OCR
RECOGNISING ACHIEVEMENT

FREE-STANDING MATHEMATICS QUALIFICATION
Intermediate Level

6989/01

FOUNDATIONS OF ADVANCED MATHEMATICS

FRIDAY 6 JUNE 2008

Morning
Time: 2 hours

Additional materials: Answer sheet (MS4)
Rough paper

To be brought by candidate: Eraser, Ruler, Scientific calculator, Soft pencil

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

- Write your name, centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.
- There are **forty** questions in this paper. Attempt as many questions as possible. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.
- **Read very carefully the instructions on the answer sheet.**

INFORMATION FOR CANDIDATES

- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- Paper is provided for rough work; this should not be handed in.

This document consists of **22** printed pages and **2** blank pages.

1 Three of the following statements are true and **one** is false. Which one is **false**?

A The highest common factor (HCF) of 42 and 70 is 14.

B 97 is a prime number.

C $\frac{1}{4} + \frac{1}{12} = \frac{1}{3}$

D 15% of £80 is £10.00.

2 The number 7654.451 is written below in four different ways.

Three of the ways are correct and **one** is incorrect. Which one is **incorrect**?

A 8000, correct to the nearest thousand.

B 7654.5, correct to 1 decimal place.

C 7600, correct to 2 significant figures.

D 7654, correct to the nearest integer.

3 An electrician charges the following rates.

Call-out charge including work for up to one hour	£42
For each extra half-hour or part of a half-hour	£21

The electrician completed a job which took 1 hour 35 minutes.

Which **one** of the following is the **correct** charge?

A £42

B £63

C £66.50

D £84

4 The table below lists the areas, in square miles, of the continents of the world.

Continent	**Area (square miles)**
Africa	1.2×10^7
Asia	1.7×10^7
Europe	3.8×10^6
North America	9.4×10^6
South America	6.9×10^6
Australasia	3.0×10^6

Three of the following statements are true and **one** is false. Which one is **false**?

A North and South America together cover a little less area than Asia.

B Asia has the largest area.

C Europe is approximately 30% larger than Australasia.

D Australasia is two and a half times as big as Africa.

5 Catherine chooses three numbers, x, y and z. She adds the first two, then multiplies her answer by itself and finally multiplies her result by the third number.

Which **one** of the following is a **correct** algebraic expression for her final answer?

A $z(x + y)^2$

B $[z(x + y)]^2$

C $x^2z + y^2z$

D zx^2y^2

6 Which **one** of the following has the **largest** value?

A $62\frac{1}{2}\%$ of 16

B 8 divided by $\frac{2}{3}$

C $\frac{4}{5}$ of 15.5

D $\sqrt{132.25}$

[Turn over

7 Anne has a number of identical rectangular boxes. She measures the length of each box to be 8 cm, the width 5 cm and the height 4 cm, all correct to the nearest cm.

Three of the following statements are true and **one** is false. Which one is **false**?

A The greatest possible length when 10 boxes are placed end to end is 85 cm.

B The width when 2 boxes are placed side by side is no more than 11 cm.

C The height when 3 boxes are stacked is at least 10.5 cm.

D The greatest possible volume of a box is 160.5 cm^3.

8 The first four terms of a sequence are −7, −2, 3, 8.

Three of the following statements are true and **one** is false. Which one is **false**?

A The next two terms of the sequence are 13 and 18.

B 93 is a term of the sequence.

C The nth term of the sequence is $5n - 7$.

D The 20th term is 50 more than the 10th term.

9 Three of the following statements are true and **one** is false. Which one is **false**?

A 12 inches is about 30 centimetres.

B 5 tonnes is 5000 kilograms.

C 1 litre is about 1.8 pints.

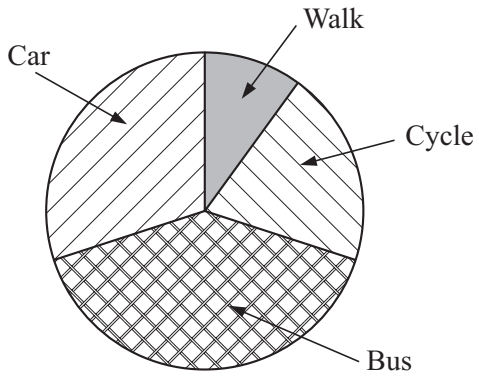
D 25 kilometres is about 40 miles.

10 The 500 students who arrived one day at a college travelled by the following means.

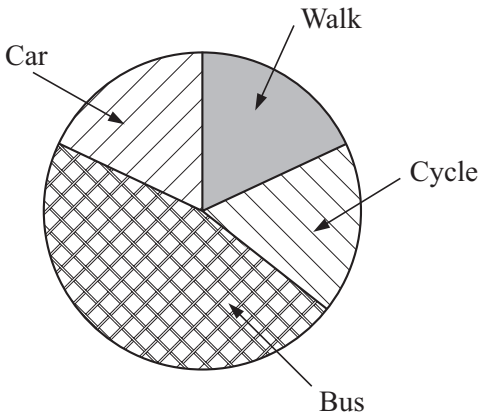
Walk	50
Cycle	100
Bus	200
Car	150

Which **one** of the following pie charts is a **correct** representation of these data?

