Lesson 7

7.1 Practical Proportionality

Calculator needed !

Example

The yacht pictured, a Vertue, is an example of a boat with a displacement hull.
It moves through the water by pushing the water to either side.
Notice that, because it's moving fairly fast, a large bow wave is being created.

A displacement hull has a speed beyond which it cannot pass through water.
As the hull speed approaches the theoretical maximum the energy from the sails
makes the bow wave bigger rather than move the hull faster.

A displacement hull's maximum speed through the water, V_{max} is directly proportional
to the square root of its waterline length, *LWL*.

The Vertue has a maximum theoretical speed of 6.3 knots.

Its *LWL* - Length Water Line - is 22 feet.

(i)   Write "V_{max} is **directly** proportional to the square root of LWL" in symbols.

(ii)   If $V_{max} = 6.3$ when $LWL = 22$, find the constant of the proportionality.

(iii)   Write down a formula relating V_{max} and LWL.

(iv)   Use your formula to complete this table.

LWL	0	100	400	900	1200
V_{max}					

(v)   On the graph paper on the following page,

         (a)   Plot the values from the table, above.

   **(b)**   Place the formula next to the curve plotted.

         (c)   Head your graph with the words
                 "A graph of Maximum Theoretical Speed against Waterline
                 Length for a Displacement Hull".

         (d)   Add the following words to the x-axis.
                 "Waterline Length in feet"

         (e)   Add the following words to the y-axis
                 "Speed in knots"

For homework you will look up the maximum speeds and waterline lengths of some famous ships to see how well real life matches what is theoretically possible.
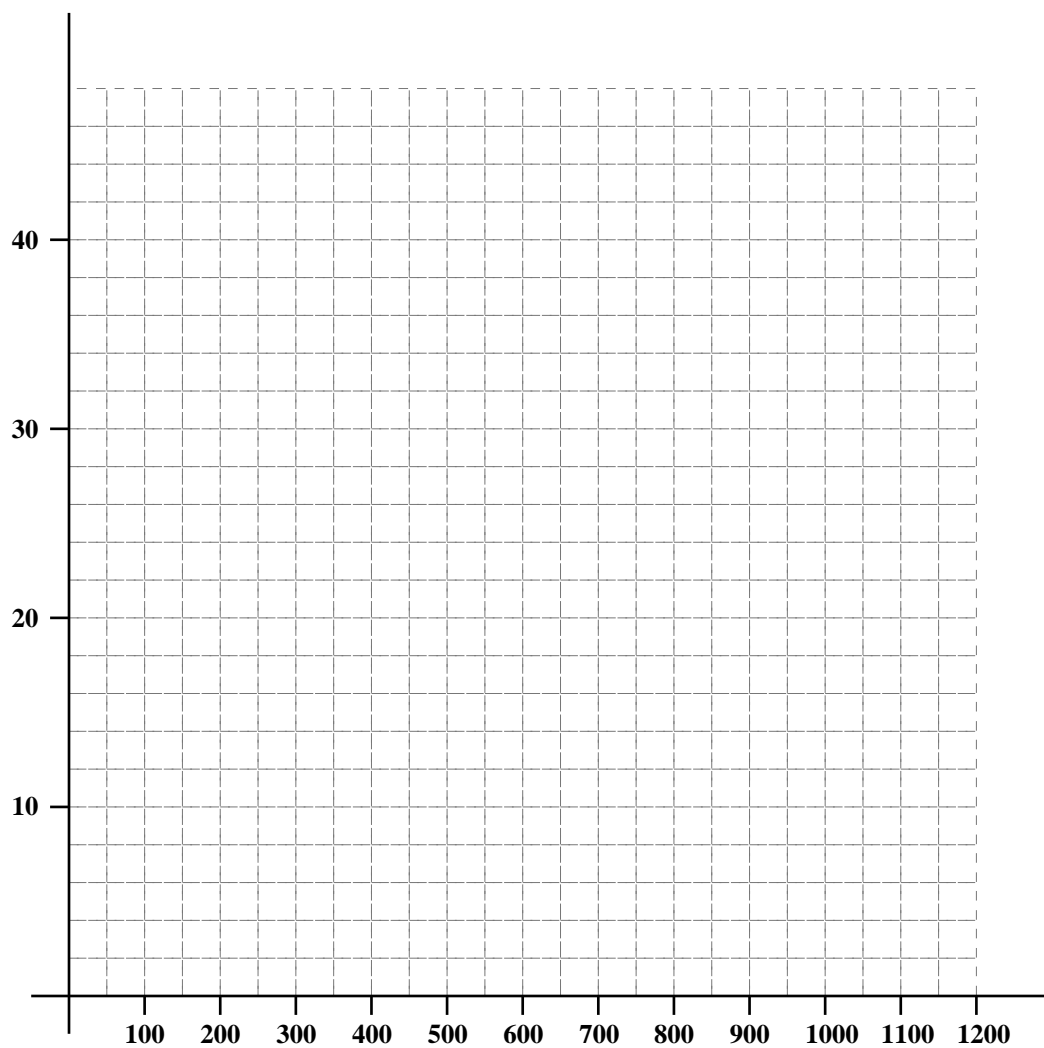
7.2 Exercise

Question 1

The cost, C, of buying pencils is ***directly proportional*** to the number, N, of pencils bought.

