Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2020

Mathematics

Unit M4
(With calculator)
Higher Tier

MV18

[GMC41]
MONDAY 13 JANUARY, 9.15am–11.15am

Time

2 hours, plus your additional time allowance.

Instructions to Candidates

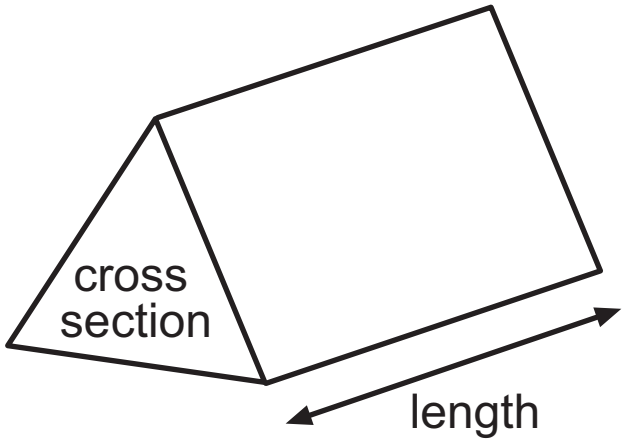
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write on blank pages.
Complete in black ink only. Answer **all twenty-four** questions.
All working should be clearly shown in the spaces provided.
Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

Information for Candidates

The total mark for this paper is 100.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on pages 2 and 3.

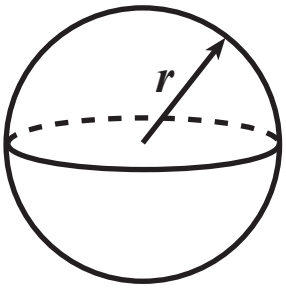
Formula Sheet

Volume of prism = area of cross section × length



Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



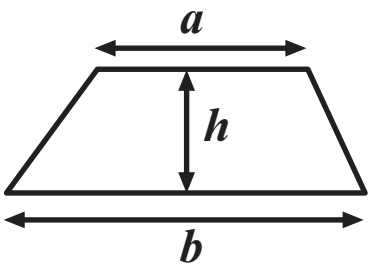
Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$, are given by

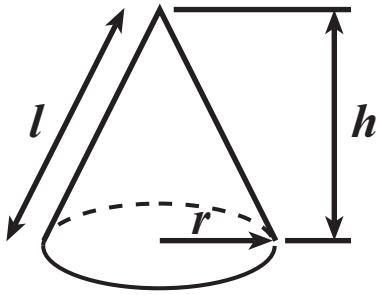
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Area of trapezium $= \frac{1}{2}(a + b)h$

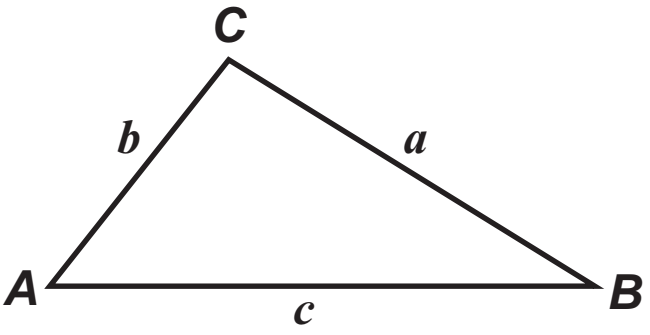


Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$



In any triangle *ABC*



Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle $= \frac{1}{2} ab \sin C$

1 BMI (Body Mass Index) is calculated using the formula

$$\text{BMI} = \frac{w}{h^2}$$

where w = weight in kilograms and h = height in metres.

Mark has a BMI of 22
His height is 1.83 m.

