First name: ______________________ **Surname:** ______________________

Current school: ____

Magdalen College School

13+ Entrance Examination

Specimen Paper

Mathematics

Please read the following information carefully before the examination starts.

- Make sure you have filled in the details at the top of this page.
- This examination is **60 minutes** long.
- Calculators **are** allowed.
- This test is designed to be challenging, so you may not find all the questions straightforward and you may not finish the whole paper.
- Read each question very carefully, think for a while and if you still do not understand what you need to do, then move on to the next question.
- All working and calculations should be written in the spaces provided on this paper. Marks are awarded for correct working, even if you don't get as far as an answer.
- The number of marks available for each question is shown in square brackets, like this: [3]. Please aim to try all **20** questions.
- Work through the paper steadily and carefully. If you have time at the end, go back and try to tackle any questions you did not find so easy when you first saw them.
- Good luck!

Method marks (M1) may be seen or implied (soi). Accuracy marks (A1) must be seen unless otherwise specified.

1. Simplify

a) $3x+2y+5x-3y$

A1

Answer: $8x - y$ .... [1]

b) $2x^2+2x^2$

A1

Answer: $4x^2$ .... [1]

c) $\dfrac{a+a+a}{a}$

A1

Answer: 3 .... [1]

d) $\dfrac{x}{3}+\dfrac{x}{4}$

$\frac{1}{3}+\frac{1}{4} = \frac{7}{12}$ M1

A1

Answer: $\dfrac{7x}{12}$ .... [2]

e) $2n^2k+k^2n+3kn^2$

$\overbrace{5n^2k}^{A1}+\overbrace{k^2n}^{A1}$

Answer: $5n^2k + k^2n$ .... [2]

f) $2+5a-5$

$\overbrace{5a}^{A1}\overbrace{-3}^{A1}$

Answer: $5a - 3$ .... [2]

2. Sound travels at 330 metres per second. If thunder is heard 24 seconds after the lightning is seen, how far away is the storm?

Give your answer in km.

distance = speed × time

= 330 × 24 = 7920 m

M1

A1

Answer: 7.92 km [2]

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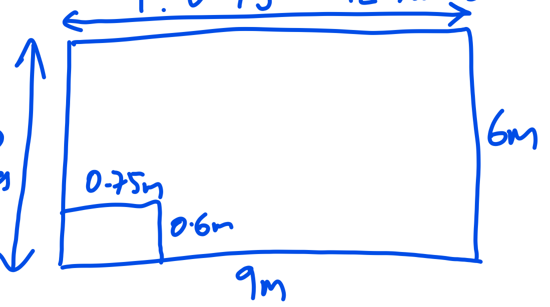
3 How many paving stones, each measuring 75cm by 60cm, are needed to cover a rectangular courtyard 9m by 6m?

M1 (either)

9 ÷ 0.75 = 12 stones

6 ÷ 0.6 = 10 stones



10 × 12 = 120 M1

A1

Answer 120 stones [3]

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4. The distance from Oxford to London is 90km. I travel from Oxford to London at 45km/h as there is a lot of traffic. The road is less congested on the return journey. I calculate that my average speed for the TOTAL journey is 60km/h. What was my average speed for the journey from London to Oxford?

Time from Oxf to Lon is $\frac{\text{distance}}{\text{speed}} = \frac{90}{45} = 2$ hours M1

TOTAL journey has average speed $= \frac{\text{total distance}}{\text{total time}} = \frac{180}{2+T} = 60$ M1

where T is time from Lon to Oxf.

$2 + T = 3$ M1

so $T = 1$ hour

Av. speed from Lon to Oxf is $\frac{\text{distance}}{\text{time}} = \frac{90}{1} = 90$ km/h

A1

Answer: 90 km/h [4]

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5. A set of five positive whole numbers has a mean of 6, a median of 5 and a mode of 4.

