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CENTRAL WELSH BOARD
EXAMINATION SERIES.

School Certificate
Examination Papers

Arithmetic and Algebra

1935—1946

PUBLISHED UNDER SPECIAL ARRANGEMENT
WITH THE CENTRAL WELSH BOARD.

LONDON:
THE EDUCATIONAL SUPPLY ASSOCIATION,
LTD.,

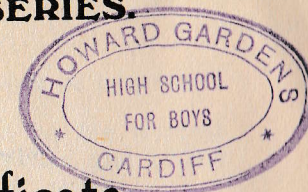
181, HIGH HOLBORN, W.C.1.

Successors to

HELFE BROTHERS (1924) LTD.

ON LOAN TO:-
1. John Ford 5A²
2. A. Ashton 5A¹
3. J. B. 5A¹
4. E. J. Ineson 5Sc 1951-2

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IN

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CENTRAL WELSH BOARD.
ARITHMETIC.

JULY, 1938.

(2½ hours.)

Mathematical Tables are not to be used in Questions 1 and 2.

1. (i) Find in francs, correct to the nearest franc, the difference between £73 10s. and 10,250 francs, assuming that £1 = 138·75 francs.

(ii) One-sixth of a man's weekly wage is spent on rent and five-eighths of the remainder on food. If 15 shillings then remain, find his weekly wage.

(iii) A number is divided by 21 by dividing by the factors 3 and 7. The successive remainders are 1 and 4 and the quotient is 68. Find the number.

2. (i) $8\frac{1}{2}$ tons of coal are sold at £1 17s. 6d. a ton and $12\frac{3}{4}$ tons at £2 a ton. Find the average price per *cwt.* correct to the nearest $\frac{1}{2}$ d.

(ii) What is the speed in miles per hour at which a bicycle is travelling if a wheel 28 inches in diameter is making 5 revolutions in 2 seconds? Assume that $\pi = \frac{22}{7}$.

(iii) Two vessels of equal capacity are each filled with a mixture of the same two liquids. In the first vessel the liquids are in the proportions 3:2 and in the second 4:3. If the vessels are emptied into the same container, what will be the resulting proportions of the two liquids?

3. (i) What is the rate per cent. per annum when £425 invested for 3 years at simple interest amounts to £482 7s. 6d.?

(ii) Find the sum to the nearest £ which will amount to £650 when invested for 3 years at 4 per cent. per annum compound interest.

4. In six months a draper sold 64 pairs of blankets at 25 shillings a pair, making a profit of 25 per cent. on the cost price. To increase his

sales he reduces the price by 1s. 6d. a pair and finds that his profit for six months increases by 12s. 6d. How many pairs does he sell during the six months?

5. A cask of wine containing 75 litres is bought abroad for 820 francs, import duty being at the rate of 8s. a gallon. Find to the nearest penny the cost per bottle in England, reckoning 6 bottles to the gallon, given that 1 gallon = 4.546 litres and assuming that £1 = 141 francs.

6. The area of a rectangular plot of ground is 2,420 square yards and its length is one and a half times its width. It is to be enclosed by a fence consisting of four parallel wires. Find the length of wire required correct to the nearest 5 yards.

7. (i) What is the price of a $4\frac{1}{2}$ per cent. stock when it gives the same percentage return on money invested in it as a $4\frac{1}{8}$ per cent. stock at 98 $\frac{1}{4}$?

(ii) A man sells his holding in a $4\frac{1}{2}$ per cent. stock when the price is 99 and invests the proceeds in 6 per cent. stock at 110. Find the change in his income if his income from the $4\frac{1}{2}$ stock was £112 10s.

ALGEBRA.

JULY, 1938.

(2 $\frac{1}{2}$ hours.)

1. (i) Given that $a = 5m + 4n$ and $b = 2m - 3n$, find the value of $\frac{b}{2a} - \frac{2a}{b}$ in terms of m and n . Express your answer as one fraction without brackets.

(ii) Factorize each of the following expressions:

$$6x^2 - x - 12; 2x^2 - 3b - 3x + 2bx;$$

$$2x^3 - x^2 - 7x + 6.$$

Write down their H.C.F.

(iii) Evaluate by logarithms

$$\frac{(0.864)^2}{7.82}.$$

2. (i) A bicycle wheel of radius a inches revolves n times in travelling a certain distance. How many times does a wheel of radius b inches revolve in travelling the same distance?

(ii) If a , b , 7, and $5a/4$ are four successive terms of an arithmetical progression, find the values of a and b .

(iii) The ratio of the weights of two parcels is $5/7$. If 10 lb. is added to each parcel, the ratio of their weights is $7/9$. Find the original weight of each parcel.

3. (i) Solve the equations:

$$(1) 3x^2 = 27x,$$

$$(2) 3x^2 = 27x + 8.$$

(ii) A man spent 13s. 9d. in buying a number of articles, and intended to sell them at such a price as would yield a total profit of 3s. 9d. He found, however, that ten were smashed and unsaleable. He then increased his intended selling price by $\frac{1}{4}d.$ per article and finally made 10d. more profit than he had originally expected. Find the original number of articles and the actual selling price of each.

4. The cost *per hour* of running a motor-boat is the sum of two charges, one of these being constant and the other varying as the square of the boat's speed. When the speeds are 18 miles per hour and 12 miles per hour, the costs *per hour* are respectively 13.48 shillings and 9.88 shillings. What is the cost per hour when the speed is 20 m.p.h.?

Find the possible steady speeds at which the boat must travel in order that the *total cost* of a journey of 60 miles shall be £2 6s. 0d.

John For

5. Draw the graph of $y = 2 + 2\frac{1}{2}x - x^2$ for values of x from -2 to $+4$.

Use your graph (i) to find the values of x when y is equal to $\frac{1}{4} - \frac{1}{2}x$, and (ii) to solve the equation $2 + 5x - 2x^2 = 0$.

6. (i) The fifth term of an arithmetical progression is 14 and the twentieth term is -31 . Find the value of the first negative term and the sum of all the positive terms.

(ii) Find the sum of the first eight terms of

$$\frac{5}{18} + \frac{5}{12} + \frac{5}{8} + \frac{15}{16} + \dots,$$

giving your answer as accurately as your logarithm tables allow.

7. ABC is a triangle, right-angled at B , and $AC = 14$ inches. $\angle BCA = 67^\circ$. On AC is drawn a rectangle $ACXY$ (XY is on the opposite side of AC from B), whose diagonals meet at M . Given that $AY = 9$ inches, calculate

- (i) the distance from X to AB ,
- (ii) the size of $\angle YCB$ to the nearest degree,
- and (iii) the distance from M to BC .

ARITHMETIC.

JULY, 1939.

(2½ hours.)

Mathematical Tables are not to be used in Questions 1 and 2.

1. (i) Express as a single fraction in its lowest terms

$$1\frac{3}{8} - \frac{2\frac{1}{8} + \frac{2}{3}}{5\frac{1}{2} - 2\frac{1}{50}}.$$

(ii) Find to the nearest shilling, the cost of 397 litres at 29.86 francs per litre, when £1 = 175 francs.

