

**FREE-STANDING MATHEMATICS QUALIFICATION**  
**Intermediate Level**  
**Foundations of Advanced Mathematics**

**6989/01**

**FRIDAY 15 JUNE 2007**

Morning  
Time: 2 hours

Additional materials:

Answer paper (MS4)

Rough paper

To be brought by candidate:

Eraser

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.

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

- A The lowest common multiple (LCM) of 20 and 60 is 120.
- B 7 is a factor of 35.
- C The reciprocal of 5 is 0.2.
- D 113 is a prime number.

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

- A  $(-7) - (-4) = (-3)$
- B  $(-7) \times (-4) = (-28)$
- C  $16 - 3 \times 5 = 1$
- D  $(-4)^2 = 16$

3 You are given that  $a = 2\frac{2}{3}$  and  $b = \frac{1}{4}$ .

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

- A  $a + b = 2\frac{11}{12}$
- B  $a - b = 2\frac{5}{12}$
- C  $a \times b = \frac{2}{3}$
- D  $a \div b = \frac{3}{2}$

4 Which **one** of the following is the **correct** simplification of  $2(x + 3) - 3(5 - 2x)$ ?

- A  $-4x - 9$
- B  $8x - 9$
- C  $8x - 12$
- D  $4x - 12$

- 5 The approximate distance of the moon from the earth is 250 000 miles.

The approximate distance of the sun from the earth is  $9.3 \times 10^7$  miles.

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

- A Expressed in standard form to 2 significant figures, the approximate distance of the moon from the earth is  $2.5 \times 10^4$  miles.
- B The approximate distance of the sun from the earth is 93 000 000 miles.
- C  $\frac{\text{Distance of the moon from the earth}}{\text{Distance of the sun from the earth}} \approx \frac{1}{370}$
- D  $9.3 \times 10^7 + 250\,000 = 9.325 \times 10^7$

- 6 John is using the formula  $t = \frac{2s}{u + v}$ .

He is given the values  $s = 59.6$ ,  $u = 2.3$  and  $v = 7.7$ . He does not know the accuracy of these values.

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

- A If the values are exact,  $t = 11.92$ .
- B If the values have been rounded to 1 decimal place, the smallest possible value of  $t$  is 12.0, correct to 1 decimal place.
- C If John rounds the values to the nearest integer, then his value for  $t$  is 12.
- D A rearrangement of the formula is  $v = \frac{2s - ut}{t}$ .

- 7 An excuse that parents have given for taking their children out of school during term-time is that air fares to holiday destinations are cheaper during term-time.

The table below gives some fares that airlines charged last year to fly from London in March (during term) and in April (during the holidays).

Destination	Fare in March	Fare in April
Paris	£242	£244
Malaga	£475	£588
Cyprus	£531	£868
New York	£699	£1293
Miami	£1068	£1834

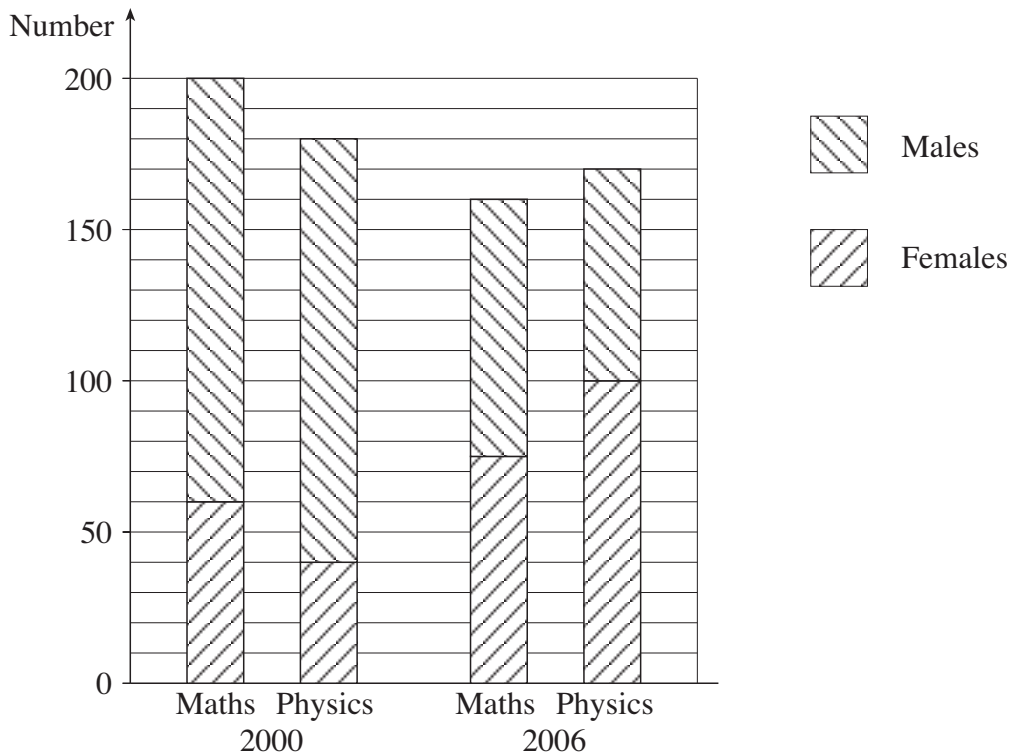
Three of the following statements are true and **one** is false. Which one is **false**?

