# Mathematics Qualifying Examination

# Sample Paper

**Section: Statistics & Probability**

Q 1: A ball is drawn at random from a box containing 6 red balls, 4 white balls and 5 blue balls. Determine the probability that the ball drawn is

1. Red
2. White
3. Blue
4. Not red
5. Red or white

Q 2: Find the probability of 4 turning up at least once in two tosses of a fair die?

Q 3: Over the course of a rugby competition, a record is kept of the number of penalties conceded per game. The results are presented in the following frequency distribution:

|  |  |
| --- | --- |
| **Number of Penalties Conceded** | **Number of Games** |
| 0 | 0 |
| 1 | 3 |
| 2 | 5 |
| 3 | 8 |
| 4 | 2 |
| 5 | 2 |

Calculate the **standard deviation** of the distribution.

**Section: Geometry & Trigonometry**

Q 4: Find all the values of $x$ for which $\cos(\left(4x\right))= ^{\sqrt{3}}/\_{2}$ , where $0°<x\leq 360°$.

Q 5: Find the equation of the perpendicular bisector of the line segment [AB], where A is the point (−14, 10) and B is the point (26, −22).

**Section: Number Systems**

Q 6: $\left(4+3i\right)$ is one root of the equation $az^{2}+bz+c=0 $ where $a, b, c \in R$, and $i^{2}=-1.$ Write the other root.

Q 7: Express $z=(3+2i)(2+2i)$ in polar form and calculate $z^{4}$. Express the results both in polar and rectangular forms.

**Section: Algebra**

Q 7: Solve the simultaneous equations:

 $x+y+z=16$

 $\frac{5}{2}x+y+10z=40$

 $2x+\frac{1}{2}y+4z=21$

Q 8: Given the equation $x^{2}+\left(k-2\right)x+\left(k-3\right)=0$:

1. Show that the roots are real for all values of $k\in R$.
2. Find the roots of the equation in terms of $k$.

**Section: Functions**

Q 9: $A$ is the closed interval $[0,5]$. That is, $A=\left\{x \right|0\leq x\leq 5\}, x\in R\}$ . The function $f $is defined on by

 $f: A\rightarrow R $with $x↦x^{3}-5x^{2}+3x+5$ .

1. Find the maximum and minimum values of $x$.
2. State whether $f$ is *injective*. Give a reason for your answer.

Q 10:The equation of a circle is $x^{2}+y^{2}=20$ . Find $\frac{dy}{dx}$ and hence find the slope of the tangent to the circle at the point $(2,4)$.