A



B



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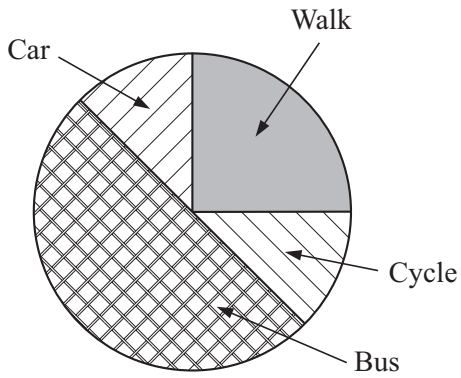
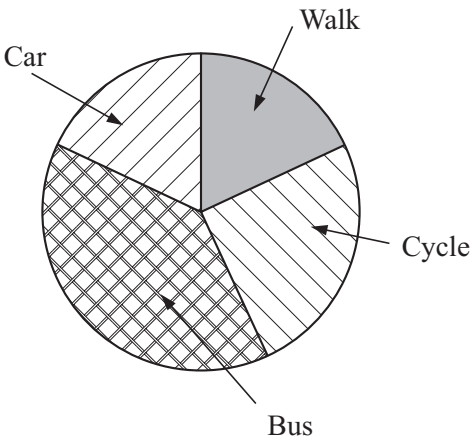
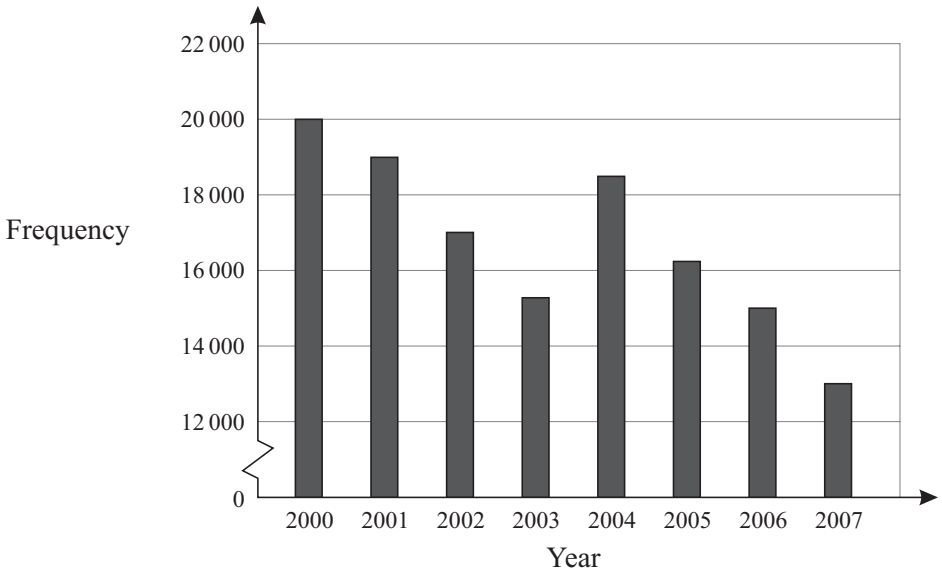


D



11 The bar chart below shows the number of books borrowed in each of the years 2000 to 2007 from a local library.



Three of the following statements are true and **one** is false. Which one is **false**?

A The only year in which there was an increase in borrowing from the previous year was 2004.

B More than twice as many books were borrowed in 2000 as in 2007.

C There was a drop of about 13% in borrowing in 2007 from 2006.

D The figure of 20 000 books borrowed in 2000 represents a rate of just under 70 books per day, given that the library was open for 286 days in the year.

12 Three of the following statements are true and **one** is false. Which one is **false**?

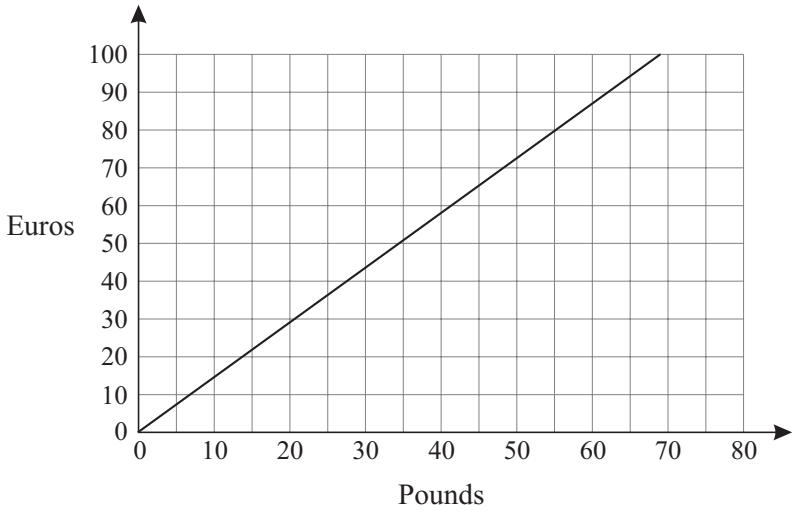
A $-2 \times -3 = -6$

B $(-2) - (-3) = 1$

C $\dfrac{3 + 4 \times 13}{17 - 3 \times 2} = 5$

D $20 - 2 \times 3 = 14$

13 The graph below shows the conversion of pounds (£) to euros (€) one day last year.



Three of the following statements are true and **one** is false. Which one is **false**?

A £40 was equivalent to nearly €60.

B €40 was approximately equivalent to £27.

C One euro was worth approximately 68p.

D On another occasion I paid £70 for €100. The conversion graph for this exchange rate has a greater gradient than that drawn above.

14 In a certain town there are 40 factories producing consumer goods. The following table shows the numbers of employees in these factories.

Number of employees	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50
Frequency	2	7	12	13	6

Based on these figures, three of the following statements are true and **one** is false. Which one is **false**?

A An estimate of the mean number of employees is 29.

B The median number of employees lies in the class 31 – 40.

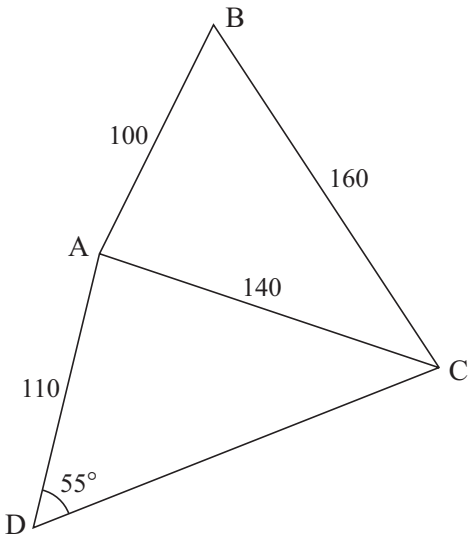
C The range could be as great as 49.

D If one of the factories is selected at random then the probability that 10 people or fewer are employed in it is 0.05.

