# Maths skills – M2.3 Substitute numerical values into algebraic equations using appropriate units for physical quantities

# Maths skills – M2.4 Solve algebraic equations

***Teacher answers***

## Quiz

1. Use the Simpson’s index of diversity for the following questions to work out which sample has the higher diversity.
2. Using quadrats, samples were taken from two fields giving the following results.

|  |  |
| --- | --- |
|  | **Number of individuals** |
| **Plant species** | **Field A** | **Field B** |
| Daisy | 300 | 20 |
| Buttercup | 335 | 49 |
| Dandelion | 365 | 931 |
| Total | 1000 | 1000 |

Field A

$$(\frac{300}{1000})^{2}+ (\frac{335}{1000})^{2}+ (\frac{365}{1000})^{2}=0.33545$$

D = 1 – 0.33545 = 0.66455

Field B

$$(\frac{20}{1000})^{2}+ (\frac{49}{1000})^{2}+ (\frac{931}{1000})^{2}=0.869562$$

D = 1 – 0.869562 = 0.130438

Field A has a higher diversity

1. Two areas of embryo dunes were sampled giving the following results.

|  |  |
| --- | --- |
|  | **Number of individuals** |
| **Plant species** | **Area A** | **Area B** |
| Saltwort | 40 | 20 |
| Sandwort | 55 | 15 |
| Frosted orache | 30 | 75 |
| Sea rocket | 90 | 80 |
| Total | **215** | **190** |

Area A

$$(\frac{40}{215})^{2}+ (\frac{55}{215})^{2}+ (\frac{30}{215})^{2} + (\frac{90}{215})^{2}=0.294753921$$

D = 1 – $0.294753921$= 0.705246079

Area B

$$(\frac{20}{190})^{2}+ (\frac{15}{190})^{2}+ (\frac{75}{190})^{2}+ (\frac{80}{190})^{2}=0.350415512$$

D = 1 – $0.350415512 $= 0.649584487

Area 1 has a higher diversity

1. Ventilation rate is the volume of air exchanged in one minute. Breathing rate is the number of breaths per minute. Tidal volume is the volume of air exchanged in one breath.

This gives the equation: $ventilation rate=tidal volume ×breathing rate$

If tidal volume is 0.5 dm3 and ventilation rate is 6 dm3 min-1, what is the breathing rate?

breathing rate = ventilation rate/tidal volume

breathing rate = 6/0.5 = 12 breaths min-1

1. If the mean number of daisies in a quadrat 0.5m x 0.5m is 10, what will be the total number of daisies in a field measuring 100m x 50m?

No. of daisies in field = No. of daisies per quadrat x No. of quadrats in the area of the field

No. of daisies per quadrat = 10

No. of quadrats in area of field = Area of field/Area of quadrat

 5000 m2/0.25 m2 = 20000

Therefore number of daisies in field is 10 x 20000 = 200000 or 2 x 105

1. When water flows along a tube, such as a blood capillary, the flow of liquid can either be laminar or turbulent. This can be calculated by putting numbers into the following equation. If the result for NR is greater than 3000 flow is turbulent, and less than 2000 flow is laminar.

The equation is

$$N\_{R}=\frac{ρvD}{µ}$$

Where

ρ = the density of the fluid (kg m-3)

$v $= flow velocity (m s-1)

D= the diameter of the tube (m)

µ = the viscosity (kg m-1s-1)

Calculate NR for the following:

1. The velocity through an aorta of diameter 2x10-2 m is 0.3 m s-1. The density of blood is 103 kg m-3

Viscosity of blood is 4 x 10-3 kg m-1 s-1

$$N\_{R}=\frac{10^{3}×0.3×2×10^{-2}}{4×10^{-3}}$$

NR = 1500

Is the flow laminar or turbulent?

laminar

1. Flow of water through a tube of diameter 4 x 10-2 m, supplying a fish tank, was found to be
0.5 m s-1.

The density of water is 103 kg m-3.

The viscosity of water is 10-3 kg m-1 s-1.

$$N\_{R}=\frac{10^{3}×0.5×4×10^{-2}}{10^{-3}}$$

NR = 20,000

Is the flow laminar or turbulent?

Turbulent

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