- A The greatest increase in fare was for the flight to Miami.
- B The greatest percentage increase in fare was for the flight to New York.
- C If the fare for the March flight to Malaga had been increased by 28% then the April fare would have been £608.
- D In April the fare for a flight to Jersey was £200 and this was an increase of 10%. The fare in March was therefore £180.

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

- A The solution of the equation  $2(x - 2) = 5 - x$  is  $x = 3$ .
- B The solution of the equation  $\frac{x+1}{3} - \frac{x}{4} = 1$  is  $x = 8$ .
- C  $x = 5$  is a root of the equation  $x^2 - 25 = 0$ .
- D The solution of the equation  $x^2 + 5x + 4 = 0$  is  $x = 1$  or  $x = 4$ .

- 9 The following chart shows the numbers of males and females entering A level Mathematics and Physics in 2000 and 2006 in a large college.



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

- A The greatest percentage of male entries illustrated in the 4 bars was in Physics in 2000.
- B There was a loss of 40 candidates from Mathematics between 2000 and 2006.
- C There was an increase of 60 female candidates taking Physics between 2000 and 2006.
- D There was a 15% increase of female candidates in Mathematics between 2000 and 2006.

- 10 Use the following conversions in this question.

$$1 \text{ kilometre} = 0.6214 \text{ miles}$$

$$1 \text{ gallon} = 4.546 \text{ litres}$$

$$1 \text{ kilogram} = 2.205 \text{ pounds}$$

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

- A 55 litres < 12 gallons
- B 9 kilograms < 20 pounds
- C 10 kilometres > 6 miles
- D 7 miles < 11.5 kilometres
- 11 It was reported that the number of visitors at a tourist attraction last May had increased from April. The approximate numbers visiting in each of the months are shown in the pictogram below. (The key is missing.)



April



May

The number of visitors in April was 10 000.

Which **one** of the following is an approximate estimate of the number of visitors in May?

- A 11 000                      B 13 000                      C 15 000                      D 17 000
- 12 Two fair six-sided dice are thrown and the numbers on the top of each die are added together.
- Which **one** of the following is the **correct** probability that the total score is 11?

- A  $\frac{1}{11}$                       B  $\frac{1}{18}$                       C  $\frac{11}{36}$                       D  $\frac{1}{36}$

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

- A  $2^6 = 8^2$
- B  $3^6 \times 3^4 = 3^{10}$
- C  $2^3 \times 3^2 = 6^5$
- D  $\sqrt[5]{40} \approx 2.1$

14 Guus is estimating the number of passengers that travel on the last train each week-day evening in a year. He records the number of people travelling on the train on 5 days of one week as follows.

24      32      19      19      84

Which **one** of the following is the **most** appropriate estimate for the total number of passengers in a year of 260 weekdays?

- A 5000
- B 6000
- C 9000
- D 46 000

15 Abdul takes part in a “triathlon” which involves a swim, a cycle and a run.

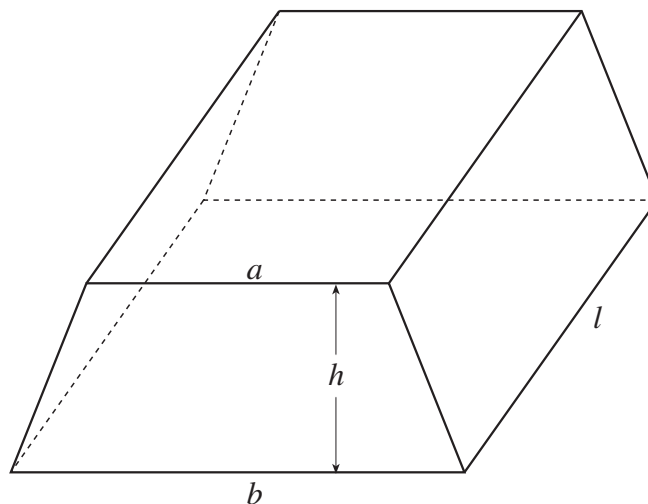
- The swim is 1.5 kilometres. He completes it at a constant speed of 50 metres per minute.
- The cycle is  $c$  kilometres. He completes it in 80 minutes.
- The run is 10 kilometres. He completes it in  $r$  minutes.

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

- A He takes 30 minutes to complete the swim.
- B His average speed for the cycle is  $0.75c \text{ km h}^{-1}$ .
- C His average speed for the run is  $\frac{1}{6r} \text{ km h}^{-1}$ .
- D His average speed for the triathlon is  $\frac{60(11.5 + c)}{110 + r} \text{ km h}^{-1}$ .