[Turn over

15 A field is a quadrilateral ABCD, as shown in the diagram.

AB = 100 m, BC = 160 m, AC = 140 m, AD = 110 m and angle ADC = 55°.



Not to scale

Three of the following statements are true and **one** is false. Which one is **false**?

A The angle ACD = 40°, correct to the nearest degree.

B The length CD = 178 m, correct to the nearest metre.

C The angle ABC = 60°.

D The angle CAB = 82°, correct to the nearest degree.

16 Three of the following statements are true and **one** is false. Which one is **false**?

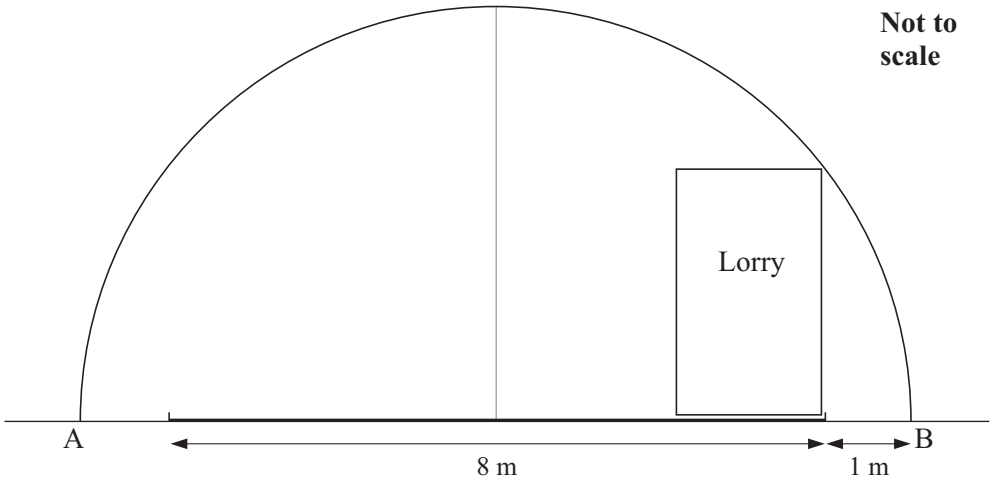
A $x^2 - 5x - 14 = (x - 7)(x + 2)$

B $x^2 - 25 = (x - 5)^2$

C $(3x - 4)(4x - 3) = 12x^2 - 25x + 12$

D $2x^2y + 4xy^2 = 2xy(x + 2y)$

17 A road tunnel has a semicircular cross-section, as shown in the diagram. The road surface is on the diameter AB of the semicircle which has length 10 metres. The road surface is symmetrically placed in the tunnel and of width 8 metres, leaving 1 metre on either side.



Which **one** of the following is the maximum height of a lorry that drives on the edge of the road?

A 2 m **B** 3 m **C** 4 m **D** 5 m

18 Michael and Madison are rearranging equations.

Michael has rearranged $v^2 = u^2 + 2as$ to give $a = \dfrac{(v-u)(v+u)}{2s}$.

Madison has rearranged $s = \frac{1}{2}(u+v)t$ to give $v = u + \dfrac{2s}{t}$.

Which **one** of the following statements is **true**?

A Both Michael and Madison are incorrect.

B Both Michael and Madison are correct.

C Michael is correct and Madison is incorrect.

D Michael is incorrect and Madison is correct.

19 Three vectors are given by $\mathbf{a} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$, $\mathbf{c} = \begin{pmatrix} 7 \\ 7 \end{pmatrix}$.

Two numbers, k and l, are such that $k\mathbf{a} + l\mathbf{b} = \mathbf{c}$.

Which **one** of the following pairs gives the **correct** values for k and l?

A $k = 1,\ \ l = 3$

B $k = 3,\ \ l = 2$

C $k = 7,\ \ l = 0$

D $k = 3,\ \ l = -2$

20 Jilly is carrying out a statistical investigation that involves recording the heights, h cm, of 30 students in her group. The heights, correct to the nearest centimetre, are as follows.

176	156	134	125	179	176	164	145	158	136
158	142	147	159	152	145	127	158	171	174
133	163	142	139	136	167	158	162	171	169

She asks four of her friends to summarise the data using the class intervals $125 \leqslant h < 135$, $135 \leqslant h < 145$, etc. The four results are shown below, but only one of them is correct.

Which **one** is the **correct** group table for these data?

A

$125 \leqslant h < 135$	$135 \leqslant h < 145$	$145 \leqslant h < 155$	$155 \leqslant h < 165$	$165 \leqslant h < 175$	$175 \leqslant h < 185$
4	6	3	9	5	3

B

$125 \leqslant h < 135$	$135 \leqslant h < 145$	$145 \leqslant h < 155$	$155 \leqslant h < 165$	$165 \leqslant h < 175$	$175 \leqslant h < 185$
3	6	3	9	6	3

C

$125 \leqslant h < 135$	$135 \leqslant h < 145$	$145 \leqslant h < 155$	$155 \leqslant h < 165$	$165 \leqslant h < 175$	$175 \leqslant h < 185$
4	5	4	9	5	3

D

$125 \leqslant h < 135$	$135 \leqslant h < 145$	$145 \leqslant h < 155$	$155 \leqslant h < 165$	$165 \leqslant h < 175$	$175 \leqslant h < 185$
3	7	4	8	5	3

