

# Spicy Question #1



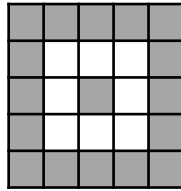
Below is a picture sequence



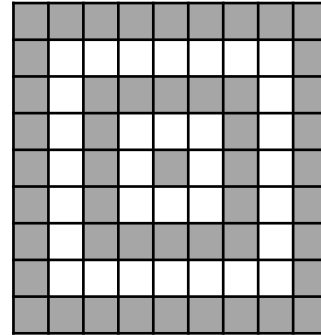
NO Calculator



Pattern 1



Pattern 2



Pattern 3

Each new pattern is created by adding a border of white squares followed by a border of grey squares to the previous pattern.

How many grey squares will be in pattern 100?

Video Solution



# Spicy Question #2

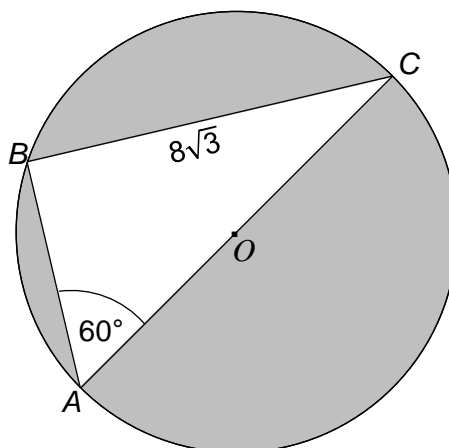


NO Calculator

$O$  is the centre of the circle.

Angle  $CAB = 60^\circ$

$BC = 8\sqrt{3}$



Work out the exact value of the total area of the shaded regions.

Video Solution



# Spicy Question #3



Calculator allowed

Tim invests a total of £12000 for 5 years.

He uses two banks shown below.

**Bank A**

4% Compound Interest

**Bank B**

1% Compound Interest

Special rate of 5% Compound Interest for the first 2 years

*Money Tim invests to Bank A : Money Tim invests to Bank B = 2 : 3*

At the end of the second year Tim takes some money from Bank B and puts it into Bank A.

At the end of the fifth year both banks have the same amount of money in them.

How much money did Tim move from Bank B to Bank A at the end of the second year?

Video Solution



# Spicy Question #4



NO Calculator

$a$ ,  $b$ , and  $c$  are integers.

The highest common factor of  $a$  and  $b$  is 12.

The highest common factor of  $a$  and  $c$  is 18.

The lowest common multiple of  $b$  and  $c$  is 1080.

Find the lowest possible value of  $a + b + c$

Video Solution



## Spicy Question #5

$$x^2 + 4x : 3x + 5 = 3 : 4 \quad \text{where } x > 0$$

Find the value of  $x$ .



Video  
Solution



## Spicy Question #6

A map has 4 towns, A, B, C and D.

$$AB = BC = 10 \text{ miles.}$$

The bearing of:

$$B \text{ from } A = x - 5$$

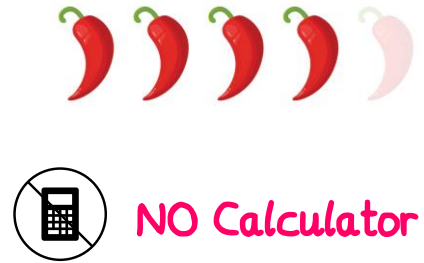
$$C \text{ from } B = 2x - 10$$

$$D \text{ from } C = 3x$$

$$A \text{ from } D = 5x - 10$$

$$D \text{ from } A = 2x + 5$$

Find the exact distance in miles from town C to town D.



Video  
Solution



## Spicy Question #7

$A$ ,  $B$ ,  $C$ ,  $D$  and  $E$  are integers.

$$A = 2^3 \times 3^4 \times 5^{20}$$

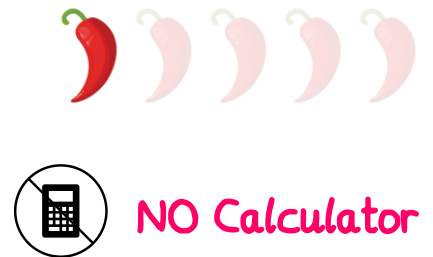
$$A : B = 3 : 5$$

$C$  is 25% of  $B$ .

$$D = 136C$$

$E$  is 92% greater than  $D$ .

Express  $E$  as a product of its prime factors.



Video  
Solution



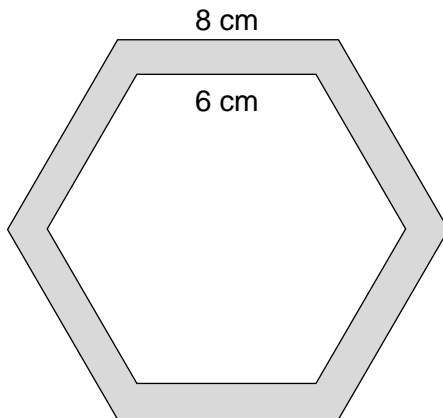
## Spicy Question #8



NO Calculator

A shape is made from two regular hexagons. The side length of the outer hexagon is 8 cm. The side length of the inner hexagon is 6 cm. The shape has 6 lines of symmetry. Calculate the area of the shaded region.

Give your answer in the form  $a\sqrt{3}$  where  $a$  is an integer.



Video Solution



## Spicy Question #9



NO Calculator

All students in year 11 were asked to rate how spicy yesterday's question was.

The ratings are shown in the table below.

Rating	Frequency
1	3
2	$x^2$
3	$4x$
4	35
5	0

The mean rating was 2.5

Calculate how many students are in year 11.

Video Solution

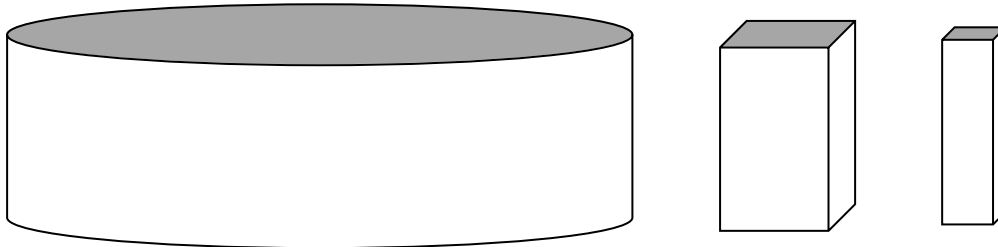


# Spicy Question #10



Calculator allowed

The cylinder and both cuboids below are hollow and open topped.



The radius of the cylinder is 2 m

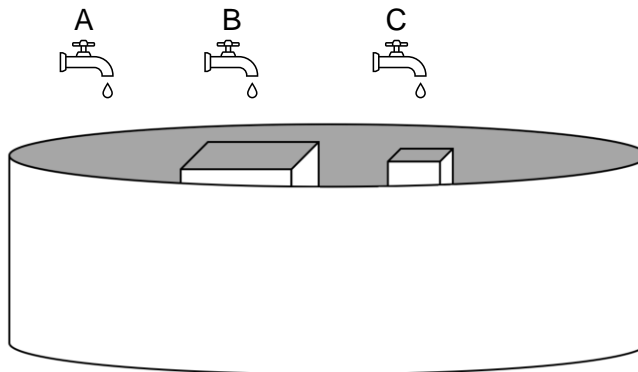
The cross section of the larger cuboid is a square of side length 80 cm.

