Solve (*i*) $\sqrt{(\alpha x+\beta)}+\sqrt{(\alpha_1 x+\beta_1)}=\sqrt{(ax+b)}+\sqrt{(a_1 x+b_1)}$
where $\alpha+\alpha_1=a+a_1$, and $\beta+\beta_1=b+b_1$.

(*ii*) $\dfrac{\sqrt[3]{(3a+a^3-3x-x^3)}}{a-x}=\dfrac{3}{a^2}+1.$

4. Find the sum of n terms of a geometrical progression when the rth and sth terms are known.

B holds an estate from A on a lease with two years unexpired. He has made permanent improvement on it and sublet it for £510 per annum. Reckoning yearly interest at 4 per cent., the present value of the estate to A is 24 times B's interest in it. What rent is B paying A?

5. Assuming the binomial theorem for a positive integral index, prove it for a fractional one.

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 $\dfrac{N}{90000}$.

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 $\tan(180°-A)=-\tan A$.

Prove directly from the definitions of the trigonometrical functions that $\dfrac{1+\cos A}{\sin A}=\cot\frac{1}{2}A$.

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 will 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 $A+B+C=180$,

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

and that if $\dfrac{\sin ra}{l}=\dfrac{\sin(r+1)a}{m}=\dfrac{\sin(r+2)a}{n}$,

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

10. Prove that, if θ be the circular measure of an angle less than a right angle, $\dfrac{\sin\theta}{\theta}$ lies between 1 and $1-\frac{1}{4}\theta^2$.

Find the value of $\sin 3''$ to 10 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 α. Shew that the height of the mountain is $\frac{1}{2}a\tan\alpha\operatorname{cosec}A$.

Shew that, if there be a small error n'' in the altitude at C, the true height is very nearly $\frac{1}{2}\dfrac{a\tan\alpha}{\sin A}\left(1+\dfrac{\cos C}{\sin A\sin B}\dfrac{\sin n''}{\sin 2\alpha}\right)$

EUCLID.

1. Prop. 35, Bk. I. Find the condition that must exist in order that it may be possible to fold the four corners of a quadrilateral piece of paper flat down on the paper so that the four angular points meet in a point, and the paper is everywhere doubled.

2. Prop. 3, Bk. III, first part. Draw from a given point P two straight lines PQ, PR, at a given inclination to one another, to meet two given straight lines in Q and R, so that PQ, PR may be equal.

3. Prop. 21, Bk. III. If A, B, be two fixed points on a circle, and C, D, the extremities of a chord of constant length, then the intersections of AD, BC and of AC, BD lie on fixed circles.

4. Prop. 35, Bk. III, case two. If P be a point in a diameter AB of a circle, and PT be the perpendicular on the tangent at a point Q, then rect. PT, AB=rect. AP, BP+sq. on PQ.

5. Prop. 8, Bk VI. Show that the middle points of the four common tangents to two circles which lie outside each other lie on a straight line.

6. Prop. 19, Bk. XI. If the perpendiculars from two of the angular points of a tetrahedron on the opposite faces meet in a point, the perpendiculars from the other two angular points meet in a point.

Problems For Solution.

T. E. Colman, B.A., Frederickton Junction, N.B. sends the following problem for solution:—"Two boys bought a cylindrical tankard of milk 6 inches deep and 4 inches in diameter. One boy drank until, by tipping the tankard so that the milk came to the mouth without spilling, he could see half the bottom. Required how much of the milk this boy drank."

J. K., Prescott, requests us to give a solution of the equations $x^2+y=7$, $y^2+x=11$. This is a famous old equation of the fourth degree and of course has four roots. We can see by inspection one solution, viz., $x=2$, $y=3$. But to find all the roots we must substitute $y=7-x^2$ in the second equation for y, and get $x^4-14x^2+x+37=0$.

$$i.e.,\ (x-2)(x^3+2x^2-10x-19)=0.$$

We next apply Horner's method of appoximation to find the roots of the equation $x^3+2x^2-10x-19=0$, and get
$x=3{\cdot}13$; $-1{\cdot}84$; $3{\cdot}28$; and corresponding values for
$y=-2{\cdot}79$; $3{\cdot}61$; $3{\cdot}75$. These together with $x=2$.
$y=3$ are the four pairs of values required.

Practical Department.

LESSONS IN CHEMISTRY.

(Continued from last month.)

EXERCISE I.

(N. B.—All answers should be carefully written out.)

1. What is the difference between a simple and compound body?

2. Name twenty elements, and give their chemical symbols and atomic weights.

3. Are we acquainted with all the elements?

4. Define *matter*, *volume*, *mass*, *molecule* and *atom*.

5. What is the *atomic weight* of an element? What is taken as the unit of comparison? How does the *molecular weight* differ from the atomic?

6. Mention differences between chemical force and physical forces?

7. What is the method of investigation in chemical research

8. How do chemical changes differ from physical chang s

9. What is the special province of the chemist in the study of matter?

10. Mention the chief means at our command for securing chemical union or decomposition.

11. What view does the chemist take of the constitution of matter?

12. Give some examples of the extreme divisibility of matter.

13. If the globe and all upon it consisted of one chemical element, say gold, would the science of chemistry be possible?

14. Explain the use of the balance to the chemist.

15. Illustrate the statement—"Matter exists in three forms."

16. When a candle is burnt in a wide-glass tube, the upper half