The volume for a cylinder is given by the formula  $V = \pi r^2 h$  where r is the radius, and h is the height. Find the following to three significant figures.

- a) the volume of a cylindrical tin can of radius  $10\ \mathrm{cm}$  and height  $15\ \mathrm{cm}$
- b) the height of a cylinder of radius 4 cm if its volume is  $60~{\rm cm}^3$
- c) the radius, in cm, of cable with volume  $50\ \mathrm{cm^3}$  and length  $45\ \mathrm{cm}$ .

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### Solution

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### Solution

a)  $4710 \text{ cm}^3$ 

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### Solution

a)  $4710 \text{ cm}^3$ 

b) 1.19 cm

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### Solution

a)  $4710 \text{ cm}^3$ 

b) 1.19 cm

c)0.595 cm

# Rearranging Formulae

Standard

MS-A1 Formulae and Equations updated: 2021-01-21

### **Learning Outcome**

Topic:

Rearranging Formulae

Syllabus: · change the subject of a formula

Activities/Tasks:

· Cambridge Ex 3E Q1-21

By performing operations to both sides of a formula, they can be **rearranged** to make **equivalent** formulae where other variables are the subjects.

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$$V=\pi r^2 h$$

By performing operations to both sides of a formula, they can be **rearranged** to make **equivalent** formulae where other variables are the subjects.

$$V = \pi r^2 h$$
$$V \div \pi r^2 = \pi r^2 h \div \pi r^2$$

By performing operations to both sides of a formula, they can be **rearranged** to make **equivalent** formulae where other variables are the subjects.

$$V = \pi r^{2} h$$

$$V \div \pi r^{2} = \pi r^{2} h \div \pi r^{2}$$

$$\frac{V}{\pi r^{2}} = h$$

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$$h = \frac{V}{\pi r^{2}}$$

$$V = \pi r^{2} h$$

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$$V = \pi r^{2} h$$

$$V \div \pi h = \pi r^{2} h \div \pi h$$

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$$r^{2} = \frac{V}{\pi h}$$

$$\sqrt{r^{2}} = \sqrt{\frac{V}{\pi h}}$$

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$$V = \pi r^{2} h$$

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$$\frac{V}{\pi h} = r^{2}$$

$$r^{2} = \frac{V}{\pi h}$$

$$\sqrt{r^{2}} = \sqrt{\frac{V}{\pi h}}$$

$$r = \sqrt{\frac{V}{\pi h}} \qquad (r > 0)$$

Make a the subject of 2a - 7b = 23.

# 

# Example 1 Make a the subject of 2a-7b=23. Solution 2a-7b=23 2a-7b+7b=23+7b

# Example 1 Make a the subject of 2a - 7b = 23. Solution

$$2a - 7b = 23$$

$$2a - 7b + 7b = 23 + 7b$$

$$2a = 23 - 7b$$

Example 1 Make 
$$a$$
 the subject

Make a the subject of 2a - 7b = 23.

$$2a - 7b = 23$$

$$2a - 7b + 7b = 23 + 7b$$
  
 $2a = 23 - 7b$ 

$$2a = 23 - 7b$$

$$2a = 23 - 7b$$

$$2a = 23 - 7b$$
$$\frac{2a}{2} = \frac{23 - 7b}{2}$$

$$7b \ 7b$$

Example 1 Make 
$$a$$
 the subject of  $2a - 7b = 23$ .

$$2a - 7b = 23$$
 $2a - 7b + 7b = 23 + 7b$ 

$$2a = 23 - 7b$$

$$\frac{2a}{2} = \frac{23 - 7b}{2}$$

### Rearranging then substituting

Previously, during formula substitution, the variables were replaced by numbers and then the equation was solved. However, often we need to substitute several values for the unknowns and solve the equation for each case. In this situation it is quicker to rearrange the formula before substituting.

The surface area of a sphere is given by  $A=4\pi r^2$  where r is the sphere's radius.

