

Shrewsbury School.

ARITHMETIC PRIZE 1913.

1. The population of England and Wales in 1831 was 13,896,797.

The successive increases in subsequent decennial periods are given by the table—

1831—41	2,017,351	1871—81	3,262,173
41—51	2,013,461	81—91	3,028,086
51—61	2,138,615	91—01	3,525,318
61—71	2,646,042	01—11	3,547,426

Find, in the shortest way possible, (correct to one decimal place) the increases per cent. in the 40 years 1831—1871, the forty years 1871—1911, and also in the whole 80 years. What equation is there connecting these three percentages?

2. A company's capital consists of ordinary and debenture shares in the proportion of 3 to 2; its profit is 10% of the whole capital; of this profit 10% is put into a reserve fund and dividends of 5 and 7 per cent. respectively are paid to the holders of debenture and ordinary stock, leaving a balance of £560. What is the capital?

3. Explain why the ordinary method of finding the HCF of two numbers by repeated division should give the HCF. The LCM of 1760 and a certain number is 258,720: the LCM of 3906 and the same number is 546,840. Find the number.

4. A grocer buys 52 kilograms of sugar for 13s. 4d. He assumes that 1lb. = $\frac{2}{3}$ kg. and by charging a certain price per lb. expects to sell it at a profit of $23\frac{1}{2}$ per cent. If 1lb. really = 453.6 grams, find his actual gain per cent. correct to one place of decimals.

5. A tree trunk is sold for 4½d. a cubic foot, its volume being estimated on the assumption that it is a cylinder of girth 12 feet and length 22 feet. It is afterwards found to weigh exactly $4\frac{3}{4}$ tons, and the specific gravity of the wood is known to be .64. Find how much the buyer gains or loses owing to the inaccuracy of the first estimate?

[Take $\pi = \frac{22}{7}$; 1 cub. foot of water weighs 1000 oz.]

6. At what rate per cent. must compound interest be reckoned so as to make the amount in 18 years on £9750 be equal to what the amount would be if simple interest at 6% were charged, given the following extracts from the tables—

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
log	20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
log	97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
antilog	01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2

7. A rectangular field of 15 acres is divided exactly into a number of square allotments each 55 yards square. The cost of digging the whole at £1 4s. an acre and putting fencing between the allotments (but *not* round the outside of the field) at 1/- a yard comes to £122 10s. Find the length and breadth of the field.

8. A London merchant owes one in S. Petersburg a certain sum; he pays a broker a sum sufficient to cover the debt when the rate of exchange is 1 rouble = 20 pence. The broker sends the money via Paris when the rate of exchange is 1fr. 75c. for 1 rouble, and English money is at a premium of 5% in Paris (at par £1 = 25.225 fr) thereby gaining £696 13s. 4d. Find the amount of the debt (in roubles).

9. A number of men went for a sail and found after a time that their boat was leaking uniformly and that it was already $\frac{1}{4}$ full; three of them began to bale out the water, but 25 minutes later it was $\frac{5}{14}$ full; 2 more began to bale, but 25 minutes later it was found to be $\frac{2}{3}$ full; then they all began to bale and the boat was emptied in $46\frac{2}{3}$ minutes. If they all baled at the same rate, find the number of men.

10. The measured edges of a rectangular box are 27.5 cm, 16.8 cm and 25 cm. It is known that the last measurement is liable to an error of 2 mm, and that the error per cent. in all the measurements may be the same. Find by how much per cent. the calculated volume of the box may be wrong, neglecting squares and higher powers of small quantities [If you use a formula explain how it can be determined]. Hence find the volume of the box correct to as many significant figures as possible.

11. In a 100 yards race D can beat A by 2 yards, C by $5\frac{1}{2}$ yards and E by 10 yards. E runs a dead heat against F and can beat B by 2 yards. If ABC run a relay race against DEF, each person running 100 yards, find which side will win and by how many yards. (A and D are the 1st, B and E the 2nd, C and F the 3rd runners for their sides).

12. Find the least number of weights which can be used to weigh every integral number of ounces up to $2\frac{1}{2}$ lbs. it being possible to put the weights in either scale pan of the balance.