MATHEMATICS

N5

Prelim Revision

(with answers)

FORMULAE LIST

The roots of: $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Sine Rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc\cos A$ or $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle: $A = \dfrac{1}{2}ab\sin C$

Volume of a sphere: $V = \dfrac{4}{3}\pi r^3$

Volume of a cone: $V = \dfrac{1}{3}\pi r^2 h$

Volume of a pyramid: $V = \dfrac{1}{3}Ah$

Standard deviation: $s = \sqrt{\dfrac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\dfrac{\sum x^2 - (\sum x)^2 / n}{n-1}}$

where n is the sample size

1. Factorise the following:
   (a) $4x^2 - 81$ (b) $x^2 - x - 6$ (c) $3x^2 - 10x + 3$

2. Simplify: (a) $\frac{x^3 y^7}{x^2 y^{10}}$ (b) $2a^2 \times 3a^3$ (c) $81^{\frac{1}{4}}$

3. Expand and simplify: (a) $(4x - 3)^2$ (b) $(4x - 3)(3x^2 + 2x - 3)$

4. Change the subject of the formula to the letter in brackets
   (a) $I = PRT$ (R)   (b) $C = \frac{D}{E^2}$ (E)   (c) $y = 5\sqrt{x}$ (x)

5. Express the following in the form: $(x + p)^2 + q$ and write down the
   coordinates of the turning point
   (a) $x^2 - 6x + 7$ (b) $x^2 + 8x + 20$

6. Write the following as fractions in their simplest form:
   (a) $\frac{4y+6}{4y^2-9}$ (b) $\frac{x^2+2x-35}{x^2+14x+49}$ (c) $\frac{3}{x-4} - \frac{2}{x+3}$

7. Simplify the following: (a) $\sqrt{48}$ (b) $\sqrt{90} + 3\sqrt{250}$

8. Rationalise the denominator:
   (a) $\frac{6}{\sqrt{3}}$ (b) $\frac{4\sqrt{3}}{\sqrt{32}}$ (c) $\frac{7\sqrt{2}}{3\sqrt{12}}$

9. Find the gradient of the line joining the two points:
   (a) A(6,5) to B(8,1)   (b) C(-3,11) to D(-1,1)   (c) E(3,-8) to F(10,-16)

10. Solve the following inequalities:
    (a) $-6z > -18$ (b) $12 - 4r \geq 4$ (c) $-5f < 4f - 9$

11. Multiply out the brackets and collect like terms: $(3x+1)(x^2 - 2x + 3)$

12. Solve the equation: $6x^2 + x - 2 = 0$.

13. Express $\frac{8}{\sqrt{10}}$ with a rational denominator in its simplest form.

14. Change the subject of the formula $a = \frac{b^2 c}{4}$ to b.

15. (a) Multiply out the brackets and simplify: $x^{\frac{1}{2}}\left(x^{\frac{5}{2}} + x^{-\frac{1}{2}}\right)$.

    (b) Find the exact value of this expression when $x = 4$.

16. A parabola has equation $y = x^2 - 6x + 14$.

(a) Write the equation in the form $y = (x - p)^2 + q$.

(b) Sketch the graph of $y = (x - p)^2 + q$, showing the coordinates of the

turning point and the point of intersection with the y-axis.

17. Colin and Jane visit a music shop. Colin buys 3 CDs and 2 DVDs. The total cost of this is £33.

(a) Write down an equation to illustrate this information.

(b) Jane buys 4 CDs and 3 DVDs.

The total cost of this is £47.

Write down an equation to illustrate this information.

(c) Find the cost of a CD and the cost of a DVD.

18. Express: $\dfrac{3}{x+2} - \dfrac{2}{x-3}$, $x \neq -2, x \neq 3$ as a single fraction in its simplest form.

19. A cylindrical pipe has water in it as shown.
The depth of the water at the deepest point is
4 centimetres.
The width of the water surface, AB, is
14 centimetres.
The radius of the pipe is r centimetres. The
distance from the centre, O, of the pipe to the
water surface is x centimetres.
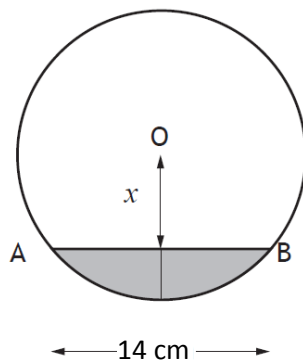
(a) Write down an expression for x in terms of r.

(b) Calculate r, the radius of the pipe.

20. For the following graphs, find: (i) where the curve cuts the y axis
(ii) co-ords of the turning point   (iii) equation of the axis of symmetry.
(a) $y = (x - 1)(x + 7)$ (b) $y = (x + 5)(x - 3)$ (c) $y = x^2 + 6x + 8$

Paper A	**ANSWERS**	**Non-Calculator**

1(a) $(2x + 9)(2x - 9)$ **(b)** $(x - 3)(x + 2)$ **(c)** $(3x - 1)(x - 3)$ **2(a)** $\dfrac{x}{y^3}$ **(b)** $6a^5$

2(c) 3 **3(a)** $16x^2 - 24x + 9$ **(b)** $12x^3 - x^2 - 18x + 9$ **4(a)** $R = \dfrac{I}{PT}$

4(b) $E = \sqrt{\dfrac{D}{C}}$ **(c)** $x = \dfrac{y^2}{25}$ **5(a)** $(x-3)^2 - 2$ TP $(3,-2)$ **(b)** $(x + 4)^2 + 4$ TP(-4,4)

6(a) $\dfrac{2}{(2y-3)}$ **(b)** $\dfrac{x-5}{x+7}$ **(c)** $\dfrac{x+17}{(x-4)(x+3)}$ **7(a)** $4\sqrt{3}$ **(b)** $18\sqrt{10}$ **8(a)** $2\sqrt{3}$ **(b)** $\dfrac{\sqrt{6}}{2}$

8(c) $\dfrac{7\sqrt{6}}{18}$ **9(a)** -2 **(b)** -5 **(c)** $-\dfrac{8}{7}$ **10(a)** z < 3 **(b)** $r \leq 2$ **(c)** $f > 1$

11. $3x^3 - 5x^2 + 7x + 3$ **12.** $\dfrac{1}{2}, -\dfrac{2}{3}$ **13.** $\dfrac{4\sqrt{10}}{5}$ **14.** $b = \sqrt{\dfrac{4a}{c}}$ **15(a)** $x^3 + 1$ **(b)** 65

16(a) $y = (x-3)^2 + 5$ **(b)** $TP(3,5), y-axis(0,14)$ **17(a)** $3C + 2D = 33$

17(b) $4C + 3D = 47$ **(c)** CD=£5, DVD=£9 **18.** $\dfrac{x-13}{(x+2)(x-3)}$ **19(a)** $x = r - 4$
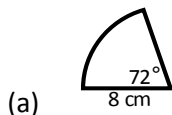
19(b) $r = \dfrac{65}{8}$ **20(a)(i)** $(0,-7)$ **(ii)** (-3,-16) **(iii)** x=-3

20(b)(i) (0,-15) **(ii)** (-1,-16) **(iii)** x=-1 **(c)(i)** (0,8) **(ii)** (-3,-1) **(iii)** x=-3

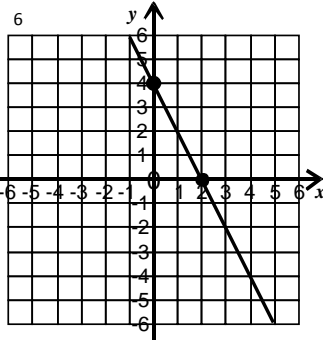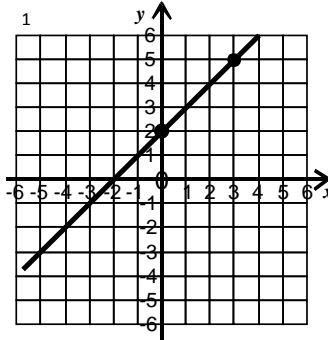|	
Paper A	**Calculator**

1. Solve the following quadratic equations correct to one decimal place:
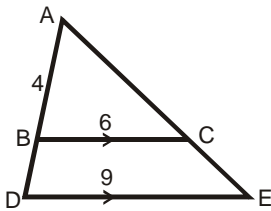   (a) $x^2 + 7x + 2 = 0$ (b) $x^2 - 10x - 4 = 0$ (c) $2x^2 + x - 4 = 0$

2. Find the length of the arc and area of the sector:
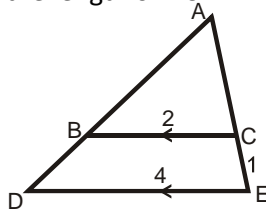
(a)
72°
8 cm
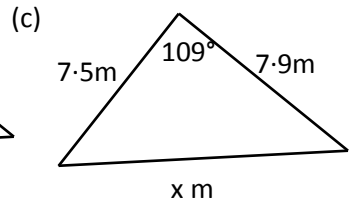
(b)
3 m 120°

(c)
12 cm
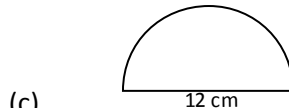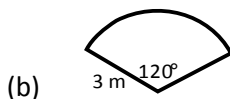
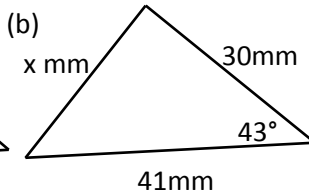3. Find the equation of the following lines:

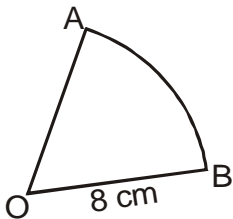4. (a) Find the length of AD   (b) Find the length of AC

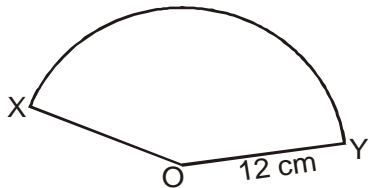
5. Find the length of the side marked x.

(a)

17cm   x cm
23°
19cm

(b)

x mm   30mm
43°
41mm

(c)

7·5m   109°   7·9m
x m
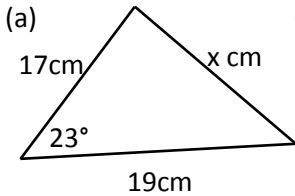
6. (a) The area of this sector is 40·2 cm². (b) The area of this sector is 150·7
    Calculate the size of angle AOB.   Calculate the size of angle XOY.

8 cm

X   12 cm   Y

7. There are 4×10^4 platelets per millilitre of blood.

   On average, a person has 6·2 litres of blood.

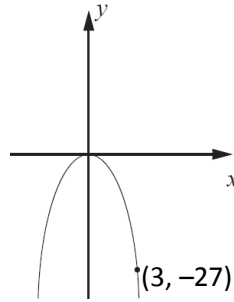   On average, how many platelets does a person have in their blood?

   Give your answer in scientific notation.
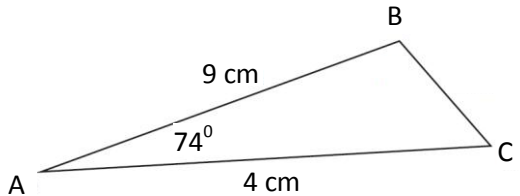
8. The graph with equation

   $y = kx^2$ is shown.

   The point (3, −27) lies on the graph.

   Determine the value of k.

   (3, −27)

9. In triangle ABC, AB = 9 cm,
   AC = 4 cm and angle BAC = 74°.

   Calculate the length of BC.

   B
   9 cm
   74°
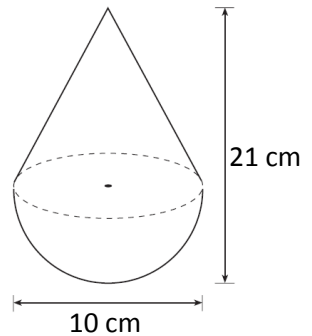   A   4 cm   C

10. A child's toy is in the shape of a hemisphere with
    a cone on top, as shown in the diagram.

    The toy is 10 centimetres wide and
    21 centimetres high.
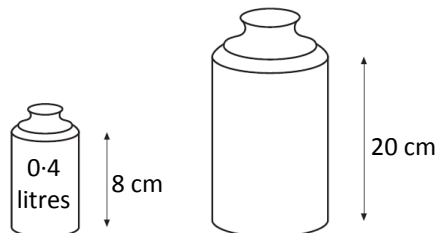
    Calculate the volume of the toy.
    Give your answer correct to 2 significant figures.
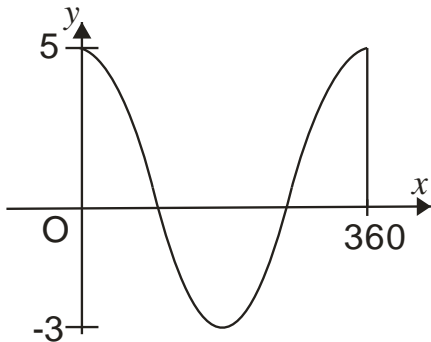

    21 cm
    10 cm

11. Screenwash is available in two different
    sized bottles, 'Mini' and 'Maxi'.

    The bottles are mathematically similar.
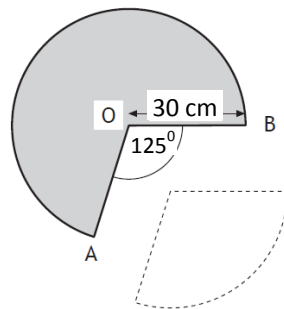
    Calculate the volume of the
    'Maxi' bottle.

