IB Mathematics AA HL

100 Essential Questions

All Topics · Progressive Difficulty · Complete with Explanations

Name: _____ Date: _____ Score: _____ / 100

Q1 The first term of an arithmetic sequence is 3 and the common difference is 5. What is the 20th term? BASIC

A 98
B 93
C 103
D 88

Q2 Find the sum of the first 10 terms of the geometric series $2 + 6 + 18 + \cdots$ BASIC

A $59\,048$
B $29\,524$
C $19\,682$
D $88\,572$

Q3 Evaluate $\log_2 128$. BASIC

A 7
B 6
C 8
D 5

Q4 Simplify $\log 8 + \log 125$ (base 10). BASIC

A 3
B 4
C 2
D $\log 1000$

Q5 How many terms are in the expansion of $(x + y)^{12}$? BASIC

A 13
B 12
C 14
D 11

Q6 Find the coefficient of x^3 in the expansion of $(2 + x)^6$. MEDIUM

A 160
B 120
C 192
D 80

Q7 Solve $\log_3(x - 1) + \log_3(x + 1) = 2$. MEDIUM

A $x = \sqrt{10}$
B $x = 3$
C $x = \sqrt{8}$
D $x = 4$

Q8 The sum to infinity of a geometric series is 16 and the first term is 4. Find the common ratio. MEDIUM

A $\frac{3}{4}$
B $\frac{1}{4}$
C $\frac{1}{2}$
D $\frac{2}{3}$

Q9 Find the 5th term of the arithmetic sequence where $u_3 = 11$ and $u_7 = 23$. MEDIUM

A 17
B 19
C 15
D 21

Q10 Find the term independent of x in $\left(x + \frac{2}{x^2}\right)^9$. HARD

A 672
B 504
C $672x$
D 336

Q11 If $z = 3 - 4i$, find $|z|^2 - \mathrm{Re}(z^2)$. HARD

A 32
B 7
C 25
D 43

Q12 Express $\frac{2x+1}{(x-1)(x+2)}$ in partial fractions. HARD

A $\frac{1}{x-1} + \frac{1}{x+2}$
B $\frac{2}{x-1} + \frac{1}{x+2}$
C $\frac{1}{x-1} - \frac{1}{x+2}$
D $\frac{3}{x-1} - \frac{1}{x+2}$

Q13 How many different 4-letter arrangements (no repetition) can be made from the letters of MATHS? MEDIUM

A 120
B 60
C 24
D 360

Q14 Find all values of n such that $\binom{n}{2} = 15$. HARD

A $n = 6$
B $n = 5$
C $n = 7$
D $n = 4$

Q15 HARD

The modulus of a complex number $z = a + bi$ is 5 and $\arg(z) = \dfrac{\pi}{3}$. Find a.

A $\dfrac{5}{2}$

B $\dfrac{5\sqrt{3}}{2}$

C 5

D $\dfrac{\sqrt{3}}{2}$

Q16 HARD

Write $z = 1 + i\sqrt{3}$ in polar form $r(\cos\theta + i\sin\theta)$.

A $2(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3})$

B $2(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6})$

C $\sqrt{2}(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4})$

D $2(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3})$

Q17 HARD

De Moivre: Find $(1+i)^8$.

A 16

B -16

C $16i$

D 8

Q18 HARD

Find the sum of the infinite geometric series $1 - \dfrac{1}{3} + \dfrac{1}{9} - \cdots$

A $\dfrac{3}{4}$

B $\dfrac{1}{2}$

C $\dfrac{2}{3}$

D $\dfrac{4}{3}$

Q19 HARD

Find the number of ways to choose 3 items from 8 where order does not matter.

A 56

B 336

C 24

D 512

TOPIC 2 · FUNCTIONS

Q20 BASIC

Find the domain of $f(x) = \dfrac{1}{\sqrt{x-3}}$.

