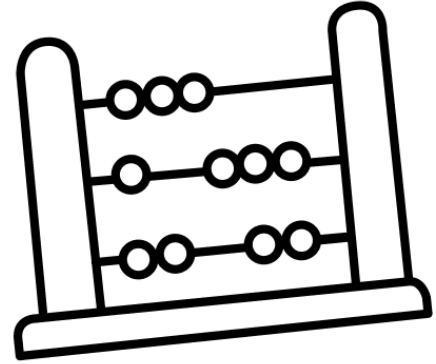


## Astaamaha isku xigxiga joomatari (geometric sequences)



## Maths

Cutub: Xiriirro aan toos ahayn (Non-linear relationships)

## Natiijo

Waxaan qiimeyn karaa astaamaha isku xigxiga joomatari (geometric sequence).

## Erayada muhiimka ah

Isku xigxiga joomatari (geometric sequence) waa isku xigxig leh xiriir isku dhufasho joogto ah oo u dhexeeya xubnaha isku xigxiga.

Saami guud (common ratio) waa astaan muhiim u ah isku xigxiga joomatari (geometric sequence). Isku dhufashada joogtada ah ee u dhexeysa xubnaha isku xigxiga waxaa loo yaqaan saamiga guud (common ratio).

## Qaabka casharka

Astaamaha isku xigxiga joomatari (geometric sequences)



Aqoonsiga isku xigxiga joomatari (geometric sequences)

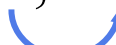


Abuurista isku xigxiga joomatari (geometric sequences)

# Aqoonsiga isku xigxiga joomatari (geometric sequences)

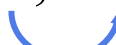
Ma garan kartaa qaababka oo ma heli kartaa saddexda xubnood ee xiga ee isku xigxigan?

7, 12, 17, 22, 27, , , , ...

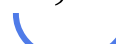
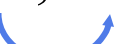
+5 +5 +5 +5 +5 +5 +5

7, 17, 27, 37, 47, , , , ...

+10 +10 +10 +10 +10 +10 +10

28, 19, 10, 1, -8, , , , ...

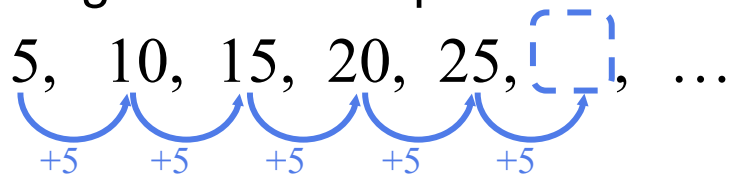
      

-9 -9 -9 -9 -9 -9 -9

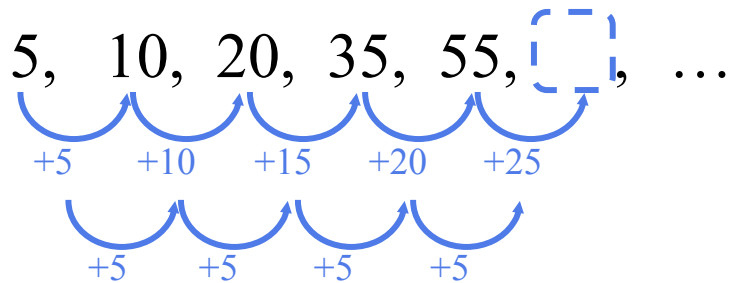
Kala duwanaanshaha isku darka (additive) ee guud ee u dhexeeya xubnaha ayaa ka dhigaya kuwan isku xigxig xisaabeed (arithmetic) (toosan (linear)).

# Aqoonsiga isku xigxiga joomatari (geometric sequences)

Ma garan kartaa qaababka oo ma heli kartaa xubnaha xiga?

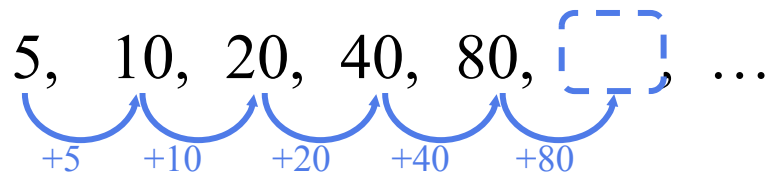


Kala duwanaanshaha isku darka (additive) ee guud - Isku xigxig xisaabeed (arithmetic) (toosan (linear)).