    0·4
    litres
    8 cm
    20 cm

12. Part of the graph of $y = a\sin x° + b$ is shown below.

(a) Explain how you can tell from the graph that $a = 4$ and $b = 1$.

(b) Calculate the x-coordinates of the points where the graph cuts the x-axis.

13. A cone is formed from a paper circle with a
sector removed as shown.
The radius of the paper circle is 30 centimetres.
Angle AOB is 125°.

(a) Calculate the area of the sector removed
from the circle.

(b) Calculate the circumference of the base of
the cone.

14. Find the range of values of p such that the equation

$px^2 - 4x + 4 = 0, \quad p \neq 0$, has no real roots.

Paper A	ANSWERS	Calculator

1(a) −0·3, −6·7 **(b)** 10·4, −0·4 **(c)** 1·2, −1·7 **2(a)** 10·1 cm, 40·2 cm^2

2(b) 6·28 m, 9·42 m^2 **(c)** 18·8 cm, 56·5 cm^2 **3(a)** $y = x+2$ **(b)** $y = -2x+4$

4(a) 6 **(b)** 1 **5(a)** 7·44 cm **(b)** 28·0 mm **(c)** 12·5 m **6(a)** 72·0° **(b)** 119·9°

7. 2.48×10^8 **8.** −3 **9.** 8·78 cm **10.** 680 cm^3 **11.** 6·25 litres

12(a) **(b)** (194·5, 0) (345·5, 0) **13(a)** 981·75 cm^2 **(b)** 123·05 cm **14.** $p > 1$

1. Expand and simplify: $(2x-3)(2x^2-5x+2)$.

2. Change the subject of the formula to q: $V = \dfrac{\sqrt{q}}{r}$.

3. In the diagram

    - O is the centre of the circle
    - PQ is the diameter
    - PQR is a straight line
    - RS is a tangent to the circle at S
    - Angle QPS is 24°
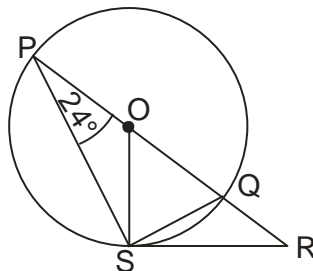
    Calculate the size of angle QRS.

4. Express $\dfrac{2y^2-6y}{y^2+y-2}$ in its simplest form.
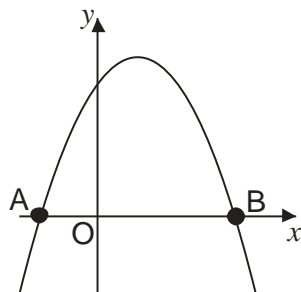
5. Evaluate $8^{\frac{2}{3}}$.

6. Simplify $\dfrac{2}{m}+\dfrac{3}{m-1}$.

7. The diagram shows part of the graph of
    $y=8+2x-x^2$.

    (a) Find the coordinates of A and B

    (b) State the equation of the axis of symmetry of
    the graph.

    (c) Hence, find the maximum value of
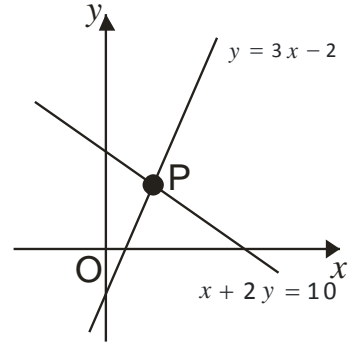 $y=8+2x-x^2$.

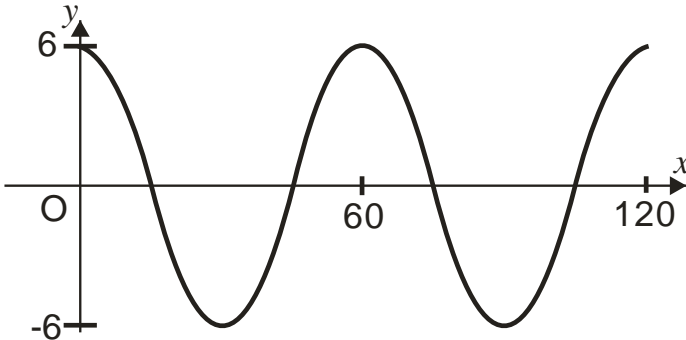8. The graph below shows two straight lines

   - $y = 3x - 2$

   - $x + 2y = 10$

   The lines intersect at the point P.

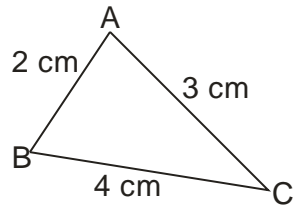   Find, **algebraically**, the coordinates of P.

9. Part of the graph of $y = a\cos bx°$ is shown in the diagram.

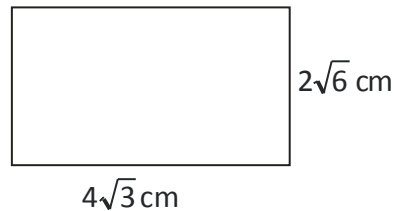   State the values of a and b.

10. In the triangle ABC, show that $\cos B = \dfrac{11}{16}$.

11. The rectangle has length $4\sqrt{3}$ centimetres and breadth $2\sqrt{6}$ centimetres.

   Calculate the area of the rectangle.

   Express you answer as a surd in its simplest form.

12. Prove that the roots of the equation $2x^2 + 3x - 2 = 0$ are real and rational.
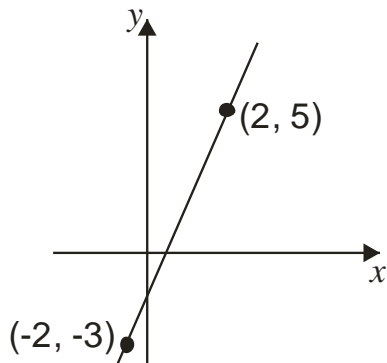
Paper B	ANSWERS	Non-Calculator

1. $4x^3 - 16x^2 + 19x - 6$ **2.** q = (vr)^2 **3.** $42°$ **4.** $\dfrac{2y(y-3)}{(y+2)(y-1)}$ **5.** 4 **6.** $\dfrac{5m-2}{m(m-1)}$

7(a) $(-2,0),(4,0)$ **(b)** $x=1$ **(c)** 9 **8.** $(2,4)$ **9.** $a=6, b=6$ **10.** *proof* **11.** $24\sqrt{2}$

12. $b^2 - 4ac = 25$ ie >0 and a perfect square

Paper B   Calculator

1. Find the equation of the straight line shown in the diagram.

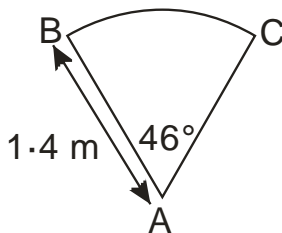

2. A spiral staircase is being designed.

    Each step is made from a sector of
    a circle as shown.

   The radius is 1·4 metres.

    Angle BAC is 46°.

    For the staircase to pass safety regulations, the arc BC must be at least
    0·8 metres. Will the staircase pass safety regulations?

3. A glass ornament is in the shape of a cone partly filled with coloured water.

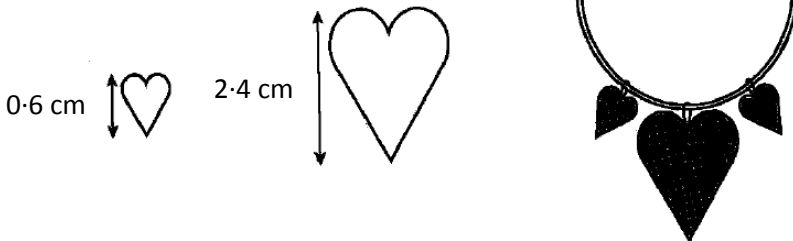   The cone is 18 centimetres high and has a base diameter 25 centimetres.

   The water is 14 centimetres deep and measures 12 centimetres across the top.
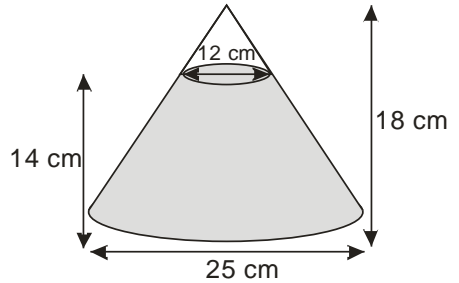
   What is the volume of the water?

   Give your answer correct to 2 significant figures.

   12 cm

   18 cm

   14 cm

   25 cm

4. A necklace is made of beads which are mathematically similar.
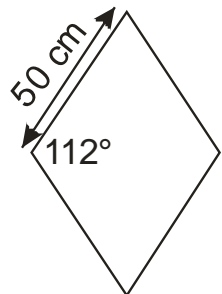

   0·6 cm   2·4 cm

   The height of the smaller bead is 0·6 centimetres and its area is 0·9 square centimetres. The height of the larger bead is 2·4 centimetres. Find the area of the larger bead.

5. Paving stones are in the shape of a rhombus.

   The side of each rhombus is 50 centimetres long.

   The obtuse angle is 112^0.
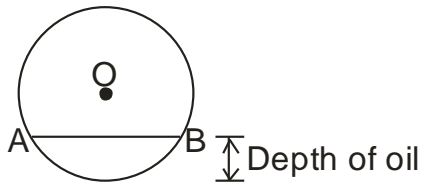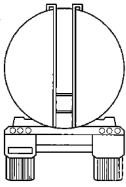
   Find the area of one paving stone.

   50 cm

   112°

6. $f(x) = 4\sin x, \ 0 \le x \le 360$.

   (a) Find $f(270)$

   (b) If $f(t) = 0·8$, find two possible values of t.

7. A tanker delivers oil to garages.

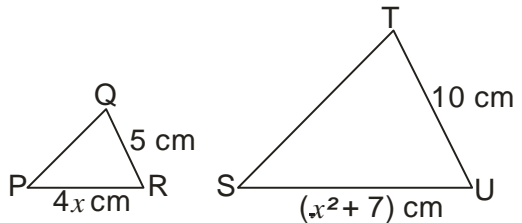   The tanker has a circular cross-section as shown.

   The radius of the circle, OA is 1·4 metres.

   The width of the surface of the oil, represented by AB in the diagram, is 2·0 metres. Calculate the depth of oil in the tanker.

8. Triangles PQR and STU are mathematically similar.

   The scale factor is 2 and PR corresponds to SU.

   (a) Show that $x^2 - 8x + 7 = 0$.

   (b) Given that QR is the shortest side of triangle PQR, find the value of x.

Paper B	**ANSWERS**	**Calculator**

1. y = 2x + 1   **2.** BC = 1·12 m, yes because 1·12 m > 0·8 m   **3.** 2800 cm³   **4.** 14·4cm²
5. 2317·8 cm² **6(a)** −4 **(b)** 11·5°, 168·5° **7.** 0·42 m **8(a)** proof **(b)** 7

Paper C	**Non-Calculator**

1. Find the value of p which gives the quadratic equation equal roots.

   (a) $x^2 - 2x + p = 0$ (b) $px^2 + 12x + 9 = 0$
   Now find the value which gives 2 real roots.
   (c) $2x^2 + 8x + p = 0$ (d) $px^2 + 6x - 2 = 0$

2. Solve each of the following pairs of simultaneous equations:
   (a) $3x - y = 1$ (b) $3x + y = 11$ (c) $5x + 9y = 8$
 $x + y = 3$ $-x + 3y = 13$ $4x + 12y = 8$

3. Find the gradient of the following lines:
   (a) $y = 3x + 2$
   (b) $2x + y = 7$
   (c) $3x + 5y + 10 = 0$

4. (a) $f(x) = 5 + 2x$
      Find: $f(3)$
      Given: $f(a) = 9$ *find* a
   (b) $f(x) = 7 - 3x$
      Find: $f(5)$
      Given: $f(a) = 1$ *find* a
   (c) $f(x) = 12 - 5x$
      Find: $f(-2)$
      Given: $f(a) = 2$ *find* a

5. Factorise fully: $3a^2 - 12$.

6. Given that $f(x) = 7 - x^2$, evaluate $f(-2)$.

7. Solve the equation $2x + 3 = \dfrac{x-2}{3}$.

8. Express $\sqrt{8} + \sqrt{18} - \sqrt{2}$ as a surd in its simplest form.

9. Express $x^2 + 8x + 7$ in the form $(x + p)^2 + q$.

10. Alan is taking part in a quiz. He is awarded x points for each correct answer and y points for each wrong answer. During the quiz, Alan gets 24 questions correct and 6 wrong. He scores 60 points.

    (a) Write down an equation in x and y which satisfies the above condition.

    Helen also takes part in the quiz. She gets 20 questions correct an 10 wrong. She scores 40 points.

    (b) Write down a second equation in x and y which satisfies this condition.

    (c) Calculate the score for David who gets 17 correct and 13 wrong.