- 16 The diagram shows a prism of length  $l$  and volume  $V$ . The cross-section is a trapezium with parallel sides  $a$  and  $b$  and height  $h$ .

The area of the trapezium is given by  $A = \frac{1}{2}(a + b)h$ .



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

A  $V = Al$

B  $b = \frac{2A}{h} - a$

C  $h = \frac{A}{2(a + b)}$

D  $V = \frac{hl(a + b)}{2}$

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

A All of the prime factors of 2007 are less than 200.

B  $2007 = [(4^2 - 1)^2 - 2] \times 3^2$

C  $2007 = 13^3 - (1^3 + 4^3 + 5^3)$

D The area of a square of side 44.8 cm differs from  $2007 \text{ cm}^2$  by less than  $0.05 \text{ cm}^2$ .



- 18 Josh investigates the time that members of a group of 80 students spent on their mathematics homework last night. He takes a sample by putting all their names into a hat and drawing out 10 names.

He then asks these 10 people how long they spent on their mathematics homework. Their responses, in minutes, are as follows.

10    18    20    25    25    25    26    30    35    40

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

- A The sample is a simple random sample.
  - B The mean of these times is 25.4 minutes.
  - C The median of these times is 25.5 minutes.
  - D The range of these times is 30 minutes.
- 19 Paul is attempting to solve a pair of simultaneous equations. His working is shown in the four steps shown below, but the final answer is incorrect.

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

$$\begin{array}{ll} \text{Equations: } 2x + 3y = 14 & \text{(i)} \\ 5x - 4y = 7 & \text{(ii)} \end{array}$$

- A Multiply (i) by 4 and (ii) by 3:

$$\begin{array}{ll} 8x + 12y = 42 & \text{(iii)} \\ 15x - 12y = 21 & \text{(iv)} \end{array}$$

- B Subtract (iv) from (iii):

$$7x = 21 \quad \text{(v)}$$

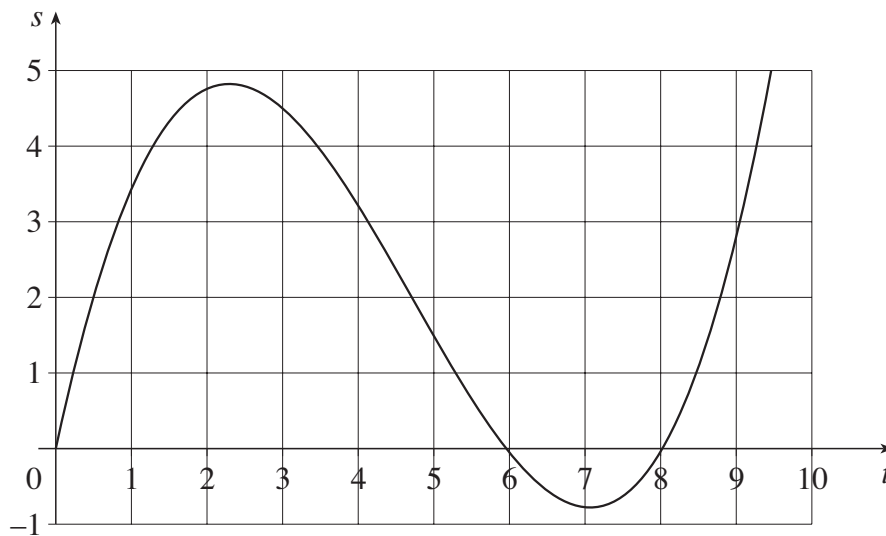
- C Divide both sides of (v) by  $-7$ :

$$x = -3$$

- D Substitute this value of  $x$  into (i) to give the answer for  $y$ .

$$-6 + 3y = 14 \text{ gives } y = \frac{20}{3}.$$

- 20 A particle moves along a straight line. The graph shows the displacement,  $s$  metres, of the particle from the starting point, O, after  $t$  seconds.



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

- A The displacement when  $t = 4$  is approximately 3 metres.
  - B The particle is stationary when  $t = 6$ .
  - C The velocity of the particle when  $t = 1$  is approximately 2.5 metres per second.
  - D The least value of  $s$  is approximately  $-0.7$  m.
- 21 A climbing rope which has diameter 9 mm has a mass of 2.7 kg.
- A second climbing rope, made of the same material, has the same length but diameter 11 mm.
- Which **one** of the following is the approximate mass of the second rope?
- A 2.9 kg
  - B 3.3 kg
  - C 4.0 kg
  - D 4.9 kg

- 22 Below are listed the areas, in square miles, of the five major oceans of the world.

Ocean	Area (square miles)
Pacific	$7.0 \times 10^7$
Atlantic	$4.0 \times 10^7$
Indian	$2.75 \times 10^7$
Antarctic	$7.5 \times 10^6$
Arctic	$5.0 \times 10^6$
<b>Total</b>	$1.5 \times 10^8$

A pie chart is drawn to represent these data.

