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FREE-STANDING MATHEMATICS QUALIFICATION

Intermediate Level

6989/01

FOUNDATIONS OF ADVANCED MATHEMATICS

THURSDAY 24 JANUARY 2008

Morning

Time: 2 hours

Additional materials:	Answer sheet (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.

This document consists of **18** printed pages and **2** blank pages.

OCR is an exempt Charity   **[Turn over**

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

   A $(-1)^3 = -1$

   B $(-24) \div (+8) = -3$

   C $-4 - 7 = -11$

   D $3 - (4 - 6)^2 = 7$

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

   A   2 hours 15 minutes = 135 minutes

   B   76.2 cm = 7.62 mm

   C   70 centilitres = 0.7 litres

   D   50 g = 0.05 kg

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

   A $\frac{7}{11} = 0.64$, correct to 2 decimal places.

   B $\sqrt{42} = 7$, correct to the nearest integer.

   C $16^4 = 66\,000$, correct to the nearest thousand.

   D $45\,678 = 45\,700$, correct to 3 significant figures.

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

   A   In the expression $x^3 - 5x^2 + 4x - 3$, the coefficient of x^2 is -5.

   B   In the expression $x^4 + 6x^2 + 9$, the highest power of x is 4.

   C   The expression $5x^2 + 4x - 3$ contains no constant term.

   D   There are two values of x for which $x^2 = 64$.

5 The times, t seconds, recorded for 20 athletes to run 100 metres are given below.

$$12.7 \quad 11.5 \quad 11.3 \quad 13.2 \quad 12.4 \quad 11.7 \quad 11.7 \quad 12.2 \quad 11.9 \quad 10.7$$
$$13.0 \quad 12.2 \quad 11.0 \quad 11.6 \quad 12.5 \quad 10.9 \quad 12.9 \quad 12.8 \quad 11.4 \quad 12.0$$

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

A   There are 2 times for which $t < 11$.

B   There are 8 times for which $11 \leqslant t < 12$.

C   There are 9 times for which $12 \leqslant t < 13$.

D   There are 2 times for which $t \geqslant 13$.

6 Andrew and Ben are studying standard form.

- Andrew claims that 93 000 000, written in standard form, is 93×10^6.
- Ben claims that $2.5 \times 10^{-3} = -0.0025$.

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

A   Andrew and Ben are both correct.

B   Andrew is correct and Ben is incorrect.

C   Andrew is incorrect and Ben is correct.

D   Andrew and Ben are both incorrect.

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

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

A $3a = 13$

B $a + b = 6\frac{5}{6}$

C $a \div b = \frac{26}{15}$

D $b^2 = 4\frac{1}{4}$

11 In a sports shop the price of tennis rackets is reduced by 25% from July 1st.

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

A For tennis rackets the ratio of the June price to the July price is 4 : 3.

B A tennis racket costing £56 in June will cost £42 in July.

C A tennis racket costing £64 in July would have cost £80 in June.

D A tennis racket reduced by £12.50 will cost £37.50 in July.

12 Three of the following statements involve sensible units and **one** does not. Which one does **not**?

A The amount of water in a bath is measured in litres.

B The mass of an apple is measured in milligrams.

C The time taken for an advertisement to be shown on television is measured in seconds.

D The length of a bus is measured in metres.

13 One of the following numbers is chosen at random.

$$2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8$$

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

A The probability that the number is prime is $\frac{3}{7}$.

B The probability that the number is a square number is $\frac{1}{7}$.

C The probability that the number is not a factor of 20 is $\frac{4}{7}$.

D The probability that the number is less than 4 is $\frac{2}{7}$.

14 The A-level Mathematics grades of the 50 candidates in a school are shown below.

Grade	A	B	C	D	E	U	Total
Boys	8	12	7	3	1	1	32
Girls	4	8	3	2	1	0	18

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

A   The ratio of boys to girls obtaining grade A is 2 : 1.

B   16% of the boys obtained grade A.