11. A circle, centre O is shown.

    In the circle

    - PB is a diameter

    - CR is a tangent to the circle at point P
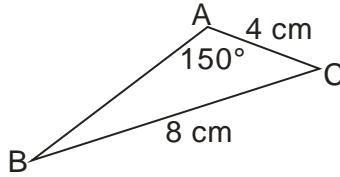
    - Angle BCP is 52^0

    Calculate the size of angle EPR.
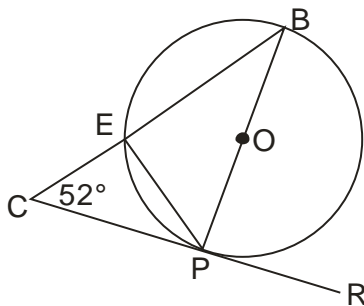
12. Express $\dfrac{a^{\frac{3}{2}} \times a^{\frac{1}{2}}}{a}$ in its simplest form.

13. In the triangle ABC,

   - AC = 4 centimetres

   - BC = 8 centimetres

   - Angle BAC = 150⁰

   Given that $\sin 30° = \dfrac{1}{2}$, show that $\sin B = \dfrac{1}{4}$.

14. Express $\dfrac{3m^2}{6} \div \dfrac{m}{2}$ as a fraction in its simplest form.

15. Prove that $\dfrac{\sin^2 A}{1 - \sin^2 A} = \tan^2 A$.

Paper C	**ANSWERS**	**Non-Calculator**

1(a) $p = 1$ **(b)** $p = 4$ **(c)** $p < 8$ **(d)** $p > -\dfrac{9}{2}$ **2(a)** $x = 1, y = 2$ **(b)** $x = 2, y = 5$

2(c) $x = 1, y = \dfrac{1}{3}$ **3(a)** 3 **(b)** -2 **(c)** $-\dfrac{3}{5}$ **4(a)** $11, a = 2$ **(b)** $-8. a = 2$ **(c)** $22, a = 2$

5. $3(a+2)(a-2)$ **6.** 3 **7.** $-\dfrac{11}{5}$ **8.** $4\sqrt{2}$ **9.** $(x+4)^2 - 9$ **10(a)** $24x + 6y = 60$

10(b) $20x + 10y = 40$ **(c)** $x = 3, y = -2, David = 25$ **11.** $142°$ **12.** a

13. sine rule proof **14.** m **15.** proof

Paper C   Calculator

1. If $P = 2QR$, find the value of P when $Q = 2\cdot 4 \times 10^{-7}$ and $R = 3\cdot 2 \times 10^{5}$.
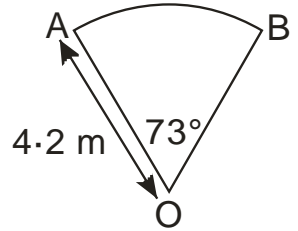
   Give you answer in scientific notation

2. Expand fully and simplify $x(x-2)^2$.

3. A sector of a circle, centre O, is shown.

   The radius of the circle is 4·2 metres.

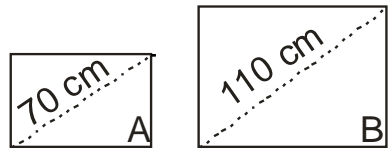   Angle AOB is 73^0. Find the length of the arc AB.

4. Change the formula $m = a + 3b^2$ to b.

5. Solve the equation $2x^2 + 5x - 9 = 0$.
   Give your answer correct to 2 significant figures.

6. Two rectangular solar panels, A and B, are mathematically similar.

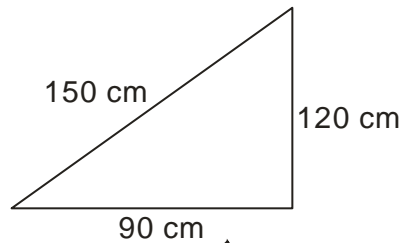   Panel A has a diagonal of 70 cm and an area of 3042 cm^2.

   A salesman claims that panel B, with a diagonal of 110 cm, will be triple the area of panel A.

   Is this claim justified?
   Show all your working.

7. A triangular paving slab has measurements as shown.

   Is the slab in the shape of a right angled triangle?
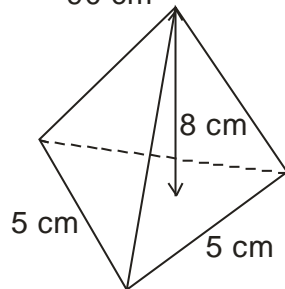
   Show your working.

8. The diagram shows a pyramid.

   The base of the pyramid is an equilateral triangle of side 5 centimetres.

   The height of the pyramid is 8 cm.

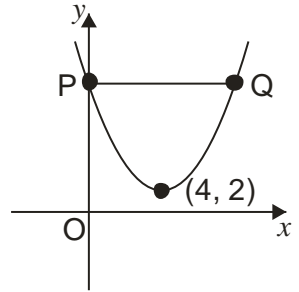   Calculate the volume of the pyramid.

9. The graph below shows part of a parabola with equation of the form $y = (x+a)^2 + b$

    (a) State the values of a and b.

    (b) The line PQ is parallel to the x-axis.
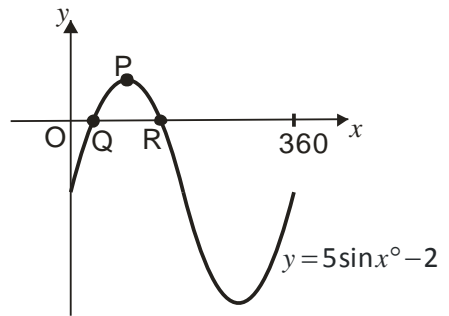
    Find the coordinates of P and Q.

10. Part of the graph of $y = 5\sin x° - 2$ is shown.

    The graph cuts the x-axis at Q and R.

    P is the maximum turning point.

    (a) Write down the coordinates of P.
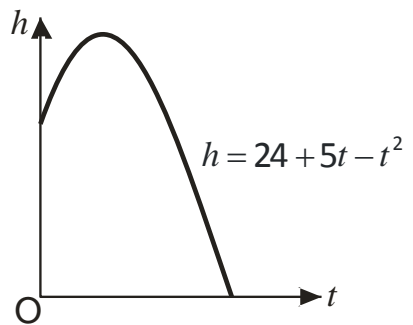
    (b) calculate the x – coordinates of Q and R.

11. The diagram shows the path of a flare after it is fired.

    The height, h metres above sea level, of the flare, is given by $h = 24 + 5t - t^2$ where t is the number of seconds after firing.

    Calculate, **algebraically**, the time taken for the flare to enter the sea.

Paper C   **ANSWERS**   **Calculator**

1. $1\cdot536\times10^{-1}$ **2.** $x^3 - 4x^2 + 4x$ **3.** $5\cdot35m$ **4.** $b = \sqrt{\dfrac{m-a}{3}}$ **5.** $1\cdot2$, $-3\cdot7$

6. area B =7511·88. Not justified because 7511·88<9126

7. 22500=22500 therefore right angled **8.** $28\cdot87cm^3$ **9(a)** $a = -4, b = 2$

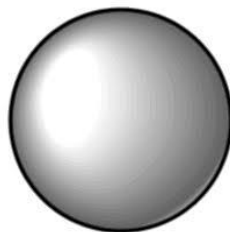**9(b)** $P(0,18), Q(8,18)$ **10(a)** $(90,3)$ **(b)** $23\cdot6, 156\cdot4$ **11.** t=8 secs

1. Solve the inequality: $2-x>3(x-2)$.

2. Factorise $2p^2+9p-5$.

*3. The diagram represents a sphere.   ***calculator**

    The sphere has a diameter of 18 centimetres.

    Calculate its volume. Take $\pi=3\cdot14$.

4. Solve algebraically the system of equations

    $3x-4y=20$
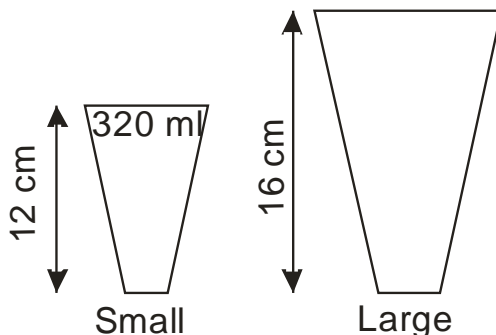 $4x+5y=6$

*5. Coffee is sold in small cups and large cups.   ***calculator**

    The two cups are
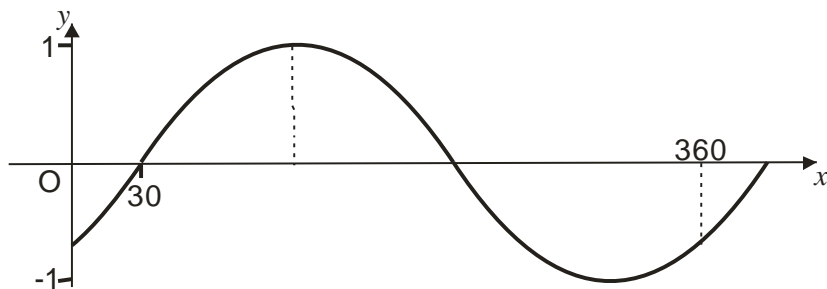   mathematically similar in shape.

    The small cup is 12 cm high
    and holds 320 millilitres.

    The large cup is 16 cm high.

    Calculate how many millilitres
    the large cup holds.

    320 ml   Small   Large

    12 cm   16 cm

6. The graph has an equation $y=\sin(x-a)°$.

    Write down the value of a.

7. Express $\dfrac{15}{\sqrt{3}}$ with a rational denominator.

Give your answer in its simplest form.

8. Brad is taking part in a cycling and running event. The course is 50 km long

   (a) On Saturday he cycles the course in x hours.

   Find his speed for the course in terms of x.

   (b) On Sunday he takes 2 hours more to run the same course.

   Find his speed in terms of x.

   (c) Hence find an expression, in terms of x, for the difference in speeds
   between the cycling on Saturday and the running on Sunday.

9. William Watson's fast Foods use a logo based on parts of three identical
   parabolas.

   This logo is represented in the diagram below.
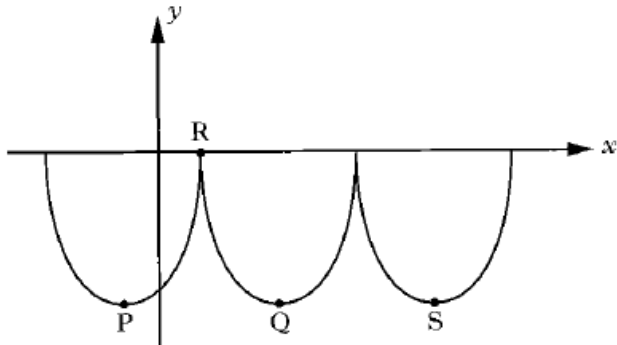
The first parabola has turning point P and equation $y=(x+3)^2-14$.

   (a) State the coordinates of P.

   (b) If R is the point (1, 0), find the coordinates of Q, the minimum turning
   point of the second parabola.

   (c) Find the equation of the parabola with turning point S.

Paper D	ANSWERS	Non-Calculator

1. $x < 2$ **2.** $(2p-1)(p+5)$ **3.** $3052 \cdot 08 cm^3$ **4.** $x = 4, y = -2$ **5.** $758 \cdot 52 ml$

6. 30° **7.** $5\sqrt{3}$ **8(a)** $\dfrac{50}{x}$ **(b)** $\dfrac{50}{x+2}$ **(c)** $\dfrac{100}{(x+2)}$ **9(a)** $(-3,-14)$ **(b)** $(5,-14)$

9(c) $y = (x-13)^2 - 14$

Paper D   Calculator
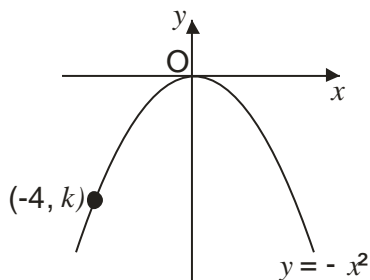
1. The National Debt of the United Kingdom was calculated as

   £1 492 719 214 375
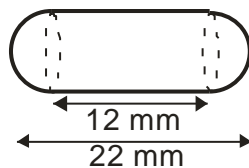
   Round this amount to four significant figures.

2. The diagram shows the graph of $y = -x^2$.

   The point (–4, k) lies on the graph.

   Find the value of k.

3. A health food shop produces cod liver oil capsules for its customers.

   Each capsule is in the shape of a cylinder with hemispherical ends as shown.

   The total length of the capsule is 22 millimetres and the length of the cylinder is 12 millimetres.

   Calculate the volume of one cod liver oil capsule.

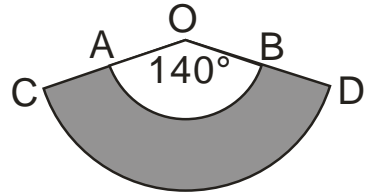4. Express in its simplest form $x^4 \times (x^2)^{-3}$.

5. A straight line is represented by the equation $3y + x = 12$.

    (a) Find the gradient of this line.

    (b) Write down the coordinates of the point where this line crosses the y-axis.

6. A pet shop manufactures protective dog collars.

    In the diagram the shaded area represents one of these collars.

    AB and CD are arcs of circles with centres at O.