The cross section of the smaller cuboid is a square of side length 30 cm.

All three shapes are the same height at 1.5 m

Both cuboids are placed into the cylinder to form a container.

The container is placed below three taps as shown below.



Water flows from tap A directly into the cylinder at a rate of 10 litres/minute.

Water flows from tap B directly into the larger cuboid at a rate of 4 litres/minute.

Water flows from tap C directly into the smaller cuboid at a rate of 3 litres/minute.

Once each cuboid is full the water spills over into the cylinder.

All three taps are turned on together at 7am.

To the nearest minute, what time does the water level in the cylinder reach half of the height of the cylinder.

[1 litre = 1000 cm<sup>3</sup>]

Video Solution 



# Spicy Question #11



Calculator allowed

A building has two cylindrical pillars.

The radius of the first cylinder is 300 cm (correct to 1 significant figure).  
The height of the first cylinder is 3 times the cylinder's radius.

The diameter of the second cylinder is 4.1 m (correct to 1 decimal place).  
The radius of the second cylinder is equal to 8% of the cylinder's height.

Calculate the greatest possible difference between the volumes of the two cylinders.  
Give your answer in  $\text{m}^3$ .

Video  
Solution



# Spicy Question #12



NO Calculator

$y$  is directly proportional to  $x$   
 $x$  is inversely proportional to  $p$   
 $p$  is directly proportional to  $t^2$

When  $y = 2\sqrt{15}$ ,  $x = \sqrt{10}$

When  $x = 4$ ,  $p = \sin(45^\circ)$

When  $p = 3 + \sqrt{3}$ ,  $t = \sqrt{\tan(60^\circ)}$

Find  $y$ , when  $t = \sqrt{3} - 1$

Video  
Solution



# Spicy Question #13



NO Calculator

$$f(x) = 3x - 1$$

$$g(x) = x^2 + 2x$$

$$h(x) = \frac{x+1}{x+2}$$

Simplify fully

$$\sqrt{\frac{gf(x) \times hf(x)}{f^{-1}(x)} \div \frac{f(x)}{g(x) \times h(x)}}$$

Video  
Solution



# Spicy Question #14



Calculator allowed

An old house needs the following jobs completed:

- New carpets
- New boiler
- Roof repairs

The owner hires 2 regular carpet fitters, 2 regular plumbers, 2 regular roofers and a “superworker”

The 2 carpet fitters work at the same speed and can fit the new carpets in 6 hours.  
The 2 plumbers work at the same speed and can install the new boiler in 8 hours.  
The 2 roofers work at the same speed and can repair the roof in 11 hours.

A super worker is capable of doing all of the jobs (but only one at a time!)  
The superworker works:

- Twice as fast as a regular carpet fitter.
- At the same speed as a regular plumber.
- Three times as fast as a regular roofer.

All jobs can happen simultaneously and are started at 7 am.

The owner asks the superworker to support the carpet fitters first.

Once the carpets are complete the superworker supports the plumbers with the boiler.

Once the boiler is installed the superworker supports the roofers with the roof repairs.

The hourly cost of each worker is shown below:

Carpet fitter	£30/hour
Plumber	£50/hour
Roofer	£40/hour
Superworker	£100/hour

All workers require an unpaid 30 minute break after each 3 hours of work apart from the superworker, who requires no breaks at all.

Work out the total cost of completing all of the work.

Video  
Solution



# Spicy Question #15



Write the following in order of size.  
Start with the **smallest**.



**NO Calculator**

$$\left(\frac{27}{8}\right)^{-\frac{2}{3}}, \quad \frac{\sqrt{20}}{\sqrt{5+4 \times 10}}, \quad \cos(60^\circ), \quad 2\frac{2}{5} \div 5\frac{1}{3}, \quad \frac{\text{HCF}(84, 175)}{\text{HCF}(135, 300)}$$

Video  
Solution



# Spicy Question #16



The diagram below shows the graphs with the following equations:



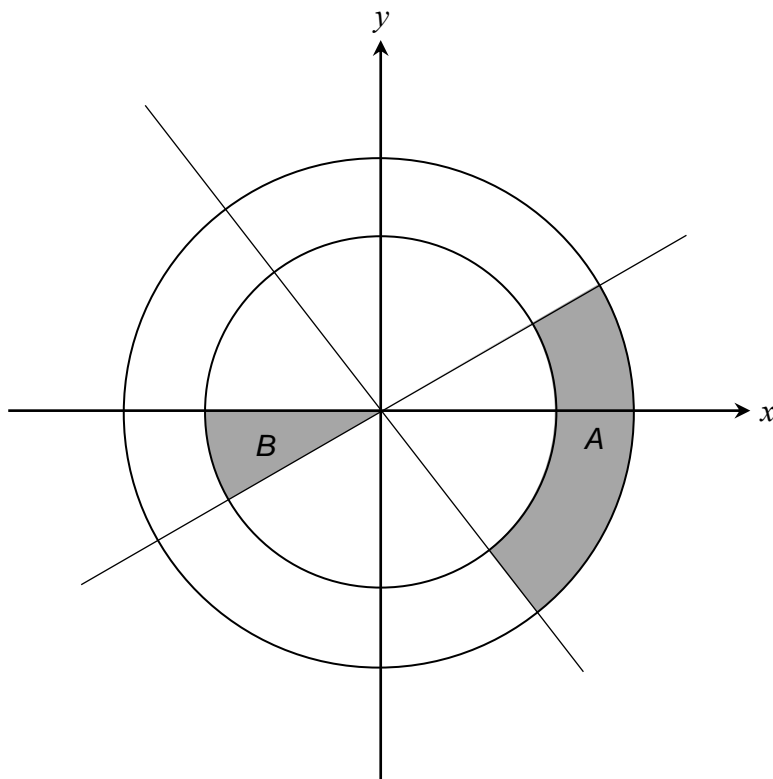
**NO Calculator**

$$x^2 + y^2 = 49$$

$$x^2 + y^2 = 25$$

$$y = -\sqrt{3}x$$

$$y = \frac{x}{\sqrt{3}}$$



The ratio of the area of region A to the ratio of region B =  $a : b$   
where  $a$  and  $b$  are integers, and the ratio is in its simplest form.

Find the values of  $a$  and  $b$ .

Video  
Solution





# Spicy Question #17



**NO Calculator**

The first 4 terms of a geometric progression are shown below.

$$3 \qquad \sqrt{3} \qquad 1 \qquad \frac{1}{\sqrt{3}}$$

Work out the product of the 10<sup>th</sup> and 14<sup>th</sup> terms.  
Give your answer in the form  $3^k$ , where  $k$  is an integer.