Calculate his weight. [2 marks]

Answer _____ kg

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2 Solve $5(3x - 2) = 7x + 4$ [3 marks]

Answer $x =$ _____

3 A badge is made from a triangle and three-quarters of a circle as shown.

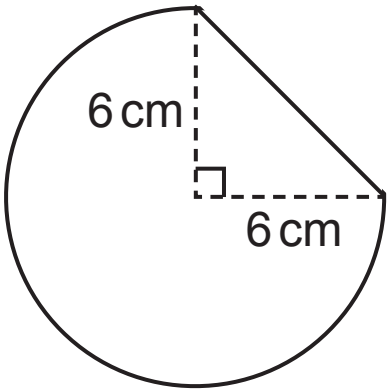


diagram not drawn accurately

Work out the perimeter of the badge. [6 marks]

Answer _____ cm

4 Write down two numbers, greater than 1, which have a lowest common multiple (LCM) of 48 [2 marks]

Answer _____ , _____

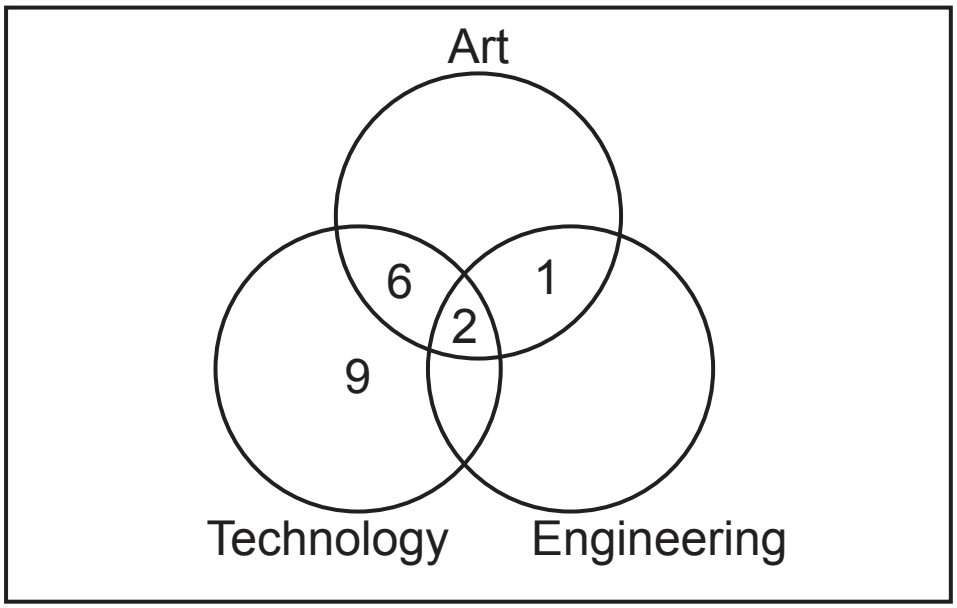
---

5 Expand and simplify $(p - 6)(p + 2)$ [2 marks]

Answer _____

6 There are 35 students in a Form Class.
Some students study Art, some study Technology, some study Engineering and some study a combination of these subjects.
Some study none of these subjects.

The Venn diagram shows some information about the number of students studying the subjects.



5 students study Technology and Engineering.
14 students study Art.
8 students study Engineering.

(a) Use this information to complete the Venn diagram.
[4 marks]

(b) Use the Venn diagram to calculate what percentage of Technology students also study Art but not Engineering.
[2 marks]

Answer _____ **%**

7 Work out the midpoint of the line PQ joining P(4, −6) and Q(8, 2). [2 marks]

Answer (_____ , _____)

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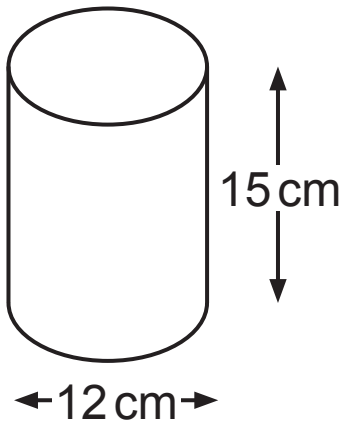
8 Calculate the volume of a cylinder with diameter 12 cm and height 15 cm. [3 marks]

Include units with your answer.