2. (i) Find the square root of 5.2775 correct to three decimal places and show that, to this degree of accuracy, it is equal to $\frac{85}{37}$.

(ii) The ratio of A 's wages to B 's is 10:11. A spends nine-tenths of his wages and saves 6s. 6d. What fraction of his wages does B spend if he saves 5s. 6d.?

3. (i) A man had money in an account on which 5 per cent. per annum was added at the end of each calendar month on the number of complete pounds to his credit during the whole of that month. He opened his account with the sum of £87 5s. 6d. on 30 June and withdrew £40.18s. 6d. on 25 July. Find the sum to his credit on 1 August. (For the purpose of calculating interest, assume that a calendar month is one-twelfth of a year.)

(ii) To allow for depreciation in the value of machinery costing £800, 15 per cent. of its cost is deducted at the end of the first year. At the end of the second and of each succeeding year, $12\frac{1}{2}$ per cent. of its value at the beginning of the year is deducted. How many years must elapse before its value falls below £500, and what will then be its value to the nearest £?

4. Silk is bought in France at 40 francs a metre and a duty of $33\frac{1}{3}$ per cent. is added when it is brought into England. A draper wishes to sell it at a whole number of shillings and elevenpence a yard and to make not less than 30 per cent. profit on the cost price including duty. What is the selling price, assuming that 1 metre = 39.37 inches and £1 = 167 francs?

5. A and B enter into partnership, A subscribing £4,000 and B £3,000 capital. It is agreed that A shall take one-tenth of the profits as manager, that a further one-tenth shall be placed to a reserve fund, and that the remainder shall be divided between A and B in proportion to the amounts of capital subscribed. How much does A receive if the profits are £1,015?

The following year they take C into partnership. For this privilege C agrees to add £200 to A 's capital and £200 to B 's, and to subscribe £2,600 on his own account. Of the profits, A is still to take one-tenth as manager, one-tenth is to be placed to the reserve fund, and the remainder is to be divided between A , B , and C in proportion to their capital. What increase does A receive over his previous year's amount if the profits are now £1,525?

6. Find, to the nearest kilogramme, the weight of a solid cylindrical iron rod, 1.76 m. long, of radius 8.3 cm. Assume that 1 c.c. of iron weighs 7.21 gm. and that $\pi = 3.142$.

A hollow iron pipe, also 1.76 m. long, and of external radius 8.3 cm., weighs 13 Kg. Find the internal radius in centimetres correct to one decimal place.

7. A man invests half his money in a $2\frac{1}{2}$ per cent. stock at 90 and half in a $3\frac{3}{4}$ per cent. stock at 108. What percentage return does he receive on his money?

He sells part of his holding in the $2\frac{1}{2}$ per cent. stock and invests it in the $3\frac{3}{4}$ per cent. How much stock does he sell if his income is increased by £10?

ALGEBRA.

JULY, 1939.

(2½ hours.)

1. (i) Solve the following equations:

$$(1) \frac{4x+1}{3} - \frac{x+6}{2} = 4;$$

$$(2) 8x = 12x^2 - 15.$$

(ii) A room is rectangular, a feet long and b feet wide. A carpet c yards square is placed on the floor, leaving part of the floor uncovered. Find the area in square yards of the part uncovered and the cost in shillings of staining it at y pence per square foot.

2. (i) Factorize

$$(1) (y+c)^2 - 25a^2;$$

$$(2) a^2b + cd - a^2d - bc;$$

$$(3) 27x^3 - 8y^3.$$

(ii) What is the remainder when $2x + 1 + x^4 - 3x^2$ is divided by $x^2 + 2x - 1$?

(iii) The volume of a sphere is 1939 cubic inches. Find the diameter of this sphere, as accurately as your logarithm tables allow, given that the volume of a sphere of radius r is πr^3 and $\pi = 3.142$.

3. (i) Express as a single fraction in its lowest terms

$$\frac{3x-1}{x^2-3x-4} - \frac{2x+1}{x^2-2x-8}$$

(ii) There are three strings of equal length. From one is cut off 8 inches, from the second 7 inches, and from the third 15 inches. The remaining pieces when put end to end form a right-angled triangle. Find the original length of one of the strings.

4. (i) A rectangular block is $(x+3)$ inches long, $(x-3)$ inches broad, and y inches high. The total surface area of the block is 62 square inches. Prove that

$$y = \frac{40-x^2}{2x}$$

(ii) Using the relation between x and y given in (i), find the values of x and y when

$$x-3y = \frac{1}{2}$$

5. Write down the gradient of the line $3y=2x+9$. With the same scales and with the same axes, draw the graphs of $y=2x^2+4x-6$ and $3y=2x+9$ from $x=-4$ to $x=+2$.

What is the minimum value of $2x^2+4x-6$?

For what range of values of x is

$$2x+9 > 6x^2+12x-18?$$

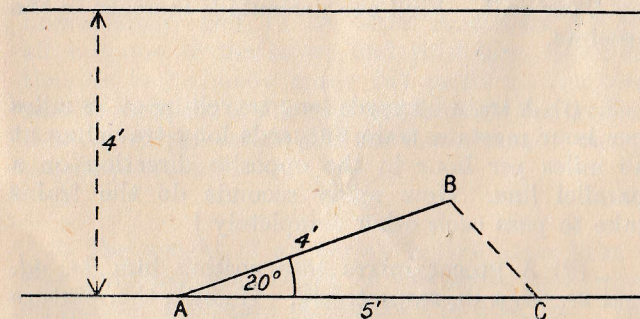
6. (i) The first and last terms of an arithmetical progression of n terms are -4 and 45 respectively. Write down an expression for the sum of these n terms. If this sum is $389\frac{1}{2}$, find the value of n and of the common difference.

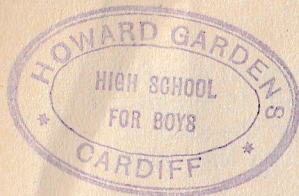
(ii) The first, third, and eleventh terms of an arithmetical progression are in geometrical progression. Given that the first term of the arithmetical progression is 2, find the third term.

7. The figure represents the passage between two walls and a gate AB , 4 feet wide, swung back on its hinges and held by a chain CB attached to one wall. If AC is 5 feet and $\angle BAC = 20^\circ$, calculate

(i) the clearance between B and the wall opposite to AC ,

(ii) the length of the chain BC .





ARITHMETIC

JULY, 1940.

 $2\frac{1}{2}$ hours.)

1. (i) Simplify $\frac{5\frac{3}{4} - (3\frac{3}{8} - 1\frac{1}{4})}{2\frac{1}{4}}$, and express the result as a decimal correct to four significant figures.

(ii) A party of schoolchildren was evacuated to three villages, one-third of the number to the first village and the remainder to the second and third villages in the ratio 3 : 2. Find the total number of the children if there were 168 in the third village.