List a set of possible numbers

Let the numbers be 4, 4, 5, X, Y (where $5 < X < Y$). M1

Mean of 6 needs $4+4+5+X+Y = 5 \times 6 = 30$

So $13 + X + Y = 30$

$X + Y = 17$ M1

So pick, for example, $X = 8$, $Y = 9$

A1 any correct solution

Answer: 4, 4, 5, 8, 9 [3]

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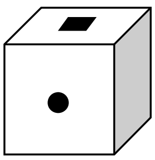
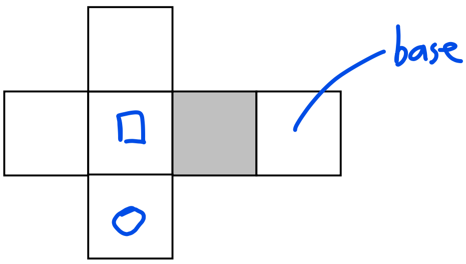
6. Consider the cube shown below



One face is painted grey, one face has a circular hole cut out of it and one face has a square hole cut out of it. All the other faces of the cube are white and have no holes in them.

Here is a net of the cube.



Draw the circular hole and the square hole on the correct places on the net

A1 □ correct

A1 ○ correct

[2]

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7. In each question, find the number that is the odd one out.

a)

$$2\times 2\times 2, 3\times 2, 2^3$$

Answer: 3×2 [1] A1

b)

$$40\%, \frac{2}{5}, \frac{40}{10}$$

Answer: $\frac{40}{10}$ [1] A1

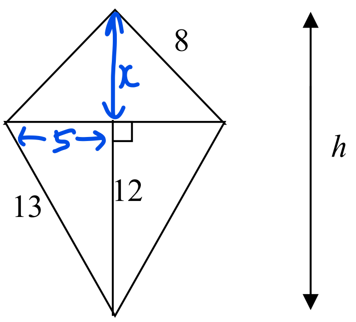
c) $\frac{2}{3}, 60\%, \frac{6}{10}$

Answer: $\frac{2}{3}$ [1] A1

d) $\frac{1+1}{1\times 1}, \frac{2+2}{2\times 2}, \frac{1+1}{-1\times -1}$

Answer: $\frac{2+2}{2\times 2}$ [1] A1

8. Here is a diagram of a kite; all **measurements are in cm.**



5, 12, 13 Pythag. Triple

M1 : Pythag

A1 : 5 correctly obtained

Work out the length h, giving your answer in millimetres correct to the **nearest millimetre.**

$x = \sqrt{8^2 - 5^2} = \sqrt{39}$ M1

$h = \underbrace{12 + \sqrt{39}}_{\text{M1}} = 18.2449\ldots$ cm

Answer: 182 mm [5] A1 cao

9. Solve the following equations

a) $\dfrac{x}{5} = 35$

A1

Answer:.......175.................... [1]

b) $\dfrac{63}{x} = 7$

A1

Answer:.......9.................... [1]

c) $\dfrac{3}{4}x - 5 = 7$

$\frac{3}{4}x = 12$ M1

$x = \frac{4}{3} \times 12 = 16$ M1

A1

Answer:.......16.................... [3]

d) $\dfrac{7}{x+1} = 3$

$7 = 3(x+1)$

$7 = 3x + 3$ M1 expand brackets

$4 = 3x$ M1 collect terms

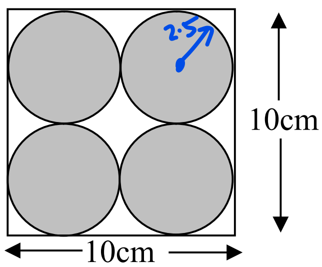
$\frac{4}{3} = x$

A1 o.e

Answer:.......$\frac{4}{3}$.................... [3]

10. Consider this diagram which shows four identical circles inside a square of side length 10cm.

A1 for 2·5



Area of circles $= 4 \times \pi r^2$

$= 4 \times \underline{\pi \times 2 \cdot 5^2}$ M1 for πr^2

$= 25\pi$

Area of square $= \underline{10^2} = 100$
M1

Unshaded area $= 100 - 25\pi$

$= 21{\cdot}5 \text{ cm}^2$ (3sf)

Find the unshaded area.