- a) Rearrange this formula to make r the subject.
- b) Hence find the radius to 3 significant figures when the surface area is:
  - i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup> iii) 30 cm<sup>2</sup>

The surface area of a sphere is given by 
$$\ A=4\pi r^2$$
 where  $r$  is the sphere's radius. a) Rearrange this formula to make  $r$  the subject.

iii) 30 cm<sup>2</sup>

b) Hence find the radius to 3 significant figures when the surface area is:

Example 2

The surface area of a sphere is given by 
$$A=4\pi r^2$$
 where  $r$  is the sphere's radius.

a) Rearrange this formula to make r the subject.

$$A = A$$

a) 
$$A=47$$

Example 2

$$A = 4\pi r^2$$













The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

iii) 30 cm<sup>2</sup>

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Solution

a) 
$$A = 4$$

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$$A = 4$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

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Solution

a) 
$$A = 4$$

a) 
$$A =$$

$$1 = 4\pi r^2$$

$$A = 4\pi r^2$$

$$A = 4\pi r^2$$

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The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is: i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup>

# Solution

a) 
$$A =$$

$$A \div 4\pi = 4\pi r$$

$$\frac{4\pi}{4} = 4\pi r^2$$

$$rac{\pi}{4\pi} = 4\pi r^2$$

$$\div 4\pi$$

$$4\pi$$





The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is:
- i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup> iii) 30 cm<sup>2</sup>

Solution  
a) 
$$A = 4\pi r^2$$
 bi)  $r = \sqrt{\frac{A}{4\pi}}$   
 $A \div 4\pi = 4\pi r^2 \div 4\pi$   
 $\frac{A}{4\pi} = r^2$   
 $\sqrt{\frac{A}{4\pi}} = \sqrt{r^2}$   
 $r = \sqrt{\frac{A}{4\pi}}$   $(r > 0)$ 



$$1 \div 4\pi = 4\pi r^2 \div$$

$$A \div 4\pi = 4\pi r^2 \div 4$$

$$A = r^2$$

$$\frac{A}{4\pi} = r^2$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is:
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# Solution

$$A = 4\pi r^2$$

$$A = 4\pi r^2$$
 $\pi = 4\pi r^2 \div 4\pi$ 

$$4\pi = 4\pi r^2 \div 4\tau$$

$$\div 4\pi$$

$$r = \sqrt{\frac{10}{4\pi}}$$

Solution a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$   $A\div 4\pi=4\pi r^2\div 4\pi$   $r=\sqrt{\frac{10}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$ 

$$=\sqrt{rac{A}{4\pi}}$$

$$\frac{\overline{A}}{4\pi}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is:
- i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup>

# Solution

$$A = 4\pi r^2$$

$$= 4\pi r^2$$
$$= 4\pi r^2 \div 4r^2$$

a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$   $A\div 4\pi=4\pi r^2\div 4\pi$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{10}{4\pi}}$   $r=0.892~\mathrm{cm}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$ 

$$= 4\pi r^2 \div 4r$$
$$= r^2$$

$$r = \sqrt{\frac{10}{4\pi}}$$

$$r =$$

$$=\sqrt{\frac{10}{4\pi}}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is:
- i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup>

# Solution

ion 
$$1 - 4\pi r^2$$

$$4\pi$$

Solution
a) 
$$A = 4\pi r^2$$
 bi)  $r = \sqrt{\frac{A}{4\pi}}$ 

$$A \div 4\pi = 4\pi r^2 \div 4\pi$$

$$\frac{A}{4\pi} = r^2$$
  $r = \sqrt{\frac{10}{4\pi}}$ 

$$\sqrt{\frac{A}{4\pi}} = \sqrt{r^2}$$

$$r = \sqrt{\frac{A}{4\pi}}$$
  $r = 0.892 \text{ cm}$ 

$$\div 4\pi$$

$$4\pi$$

$$\frac{1}{4\pi}$$
 $\sqrt{\frac{10}{10}}$ 

$$\sqrt{4\pi}$$

bii) 
$$r=\sqrt{rac{A}{4\pi}}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

