MATHEMATICS A · Practice paper

Mathematics A Exam-Style Paper 1

NAME _____

DATE _____

QUESTIONS
32

TOTAL MARKS
114

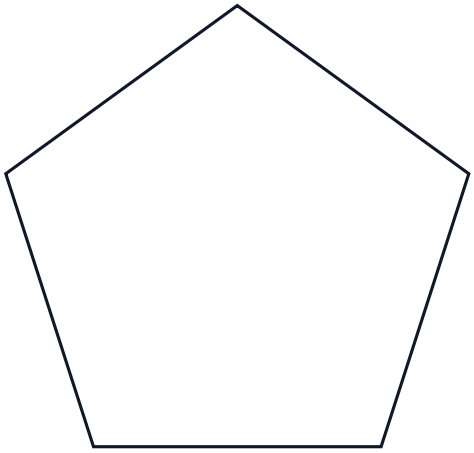
SUGGESTED TIME
135 minutes

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Instructions

Answer all questions in the spaces provided or on lined paper. Show your working — you can earn marks for your method even if the final answer is wrong. Number each answer clearly.

1. **(a)** Look at the diagram below. [1] [2 marks]



A regular pentagon.

Write down the number of lines of symmetry this shape has.

(b) Write down the order of rotational symmetry of the same shape. [1]

2. Write down the mathematical term for an object belonging to a set. [1 mark]

3. Find the gradient of the straight line passing through the points $(1, 2)$ and $(5, 10)$. [2 marks]

4. Factorise completely: $8x^2 - 20x$ [2 marks]

5. Calculate the size of angle θ in a right-angled triangle where the side opposite θ is 7 m and the hypotenuse is 14 m. Give your answer correct to 3 significant figures. [2 marks]

6. A length is measured as 40 cm, correct to the nearest cm. [2 marks]

Write down the lower and upper bounds of the measurement.

7. The cost, C dollars, of printing a set of posters is directly proportional to the number of posters, n. [4 marks]

When 50 posters are printed, the cost is $80.

(a) Write the formula for C in terms of n. [1]

(b) Calculate the cost of printing 120 posters. [2]

(c) How many posters can be printed for $200? [1]

8. Solve the following equation for y: [3 marks]

$$\frac{y}{4} + 2 = 5$$

(a) Write down the first step you would use to start solving the equation. [1]

(b) Complete the solution to find the value of y. [2]

9. Here are three fractions: $\frac{5}{12}$, $\frac{2}{3}$, and $\frac{3}{4}$. [4 marks]

A point A has coordinates (2, 3) on the Cartesian plane.

(a) Place these fractions in increasing order. [2]

(b) Write down the coordinates of the point that is reflected across the x-axis from point A. [1]

(c) What is the value of the numerator in the fraction that is equivalent to $\frac{2}{3}$ with denominator 12? [1]

10. List all the elements of the set A where $A = \{x : x$ is a whole number and $4 \leq x < 9\}$. [2 marks]

11. Scientists measured the mass of a grain of rice as 0.000028 kg. In a laboratory, a student investigates a relationship using the formula $E = mc^2$, where m is mass in kilograms and $c = 3 \times 10^8$ m/s. [5 marks]

(a) Express the mass of one grain of rice in standard form. [1]

(b) Calculate c^2 and write your answer in standard form. [2]

(c) Using your answers to (a) and (b), work out the value of E for one grain of rice. Give your answer in standard form. [2]