**Video Solution**



# Spicy Question #18



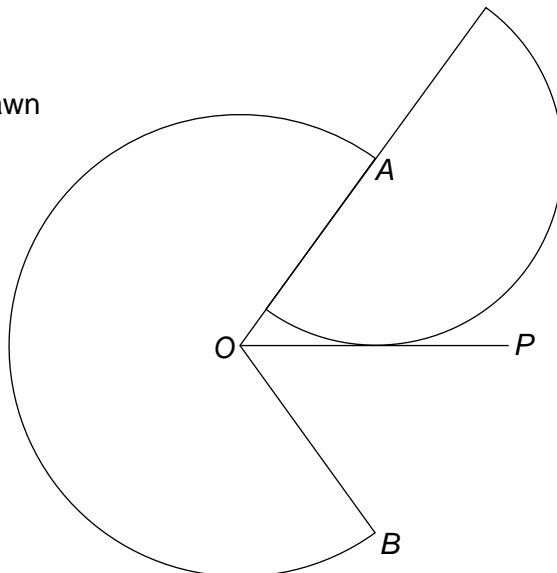
**Calculator allowed**

$AOB$  is a sector of a circle with radius 6 cm.  
The area of  $AOB$  is  $25\pi$  cm<sup>2</sup>

The line  $OP$  bisects the angle  $AOB$ .  
 $OP$  is tangential to a semi circle with centre  $A$ .

Work out the area of the semi circle.  
Give your answer to 1 decimal place.

Diagram not drawn accurately ☺



**Video Solution**



# Spicy Question #19



Calculator allowed

In 1995 a brand new car is released at a sale price of £39500.

Kevin wants to buy the car but does not have enough money.  
He invests £5885 into a bank account with 5% compound interest.

The car's value depreciates over time at a fixed percentage per year.  
In the year 1998 the price of the car is now £20224.

In which year will Kevin's investment be enough to buy the car?

Video  
Solution

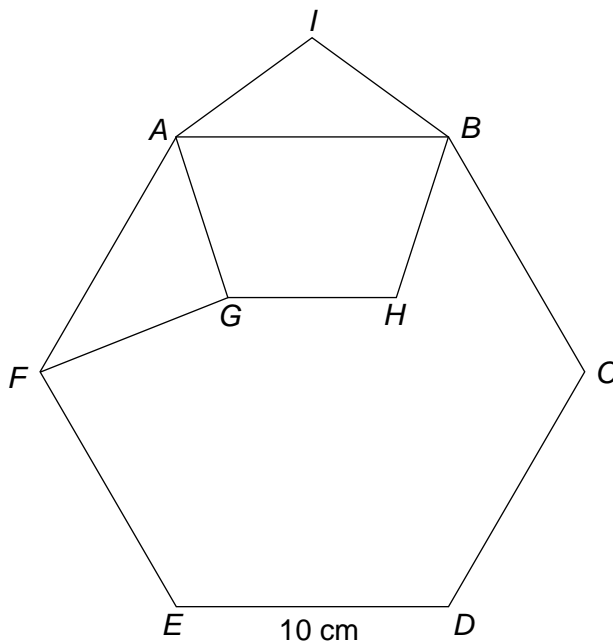


# Spicy Question #20



Calculator allowed

$ABCDEF$  is a regular hexagon.  
 $AIBHG$  is a regular pentagon.  
 $ED = 10$  cm



Calculate the area of triangle  $AFG$ .  
Give your answer to 4 significant figures.

Video  
Solution



## Spicy Question #21



NO Calculator

Find the exact value of  $\frac{3[\tan(60^\circ) + \tan(45^\circ)]^2}{2\sin(60^\circ) \times 5\sin(30^\circ)} \div \frac{2\sin(45^\circ)}{\cos(30^\circ) + \tan(30^\circ)}$

Give your answer in the form  $a\sqrt{b} + \sqrt{c}$  where  $a$ ,  $b$  and  $c$  are integers.

Video  
Solution



## Spicy Question #22



NO Calculator

I am thinking of 7 numbers.

One of the numbers is equal to  $\sin(45^\circ)$

The median = mode =  $\sin(60^\circ)$

The ratio of the lower quartile to the median to the greatest value is  $1 : \sqrt{6} : \sqrt{10}$

The range =  $\frac{5\sqrt{5} - \sqrt{10}}{10}$

The interquartile range =  $\frac{4\sqrt{30} - 5\sqrt{2}}{20}$

The exact value of the product of all my numbers is  $\frac{a\sqrt{15}}{b}$ , where  $a$  and  $b$  are integers and  $\frac{a}{b}$  is fully simplified.

Find the values of  $a$  and  $b$ .

Video  
Solution



## Spicy Question #23



NO Calculator

Video  
Solution

$A = (54, 3)$   
 $B = (78, 3)$   
 $C = (54, 39)$

Triangle  $ABC$  is enlarged by scale factor  $0.41\hat{6}$ , with centre  $(-18, 3)$ , to give triangle  $DEF$ .

Triangle  $DEF$  is then rotated 180 degrees about the point  $(34, 8)$ , to give triangle  $GHI$ .

Triangle  $ABC$  and triangle  $GHI$  overlap.

The shape created by this overlap is a rectangle. Calculate the area of this rectangle.



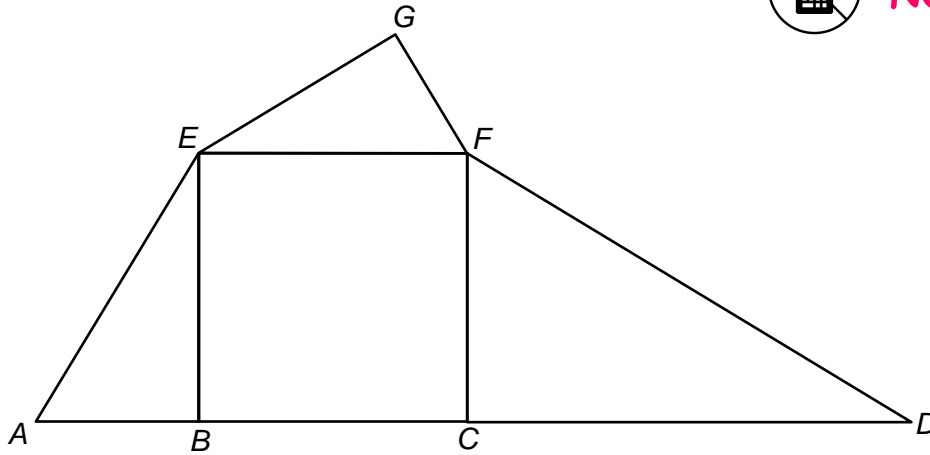
# Spicy Question #24



A compound shape is made from a square and 3 similar triangles.  
 $ABCD$  is a straight line.  
Angle  $GFE = 60^\circ$   
 $GF = 4$  cm



**NO Calculator**



Work out the total area of the compound shape.

Give your answer in the form  $\frac{a\sqrt{3} + b}{c}$  where  $a$ ,  $b$  and  $c$  are integers.