Answer _____

9 A restaurant bill, including 15% service charge, was £98.90
How much was the service charge? [3 marks]

Answer £ _____

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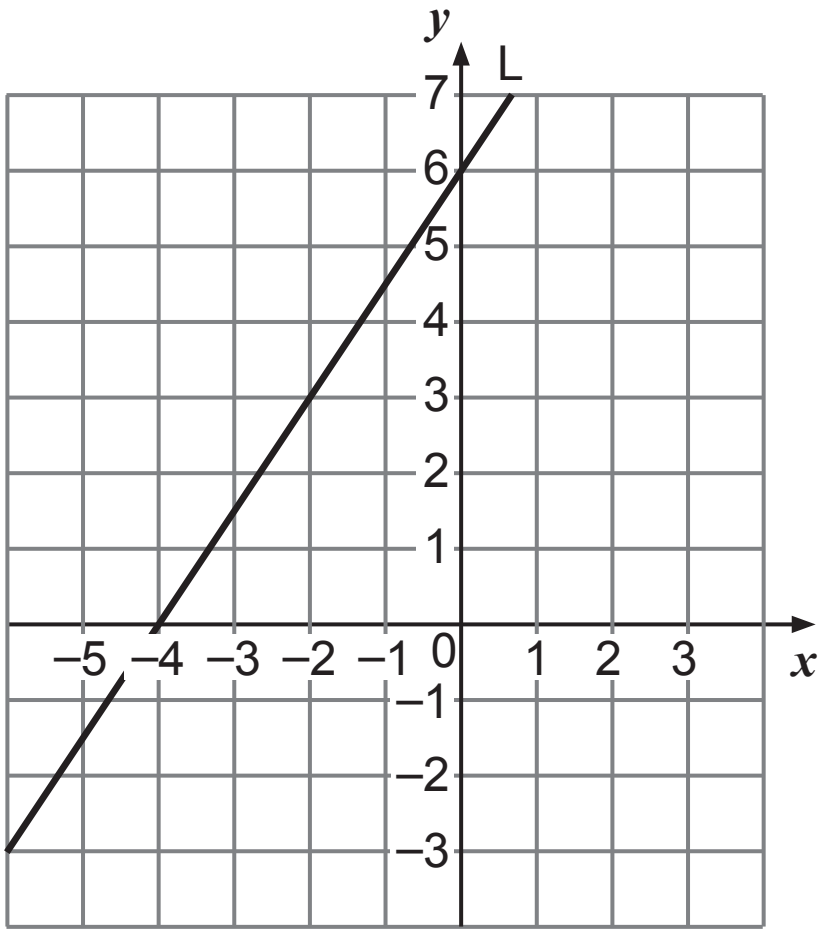
10 Simplify $\frac{x^2 - 2x}{3} \times \frac{6}{x^2 + 2x - 8}$ [3 marks]

Answer _____

11



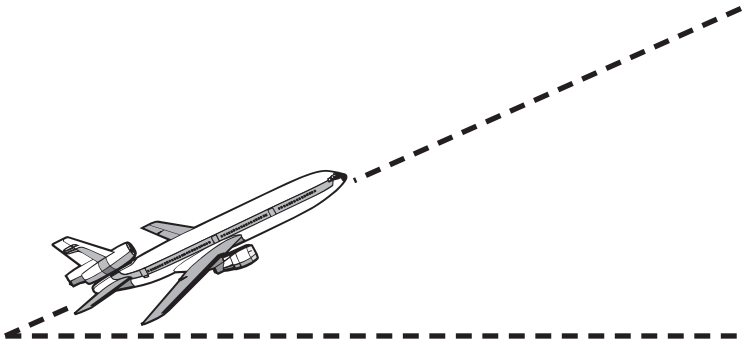
(a) Write down the equation of the line L shown.
[3 marks]

