

days will A be walking down hill a distance which B accomplished up hill in 3 days; supposing that a man's rate of walking is increased by one-third in going down hill, and decreased by one fourth in going up.

6. If 1000 men can excavate a square basin whose side is 1600 yds., and which is 30 yds. deep, in 9 months, how many will be required to excavate a square basin whose side is 2000 yds., and which is 40 yds. deep, in twelve months?

7. The hands of a clock move irregularly, the hour hand moving 5 per cent. too fast, and the minute hand 10 per cent. too slow. In 15' (true time) they will be together; how many minutes, measured on the face of the clock, are they apart now?

8. A money lender has \$1500 out at 8 per cent., \$1200 at 7½, and \$1000 at 6; find the percentage he receives on the average.

9. A mortgage for \$1000, paying 7 per cent. per annum, payable yearly, has two years to run; what should a loan society give for the mortgage that it may receive 8 per cent. on its investment, it being assumed that all monies received by the society can be lent out at 8 per cent.?

Values—1, 5+9; 2, 2+6+6; 3, 6+6; 4, 6+8; 5, 10; 6, 7; 7, 10; 8, 7; 9, 12.

ALGEBRA.

TIME—TWO HOURS AND A HALF.

Examiner—ALFRED BAKER, M.A.

1. Factor $x^3 + y^3$; and $x^3 + y^3 + z^3 - 3xyz$.
Utilize your results to show that

$$(1) (x+z)^3 + (y-z)^3 - (x+y)(x-y+2z)^2$$

$$(2) (a^2 - bc)^3 + (b^2 - ca)^3 + (c^2 - ab)^3 - 3(a^2 - bc)(b^2 - ca)(c^2 - ab) = (a^3 + b^3 + c^3 - 3abc)^2.$$

2. If $a^2 - bc = b^2 - ca$, and a be not equal to b , then $a(b^3 + bc + c^3) + b(c^3 + ca + a^3) + c(a^3 + ab + b^3) = 0$.

3. Show how to find the L.C.M. of two Algebraic expressions. Find the conditions that $x^3 + ax^2 + b$ and $x^3 + cx + d$ may have a L.C.M. of the form $x^4 + px^3 + qx^2 + rx + s$.

4. Simplify $\frac{(x+y)z^2}{(y-z)(z-x)} + \frac{(y+z)x^2}{(z-x)(x-y)} + \frac{(z+x)y^2}{(x-y)(y-z)}$.

5. Extract the square root of

$$(1) 2\left(1 - \frac{b^2 + c^2 - a^2}{2bc}\right)\left(1 - \frac{c^2 + a^2 - b^2}{2ca}\right)\left(1 - \frac{a^2 + b^2 - c^2}{2ab}\right).$$

$$(2) x^4 + x^3 + 2x^2 + 3x + 4.$$

6. Find the value of x in

$$(x+a)(b-c) + (x+b)(c-a) + (x+c)(a-b) = 0.$$

Explain result.

7. Find an expression for k in terms of a, b, c , that will make

$$\frac{b^2 - c^2}{k-a} + \frac{c^2 - a^2}{k-b} + \frac{a^2 - b^2}{k-c}, \text{ vanish.}$$

8. If for every \$3.00 of income A has, B has \$2.00; for every \$12.00 A spends, B spends \$1.00; and for every \$4.00 A saves, B saves \$5.00; find the proportion of his income that A saves.

9. Solve the equations

$$(1) \frac{x+1}{5} + x(x-1) = (x-1)^2.$$

$$(2) \frac{1}{x-a} - \frac{1}{x-2a} = \frac{1}{x-3a} - \frac{1}{x-4a}.$$

$$(3) \frac{2x^2 + 2x^2 + 3x + 1}{x^2 + x + 1} = \frac{x^2 - x + 1}{x-1} + \frac{x^4 - x + 1}{x^3 - 1}.$$

$$(4) \begin{cases} x^2 + xy + y = 25 \\ x + xy + y^2 = 31 \end{cases}.$$

Values—1, 1+3+4+7; 2, 6; 3, 6+8; 4, 6; 5, 5+4; 6, 7; 7, 7; 8, 7; 9, 4+7+8+10.

