Prove that, if the difference between p and a perfect cube, N^3, be less than one per cent. of either, $\sqrt[3]{p}$ differs from $\frac{2}{3}N+\frac{1}{3}\frac{p}{N^2}$ by less than $\frac{N}{90000}$.

6. Find the number of combinations of n things taken r together.

Prove that, if each of m points in one straight line be joined to each of n in another by straight lines terminated by the points, then, excluding the given points, the lines will intersect $\frac{1}{4}mn(m-1)(n-1)$ times.

7. Define the tangent of an angle, and from the definition show that

$$\tan(180^\circ - A) = -\tan A.$$

Prove directly from the definitions of the trigonometrical functions that

$$\frac{1+\cos A}{\sin A} = \cot \tfrac{1}{2}A.$$

Find the general values of A from the equation $\tan A + \sec 2A = 1$.

8. Show *a priori* that when $\sin A$ is expressed in terms of $\sin 2A$, four values are to be expected generally.

If $\sin 2A = a$, what values of A give the following equation,

$$2\sin A = -\sqrt{(1+a)} + \sqrt{(1-a)}?$$

Prove that, if $\sin 4A = a$, the four values of $\tan A$ are given by

$$\frac{1}{a}\left\{(1+a)^{\frac{1}{2}} - 1\right\}\left\{1 + (1-a)^{\frac{1}{2}}\right\}.$$

9. Prove that, if $A+B+C=180^\circ$,

$$\sin^4 A + \sin^4 B + \sin^4 C = \tfrac{3}{2} + 2\cos A \cos B \cos C + \tfrac{1}{2}\cos 2A \cos 2B \cos 2C,$$

and that, if

$$\frac{\sin ra}{l} = \frac{\sin(r+1)a}{m} = \frac{\sin(r+2)a}{n},$$

$$\frac{\cos ra}{2m^2 - l(l+n)} = \frac{\cos(r+1)a}{m(n-l)} = \frac{\cos(r+2)a}{n(l+n) - 2m^2}.$$

10. Prove that, if θ be the circular measure of an angle less than a right angle, $\frac{\sin\theta}{\theta}$ lies between 1 and $1 - \frac{1}{6}\theta^2$.

Find the value of $\sin 3''$ to ten places of decimals.

11. Find the area of a triangle in terms of one side and the adjacent angles.

If a triangle be cut out in paper and doubled over so that the crease passes through the centre of the circumscribed circle and one of the angles A, the area of the doubled portion is $\frac{1}{2}b^2 \sin^2 C \cos C \operatorname{cosec}(2C-B) \sec(C-B)$, C being $> B$.

12. It is observed that the altitude of the top of a mountain at each of the three angular points A, B, C of a plane horizontal triangle ABC is a: show that the height of the mountain is $\frac{1}{2}a \tan a \operatorname{cosec} A$.

Show that, if there be a small error n'' in the altitude at C, the true height is very nearly

$$\frac{1}{2}\frac{a\tan a}{\sin A}\left(1 + \frac{\cos C}{\sin A \sin B}\,\frac{\sin n''}{\sin 2a}\right).$$

PROBLEMS IN ARITHMETIC,

by W. S. Ellis, B.A., Mathematical Master, Collegiate Institute, Cobourg.

1. Find the largest square number which is an exact divisor of 3780? *Ans.* 36.

2. The prices of seats at a lecture were 50 cts., 35 cts., and 25 cts. It is known that for every 3 seats sold at 35 cts. there were 4 at 25 cts., and for every 3 at 50 cts. there were 4 at 35 cts.; and the whole sum realized from the sale of seats was $76.20. How many of each kind were sold?

Ans. 96 at 25 cts., 72 at 35 cts., and 54 at 50 cts.

3. At an examination $\frac{1}{16}$ of the candidates made 75 per cent. on the paper set, $\frac{1}{5}$ of the remainder made 60 per cent., $\frac{1}{3}$ of the remainder made 50 per cent., and half of the remainder failed; but the number who failed was greater by 9 than the number that made 75 per cent. How many were in the class? *Ans.* 48.

4. By what must $\frac{4}{15}$ of $\frac{3}{8}$ of $\frac{5}{8}$ be diminished so that the result may be $\frac{1}{3}$ of that obtained by multiplying ($\frac{2}{5}$ of $\frac{3}{8}+\frac{1}{7}$) by ($\frac{5}{6}-\frac{2}{3}$ of $\frac{5}{8}$). *Ans.* $\frac{91}{1703}$.

5. Which is greatest, $.44$, $.4\dot{4}$, or $.\dot{4}\dot{4}$? Express the difference between each pair as a decimal, and determine in each case whether this decimal is finite, a mixed repetend, or a pure repetend. *Ans.* Last two are equal.

6. If 20 lbs. of green tea be mixed with