2. (i) In a factory 127 men are paid an average wage of £2 5s. a week and 53 men an average wage of £2 12s. 6d. a week. Find the average weekly wage paid to a man.

(ii) When the price of an article was increased by 10 per cent. the number of articles sold decreased by 5 per cent. Find the percentage increase in the receipts.

3. (i) A train 85 yards long travelling at 38 miles per hour meets a train 69 yards long travelling at 46 miles per hour in the opposite direction on a parallel line. How many seconds do the trains take to pass each other completely?

(ii) A grocer mixes teas costing him 1s. 4d. and 2s. 6d. a lb. respectively. He sells the mixture at 3s. a lb. making a profit of 9d. per lb. What weights of the two teas are there in 1 cwt. of the mixture?

4. (i) A sum of £480 is invested, on which simple interest is paid at the end of each month. After 3 months the rate of interest is reduced by $\frac{1}{2}$ per cent. per annum. How much is lost in interest in the remaining 9 months of the year as a result of this reduction?

Find the original rate per cent. per annum if the sums paid in interest during these twelve months amount to £18 12s.

(ii) A debt of £250 is due to be paid on 1st August, 1942. What sum on 1st August, 1940, would pay the debt, reckoning compound interest at 4 per cent. per annum? Give the answer to the nearest penny.

5. A shopkeeper's price for an article was £12, but on this price he allowed 1s. in the £ discount to customers who paid him immediately. He sold 15 of the articles to customers who paid him immediately, and 13 to other customers. When all but one of the latter had paid him, he found that he had already made £63 profit on the total sum he had paid to the manufacturer for the articles. How much per article did the manufacturer charge the shopkeeper?

6. The weight of an empty hollow glass tube is 4.46 gm. and the weight of the same tube when containing a column of mercury is 6.39 gm. The length of the column is 8 cm. and mercury weighs 13.6 gm. per c.c. Find the inner diameter of the tube in millimetres correct to one decimal place, assuming π to be 3.142.

John Ford 5A2

7. Find the difference between the annual incomes derived from £1,560 invested in a 4 per cent. stock at 104 and the same sum invested in a $3\frac{1}{2}$ per cent. stock at 96.

A sum of £2,992 is invested partly in a 4 per cent. stock at 104 and partly in a $3\frac{1}{2}$ per cent. stock at 96, so that the incomes from the two stocks are equal. How much of each stock is bought?

ALGEBRA

JULY, 1940.

 $2\frac{1}{2}$ (hours.)

1. (i) Simplify $\frac{(2x^3y^2z)^3}{(-3x^4yz^3)^2}$.

(ii) Factorize completely each of the following:

$$6x^2 + 7x - 20; \quad a^3 + 3a^2b - 3ab^2 - 9b^3;$$

$$x^3 + 2x^2 - 11x - 12.$$

(iii) Find x in terms of a , b , and c , when

$$a - \sqrt{\frac{b}{x}} = c.$$

2. (i) Solve the equations

$$(a) \quad \left. \begin{aligned} \frac{2y}{3} - \frac{3-4x}{7} &= 0, \\ 4x &= 7 - 2y; \end{aligned} \right\}$$

$$(b) \quad \frac{3}{x} + \frac{2}{x-1} = 2.$$

(ii) x varies directly as y and inversely as the square of z . Given that $x = \frac{1}{2}$ when $y = 48$ and $z = 8$, calculate, by using logarithms, the value of x when $y = 150.1$ and $z = 9.2$.

3. (i) Solve the equation, giving the results correct to two decimal places,

$$\frac{x^2}{2} - \frac{x}{3} = 1.$$

(ii) What is the price of tea if a rise in price of 6d. per lb. gives 4 oz. less for 3s. 9d.?

4. The length of one rectangle is 2 inches more than the length of a second rectangle. The breadth of the first is 4 inches more than that of the second. The sum of the perimeters of the rectangles is 50 inches, and the sum of their areas is 81 square inches. Find the dimensions of the first rectangle.

5. With the same scales and axis, draw the graphs from

$$x = -2 \text{ to } x = +2 \text{ of } y = 2x^2 \text{ and } 4y = 6x + 9.$$

What is the gradient of the line $4y = 6x + 9$?

Use your graphs to find

(i) The value of $\sqrt{1.6}$,

(ii) The values of x between which the expression $6x + 9 - 8x^2$ is positive.

6. (i) Write down an unsimplified expression for the ninth term of the geometrical progression

$$64 + 48 + 36 + 27 + \dots$$

and then evaluate it by logarithms.

Calculate also the sum of the first eight terms of the progression.

(ii) A piece of wire 6 feet long is cut into 18 pieces. Each successive piece is 0.2 inch longer than the piece just cut off. What was the length of the first piece cut off?

7. A quadrilateral $ABCD$ has $\angle A = 67^\circ$, $\angle C = 71^\circ$, $\angle D = 90^\circ$, $AB = 18$ feet, and $CD = 25$ feet.

Calculate—

(i) the lengths of the perpendiculars from B to AD and from B to CD ,

(ii) the size of $\angle ACD$.

ARITHMETIC

JULY, 1941.

(2½ hours.)

Mathematical Tables are not to be used in Question 1.

1. (i) Evaluate $\frac{37.69 \times 0.407}{25.83}$ correct to three decimal places.

(ii) Find the cost of 7 tons 13 cwt. 3 qr. 14 lb. at £3 13s. 4d. a ton, correct to the nearest sixpence.

2. (i) A man's rent was $\frac{1}{5}$ of his wages and his other expenses were £2 a week. He moved into a cheaper house for which the rent was $\frac{1}{8}$ of his wages; his other expenses were £2 2s 6d. a week and he saved the same amount as before. How much a week did he save?

(ii) A submarine travelled at 16 knots on the surface and 8 knots when submerged. If it covered 68 nautical miles in 5 hours, for how long was it submerged? (A knot = 1 nautical mile per hour.)

3. (i) The engine of a car makes 5 revolutions for each revolution of the road wheel and the diameter of the road wheel is 28 inches. How many revolutions per minute does the engine make when the car is travelling at 30 miles per hour? (Assume that $\pi = 22/7$.)

(ii) A hall can be cleared by each of three exits in 6, 8, and 10 minutes respectively. How long, to the nearest half-minute, does it take to clear the hall when all three exits are open?

4. (i) A man invests £300, 6 months later £100, and after a further 3 months, a second £100. Simple interest is paid quarterly and the total interest at the end of a year is £13 2s. 6d. What is the rate per cent. per annum?

(ii) A man borrowed £250 at 4 per cent. per annum compound interest. He agreed to pay £50 at the end of each of the first three years after

borrowing and to complete the repayment of the debt at the end of the fourth year. What was the amount of his last payment to the nearest penny?

