Algebra.—For Class D, and for Junior Civil Service. Time allowed: 3 hours.

1. Write down the algebraical expression for the following:—

The number x is mutiplied by itself and is added to the result obtained by multiplying the number y by itself, and the sum is divided by the sum of the numbers x and y; the quotient is subtracted from that number which when multiplied by itself gives the product of the numbers x and y. If $x=4$ and $y=9$, find the numerical value of the final result obtained.

2. Multiply $3-2x+4x^2-5x^3$ by $2x^2-x+4$, and find the value of x which makes the product exactly divisible by x^2-x+3.

3. Find the factors of—

$$6a^2-7ab-3b^2;$$
$$x^3+a^3-a^2x-ax^2;$$
$$2a^2-2b^2-2c^2+3ac-5bc.$$

4. Simplify $[1-(1+(1-x))+x^2]\times[-1+(1-(1-x+x^2))]$;
and find the quotient when $(x+y)^3+(y+z)^3+(z+x)^3-3(x+y)(y+z)(z+x)$ is divided by $x+y+z$.

5. Simplify $\dfrac{2x^3-5x^2-4x+3}{3x^3-8x^2-5x+6}$

$$\frac{\frac{a-1}{3}+\frac{a-1}{a-2}}{\frac{a+2}{4}+\frac{a+2}{a-3}}\div\frac{\frac{a+3}{7}-\frac{a+3}{a+4}}{\frac{a-2}{3}+\frac{a-2}{a-1}}$$

6. Show that if $2s=a+b+c$, then $(s-a)^2+(s-b)^2+(s-c)^2+s^2=a^2+b^2+c^2$, and
$\dfrac{1}{s-a}+\dfrac{1}{s-b}+\dfrac{1}{s-c}-\dfrac{1}{s}=\dfrac{abc}{s(s-a)(s-b)(s-c)}$

7. Solve the equations $\dfrac{1}{x-a}-\dfrac{1}{x-b}=\dfrac{1}{x+b}-\dfrac{1}{x+a}$

$$\left.\begin{aligned}\frac{x-y}{2}+\frac{x+y}{3}&=2\tfrac{1}{2}\\ \frac{x+y}{2}+\frac{x-y}{3}&=4\tfrac{1}{6}\end{aligned}\right\}$$

8. A rectangular field is p feet long and q feet wide, and from one corner there is cut off a portion in the shape of a right-angled triangle, of which the right angle coincides with one of the corners of the field, and whose sides, which contain the right angle and which are each a feet long, are in the direction of the sides of the field. Find the cost of fencing in the remainder at £x a chain.

9. How much tea at 1s. 8d. a pound must be mixed with 150 lb. at 2s. a pound so that when the mixture is retailed at 2s. a pound a gain of 8 per cent. is made?

10. A cyclist sets out from P and travels at a uniform speed towards Q, which is 180 miles distant. At the same instant as he starts another cyclist starts from Q and travels uniformly towards P. They reach their destinations respectively $12\frac{1}{2}$ hours and 8 hours after they meet: find the rate at which each travels.

Algebra.—For Senior Civil Service. Time allowed: 3 hours.

1. Define the terms *power, index, cube root, reciprocal.*

Show that $a^0=1$, that $a^{\frac{1}{3}}=\sqrt[3]{a}$, and that a^{-n} is the reciprocal of a^n.

2. Divide $x^{\frac{4}{3}}-2x^{\frac{2}{3}}y^{\frac{2}{3}}+y^{\frac{4}{3}}$ by $x^{\frac{2}{3}}+2x^{\frac{1}{3}}y^{\frac{1}{3}}+y^{\frac{2}{3}}$, and $25x^{6n}-16x^{4n}-8x^{2n}-1$ by $5x^{3n}+6x^{2n}+2x^n+1$.

3. Explain what is meant by the *highest common factor* and the *lowest common multiple* of two quantities, and show that the lowest common multiple is the product of the two quantities divided by their highest common factor.

4. Find the H.C.F. and the L.C.M. of—

(*a.*) $4(x^2y+xy^2)$; $6(x^3-xy^2)$, and $9(xy^2+y^3)$

(*b.*) x^6+3x^5+x+3 and x^3-8x+3

5. Simplify the expressions—

(*a.*) $\left(\dfrac{1}{a}+\dfrac{1}{ab^3}\right)\div\left(b-\dfrac{1}{b}\right)$

(*b.*) $\dfrac{x-(x^2-y^2)^{\frac{1}{2}}}{(x+y)^{\frac{1}{2}}-(x-y)^{\frac{1}{2}}}+\dfrac{x+(x^2-y^2)^{\frac{1}{2}}}{(x+y)^{\frac{1}{2}}+(x-y)^{\frac{1}{2}}}$

6. Extract the square roots of—

$a^{4n+2}+6a^{3n+1}+9a^{2n}-10a^{2n+1}c^{n-2}-30a^nc^{n-2}+25c^{2n-4}$, and of $38-12\sqrt{10}$.

7. Solve the equations—

(*a.*) $\dfrac{1}{x}+\dfrac{b}{x+a}=\dfrac{b+1}{x+b}$

(*b.*) $\sqrt{4a+x}=2\sqrt{b+x}-\sqrt{x}$

(*c.*) $\dfrac{x+y}{3}+2z=21$, $\dfrac{y+z}{2}-3x=-65$, $\dfrac{3x+y}{9}-z=4$

(*d.*) $\dfrac{a}{x}+\dfrac{b}{y}=c$, $\dfrac{b}{y}+\dfrac{c}{z}=a$, $\dfrac{c}{z}+\dfrac{a}{x}=b$