both sides

If T = 25 and b = 2

Q2. Given that (

Soln.

(.

Find the square root of both sides

N/B: If a number is raised to the third power and we want to remove the power, we must find the cube root of the number.

Examples:

(3)

Q3. If (2b + 1

1. b the subject.

11) v the subject.

Soln.

(2b + 1

Find the cube root of both sides

.

(11) (2b + 1

Divide through using 3

Q4. Given the formula (

Soln.

(.

Find the cube root of both sides

,

If v = 1 and T = 8

Questions:

Q1. Given that 3

Ans: 0.2 .

Q2. If 3ab + v = 3w, a) make a the subject.

Ans: a =

b) find a when w = 10, v = 15 and b = 1.

Ans: a = 5 .

Q3. The variables v, u, s and b are connected by the formula Make u the subject..

Ans: u =

Calculate u when v = 10, b = 20 and s = 15.

Ans: 4

Q4. Given the formula 2a,

a) make t the subject.

Ans: t =

b) calculate t when u = 10, v = 5 and a = 1.

Ans: 26.5 .

Q5. Given the formula

Ans: 6

Q6. A certain equation is such that Make v the subject. Ans: v =

Q7. If

Ans: a =

(ii) calculate a when v = 40 and t = 2.

Ans: a = 30 .

Q8. Given the formula

make a the subject.

Ans: a = .

Q9. In a certain formula,

a) Make Q the subject.

Ans: Q =

b) Find Q when k = 2 and v = 1

Ans: Q = 2 .

Ans: v =

Q11. Given that

Ans: Q = 33

Q12. If

Ans: v =

Q13. Given that 2π

a) make g the subject.

Ans: g =

b) calculate g when π= 3.14. l = 10 and T = 5 .

Ans: g = 79 .

Q14. Given that 2

Ans: T =

Q15. If (

Ans: T =

Q16. If T (

Ans: g =

Q17. Given the formula

Ans: 80 .

Q18. Given the formula 2π(

Ans: g = .