5. The list price of a typewriter is £16, and the manufacturer allows a retailer a discount of 30 per cent. on the list price. The retailer allows his customers a discount of $2\frac{1}{2}$ per cent. on the list price; a customer buys a new typewriter from the retailer and is allowed £3 for an old typewriter, which the retailer sells for £5 after employing a workman for 8 hours at 2s an hour to repair it. What is the total profit made by the retailer, and what percentage is this of the amount paid by him to the manufacturer?

6. An ink bottle is in the shape of a cylinder of 5 cm. diameter and 4 cm. high with a cylindrical neck 2 cm. in diameter and 1.5 cm. high. How many bottles could be filled to within 5 mm. of the top of the neck, from 1 litre of ink, and how many c.c. would remain? (1 litre = 1,000 c.c. Assume that $\pi = 3.142$.)

7. A man who bought equal amounts of $3\frac{3}{4}$ per cent. stock at 93 and $4\frac{1}{4}$ per cent. stock at 101, received an income of £72. How much money did he invest, and what was his percentage return on it correct to two decimal places?

ALGEBRA.

JULY, 1941.

(2½ hours)

[Answer SEVEN questions, choosing NOT MORE than THREE of the first four questions.]

1. (i) Factorize each of the following:—

$$20x^2 - x + 12; \quad ax - 4a + 2x - 8; \\ x^3 - 4x^2 + 6x - 4.$$

(ii) Given that $3x^2 - x + 1$ is a factor of

$$6x^4 - 11x^3 + 11x^2 - 5x + 2,$$

find and state another factor.

2. Solve the equations

$$(i) \quad \left. \begin{array}{l} 2x = 5 - y \\ 3y = 12\frac{3}{4} - 5x \end{array} \right\};$$

$$(ii) \quad (2x + 1)(x + 2) = 14;$$

$$(iii) \quad \left. \begin{array}{l} x + y = 5 \\ x^2 - 7 = y \end{array} \right\}.$$

3. (i) A rectangular table-top has a perimeter of 60 inches. Its length is m times its breadth; find the breadth in terms of m .

(ii) Given that $y = mx^2 + \frac{l}{x}$ and that $y = 9\frac{1}{2}$

when $x = 2$ and $y = 25\frac{1}{3}$ when $x = 3$, what is the value of y when $x = 2\frac{1}{2}$?

4. Use your logarithm tables to find the values of

(i) $(3.142)^3$, (ii) $\sqrt{(0.3142)}$,

(iii) $(8.742)^2 \times 46.5 - \frac{27.9}{0.03142}$.

5. (i) Express as a fraction in its lowest terms

$$\frac{1}{x^2 - 3x} + \frac{4}{3x} - \frac{1}{3x - 9}.$$

(ii) The breadth of a rectangle is $1\frac{1}{2}$ inches less than twice the length. The area of the rectangle is 2 square inches. Find the length correct to the nearest tenth of an inch.

6. (i) An article costing $\text{£}\frac{2}{5}x$ is sold for $\text{£}\frac{1}{2}x$. Find the profit per cent.

(ii) Of the two progressions $\frac{1}{12} + \frac{1}{6} + \frac{1}{4} + \dots$ and $\frac{1}{3} + \frac{1}{2} + \frac{3}{4} + \dots$ one is arithmetic and the other geometric. Find the 8th term of the geometric progression and the sum of the first eight terms of the arithmetic progression.

7. Using 1 inch as unit for both x and y and the same axes, draw the graphs from $x = -4$ to $x = +4$ of $y = \frac{1}{2}x^2$ and of $2x = 9 - 4y$.

Use one of the graphs to find the value of $\sqrt{2.5}$.

What quadratic equation has as its solutions the x value of the intersections of your graphs?

8. A school used footballs to the value of £28 each school year. The footballs go up in price by 5 shillings each and the school decides to use two footballs fewer this year and the bill remains the same. How many footballs were used per year originally?

9. An isosceles triangle ABC (in which $AB = AC$) has the base BC 4.2 inches and $\angle ABC = 67^\circ$. A square $BCPQ$ is drawn on BC on the side opposite to A . The line AXY is perpendicular to BC , cutting BC , PQ at X and Y . Calculate—

(i) the length of AY ,

(ii) $\angle BAQ$ to the nearest degree,

(iii) the length of AQ .

ARITHMETIC

JULY, 1942. — 1, 3, 5, 7.

($2\frac{1}{2}$ hours.)

1. (i) Express as a single fraction in its lowest terms:

$$\frac{2\frac{2}{7} - \frac{3}{5}(4\frac{1}{2} - 3\frac{1}{8})}{1\frac{2}{5} \div 1\frac{3}{5}}.$$

(ii) By expressing $\frac{355}{113}$ as a decimal to a sufficient number of places, show that this fraction is an approximation to π correct to six decimal places, given that $\pi = 3.14159265$.

2. (i) A cricketer's scores in seven completed innings are 84, 129, 5, 25, 94, 55, 98. What is his average?

How many runs does he score in his next innings if his average after it is 67?

(ii) Express 1540, 4235, and 5880 in prime factors, and hence find the L.C.M. of these numbers, in prime factors, and their H.C.F.

John Ford 5/4/21

3. (i) A man left money to be divided amongst his eldest, second, and youngest sons in the proportions 5:4:3. If the eldest received £948 more than the youngest, how much did each receive?

(ii) A train 68 yards long, travelling at uniform speed, passes a station platform 130 yards long. Find the speed of the train in miles per hour if there is an interval of 15 seconds from the time when the engine reaches the platform to the time when the guard's van leaves the other end.

✓ 4 (i) A man invests a sum of money for a year at simple interest. For the first 3 months the rate of interest is $3\frac{3}{4}$ per cent. per annum and for the remaining 9 months it is $3\frac{1}{4}$ per cent. per annum. What is the sum invested if the total interest at the end of the year is £10 16s.?

(ii) Find, to the nearest shilling, the sum of money a man could borrow now, if he agreed to repay the debt in two instalments, one of £200 a year hence and a second of £200 two years hence, reckoning compound interest at 5 per cent. per annum.

5. A powder is sold in cylindrical tins $3\frac{1}{2}$ inches in diameter and 5 inches high. It is decided to sell it in tins 5 inches high with square bases, a tin to contain one-tenth less than before. Find the side of the square base to the nearest $\frac{1}{10}$ inch, assuming that $\pi = 3.142$.

What is the total surface area of one of the new tins?

X 6. A man bought £600 of $3\frac{1}{2}$ per cent. stock at 87. To pay for this he sold £200 of 4 per cent. stock at 93 and sufficient $4\frac{1}{2}$ per cent. stock at 96. How much of the latter stock did he sell and what was the effect of these transactions on his income?

7. A retailer bought vacuum cleaners at £15 each and sold them at a profit of 20 per cent. on the cost price. If the price to the retailer is increased by 15 shillings, what should be the increase in his selling price in order that he may make the same percentage profit as formerly?

After the increase in price the number sold in a week decreases by 10 per cent. Express the weekly profit now made by the retailer as a percentage of the weekly profit he made before the increase in price.

ALGEBRA

JULY, 1942. 1387.

(2½ hours.)