Ma jiro kala duwanaansho isku darka (additive) oo guud.

Kala duwanaansho 2aad oo guud - Kani waa nooc gaar ah oo isku xigxig aan toos ahayn (non-linear sequence).



Ma jiro kala duwanaansho isku darka (additive) oo guud, laakiin waxaa jira qaab.

# Aqoonsiga isku xigxiga joomatari (geometric sequences)

Isku xigxigga dambe waa nooc gaar ah oo isku xigxig.

5, 10, 20, 40, 80, 160, ...

+5 +10 +20 +40 +80

+5 +10 +20 +40 +80

+5 +10 +20 +40 +80

Tan waxay caddaynaysaa in kani yahay nooc aad u gaar ah oo isku xigxig.

5, 10, 20, 40, 80, 160, ...

+5 +10 +20 +40 +80

Ma raadin karnaa kala duwanaansho 2aad oo guud?...

Taxanahan ugu dambeeya waa nooc gaar ah oo taxane (sequence) ah.

Kan ayaan jeclahay. Waxaan u arkaa taxane "isku-dar nafteeda" (Add itself).



$$\begin{aligned}5 + 5 \\10 + 10 \\20 + 20 \\40 + 40 \\80 + 80\end{aligned}$$

Waxaan u malaynayaa inaan arko hab ka hufan oo aan ahayn mid isku-darka (additive) ah.



5, 10, 20, 40, 80, 160, ...

+5 +10 +20 +40 +80

Taxanahan ugu dambeeya waa nooc gaar ah oo taxane (sequence) ah.

$$5 + 5 = 5 \times 2$$

$$10 + 10 = 10 \times 2$$

$$20 + 20 = 20 \times 2$$

$$40 + 40 = 40 \times 2$$

$$80 + 80 = 80 \times 2$$

Dhab ahaantii waa taxane  
isku-dhufasho  
(multiplicative sequence)!



Cali

5, 10, 20, 40, 80, 160, ...



Isra

Taxanahan ugu dambeeya waa nooc gaar ah oo taxane (sequence) ah.

Taasi aad bay u hufan tahay  
Isra. Si fiican ayaad u aragtay!



Cali

5, 10, 20, 40, 80, 160, ...

$\times 2$   $\times 2$   $\times 2$   $\times 2$   $\times 2$

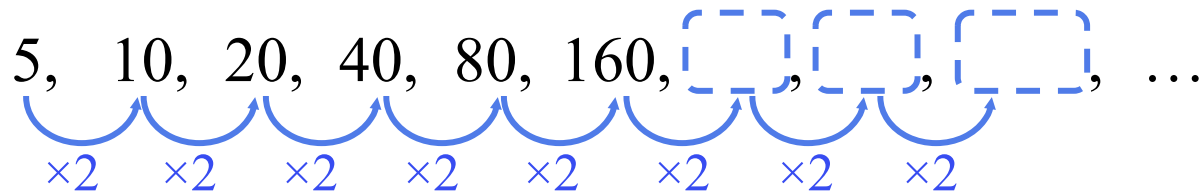
$$\begin{aligned}5 + 5 &= 5 \times 2 \\10 + 10 &= 10 \times 2 \\20 + 20 &= 20 \times 2 \\40 + 40 &= 40 \times 2 \\80 + 80 &= 80 \times 2\end{aligned}$$

Dhab ahaantii waa taxane  
isku-dhufasho  
(multiplicative sequence)!



Isra

Isticmaal qaanuunka xilli-ilaa-xilli (term-to-term rule) ee Isra si aad u hesho saddexda xilli ee xiga.



Taxanaha leh xiriir isku-dhufasho (multiplicative) oo guud oo u dhexeeya xilliyada is-xiga waxaa loo yaqaan taxanaha joomatari (geometric sequences).