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

- A The sector representing the Pacific ocean has an angle of  $168^\circ$ .
- B The sector representing the Arctic ocean has an angle of  $120^\circ$ .
- C The sector representing the Atlantic ocean has an angle of  $96^\circ$ .
- D The angle for the Indian ocean is greater than the sum of the angles for the Arctic and Antarctic oceans.

- 23 It was reported on a web-site that 150 million text messages were sent from phones in the UK on New Year's Day, 2005 and that this represented a "huge increase" on the 111 million text messages sent on January 1, 2004.

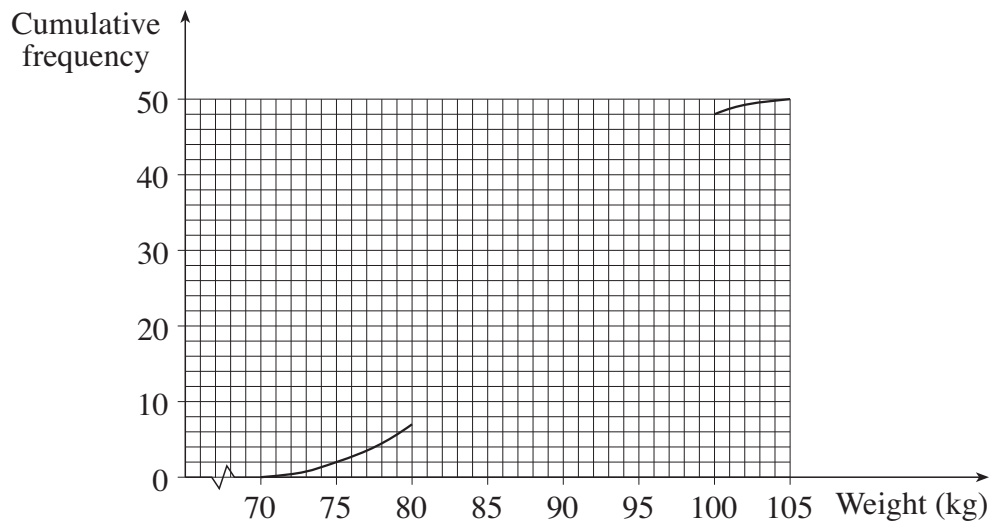
Three of the following statements are true and **one** is false. Which one is **false**?

- A The increase from 111 million to 150 million is an increase of about 26%.
- B 150 million messages in a day represents an average of over 1730 per second.
- C If there were 150 million messages sent every day in 2005 then the total number of messages would have exceeded  $5 \times 10^{10}$ .
- D Given that the number of text messages on New Year's Day, 2005 is given to 3 significant figure accuracy only, the difference in the greatest possible number and the least possible number per second is a little over 11.

- 24 At a slimming class one day, the distribution of weights of 50 people is summarised below. The cumulative frequency column is incomplete.

Weight, $w$ kg	Frequency	Cumulative frequency
$70 \leq w < 75$	2	2
$75 \leq w < 80$	5	7
$80 \leq w < 85$	8	
$85 \leq w < 90$	14	
$90 \leq w < 95$	13	
$95 \leq w < 100$	6	48
$100 \leq w < 105$	2	50

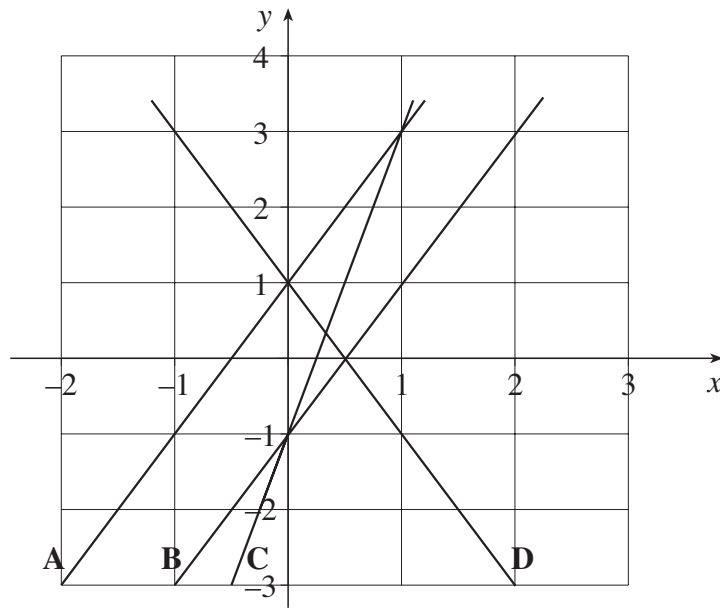
The cumulative frequency graph shown below is also incomplete.