12. An engineer records the following readings for three components in a circuit: [4 marks]

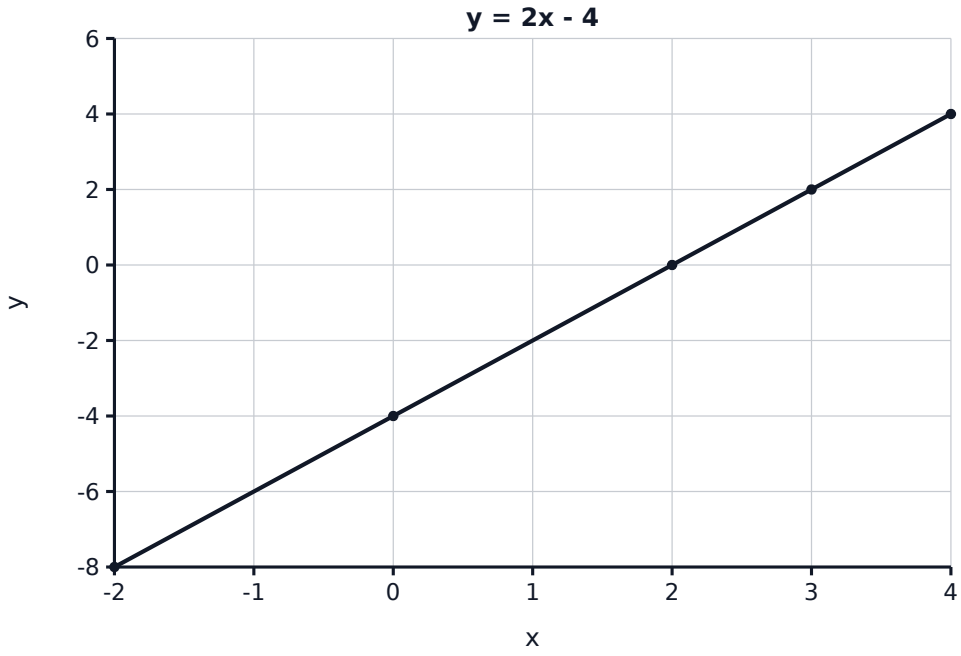
Component	Measurement
A	4.5×10^{-2}
B	7.3×10^{-1}
C	2.8×10^{1}

(a) Write the value of component B as an ordinary number. [1]

(b) Write the value of component C in standard form to 1 decimal place. [1]

(c) Calculate the product of component A and component C. Write your answer in standard form. [2]

13. The line $y = 2x - 4$ is shown below. [4 marks]



Graph of \(y = 2x - 4\)

(a) Write down the coordinates where the line crosses the y-axis. [1]

(b) Find the gradient of this line. [1]

(c) Find the x-coordinate where the line crosses the x-axis. [1]

(d) Write down the equation of a line parallel to $y = 2x - 4$ that passes through (0, 3). [1]

14. Expand and then fully factorise the following expression: [4 marks]

(a) $(x+5)(x-3)$ [2]

(b) Now, factorise completely: $x^2+2x-15$ [2]

15. A garden centre increases the price of a decorative plant by 6% each year. Meanwhile, the area of land for these plants is calculated using a formula. [6 marks]

The plant originally costs \$15. The land forms a rectangle with length 8 m and width 5 m.

(a) Calculate the price of the plant after 3 years. Give your answer correct to 2 decimal places. [3]

(b) Write an algebraic expression for the area A of the rectangular land in terms of its length l and width w. [1]

(c) Calculate the area of the land using the formula you wrote in (b). [2]

16. Saira is baking cupcakes for a charity sale. Each cupcake sells for £2. She expects the sale to raise £180. However, due to a last minute change, a 15% discount is applied to all cupcakes. [6 marks]

(a) How many cupcakes does Saira originally plan to sell? [1]

(b) What is the price of each cupcake after the discount? [2]

(c) How much money will she actually raise if she sells the same number of cupcakes at the new discounted price? [2]

(d) If she wants to raise exactly £180 after the discount, how many cupcakes must she sell? Round your answer to the nearest whole number. [1]

17. Explain why the product of the gradients of two perpendicular lines (neither vertical nor horizontal) is always -1. [2 marks]

18. The mass m grams of a medicine needed is directly proportional to a patient's mass. A patient who weighs 72 kg requires 24 grams. How much medicine does a patient of 54 kg need? Write a formula relating m to the patient's mass in kg. [3 marks]

19. Write the following numbers as decimals, giving your answer to two decimal places where necessary. [3 marks]

(a) $\frac{5}{8}$ [1]

(b) $\frac{7}{20}$ [1]

(c) 0.18 as a fraction in its simplest form. [1]

20. This question tests your skill in converting metric units and finding the inverse of functions. [9 marks]

(a) A field has an area of 24000 cm². Convert this area to m². [2]

(b) Let $f(x) = x^2 + 3$, where x is a positive real number.

i) Calculate $f(5)$.

(ii) Find the inverse of f, $f^{-1}(y)$, expressing your answer in terms of y. [3]

(c) A patch of land has an area of 27 m². Using your answer from part (b), find the value of x such that $f(x) = 27$. [4]

21. In the country of Kalculus, the tax rates are: [3 marks]

Band	Salary (p.a.)	Tax rate
A	$0–$50,000	20%
B	>$50,000	40%

Abdullah earns $85,000 per year. Calculate his total annual income tax.