## Run mise been?

**Taxanaha joomatari (Geometric sequences) waxay leeyihiin farqi isku mid ah oo lagu daro (additive) oo u dhexeeya xubnaha isku xiga.**



Run



Been



## Sabab u sheeg jawaabtaada

**a**

Qaanuunka guud ee xilli-ilaa-xilli (term-to-term rule) ee taxanaha joomatari (geometric sequence) waa isku-dhufasho (multiplicative).

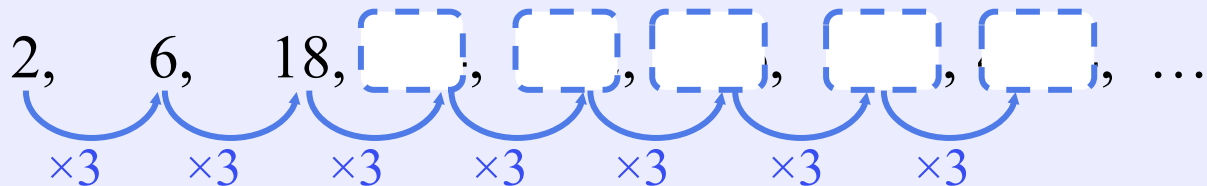


**b**

Qaanuunka guud ee xubnaha taxanaha joomatari (Geometric sequences) waa isku darka (additive).

## Aqoonsiga taxanaha joomatari (Geometric sequences)

Raadi shanta xubnood ee xiga ee taxanahan joomatari (Geometric sequences).

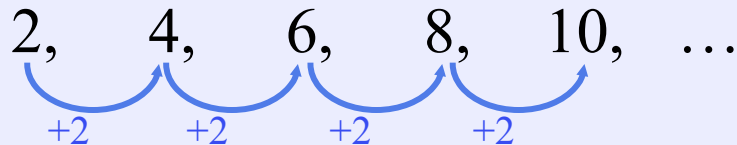


**Taxanaha joomatari (Geometric sequences) waxay leeyihiin xiriir isku dhufasho (multiplicative) oo u dhexeeya xubnaha isku xiga.**

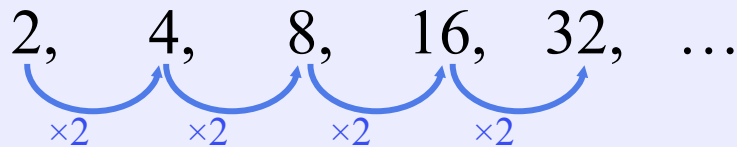
# Aqoonsiga taxanaha joomatari (Geometric sequences)



Waa maxay farqiga u dhexeeya dabeecadda labadan taxane?



Farqi isku mid ah oo lagu daro (additive) oo u dhexeeya xubnaha.  
Taxane toosan (arithmetic) (linear (arithmetic) sequence).



Xiriir isku dhufasho (multiplicative) oo u dhexeeya xubnaha isku xiga. Taxane joomatari (geometric sequence).

Cali iyo Isra waxay eegayaan taxanahan.

$$1, 2, 6, 24, 120, 720, \dots$$

$\times 2$   $\times 3$   $\times 4$   $\times 5$   $\times 6$

Taxanahan waa isku dhufasho (multiplicative) oo u dhexeeya xubnaha. Ma macnaheedu waa inuu yahay joomatari (geometric)?

Maya. Iska jir! Waa inay tahay isku dhufasho (multiplier) isku mid ah oo u dhexeeya xubnaha.



**Taxanaha joomatari (Geometric sequences) waxay leeyihiin xiriir isku dhufasho (multiplicative) oo u dhexeeya xubnaha isku xiga.**

**Taxanaha joomatari (Geometric sequences) waxay leeyihiin \_\_\_\_\_ xiriir isku dhufasho (multiplicative) oo u dhexeeya xubnaha isku xiga.**

**a**

**b**



**c**

1) Kala saar taxanahan (sequences) kuwa joomatari (geometric), xisaabeed (arithmetic) iyo 'kuwa kale'.

a) 1, 2, 3, 4, 5, ...

g) 4, 16, 30, 46, 64, ...

b) 1, 2, 4, 8, 16, ...

h) 10, 15, 20, 30, 40, ...

c) 1, 2, 5, 10, 17, ...

i) 10, 40, 70, 100, 130, ...

d) -1, -2, -4, -8, -16, ...

j) 10, 20, 60, 240, 1200, ...

e) 1, 4, 16, 64, ...

k) 10, 20, 40, 80, 160, ...

f) 4, 16, 28, 40, 52, ...

l) 10, 100, 1000, 10 000, ...