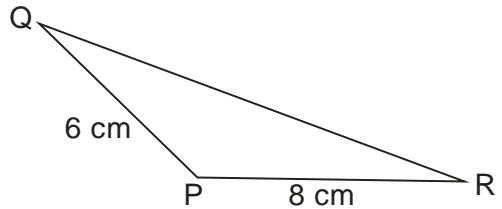   The radius, OA is 12 inches and the radius OC, is 16 inches.

    Angle AOB is 140^0. Calculate the area of the collar.

7. Show that the equation $x(2 - 3x) = 5$ has no real roots.

8. In triangle PQR

    - PQ = 6 cm
    - PR = 8 cm
    - Area of triangle PQR = 21 cm^2
    - Angle QPR is obtuse

    Calculate the size of angle QPR.
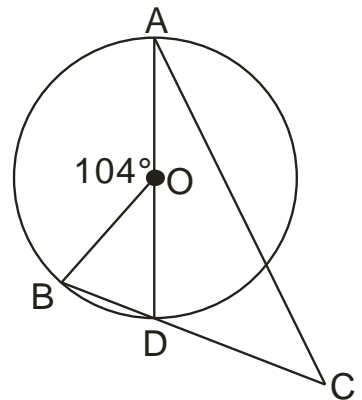
9. AD is a diameter of a circle, centre O.

    B is a point on the circumference of the circle.

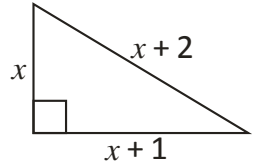   The chord BD is extended to a point C, outside the circle.

    Angle BOA = 104^0. DC = 8 centimetres.

    The radius of the circle is 6 centimetres.

    Calculate the length of AC.

10. Aright-angled triangle has dimensions, in centimetres, as shown.

    Calculate the value of x.

11. The depth of water, D metres, in a harbour is given by the formula

    $$D = 4 + 1 \cdot 5\sin30h°$$

    where h is the number of hours after midnight.

    (a) Calculate the depth of the water at 6 am.

    (b) Calculate the maximum difference in depth of the water in the harbour.

    Do not use a trial and improvement method.

Paper D	ANSWERS	Calculator

1. £1 493 000 000 000 **2.** -16 **3.** $1466 \cdot 05 mm^3$ **4.** $\dfrac{1}{x^2}$ **5(a)** $-\dfrac{1}{3}$ **(b)** (0, 4)

6. $136 \cdot 83$ cm^3 **7.** $b^2 - 4ac = -56$ **8.** $119°$ **9.** $18 \cdot 06cm$ **10.** 3 **11(a)** 4 m **(b)** 3 m

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Paper E — Non-Calculator

1. Multiply out the brackets and collect like terms: $(2x+5)(x^2 - x + 4)$

2. Solve the equation: $6x^2 + 13x - 5 = 0$.

3. Express $\dfrac{2}{\sqrt{6}}$ with a rational denominator in its simplest form.

4. Change the subject of the formula $p = \dfrac{4\sqrt{q}}{r}$ to q.

5. (a) Multiply out the brackets and simplify: $x^{\frac{3}{2}}\left(x^{\frac{1}{2}} + x^{-\frac{1}{2}}\right)$.

    (b) Find the exact value of this expression when $x = 6$.

6. A parabola has equation $y = x^2 + 4x + 2$.

(a) Write the equation in the form $y = (x - p)^2 + q$.

(b) Sketch the graph of $y = (x - p)^2 + q$, showing the coordinates of the

turning point and the point of intersection with the y-axis.

7. Colin and Jane visit a music shop. Colin buys 2 CDs and 3 DVDs. The total cost of this is £40.

(a) Write down an equation to illustrate this information.

(b) Jane buys 5 CDs and 2 DVDs.

The total cost of this is £45.

Write down an equation to illustrate this information.

(c) Find the cost of a CD and the cost of a DVD.

8. Express: $\dfrac{5}{x+1} - \dfrac{3}{x-2}$, $x \neq -1, x \neq 2$ as a single fraction in its simplest form.
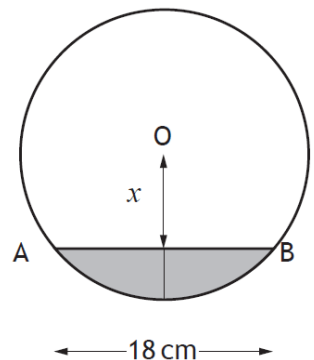
9. A cylindrical pipe has water in it as shown.
The depth of the water at the deepest point is
6 centimetres.
The width of the water surface, AB, is
16 centimetres.
The radius of the pipe is r centimetres. The
distance from the centre, O, of the pipe to the
water surface is x centimetres.

(a) Write down an expression for x in terms of r.

(b) Calculate r, the radius of the pipe.

Paper E	ANSWERS	Non-Calculator

1. $2x^3 + 3x^2 + 3x + 20$ **2.** $-\dfrac{5}{2}, \dfrac{1}{3}$ **3.** $\dfrac{\sqrt{6}}{3}$ **4.** $q = \dfrac{p^2 r^2}{16}$ **5(a)** $x^2 + x$ **(b)** 42

6(a) $y = (x+2)^2 - 2$ **(b)** $TP(-2, -2), (0, 2)$ **7(a)** $2C + 3D = 40$ **(b)** $5C + 2D = 45$

7(c) CD=£5, DVD=£10 **8.** $\dfrac{2x-13}{(x+1)(x-2)}$ **9(a)** $x = r - 6$ **(b)** $\dfrac{25}{3} cm$

Paper E   Calculator

1. There are 5×10^6 platelets per millilitre of blood. On average, a person has 2·9 litres of blood. On average, how many platelets does a person have in their blood? Give your answer in scientific notation.

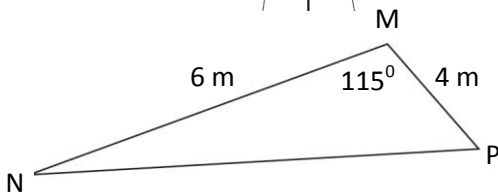2. The graph with equation $y = kx^2$ is shown.

   The point (2, −32) lies on the graph.

   Determine the value of k.
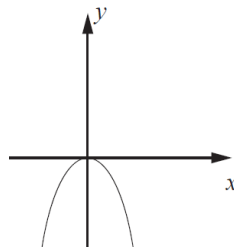
3. In triangle MNP, MP = 4 m,
   MN = 6 cm and
   angle PMN = 115°.

   Calculate the length of PN.
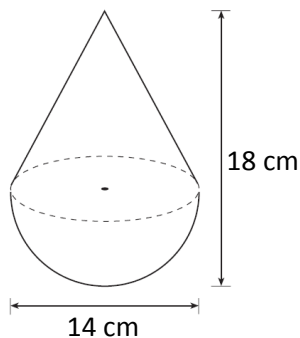

6 m   115°   4 m

4. A child's toy is in the shape of a hemisphere with a cone on top, as shown in the diagram.

   The toy is 14 centimetres wide and 18 centimetres high.
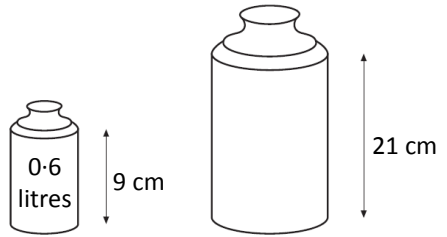
   Calculate the volume of the toy.
   Give your answer correct to 2 significant figures.
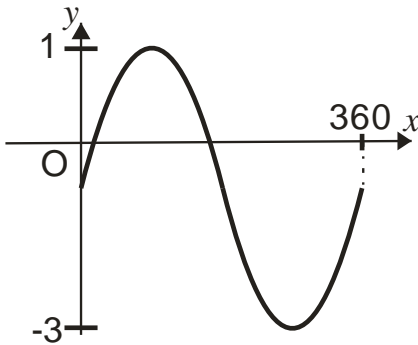

18 cm

14 cm

5. Screenwash is available in two different sized bottles, 'Mini' and 'Maxi'.

   The bottles are mathematically similar.

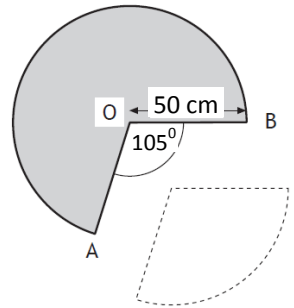   Calculate the volume of the 'Maxi' bottle.

   0·6 litres 9 cm

   21 cm

6. Part of the graph of $y = a\sin x° + b$ is shown below.

   (a) Explain how you can tell from the graph that $a = 2$ and $b = -1$

   (b) Calculate the x-coordinates of the points where the graph cuts the x-axis.

7. A cone is formed from a paper circle with a sector removed as shown.
   The radius of the paper circle is 50 centimetres.
   Angle AOB is 105°.

   O ← 50 cm → B
   105°
   A

   (a) Calculate the area of the sector removed from the circle.

   (b) Calculate the circumference of the base of the cone.

8. Find the range of values of p such that the equation

$px^2 + 2x - 4 = 0$, $p \neq 0$, has no real roots.

Paper E	**ANSWERS**	**Calculator**

1. $1 \cdot 45 \times 10^{10}$ **2.** -8 **3.** $8 \cdot 50m$ **4.** $1300cm^3$ **5.** $7 \cdot 62litres$ **6(a)** **(b)** $(30, 0), (150, 0)$

7(a) $2290 \cdot 7cm^2$ **(b)** $222 \cdot 5cm$ **8.** $p < -\dfrac{1}{4}$
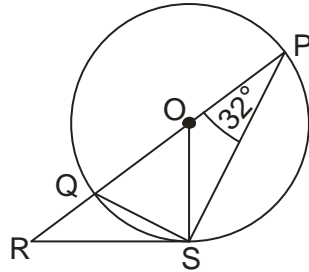
Paper F   Non-Calculator

1. Expand and simplify: $(2x - 3)(2x^2 - 5x + 2)$.

2. Change the subject of the formula to d: $a = \dfrac{5}{cd^2}$.

3. In the diagram

   - O is the centre of the circle
   - PQ is the diameter
   - PQR is a straight line
   - RS is a tangent to the circle at S
   - Angle QPS is 32°

   Calculate the size of angle QRS.

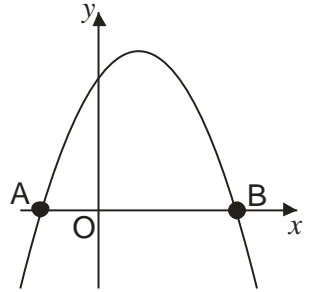4. Express $\dfrac{6x^2 - 3x}{2x^2 + 9x - 5}$ in its simplest form.

5. Evaluate $9^{\frac{3}{2}}$.

6. Simplify $\dfrac{5}{a+1} + \dfrac{2}{a-2}$.

7. The diagram shows part of the graph of

$y = 3 + 2x - x^2$.

(a) Find the coordinates of A and B

(a) State the equation of the axis of symmetry of the graph.

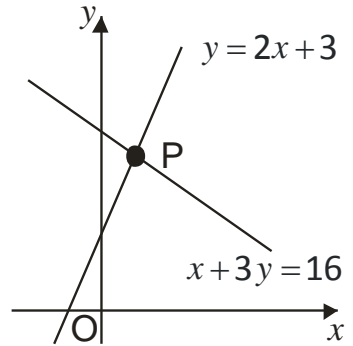(b) Hence, find the maximum value of

$y = 3 + 2x - x^2$.

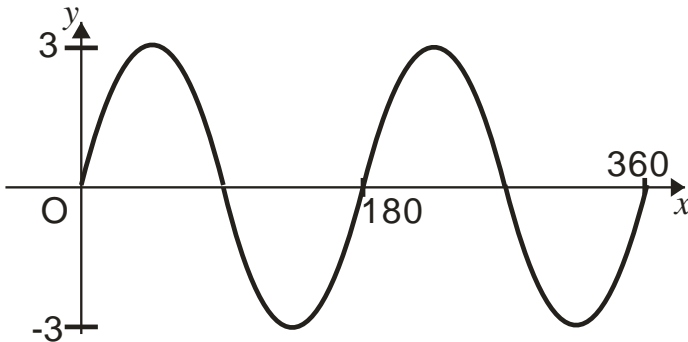8. The graph below shows two straight lines

- $y = 2x + 3$

- $x + 3y = 16$

The lines intersect at the point P.

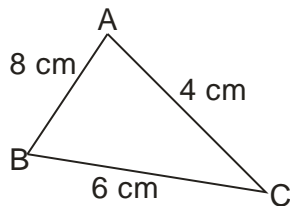Find, **algebraically**, the coordinates of P.

9. Part of the graph of $y = a \sin x°$ is shown in the diagram.
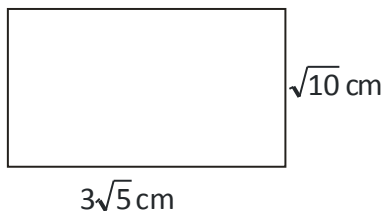

State the values of a and b.