Video Solution 



# Spicy Question #25



Here are three sequences

Sequence A:	11	24	39	56
Sequence B:	410	420	430	440
Sequence C:	530	507	486	467



**NO Calculator**

(a) Find the  $n^{\text{th}}$  term of each sequence.

(b) Find a range of values of  $n$ , for which

$$\text{Sequence A} > \text{Sequence B} > \text{Sequence C}$$

Video Solution 



## Spicy Question #26



Calculator allowed

740 students in a school were asked which local supermarkets they had visited in the last week. The local supermarkets are Sinsbury's, Cosda and Tanco.

The number of students who visited all three supermarkets is a multiple of 3.

All students who visited Sinsbury's **and** Cosda also visited Tanco.

Half of the students who visited Cosda **and** Tanco also visited Sinsbury's.

$\frac{6}{7}$  of the students who visited Cosda also visited another supermarket.

20 students visited Sinsbury's **and** Tanco.

60 students visited Tanco.

The number of students who visited Sinsbury's is the same as the number who visited both Cosda **and** Tanco.

The number of students who visited none of the supermarkets is equal to the product of the number who visited Sinsbury's and the number who visited Cosda.

Two students from the school are selected at random.

What is the probability that both students **only** visited Tanco.

Give your answer to 4 significant figures.

Video  
Solution



## Spicy Question #27



NO Calculator

Triangle ABC is formed by the intersecting points of the lines

$$y = 2$$

$$y = 3x + 17$$

$$y = 3 - 0.5x$$

Triangle ABC is enlarged with centre (4, 6) to give triangle DEF.

Triangle DEF is formed by the intersecting points of three lines.

One of the lines has equation  $y = 14$

Find the equations of the other two lines.

Video  
Solution



## Spicy Question #28



NO Calculator

Sequence A and Sequence B begin with the same first two terms.

Sequence A:  $x^2, 5y$

Sequence B:  $x^2, 5y$

The rules for continuing each sequence are however different.

Sequence A: Each term is the sum of the previous 2 terms.

Sequence B: Each term is the product of the previous 2 terms.

The fifth term of sequence A is 227

The third term of sequence B is 1040

Given that  $x$  and  $y$  are both non-negative integers, find the values of  $x$  and  $y$ .

Video  
Solution



## Spicy Question #29

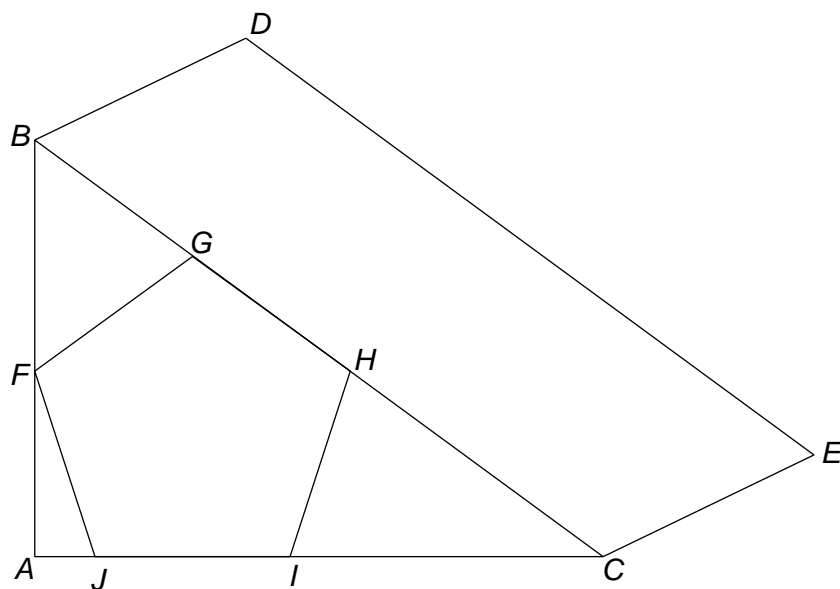


Calculator allowed

Below is a prism with a triangular cross-section  $ABC$ .

Angle  $BAC = 90^\circ$

$FGHIJ$  is a regular pentagon of side length 8 cm.



The volume of the prism is  $900 \text{ cm}^3$

Calculate the length of  $CE$ .

Give your answer to 2 decimal places.

Video  
Solution



## Spicy Question #30



Calculator allowed

During half term a school requires the entire site to be painted. The school is only open on Monday – Wednesday and is closed on Thursday and Friday so the job must be done in 3 days or less.

A company sends in some painters on Monday and they complete  $\frac{3}{16}$  of the painting.

Fearing they may be behind schedule on Tuesday the company sends 12 more painters that they sent on Monday.

On Tuesday they manage to complete another  $\frac{33}{112}$  of the painting.

Assuming that all painters work at the same rate, and each day has the same amount of working hours, how many painters should the company send on Wednesday to complete the job in time?

Video Solution



## Spicy Question #31



Calculator allowed

A game is played at the school fair.

A bag contains 3 blue balls and some red balls.

A player randomly draws a ball from the bag. The ball is then returned to the bag along with another ball of the same colour.

The player then randomly draws another ball. This ball is then removed from the bag along with 2 more balls of the same colour.

The player randomly draws another ball.

If at any point the player draws a blue ball then they lose the game.

The probability that the player loses the game is 0.5

How many balls are in the bag at the start of the game?

Video Solution

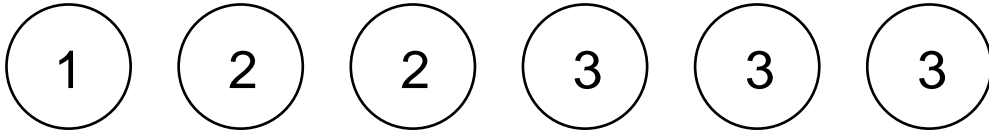


# Spicy Question #32



**NO Calculator**

A bag contains the following numbered counters.



A counter is removed from the bag at random and the number noted. The counter remains out of the bag.

Next, a number of counters is removed from the bag equal to the value of the number written on the previously drawn counter. These are removed at random.

Calculate the probability that the sum of the counters remaining in the bag is equal to 6 or 10.

Video Solution



# Spicy Question #33



**NO Calculator**

The curve  $C$  has equation  $y = ax^2 + bx + c$

The roots of the equation  $ax^2 + bx + c = 0$  are  $x = 6$  and  $x = 10$

The turning point of the graph of  $C$  has coordinates  $(k, -12)$

The line  $L_1$  has equation  $y = -3x + 18$

$L_1$  intersects the curve  $C$  at the points  $P = (x_1, y_1)$  and  $Q = (x_2, y_2)$ , where  $x_1 < x_2$

Line  $L_2$  is perpendicular to  $L_1$  and also goes through the point  $P$ .

Line  $L_3$  goes through the point  $Q$  and intersects line  $L_2$  at the point  $R$ .

The area of triangle  $PQR = 60$  units<sup>2</sup>

Find the equation of the line  $L_3$

Video Solution





# Spicy Question #34



**NO Calculator**

Students from Y7 to Y11 were all asked to pick a sport to play on their final day of school. The options for sport were Athletics, Basketball, Cricket, Swimming and Table Tennis.