*In order to select your answer to this question you are advised to complete the cumulative frequency table and graph on this page first.*

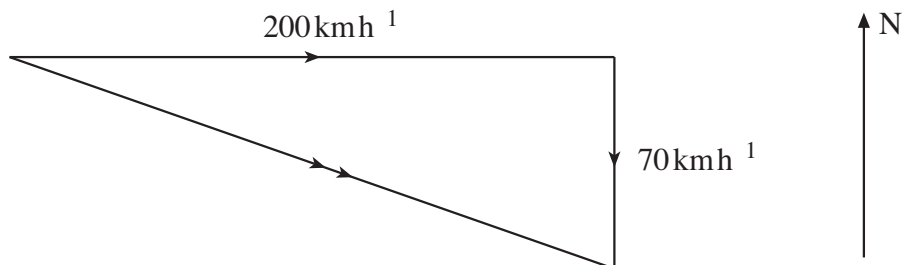
Three of the following statements are true and **one** is false. Which one is **false**?

- A The number 29 appears in the completed cumulative frequency column of the table.
- B The median is a little under 89 kg.
- C The interquartile range is between 8 kg and 10 kg.
- D Approximately 80% weigh more than 94 kg.



Which **one** of the lines **A**, **B**, **C** or **D** represents  $y = 2x + 1$ ?

- 26** Rhys flies a small aircraft at a constant speed of  $200 \text{ km h}^{-1}$ . He flies on a bearing of due East, but there is a constant wind of speed  $70 \text{ km h}^{-1}$  from the North.



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

- A** The speed over the ground of the aircraft is increased due to the effect of the wind.
- B** Rhys takes between 1 hour 27 minutes and 1 hour 28 minutes to fly 310 km.
- C** The aircraft actually travels on a bearing of  $109^\circ$ , correct to the nearest degree.
- D** In order to actually fly due East, Rhys must fly his aircraft on a bearing of  $071^\circ$ , correct to the nearest degree.

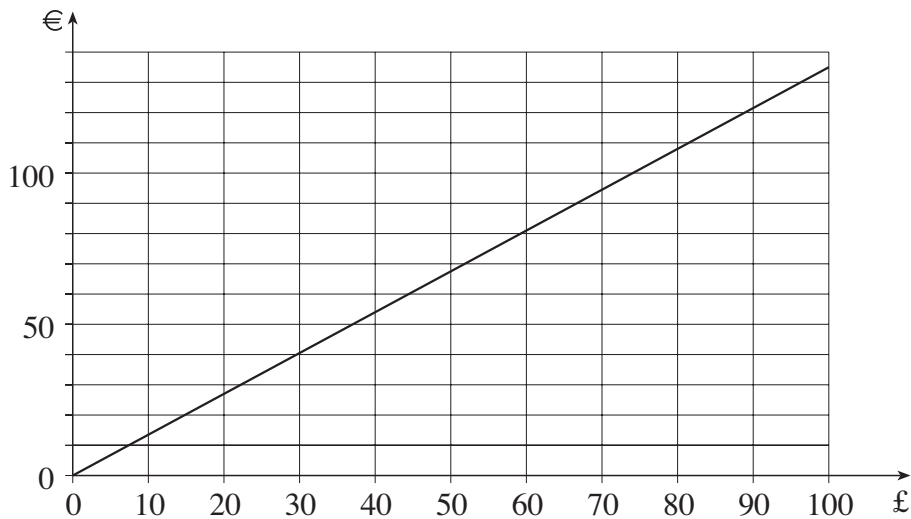
- 27 The vectors  $\mathbf{a}$  and  $\mathbf{b}$  are given by  $\mathbf{a} = \mathbf{i} + 2\mathbf{j}$  and  $\mathbf{b} = 3\mathbf{i} - \mathbf{j}$ .

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

- A  $2\mathbf{a} + 3\mathbf{b} = 11\mathbf{i} + \mathbf{j}$
- B  $3\mathbf{a} - \mathbf{b} = 7\mathbf{j}$
- C  $4\mathbf{a} - \mathbf{b}$  is parallel to  $\mathbf{i} + \mathbf{j}$ .
- D  $\mathbf{a} + 2\mathbf{b}$  is in the  $\mathbf{i}$  direction.

- 28 One day the exchange rate from euros to pounds sterling is €1.35 to £1.

The graph below represents the conversion between pounds and euros at this rate.



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

- A The exchange rate is 74p to €1, correct to the nearest 1p.
- B €50 is equivalent to just over £37.
- C £50 is equivalent to €67.50.
- D On another day I paid £30 for €42. The conversion graph for this exchange rate would be less steep than that drawn above.

29 Which **one** of the following is the **correct** solution of the inequality  $3(x - 5) > 2 - x$ ?

A  $x > 8\frac{1}{2}$

B  $x > 4\frac{1}{4}$

C  $x > 3\frac{1}{2}$

D  $x > 1\frac{3}{4}$

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

A  $x^2 - 9 = (x - 3)(x + 3)$

B  $x^2 - 9x + 20 = (x - 4)(x + 5)$

C  $(2x - 3)(x + 3) = 2x^2 + 3x - 9$

D  $x(x + 3) - x(x - 3) = 6x$

31 The cooking instructions for a turkey are as follows.

**Cook for  $\frac{1}{2}$  an hour per kilogram plus 20 minutes**

$T$  is the cooking time in minutes.

