2. Give the width of the zones in degrees, and the names of the circles bounding them.

3. What is the highest latitude possible? The highest longitude? Why is there a difference in the two cases?

4. (*a*) Describe the position of the Dominion of Canada. (*b*) Of what does it consist? (*c*) What is its population?

(*d*) How many provinces as large as Ontario might be formed in the Dominion?

(*e*) Name the Capital of the Dominion; the largest and the oldest city in it.

5. (*a*) What was the population of Ontario at the time of the last census?

(*b*) Name its chief productions?

(*c*) Name its chief minerals?

(*d*) Name all its cities?

(*e*) Name its railroads giving their termini?

6. Name the principal rivers of Europe, and one city on the bank of each.

7. Sketch Asia, showing its countries, five seas, three peninsulas, four gulfs, and the rivers running South.

8. Where and what are Aden, Father Point, Khyber Pass, Natal, Melbourne, Falkland, Sydney, Zambesi, Medina, Sedan, Gothland, Valparaiso, Ortegal, Guayaquil, Como, Havana, and Onega.

ALGEBRA.—SOLUTIONS.

SECOND CLASS.

1. Given expression

$$=\left(\frac{a(x^2-y^2)+2bxy}{x^2+y^2}\right)^2+\left(\frac{-b(x^2-y^2)+2axy}{x^2+y^2}\right)^2$$

$$=\frac{(a^2+b^2)(x^2-y^2)^2+4xy(a^2+b^2)}{(x^2+y^2)^2}$$

$$=(a^2+b^2).$$

2. Quotient $= a^2+ab+b^2+ac-bc+c^2$. Apply preceding, putting $a=1+x+x^2$, $b=1-x+x_2$, $c=2x$.

3. $x^4+y^4-\frac{1}{4}x^2y^2=(x^2+y^2)^2-\frac{9}{4}x^2y^2=(x^2+y^2+\frac{3}{2}xy)(x^2+y^2-\frac{3}{2}xy)$. $(7x+6y-9)(x-y+4)=7x^2-6y^2-xy+19x+33y-36$.

4.

$$\begin{array}{r|rrrrr|r}
-99 & 5 & +497 & +200 & +196 & -218 & -2000 \\
 & & -495 & -198 & -198 & +198 & +1980 \\
\hline
 & 5 & +2 & +2 & -2 & -20 & -20
\end{array}$$

$\therefore -20 =$ value.

$$\begin{array}{r|rrrr|rr}
 & 6 & +5 & -17 & -6 & +10 & -2 \\
-\frac{3}{2} & & -9 & +6 & +12 & -6 & \\
+\frac{1}{2} & & & +3 & -2 & -4 & +2 \\
\hline
 & 6 & -4 & -8 & +4 & 0 &
\end{array}$$

$\therefore 0 =$ value.

5. Rationalizing, expression becomes

$$\frac{a+\sqrt{a^2-x^2}}{x}=\frac{1}{b}$$

6. $\frac{1}{a}+\frac{a}{1+a}>1$, if $1+a+a^2>a+a^2$, if $1>0$. $\frac{a}{b}+\frac{b}{a}>2$, if $(a-b)^2$ is $+ve$.

7. (1) $\left.\begin{matrix}x=4 \text{ or } 9\\ y=9 \text{ or } 4\end{matrix}\right\}$. 2. $\left.\begin{matrix}x=1\\ y=2\\ z=3\end{matrix}\right\}$.

(3) $(x^2+7x+6)(x^2+7x+12)=16$, forming a quadratic in (x^2+7x). Solving this $=n$, we have

$$x=\frac{-7\pm\sqrt{33}}{2} \text{ or } \frac{-7\pm\sqrt{-7}}{2}.$$

8. Let $x-1$, x, $x+1$ be the numbers

$$(x-1)^3+x^3+(x+1)^3=16\tfrac{2}{7}\,x(x+1),$$

whence $x=0$, 6 or $-\frac{4}{7}$: numbers are therefore -1, 0, 1, etc.

9. (1) Roots, such as those given in the question, enter equations in pairs: let the equation composed of the remaining roots be represented by the symbol $f(x)=0$: the equation will be $x(x-\sqrt{-3})(x+\sqrt{-3})$

$$(x-1+\sqrt{2})(x+1-\sqrt{2})f(x)=0,$$

or $\quad x(x^2+3)(x^2-2x-1)f(x)=0.$

The coefficients of the equation are assumed to be rational and real.

(2) $\sqrt{pq}$ is a mean proportional between p and q, and therefore, by the question, is a root; by substitution we obtain $pq+p\sqrt{pq}+q=0$, or $q(p+1)^2=p^3$.

10. Let $x=$number of miles train moving from A goes per hour; let $y=$number of miles train moving from B goes per hour. Whole distance $=\frac{3}{2}(x+y)$:

$$\text{time for first train}=\frac{\frac{3}{2}(x+y)}{x},$$

$$=\text{second train's time}+52\tfrac{1}{2}'$$

$$=\frac{\frac{3}{2}(x+y)}{y}+\tfrac{7}{8}h.$$

By simplifying we have $\frac{y^2}{x^2}-\frac{7}{12}\frac{y}{x}=1$, or $\frac{y}{x}=\frac{4}{3}$.