[Answer SEVEN questions, choosing NOT MORE than THREE of the first four questions]

1. (i) Evaluate $-a^2(b-c) - b^2(c-a) - c^2(a-b)$ when $a = -1$, $b = 2$, $c = -3$.

(ii) Factorize each of the following:—

$$6x^2 - x - 12; \quad 3px - 4qx - 6p + 8q; \\ x^2 + 2ax + a^2 - 9b^2.$$

✓ 2. (i) Simplify $\frac{a^6 \times a^4}{(a^3)^3}$

and $(-3a^2b^3)^2 \{2a^4b^6 - 4b^2(a^2b^2)^2\}$

(ii) Use the 'Remainder Theorem' to show that $x - a$ is a factor of $x^3 + (2-a)x^2 + (5-2a)x - 5a$ and hence factorize the expression.

3. Solve the equations

(i) $\frac{x-1}{3} - \frac{2x+1}{5} + 1 = 0;$

(ii) $2x + 3y - 5a = 0$, $3x - 4y + 18a = 0$, giving the values of x and y in terms of a ;

(iii) $x(x - 2) - 4x(x - 5) = 0$.

4. (i) The total surface area, A sq. cm. of a cylinder of height h cm. and radius r cm. is given by

$$A = 2\pi r^2 + 2\pi rh.$$

Express h in terms of π , A , and r .

(ii) Use logarithm tables to find the values of $(0.3127)^3$ and $\sqrt{(4.153)^2 - (4.065)^2}$.

5. (i) If $\frac{2x-3y}{3x-2y} = \frac{1}{4}$, find the value of $\frac{x^2+y^2}{x^2-y^2}$.

(ii) If B tons is the breaking load of a wire rope of diameter d inches, B is the sum of two numbers, one being constant and the other varying as d^2 . The breaking load is 7.6 tons when the diameter is $\frac{1}{2}$ inch and 28.6 tons when the diameter is 1 inch. Find the breaking load when the diameter is $\frac{3}{4}$ inch.

6. With the same axes and to the same scales draw the graph of $y = (x-1)^2$ from $x = -2$ to $x = 4$ and of $y^2 = 8x$ from $x = 0$ to $x = 4$. Hence find two approximate solutions of the equation $y = \left(\frac{y^2}{8} - 1\right)^2$.

7. (i) x is positive and $2x$, $3x+3$, and $3x^2+5$ are three terms in arithmetic progression. Find an equation for x and hence calculate its value correct to two places of decimals.

(ii) The first term of an arithmetic progression of increasing terms is 3 and the first, second, and fifth

terms are in geometric progression. Find the sum of the first 20 terms of the arithmetic progression.

8. Purchase tax of 1s. 6d. a yard is added to the selling price of silk. As a result, the number of yards which it is possible to buy for £7 14s. is 6 fewer than before. What was the original selling price per yard?

9. A ship, sailing from P , steams 2 miles in a direction 27° east of north, then 3 miles north-east, and finally 1 mile north-west, arriving at Q . Find the distances of Q east and north of P and hence the bearing of Q from P .

ARITHMETIC

JULY, 1943.

(2½ Hours)

1. (i) Express each of the fractions $\frac{40}{43}$ and $\frac{359}{386}$ as a decimal correct to five places. Hence show that the difference between the fractions is less than $\frac{1}{5000}$.

(ii) A woman spent two-thirds of her money in one shop and one-quarter of the remainder in a second shop; she then had 17s. $10\frac{1}{2}d$. How much money had she originally?

2. (i) A map is drawn to a scale of 10 in. to 1 mile. What area in acres is represented by 17 sq. in. on the map? (1 sq. mile = 640 acres.)

(ii) What is the smallest number which must be added to 66598 in order that the result shall be the square of a whole number?

3. (i) In a factory the weekly wages of a man and a woman are in the ratio of 5:4. the ratio of the number of men to the number of women employed is 7:10. If the weekly wage bill is £10,200, what is the total sum paid to the men per week?

(ii) The profits in a business in four successive years were £2,378, £3,193, £2,845 and £2,732 respectively. What must

be the profits in a fifth year, if the average for the five years exceeds the average for the four given years by £25?

4. (i) A wholesaler allows a shopkeeper a discount of 30 per cent. on the price with which the latter marks an article for sale; the shopkeeper allows a customer a discount of 6d. in the £ on this marked price. How much does the wholesaler receive for an article for which the customer pays the shopkeeper £2 18s. 6d.?

(ii) £325 is invested at compound interest for 2 years at 4 per cent. per annum. What would be the change, to the nearest penny, in the compound interest, if the interest were added at the rate of 2 per cent. per half-year? (Logarithms are not to be used for this question.)

5. A man bought a house for £2,500 and spent a further £1,000 in converting it into four flats, which he decided to let at equal rents. The rateable value of the whole building was £360, on which he paid rates yearly at 12s. 6d. in the £; he also spent £100 yearly in improvements. What was the weekly rent of a flat if, at the end of a year, the man had made 8 per cent. on the money spent in purchasing and converting the house? (Assume that there are 52 weeks in a year and give your answer to the nearest sixpence.)

6. A cylindrical tin is made of thin sheet metal. It is 9 cm. in diameter, and has a lid which overlaps the curved surface to a depth of 5 mm. If the area of sheet metal forming the tin (including the lid) is 594 sq. cm., find the height of the tin to the nearest mm. (Assume that $\pi = 3.142$.)

If one-tenth of the original sheet metal is wasted in manufacturing tins, what area of sheet metal would originally be required to manufacture 100 tins? Give your answer in square metres.

X 7. A man held a certain amount of $3\frac{1}{2}$ per cent. stock at 93 and an equal amount of $4\frac{1}{2}$ per cent. stock at 99; his total income from the two stocks was £100. How much of each stock did he hold?

He sold £1,000 of the $4\frac{1}{2}$ per cent. stock and invested the proceeds in a $4\frac{3}{4}$ per cent. stock at 110. What was the change in his income?

ALGEBRA

JULY, 1943.

(2½ Hours)

[Answer THREE questions from Section A and FOUR from Section B.]

SECTION A.

1. (i) Simplify $\frac{x-1}{x-2} - \frac{x+2}{x+1}$

(ii) Solve the equation

$$\frac{3x-5}{7} - \frac{2x-9}{3} = 3.$$

(iii) If $\frac{3a+5b}{5a-7b} = \frac{3}{2}$, find $a:b$.

2. (i) Simplify $\frac{a^5(ab^2c^3)^3}{(a^2b^3)^2}$.

(ii) Use logarithms to evaluate

(1) $\frac{15.7 \times 0.318}{0.0427}$;

(2) $\pi r^2 + 2\pi rh$, where $\pi = 3.142$, $r = 2.78$, $h = 9.34$.

3. Solve the equations:

(i) $4x - 3y = -8$, $3x - \frac{y}{4} = -2$;

(ii) $2x^2 + 3x - 1 = 0$, giving each root correct to two places of decimals.