1) Kala saar taxanahan (sequences) kuwa joomatari (geometric), xisaabeed (arithmetic) iyo 'kuwa kale'.

### Taxanaha joomatari (Geometric sequences)

b) 1, 2, 4, 8, 16, ...  $\times 2$

d) -1, -2, -4, -8, -16, ...  $\times 2$

e) 1, 4, 16, 64, ...  $\times 4$

k) 10, 20, 40, 80, 160, ...  $\times 2$

l) 10, 100, 1000, 10 000, ...  $\times 10$

### Taxanaha xisaabeed (Arithmetic sequences)

a) 1, 2, 3, 4, 5, ...  $+1$

f) 4, 16, 28, 40, 52, ...  $+12$

i) 10, 40, 70, 100, 130, ...  $+30$

### Taxanaha kale (Other sequences)

c) 1, 2, 5, 10, 17, ...  
 $+1 \quad +3 \quad +5 \quad +7$

g) 4, 16, 30, 46, 64, ...  
 $+12 \quad +14 \quad +16 \quad +18$

h) 10, 15, 20, 30, 40, ...  
 $+5 \quad +5 \quad +10 \quad +10$

j) 10, 20, 60, 240, 1200, ...  
 $\times 2 \quad \times 3 \quad \times 4 \quad \times 5$

Astaamaha taxanaha joomatari (Features of geometric sequences)



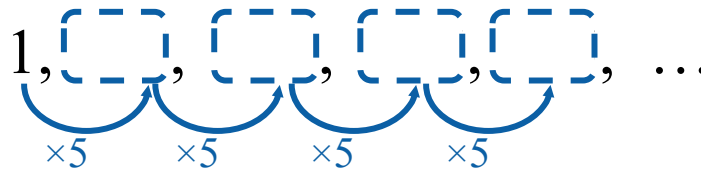
Aqoonsiga taxanaha joomatari (geometric sequences)



Abuurista taxanaha joomatari (Generating geometric sequences)

Cabdi iyo Layla waxay abuuraan taxanayaal joomatari (geometric sequences).

Waxaan bilaabayaa xubin koobaad (first term) oo ah 1 oo waxaan adeegsanayaa saami guud (common ratio) oo ah 5 ee u dhexeeya xubnaha (terms).



Waxaan u malaynayaa inaan abuuri karo isla taxanaha (sequence) anigoo ka bilaabaya 1 oo adeegsanaya saamiga (ratio) 1 : 5 ee u dhexeeya xubnaha (terms).



# Abuurista taxanaha joomatari (Generating geometric sequences)

Cabdi iyo Layla waxay abuuraan taxanayaal joomatari (geometric sequences).

$$\begin{array}{c} \times 5 \\ \text{1} : \text{5} \\ : \\ : \\ : \\ : \end{array}$$

$$\text{1, 5, 25, 125, 625, ...}$$

$\times 5$   $\times 5$   $\times 5$   $\times 5$

Waxaan u malaynayaa inaan abuuri karo isla taxanaha (sequence) anigoo ka bilaabaya 1 oo adeegsanaya saamiga (ratio) 1 : 5 ee u dhexeeya xubnaha (terms).

Waxaan u isticmaali karnaa saami (ratio) si aan u qeexno xidhiidhka isku dhufashada (multiplicative relationships) ee u dhexeeya xubnaha isku xiga (successive terms) ee taxanaha joomatari (geometric sequence).