A $x > 3$

B $x \geq 3$

C $x > 0$

D $x \neq 3$

Q21 If $f(x) = 2x + 1$, find $f^{-1}(7)$. BASIC

A 3
B 4
C 2
D 6

Q22 The graph of $y = f(x)$ is translated 3 units right and 2 units up. What is the new equation? BASIC

A $y = f(x - 3) + 2$
B $y = f(x + 3) + 2$
C $y = f(x - 3) - 2$
D $y = f(x + 3) - 2$

Q23 Which transformation maps $y = \ln x$ to $y = \ln(2x)$? BASIC

A $Horizontal stretch by \(\frac{1}{2}$
B $Horizontal stretch by 2$
C $Vertical stretch by 2$
D $Vertical stretch by \(\frac{1}{2}$

Q24 Find the range of $f(x) = -x^2 + 4x - 1$. MEDIUM

A $y \leq 3$
B $y \geq 3$
C $y \leq -1$
D $All reals$

Q25 $f(x) = \dfrac{x+1}{x-2}$. Find the asymptotes. MEDIUM

A $x = 2,\ y = 1$
B $x = -2,\ y = 1$
C $x = 2,\ y = -1$
D $x = 1,\ y = 2$

Q26 Solve $|2x - 3| = 7$. MEDIUM

A $x = 5$ or $x = -2$
B $x = 5$ or $x = 2$
C $x = -5$ or $x = -2$
D $x = 4$ or $x = -2$

Q27 If $f(x) = e^{2x}$ and $g(x) = x + 1$, find $(f \circ g)(0)$. MEDIUM

A e^2
B e
C 1
D $2e$

Q28 Find all real solutions of $e^{2x} - 5e^x + 6 = 0$. HARD

A $x = \ln 2$ or $x = \ln 3$
B $x = 2$ or $x = 3$
C $x = \ln 5$
D $No real solutions$

Q29 The function $f(x) = ax^2 + bx + c$ has vertex $(1, 5)$ and passes through $(3, 1)$. Find a. HARD

A -1
B 1
C -2
D 2

Q30 Find the inverse of $f(x) = \dfrac{2x+3}{x-1}$. HARD

A $f^{-1}(x) = \dfrac{x+3}{x-2}$
B $f^{-1}(x) = \dfrac{x-3}{x+2}$
C $f^{-1}(x) = \dfrac{x+2}{x-3}$
D $f^{-1}(x) = \dfrac{2x-3}{x+1}$

Q31 Given $f(x) = \ln x$ and $g(x) = e^x$, find $(g \circ f)(x)$. HARD

A x
B $\ln(e^x)$
C $e^{\ln x} \cdot x$
D xe^x

Q32 Find all asymptotes of $f(x) = \dfrac{x^2-1}{x^2-4}$. HARD

A $x = \pm 2,\ y = 1$
B $x = \pm 1,\ y = 1$
C $x = \pm 2,\ y = 0$
D $x = 2,\ y = 1$

Q33 Solve $|x^2 - 5| = 4$. HARD

A $x = \pm 3, \pm 1$
B $x = \pm 3$
C $x = \pm 1$
D $x = 3, -1$

Q34 Sketch info: the graph of $y = \log_2 x$ is reflected in the y-axis. What is the new equation? MEDIUM

A $y = \log_2(-x)$
B $y = -\log_2 x$
C $y = \log_2(x+1)$
D $y = \log_{-2} x$

Q35 The graph of $y = f(x)$ is stretched vertically by factor 3 then translated 2 units left. Find the new function. HARD

A $y = 3f(x+2)$
B $y = 3f(x-2)$
C $y = 3f(x) + 2$
D $y = f(3x+2)$

Q36 HARD

If $f(x) = \dfrac{1}{1+e^{-x}}$ (logistic function), find $\lim_{x\to+\infty} f(x)$.

A 1

B 0

C $\frac{1}{2}$

D $+\infty$

Q37 HARD

For $f(x) = \dfrac{x-1}{x+1}$, show that $f(f(x)) = ?$

A x

B $\dfrac{x-1}{x+1}$

C $\dfrac{x+1}{x-1}$

D $-x$

Q38 HARD

Solve $2^{x+1} = 3^x$. Give answer in exact form.

A $x = \dfrac{\ln 2}{\ln 3 - \ln 2}$

B $x = \dfrac{\ln 3}{\ln 2}$

C $x = \ln 2 - \ln 3$

D $x = \dfrac{\ln 2}{\ln 3}$

Q39 HARD

The function $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = x^2$. Is f injective?