Answer: $100 - 25\pi$ or $21{\cdot}5 \text{ cm}^2$ A1 [4]

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11. The year 2011 is one where the digits add up to a total of 4. List the years where this occurred between 1000 and 2000 AD

Need $1\ \underbrace{\_\ \_\ \_}_{\text{digit sum is } 3}$

1003
1030
1300] A1 for all three

1012 1021
1102 1201
1120 1210] A1 for all six

1111 A1

Answer:……………………………………………………………………………[3]

12. If:

$A + C = A$ so $C = 0$

$F \times D = F$ so $D = 1$

$B - G = G$

$A + H = E$

$B \div H = G$

$E - G = F$

and A - H represent the numbers from 0 to 7

Find the values of A, B, C, D, E, F, G and H.

$B \div H = G$: only options are $6 \div 3 = 2$ or $6 \div 2 = 3$.
Either way $B = 6$

$B - G = G$ so $B = 2G$ so $G = 3$, and hence $H = 2$

We have A, E, F and $4, 5, 7$ remaining

Consider $E - G = F$

so $E - 3 = F$, must have $E = 7$, $F = 4$

Which leaves $A = 5$

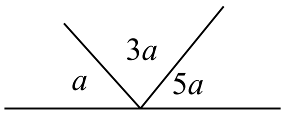
Check : $A + H = E$

$5 + 2 = 7$ ✓ which works.

Answer: A = ……5……B = ……6……C = ……0……D= ……1……E = ……7……F = ……4…… G = ……3…… H = ……2……[8]

A1 for each correct answer

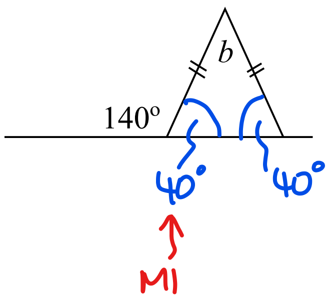
13. The diagrams below are not drawn to scale.
Find the values of the angles a and b.



$9a = 180°$ M1

$a = \frac{180°}{9}$

Answer: $a =$ ..... 20° ..... A1 [2]



$b = 180° - 40° - 40°$ M1

$= 100°$

Answer: $b =$ ..... 100° ..... A1 [3]

14. These are approximate equivalents of some metric and imperial units:

1 metre ≈ 1.1 yards, 2.5 cm $\approx$ 1 inch, 1 pint $\approx \frac{3}{5}$ litre

Answer the following questions using these approximations.

(a) The male shot putt world record stands at 23 metres. What is this record in yards?

$23 \times 1.1 = 25.3$

M1

Answer 25.3 yards. [2] A1

(b) The world's tallest ever woman was recorded at a height of 250 cm. Given that there are 12 inches in one foot, how tall is this in feet and inches?

250 cm $\approx$ 100 inches M1

$100 = 96 + 4$ M1

$=$ 8 feet 4 inches

Answer 8 ft 4 inches [3] A1

(c) The average female human's body contains 5.6 litres of blood. When pregnant, the amount of blood in a female's body doubles.
How much blood would the average pregnant human female have in her body in pints?