# Abuurista taxanaha joomatari (Generating geometric sequences)

Cabdi iyo Layla waxay abuuraan taxanayaal joomatari (geometric sequences).

$$\begin{array}{l} \times 5 \\ \text{1 : 5} \\ \text{5 : 25} \\ \text{25 : 125} \\ \text{125 : 625} \end{array}$$

$$1, 5, 25, 125, 625, \dots$$

Diagram showing the sequence 1, 5, 25, 125, 625, ... with arrows indicating multiplication by 5 between consecutive terms.

Isticmaalka isku dhufashada guud ee 5, ama saamiga 1 : 5 ee u dhexeeya xubnaha waxay soo saartaa isku taxane joomatari (geometric sequence). Luuqadda aan u isticmaalno isku dhufashada guud waa in loogu yeedho saamiga guud (common ratio).



Cabdi iyo Layla waxay soo saarayaan taxanayaal joomatari (geometric sequences).

Aan hubiyo inaan tan fahmay Layla! Waxaan ka bilaabi karaa 7 oo aan isticmaali karaa saami 1 : 2 si aan u soo saaro taxane.

$$\begin{array}{ccc} & \times 2 & \\ & \text{↖} & \text{↗} \\ 1 & : & 2 \\ & : & \\ & : & \\ & : & \end{array}$$



Waa ku mahadsan tahay Cabdi! Taxanaha 7, 14, 28, 56, ...

Taxane joomatari (geometric sequence) oo leh saami guud (common ratio) ah 2



Cabdi iyo Layla waxay soo saarayaan taxanayaal joomatari (geometric sequences).

Ma yeelan kartid saami guud (common ratio) oo ah hase  
yeeshee Layla? Waa inuu ka weyn yahay hal, sax?

$$\frac{1}{2}$$



Waa ku mahadsan tahay Cabdi! Taxanaha 7, 14, 28, 56, ...

Taxane joomatari (geometric sequence) oo leh saami guud (common ratio) ah 2



Cabdi iyo Layla waxay soo saarayaan taxanayaal joomatari (geometric sequences).

Ma yeelan kartid saami guud (common ratio) oo ah  $\frac{1}{2}$  hase yeeshee Layla? Waa inuu ka weyn yahay hal, sax?

2 : 1

1 :  
:  
:  
:  
:



Waa suurtagal! Tusaale ahaan, ku bilow xubinta 1aad ee 128 oo isticmaal saami 2 : 1 oo u dhexeeya xubnaha.



# Soo saarista taxanayaasha joomatari (geometric sequences)

Cabdi iyo Layla waxay soo saarayaan taxanayaal joomatari (geometric sequences).

Waa fiican! Taxanaha 128, 64, 32, 16, 8, ... Marka isticmaalka saamiga 2 : 1, saami guud (common ratio) oo ah u dhexeeya xubnaha, wuxuu ka dhigayaa taxanaha inuu hoos u dhaco!



$$\begin{array}{ccccccc} 128, & 64, & 32, & 16, & 8, & \dots \\ \downarrow & \downarrow & \downarrow & \downarrow & & \\ \times \frac{1}{2} & \times \frac{1}{2} & \times \frac{1}{2} & \times \frac{1}{2} & & \end{array}$$

$$\begin{array}{c} \times \frac{1}{2} \\ \downarrow \\ 2 : 1 \\ 128 : 64 \\ 64 : 32 \\ 32 : 16 \\ 16 : 8 \end{array}$$



Waa suurtagal in la yeesho taxanayaal joomatari (geometric sequences) oo hoos u dhacaya.

# Soo saarista taxanayaasha joomatari (geometric sequences)

Soo saar shanta xubnood ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo leh xubinta 1aad 81 iyo saami 3 : 4 oo u dhexeeya xubnaha isku xigta.

3 : 4

:

:

:

:

81, 108, 144, 192, 256, ...

# Abuurista taxanaha joomatari (Generating geometric sequences)

Soo saar shanta erey ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo ereyga koowaad yahay 81 iyo saamiga 3 : 4 ee u dhexeeya ereyada isku xiga.

$$3 : 4$$

$$81 : 108$$

$$108 : 144$$

$$144 : 192$$

$$192 : 256$$

81, 108, 144, 192, 256, ...