4. (i) Factorize:

(1) $2x^2 + 5xy - 12y^2$;

(2) $a^2x - 2a^2 - b^2x + 2b^2$.

(ii) Use the Remainder Theorem to show that $2x-1$ is a factor of $2x^3 - 5x^2 - 4x + 3$, and factorize the expression.

SECTION B

5. Draw the graph of $y^2 = 4(x-1)$ for values of x from 1 to 5.

With the same axes and scales, draw the graph of $3x + y - 8 = 0$.

Show that the values of x where the graphs intersect are roots of the equation $9x^2 - 52x + 68 = 0$, and hence solve this equation.

6. (i) The ratio of two numbers is $3/2$. When each number is increased by $\frac{1}{2}$, the ratio becomes $23/16$. Find the numbers.

(ii) The height of a cylinder varies directly as the volume and inversely as the square of the radius. Two cylinders are made, the volume of the second being $1\frac{1}{2}$ times that of the first and the radius of the second being twice that of the first. Express the height of the second cylinder as a fraction of that of the first.

7. (i) The first term of an arithmetic progression is 3 and the sum of the first 10 terms is 60 less than the sum of the first 4 terms. Find the first 3 terms.

(ii) The sum of the first and second terms of a geometric progression is 45 and the sum of the second and third terms is 30. Show that the common ratio is $2/3$, and find the sum of the first 10 terms, giving your answer as a decimal correct to three significant figures.

8. A train travels uniformly over 9 miles of track. If the speed were increased by 9 m.p.h., the time would be reduced by 3 min. What is the time for the 9 miles at the original speed?

9. A rod AO , 2 ft. long, can turn freely about a fixed point O . To A is hinged a rod AP , 5 ft. long, and the end P slides along a straight line passing through O . Calculate the angle APO and the length of OP when the angle AOP is 60° .

ARITHMETIC.

JULY, 1944.

($2\frac{1}{2}$ hours.)

[Logarithms must NOT be used in Questions 1 and 2.]

1. (i) Express as a single fraction in its lowest terms

$$\frac{3\frac{1}{2} - (3\frac{5}{8} \times \frac{3}{5})}{4\frac{3}{8} - 2\frac{4}{5}}$$

(ii) Multiply £82. 16s. $4\frac{1}{2}$ d. by $7\frac{2}{3}$.

(iii) Express 17325 in prime factors, and hence find the least number by which 17325 must be multiplied to make it a perfect square.

2. (i) Find the value, correct to one decimal place, of $\sqrt{(8 \cdot 5^2 + 5 \cdot 6^2)}$.

(ii) The distance by road from town A to town B is 54 miles, of which 20 miles is uphill, 16 miles downhill, and the

rest level. A car averages 20 m.p.h. uphill and 40 m.p.h. downhill. In travelling from A to B the car averaged 27 m.p.h. for the whole journey. What was its average speed on the level?

3. (i) Given that 1 in. = 2.54 cm., 1 cu. ft. of water weighs 62.3 lb., and 1 cu. cm. of water weighs 1 gram, find, to three significant figures, how many grams there are in a lb.

(ii) A man earns £450 one year. His income tax is calculated as follows:—

An allowance of one-tenth of the income is made, i.e., no tax is charged on that amount.

As he is married with one child a further allowance of £190 is made.

What remains of his income after these allowances have been deducted is called his "taxable income."

Tax is deducted at the rate of 6s. 6d. in the £ on £165 of the taxable income and at the rate of 10s. in the £ on the rest.

What is the total amount of income tax deducted?

4. (i) In ten years 15s. amounts to £1. 0s. 6d. To what rate of simple interest per annum does this correspond?

(ii) A man invests £427 at compound interest of 3 per cent. per annum. At the end of the first year he invests a further £100, and at the end of the third year he withdraws £250. What will be the amount of his investment (to the nearest shilling) at the end of the fourth year?

5. (i) The internal dimensions of a rectangular tank are 13 ft. 6 in. $\times$ 7 ft. 3 in. $\times$ 4 ft. 6 in. Water flows into it through a pipe at the rate of 12.7 gallons a second. Given that 1 gallon is the equivalent of 0.1604 cu. ft., find how long it will take, to the nearest second, to fill the tank.

(ii) The inside edge of a circular running-track is $\frac{1}{8}$ of a mile long. The track is 10 yds. wide. Find the area of the track in square yards, and also the distance covered by a runner who goes round eight times and always keeps to the middle of the track. (Assume that $\pi = \frac{22}{7}$.)

6. A shopkeeper sells goods at a profit of 20 per cent. of the cost price. One week he decides to allow customers a discount of 1s. in the £ on the marked price and, as a result, the number of articles he sells is 75 per cent. greater than in the previous week. Are his profits in this one week greater or less than those of the previous week and by how much per cent.?

7. (i) A man invests in a 5 per cent. stock at 125. What is his percentage return on his money?

(ii) A man has £2,775 of 4 per cent. stock and buys in addition sufficient $3\frac{1}{2}$ per cent. stock at 97 to bring his total income up to £300. How much of the second stock does he buy, and what does he pay for it?

ALGEBRA.

JULY, 1944.

(2½ hours.)

[Answer ALL questions from Section A and FOUR from Section B.]

SECTION A.

1. (i) Solve the equation

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

(ii) Factorize completely:

(1) $15x^2 + 19x - 8$;

(2) $(x^2 - 12)^2 - x^2$.

(iii) The time of swing of a simple pendulum is given by the formula $t = 2\pi\sqrt{l/g}$. Rearrange the formula so as to express l in terms of π , t , and g .

2. (i) Prove that

$$(a^2 + b^2)(c^2 + d^2) \equiv (ac + bd)^2 + (ad - bc)^2.$$

(ii) If $2x = 128$, what is the value of x ?

(iii) Use logarithms to evaluate

$$\sqrt{\left(\frac{1.567 \times 3.142}{0.8127 \times 17.35}\right)}$$

3. (i) Solve the equation $3x^2 + 5x = 4$, giving each root correct to two places of decimals.

(ii) Given that $y = ax^2 + bx$ and that $y = 17$ when $x = -2$ and $y = \frac{3}{4}$ when $x = \frac{1}{2}$, find the value of y when $x = -\frac{3}{2}$.

SECTION B.

4. (i) Express as a single fraction in its lowest terms

$$\frac{x-2y}{x^2-3xy} - \frac{x+y}{x^2+3xy} + \frac{x-y}{x^2-9y^2}.$$

(ii) Two numbers A and B are such that A is x per cent. of B more than B , and B is y per cent. of A less than A . Prove that

$$100(x-y) = xy.$$

5. (i) Prove that $a-b$ is a factor of

$$a^2(b-c) + b^2(c-a) + c^2(a-b).$$

Factorize the expression completely.

(ii) Solve the equations:

$$\begin{cases} x + 3y = 7 \\ x^2 + xy = 3 \end{cases}.$$

6. A stone thrown vertically upwards with a velocity of 60 ft. per sec. is y ft. above its starting-point after x seconds, where $y = 60x - 16x^2$.