EUCLID.

TIME—TWO HOURS AND A HALF.

Examiner—ALFRED BAKER, M.A.

(All intelligible abbreviations permitted).

1. Show clearly that in Book I. Euclid proves that if the three sides of a triangle be given, or two sides and the contained angle, then the triangle is determinate. (The proofs of the propositions in which this is made out are not required.)

Is there any other case in which Euclid shows that if certain parts be given the triangle is determinate?

2. If two parallel lines be also equal, the lines joining their ends are either parallel and equal or else they bisect one another.

State converses of these propositions, and prove one of such converses.

3. If a parallelogram be on the same base with a triangle, and both have the same altitude, the former is double the latter.

4. Show that the square on the hypotenuse of a right-angled triangle is equal to the sum of the squares on the sides.

5. ABCD is a quadrilateral having AD parallel to BC; show that if E be the bisection of AB, the triangle EOD is half the quadrilateral.

Show also that if F be the bisection of AD, and FBC be half the quadrilateral, then the quadrilateral is a parallelogram.

6. ABCD is a quadrilateral having the sides DA, DC respectively greater than BA, BC; prove that if BA, CD meet, when produced, toward A and D, then will DA, CB meet, when produced, towards A and B.

7. Show how to divide a straight line into two parts such that the rectangle contained by the whole line and one part may be equal to the square on the other part.

Show how to produce AB to C, so that the rectangle contained by AC, CB may be equal to the square on AB.

8. Construct a square equal to a given rectangle.

Values.—1, 8+3; 2, 5+5+3+3+6; 3, 6; 4, 9; 5, 9+9; 6, 9; 7, 10+7; 8, 8.

CHEMISTRY.

TIME—ONE HOUR AND A HALF.

Examiner—E. HAANEL, Ph. Dr.

1. $\text{KNO}_3 + \text{H}_2\text{SO}_4 = \text{HNO}_3 + \text{KHSO}_4$.

(i.) Give, first, the names of the compounds entering into the reaction represented by above equation, and, second, the names of the elements, with their combining weights, entering into the constitution of these compounds.

(ii.) Represent, by diagram, the necessary apparatus for conducting the experiment indicated by the equation.

(iii.) What effect would H_2SO_4 , HNO_3 and KNO_3 , each have upon a solution of blue litmus?

2. It is required to make 3½ pounds of HNO_3 by experiment

1. (ii.) How much H_2SO_4 is required?

3. Explain the principle of Davy's safety lamp.

4. It is required to prepare the elements hydrogen and nitrogen for class purposes:

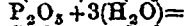
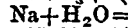
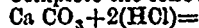
(i.) Describe the apparatus and name the substances needed for the preparation of each of the elements.

(ii.) Write out the equations representing the reactions occurring in their elimination.

(iii.) Describe the experiments you would perform to demonstrate their distinguishing properties.

5. Assign reasons for assuming that charcoal, graphite and diamond are different modifications of the same element.

6. Complete the following equations:



7. Coal gas and phosphorus burn with a luminous sulphur and hydrogen with a non-luminous flame. Account for this difference.

8. A certain quantity of zinc furnished, when treated with sulphuric acid, 3½ pounds of zinc sulphate. How much zinc was employed? $\text{Zn} = 65$.

Values—1, 4+8+10+6; 2, 12; 3, 8; 4, 8+5+7; 5, 10; 6, 2+2+4+2; 7, 10; 8, 12.

NATURAL PHILOSOPHY.

TIME—TWO HOURS AND A HALF.

Examiner—J. C. GLASHAN.

1. Define Force, Weight, Mass.

How are they respectively measured?

Is the weight of a body the same at all points of the earth's surface? How can any difference be detected?