Answer _____

(b) Write down the equation of any line parallel to line L.
[1 mark]

Answer _____

12 After take-off, an aircraft flies for 16 km at an angle of 24° to the horizontal.



Calculate the height it reaches. [3 marks]

Answer _____ km

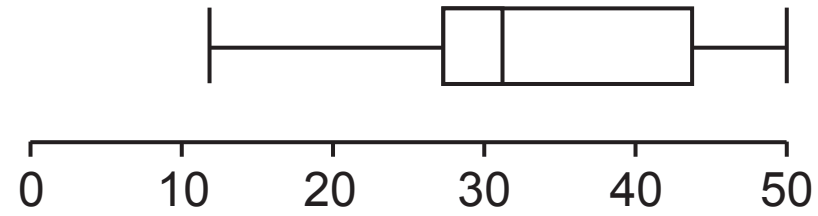
13 The test marks for 35 students are displayed in two different ways.

Stem and leaf

1	2 2 2 3 4
2	0 4 5 8 8 8 8
3	0 0 0 1 1 2 3 4 5 7 8 9 9
4	2 4 5 5 6 7 8 9 9
5	0

KEY: 4 | 6 = 46

Box plot



(a) Give one advantage of the information being displayed in the stem and leaf diagram. [1 mark]

(b) Give one advantage of the information being displayed in the box plot. [1 mark]

14 (a) Write 84 and 154 as a product of their prime factors. [2 marks]

Answer 84 = _____ 154 = _____

(b) Hence, or otherwise, find the highest common factor (HCF) of 84 and 154 [2 marks]

Answer _____

15 Rory has x golf balls.

Graham has one less than Rory.

Darren has one less than Graham.

After a round of golf, Rory still has x golf balls but Graham has lost half of his golf balls and Darren has lost two-thirds of his golf balls.

They **now** have a total of 74 golf balls between them.

Set up a linear equation and solve it to find how many golf balls each player now has. [5 marks]

A solution by trial and improvement will not be accepted.

Answer

Rory _____

Graham _____

Darren _____

16 The diagram shows an L-shape with a total area of 47 cm^2

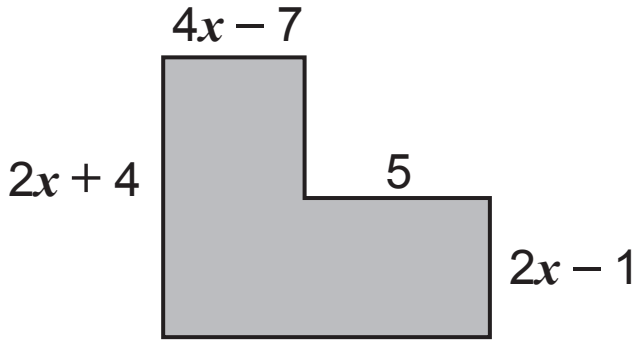


diagram not drawn accurately

All corners are right angles.

All lengths are in cm.

(a) Show that $2x^2 + 3x - 20 = 0$ [4 marks]

(b) Solve this equation to find the value of x. [2 marks]

Answer $x =$ _____

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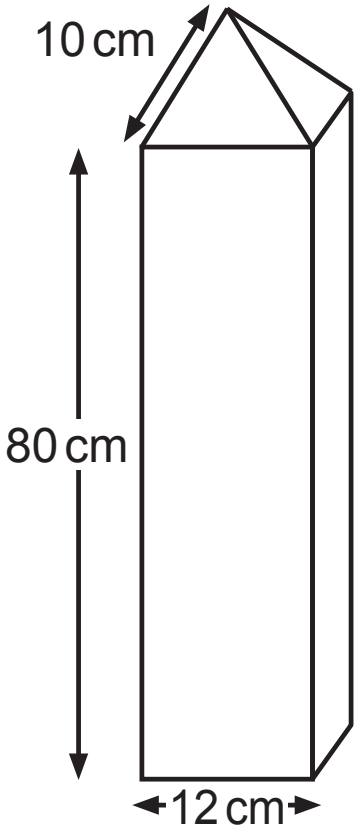
17 Factorise fully $8x^2 - 50y^2$ [3 marks]

Answer _____

18 The diagram shows a wooden post consisting of a cuboid with a square-based pyramid on top. Each slanted edge is 10 cm.