$m$  is the mass of the turkey in kilograms.

Which **one** of the following is the **correct** formula for  $T$ ?

A  $T = 30m + 20$

B  $T = 30(m + 20)$

C  $T = \frac{(m + 20)}{2}$

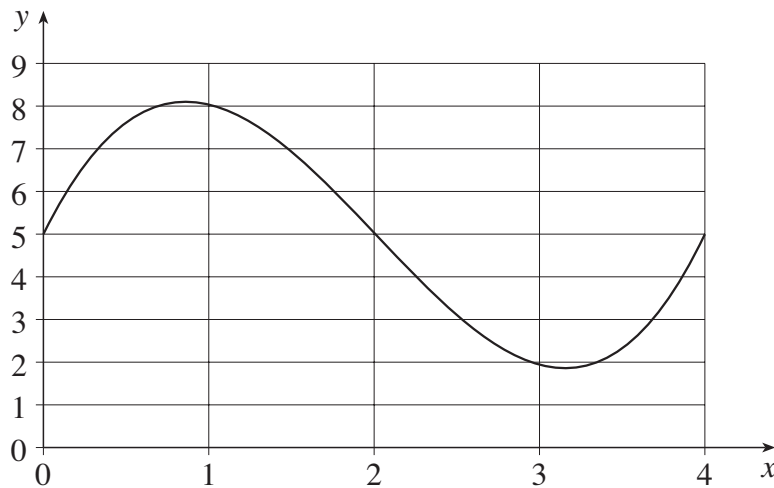
D  $T = \frac{1}{2}m + 20$

- 32 You are given that  $x = 3$ ,  $y = 7$  and  $z = -2$ .

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

- A  $y - z = x^2$
- B  $x = y + 2z$
- C  $x + y + 5z = 0$
- D  $y^2 - x^2 = 20z$

- 33 The diagram shows part of the curve  $y = x^3 - 6x^2 + 8x + 5$ .



Which **one** of the following is the **best** estimate for the area enclosed by the curve, the  $x$ -axis and the lines  $x = 0$  and  $x = 4$ ?

- A 10
- B 20
- C 30
- D 40



- 34 The formula for converting degrees Celsius to degrees Fahrenheit is

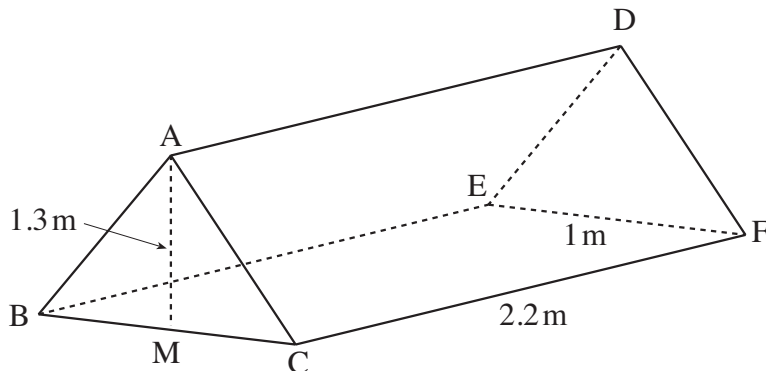
$$F = \frac{9}{5}C + 32.$$

Three of the following methods for calculating  $F$  are correct and **one** is wrong. Which one is **wrong**?

- A Multiply  $C$  by 9, divide by 5 and add 32.
  - B Multiply  $C$  by 1.8 and add 32.
  - C Multiply  $C$  by 9, then add 160 and divide the result by 5.
  - D Add 32 to  $C$  and then multiply the result by 1.8.
- 35 The diagram shows a tent which has the shape of a prism. The two vertical ends, ABC and DEF, are isosceles triangles with equal sides AB, AC, DE and DF.

The base CBEF is a rectangle.  $BC = EF = 1$  metre and  $CF = BE = AD = 2.2$  metres.

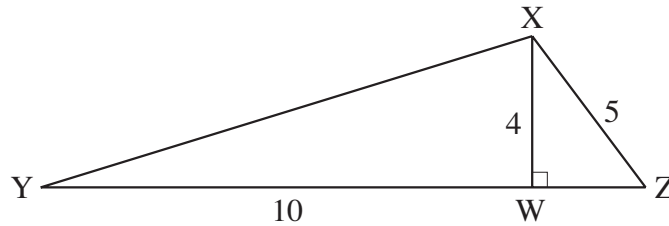
M is the mid-point of the side BC and the height of the tent, AM, is 1.3 metres.



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

- A The angle ABC is  $69^\circ$ , correct to the nearest degree.
- B The length of DM is 2.56 m, correct to 2 decimal places.
- C The ground area of the tent is  $4.84 \text{ m}^2$ .
- D The volume of the tent is  $1.43 \text{ m}^3$ .