22. The straight line L passes through the points (–5, 7) and (3, –9). [4 marks]

(a) Calculate the gradient of line L. [2]

(b) Find the equation of line L in the form $y = mx + c$. [2]

23. The distance from the Earth to Star X is 2.46×10^{12} km. The distance from the Earth to Star Y is 7.82×10^{13} km. [5 marks]

(a) Calculate how many times farther Star Y is from Earth compared to Star X. Give your answer in standard form. [3]

(b) If a spaceship travels at 2.05×10^{5} km per hour, estimate how many hours it would take to reach Star X from Earth. Give your answer in standard form. [2]

24. A school is holding a sports day with relay races. There are 198 boys and 135 girls. Each relay team must have the same number of boys and the same number of girls, and no students can be left out. [4 marks]

Find the greatest number of teams that can be formed and state how many boys and how many girls would be in each team.

25. A large TV loses 15% of its value in the first year after purchase, and then loses another 10% of its remaining value in the second year. The TV originally cost $2,400. [3 marks]

(a) Calculate the value of the TV after the first year. [1]

(b) Calculate the value of the TV after the second year. [1]

(c) Calculate the total percentage loss in value over the two years. Give your answer to 1 decimal place. [1]

26. Shape A has vertices at (–4, 1), (–1, 1), and (–4, 4). Shape A is enlarged by scale factor k about the origin to produce shape B, which has one vertex at (–8, 2). [5 marks]

(a) *Find the value of the scale factor k.* [2]

(b) *Write down the coordinates of the other two vertices of shape B.* [3]

27. A stopwatch measures time in a sprint race as 12.4 seconds, correct to the nearest 0.1 second. [4 marks]

The distance of the race is measured as 100 metres, correct to the nearest metre.

Calculate the upper bound for the runner's average speed in m/s. Give your answer correct to 3 significant figures. (Speed = distance/time)

28. The universal set is $U = \{a, b, c, d, e, f, g\}$. [2 marks]

Let $X = \{a, b, c, d\}$, $Y = \{c, d, e\}$.

List the elements belonging to $X \cap Y$.

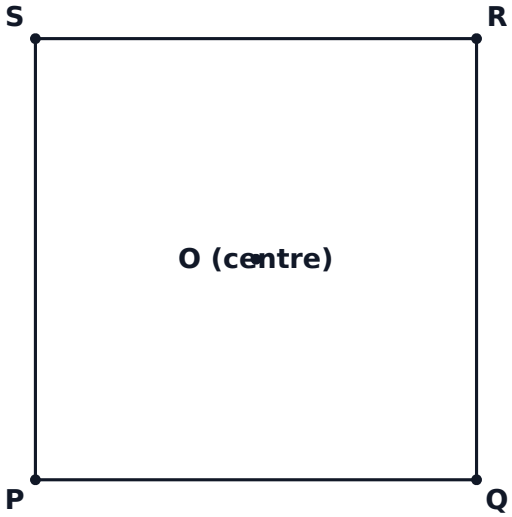
29. Two solid spheres are similar. The surface area of the smaller sphere is 48 cm² and the surface area of the larger sphere is 192 cm². [4 marks]

(a) Explain how you would find the ratio of the radii of the two spheres. [2]

(b) Using your answer to (a), work out the ratio of the volumes of the smaller sphere to the larger sphere. [2]

30. A vector $\vec{s} = \begin{pmatrix} x \\ y \end{pmatrix}$ has a magnitude of 13 and makes an angle of 67.4° with the positive x-axis. Prove that the vector could be $\begin{pmatrix} 5 \\ 12 \end{pmatrix}$, giving your reasoning using the definitions of vector magnitude and direction. [4 marks]

31. A square-based pyramid has a base of side 10 cm. The vertex V is vertically above the centre of the base and is 14 cm above the centre. Explain, step by step, how trigonometry can be used to calculate the angle between a slant edge (V to one corner of the base) and the base. You may use a diagram to support your answer. [4 marks]



Square-based pyramid with base PQRS, side 10 cm, vertex V above base centre, height 14 cm, slant edge VP.

32. Simplify the following algebraic fraction as far as possible: [2 marks]

$$\frac{2x^2 - 8}{x^2 - 4}$$

End of paper.

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