10. In the triangle ABC, show that $\cos C = -\dfrac{1}{4}$.

11. The rectangle has length $3\sqrt{5}$ centimetres and breadth $\sqrt{10}$ centimetres.

    Calculate the area of the rectangle.
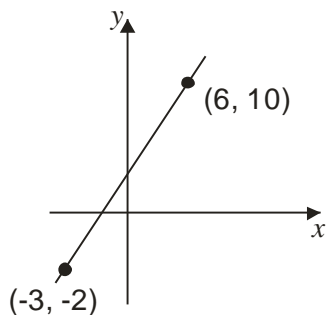
    Express you answer as a surd in its simplest form.

$\sqrt{10}$ cm

$3\sqrt{5}$ cm

12. Prove that the roots of the equation $3x^2 + 8x + 2 = 0$ are real and irrational.

Paper F	**ANSWERS**	**Non-Calculator**

1. $4x^3 - 16x^2 + 19x - 6$ **2.** $d = \sqrt{\dfrac{5}{ac}}$ **3.** $26°$ **4.** $\dfrac{3x}{x+5}$ **5.** 27 **6.** $\dfrac{7a-8}{(a+1)(a-2)}$

7(a) $A(-1,0), B(3,0)$ **(b)** $x=1$ **(c)** $\max = 4$ **8.** $P(1,5)$ **9.** $a=3, b=2$ **10.** *proof*

11. $15\sqrt{2}$ **12.** $b^2 - 4ac = 40$

Paper F   Calculator

1. Find the equation of the straight line shown in the diagram.
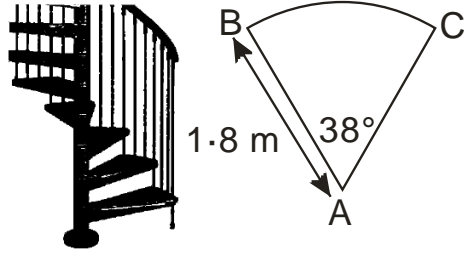

(6, 10)

(-3, -2)

2. A spiral staircase is being designed.

    Each step is made from a sector of
    a circle as shown.

    The radius is 1·8 metres.

    Angle BAC is 38º.

    For the staircase to pass safety regulations, the arc BC must be at least
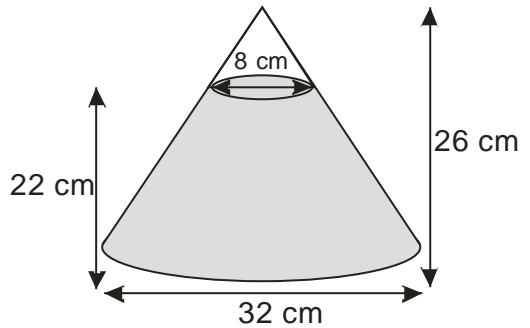   1·1 metres. Will the staircase pass safety regulations?

3. A glass ornament is in the shape of a cone partly filled with coloured water.

    The cone is 26 centimetres high and has a base diameter 32 centimetres.
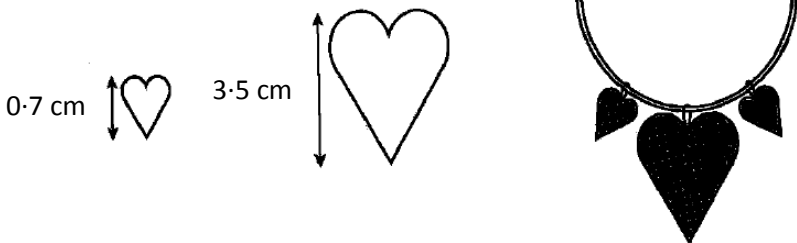
    The water is 22 centimetres
    deep and measures
    8 centimetres across the top.

    What is the volume of the
    water?

    Give your answer correct to
    2 significant figures.

4. A necklace is made of beads which are mathematically similar.

    The height of the smaller bead is 0·7 centimetres and its area is 0·8 square
    centimetres. The height of the larger bead is 3·5 centimetres. Find the area
    of the larger bead.

5. Paving stones are in the shape of a rhombus.

   The side of each rhombus is 50 centimetres long.

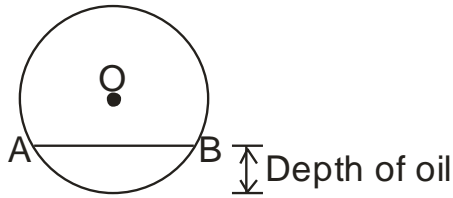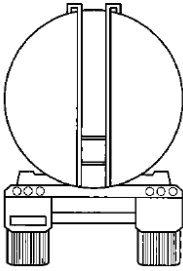   The obtuse angle is 112^{0}.

   Find the area of one paving stone.

   35 cm

   108°
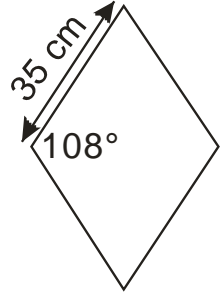
6. $f(x)=3\cos x,\ 0 \leq x \leq 360$.

   (a) Find $f(180)$

   (b) If $f(t)=1 \cdot 2$, find two possible values of t.

7. A tanker delivers oil to garages.

   The tanker has a circular cross-section as shown.

   O

   A   B   ↕Depth of oil

   The radius of the circle, OA is $1 \cdot 5$ metres.

   The width of the surface of the oil, represented by AB in the diagram, is $2 \cdot 2$ metres.
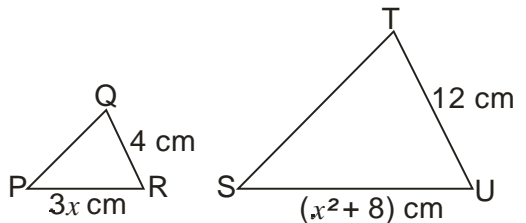
   Calculate the depth of oil in the tanker.

8. Triangles PQR and STU are mathematically similar.

   The scale factor is 3 and PR corresponds to SU.

   Q

   4 cm

   P   R

   $3x$ cm

   T

   12 cm

   S   U

   (x^2+8) cm

   (a) Show that $x^2 - 9x + 8 = 0$.

   (b) Given that QR is the shortest side of triangle PQR, find the value of x.

1. $y = \dfrac{4}{3}x + 2$ **2.** *yes* because $1\cdot19 > 1\cdot1$ **3.** $6900 cm^3$ **4.** $20 cm^2$ **5.** $1165\cdot04 cm^2$

6(a) -3 **(b)** $66\cdot4°, 293\cdot6°$ **7.** $0\cdot48m$ **8(a).** *proof*   **(b)** $x = 1$

Paper G   Non-Calculator

1. Factorise fully: $5x^2 - 45$.

2. Given that $f(x) = x^2 - 2x + 3$, evaluate $f(-4)$.

3. Solve the equation $\dfrac{x+4}{2} = \dfrac{2x-1}{3}$.

4. Express $\sqrt{12} + \sqrt{184} - \sqrt{3}$ as a surd in its simplest form.

5. Express $x^2 - 6x + 2$ in the form $(x+p)^2 + q$.

6. Alan is taking part in a quiz. He is awarded x points for each correct answer and y points for each wrong answer. During the quiz, Alan gets 24 questions correct and 6 wrong. He scores 60 points.

   (a) Write down an equation in x and y which satisfies the above condition.
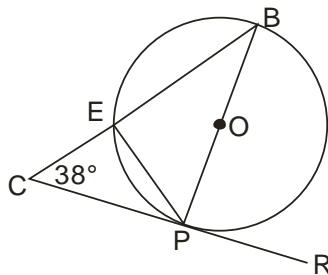
   Helen also takes part in the quiz. She gets 20 questions correct an 10 wrong. She scores 40 points.

   (b) Write down a second equation in x and y which satisfies this condition.

   (c) Calculate the score for David who gets 17 correct and 13 wrong.

7. A circle, centre O is shown. In the circle

   - PB is a diameter
   - CR is a tangent to the circle at point P
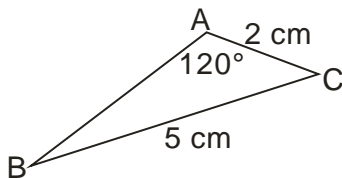   - Angle BCP is 38^0

   Calculate the size of angle EPR.

8. Express $\dfrac{y^{\frac{1}{2}} \times y^{\frac{7}{2}}}{y^2}$ in its simplest form.

9. In the triangle ABC,

   - AC = 2 centimetres

   - BC = 5 centimetres

   - Angle BAC = 120^0

   Given that $\sin 60° = \dfrac{\sqrt{3}}{2}$, show that $\sin B = \dfrac{\sqrt{3}}{5}$.

10. Express $\dfrac{7y^2}{10} \div \dfrac{y}{5}$ as a fraction in its simplest form.

11. Prove that $\cos^2 a - \sin^2 a = 2\cos^2 a - 1$

Paper G   **ANSWERS**   **Non-Calculator**

1. $5(x+3)(x-3)$ **2.** 27 **3.** $x=14$ **4.** $\sqrt{3}+2\sqrt{46}$ **5.** $(x-3)^2 - 7$

6(a) $24x+6y=60$ **(b)** $20x+10y=40$ **(c)** $x=3, y=-2,\ David=25$ **7.** $128°$ **8.** y^2

9. sine rule   **10.** $\dfrac{7y}{2}$ **11.** *proof*

Paper G   Calculator

1. If $A = BC^2$, find the value of A when $B = 5\cdot6\times10^{10}$ and $C = 2\cdot9\times10^{-3}$.
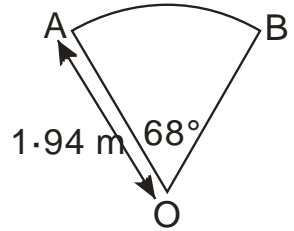   Give you answer in scientific notation

2. Expand fully and simplify $(x+1)(x-2)(x+3)$.

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3. A sector of a circle, centre O, is shown.

    The radius of the circle is 1·94 metres.

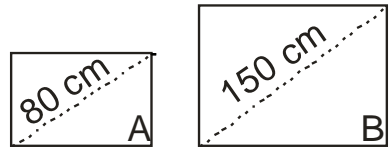   Angle AOB is 68^0. Find the length of the arc AB.

4. Change the formula $P = \dfrac{3qr^2}{t}$ to r.

5. Solve the equation $x^2 - 6x + 3 = 0$.
    Give your answer correct to 2 significant figures.

6. Two rectangular solar panels, A and B, are
    mathematically similar.

    Panel A has a diagonal of 80 cm and an
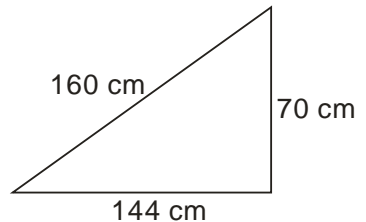   area of 4512 cm^2.

    A salesman claims that panel B, with a diagonal of 150 cm, will be double
    the area of panel A.

    Is this claim justified? **Show all your working.**

7. A triangular paving slab has measurements
    as shown.

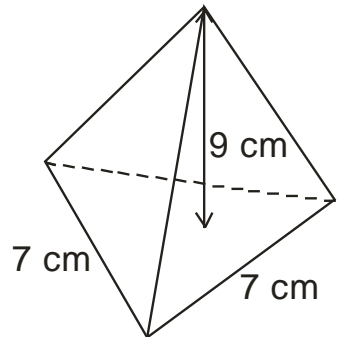   Is the slab in the shape of a right angled
    triangle?

    Show your working.

8. The diagram shows a pyramid.

    The base of the pyramid is an equilateral
    triangle of side 7 centimetres.
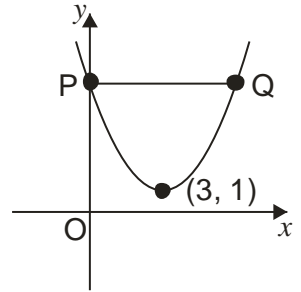
    The height of the pyramid is 9 cm.

    Calculate the volume of the pyramid.

9. The graph below shows part of a parabola with equation of the form

$$y = (x+a)^2 + b$$

(3, 1)

(a) State the values of a and b.
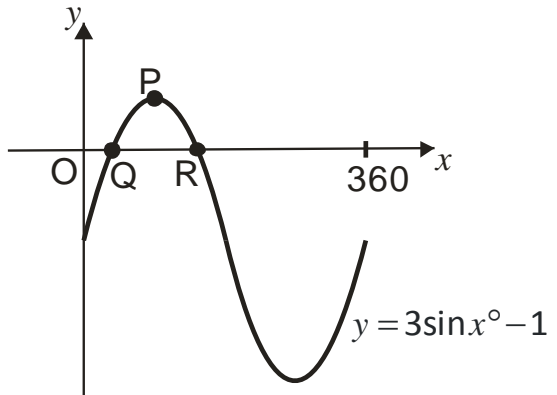
(b) The line PQ is parallel to the x-axis.

    Find the coordinates of P and Q.

10. Part of the graph of $y = 3\sin x° - 1$ is shown.

The graph cuts the x-axis at Q and R.

P is the maximum turning point.
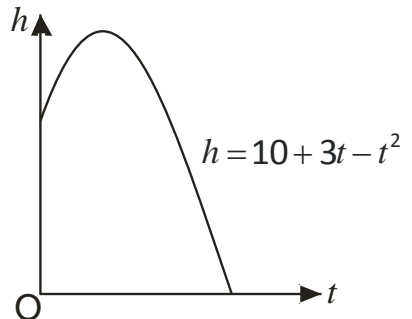

$$y = 3\sin x° - 1$$

(a) Write down the coordinates of P.