C   Two thirds of the girls obtained grade A or B.

D   20% of the candidates obtained grade C.

15 Clare is attempting to solve the equation $7x - 15 = 3(x + 6)$.

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

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

A $7x - 15 = 3x + 18$

B $7x - 3x = 18 - 15$

C $4x = 3$

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

16 A football pitch is 105 metres long and 73 metres wide, both correct to the nearest metre.

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

A   The minimum possible length of the pitch is 104.5 metres.

B   The width of the pitch is less than 73.5 metres.

C   The minimum possible area of the pitch is 7576.25 square metres.

D   The perimeter of the pitch, correct to the nearest metre, is definitely 356 metres.

17 Lubica is trying to draw the graph of $y = x^2 - 4x$ from $x = -2$ to $x = 3$. She plots the points corresponding to $x = -2$, $x = -1$, $x = 0$, $x = 1$, $x = 2$ and $x = 3$ as shown below.
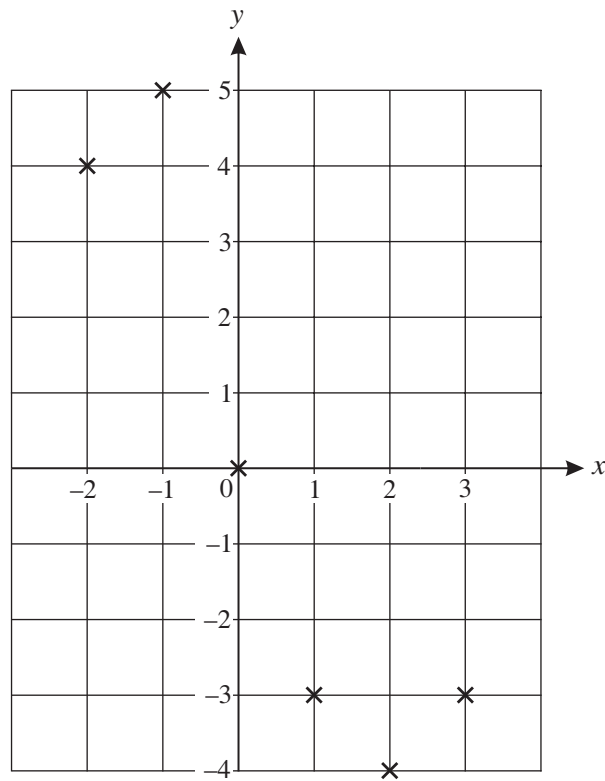
Which **one** of the following statements is **true**?

A   All 6 points are correctly plotted.

B   Exactly 5 points are correctly plotted.

C   Exactly 4 points are correctly plotted.

D   Fewer than 4 points are correctly plotted.

18 Three vectors are given by $\mathbf{x} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$, $\mathbf{y} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$ and $\mathbf{z} = \begin{pmatrix} -5 \\ 0 \end{pmatrix}$.

Which **one** of the following is the **correct** value of $2\mathbf{x} - 3\mathbf{y} + 4\mathbf{z}$?

A $\begin{pmatrix} 17 \\ 2 \end{pmatrix}$ **B** $\begin{pmatrix} 17 \\ -2 \end{pmatrix}$ **C** $\begin{pmatrix} -17 \\ 2 \end{pmatrix}$ **D** $\begin{pmatrix} -17 \\ -2 \end{pmatrix}$