Calculate the total surface area of the wooden post.
[5 marks]

Answer _____ cm^2

19 The head cook at Dundee Secondary School wants to take a stratified sample to complete a survey on school meals.

A sample of 50 pupils is required.

The table below shows the number of pupils in each year group.

Year	8	9	10	11	12
Number of pupils	182	124	150	108	97

(a) How many pupils should be selected from each year group using a stratified sample? [4 marks]

Answer

Year 8 _____

Year 9 _____

Year 10 _____

Year 11 _____

Year 12 _____

(b) Write down one advantage and one disadvantage of using a stratified sample. [2 marks]

Advantage _____

Disadvantage _____

20

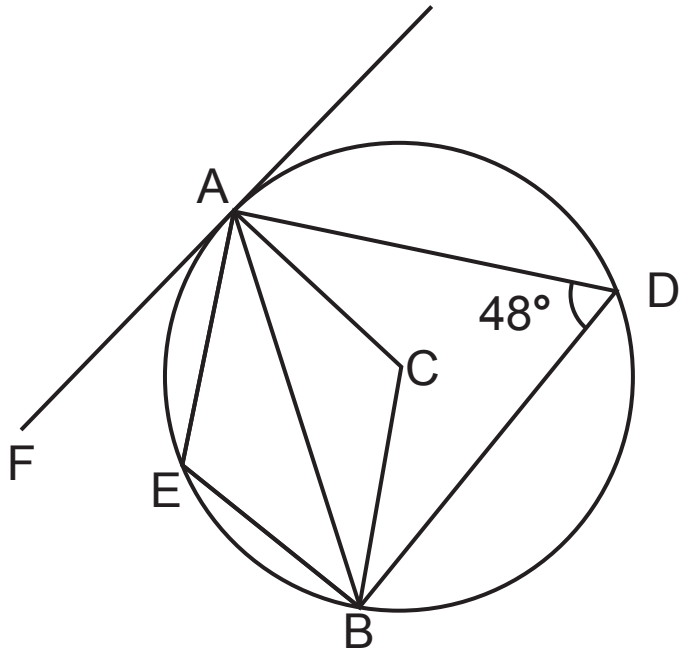


diagram not drawn accurately

A, B, D and E are points on the circumference of a circle, centre C.

$\angle ADB = 48°$

AF is a tangent to the circle.

Find the size of the following angles, giving a reason for each answer. [2 marks for each]

(a) $\angle AEB =$ _____ ° because _____

_____

(b) $\angle ACB =$ _____ ° because _____

_____

(c) $\angle BAF =$ _____ ° because _____

_____

21 Solve the equation

$$\frac{4}{2x-3} = \frac{2}{3x+1} + 2$$

giving your answers correct to 2 decimal places.
[7 marks]

Answer $x =$ _____

22 The line joining $(a, 7)$ to $(-1, 10)$ is perpendicular to the line joining $(a, 7)$ to $(9, -6)$.

Find the possible values of a. [6 marks]

A solution by trial and improvement will not be accepted.