- 36 In the triangle XYZ shown, W is the foot of the perpendicular from X to YZ.  $XW = 4$  cm, and  $WY = 10$  cm.

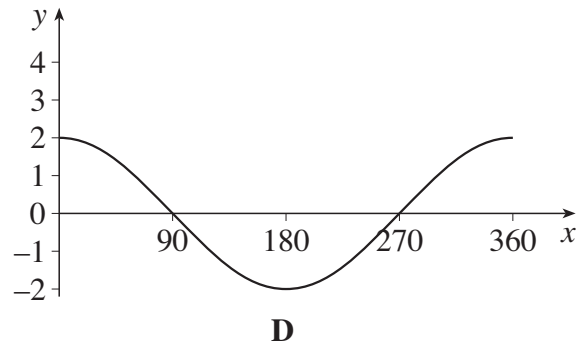
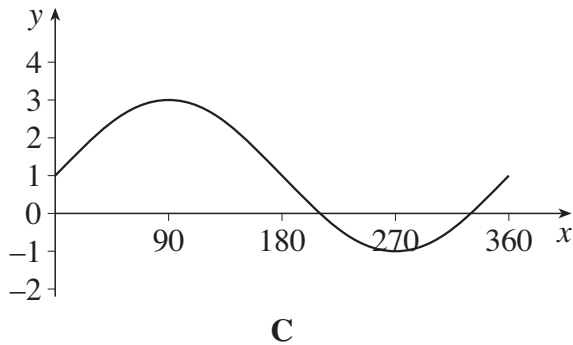
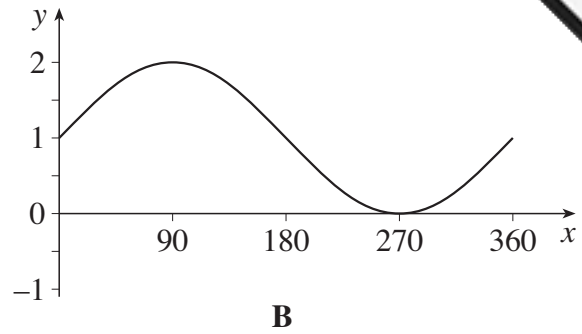
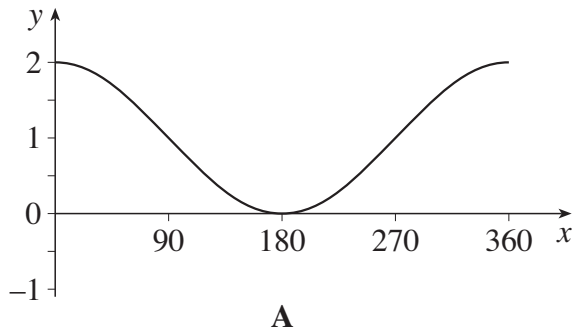


Three of the following statements are true and **one** is false. Which one is **false**?

- A Angle  $WXZ = 36.9^\circ$ , correct to the nearest  $0.1^\circ$ .
- B  $\cos XZY = \frac{5}{13}$
- C  $\tan XYW = 0.4$
- D  $XY^2 = 116 \text{ cm}^2$
- 37 Which **one** of the following expressions can be **correctly** simplified to  $\frac{x+1}{12}$ ?

- A  $\frac{x+2}{24}$
- B  $\frac{x+3}{15} - \frac{2}{3}$
- C  $\frac{5-x}{24} + \frac{x-1}{8}$
- D  $\frac{x}{2} + \frac{1}{6}$

38 Which **one** of the following is the **correct** graph of  $y = 1 + \cos x^\circ$ ?



39 The first four terms of a quadratic sequence are 0, 0, 2, 6.

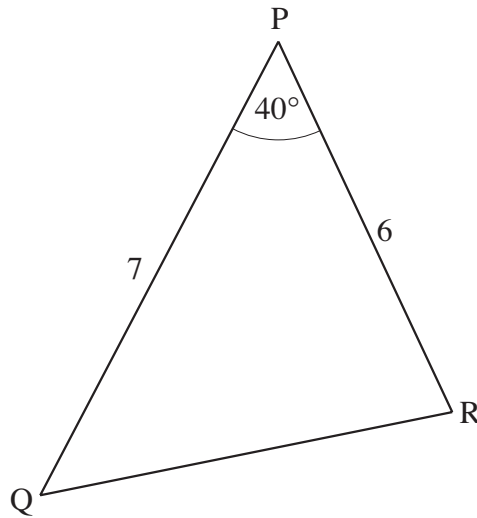
Three of the following statements are true and **one** is false. Which one is **false**?

- A** All the terms are even.
- B** 20 is a term in the sequence.
- C** The difference between the 8th and 9th terms of the sequence is 12.
- D** The  $n$ th term of the sequence is  $n^2 - 3n + 2$ .