21 Three of the following statements are true and **one** is false. Which one is **false**?

A $(3xy^2)^3 = 27x^3y^6$

B $(3xy^2) \times 3 = 27xy^2$

C $\dfrac{x^5 \times x^3}{x^4} = x^4$

D $2(x - 1) - 3(2 - x) = 5x - 8$

22 Three of the following statements are true and **one** is false. Which one is **false**?

A $2^3 \times 3^2 = 6^5$

B $3^8 \div 3^4 = 3^4$

C $2^9 \div 2^{-3} = 2^{12}$

D $\dfrac{2^5 \times 3^4}{6^2 \times 9} = 2^3$

23 Which **one** of the following is a **correct** simplification of $\dfrac{1 - x}{3} - \dfrac{2(x - 3)}{5}$?

A $\dfrac{4 - 3x}{2}$

B $\dfrac{23 - 11x}{15}$

C $\dfrac{x - 13}{15}$

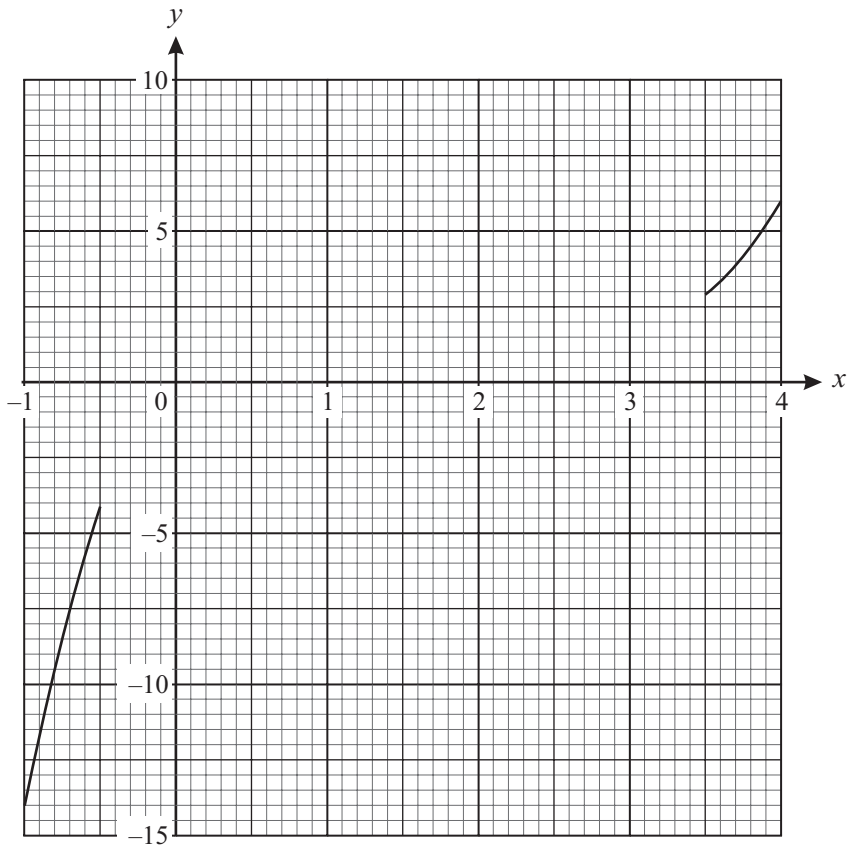
D $\dfrac{x + 23}{15}$

24 This question concerns the graph of the function $y = x^3 - 6x^2 + 9x + 2$.

The following table gives values of y for some integer values of x.

x	−1	0	1	2	3	4
x^3	−1	0		8		
$-6x^2$	−6	0		−24		
$9x$	−9	0		18		
2	2	2		2		
y	−14	2		4		

Part of the graph is shown on the grid below.



In order to complete this question you are advised to complete the table above and complete the graph on the grid using your values from the table.

Three of the following statements are true and **one** is false. Which one is **false**?

A The value of y when $x = 3$ is 2.

B Between $x = -1$ and $x = 3$ the maximum value of y occurs when $x = 1$.

C The gradient of the curve when $x = 2$ is approximately 3.

D The area between the x-axis, the lines $x = 0$, $x = 2$ and the curve is approximately 10 square units.

25 In this question, $a = 2$, $b = 3$, $c = -1$.

Three of the following statements are true and **one** is false. Which one is **false**?

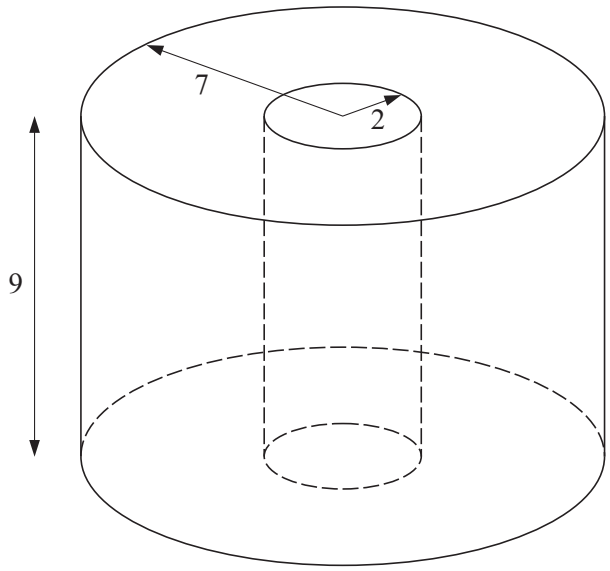
A $ab^2 = 18$

B $abc^3 = -6$

C $ab + bc + ca = 1$

D $\dfrac{a + 2b}{4 - 2c} = 4$

26 A piece of insulation fits round a pipe. It has the shape of a cylinder with a smaller cylinder cut out of it, as shown in the diagram. The cross-section consists of 2 circles with the same centre. The inside radius is 2 cm and the outside radius is 7 cm. The length is 9 cm.



Which **one** of the following is the **correct** volume of the piece of insulation, correct to 3 significant figures?

A $1270\,\text{cm}^3$

B $707\,\text{cm}^3$

C $6360\,\text{cm}^3$

D $1340\,\text{cm}^3$

[Turn over

27 John records the distance that he runs as 20 kilometres, correct to the nearest kilometre. He also notes that the run has taken him 100 minutes, correct to the nearest minute.

Which **one** of the following is the **correct** value for John's least possible average speed?

A $11.64\,\text{km}\,\text{h}^{-1}$, correct to 2 decimal places.

B $11.29\,\text{km}\,\text{h}^{-1}$, correct to 2 decimal places.

C $12.36\,\text{km}\,\text{h}^{-1}$, correct to 2 decimal places.