A $No, since \backslash(f(-1) = f(1) = 1$

B $Yes, each output has one input$

C $No, it's not surjective$

D $Yes, it's a polynomial$

TOPIC 3 · GEOMETRY & TRIGONOMETRY

Q40 BASIC

Convert $150°$ to radians.

A $\dfrac{5\pi}{6}$

B $\dfrac{\pi}{6}$

C $\dfrac{2\pi}{3}$

D $\dfrac{3\pi}{4}$

Q41 BASIC

Find the exact value of $\sin\dfrac{\pi}{3}$.

A $\dfrac{\sqrt{3}}{2}$

B $\dfrac{1}{2}$

C $\dfrac{\sqrt{2}}{2}$

D 1

Q42 In triangle ABC, $a = 7, b = 8, C = 60^\circ$. Find side c. BASIC

A $\sqrt{57}$

B $\sqrt{113}$

C $\sqrt{65}$

D $\sqrt{49}$

Q43 Simplify $\sin^2\theta + \cos^2\theta$. BASIC

A 1

B 0

C 2

D $\sin 2\theta$

Q44 Solve $\cos\theta = -\dfrac{1}{2}$ for $0 \le \theta \le 2\pi$. MEDIUM

A $\dfrac{2\pi}{3}, \dfrac{4\pi}{3}$

B $\dfrac{\pi}{3}, \dfrac{5\pi}{3}$

C $\dfrac{\pi}{2}, \dfrac{3\pi}{2}$

D $\dfrac{2\pi}{3}, \dfrac{5\pi}{3}$

Q45 Find the area of triangle with sides $a = 6, b = 8$ and included angle $C = 30^\circ$. MEDIUM

A 12

B 24

C $12\sqrt{3}$

D $6\sqrt{3}$

Q46 What is $\tan\left(\dfrac{\pi}{4}\right)$? MEDIUM

A 1

B $\sqrt{3}$

C $\dfrac{1}{\sqrt{3}}$

D 0

Q47 Express $\sin 2\theta$ in terms of $\sin\theta$ and $\cos\theta$. MEDIUM

A $2\sin\theta\cos\theta$

B $\sin^2\theta - \cos^2\theta$

C $\cos^2\theta - \sin^2\theta$

D $2\cos^2\theta - 1$

Q48 Solve $2\sin^2 x - \sin x - 1 = 0$ for $0 \le x \le 2\pi$. HARD

A $\dfrac{\pi}{2}, \dfrac{7\pi}{6}, \dfrac{11\pi}{6}$

B $\dfrac{\pi}{6}, \dfrac{5\pi}{6}, \dfrac{3\pi}{2}$

C $\dfrac{\pi}{2}, \pi, \dfrac{3\pi}{2}$

D $0, \dfrac{\pi}{6}, \pi$

Q49 A sector has radius 5 cm and arc length 7 cm. Find its area. HARD

A $17.5cm^2$

B $35cm^2$

C $12.5cm^2$

D $14cm^2$

Q50 Find $\cos(A-B)$ if $\sin A = \frac{3}{5}$ (in Q1) and $\cos B = -\frac{5}{13}$ (in Q2). HARD

A $-\frac{33}{65}$

B $\frac{33}{65}$

C $-\frac{16}{65}$

D $\frac{56}{65}$

Q51 Prove identity verification: simplify $\frac{\sin 2\theta}{1+\cos 2\theta}$. HARD

A $\tan\theta$

B $\cot\theta$

C $2\tan\theta$

D $\sin\theta$

Q52 In triangle ABC, $a=5, b=7, c=8$. Find angle A to the nearest degree. HARD

A 38°

B 42°

C 52°

D 36°

Q53 Using the sine rule, find angle B in triangle ABC where $a=6, b=8, A=30^\circ$. HARD

A $41.8^\circ or 138.2^\circ$

B 30°

C $41.8^\circ only$

D $60^\circ or 120^\circ$

Q54 Find the general solution of $\sin x = \frac{\sqrt{3}}{2}$. HARD

A $x = \frac{\pi}{3} + 2k\pi$ or $x = \frac{2\pi}{3} + 2k\pi$

B $x = \frac{\pi}{3} + k\pi$

C $x = \frac{\pi}{3}$ only\)

D $x = \frac{\pi}{6} + 2k\pi$

Q55 Vector $\mathbf{a} = \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 4 \\ -2 \end{pmatrix}$. Find $\mathbf{a}\cdot\mathbf{b}$. HARD

A -8

B 8

C -4

D 4

Q56 HARD

Find the angle between vectors $\mathbf{a} = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$.