$5.6 \times 2 = 11.2$ litres M1

1 pint is $\frac{3}{5}$ litres, so 1 litre is $\frac{5}{3}$ pints

$\underbrace{11.2 \times \frac{5}{3}}_{M1} = 18.7$ pints (3sf)

Answer 18.7 pints [3] A1

15. Solve these equations.

(a) $3x - 7 = 8$

$3x = 15$ M1

$x = 5$

Answer ......5...........[2] A1

(b) $2(x-1) = 10$

$x - 1 = 5$ M1

$x = 6$

Answer ......6...........[2] A1

(c) $3(2x-4) = x - 7$

$6x - 12 = x - 7$ M1 expand brackets

$5x = 5$

$x = 1$

Answer ......1...........[2] A1

d) $2(x-3) - (4x-2) = 5$

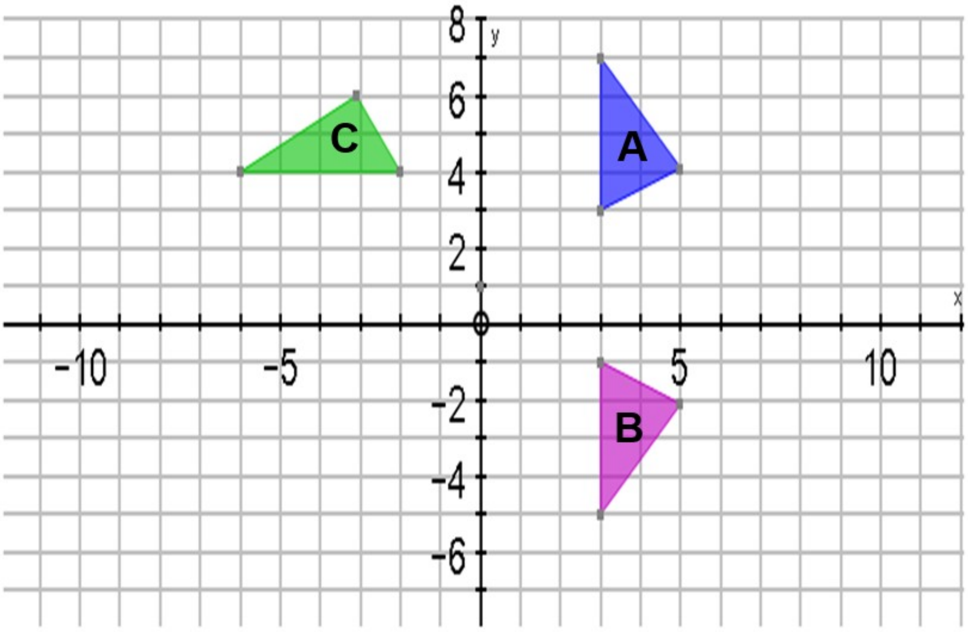
$2x - 6 - 4x + 2 = 5$ M1 expand brackets

$-2x = 9$ M1 collect ~~terms~~

$x = -\frac{9}{2}$

Answer ......$-\frac{9}{2}$ o.e.......[3] A1

16.



(a) Describe the single transformation which will take shape A onto shape B.

Answer: Reflection in line $y = 1$ .... [2]

$\underbrace{\text{Reflection}}_{A1}$ $\underbrace{y=1}_{A1}$

(b) Describe the single transformation which will take shape A onto shape C.

①, ②, ③ all correct : 2 marks

At most one of ①, ②, ③ missing : 1 mark

Otherwise : 0 marks

Answer $\underbrace{\text{Rotation}}_{①}$, $\underbrace{90^\circ\text{ ACW}}_{②}$, $\underbrace{\text{about }(0,1)}_{③}$ .... [2]

(c) If each of the squares on the grid is a square of side length 1, what is the area of shape A?

$\frac{1}{2} \times 4 \times 2 = 4$ M1

A1

Answer 4 .... [2]

(d) A new transformation is maps shape A onto shape D, and causes all of the lengths of shape A to double.
Write down the area of shape D.