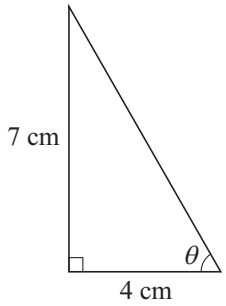
D $12\,\text{km}\,\text{h}^{-1}$ exactly.

28 Three of the following statements are true and **one** is false. Which one is **false**?

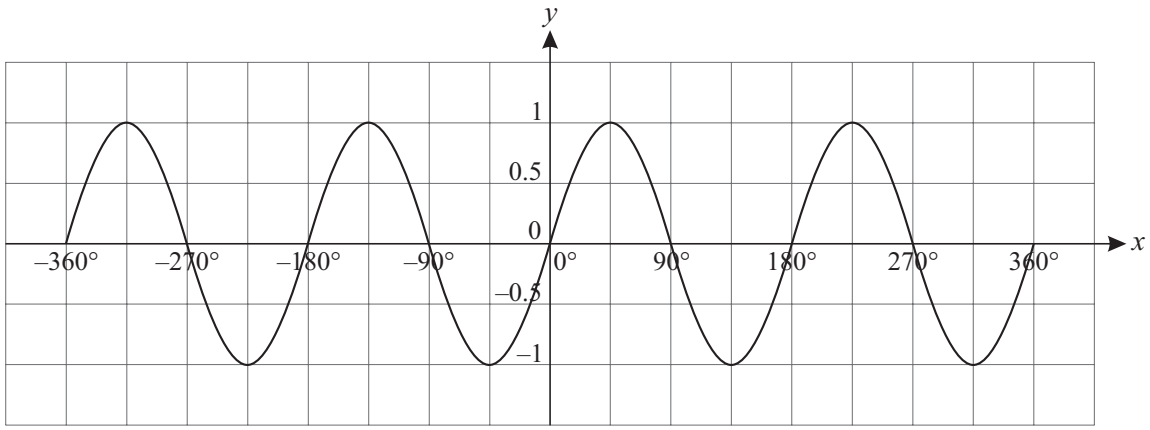
A A value of θ that satisfies $\sin\theta = 0.6$ is $\theta = 143°$, correct to the nearest degree.

B $\cos 170° = \cos 190°$

C In this triangle, $\theta = 60°$, correct to the nearest degree.

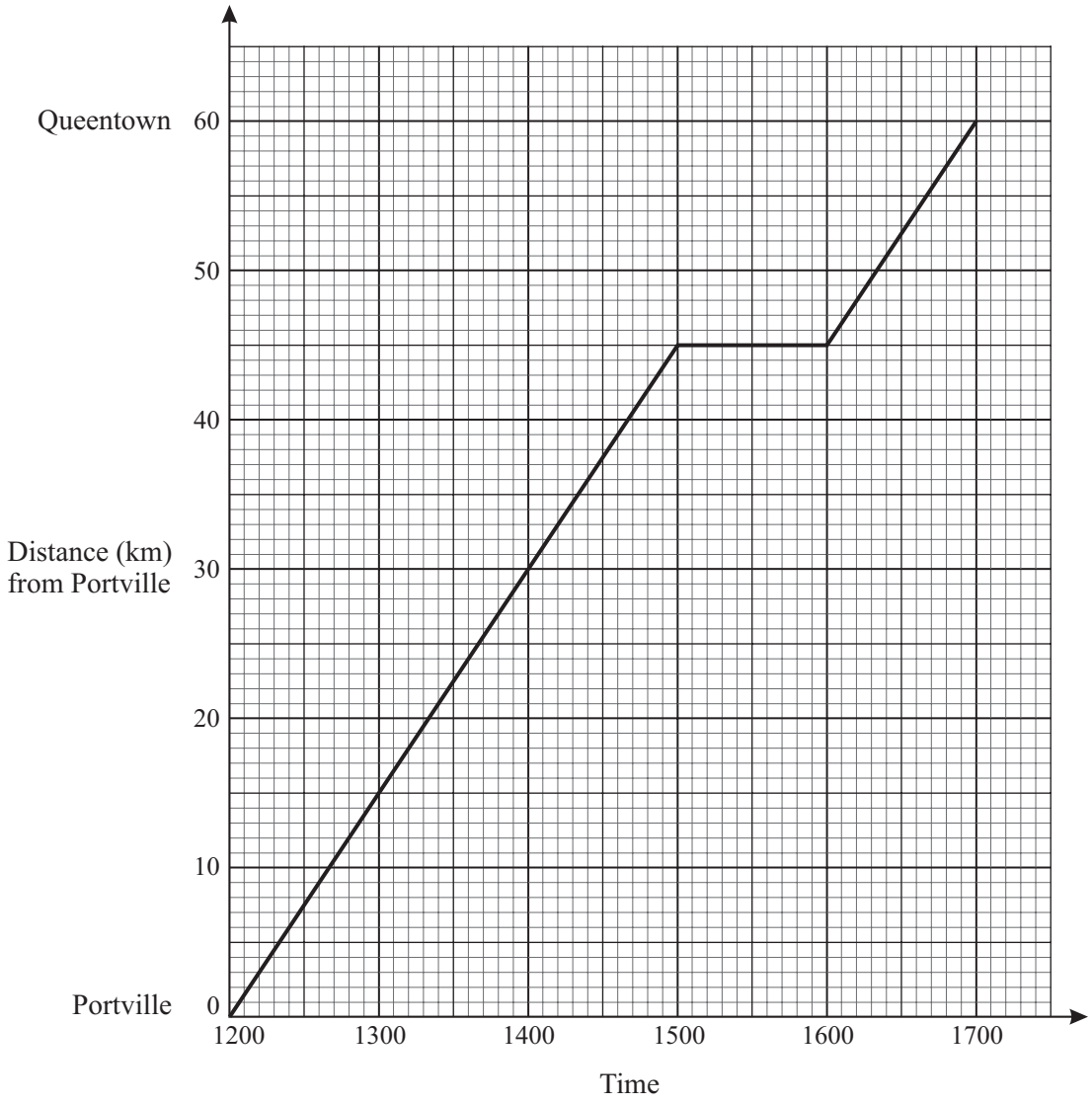


D This graph is part of the curve $y = \sin x$.