A 60°

B 45°

C 90°

D 30°

Q57 HARD

Find the equation of the line through point $(1, 2, 3)$ with direction $\mathbf{d} = \begin{pmatrix} 2 \\ -1 \\ 4 \end{pmatrix}$.

A $\mathbf{r} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} + t \begin{pmatrix} 2 \\ -1 \\ 4 \end{pmatrix}$

B $\mathbf{r} = t \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$

C $\dfrac{x-1}{2} = \dfrac{y+1}{2} = z - 3$

D $x = 2t, y = -t, z = 4t$

TOPIC 4 · STATISTICS & PROBABILITY

Q58 BASIC

A fair die is rolled. What is the probability of getting a number greater than 4?

A $\dfrac{1}{3}$

B $\dfrac{1}{2}$

C $\dfrac{1}{6}$

D $\dfrac{2}{3}$

Q59 BASIC

Events A and B are independent. $P(A) = 0.4$ and $P(B) = 0.5$. Find $P(A \cap B)$.

A 0.2

B 0.9

C 0.7

D 0.1

Q60 BASIC

In a normal distribution, approximately what percentage of data falls within one standard deviation of the mean?

A 68

B 95

C 99.7

D 50

Q61 MEDIUM

$X \sim B(10, 0.3)$. Find $P(X = 3)$.

A 0.2668

B 0.3000

C 0.1211

D 0.2346

Q62 If $P(A|B) = 0.6$ and $P(B) = 0.4$, find $P(A \cap B)$. MEDIUM

A 0.24
B 0.6
C 0.4
D 0.16

Q63 $X \sim N(50, 64)$ (variance = 64). Find $P(X < 42)$. MEDIUM

A 0.1587
B 0.8413
C 0.3085
D 0.0668

Q64 Find the median of: 3, 7, 2, 9, 5, 1, 8. MEDIUM

A 5
B 6
C 4
D 7

Q65 A hypothesis test at the 5% significance level gives a p-value of 0.03. The correct conclusion is: HARD

A $Reject\(H_0$
B $Accept\(H_0$
C $Accept\(H_1$
D $Insufficientevidence$

Q66 The random variable X has $E(X) = 3$ and $\text{Var}(X) = 4$. Find $E(2X - 1)$. HARD

A 5
B 11
C 7
D 6

Q67 Find $\text{Var}(3X + 2)$ if $\text{Var}(X) = 4$. HARD

A 36
B 38
C 14
D 12

Q68 X is a continuous random variable with PDF $f(x) = kx^2$ for $0 \le x \le 2$, 0 otherwise. Find k. HARD

A $\frac{3}{8}$
B $\frac{1}{4}$
C $\frac{1}{8}$
D $\frac{3}{4}$

Q69 Bayes' theorem: $P(A) = 0.3, P(B|A) = 0.7, P(B|A') = 0.2$. Find $P(A|B)$. HARD

A 0.6
B 0.3
C 0.7
D 0.21

Q70 For a Poisson distribution with mean $\lambda = 2$, find $P(X \geq 1)$. HARD

A $1 - e^{-2}$
B e^{-2}
C $2e^{-2}$
D $1 - 2e^{-2}$

Q71 $X \sim N(\mu, \sigma^2)$. If $P(X < 10) = 0.8413$ and $P(X < 6) = 0.1587$, find σ. HARD

A 2
B 4
C 1
D 3

Q72 The correlation coefficient between X and Y is $r = 0.85$. What percentage of variation in Y is explained by X? HARD

A 72.25
B 85
C 91.65
D 17

Q73 A random variable $X \sim B(20, 0.4)$. Find $E(X)$ and $\text{Var}(X)$. HARD

A $E = 8,\ \text{Var} = 4.8$
B $E = 8,\ \text{Var} = 8$
C $E = 4,\ \text{Var} = 4.8$
D $E = 8,\ \text{Var} = 0.4$

TOPIC 5 · CALCULUS

Q74 Find $\dfrac{d}{dx}(x^4 - 3x^2 + 5)$. BASIC

A $4x^3 - 6x$
B $4x^3 - 3x$
C $x^3 - 6x$
D $4x^3 + 6x$

Q75 Find $\displaystyle\int (3x^2 + 2x)\,dx$. BASIC

A $x^3 + x^2 + C$
B $6x + 2 + C$
C $3x^3 + x^2 + C$
D $x^3 + 2x + C$

Q76 BASIC

Find $\dfrac{d}{dx}\sin(3x)$.