Draw the graph of this equation for values of x from 0 to 4, taking 2 in. for the unit along the x -axis and 0.1 in. for the unit along the y -axis.

Use your graph to answer the following questions:—

(i) What is the greatest height the stone reaches?

(ii) How long is the stone in the air?

(iii) At what times is the stone 30 ft. above its starting-point?

(iv) Can you give any meaning to the part of the graph near $x = 4$?

7. (i) Find the sum of the numbers between 500 and 1,000 which are multiples of 3.

(ii) For the series 25, 20, 16, 12.8, ...

(1) write down an expression for the 10th term;

(2) evaluate as accurately as your tables permit the sum of 10 terms.

8. In January 1944 my coke bill was £1 13s. The price of coke was raised by 4s. per ton in February, when I bought 1 cwt. less and my bill was 1s. less. What was the price of coke per ton in January?

9. ABC is an isosceles triangle in which $AB = AC$ and the angle A is 44° . D is the foot of the perpendicular from A to BC and E is the foot of the perpendicular from B to AC . The length of AD is 5 in. Calculate (i) the area of $\triangle ABC$, and (ii) the length of AE .

ARITHMETIC

JULY, 1945

 $(2\frac{1}{2}$ hours)

[Logarithms must NOT be used in Questions 1 and 2.]

1. (i) Express as a single fraction in its lowest terms

$$(1\frac{2}{3} \div 3\frac{2}{3})^2.$$

- (ii) Multiply £7. 11s. 7½d. by 147.

- (iii) A square field has an area of
- $3\frac{1}{2}$
- acres. Find the length of a side to the nearest yard.

[1 acre = 4,840 sq. yds.]

2. (i) Two athletics records are:—

(1) 100 metres in 10.2 seconds;

(2) 100 yards in 9.4 seconds.

Express the average speed in each of the above cases in yards per second correct to one place of decimals.

[1 metre = 39.37 in.]

- (ii) Find the L.C.M. of 2160 and 4536.

Express $\frac{1}{2160} - \frac{1}{4536}$ as a single fraction in its lowest terms.

3. (i) A boy walks to school at an average speed of 4 miles per hour and returns by bus at an average speed of 15 miles per hour; the distance each way is 3 miles. What is his average speed for the double journey?

(ii) Every Christmas Day a father gives £1 to be divided between his three sons in the ratio of their ages on the last birthdays. Their dates of birth were:—Arthur, 2 February 1934; Bertram, 17 May 1932; Charles, 30 December 1928. How much will each boy get on Christmas Day 1945?

In which year did Arthur get half as much as Charles?

4. (i) A sum of money was invested at compound interest of 5 per cent. per annum. The interest for the second year was £17. 10s. What was the sum invested?

(ii) A man buys 2,000 £1 shares at 27s. 6d., but when the price drops suddenly to 18 shillings he sells out. With the cash received he buys other shares at 25 shillings which pay a dividend of 1s. 3d. per share per annum. What yearly income does this give him and what percentage of his original capital does it represent?

5. (i) In a class of boys one-half do not play cricket, one-quarter do not play football, and one-third play both games. What fraction play only one of the games?

If two boys play neither game, how many boys are there in the class?

- (ii) A man invests £2,000 partly at 5 per cent. and partly at 6 per cent. per annum; his total yearly income is £113. How much does he invest at each rate?

6. A rectangular water-tank, 4 ft. 6in. long and 3 ft. 9 in. wide internally, contains 300 gallons of water. Taking 1 cu. ft. to be equivalent to 6.23 gallons, write down an expression for the depth of water in inches and evaluate it to the nearest inch.

The tank is emptied in 23 minutes by a cylindrical pipe of internal diameter $1\frac{1}{2}$ inches. Write down an expression for the average speed, in feet per second, of the water through the pipe and evaluate it to three significant figures.[$\pi = 3.142$.]

7. A greengrocer has some apples to sell and marks their price up in his shop so as to make a profit of 20 per cent. of the cost price. When he has sold three-quarters of them, as they are beginning to go bad, he reduces the selling price by one-third. At this reduced price he sells all his remaining stock except 3 lb. which he has to throw away. He then finds that he has made a profit of 6 per cent. on the total cost. How many lb. of apples did he sell?

ALGEBRA

JULY, 1945

 $(2\frac{1}{2}$ hours)

[Answer ALL questions from Section A and FOUR from Section B.]

SECTION A

1. (i) Solve the equation

$$\frac{2}{3}(x-1) - \frac{1}{5}(2x+3) = \frac{1}{2}. \quad C$$

- (ii) Simplify

$$\left(\frac{9}{a^2} - \frac{1}{b^2}\right) \div \left(\frac{3}{a} + \frac{1}{b}\right).$$

(iii) Factorize completely:

- (1) $6x^2 - 5xy - 6y^2$;
- (2) $x^2 + xy + y - 1$;
- (3) $(n+1)(n^2-6) - 3n - 3$.

2. (i) The difference of two numbers is 2. If each number is increased by 5, their product is increased by 105. What are the numbers?

(ii) If $2^{3x} = 16$, find the value of x .

(iii) Use logarithms to evaluate

$$(1) \frac{17 \cdot 23 \times 35 \cdot 89}{143 \cdot 5}$$

$$(2) \sqrt{\frac{5}{6}}.$$

3. (i) Solve for x and y the simultaneous equations:

$$\begin{aligned} 3x - y &= a - 4b, \\ 2x + 3y &= 8a + b. \end{aligned}$$

(Your answer should give x and y each in terms of a and b .)

(ii) Solve the equation $2x^2 + 3x - 4 = 0$, giving each root correct to two places of decimals.

SECTION B

4. (i) Rearrange the formula $I = \frac{M(a^2 + b^2)}{4}$ so as to express a in terms of I , M , and b .

(ii) The horse-power of a railway engine going up an incline is given by the sum of two terms, of which one is proportional to the velocity and the other is proportional to the square of the velocity. The horse-power is 720 when the velocity is 40 m.p.h., and the horse-power is 595 when the velocity is 35 m.p.h. What is the horse-power when the velocity is 30 m.p.h.?

5. (i) Multiply $x^2 + px + 3$ by $x + 1$.

If the product is identical with $x^3 + 3x^2 + qx + 3$, find the numerical values of p and q .

(ii) It is known that $x - 2$ is a common factor of the expressions $x^3 + ax^2 + x + b$ and $x^3 - 3x^2 + ax + 2b$. Find the numerical values of a and b . Show that the two expressions have a second common factor.

6. Find the values of the function $6 - \left(\frac{2x}{3} - 1\right)^2$ when x has the values: $-1\frac{1}{2}$, -1 , 0 , $+1$, $+1\frac{1}{2}$, $+2$, $+3$, $+4$, $+5$.

Draw the graph of $y = 6 - \left(\frac{2x}{3} - 1\right)^2$ for values of x from $-1\frac{1}{2}$ to $+5$, taking 1 in. as the unit on both axes.

