La Scuola d'Italia / Huson / IB Math: Sequences
6 November 2025

First & last name: SOLUTIONS
Grade: 41 points

2.6 Test: Sequences, Regression, Interest, Functions, Logs

1. A geometric sequence has first term 24 and common ratio $\frac{1}{2}$. [10 marks]

   (a) Write down the second and third terms.

   (b) Write an expression for the sum of the first n terms, S_n.

   (c) Hence or otherwise find the sum of the first 10 terms of the sequence S_{10}.

   An arithmetic sequence has a first term 150 and fourth term 111.

   (d) Find the common difference d.

   (e) Find the number of the first negative term in the arithmetic sequence, i.e. n such that $u_n < 0$.

(a) 12, 6 (2)

(b) $S_n = \frac{24\left(1-\left(\frac{1}{2}\right)^n\right)}{1-\frac{1}{2}}$ (2) optional simplification $= \frac{48}{1}\left(1-\left(\frac{1}{2}\right)^n\right)$

(c) $S_{10} = \frac{24\left(1-\left(\frac{1}{2}\right)^{10}\right)}{1-\frac{1}{2}} = \frac{3069}{64}$

$= 47.9531$

≈ 48.0 (2)

(d) $u_4 = 150 + d(4-1) = 111$

$d = -13$ (2)

(e) $u_n = 150 + (-13)(n-1) < 0$

$n - 1 > \frac{150}{13} = 11.5385$

$n > 12.53\ldots$

13th term (2)

2. Six piano students reported their average weekly practice time and their Music class grade (out of 100). The data are shown below. [7 marks]

Practice time (h)	8	3	5	3	7	9
Grade (G)	85	70	75	85	90	95

(a) Find the Pearson product–moment correlation coefficient r for these data.

(b) Based on the following guidance:

$0 \leq |r| < 0.4$: weak, $0.4 \leq |r| < 0.8$: moderate, $0.8 \leq |r| \leq 1$: strong.

Comment on the strength of the correlation for this data.

(c) The relationship between h and G can be modelled by a regression equation $G = ah + b$. Write down the values of a and b.

(d) One of the students says she should have practised more. Based on the data and assuming that she practiced 6 hours per week, estimate what her score would have been.

(a) $r = 0.7406 \approx 0.741$ 2

(b) moderate (positive) 1

(c) $a = 2.69036... \approx 2.69$

$b = 67.6395...$

≈ 67.6 2

(d) $G_6 = 2.69(6) + 67.6$

$= 83.7812...$

≈ 83.8 2

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3. Give all numerical answers correct to two decimal places. [8 marks]

Sofia invests \$1000 in an annuity on 1 January 2020. The investment earns a fixed amount of \$60 per year.

(a) Find the value of her investment on 1 January 2022.

Rafael also invests \$1000 on 1 January 2020. He deposits his funds in a bank account that pays a nominal annual rate of 5% compounded monthly.

(b) Find his balance after two years.

(c) Determine the number of complete years from 1 January 2020 until Rafael's account first has a greater balance than Sofia's investment.

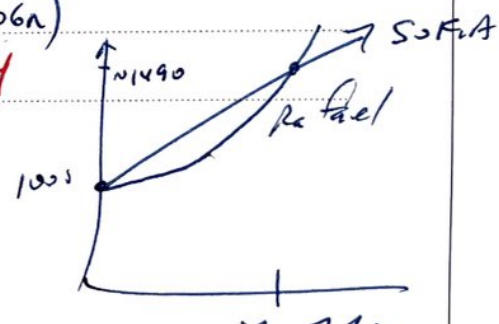
(a) $1000 + 2(60) = \$1120$ 2

(b) $FV = 1000\left(1 + \frac{0.05}{12}\right)^{12\cdot 2} = \$1104.94$ 2

$1000\left(1+\frac{0.05}{12}\right)^{12n} > 1000(1+0.06n)$

(c) $t > 7.18$ y 4

8 years



4. In an experiment the area of a bacteria culture is modelled by [4 marks]

$$P(t) = Ae^{kt},$$

where P is the area in mm^2 and t is the time in hours. At $t = 0$ the area is 80 mm^2, and after 11 hours the area is 612 mm^2.

(a) Write down the value of A.

(b) Find the value of k.

(a) $A = 80$ 2

(b) $P(11) = 80e^{11k} = 612$

$e^{11k} = \frac{612}{80}$

$11k = \ln\left(\frac{612}{80}\right)$

$k = 0.184972$

≈ 0.185 2

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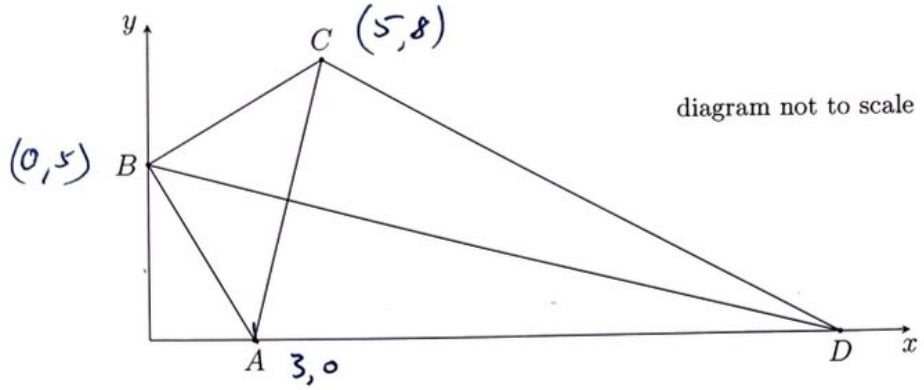
5. Camilla is designing a kite $ABCD$ on a coordinate plane (1 unit = 10 cm). The points are $A(3,0)$, $B(0,5)$, $C(5,8)$, and point D lies on the x–axis. Segment AC is perpendicular to segment BD. [6 marks]



(a) Find the gradient of the line through A and C.

(b) Hence write down the gradient of the line through B and D.

(c) Find the equation of line BD in the form $ax+by+d=0$, where a, b, d are integers.

(d) Write down the x–coordinate of D.

(a) $m_{AC} = \frac{8-0}{5-3} = 4$ 1

(b) $m_{BD} = -\frac{1}{4}$ 1

(c) $y = -\frac{1}{4}x + 5$
$x + 4y - 20 = 0$ 2

(d) 20 2

6. Solve the following, giving exact values when possible. [6 marks]

(a) $3^x = 243$.

(b) $\log_5(2x - 1) = 2$.

(c) $\ln(4) - \ln(x) = \ln(2)$.

(a) $x = 5$ 2

(b) $2x - 1 = 5^2 = 25$ 2

$x = 13$

(c) $\ln x = \ln 4 - \ln 2 = \ln \frac{4}{2}$ 2

$x = 2$