Answer $a =$ _____ or $a =$ _____

23 Given $m = \frac{\sqrt{s}}{t}$ and

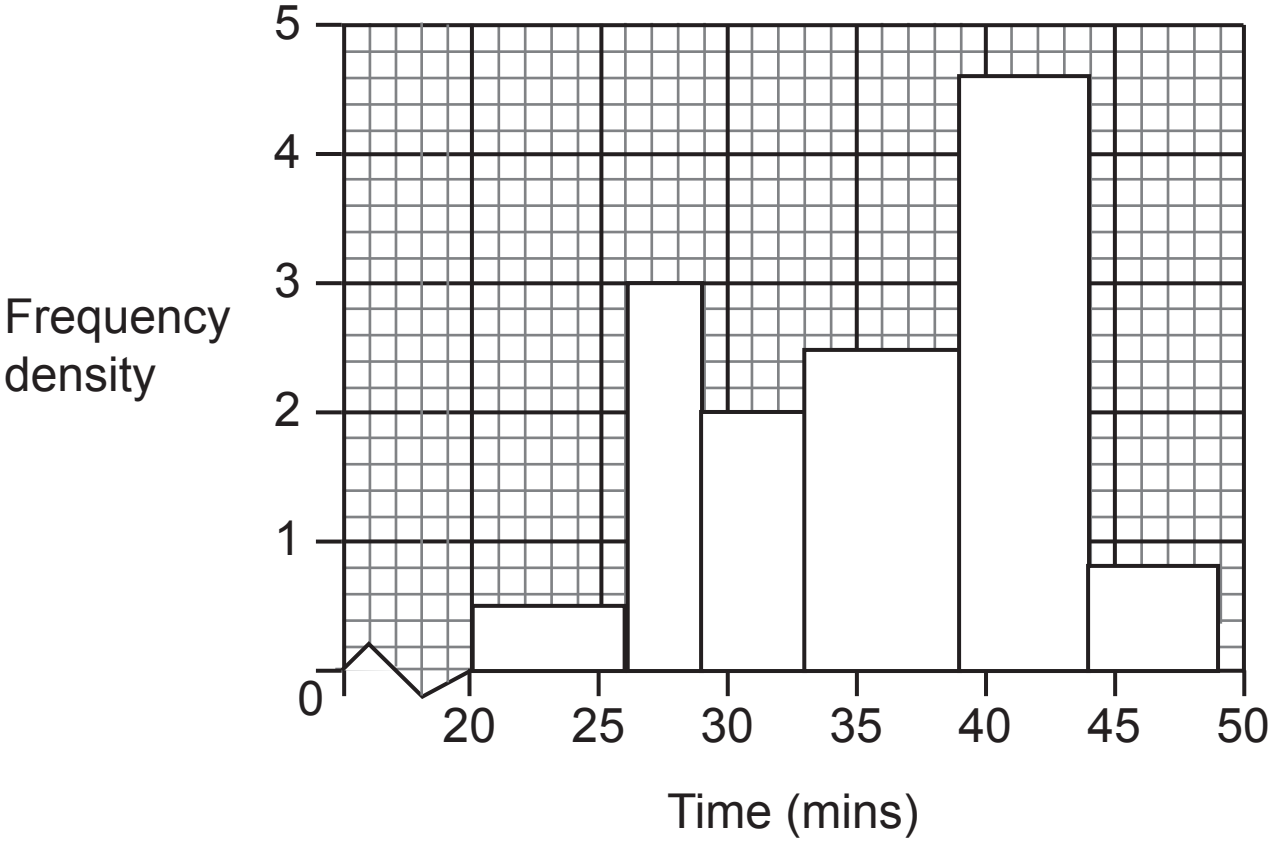
$s = 5.14$ rounded to 2 decimal places
$t = 9.384$ rounded to 3 decimal places

find the upper bound of m. [3 marks]

Answer _____

24 62 pupils completed a couch to 5km programme, which ended with everyone completing a 5 km run.

Their times were recorded and the histogram below illustrates the data collected.



(a) Complete the table below. [4 marks]

Time (t minutes)	Frequency
$20 \leqslant t < 26$	3
$26 \leqslant t < 29$	
$29 \leqslant t < 33$	

(b) Find an estimate for the mean time taken by the 62 pupils to complete the 5 km. [4 marks]

Answer _____ minutes

This is the end of the question paper

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
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Total Marks	

Examiner Number