29 Andy set off at 1200 one day on a bicycle from Portville to Queentown, a distance of 60 kilometres. While riding he travelled at a speed of 15 kilometres per hour, but stopped for an hour on the way. The distance-time graph below shows this journey.

At 1500, Bob set off from Queentown to Portville, riding at a speed of 20 kilometres per hour.



To answer this question you are advised to draw a line on the graph to represent Bob's journey.

Which **one** of the following statements is **true**?

A Andy and Bob pass each other at 1345.

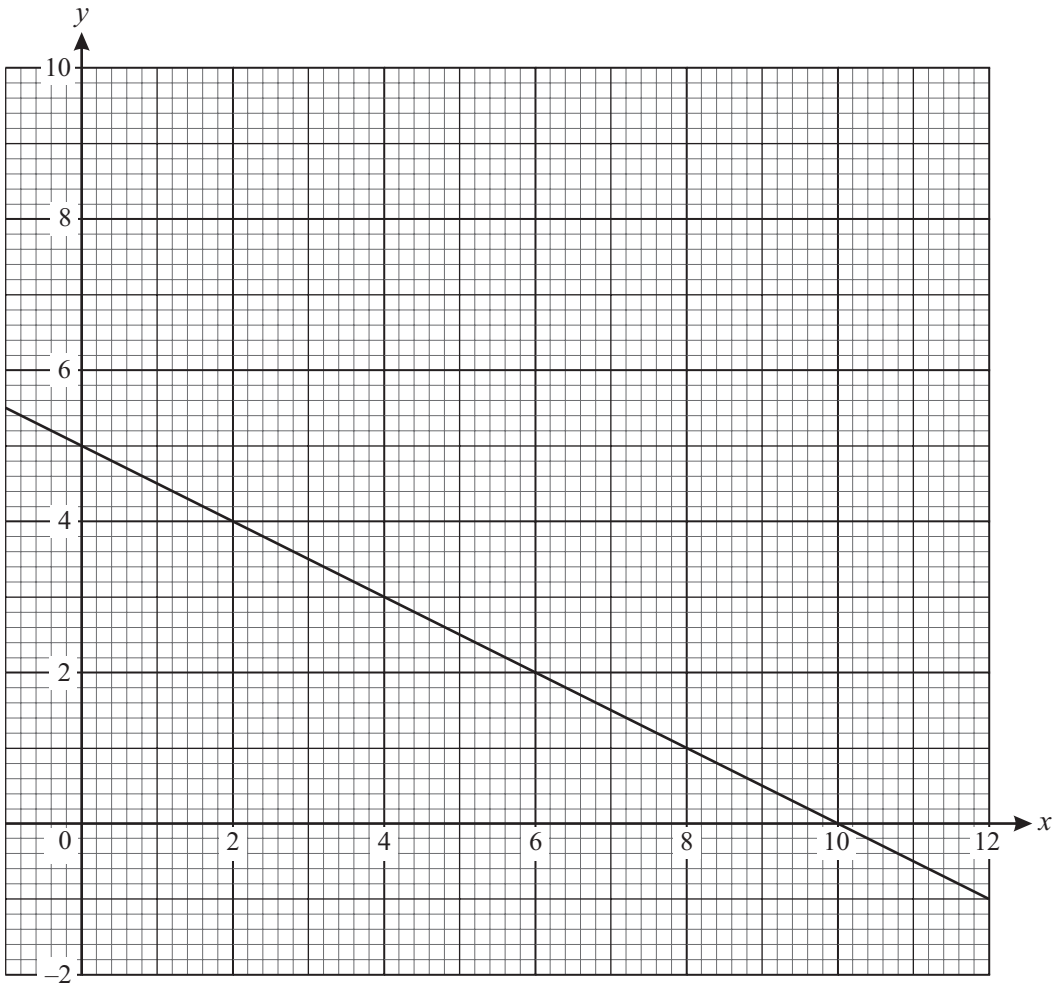
B Andy and Bob pass each other at 1445.

C Andy and Bob pass each other at 1545.

D Andy and Bob do not pass each other.

[Turn over

30 The graph of a line is shown below.



Draw the graph of the line $y = 3x - 2$ on the same axes.

Which **one** of the following is the point of intersection of these two lines?

A (2, 4)

B (4, 3)

C (6, 2)

D (3, 7)

31 Which **one** of the following gives the solution, correct to 1 decimal place, of the equation $x^2 + 3x = 1$?

A $x = 0.3$ or $x = -3.3$

B $x = -0.3$ or $x = 3.3$

C $x = -0.4$ or $x = 2.6$

D $x = 0.4$ or $x = -2.6$

32 When a pot of paint is half full it weighs 4 kg. When it is one quarter full it weighs 3 kg.

Which **one** of the following is the **correct** weight of the pot of paint when full?

A 4 kg **B** 6 kg **C** 8 kg **D** 12 kg

33 Emma is attempting to solve this pair of simultaneous equations.

$$3x + 2y = 9 \quad \text{(i)}$$
$$4x - y = 1 \quad \text{(ii)}$$

Her working is shown in the four steps below, but her final answer is incorrect.

In **which** of the following steps **A**, **B**, **C** or **D** does her **first** error occur?

A Multiply (ii) by 2: $8x - 2y = 2$ (iii)

B Add (iii) and (i): $11x = 11$ (iv)

C Divide both sides of (iv) by 11: $x = 1$

D Substitute this value of x into (ii): $4 - y = 1$ gives $y = 5$

34 In the four statements below, n stands for an integer.

Three of the following statements are true and **one** is false. Which one is **false**?

