

Grade 7–9 Challenge

Mixed practice paper · Calculator allowed · 12 questions · 34 marks · seed 7

1. Probability (tree diagram)

3 marks

A bag contains 3 red counters and 5 blue counters. Two counters are taken at random without replacement. Work out the probability that both counters are red.

Answer: $\frac{3}{28}$

M1 $P(\text{first red}) = 3/8$

M1 $P(\text{second red}) = 2/7$

A1 $\frac{3}{28}$

2. Algebraic fractions

2 marks

Simplify $\frac{x^2 - 25}{x + 5}$.

Answer: $x - 5$

M1 Factorise the numerator: $x^2 - 25 = (x - 5)(x + 5)$

A1 $x - 5$

3. Functions

4 marks

$f(x) = 3x - 3$ and $g(x) = x^2 + 1$.

(a) Work out $fg(2)$.

(b) Find $f^{-1}(x)$.

Answer: (a) 12 (b) $(x + 3)/3$

M1 (a) $g(2) = 2^2 + 1 = 5$

A1 (a) 12

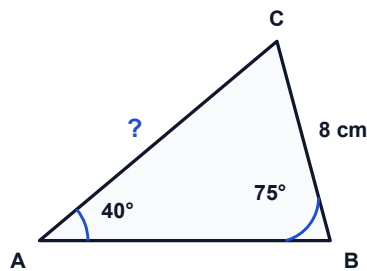
M1 (b) Let $y = f(x)$ and rearrange for x

A1 (b) $(x + 3)/3$

4. Sine rule

3 marks

In triangle ABC, angle A = 40° , angle B = 75° and side a = 8 cm. Work out the length of side b. Give your answer to 3 significant figures.



Answer: 12 cm

M1 Use $a/\sin A = b/\sin B$

M1 $b = 8 \times \sin(75^\circ) / \sin(40^\circ)$

A1 12 cm

5. Surds

2 marks

Rationalise the denominator of $4/\sqrt{2}$. Give your answer in its simplest form.

Answer: $2\sqrt{2}$

M1 Multiply numerator and denominator by $\sqrt{2}$

A1 $2\sqrt{2}$

6. Venn diagrams

3 marks

In a class of 40 students, 15 study French, 18 study Spanish and 6 study both. Work out the number of students who study neither.

Answer: 13

M1 French or Spanish = $15 + 18 - 6 = 27$

M1 $40 - 27$

A1 13

7. Quadratic formula

3 marks

Solve $x^2 + 4x - 11 = 0$. Give your answers to 3 significant figures.

Answer: $x = -5.87$ or $x = 1.87$

M1 Substitute into the quadratic formula

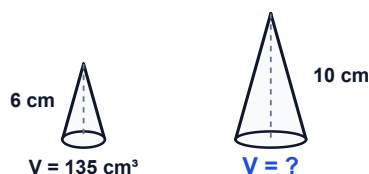
M1 Discriminant = $(4)^2 - 4(1)(-11) = 60$

A1 $x = -5.87$ or $x = 1.87$

8. Similar shapes

3 marks

Two mathematically similar cones have heights 6 cm and 10 cm. The volume of the smaller cone is 135 cm^3 . Work out the volume of the larger cone.



Answer: 625 cm^3

M1 Volume scale factor = $(5/3)^3$

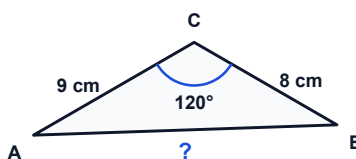
M1 $135 \times (5/3)^3$

A1 625 cm^3

9. Cosine rule

3 marks

In triangle ABC, side a = 8 cm, side b = 9 cm and angle C = 120° . Work out the length of side c. Give your answer to 3 significant figures.



Answer: 14.7 cm

M1 Use $c^2 = a^2 + b^2 - 2ab \cos C$

M1 $c^2 = 8^2 + 9^2 - 2(8)(9)\cos 120^\circ$

A1 14.7 cm

10. Completing the square

3 marks

Write $x^2 + 10x + 27$ in the form $(x + p)^2 + q$.

Answer: $(x + 5)^2 + 2$

M1 $p = 10/2 = 5$

M1 $q = 27 - (5)^2 = 2$

A1 $(x + 5)^2 + 2$

11. **Direct & inverse proportion**

3 marks

y is inversely proportional to x. When $x = 6$, $y = 3$. Work out y when $x = 2$.

Answer: 9

M1 Write $y = k/x$

M1 $k = 6 \times 3 = 18$

A1 $y = 9$

12. **Bounds**

2 marks

A number x is rounded to 1 decimal place to give 4.7. Write down the lower and upper bounds of x.

Answer: Lower bound = 4.65, upper bound = 4.75

B1 Lower bound 4.65

B1 Upper bound 4.75