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# Solution

a) 
$$A=4\pi r^2$$

Solution a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$  bii)  $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{10}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$ 

$$\frac{4\pi}{4\pi} = 4\pi r^2 \div 4\pi$$

$$\div 4\pi$$

$$r=\sqrt{}$$

$$r = \sqrt{}$$

$$\sqrt{\frac{10}{4\pi}}$$

$$r = \frac{1}{2}$$

$$\sqrt{\frac{A}{4\pi}}$$

$$\frac{A}{4\pi}$$

$$\frac{\overline{A}}{1\pi}$$

$$\overline{A}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

b) Hence find the radius to 3 significant figures when the surface area is:

a) 
$$A =$$

Solution a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$  bii)  $r=\sqrt{\frac{A}{4\pi}}$  bii)  $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=0.892~\mathrm{cm}$   $r=1.26~\mathrm{cm}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{$ 

$$\sqrt{rac{4\pi}{10}}$$

DII) 
$$T =$$

r = 1.26 cm

$$=\sqrt{\frac{A}{4\pi}}$$

$$\frac{\overline{A}}{\pi}$$

$$\frac{1}{\pi}$$

$$\frac{1}{\pi}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is:

# Solution

i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup> iii) 30 cm<sup>2</sup>

Solutio 
$$a$$
)  $A =$ 

$$4 = 4\pi r^2$$

Solution a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$  bii)  $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{20}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A}{$ 

$$r = \sqrt{\frac{1}{2}}$$

$$\sqrt{\frac{A}{4\pi}}$$

bii) 
$$r = \sqrt{\frac{A}{4\pi}}$$
 
$$r = \sqrt{\frac{20}{4\pi}}$$

r = 1.26 cm

biii) 
$$r = \sqrt{\frac{A}{4\pi}}$$

$$\sqrt{rac{A}{4\pi}}$$

$$\sqrt{4\pi}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

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- i) 10 cm<sup>2</sup> ii) 20 cm<sup>2</sup> iii) 30 cm<sup>2</sup>

# Solution

a) 
$$A = 4\pi r^2$$
$$A \div 4\pi = 4\pi r^2 \div$$

Solution a) 
$$A=4\pi r^2$$
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$$A \div 4\pi = 4\pi r^2 \div 4\pi$$

$$A = 2 \qquad r = 2$$

$$r = \sqrt{\frac{10}{4\pi}}$$
  $r = \sqrt{\frac{10}{4\pi}}$ 

$$A \div 4\pi = 4\pi r^2 \div 4\pi$$
$$\frac{A}{4\pi} = r^2$$

$$r = \sqrt{\frac{10}{4\pi}}$$

$$r = \sqrt{\phantom{a}}$$

$$\sqrt{\frac{A}{4\pi}}$$

$$\sqrt{rac{A}{4\pi}}$$

biii) 
$$\it r$$

$$-\sqrt{\frac{A}{A}}$$

$$\sqrt{rac{A}{4\pi}}$$

The surface area of a sphere is given by  $A = 4\pi r^2$  where r is the sphere's radius. a) Rearrange this formula to make r the subject.

- b) Hence find the radius to 3 significant figures when the surface area is: i) 10 cm<sup>2</sup>

# Solution

ii) 20 cm<sup>2</sup>

Solution a) 
$$A=4\pi r^2$$
 bi)  $r=\sqrt{\frac{A}{4\pi}}$  bii)  $r=\sqrt{\frac{A}{4\pi}}$  biii)  $r=\sqrt{\frac{A}{4\pi}}$  biii)  $r=\sqrt{\frac{A}{4\pi}}$  biii)  $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{30}{4\pi}}$   $r=\sqrt{\frac{30}{4\pi}}$   $r=\sqrt{\frac{30}{4\pi}}$   $r=\sqrt{\frac{A}{4\pi}}$   $r=\sqrt{\frac{A$ 

$$\div 4\pi$$

bii) 
$$r$$

$$=\sqrt{\frac{1}{2}}$$

$$\sqrt{rac{20}{4\pi}}$$

iii) 30 cm<sup>2</sup>

$$\dot{} = \sqrt{}$$

r = 1.55 cm

$$=\sqrt{\frac{A}{4\pi}}$$

$$\frac{4}{\pi}$$

## Today's work

· Cambridge Ex 3E Q1-21