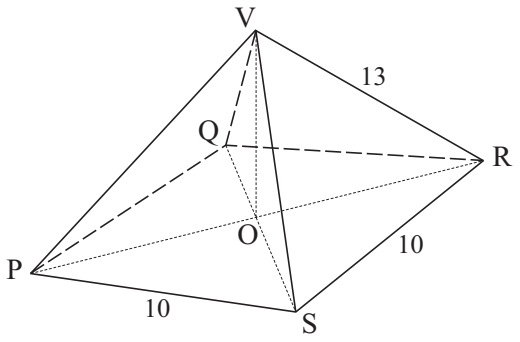
A $n - 2 > 3$ for the integers 6, 7, 8, ...

B 0, 1, 2 and 3 are the only integers for which $n^2 \leqslant 9$.

C $3 - 2n > 1$ for the integers 0, −1, −2, ...

D $2 < n + 6 < 10$ can be rewritten as $-4 < n < 4$.

35 The diagram shows a pyramid with a square base. The vertex, V, is directly above the centre, O, of the base, PQRS.
The length of each side of the base is 10 cm and the length of each sloping edge is 13 cm.



Which **one** of the following is the **correct** value for the height of the pyramid?

A $\sqrt{119}$ cm

B $\sqrt{69}$ cm

C $\sqrt{219}$ cm

D $\sqrt{269}$ cm

36 In a group of students, twenty are male and thirty are female.
Three tenths of the students are aged 20 years or less and one fifth are over 40 years old.

Three of the following statements are true and **one** is false. Which one is **false**?

A The ratio, the number of males : the number of females = 2 : 3.

B 35 students are aged over 20.

C The number of males in the group is $0.4 \times$ (the total number in the group).

D 60% of the students are aged over 20 but not over 40.

37 Three of the following statements are true and **one** is false. Which one is **false**?

A $x = 3$ is the solution of the equation $2(x + 1) = 8$.

B $x = -4$ is the solution of the equation $3x - 12 = 0$.

C $x = -3$ is one of the roots of the equation $x^2 - 9 = 0$.

D The two roots of the equation $x^2 = 8x$ are $x = 0$ and $x = 8$.

38 Abdul and Raj have taken a sample of 30 students from the 600 students in their college in order to carry out a survey on the quality of catering in the college.

Abdul takes the college list, which numbers the students from 1 to 600. He uses his calculator to generate a sample of 30 random numbers in the range 1 to 600. His sample consists of the students with these numbers.

Raj stands at the entrance to the college refectory and takes the first 30 students who enter one lunch time.

Shainez makes two statements about their methods of sampling.

P: Abdul's sample is random.

Q: Raj's sample may be biased.

Which **one** of the following statements is **true**?

A P and Q are both correct.

B P and Q are both incorrect.

C P is correct but Q is incorrect.

D Q is correct but P is incorrect.

[Turn over

39 A pilot flies an aeroplane with a steady airspeed of $500\,\text{km}\,\text{h}^{-1}$. The aeroplane is flying on a bearing of 090° but is experiencing a wind blowing from the North-East of $150\,\text{km}\,\text{h}^{-1}$.

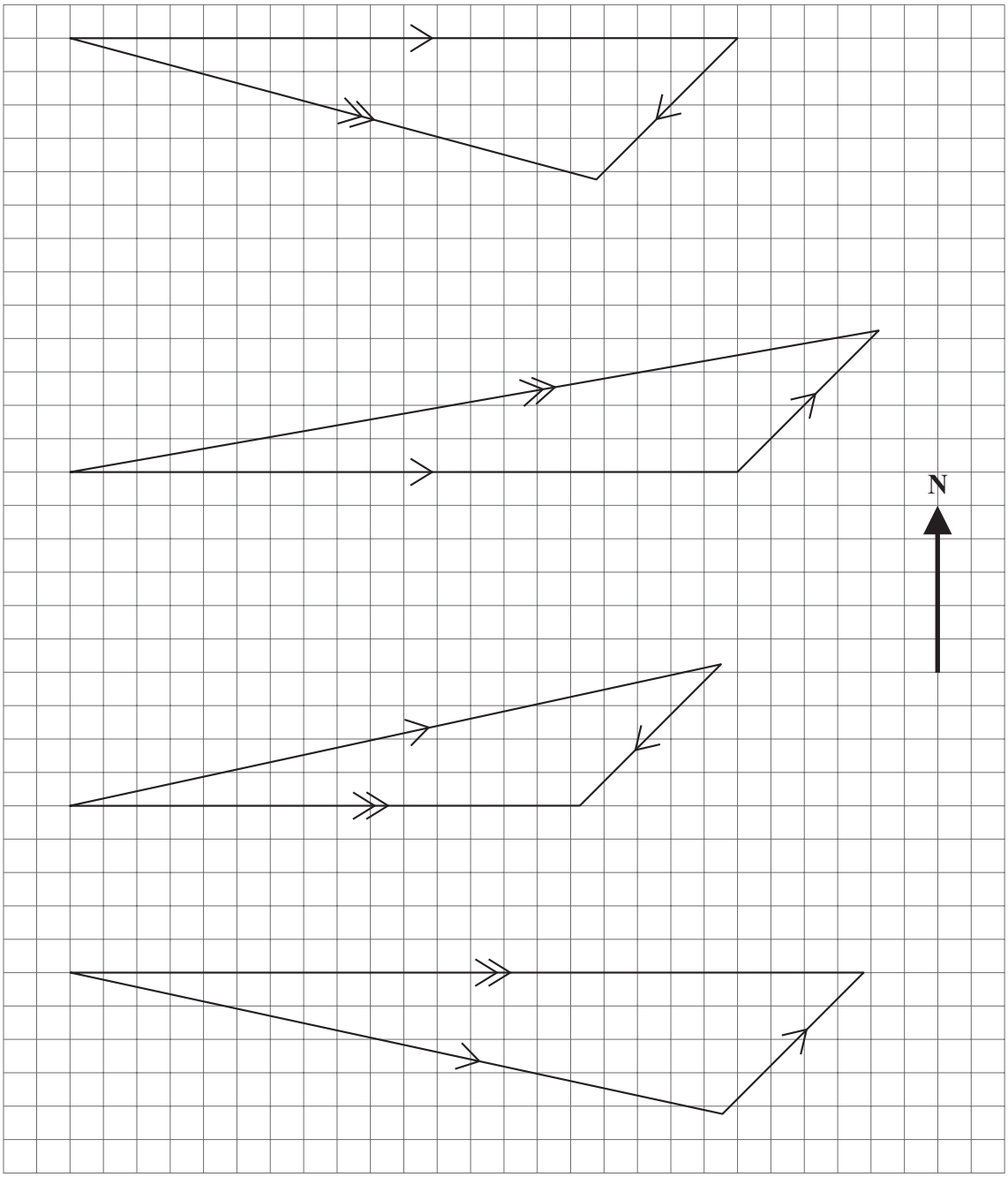
Which **one** of **A**, **B**, **C** or **D** shows the actual speed and direction of the aeroplane if 1 cm represents $50\,\text{km}\,\text{h}^{-1}$?