Y9 students who picked Athletics : Y9 students who picked Cricket : Y9 students who picked Table Tennis = 13 : 12 : 11

Y7 students who picked Table Tennis : Y9 students who picked Table Tennis : Y11 students who picked Table Tennis = 20 : 11 : 6

- The number of Y7 who picked Athletics as a percentage of Y10 students who picked Swimming is 88.8%
- 60% more Y9 students picked Cricket than Y11 students who picked Athletics.
- The number of Y9 students who picked Swimming was five times as many as Y11 who picked Swimming.
- The mean number of students per year group who picked Athletics is 55.
- The number of Y11 students who picked Cricket is a root of the equation  $x^2 - 1600 = 0$
- The number of Y8 students who picked Cricket is equal to the largest prime number smaller than 50.
- The total number of students from all year groups that chose Swimming is equal to  $6.6 \div 0.03$
- The number of Y7 who chose Swimming is less than the number of Y8 who chose Swimming.
- The total number of Y9 students is  $2 \times 11^2$
- 20% more Y9 students picked Cricket than Y7 students who picked Athletics.
- Two fifths of the students who chose Table Tennis were in Y7.
- The number of Y8 students who chose Table Tennis is the same as the number of Y10 students who chose Table Tennis.
- There are 6 more Y8 students than there are Y9 students.
- The number of Y8 students who chose Basketball is equal to  $p$ , where  $\tan(p^\circ) = 1$
- 40 Y7 students picked Athletics.
- The number of Y10 students who chose Basketball is equal to the square of the number of Y9 students who chose Basketball.
- The number of Y7 who chose Basketball is equal to  $(\sqrt{3})^{18} \div (\sqrt{27})^4$
- The number of Y10 students who chose Cricket is equal to a quarter of the exterior angle of a regular decagon.
- The number of Y7 who chose Swimming and the number of Y8 who chose Swimming are both square numbers.
- The total number of Y11 students is 400% more than the number of Y11 students who picked Athletics.
- The number of Y11 student who picked Basketball was three times as many as Y9 who picked Basketball.
- The number of Y7 students who chose Cricket is equal to the area of a right angled isosceles triangle with a hypotenuse of  $12\sqrt{2}$

What percentage of the students in the school are Y10 who chose Athletics?  
Give your answer to 3 significant figures.

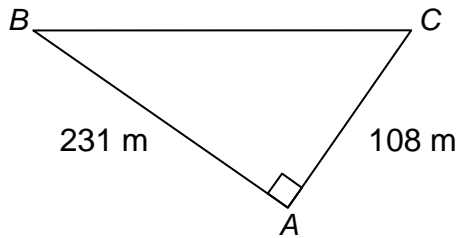
**Video Solution**



## Spicy Question #35



Calculator allowed



The diagram above shows a course used for a 2-lap race.

Two runners both start at point  $A$  and then run 2 laps but in opposite directions to each other.

Runner 1 starts at  $A$ , runs to  $B$ , then to  $C$ , then back to  $A$ . They then repeat this for their second lap.  
Runner 2 starts at  $A$ , runs to  $C$ , then to  $B$ , then back to  $A$ . They then repeat this for their second lap.

Runner 1 runs at a constant speed of 5 m/s

Runner 2 runs at a constant speed of 4 m/s

During the two laps the runners pass each other three times, at points  $D$ ,  $E$  and  $F$ .

Find, in metres, the perimeter of triangle  $DEF$ .

Give your answer to 4 decimal places.

Video  
Solution



## Spicy Question #36



NO Calculator

Prove algebraically that

$$\frac{n^2 + 1}{8} + \frac{n}{2} \times \frac{n + 2}{3} - \frac{n^2 - 1}{12}$$

is greater than or equal to  $\frac{3}{40}$  for all values of  $n$

Video  
Solution



# Spicy Question #37



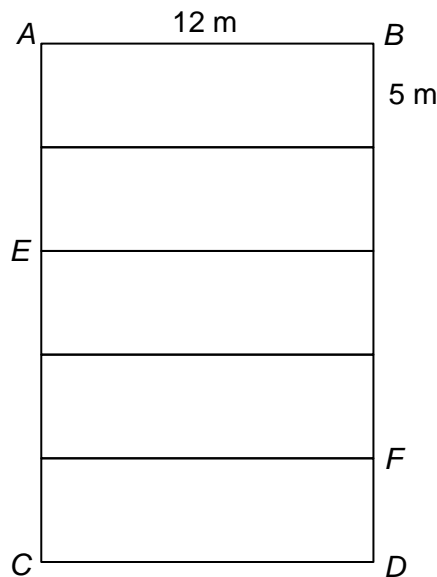
Calculator allowed

5 congruent rectangles are arranged as shown in the diagram below.  
Each rectangle has length 12 m and height 5 m.

The edge  $AB$  is joined to the edge  $CD$  so that an open ended prism is formed.  
The cross section of the prism is a regular pentagon.

Once the prism has been formed a line directly connects point  $E$  to point  $F$ .

Calculate the length of the line  $EF$ .  
Give you answer to 4 significant figures.



Video  
Solution



# Spicy Question #38

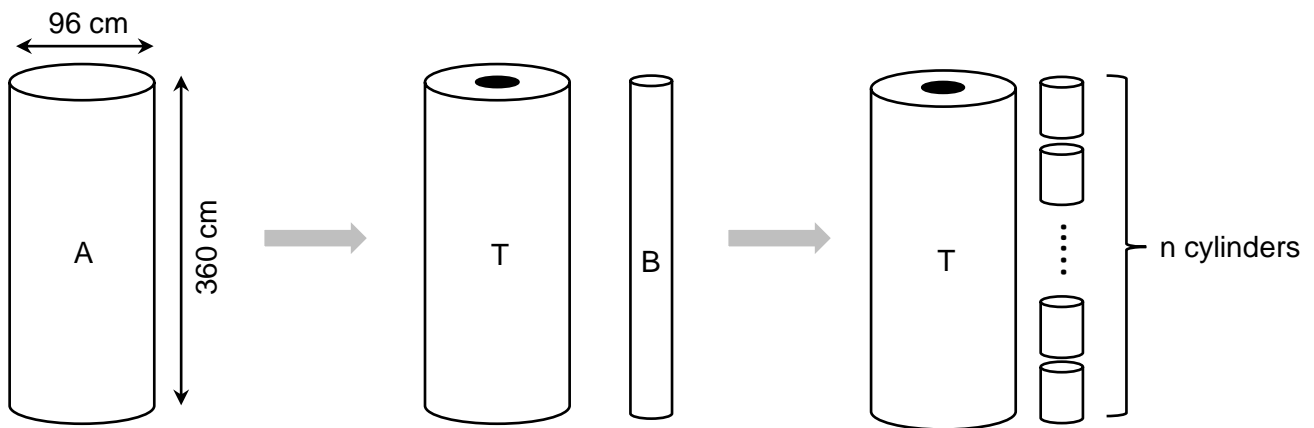


Calculator allowed

Cylinder (A) is shown below. The height of cylinder (A) is 360 cm, and the diameter is 96 cm.