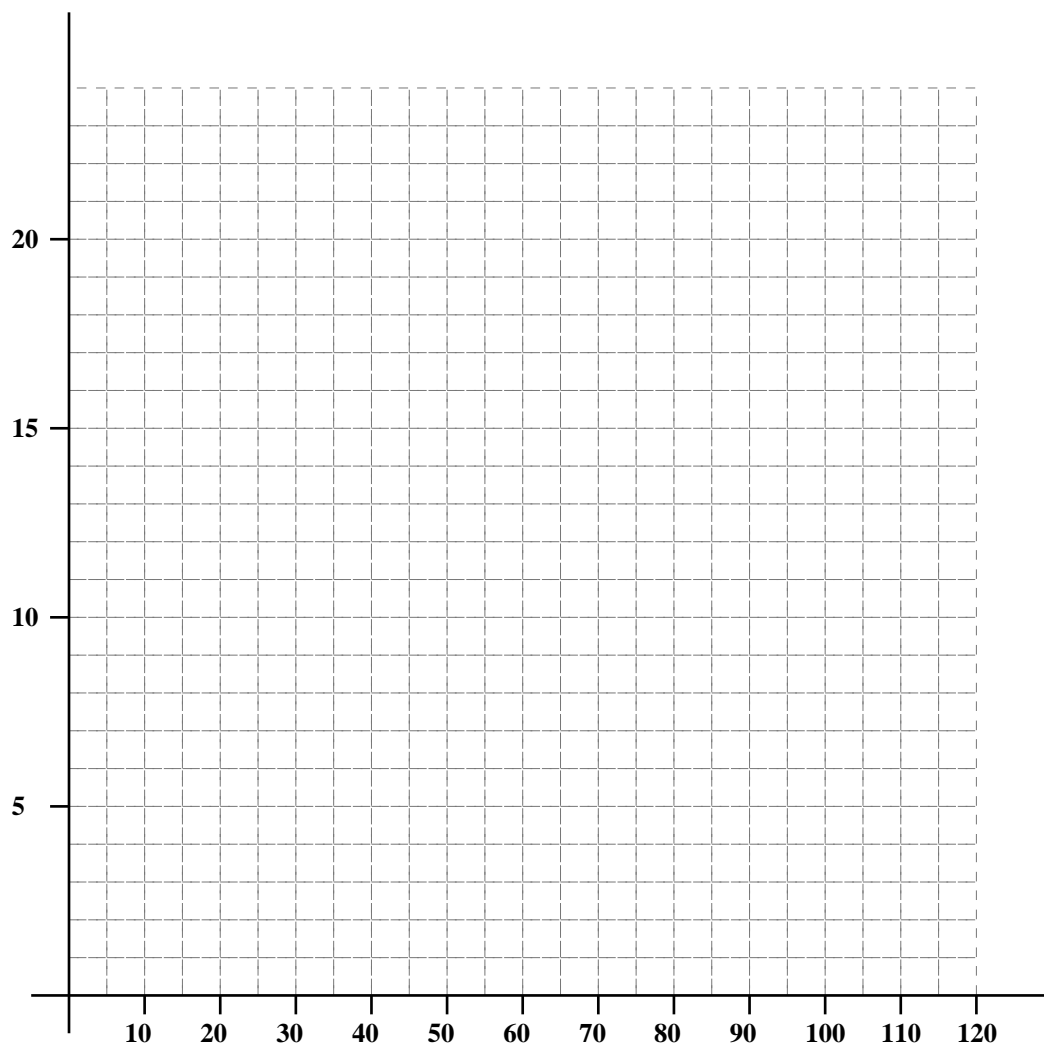(**i**)   Express this statement as a proportionality.

(**ii**)   If £4 buys 20 pencils, find the constant of the proportionality.

(**iii**)   Write down a formula relating C and N.

(**iv**)   Use your formula to complete this table.

N	0	10	40	90	120
C					

(**v**)   On the graph paper on the following page,

(**a**)   Plot the values from the table, above.

(**b**)   Place the formula next to the curve plotted.

(**c**)   Head your graph with the words
"A graph of Cost against Number of Pencils".

(**d**)   Add the following words to the x-axis.
"Number of Pencils"

(**e**)   Add the following words to the y-axis
"Cost in £"

Question 2

The amount of paint, *p*, needed to paint a circle is ***directly proportional to the square*** of the circle's radius, *r*.

(i)   Express this statement as a proportionality.

(ii)   If 3 litres of paint is needed to paint a circle of radius 6 metres, find the constant of the proportionality.

(iii)   Write down a formula relating *p* and *r*.

