| DO NOT WRITE ON THIS PAPER | TIME 2 hours | Paper 4 of 5 from ZigZag Education |
| :---: | :---: | :---: |
| Sample GCSE Examination Paper | Standard Equipment: lined or squared paper, pen, pencil, ruler. |  |
| Higher Tier Non-Calculator Paper | Additional Equipment: graph paper. |  |

1. There are 50 trillion cells in the average human. A trillion is $1,000,000,000,000$.
a) i) Write a trillion in standard index form.

ii) Write the average number of cells in a human in standard index form.

The area inside the orbital path of Pluto is 36 quintillion square miles, where a quintillion is $1 \times 10^{18}$.
b) Assuming the orbital path is circular, estimate the radius of the orbital path. Use 1.5 as an estimated value for $\sqrt{ } \pi$.


5 marks
2. a) Display the inequality $-1 \leq x<3$ on a number line.

Solve the inequalities
b) $\quad$ i) $\quad-1 \leq 2 x+4$
ii) $\quad-1<-2 x$

6 marks
3. Calculate the missing lengths $\boldsymbol{x}$ and $\boldsymbol{y}$, giving your answer exactly.


5 marks
4. A rhombus has side of 5 cm and a smallest angle of $40^{\circ}$. Using the estimate $\cos 20^{\circ} \approx 94 / 100$, calculate the length of the longest diagonal of the rhombus.
5. a) Work out the highest common factor of 112 and 64
b) Work out the lowest common multiple of 112 and 64 . 4 marks
6. An ink blot is spilt on some tissue paper and ink blot has an area of approximately $0.16 \mathrm{~cm}^{2}$.
a) Calculate the area of the ink plot in square millimetres.

The volume of ink spilt to create the blot is approximately $0.032 \mathrm{~cm}^{3}$.
b) What is this volume, in cubic millimetres?
c) Assuming the blot penetrates the tissue paper to an equal depth, estimate the depth of the ink penetration in mm .

5 marks
7. Write down the reciprocal of:
a) 17
b) $\frac{1}{3}$
c) $-\frac{2}{3}$
3 marks
8. John throws two four sided dice and adds the scores. He throws the pair of dice 200 times and uses his results to work out experimental probability. He also works out the theoretical probabilities.
a) Copy and complete the table of probabilities.
b) Calculate the number of times his sum was 8 .

5 marks

| Sum of the <br> two dice | Experimental <br> Probability | Theoretical <br> probability |
| :---: | :---: | :---: |
| 2 | 0.07 | $1 / 16$ |
| 3 | 0.14 |  |
| 4 | 0.2 |  |
| 5 |  |  |
| 6 | 0.24 |  |
| 7 | 0.15 |  |
| 8 | 0.04 | $1 / 16$ |

9. Bag A has green and red balls in it, in the ratio 3:1 respectively.

Bag B has green and red balls in it, in the ratio 5:3 respectively. The same number of balls are in Bags A and B.
a) Calculate the least number of balls in bag A.

BAG A BAG B
A ball is selected from each bag.
The diagram shows the part of a tree diagram.
b) Calculate the probability that both balls selected are red.


The number of balls in bags A and B is changed but the ratio of balls remains 3:1 and 5:3 as before. Bag C has green and red balls in it, in the ratio $5: 1$ respectively.
The same number of balls are in Bags A, B and C.
c) Calculate the least number of red balls that are contained altogether in the three bags. 8 marks
10. Match-up the six sketch graphs to the six suggested curves,
i) Quadratic with a minimum point
ii) Reciprocal
iii) Sin curve
iv) Quadratic with a maximum point
v) Cubic
vi) Linear

As an example, the graph labelled $i$ ) is a quadratic function.

a)

b)

c)

d)

e)

f)
11. Calculate-
a) $27^{-\frac{2}{3}}$
b) $\left(16^{\frac{1}{4}}\right)^{3}$
c) $4^{0}+16^{\frac{1}{2}}$
3 marks
12. Gavin is investigating the distribution of shoe sizes among pupils in his school. He decides to take a random stratified sample of his school to perform the survey. He divides the schools into 10 strata by year group and gender. There are 1000 pupils in Gavin's school and he decides to use a sample of size 100.

| Year | Boys | Girls |
| :---: | :---: | :---: |
| 7 | 120 | 110 |
| 8 | 80 | 90 |
| 9 | 105 | 100 |
| 10 | 95 | 100 |
| 11 | 98 | 102 |

If simple rounding is used in calculations to decide the make up of the sample; what problem does this cause in this case and suggest a solution. Hence decide the make up of the sample for a sample size of 100 pupils.

3 marks
13. a) Sketch the graph of $y=\sin x$ for $0 \leq x \leq 360^{\circ}$.
b) One solution to the equation $\sin x=0.5$ is $x=30^{\circ}$, find another solution such that $0 \leq x \leq 360^{\circ}$.
b) One solution to the equation $\sin x=\frac{\sqrt{3}}{2}$ is $x=60^{\circ}$, find another solution such that $0 \leq x \leq 360^{\circ}$.
c) Sketch the graph of $y=\sin 2 x$ for $0 \leq x \leq 180^{\circ}$.
d) Solve the equation $\sin 2 x=0.5$ for $0 \leq x \leq 180^{\circ}$.
14. When objects are launched upwards through a fluid with an initial velocity, $v$ metres per second, they achieve a maximum height of $h$ metres.
$h$ is directly proportional to the square of $v$. When $v=10, h=5$.
a) Work out an equation for $h$ in terms of $v$, evaluating any constants.
b) Calculate the value of $v$ when $h=8.45$.

Two identical balls are launched upwards. The ratio of their initial speeds is 5:2.
c) Work out the ratio of the maximum heights achieved.

6 marks
15. A student is analysing the results from a game of chance, which had 20 rounds. In the last 20 rounds, he won 8 rounds, lost 4 rounds, and drew 8 rounds.

Estimate the probability that-
a) In the next two rounds, they win one round and lose the other.
b) They lose the next three rounds.
16. $A$ is the point $(4,1), B$ is the point $(-3,5)$ and $O$ is the point $(0,0)$.
a) i) Write $\overrightarrow{A B}$ as a column vector.
ii) Find the length of $\overrightarrow{A B}$ leaving your answer as a surd.
$D$ is a point such that $B D$ is parallel to $\binom{0}{1}$ and the length of $\overrightarrow{A D}$ is the same as the length of $\overrightarrow{A B}$.
b) Find $O D$ as a column vector.
$C$ is the point such that $A B C D$ is a rhombus.
c) Find the coordinates of $C$.
17. The lengths of the sides, in metres, of a rectangle are $3-\sqrt{ } 5$ and $3+\sqrt{ } 5$ respectively.

Find, in their simplest forms-
a) The rectangle's perimeter.
b) The rectangle's area.
18. Make $Q$ the subject of the equation, $\frac{Q}{V^{2}}=2 Q p+12$
19. Solve the equation, $\frac{1}{x}+\frac{6 x}{x-1}=6$
20. a) Show that the $x$-coordinate of the points of intersection of the line $y=2 x+2$ and the circle $x^{2}+y^{2}=8$ must satisfy the equation $5 x^{2}+8 x-4=0$.
b) Hence find the coordinates of the points where the line $y=2 x+2$ intersects the circle $x^{2}+y^{2}=8$.