Soo saar shanta erey ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo ereyga koowaad yahay 16 iyo saamiga 2 : 5 ee u dhexeeya ereyada isku xiga.

$$2 : 5$$

$$\square : \square$$

$$\square : \square$$

$$\square : \square$$

$$\square : \square$$

16, 40, 100, 250, 625, ...

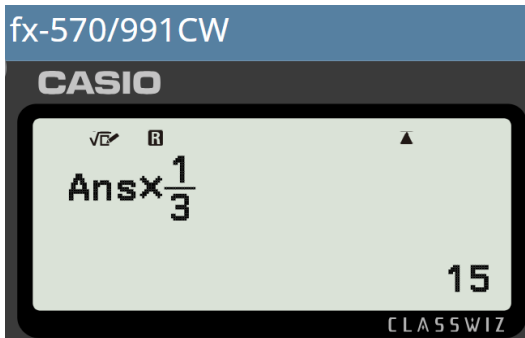
# Abuurista taxanaha joomatari (Generating geometric sequences)

Soo saar toddobada erey ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo ereyga koowaad yahay 405 iyo saamiga guud (common ratio) ee  $\frac{1}{3}$

$$405, 135, 45, 15, 5, \dots, \frac{5}{3}, \dots, \frac{5}{9}$$

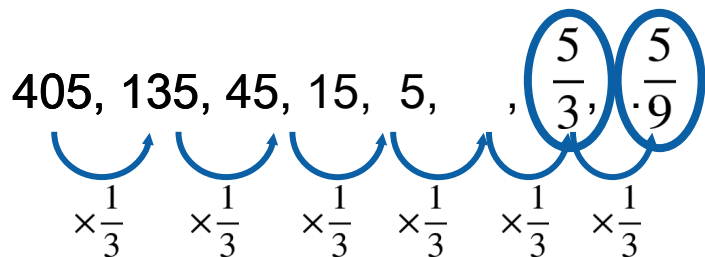
Diagram illustrating the generation of the geometric sequence by multiplying each term by the common ratio  $\frac{1}{3}$ :

$405 \times \frac{1}{3} = 135$   
 $135 \times \frac{1}{3} = 45$   
 $45 \times \frac{1}{3} = 15$   
 $15 \times \frac{1}{3} = 5$   
 $5 \times \frac{1}{3} = \frac{5}{3}$   
 $\frac{5}{3} \times \frac{1}{3} = \frac{5}{9}$



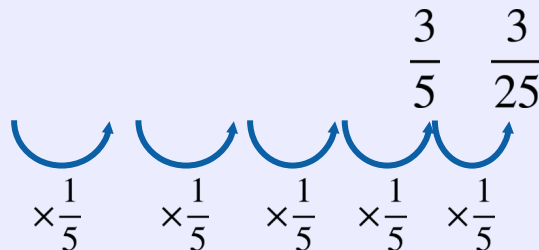
# Abuurista taxanaha joomatari (Generating geometric sequences)

Soo saar toddobada erey ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo ereyga koowaad yahay 405 iyo saamiga guud (common ratio) ee  $\frac{1}{3}$



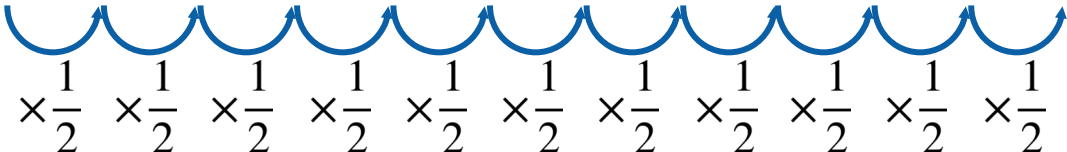
Ereyada aan ahayn tiro dhammaystiran (non-integer) waxaa inta badan si fiican oo sax ah loogu gudbiyaa jajab (fractions).