(b) calculate the
    x – coordinates of Q and R.

11. The diagram shows the path of a flare after it is fired.

The height, h metres above sea level, of the flare, is given by $h = 10 + 3t - t^2$ where t is the number of seconds after firing.

$$h = 10 + 3t - t^2$$

Calculate, **algebraically**, the time taken for the flare to enter the sea.

Paper G	**ANSWERS**	**Calculator**

1. $4 \cdot 7096$ x x10^5 **2.** $x^3 + 2x^2 - 5x - 6$ **3.** $2 \cdot 30m$ **4.** $r = \sqrt{\dfrac{pt}{3q}}$ **5.** $0 \cdot 55, 5 \cdot 4$

6. Area B = $15862 \cdot 5$. Justified because $15862 \cdot 5 > 9024$

7. $25600 \neq 25636$ therefore not right angled **8.** $63 \cdot 65cm^3$ **9(a)** $a = -3, b = 1$

9(b) $P(0,10), Q(6,10)$ **10(a)** $(90,2)$ **(b)** $x_Q = 19 \cdot 5, x_R = 160 \cdot 5$ **11.** t= 5 secs

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Paper H	**Non-Calculator**

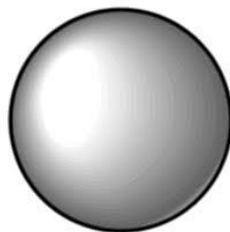1. Solve the inequality: $2(x-1) - 3(x-2) \leq 4x - 7$.

2. Factorise $6p^2 + p - 12$.

3. The diagram represents a sphere.

   The sphere has a diameter of 6 centimetres.

   Calculate its volume.
   Take $\pi = 3 \cdot 14$.

4. Solve algebraically the system of equations

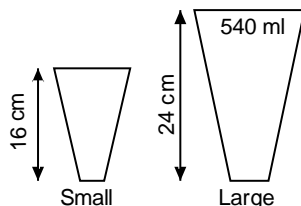 $2x - 3y = 9$
   $5x + 2y = 13$

5. Coffee is sold in small cups and large cups.

   The two cups are mathematically similar in shape.
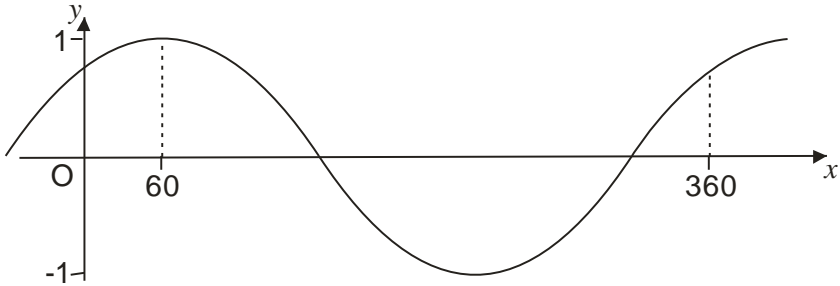
   The small cup is 16 cm high.

   The large cup is 24 cm high and holds 540 millilitres.

   Calculate how many millilitres the small cup holds.

6. The graph has an equation $y = \cos(x - a)^\circ$.

Write down the value of a.

7. Express $\dfrac{10}{\sqrt{2}}$ with a rational denominator.

Give your answer in its simplest form.

8. Brad is taking part in a cycling and running event. The course is 60 km long

(a) On Saturday he cycles the course in x hours.

Find his speed for the course in terms of x.

(b) On Sunday he takes 3 hours more to run the same course.

Find his speed in terms of x.

(c) Hence find an expression, in terms of x, for the difference in speeds between the cycling on Saturday and the running on Sunday.

9. William Watson's fast Foods use a logo based on parts of three identical parabolas. This logo is represented in the diagram below.
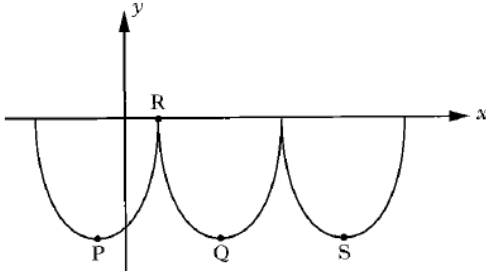
The first parabola has turning point P and equation $y = (x+2)^2 - 10$.

(a) State the coordinates of P.

(b) If R is the point (3, 0), find the coordinates of Q, the minimum turning point of the second parabola.

(c) Find the equation of the parabola with turning point S.

Paper H	ANSWERS	Non-Calculator

1. $x \geq \dfrac{11}{5}$ **2.** $(2p+3)(3p-4)$ **3.** $113 \cdot 04 cm^3$ **4.** $x=3, y=-1$ **5.** $160ml$ **6.** 60°

7. $5\sqrt{2}$ **8(a)** $\dfrac{60}{x}$ **(b)** $\dfrac{60}{x+3}$ **(c)** $\dfrac{180}{x(x+3)}$

9(a) $(-2,10)$ **(b)** $(8,-10)$ **(c)** $y = (x-18)^2 - 10$

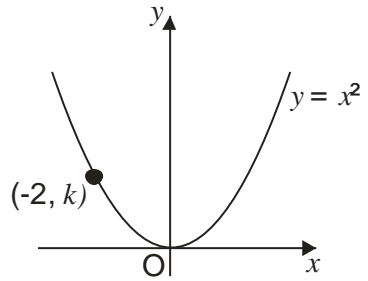1. The National Debt of the United Kingdom was calculated as

    £2 473 325 619 281

    Round this amount to four significant figures.

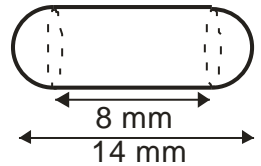2. The diagram shows the graph of $y = x^2$.

   The point (−2, k) lies on the graph.

   Find the value of k.

3. A health food shop produces cod liver oil capsules for its customers.

   Each capsule is in the shape of a cylinder with hemispherical ends as shown.

   The total length of the capsule is 14 millimetres and the length of the cylinder is 8 millimetres.

   Calculate the volume of one cod liver oil capsule.

4. Express in its simplest form $(a^3)^{-4} \times a^7$.
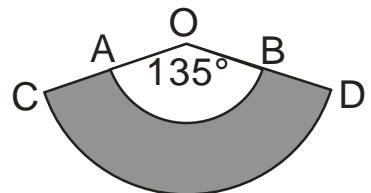
5. A straight line is represented by the equation $4y - x = 8$.

   (a) Find the gradient of this line.

   (b) Write down the coordinates of the point where this line crosses the y-axis.

6. A pet shop manufactures protective dog collars.

   In the diagram the shaded area represents one of these collars.

   AB and CD are arcs of circles with centres at O.

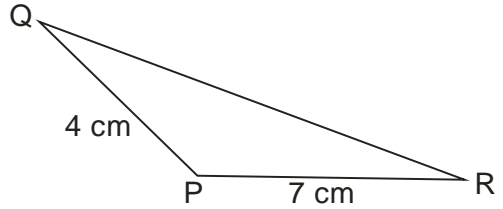   The radius, OA is 10 inches and the radius OC, is 14 inches.

   Angle AOB is 135⁰.

   Calculate the area of the collar.

7. Show that the equation $3x^2 - 4x + 2 = 0$ has no real roots.

8. In triangle PQR
   - PQ = 4 cm
   - PR = 7 cm
   - Area of triangle PQR = 9 cm^2
   - Angle QPR is obtuse

   Calculate the size of angle QPR.

9. AD is a diameter of a circle, centre O.
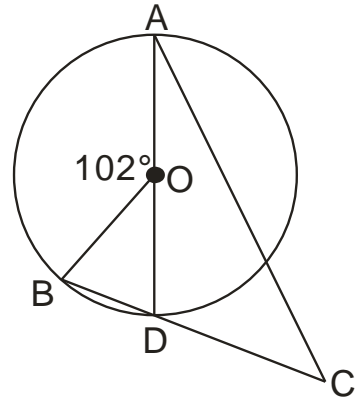
   B is a point on the circumference of the circle.

   The chord BD is extended to a point C, outside the circle.

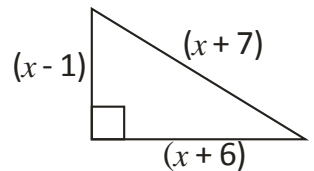   Angle BOA = 102^0.

   DC = 11 centimetres.

   The radius of the circle is 8 centimetres.

   Calculate the length of AC.

10. Aright-angled triangle has dimensions, in centimetres, as shown.

    Calculate the value of x.

11. The depth of water, D metres, in a harbour is given by the formula

    $$D = 3 + 2 \cdot 4 \sin 30h°$$

    where h is the number of hours after midnight.

    (a) Calculate the depth of the water at 8 am.

    (b) Calculate the maximum difference in depth of the water in the harbour.

    Do not use a trial and improvement method.

Paper H	ANSWERS	Calculator

1. £2473000000000 **2.** $k = 4$ **3.** $339.29mm^3$ **4.** $\dfrac{1}{a^5}$ **5(a)** $\dfrac{1}{4}$ **(b)** $(0,2)$

6. $113 \cdot 1\, inches^2$ **7.** $b^2 - 4ac = -8$ **8.** 140° **9.** $24 \cdot 46cm$ **10.** $x = 6$

11(a) $0 \cdot 922m$ **(b)** $4 \cdot 8m$

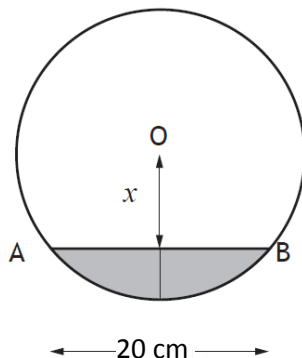# Paper I   Non-Calculator

1. Multiply out the brackets and collect like terms: $(2x - 3)(2x^2 - 2x + 1)$

2. Solve the equation: $2x^2 - 7x + 3 = 0$.

3. Express $\dfrac{2}{\sqrt{3}}$ with a rational denominator in its simplest form.

4. Change the subject of the formula $M = q + \dfrac{p}{r}$ to r.

5. (a) Multiply out the brackets and simplify: $x^{\frac{1}{2}}\left(x^{\frac{3}{2}} + x^{-\frac{1}{2}}\right)$.

   (b) Find the exact value of this expression when $x = 5$.

6. A parabola has equation $y = x^2 - 8x - 1$.

   (a) Write the equation in the form $y = (x - p)^2 + q$.

   (b) Sketch the graph of $y = (x - p)^2 + q$, showing the coordinates of the turning point and the point of intersection with the y-axis.

7. Colin and Jane visit a music shop. Colin buys 4 CDs and 5 DVDs. The total cost of this is £55.

   (a) Write down an equation to illustrate this information.

   (b) Jane buys 3 CDs and 2 DVDs. The total cost of this is £29.

      Write down an equation to illustrate this information.

   (c) Find the cost of a CD and the cost of a DVD.

---

8. Express: $\dfrac{4}{x+3} - \dfrac{2}{x-1}$, $x \neq -3, x \neq 1$ as a single fraction in its simplest form.

9. A cylindrical pipe has water in it as shown.
   The depth of the water at the deepest point is
   5 centimetres. The width of the water surface,
   AB, is 20 centimetres.
   The radius of the pipe is r centimetres. The
   distance from the centre, O, of the pipe to the
   water surface is x centimetres.

   (a) Write down an expression for x in terms of r.

   (b) Calculate r, the radius of the pipe.

—20 cm—

| **Paper I** | **ANSWERS** | **Non-Calculator** |

1. $4x^3 - 10x^2 + 8x - 3$ **2.** $\dfrac{1}{2},3$ **3.** $\dfrac{2\sqrt{3}}{3}$ **4.** $r = \dfrac{p}{M-q}$ **5(a)** $x^2 + 1$ **(b)** 26

6(a) $y = (x-4)^2 - 17$ **(b)** $TP(4,-17)$ $(0,-1)$ **7(a)** $4C + 5D = 55$ **(b)** $3C + 2D = 29$

7(c) CD = £5, DVD = £7 **8.** $\dfrac{2x-10}{(x+3)(x-1)}$ **9(a)** $r-5$ **(b)** $r = 12 \cdot 5 cm$

| **Paper I** | **Calculator** |

1. There are 4×10^5 platelets per millilitre of blood. On average, a person has
   4·6 litres of blood. On average, how many platelets does a person have in
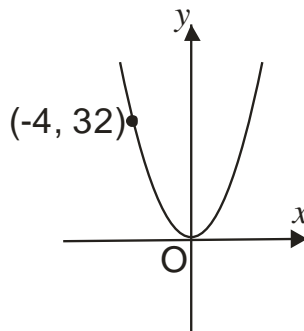   their blood?
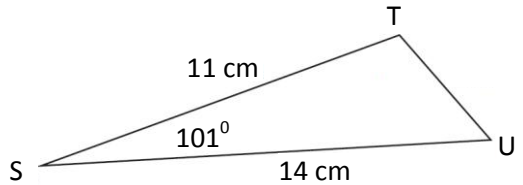   Give your answer in scientific notation.