Area increases by $2^2 = 4$
M1

$4 \times 4 = 16$
M1

M1

Answer 16 ....[3]

17. Leaving your answers as top heavy fractions work out:

(a) $\dfrac{1}{1+\dfrac{1}{2}}$. $= \dfrac{1}{\frac{3}{2}} = \dfrac{2}{3}$ A1

M1

(b) $\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{2}}}$ $= \dfrac{1}{1+\frac{2}{3}} = \dfrac{1}{\frac{5}{3}} = \dfrac{3}{5}$ A1

M1

(c) $\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{2}}}}$ $= \dfrac{1}{1+\frac{3}{5}} = \dfrac{1}{\frac{8}{5}} = \dfrac{5}{8}$ A1

[5]

Predict the next two answers if the pattern in the question continues in the same way.

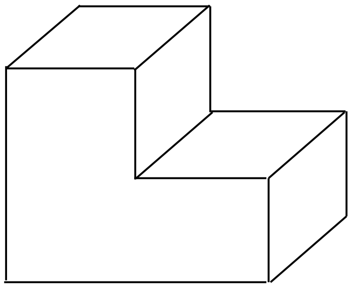
$\dfrac{2}{3}, \dfrac{3}{5}, \dfrac{5}{8}, \underbrace{\dfrac{8}{13}, \dfrac{13}{21}}_{\text{next two}}$

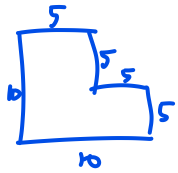
A1 A1 A1 A1

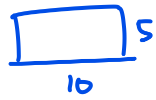
[Numerators and denominators follow Fibonacci sequence
1, 1, 2, 3, 5, 8, 13, 21, ...]

Answer ....$\dfrac{8}{13}$......, ...$\dfrac{13}{21}$.....[4]

18. A polystyrene moulding has a cross section in the shape of a letter L with its longer edges 10cm and all other measurements 5cm, including its depth. What is its total surface area?



Total area = 2 × 

+ 4 × 

$= 2 \times (10^2 - 5^2) + 4 \times 10 \times 5$

$= 150 + 200$

$= 350 \text{ cm}^2$

M1 : sensible decomposition to rectangles

M1 : ... with correct dimensions

A1 soi : at least one rectangle area correctly found

A1 soi : all rectangle areas correctly found

A1

Answer 350 cm² ....[5]

19. Suppose $x = 2$, $y = 0.5$ and $z = -3$.

Find the value of:

a) $2x + y$

A1

Answer:............4.5.............. [1]

b) $x + (y - z)$

$2 + (0.5 - -3)$

$= \underbrace{2 + 3.5}$

M1 for $+3.5$

A1

Answer:............5.5.............. [2]

c) $x - 2(z - y)$

$2 - 2(-3 - 0.5)$

$= 2 - 2 \times -3.5$

$= \underbrace{2 + 7}$

M1 for $+7$

A1

Answer:............9.............. [2]

d) $\dfrac{x^2}{y^2}$

$\dfrac{2^2}{0.5^2} = \dfrac{4}{0.25}$ M1

A1

Answer:............16.............. [2]

20. James and Michael are arguing. James says that

n^2+n+41 is a prime number for any positive integer n. He uses the example

When n=1, $n^2+n+41 = 1+1+41=43$ which is a prime number

Michael is not sure, wants to try out a few more values of n and then wants to think about the problem.

(a) Try n=2. Is n^2+n+41 a prime number?

$2^2+2+41=47$

A1

Answer: Yes A1 [2]

(b) Try n=3. Is n^2+n+41 a prime number?

$3^2+3+41 = 53$

A1

Answer: Yes A1 [2]

(c) Do you think that n^2+n+41 is a prime number for any value of n?

Counter example : when $n=41$, we get $41^2+41+41 = 1763$
$= 41 \times 43$

so isn't prime

Explain your reasoning fully.

1 mark for specifying a value of n which doesn't give a prime

1 mark for "their" 1763

1 mark for showing "their" 1763 factorises

1 mark for correct and convincing, plus correctly concluded.

Answer: No. [4]

END OF TEST – GO BACK AND CHECK YOUR ANSWERS