With the same axes and scales draw the graph of $y = \frac{x}{2} +$ and hence solve the equation

$$6 - \left(\frac{2x}{3} - 1\right)^2 = \frac{x}{2} + 4.$$

Use your graph to find for what value of c the equation

$$6 - \left(\frac{2x}{3} - 1\right)^2 = \frac{x}{2} + c \text{ has one root equal to } 3.$$

7. The first and second terms of a series are a and b respectively. Find an expression for the third term if the series is (i) an arithmetic progression, (ii) a geometric progression.

Find the sum of 12 terms of each of the following series (using logarithms where convenient):

$$(i) 3\frac{1}{3}, 5, 7\frac{1}{2}, 11\frac{1}{4}, \dots;$$

$$(ii) 3\frac{1}{3}, 5, 6\frac{2}{3}, 8\frac{1}{3}, \dots$$

8. On a journey of 90 miles a train is 10 minutes late; if its average speed had been increased by 5 miles per hour it would have been 5 minutes early. Find the actual average speed of the train on the journey, and deduce the average speed when the train is running to time.

9. A point B is 173 yds. from A in a direction $N. 33^\circ E.$; C is 359 yds. from A in a direction $N. 42^\circ W.$ Calculate

(i) the distance of C west of B ,

(ii) the distance of C north of B ,

(iii) the bearing of C from B (to the nearest degree).

ARITHMETIC.

JULY, 1946.

(2½ hours)

(Logarithms must NOT be used in Questions 1, 2, and 3.)

1. (i) Simplify $(1\frac{1}{2} \times 1\frac{5}{9}) - (1\frac{1}{3})^2$.

(ii) Find the H.C.F. of 714,969, and 1020.

(iii) Evaluate $\frac{17.2}{0.13} \times \frac{0.062}{5.3}$ correct to three significant figures.

2. (i) An acre of land cost £544 10s. What was the cost per square foot?

(1 acre = 4,840 sq. yds.)

(ii) There are 17 boys and 11 girls in a class. The average age of the boys is 14 years 7 months and the average age of the whole class is 15 years 6 months. Find the average age of the girls.

3. (i) A profit of 5 per cent. of the cost price is made by selling an article for £3 10s. What percentage profit would be made by selling it for £3 14s. 8d?

(ii) In an election for which there were three candidates, A and B together received 65 per cent. of the total votes; B and C together received 10,389 votes and A 4,331 votes. How many votes did C receive?

4. (i) In a straight 220 yds. race the winner is timed by a man at the finishing post who starts his watch when he hears the sound of the starting pistol; the time so obtained is $26\frac{2}{3}$ secs. If sound travels at 1,100 ft. per sec., find the average speed of the winner in feet per second correct to three significant figures.

(ii) Given that 1 in. = 2.54 cm., find the number of square feet in a square metre correct to three significant figures.

5. (i) Find the difference between the compound and simple interest on £100 for 3 years at 4 per cent. per annum, giving the answer as a decimal of a pound.

The difference between the compound and simple interest for 3 years at 4 per cent. per annum on a certain principal is £243 4s. Find the principal.

X (ii) £3,000 is invested, one half in 4 per cent. stock at 120 and the other half in 6 per cent. stock at 135. Find the annual income as a percentage of the capital.

6. (i) A man sitting in a train travelling at 20 miles per hour notices that a train travelling in the opposite direction at 40 miles per hour takes 7 secs. to pass him. What is the length of the other train in feet?

(ii) A cubical tank of side 6 in. contains water to a depth of 4 in. How many marbles of diameter 1 in. can be put into the tank without any water running over?

(The volume of a sphere is $\frac{4}{3}\pi r^3$; take $\pi = 3.142$.)

7. A vertical pillar is in the form of a circular cylinder, 6 ft. high with the base-radius 1 ft. Calculate the dimensions of the rectangular sheet which can be wrapped once round the curved surface of the pillar so as just to cover it completely.

Hence calculate, correct to the nearest inch, the length of the shortest line which can be painted on the pillar so that it passes once round the pillar from a point on the circumference of the top to the point immediately below it on the circumference of the bottom.

(Take $\pi = 3.142$.)

ALGEBRA.

JULY, 1946.

(2½ hours)

(Answer ALL questions from Section A and FOUR from Section B.)

SECTION A.

1. (i) If $a=2$, $b=-3$, $c=-4$, find the value of $a(b+c)^2 + b(c+a)^2 + c(a+b)^2$.

(ii) Factorize completely:

(1) $(p+q)^2 - 3p - 3q$;

(2) $x^3 - a - x + ax^2$.

(iii) Solve the equation

$$3 - \frac{x-1}{x+2} = \frac{10}{x}.$$

2. (i) If I buy x foreign stamps at the rate of y per shilling and p stamps at q pence each, what is the average cost in pence of each stamp?

(ii) Solve the equation $3x^2 - 5x = 10$, giving each root correct to two places of decimals.

3. (i) Use logarithms to evaluate $\left(\frac{0.7639}{1.735 \times 0.0243}\right)^3$.

(ii) A fraction is such that, if one is added to both numerator and denominator, it becomes equal to $\frac{2}{3}$; if four is added to the numerator and three to the denominator, the fraction becomes equal to $\frac{3}{4}$. Find the original fraction.

4. (i) If $\frac{W}{w} = \frac{T-t}{L+l}$, express t in terms of W , w , T , and L .

(ii) Factorize $2x^3 + x^2 - 13x + 6$.

- (iii) Simplify $\left(\frac{3x^2y^3}{2x^3y}\right)^2$.

5. (i) Factorize $3A^2 + 4AB - 4B^2$.

Hence, or otherwise, factorize

$$3(x+2y)^2 + 4(x+2y)(x-3y) - 4(x-3y)^2$$

(ii) Solve the equations:

$$\begin{aligned} x + 2y + 5 &= 0, \\ 2x^2 - xy &= 5. \end{aligned}$$

6. Draw the graph of $y = \frac{1}{2}x^2$ for values of x from $-5\frac{1}{2}$ to $+5\frac{1}{2}$, taking $\frac{1}{2}$ in. as the unit on both axes.

Use this graph and the appropriate straight line graph to solve the equation $x^2 - 2x - 10 = 0$.

7. (i) The tenth term of an arithmetic progression is 47 and the sum of the first three terms is 237. How many terms must be taken to give a sum of 42?

(ii) The first, fourth, and thirteenth terms of an arithmetic progression are in geometric progression, and the first term of the arithmetic progression is 3. Find the common ratio of the geometric progression.

8. A librarian bought 110 books and the total bill was £42 15s. There were only two prices for the books and the higher price was 3s. more than the other; the cheaper books cost £37 10s. altogether. What were the two prices?

9. $ABCD$ is a quadrilateral in which $AB = 2.5$ in., $BC = 4$ in., $\angle ABC = 90^\circ$, $\angle BCD = 80^\circ$, and $AD = DC$. Calculate the length of DC .

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