WESTMINSTER SCHOOL

2011 CHALLENGE

MATHEMATICS II

Tuesday 3rd May 2011

Time allowed: 1 hour 30 minutes

You will need a calculator for this paper.

All your working should be clearly shown.

You should attempt all the questions.

1 A solar year (the time the Earth takes to rotate round the sun) is 365·24 days. The time the Earth takes to rotate on its axis is just less than a day: in fact it takes 23 hours 56 minutes and 4 seconds to rotate on its axis. How many times does the Earth rotate on its axis in a solar year?

2 a A brass cylinder of mass 1000 grams has a radius of 2·28 cm and a height of 7·17 cm. What is the density of the brass in grams per cubic centimetre?

b A nickel cylinder of mass 1000 grams has a radius of 2·17 cm. The density of the nickel is 8·79 grams per cubic centimetre. What is the height of the cylinder?

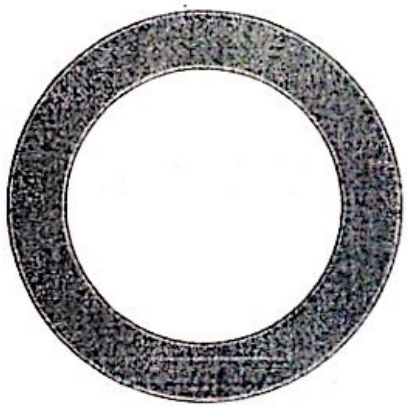
3 a Simplify $\frac{1}{2}x - \frac{1}{3}(x+1)$.

b Multiply $2x$ by $\frac{1}{2}x$.

c By what would you have to multiply $x+2$ to get $\frac{x}{2}+1$?

d Solve the equation $\frac{x+3}{x} = 3$.

4 The diagram shows two circles with the same centre.
The shaded region between the two circles has the same area as the smaller circle.
The radius of the smaller circle is 2·9 cm.
What is the radius of the outer circle?



5 In 2006, the UK Government spent £502·7 billion. In the four years between 2006 and 2010, the UK Government's spending went up by an average of 7·1% per year.

a How much did the UK Government spend in 2010?

In 2010, the UK Government had an income of £539·2 billion. In the four years between 2006 and 2010, the UK Government's income went up by an average of 3·4% per year.

b What was the UK Government's income in 2006?

c In 2006 the UK Government had a borrowing requirement of £31·0 billion. In 2010, the UK Government had a borrowing requirement of £122·2 billion. What was the annual average percentage increase in the UK Government's borrowing requirement in that four-year period?

6 George is going on holiday. He has £105 spending money. He has to pay 3% of this to the Bureau de Change as commission; the rest is converted into Euros, at a rate of 1 Euro to every £0·84.

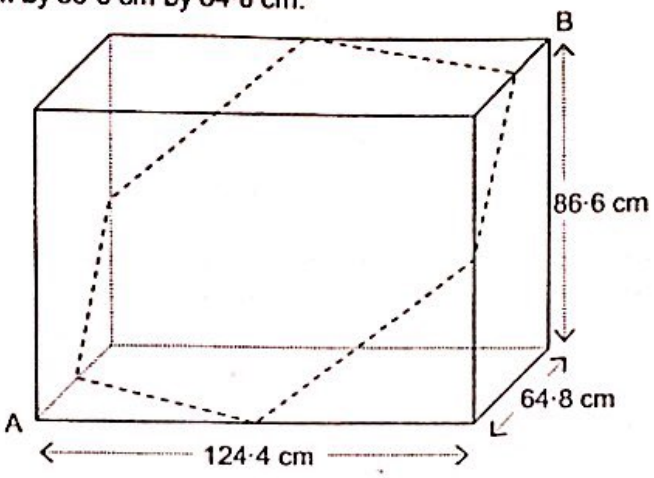
a How much did he end up with to take on holiday, in Euros and cents?

When George came home, he still had 40 Euros left to change back into British currency. He again had to pay 3% commission to the Bureau de Change, but the exchange rate had changed while he was away. He ended up with £32·98 left.

b What was the new exchange rate? Give your answer in the form 1 Euro = £..... .

7 Twice the cube of a number plus three times the square of that number make 500000.
Use your calculator to find the number exactly.

8 The diagram shows an arachnarium, which is a cuboidal glass tank with internal measurements 124·4 cm by 86·6 cm by 64·8 cm.

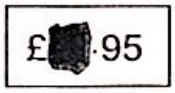


a A spider kept in the tank crawls round the path shown by the dashed line, which joins the midpoints of all the edges it crosses. How far does the spider travel?

b The spider attaches a piece of silk to points A and B. The silk makes a straight line between the two points. How long is this piece of silk?

9 a What would be the price of a book if "£4·50 off" was exactly the same discount as "12% off"?

b The price sticker on a book has been damaged. It looks like this.



When comparing discounts on the book, Sam is told that £5·50 off is better than 14% off, but that £3·50 off is not as good as 9% off. How much did the book cost?

10 In a sweet shop, sweets are sold from large jars and their prices are given in pence per 100g. Wine gums cost 15 pence per 100g less than pear drops, but peppermints cost 5 pence per 100g more than pear drops.

a Pear drops cost x pence per 100g.

i What is the cost of 60g of pear drops?

ii How much do wine gums cost per 100g?

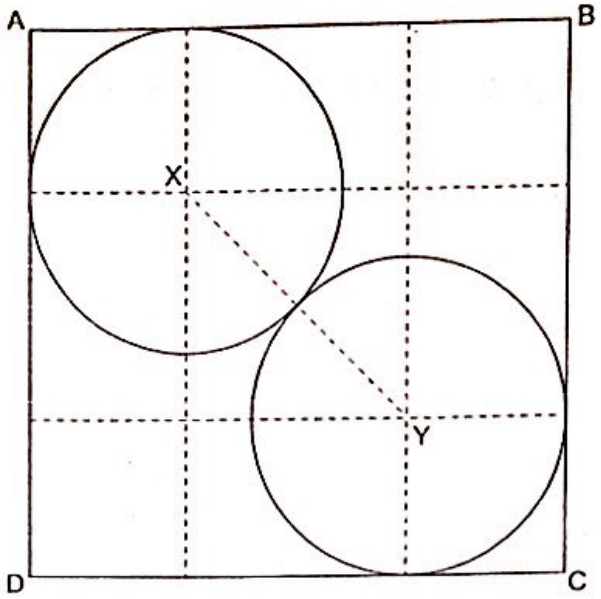
iii What is the cost of 110g of wine gums?

Charlie has £2 and finds he can buy 60g of pear drops, 110g of wine gums and 80g of peppermints, with no change.

b How much do pear drops cost?

Turn over for question 11.

11 The diagram shows how two identical circles fit in a square. X and Y are the centres of the circles.



a If the radius of each circle is 5·8 cm, find the side length AB of the square.

b If the length AB is 29·7 cm, find the radius of each circle.