2. The graph with equation
   $y = kx^2$ is shown.
   The point (–4, 32) lies on the graph.
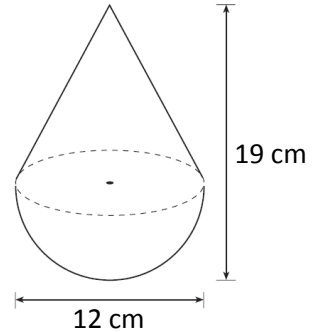   Determine the value of k.

(-4, 32)

3. In triangle STU, ST = 11 cm,
   SU = 14 cm and
   angle TSU = 101°.

   Calculate the length of TU.

4. A child's toy is in the shape of a hemisphere with
   a cone on top, as shown in the diagram.

   The toy is 12 centimetres wide and
   19 centimetres high.

   Calculate the volume of the toy. Give your
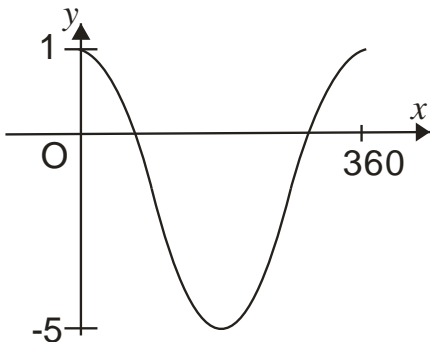   answer correct to 2 significant figures.

5. Screenwash is available in two
   different sized bottles, 'Mini' and 'Maxi'.

   The bottles are mathematically similar.

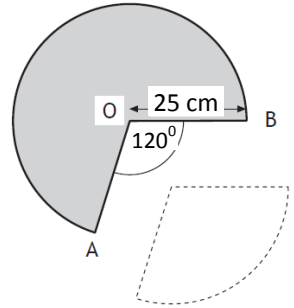   Calculate the volume of the 'Maxi' bottle.

6. Part of the graph of $y = a\cos x° + b$ is shown below.

   (a) Explain how you can tell from the graph that $a = 3$ and $b = -2$.

   (b) Calculate the x-coordinates of the points where the graph cuts the x-axis.

7. A cone is formed from a paper circle with a sector removed as shown.

The radius of the paper circle is 25 centimetres.

Angle AOB is 120°.

(a) Calculate the area of the sector removed from the circle.

(b) Calculate the circumference of the base of the cone.

8. Find the range of values of p such that the equation

$px^2 - 3x - 6 = 0, \quad p \neq 0$, has no real roots.

Paper I	ANSWERS	Calculator

1. $1 \cdot 84 \times 10^9$ **2.** $k = 2$ **3.** $19 \cdot 38 cm$ **4.** $940 cm^3$ **5.** $0 \cdot 977$ litres

6(a) (b) $48 \cdot 2, 311 \cdot 8$ **7(a)** $654 \cdot 5 cm^2$ **(b)** $104 \cdot 7 cm$ **8.** $p < -\dfrac{3}{8}$

Paper J   Non-Calculator

1. Expand and simplify: $(4x - 3)((3x^2 + 6x - 3)$.

2. Change the subject of the formula to n: $m = \dfrac{7 + n}{3p}$.

3. In the diagram

- O is the centre of the circle
- PQ is the diameter
- PQR is a straight line
- RS is a tangent to the circle at S
- Angle QPS is 16°
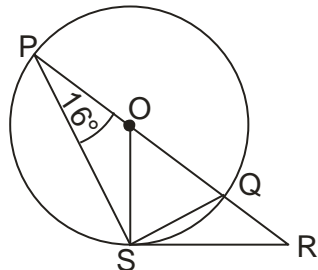
Calculate the size of angle QRS.

4. Express $\dfrac{x^2-9}{3x^2-5x-12}$ in its simplest form.

5. Evaluate $4^{\frac{5}{2}}$.

6. Simplify $\dfrac{3}{p}+\dfrac{5}{p+1}$.
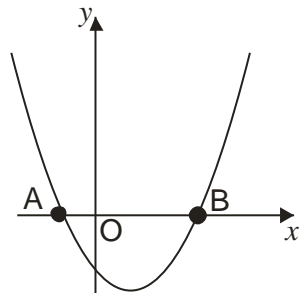
7. The diagram shows part of the graph of

$y=x^2-6x-7$.

   (a) Find the coordinates of A and B

   (b) State the equation of the axis of symmetry of the graph.
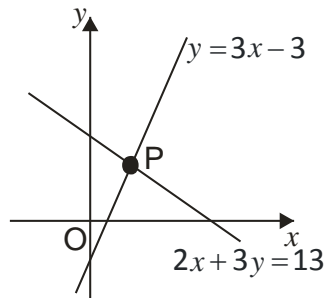
   (c) Hence, find the minimum value of

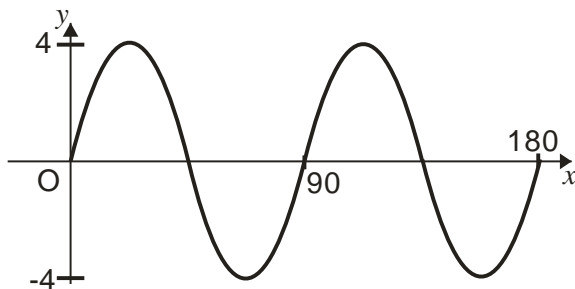$y=x^2-6x-7$.

8. The graph below shows two straight lines

   • $y=3x-3$

   • $2x+3y=13$

   The lines intersect at the point P.
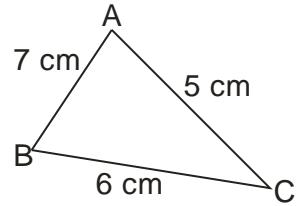
   Find, **algebraically**, the coordinates of P.

9. Part of the graph of $y=a\sin bx°$ is shown in the diagram.
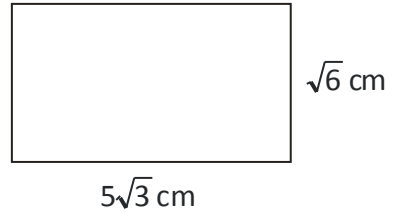

   State the values of a and b.

10. In the triangle ABC, show that $\cos A = \dfrac{19}{35}$.

11. The rectangle has length $5\sqrt{3}$ centimetres and breadth $\sqrt{6}$ centimetres.

    Calculate the area of the rectangle.
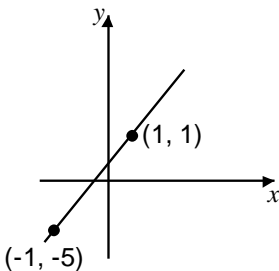
    Express you answer as a surd in its simplest form.

$\sqrt{6}$ cm

$5\sqrt{3}$ cm

12. Prove that the roots of the equation $4x^2 + 2x - 3 = 0$ are real and irrational.

Paper J	**ANSWERS**	**Non-Calculator**

1. $12x^3 + 15x^2 - 30x + 9$ **2.** $n = 3mp - 7$ **3.** $58°$ **4.** $\dfrac{(x+3)}{(3x+4)}$ **5.** 32 **6.** $\dfrac{8p+3}{p(p+1)}$

7(a) $A(-1,0), B(7,0)$ **(b)** $x = 3$ **(c)** $\min = -16$ **8.** $(2,3)$ **9.** $a = 4, b = 4$

10. cosine rule **11.** $15\sqrt{2}$ **12.** $b^2 - 4ac = 52$

Paper J   Calculator

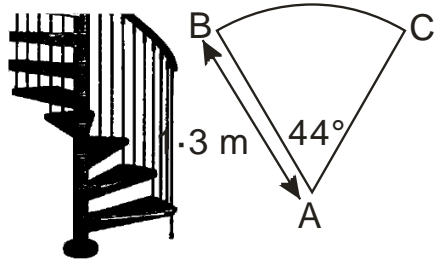1. Find the equation of the straight line shown in the diagram.

2. A spiral staircase is being designed.

   Each step is made from a sector of a circle as shown.

   The radius is 1·3 metres.
   Angle BAC is 44°.

   For the staircase to pass safety

   regulations, the arc BC must be at least 0·9 metres. Will the staircase pass safety regulations?
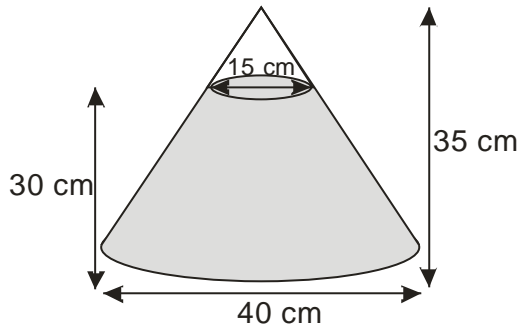
3. A glass ornament is in the shape of a cone partly filled with coloured water.

   The cone is 35 centimetres high and has a base diameter 40 centimetres.

   The water is 30 centimetres deep and measures 15 centimetres across the top.

   What is the volume of the water?

   Give your answer correct to 2 significant figures.

4. A necklace is made of beads which are mathematically similar.

   The height of the smaller bead is 0·5 centimetres and its area is 1·3 square centimetres. The height of the larger bead is 3 centimetres. Find the area of the larger bead.

5. Paving stones are in the shape of a rhombus.

   The side of each rhombus is 42 centimetres long.

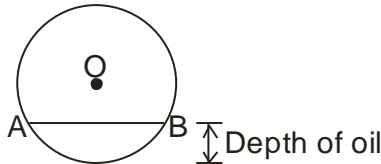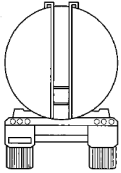   The obtuse angle is 114^0.

   Find the area of one paving stone.
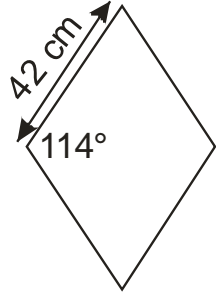
6. $f(x) = 2\sin x,\ 0 \le x \le 360$.

   (a) Find $f(90)$

   (b) If $f(t) = 0 \cdot 7$, find two possible values of t.

7. A tanker delivers oil to garages.

   The tanker has a circular cross-section as shown.

   The radius of the circle, OA is $1 \cdot 7$ metres.

   The width of the surface of the oil, represented by AB in the diagram, is $2 \cdot 4$ metres. Calculate the depth of oil in the tanker.
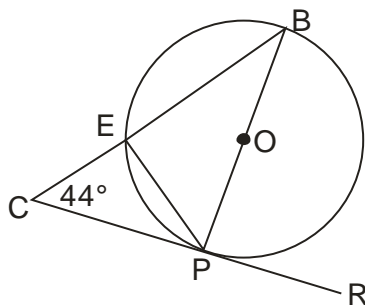
Paper J	ANSWERS	Calculator

1. $y = 3x - 2$ **2.** Yes because 1·0>0·9 **3.** $14000 cm^3$ **4.** $46 \cdot 8 cm^2$ **5.** $1611 \cdot 49 cm^2$

6(a) 2 **(b)** $20 \cdot 5°, 159 \cdot 5°$ **7.** $0 \cdot 5m$

1. Factorise fully: $100 - 4y^2$.

2. Given that $f(x) = 2x - x^2$, evaluate $f(-3)$.

3. Solve the equation $3x - 1 = \dfrac{2x + 1}{3}$.

4. Express $\sqrt{45} - \sqrt{20} + \sqrt{5}$ as a surd in its simplest form.

5. Express $x^2 + 4x - 3$ in the form $(x + p)^2 + q$.

6. Alan is taking part in a quiz. He is awarded x points for each correct answer and y points for each wrong answer. During the quiz, Alan gets 24 questions correct and 6 wrong. He scores 60 points.

   (a) Write down an equation in x and y which satisfies the above condition.

   Helen also takes part in the quiz. She gets 20 questions correct an 10 wrong. She scores 40 points.

   (b) Write down a second equation in x and y which satisfies this condition.

   (c) Calculate the score for David who gets 17 correct and 13 wrong.

7. A circle, centre O is shown.

   In the circle

   - PB is a diameter

   - CR is a tangent to the circle at point P
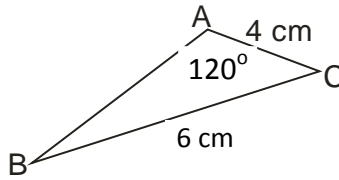
   - Angle BCP is 44^0

   Calculate the size of angle EPR.

8. Express $\dfrac{b^{\frac{7}{2}} \times b^{\frac{3}{2}}}{b^3}$ in its simplest form.

9. In the triangle ABC,

- AC = 4 centimetres

- BC = 6 centimetres

- Angle BAC = 120^0

Given that $\sin 60° = \dfrac{\sqrt{3}}{2}$, show that $\sin B = \dfrac{\sqrt{3}}{3}$.

