Merit

1. A doctor prescribes a drug called Paracetamol® to help reduce pain.

The formula *P* = *A*(0.75)t the amount of the Paracetamol *P* mg in the blood *t* hours after the drug has been released in the blood stream.

*A* is the initial amount of Paracetamol released in the blood stream.

If the initial amount released in the blood stream is 500 mg (ie *A =* 500), how long does it take for the amount of Paracetamol to reduce to 250 mg?

(2004)

2. The perimeter of a circular garden is represented by the equation *x2*+ *y*2 = 16 .

A gardener wants to put a drain through the garden.

The path of the drain is represented by the equation *y* = 3*x* + 4 .

Find the *x*-coordinates of the points where the drain

 meets the perimeter of the garden.

(2004)

3. A Ball Committee looks at two options when deciding on the ticket price for the School Ball.

**Option A:**

The fixed costs are $1600 and it costs $18 for food for each person.

Twenty people get free tickets.

The ticket price *T* A for this option can be calculated using the formula $T\_{A}=\frac{1600+18x}{x-20}$

where *x* is the number of tickets sold.

**Option B:**

The fixed costs are $1200 and it costs $22 for food for each person.

Fifteen people get free tickets.

The ticket price *T* B for this option can be calculated using the formula $T\_{B}=\frac{1200+22x}{x-15}$

where *x* is the number of tickets sold.

By solving $\frac{1600+18x}{x-20}=\frac{1200+22x}{x-15} $find the minimum number of tickets that need to be sold so that the price of tickets for option A is less than the price of the tickets for option B*.*

(2004)

4. The weight, *W* kg, of a giraffe over its first two years of life, is given by the equation $W=\frac{t^{2}}{4}-t+68 $where *t* is the time in months since the giraffe was born.

How long does it take the giraffe to weigh 85 kg?

(2005)

5. Find the ***x* - coordinates** of the points of intersection of the parabola $y=2x^{2}-x-6$ and the line *y* = 4*x* - 3.

(2005)

6. A newborn giraffe is 1.8 metres tall.

A formula that gives the height, *H* metres, of a giraffe over its first five years is

$$H=1.8×3^{0.16t}$$

where *t* is the time in years since the giraffe was born.

How long does it take for a giraffe to reach a height of 2.7 metres?

(2005)

7. Emma draws the graph of the circle $x^{2} +y^{2} = 25$.

She is then told to draw the graph of the line *x* + *y* = –1 on the same set of axes.

Find the coordinates of **both** points where the line intersects the circle.

(2006)

8. A chemical was used to treat the water in a swimming pool.

The concentration of the chemical at 8 am was 200 mg per litre.

The concentration of the chemical in the water reduces by 30% each hour.

It is not safe to swim in a pool in which the concentration of the chemical is more than 25 mg per litre.

The concentration *C* mg per litre of the chemical in the water *t* hours after 8 am is given by

$$C=200×0.7^{t}$$

How many hours after 8 am will it be safe to swim in the pool?

(2006)

9. Wiremu planted a tree that was 1.5 m high.

He is told that the tree will increase in height at a rate of 8% a year.

The height *h* metres of the tree can be modelled by the function

$$h=1.5(1+0.08)^{t}$$

where *t* is the time in years since the tree was planted.

When will the height of the tree be 12 m?

(2007)

10. Shapes A and B below are made from rectangles.

For what value of *x* are the areas of shape A and shape B the same?

**(Di agr ams NOT to scale)**

2x cm

(x + 5.5) cm

(x + 2.75) cm

B

x cm

A

2x cm

x cm

(2007)

11. Find the co-ordinates of the points of intersection of the graphs of *y* = 5*x* + 14 and $y=(x+4)^{2}$.

(2007)

12. The theme park has a rectangular playground, which is 30 metres long and 15 metres wide.

It is surrounded by a border, which has a constant width *x* metres.

The area of the border is twice the area of the playground.

Find the value of *x*.

30m

x

15m

x

**You must show any equations that you use in solving the problem.**

(2008)

13. The theme park will need to close if the number of people entering the park in any month falls below 30 000.

A model for the number entering is

$$P=45 000 × 0.96^{n+2}$$

where:

*P* is the number of people entering the park in a month

and *n* is the number of months since the start of the year.

Assuming this model continues to hold, after how many months will the park close?

(2008)

14. Find the solution(s) to the simultaneous equations :

*y* = *x* + 7 and $y=\frac{-12}{x}$.

(2008)

15. A cuboidal container has a height of *h* metres, a width of (*h*+3) metres and a length of (2*h* + 1) metres.

h + 3

h

2h + 1

The volume of the box in cubic metres is 20 times the height in metres (*V* = 20*h* m3).

Find the value of *h*.

(2009)

16. The equation $x^{2}+y^{2}-10x=0 $represents a circle.

The straight line *y* = 2*x* – 5 intersects the circle.

Find the point(s) of intersection of the line and the circle.

You must solve this algebraically and show all working.

(2009)

17. The height of an antelope, in metres, can be modelled by the equation

$$h=0.7×(1.018)^{t}$$

where *t* is the time in months since the birth of the antelope and *t* < 36.

How long after its birth will the antelope reach a height of 1.2 metres?

Give your answer to one decimal place.

(2010)

18. Find the coordinates of the point(s) of intersection of the hyperbola $y=\frac{6}{x} $and the line *x* – 3*y* + 3 = 0.

You must solve this algebraically and show all working.

(2010)

ANSWERS

1. t = 2.409 hours

2. x = 0 and -2.4

3. 143 people

4. 10.5 months

5. x = -0.5 and 3

6. 2.3 years

7. (3, -4) and (-4, 3)

8. 5.83 hours

9. 27.02 years

10. x = 5.5

11. (-1, 9) and (-2, 4)

12. 7.5 metres

13. 7.93 months

14. (-3, 4) and (-4,3)

15. 1.65 metres

16. (1, -3) and (5, 5)

17. 30.2 months

18. (-6, -1) and (3,2)