A cylindrical hole is cut through the center of cylinder (A) leaving two solid shapes. These are a tube (T) and a new cylinder (B).

Cylinder B is then cut horizontally into  $n$  identical smaller cylinders. Each of the  $n$  smaller cylinders is similar to the original cylinder (A).



The total surface area of the tube and the  $n$  smaller cylinders equal to  $42232\pi \text{ cm}^2$

Work out how many smaller cylinders there are.

Video Solution



# Spicy Question #39



The histogram below shows the times taken for some students to complete a spicy question.

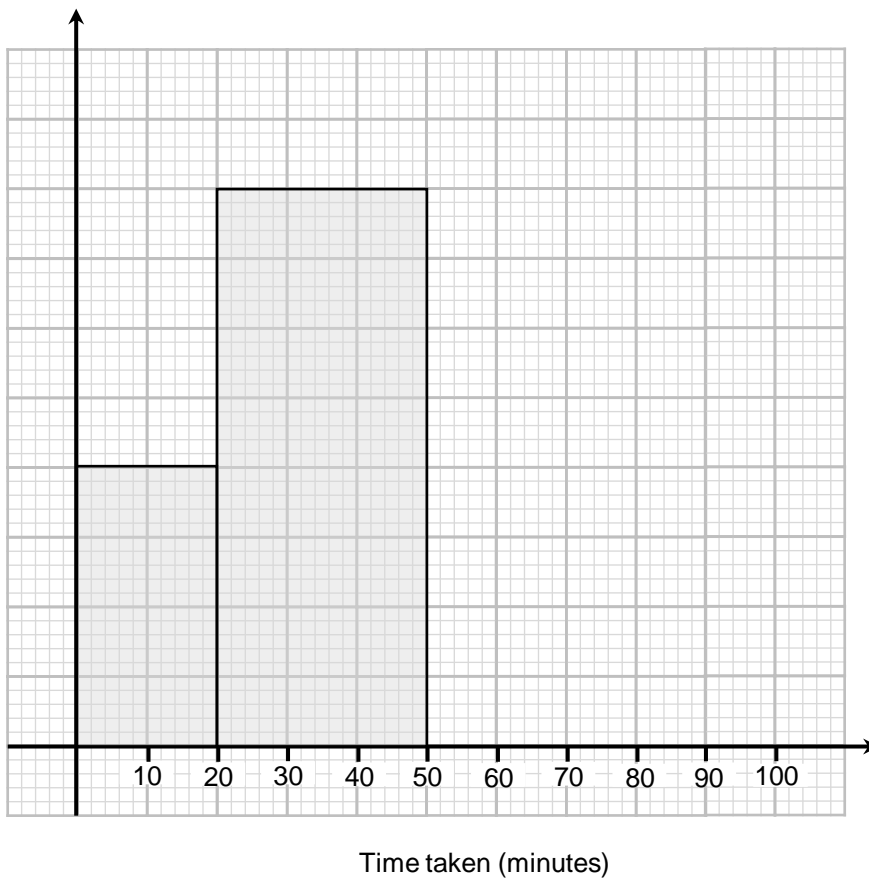
60% of the times were greater than 50 minutes.  
No student took longer than 100 minutes.



**NO Calculator**

The ratio of the number of students who took between 50 and 60 minutes to the number of students who took between 60 and 100 minutes is equal to 3 : 5

Work out an estimate for the interquartile range of the times taken to solve the question.



Video Solution



# Spicy Question #40



$$(2x - 3)^3 + (3x + 5)^2 + (5 - 2x)^3 \equiv a(x + b)^2 + c$$

Find the value of  $a + b + c$



**NO Calculator**

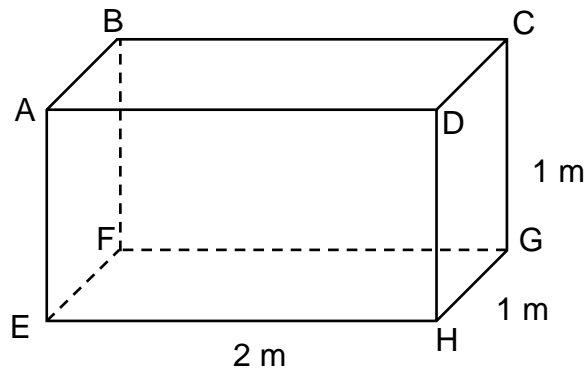
Video Solution



# Spicy Question #41



Calculator allowed

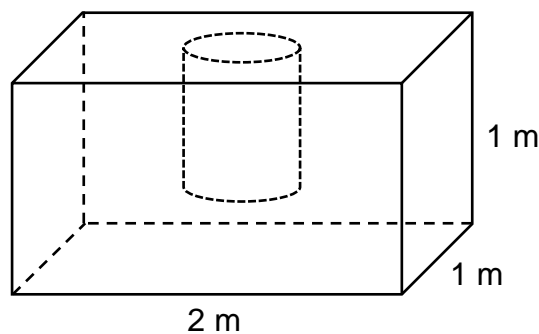


ABCDEFGH is a cuboid with a density of  $0.1 \text{ g/cm}^3$

A cylindrical hole is then cut into the face ABCD.

An example of how this could look is shown in the diagram below.

The cylinder has height  $h$  and radius  $r$ .



The cylindrical hole left behind is then filled with a metal of density  $12 \text{ g/cm}^3$

The resulting cuboid has a density of  $1 \text{ g/cm}^3$

Work out a range of possible values for  $h$ , the height of the cylinder.

Video  
Solution



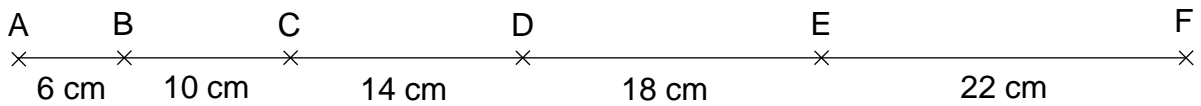
# Spicy Question #42



**NO Calculator**

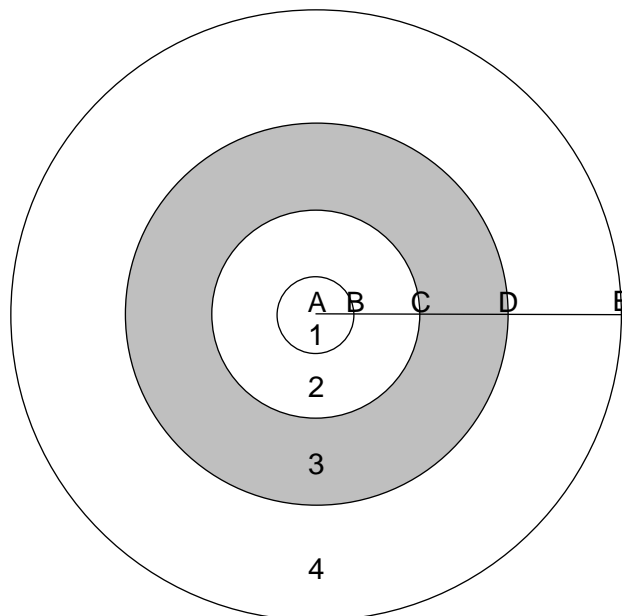
An infinite number of points starting A, B, C, D, ... all lie on the same straight line. The distances between successive points form a linear sequence so that

- AB = 6 cm
- BC = 10 cm
- CD = 14 cm
- DE = 18 cm
- EF = 22 cm
- ...