10. Express $\dfrac{3a^5}{8} \div \dfrac{a^3}{2}$ as a fraction in its simplest form.

11. Prove that $\cos^2 a - \sin^2 a = 1 - 2\sin^2 a$.

Paper K	ANSWERS	Non-Calculator

1. $4(5+y)(5-y)$ **2.** -15 **3.** $\dfrac{4}{7}$ **4.** $2\sqrt{5}$ **5.** $(x+2)^2 - 7$ **6(a)** $24x + 6y = 60$

6(b) $20x + 10y = 40$ **(c)** $x = 3, y = -2, \text{David} = 25$ **7.** $134°$ **8.** b^2 **9.** sine rule

10. $\dfrac{3a^2}{4}$ **11.** proof

Paper K   Calculator

1. If $R = \dfrac{2I}{Q}$, find the value of R when $I = 2 \times 10^5$ and $Q = 3 \cdot 2 \times 10^{-3}$.
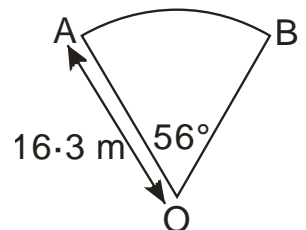
   Give you answer in scientific notation

2. Expand fully and simplify $x(x+3)^2$.
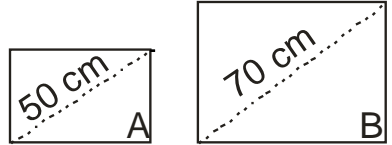
3. A sector of a circle, centre O, is shown.

   The radius of the circle is 16·3 metres.

   Angle AOB is 56^0. Find the length of the arc AB.

4. Change the formula $d = 2e^2 - 3m$ to e.

5. Solve the equation $3x^2 - 7x - 11 = 0$.
   Give your answer correct to 2 significant figures.

6. Two rectangular solar panels, A and B, are mathematically similar.

   Panel A has a diagonal of 50 cm and an area of 3200 cm^2.

   A salesman claims that panel B, with a diagonal of 70 cm, will be double the area of panel A. Is this claim justified? **Show all your working.**

7. A triangular paving slab has measurements as shown.

   Is the slab in the shape of a right angled triangle?
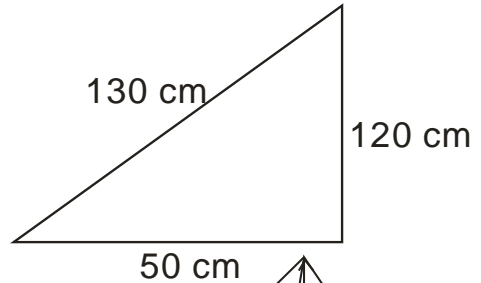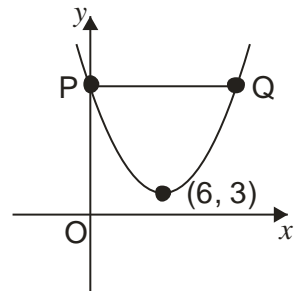
   Show your working.

8. The diagram shows a pyramid.

   The base of the pyramid is an equilateral triangle of side 8 centimetres.

   The height of the pyramid is 11 cm.

   Calculate the volume of the pyramid.
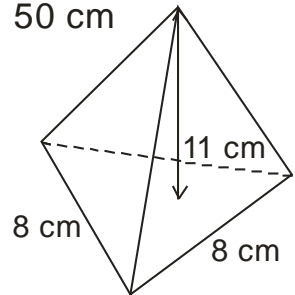
9. The graph below shows part of a parabola with equation of the form

   $$y = (x + a)^2 + b$$

   (a) State the values of a and b.
   (b) The line PQ is parallel to the x-axis.
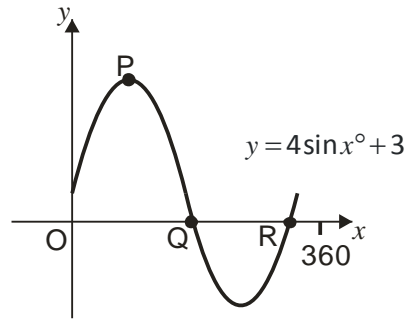   Find the coordinates of P and Q.

10. Part of the graph of $y = 4\sin x° + 3$ is shown.

The graph cuts the x-axis at Q and R.

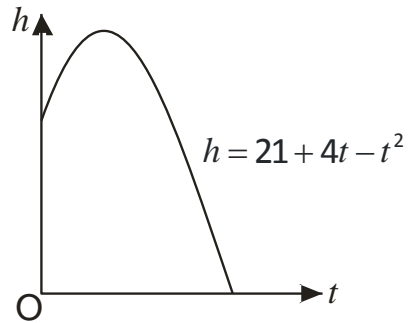P is the maximum turning point.

(a) Write down the coordinates of P.

(b) calculate the x – coordinates of Q and R.

$y = 4\sin x° + 3$

11. The diagram shows the path of a flare after it is fired.

The height, h metres above sea level, of the flare, is given by $h = 21 + 4t - t^2$ where t is the number of seconds after firing.

$h = 21 + 4t - t^2$

Calculate, **algebraically**, the time taken for the flare to enter the sea.

Paper K	ANSWERS	Calculator

1. $1·25 \times 10^8$ **2.** $x^3 + 6x^2 + 9x$ **3.** $15·93m$ **4.** $e = \sqrt{\dfrac{d + 3m}{2}}$ **5.** $3·4, -1·1$

6. area B =6272. Not justified because 6272<6400

7. 16900=16900 therefore right angled **8.** $101·6cm^3$ **9(a)** $a = -6, b = 3$

9(b) $P(0,39), Q(12,39)$ **10(a)** $(90,7)$ **(b)** $228·6, 311·4$ **11.** t=7 secs

Paper L   Non-Calculator

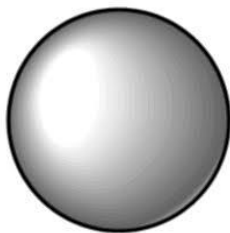1. Solve the inequality: $4 - 2(x - 2) \geq x + 5$.

2. Factorise $3p^2 - 23p + 14$.

*3. The diagram represents a sphere.   *** calcualtor**

The sphere has a diameter of 12 centimetres.

Calculate its volume.
Take $\pi = 3 \cdot 14$.

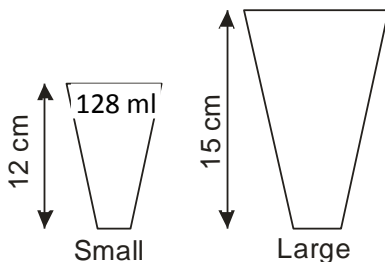4. Solve algebraically the system of equations

$$4x + 2y = 2$$
$$3x + 5y = 19$$

5. Coffee is sold in small cups and large cups.

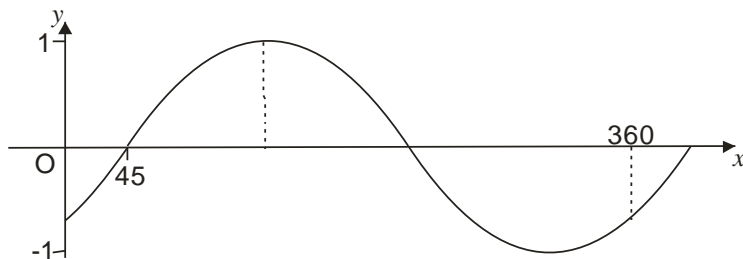The two cups are mathematically similar in shape.

The small cup is 12 cm high and holds 128 millilitres.

The large cup is 15 cm high.

Calculate how many millilitres the large cup holds.

6. The graph has an equation $y = \sin(x - a)^\circ$.

Write down the value of a.

7. Express $\dfrac{20}{\sqrt{5}}$ with a rational denominator.

Give your answer in its simplest form.

8. Brad is taking part in a cycling and running event. The course is 30 km long

   (a) On Saturday he cycles the course in x hours.

   Find his speed for the course in terms of x.

   (b) On Sunday he takes 1 hour more to run the same course.

   Find his speed in terms of x.

   (c) Hence find an expression, in terms of x, for the difference in speeds between the cycling on Saturday and the running on Sunday.

9. William Watson's fast Foods use a logo based on parts of three identical parabolas.

   This logo is represented in the diagram below.
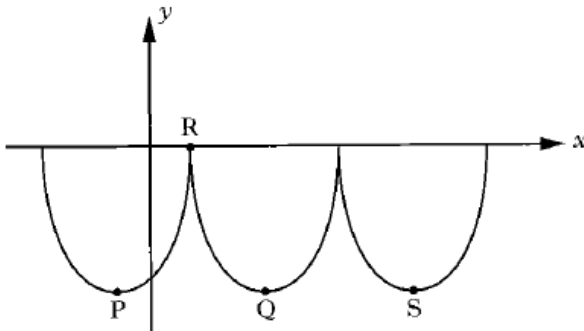
   The first parabola has turning point P and equation $y=(x+4)^2-15$.

   (a) State the coordinates of P.

   (b) If R is the point (2, 0), find the coordinates of Q, the minimum turning point of the second parabola.

   (c) Find the equation of the parabola with turning point S.

Paper L	ANSWERS	Non-Calculator

1. $x \leq 1$ **2.** $(p-7)(3p-2)$ **3.** $904 \cdot 32 cm^3$ **4.** $x=-2, y=5$ **5.** $250ml$ **6.** 45°

7. $4\sqrt{5}$ **8(a)** $\dfrac{30}{x}$ **(b)** $\dfrac{30}{x+1}$ **(c)** $\dfrac{30}{x(x+1)}$ **9(a)** $(-4,-15)$ **(b)** $(8,-15)$

9(c) $y = (x-20)^2 - 15$

Paper L   Calculator

1. The National Debt of the United Kingdom was calculated as
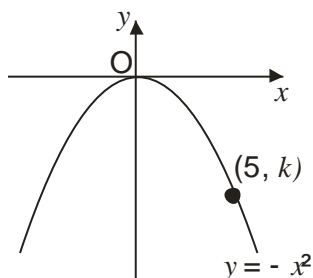
   £1 432 796 278

   Round this amount to four significant figures.
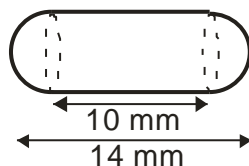
2. The diagram shows the graph of $y = -x^2$.

   The point $(5, k)$ lies on the graph.

   Find the value of k.

3. A health food shop produces cod liver oil capsules for its customers.

   Each capsule is in the shape of a cylinder with hemispherical ends as shown.

   The total length of the capsule is 14 millimetres and the length of the cylinder is 10 millimetres.

   Calculate the volume of one cod liver oil capsule.

4. Express in its simplest form $a^8 \times (a^5)^{-1}$.
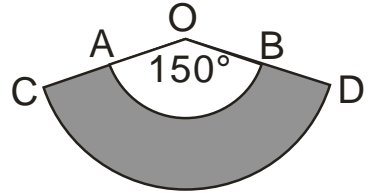
5. A straight line is represented by the equation $2y + 3x = 8$.

   (a) Find the gradient of this line.

   (b) Write down the coordinates of the point where this line crosses
   the y-axis.

6. A pet shop manufactures protective dog
   collars.

   In the diagram the shaded area represents
   one of these collars.

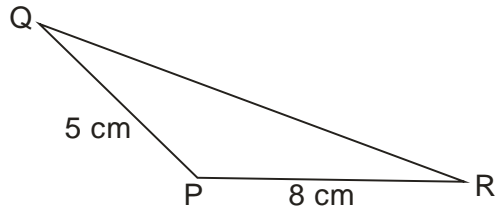   AB and CD are arcs of circles with centres at O.

   The radius, OA is 8 inches and the radius OC, is 11 inches.

   Angle AOB is 150^0. Calculate the area of the collar.

7. Show that the equation $2x(x-2) + 3 = -(x^2 + 2)$ has no real roots.

8. In triangle PQR
   - PQ = 5 cm
   - PR = 8 cm
   - Area of triangle PQR = 10 cm^2
   - Angle QPR is obtuse
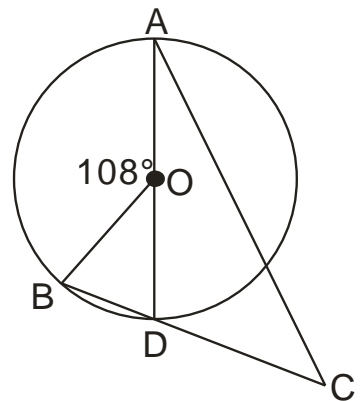
   Calculate the size of angle QPR.

9. AD is a diameter of a circle, centre O.

   B is a point on the circumference of the
   circle.

   The chord BD is extended to a point C,
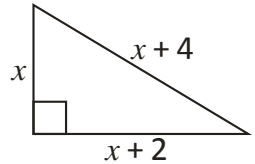   outside the circle.

   Angle BOA = 108^0.

   DC = 10 centimetres.

   The radius of the circle is 7 centimetres. Calculate the length of AC.

10. A right-angled triangle has dimensions, in centimetres, as shown.

Calculate the value of x.

11. The depth of water, D metres, in a harbour is given by the formula

$$D = 5 + 1\cdot9\sin30h°$$

where h is the number of hours after midnight.

(a) Calculate the depth of the water at 9 am.

(b) Calculate the maximum difference in depth of the water in the harbour.

Do not use a trial and improvement method.

Paper L	ANSWERS	Calculator

1. £1433000000 **2.** $k = -25$ **3.** $159\cdot17mm^3$ **4.** a^3 **5(a)** $-\dfrac{3}{2}$ **(b)** $(0,4)$

6. $74\cdot61cm^2$ **7.** $b^2 - 4ac = -44$ **8.** 150^0 **9.** $21\cdot46cm$ **10.** $x = 6$

11(a) $3\cdot1m$ **(b)** $3\cdot8m$