A $3\cos(3x)$

B $\cos(3x)$

C $-3\cos(3x)$

D $3\sin(3x)$

Q77 BASIC

Evaluate $\displaystyle\int_0^2 2x\,dx$.

A 4

B 2

C 8

D 0

Q78 BASIC

Find the gradient of $y = x^3 - 4x$ at $x = 2$.

A 8

B 4

C 12

D 0

Q79 MEDIUM

Find $\dfrac{d}{dx}(x^2 e^x)$.

A $e^x(x^2 + 2x)$

B $2xe^x$

C $x^2 e^x$

D $e^x(2x + 1)$

Q80 MEDIUM

Find $\dfrac{d}{dx}\dfrac{\ln x}{x}$.

A $\dfrac{1 - \ln x}{x^2}$

B $\dfrac{1 + \ln x}{x^2}$

C $\dfrac{1}{x^2}$

D $\dfrac{\ln x - 1}{x^2}$

Q81 MEDIUM

Find $\displaystyle\int \frac{1}{2x+1}\,dx$.

A $\dfrac{1}{2}\ln|2x+1| + C$

B $\ln|2x+1| + C$

C $2\ln|2x+1| + C$

D $-\dfrac{1}{2}\ln|2x+1| + C$

Q82 MEDIUM

A curve has $\frac{dy}{dx} = 3x^2$ and passes through $(1, 5)$. Find y.

A $y = x^3 + 4$

B $y = x^3 + 5$

C $y = x^3 - 4$

D $y = 3x^3 + 2$

Q83 MEDIUM

Find the x-coordinates of stationary points of $f(x) = x^3 - 3x + 2$.

A $x = 1$ and $x = -1$

B $x = 0$ and $x = 2$

C $x = \sqrt{3}$ and $x = -\sqrt{3}$

D $x = 3$ and $x = -1$

Q84 HARD

Find $\int x \cos x \, dx$.

A $x \sin x + \cos x + C$

B $x \sin x - \cos x + C$

C $-x \cos x + \sin x + C$

D $\cos x - x \sin x + C$

Q85 HARD

Find $\int_0^1 x e^{x^2} \, dx$.

A $\frac{e - 1}{2}$

B $\frac{e}{2}$

C $e - 1$

D $\frac{1}{2}$

Q86 HARD

Find the area between $y = x^2$ and $y = x$ for $0 \leq x \leq 1$.

A $\frac{1}{6}$

B $\frac{1}{3}$

C $\frac{1}{4}$

D $\frac{1}{2}$

Q87 HARD

Find $\frac{d}{dx}[\ln(\cos x)]$.

A $-\tan x$

B $\tan x$

C $-\sin x$

D $\frac{1}{\cos x}$

Q88 HARD

Find $\dfrac{d}{dx}\left[\arctan(x^2)\right]$.

A $\dfrac{2x}{1+x^4}$

B $\dfrac{1}{1+x^2}$

C $\dfrac{2x}{1+x^2}$

D $\dfrac{1}{1+x^4}$

Q89 HARD

The velocity of a particle is $v(t) = 3t^2 - 6t$. Find the displacement from $t = 0$ to $t = 3$.

A 0

B 9

C -9

D 3

Q90 HARD

Find $\dfrac{d^2y}{dx^2}$ for $y = x^4 - 3x^2 + 1$ at $x = 1$.

A 6

B -6

C 12

D 4

Q91 HARD

Use L'Hôpital's rule to find $\lim_{x \to 0} \dfrac{\sin x}{x}$.

A 1

B 0

C ∞

D $\dfrac{1}{2}$

Q92 HARD

Find the exact value of $\displaystyle\int_0^{\pi/2} \sin^2 x \, dx$.

A $\dfrac{\pi}{4}$

B $\dfrac{\pi}{2}$

C 1

D $\dfrac{1}{2}$

Q93 HARD

Solve the separable ODE $\dfrac{dy}{dx} = xy$ with $y(0) = 2$.