A

B

C

D



40 Freda has a bag containing coloured balls. 6 are red, 5 are green and 9 are blue. She picks two balls at random.

Three of the following statements are true and **one** is false. Which one is **false**?

A The probability that the first ball is red is 0.3.

B If the first ball is replaced before the second ball is drawn then the probability that both balls are red is 0.6.

C If the first ball is not replaced before the second ball is drawn then the probability that both balls are red is $\frac{3}{38}$.

D If the first ball is replaced before the second ball is drawn then the probability that one ball is green and the other is blue is 0.225.

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OCR
RECOGNISING ACHIEVEMENT

FSMQ

Foundations of Advanced Mathematics (MEI)

INTERMEDIATE FSMQ **6989**

Mark Scheme and Report on the Unit

June 2008

6989/MS/R/08

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Foundations of Advanced Mathematics FSMQ (6989)

MARK SCHEME AND REPORT ON THE UNIT

Foundations of Advanced Mathematics – 6989

Report, June, 2008

There were 1300 entries for this session, a significant increase from previous years. The mean mark was 22.3. The minimum mark scored by 3 candidates was 6 and the maximum mark was 39, scored by 6 candidates.
There were 16 questions for which at least one candidate offered no answer but these were scattered throughout the paper so this did not provide any evidence that candidates found the paper too long.

Unusually, in Q3 (Electrician's charges) no candidate offered response A as an answer. In all other questions each of the distracting answers was selected by at least one candidate.

In 5 questions the wrong response was selected by more candidates than the right response, and in 11 others fewer than 50% chose the correct response.

Q22 (Indices) Only 39% of the candidature thought that $2^3 \times 3^2 = 6^5$ was false, while 43% clearly found $\frac{2^5 \times 3^4}{6^2 \times 9}$ hard to calculate and decided that it was not 2^3.

Q27 (maximum and minimum values) Only 23% gave the correct response here, with 25% and 32% giving incorrect values. The idea of the least value of a fraction requiring the least numerator and greatest denominator is a concept that many have not grasped.

Q29 (Distance - time graph) This question required candidates to draw the line representing a journey on top of one already drawn to see where they intersected. The question stated explicitly that Bob left Queentown for Portville before Andy, riding from Portville to Queentown, had arrived, yet 43% of candidates thought that they did not pass each other. Although we do not have their graphs (which were drawn on the question paper which is not handed in) one must presume that the majority of these misread the question and thought that the two were travelling in the same direction.

Q34 (Solution sets to inequalities) Equal numbers chose the right answer and one of the wrong ones, but even more (37%) chose the response $2 < n + 6 < 10 \Rightarrow -4 < n < 4$ as false.

Q40 (Probability) The non-replacement probability was chosen to be false by marginally more candidates than those choosing the correct response.

As in previous sessions I offer a summary of questions and topics with the approximate percentage of candidates giving the correct responses. I noted in my January report that the questions on trigonometry had not been answered well. The situation is no better this session!

Question		Topic
91 – 100%	10	Statistics - pie chart
81 – 90%	1	Arithmetic
	5	Algebra
	12	Arithmetic - order of operations
71 - 80%	2	Arithmetic - decimal places and significant figures
	3	Arithmetic - electrician's charges
	6	Arithmetic
	8	Algebra - linear sequence
	13	Graphs - conversion graph
	25	Algebra - substitution of numbers into expressions
61 - 70%	4	Arithmetic - standard form
	11	Statistics - interpretation of bar chart
	19	Vectors
	20	Statistics - formation of frequency table
	30	Graphs - intersection of two lines, one of which had to be drawn
	37	Algebra - solution of equations
51 - 60%	14	Statistics - average and spread of grouped data
	16	Algebra - identities
	21	Algebra - powers
	26	Arithmetic - mensuration
	31	Algebra - solution of quadratic equations
	33	Algebra - solution of linear simultaneous equations
	36	Arithmetic - ratios
	38	Statistics - sampling
41 - 50%	7	Arithmetic - rounding of numbers
	9	Arithmetic - conversion of units
	17	Arithmetic - Pythagoras in a circle
	18	Algebra - rearranging formulae
	24	Graphs - completion of a cubic curve
	29	Graphs - time distance graph
	32	Algebra
31 - 40%	15	Trigonometry - sin and cosine rules
	22	Arithmetic - indices
	23	Algebra - simplification of an expression
	35	Trigonometry - Pythagoras in 3-D diagram
	39	Vectors
	40	Probability
21 - 30%	27	Arithmetic - maximum and minimum values
	28	Trigonometry - trig ratios of angles greater than 90^0
	34	Algebra - solutions of inequalities

Answers

1	D	21	B
2	C	22	A
3	D	23	B
4	D	24	C
5	A	25	D
6	C	26	A
7	D	27	A
8	C	28	D
9	D	29	C
10	A	30	A
11	B	31	A
12	A	32	B
13	D	33	D
14	B	34	B
15	B	35	A
16	B	36	D
17	B	37	B
18	C	38	A
19	B	39	A
20	C	40	B

Grade Thresholds

Unit Threshold Marks
June 2008

Unit	Maximum Mark	A	B	C	D	E	U
6989	40	32	28	24	20	16	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
6989	8.8	21.1	42.1	65.1	85.5	100	1273

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