Soo saar lixda erey ee ugu horreeya ee taxanaha joomatari (geometric sequence) oo ereyga koowaad yahay 375 iyo saamiga guud (common ratio) ee  $\frac{3}{5}$



# Abuurista taxanaha joomatari (Generating geometric sequences)

Lucas iyo Laura waxay soo saarayaan taxano joomatari (geometric sequences).

$$128, 64, 32, 16, 8, 4, 2, 1, \quad , \quad \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$$


$\times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2} \quad \times \frac{1}{2}$

Waxaan sii waday taxanahan joomatari (geometric sequence) oo waxaan ogaaday wax aad u qurux badan!  
Inkastoo ay hoos u dhacayso, weligeed ma gaari doonto eber.



Does that mean we will never see negative terms in **geometric sequences**?

Maxaad u malaynaysaa?

# Abuurista taxanaha joomatari (Generating geometric sequences)

Lucas iyo Laura waxay soo saarayaan taxano joomatari (geometric sequences).

Maya. Waxaan arkay taxane leh saami guud (common ratio)  $\times 2$  iyo erey koowaad oo ah  $-1$   
It had all negative terms.

$-1, -2, -4, -8, -16, \dots$

Waa fiican! Aan tijaabino. Maxaa dhacaya haddii aan isku beddelno? Ka dhigi xubinta koowaad 2 iyo isku dhufashada  $-1$



2, , , , , ...  
 $\times -1 \quad \times -1 \quad \times -1 \quad \times -1 \quad \times -1$

Maxaad u malaynaysaa inay dhacdo?

Lucas iyo Laura waxay soo saarayaan taxanayaal joomatari (geometric sequences).

Waxay u dhexgashay togan iyo taban! Taasi waa qurux!

Waa fiicantahay! Aynu tijaabino (experiment). Maxaa dhacaya haddii aan isku bedelno? Ka dhigo xubinta koowaad 2 iyo tirada lagu dhufo (multiplier)  $-1$



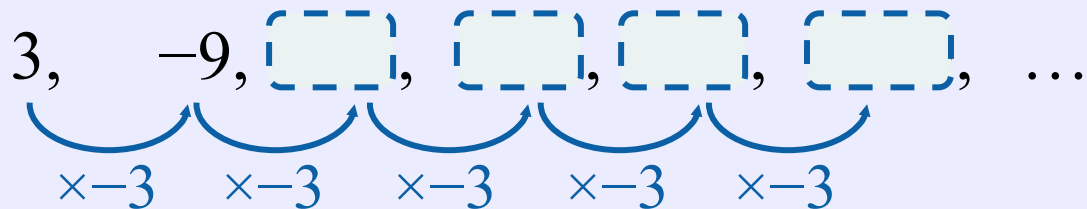
$$2, -2, 2, -2, 2, -2, \dots$$

$\times -1 \quad \times -1 \quad \times -1 \quad \times -1 \quad \times -1$

Maxaad u malaynaysaa inay dhacdo?

# Abuurista isku-xigxigyada joomatari (geometric sequences)

Raadi afarta xubnood ee xiga ee isku-xigxigan joomatari (geometric sequence).



Marka saamiga guud (common ratio) uu yahay taban, waxaan helnaa isku-xigxigyo joomatari oo isbeddelaya (oscillating).

1) Soo saar shanta xubnood ee ugu horreeya ee isku-xigxigadan joomatari (geometric sequences).

a) Xubinta 1aad waa 1, saamiga guud (common ratio) waa 3

b) Xubinta 1aad waa 10, saamiga guud (common ratio) waa 3

c) Xubinta 1aad waa 5, saamiga (ratio) 1 : 3 ee u dhexeeya xubnaha

d) Xubinta 1aad waa 3, saamiga (ratio) 1 : 5 ee u dhexeeya xubnaha

e) Xubinta 1aad waa 64, saamiga (ratio) 2 : 5 ee u dhexeeya xubnaha

f) Xubinta 1aad waa 81, saamiga guud (common ratio) waa  $\frac{1}{3}$

g) Xubinta 1aad waa 1875, saamiga (ratio) 5 : 1 ee u dhexeeya xubnaha

h) Xubinta 1aad waa 3, saamiga (ratio) 3 : 1 ee u dhexeeya xubnaha

2) Axmed wuxuu soo saarayaa isku-xigxigyadan joomatari (geometric sequences).

a) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{1}{3}$

b) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{2}{3}$

c) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{3}{2}$

Sababtoo ah tiro-ku-dhufashadaani (multipliers) waa jajab (fractions), kuwaan oo dhami waxay noqon doonaan taxane (sequences) hoos u dhacaya (decreasing).