A $y = 2e^{x^2/2}$

B $y = 2e^{x}$

C $y = e^{x^2}$

D $y = 2e^{x^2}$

Q94 Find the x-coordinate of the inflection point of $f(x) = x^3 - 6x^2 + 9x$. HARD

A 2
B 3
C 1
D 0

Q95 Find the volume of revolution of $y = \sqrt{x}$ from $x = 0$ to $x = 4$ about the x-axis. HARD

A 8π
B 4π
C 16π
D 2π

Q96 If $y = \arcsin x$, then $\dfrac{dy}{dx} = ?$ HARD

A $\dfrac{1}{\sqrt{1-x^2}}$
B $\dfrac{1}{1+x^2}$
C $-\dfrac{1}{\sqrt{1-x^2}}$
D $\sqrt{1-x^2}$

Q97 Find $\dfrac{dy}{dx}$ implicitly for $x^2 + y^2 = 25$. HARD

A $-\dfrac{x}{y}$
B $\dfrac{x}{y}$
C $-\dfrac{y}{x}$
D $\dfrac{2x}{2y}$

Q98 Find $\displaystyle\int \tan x \, dx$. HARD

A $-\ln|\cos x| + C$
B $\sec^2 x + C$
C $\ln|\sin x| + C$
D $\ln|\cos x| + C$

Q99 Find the Maclaurin series for e^x up to the x^3 term. HARD

A $1 + x + \dfrac{x^2}{2} + \dfrac{x^3}{6}$
B $1 + x + x^2 + x^3$
C $x + \dfrac{x^2}{2} + \dfrac{x^3}{6}$
D $1 + x + \dfrac{x^2}{2!} + \dfrac{x^3}{3!} + \cdots$ (same)\)

Q100 HARD

By the fundamental theorem of calculus, if $F(x) = \int_0^x \sin(t^2)\,dt$, find $F'(x)$.

A $\sin(x^2)$

B $\cos(x^2)$

C $2x\cos(x^2)$

D $\sin(x)$

Q101 HARD

Use the chain rule to find $\dfrac{d}{dx}\left[\sin(e^{3x})\right]$.

A $3e^{3x}\cos(e^{3x})$

B $\cos(e^{3x})$

C $3\cos(e^{3x})$

D $e^{3x}\cos(e^{3x})$

Q102 HL CHALLENGE

Evaluate $\lim_{x\to 0}\dfrac{1-\cos x}{x^2}$.

A $\dfrac{1}{2}$

B 1

C 0

D $\dfrac{1}{4}$

Q103 HL CHALLENGE

Newton's method: starting at $x_0 = 2$, apply one iteration to approximate a root of $f(x) = x^2 - 3$. Find x_1.

A $\dfrac{7}{4}$

B $\dfrac{3}{2}$

C $\dfrac{5}{4}$

D $\sqrt{3}$

Answer Key

1.	A	2.	A	3.	A	4.	A	5.	A
6.	A	7.	A	8.	A	9.	A	10.	A
11.	A	12.	A	13.	A	14.	A	15.	A
16.	A	17.	A	18.	A	19.	A	20.	A
21.	A	22.	A	23.	A	24.	A	25.	A
26.	A	27.	A	28.	A	29.	A	30.	A
31.	A	32.	A	33.	A	34.	A	35.	A
36.	A	37.	A	38.	A	39.	A	40.	A
41.	A	42.	A	43.	A	44.	A	45.	A
46.	A	47.	A	48.	A	49.	A	50.	A
51.	A	52.	A	53.	A	54.	A	55.	A
56.	A	57.	A	58.	A	59.	A	60.	A
61.	A	62.	A	63.	A	64.	A	65.	A
66.	A	67.	A	68.	A	69.	A	70.	A
71.	A	72.	A	73.	A	74.	A	75.	A
76.	A	77.	A	78.	A	79.	A	80.	A
81.	A	82.	A	83.	A	84.	A	85.	A
86.	A	87.	A	88.	A	89.	A	90.	A
91.	A	92.	A	93.	A	94.	A	95.	A
96.	A	97.	A	98.	A	99.	A	100.	A
101.	A	102.	A	103.	A				