[TURN OVER FOR QUESTION 40.]

20

- 40 In the triangle PQR shown,  $PQ = 7$  cm,  $PR = 6$  cm and angle  $QPR = 40^\circ$ .



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

- A  $QR = 4.54$  cm, correct to 2 decimal places.
- B Angle  $Q = 58^\circ$ , correct to the nearest degree.
- C Angle  $R = 82^\circ$ , correct to the nearest degree.
- D P is approximately 6.5 cm from QR.

# Foundations of Advanced Mathematics (MEI)

INTERMEDIATE FSMQ 6989

## Combined Mark Scheme And Report on the Unit

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June 2007

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### Foundations of Advanced Mathematics FSMQ (6989)

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**Mark Scheme and Report on the UN  
June 2007**

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## Foundations of Advanced Mathematics – 6989

### Report and Mark Scheme, June, 2007

There were 933 entries for this session, easily the largest number in a session, which is most encouraging. The mean mark was 21.5, slightly up on last year. The minimum mark scored by three candidates was 6; no candidate scored full marks, though 2 scored 39.

These statistics are in spite of the fact that there were rather more questions than usual that caught out candidates, and there were 7 questions in which the wrong answer was selected by more candidates than the right answer.

In many papers the correct answer has been given by between 80% and 90% of the candidature on a number of questions; on this paper this happened only twice (Q2 operations and Q32, Substitution). A number of other questions attracted over 70% of correct responses.

The greatest problem was caused by Q21 (proportions). Here the mass of a length of rope is proportional to its volume so if the radius is doubled the mass is multiplied by 4; 81% simply took the answer that was the ratio of radii.

Q26 (Vector diagram) was also unusual in that the correct answer was the least popular answer. Here, candidates tend to take the mirror image of the diagram given in order to get the plane to fly due east, instead of taking a triangle in which the speed of the plane is the hypotenuse.

In Q6 (approximate values in formula and rearrangement) nearly 50% of candidates thought that the correct rearrangement of the formula was incorrect while an incorrect approximation was thought to be correct by 38%.

In Q15 (setting up equations involving speed and distance) the correct response giving the speed of a cycle ride as distance over time multiplied by 60 to convert the units was thought to be incorrect by 37% while only 29% took the same idea for the run but divided by 60 to convert the units as the correct response.

In Q20 (displacement/time graph) candidates clearly confused the graph with that of a speed/time graph, and so saw the response “the particle is stationary” at the point where the curve crossed the x-axis as a correct answer while the response to do with the gradient of the tangent was seen as incorrect.

In Q37 (Algebraic simplification) response A was the most popular choice of the correct answer. It is likely that by this time candidates are beginning to run out of time and made a predictable error without checking the other responses.

Likewise, in Q40 (Sine and cosine rules), response A was the most straightforward of applications to give a correct value for the third side of the triangle, but was chosen as incorrect. It may be that lack of time meant not considering the question carefully and trying to apply Pythagoras in some way which would obviously yield this answer as incorrect.

As in previous sessions I offer a summary of questions and topics with the approximate percentage of candidates giving the correct responses. As noted in previous reports, the giving of the correct response may not be because the candidate understands the question and can discern the errors being made in the distracting responses. Attempts are made not to offer distractors in such a way that the correct response is clearly different to the rest, but our perception of typical errors might result in that happening.

Mark Scheme and Report on the Unit taken in June 2007

Question	Topic
81 – 90%	2 Operations
32	Substitution
71 – 80%	3 Algebra - substitution
11	Interpreting pictogram
18	Sampling, average and range
19	Simultaneous equations
28	Conversion graph
61-70%	5 Standard form
8	Equations
9	Interpreting a compound bar chart
13	Indices
25	Graphs of linear functions
30	Quadratic functions
31	Setting up an equation
51 –60%	4 Algebraic simplification
7	Percentages
10	Conversion of units
14	Estimation
17	Arithmetic
23	Percentage increase
24	Cumulative frequency
29	Inequalities
33	Area under curve
34	Interpreting equation
35	3-D geometry
39	Quadratic sequence
41 – 50%	1 Number
12	Probability
22	Pie chart
27	Vectors
36	Trigonometry
31 – 40%	6 Approximations and rearrangements
38	Graphs of trigonometrical functions
40	Sine and cosine rules
21 – 30%	15 Setting up equations
16	3-D geometry
20	Displacement-time graph
37	Algebraic simplification
11 – 20%	26 Vector diagram
0 ~ 10%	21 Proportions

Answers.

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

**FSMQ Intermediate Foundations of Advanced Mathematics (FAM)  
June 2007 Assessment Session**

**Unit Threshold Marks**

Unit	Maximum Mark	A	B	C	D	E	U
6989	40	31	27	23	19	15	0

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

	A	B	C	D	E	U	Total Number of Candidates
6989	8.5	22.6	44.1	66.6	85.3	100	933

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**1 Hills Road**  
**Cambridge**  
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