Tus Axmed inuu qaldan yahay.

1) Soo saar shanta xubnood ee ugu horreysa taxanahan joomatari (geometric sequences).

a) Xubinta 1aad waa 1, saamiga guud (common ratio) waa 3

1, 3, 9, 27, 81, ...

b) Xubinta 1aad waa 10, saamiga guud (common ratio) waa 3

10, 30, 90, 270, 810, ...

c) Xubinta 1aad waa 5, saamiga (ratio) 1 : 3 ee u dhexeeya xubnaha

5, 15, 45, 135, 405, ...

d) Xubinta 1aad waa 3, saamiga (ratio) 1 : 5 ee u dhexeeya xubnaha

3, 15, 75, 375, 1875, ...

e) Xubinta 1aad waa 64, saamiga (ratio) 2 : 5 ee u dhexeeya xubnaha

64, 160, 400, 1000, 2500, ...

f) Xubinta 1aad waa 81, saamiga guud (common ratio) waa  $\frac{1}{3}$

81, 27, 9, 3, 1, ...

g) Xubinta 1aad waa 1875, saamiga (ratio) 5 : 1 ee u dhexeeya xubnaha

1875, 375, 75, 15, 3, ...

h) Xubinta 1aad waa 3, saamiga (ratio) 3 : 1 ee u dhexeeya xubnaha

3, 1,  $\frac{1}{3}$ ,  $\frac{1}{9}$ ,  $\frac{1}{27}$ , ...

2) Axmed wuxuu soo saarayaa taxanahan joomatari (geometric sequences).

- a) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{1}{3}$  216, 72, 24, 8, ...
- b) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{2}{3}$  216, 144, 96, 64, ...
- c) Xubinta 1aad waa 216, saamiga guud (common ratio)  $\times \frac{3}{2}$  216, 324, 486, 729, ...

Sababtoo ah tiro-ku-dhufashadaani (multipliers) waa jajab (fractions), kuwaan oo dhami waxay noqon doonaan taxane (sequences) hoos u dhacaya (decreasing).

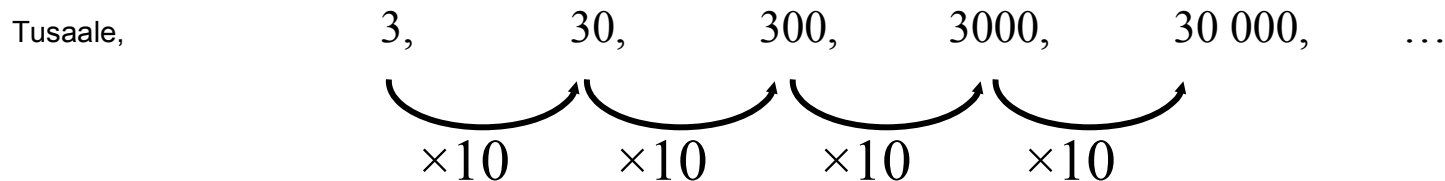
Tiro-ku-dhufashuhu (multiplier) waa ka weyn yahay 1, sidaa darteed taxanuhu (sequence) wuu kordhayaa (increases).



Tus Axmed inuu qaldan yahay.

**Taxanaha joomatari (Geometric sequences) waxay leeyihiin sifo muhiim ah oo ah xiriir isku-dhufasho (multiplicative relationship) oo guud oo ka dhexeeya xubnaha.**

Xiriirkan isku-dhufashada (multiplicative relationship) waxaa sidoo kale loo yaqaan saami guud (common ratio).



Tirada isku dhufashada  $\times 10$  waxaan ugu yeernaa saami guud (common ratio) oo ah 10.