A series of circles are drawn, each with centre A, and radii AB, AC, AD, AE, AF, ... The first few of these are shown below.

The inner most region is a circle and known as region 1 as shown on the diagram below. All other regions are rings of increasing size. For clarity region 3 is shaded on the diagram below.



Work out an expression, in terms of pi for the area on the  $n^{\text{th}}$  region in  $\text{cm}^2$ . Give your answer in simplest form.

**Video Solution**



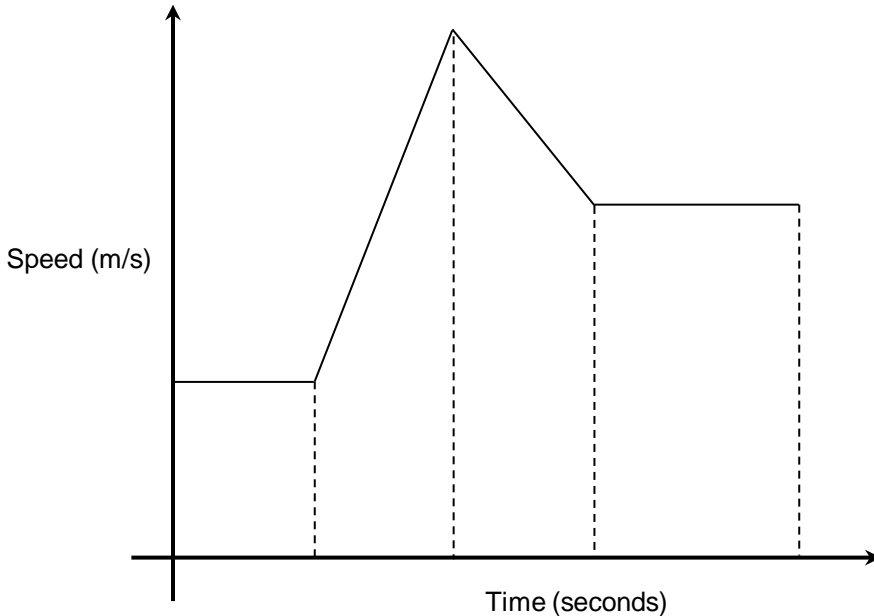
# Spicy Question #43



The diagram below shows a sketch of a journey for a vehicle.



Calculator allowed



The vehicle's speed is constant at  $y$  m/s for the first  $x$  seconds of the journey.  
The vehicle accelerates for the next  $x$  seconds to a maximum speed of  $3y$  m/s.  
During the next  $x$  seconds the vehicle decelerates to a speed of  $2y$  m/s.  
The vehicle's speed then remains constant at  $2y$  m/s for  $y$  more seconds.

The vehicle travels a total distance of 1000 metres and the journey lasts for 42.5 seconds.

Work out how far the vehicle travels in the first  $x$  seconds of the journey.

Video Solution



# Spicy Question #44



Some students were asked how many minutes they spent on their maths homework.  
The data is shown in the table below.

Time (minutes)	Cumulative Frequency
$0 \leq t < 20$	$x$
$20 \leq t < 40$	$x + 10$
$40 \leq t < 60$	$x^2 + x + 10$
$60 \leq t < 80$	$x^2 + x + 10 + 3y$

Video Solution



The number of students who took between 0 and 20 minutes is equal to  $\frac{1}{15}$  of all students asked.

A teacher estimated the mean time to be exactly 54 minutes.

Work out two possible values for  $y$ .



# Spicy Question #45

$$f(x) = 3x - 1$$

$$fg(x) = 3x^2 - 4$$

Solve  $gf(x) = 0$



NO Calculator

Video Solution



# Spicy Question #46



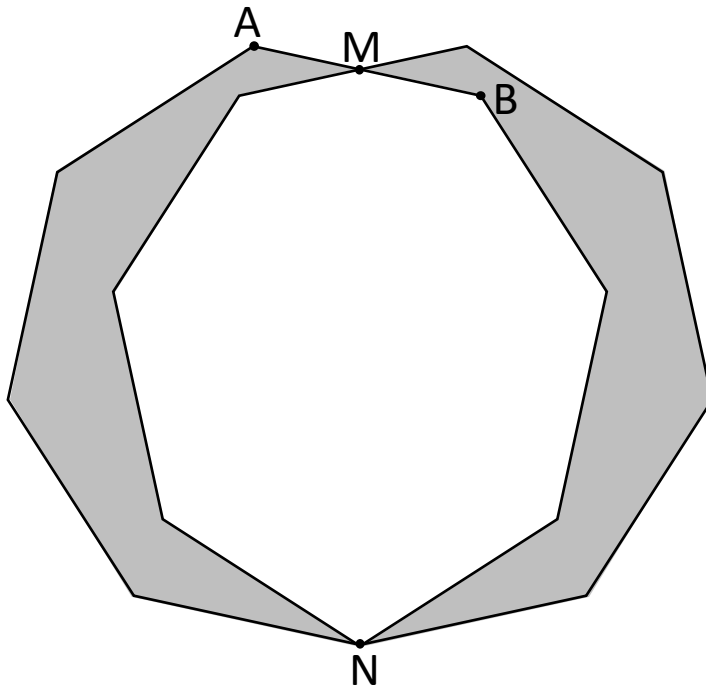
NO Calculator

Two identical, regular octagons are used to form the diagram below.

M is the midpoint of the line AB.

MN is a line of symmetry.

What fraction of the diagram is shaded?



Note: Area of a triangle/trapezium can be used freely if you wish as they are assumed knowledge.

Any formula for the area of an octagon, if used, must be **clearly derived**. It is not assumed knowledge.