(iv)   Use your formula to complete this table.

r	0	2	4	6	8	10	12
p							

(v)   On the graph paper on the following page,

   (a)   Plot the values from the table, above.

   (b)   Place the formula next to the curve plotted.

   (c)   Head your graph with the words
   "A graph of Amount of paint against Circle radius".

   (d)   Add the following words to the *x*-axis.
   "Circle radius in metres"

   (e)   Add the following words to the *y*-axis
   "Amount of paint in litres"
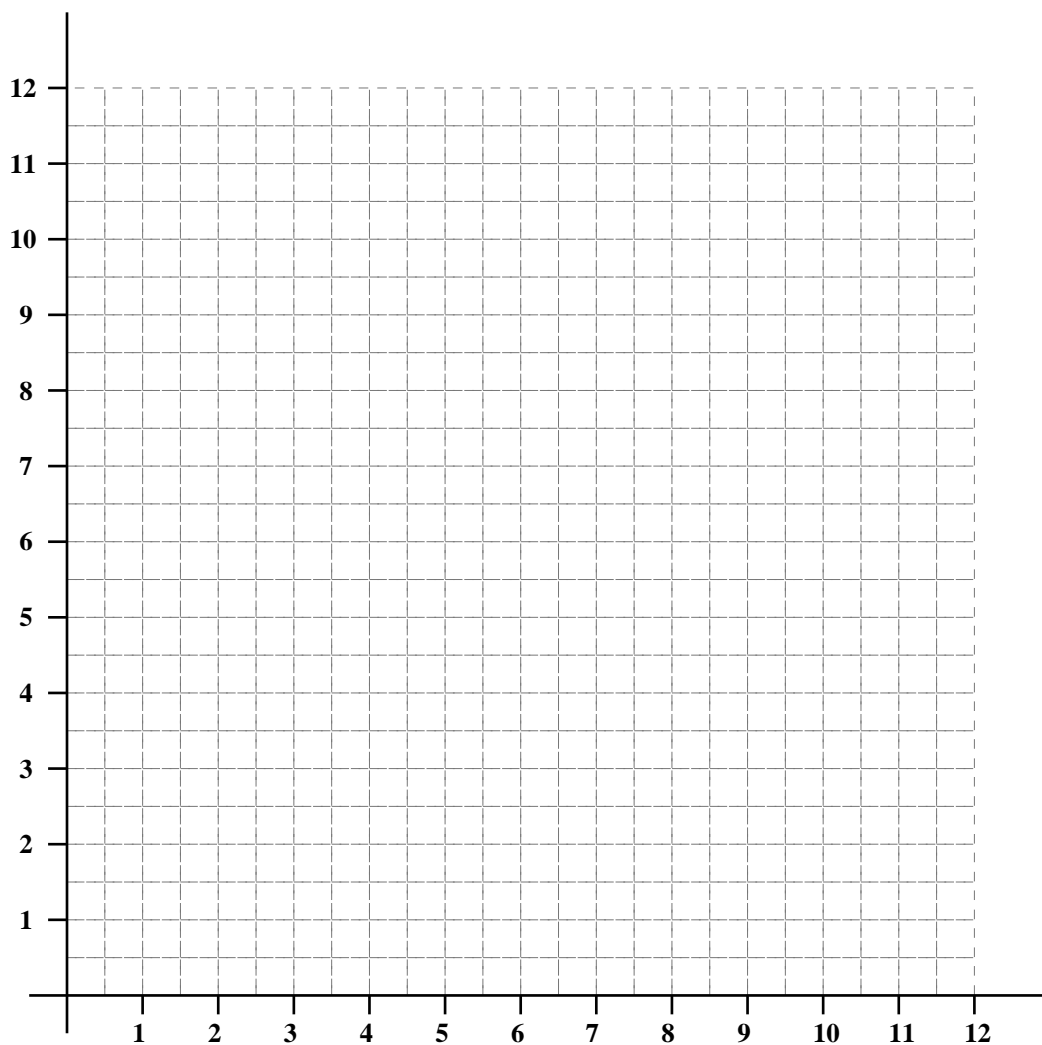
Question 3
The apparent power of a light bulb, *P*, is ***inversely proportional to the square of the distance*** of the viewer's eye from the light bulb, *D*.

(**i**)   Express this statement as a proportionality.

(**ii**)   If a light bulb appears to have a power of 60 watts from a distance of 4 metres find the constant of the proportionality.

(**iii**)   Write down a formula relating *P* and *D*.

(**iv**)   Use your formula to complete this table.

D	2	4	6	8	10	12
P						

(**v**)   On the graph paper on the following page,

      (**a**)   Plot the values from the table, above.

      (**b**)   Place the formula next to the curve plotted.

      (**c**)   Head your graph with the words
                 "A graph of Distance from light bulb against Apparent power".

      (**d**)   Add the following words to the *x*-axis.
                 "Distance from light bulb in metres"

      (**e**)   Add the following words to the *y*-axis
                 "Apparent power in watts"