Video Solution



# Spicy Question #47

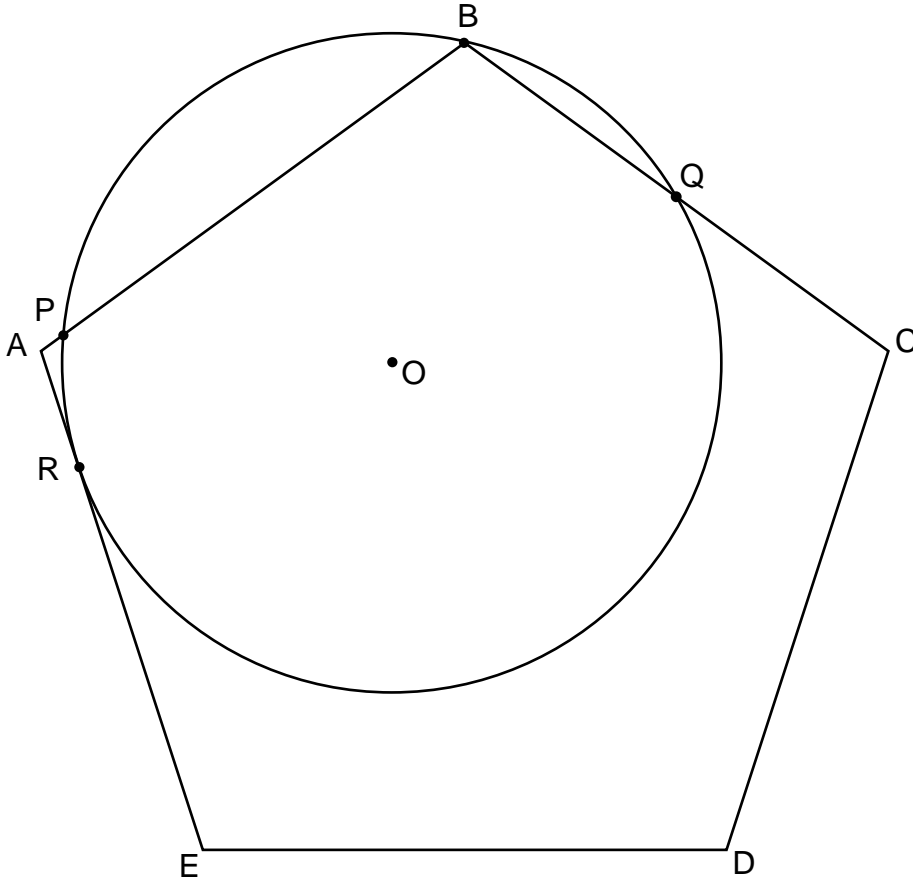


NO Calculator

ABCDE is a regular pentagon.

The points P, B, Q and R lie on the circumference of a circle with centre O, radius  $r$ .

The line AE is the tangent to the circle at point R.



Angle BQR =  $4 \times$  Angle POR

$\frac{AB}{OR} = k\sqrt{2}$  where  $k$  is a constant.

Find the **exact** value of  $k$ . Give your answer in terms of trigonometric functions.

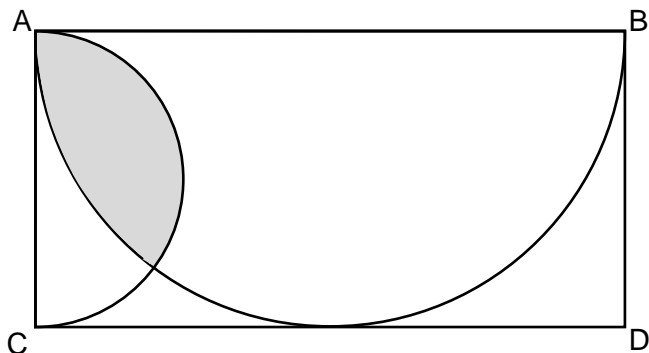
Video  
Solution



# Spicy Question #48



Calculator allowed



ABCD is a rectangle.

Two semicircles are drawn inside the rectangle.

The line AB is the diameter of the larger semicircle.

The line CD is a tangent to the larger semicircle.

The line AC is the diameter of the smaller semicircle.

Calculate the percentage of the rectangle that is shaded.  
Give your answer to 4 decimal places.

Video Solution



# Spicy Question #49



NO Calculator

OABC is a parallelogram.

M is the midpoint of AC

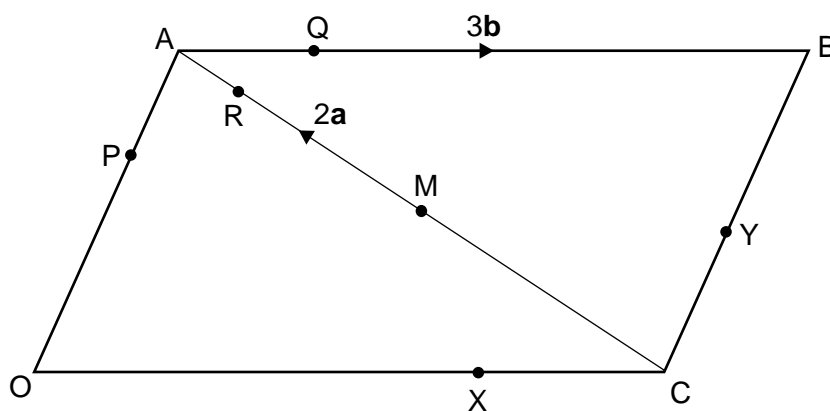
$$\vec{MA} = 2\mathbf{a}$$

$$\vec{AB} = 3\mathbf{b}$$

$$OX : XC = 3 : 1$$

$$CY : YB = 2 : 3$$

$$AR : RM = 3 : 7$$



Points P, Q and R all lie on the same straight line.

PQ is parallel to XY.

Find OP : PA

Video Solution



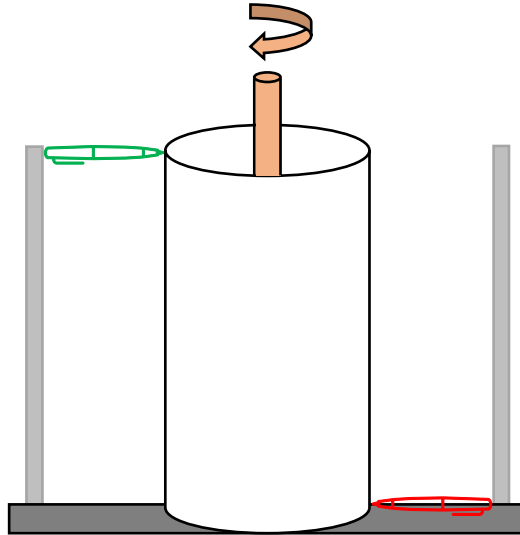
# Spicy Question #50



Calculator allowed

An open topped cylinder of height 12 cm and radius  $\frac{10}{\pi}$  cm is placed onto a machine.

Two pens of different colours are attached to poles at opposite sides of the cylinder. The green pen just touches the top and the red pen the bottom.



When the machine is turned on:

- The cylinder turns at a constant speed, completing one turn every 3 seconds.
- The pens move vertically at a constant speed, whilst remaining in contact with the cylinder, leaving a coloured trail. The green pen moves down and the red pen moves up.

Once each pen reaches the other end of the cylinder the poles are moved so that the pen is no longer in contact with the cylinder.

The green pen lowers at a rate of 1 cm/second.

The red pen rises at a rate of  $\frac{4}{3}$  cm/second.

The trails left by the pens intersect each other a total of 7 times.

The intersection closest to the top of the cylinder is point A.

The intersection closest to the bottom of the cylinder is point B.

Points A and B are connected directly with a straight line that goes through the cylinder (not along the surface).

Calculate the length of the line AB.

Give your answer to 4 decimal places.

Video  
Solution