19 Three of the following statements are true and **one** is false. Which one is **false**?
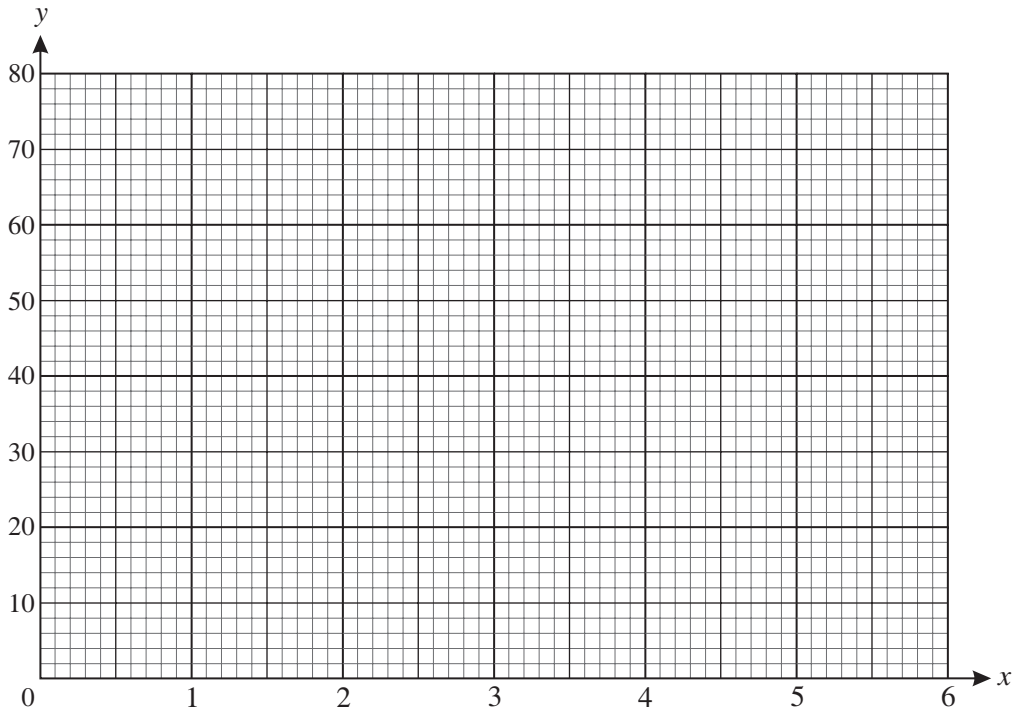
A $x + 7(x + 3) = 8x + 21$

B $10x^2 + 6xy = 2x(5x + 3y)$

C $x(x - 1) = x^2 - 1$

D $5(x - 3) - x = 4x - 15$

20 This question is about finding the gradient of the curve $y = \dfrac{120}{x}$.

In order to complete this question you are advised to draw the graph of $y = \dfrac{120}{x}$, *from* $x = 2$ *to* $x = 6$, *on the grid below.*

Which **one** of the following is the best estimate of the gradient of the curve $y = \dfrac{120}{x}$ when $x = 3.5$?

A -10

B -0.5

C 0.5

D 10

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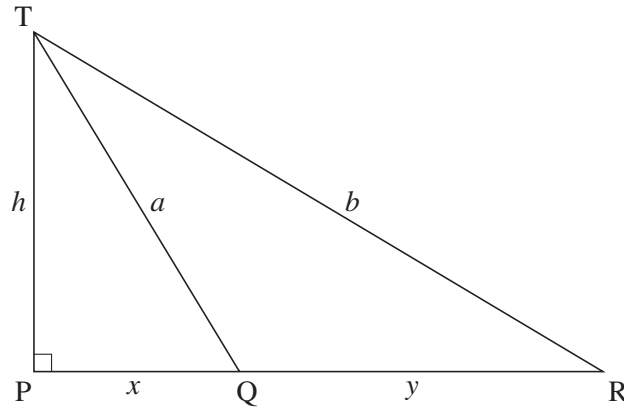
Three of the following statements are true and **one** is false. Which one is **false**?

A $\sin TRQ = \dfrac{a}{b}$

B $\tan PTR = \dfrac{x + y}{h}$

C Area of triangle TQR $= \frac{1}{2}hy$

D $h = \sqrt{a^2 - x^2}$

22 The front wheel of Harry's bicycle has a diameter of 66 cm. Harry cycles two kilometres.

Which **one** of the following is the approximate number of times that the front wheel goes round?

A 58

B 241

C 482

D 965

23 Which **one** of the following is the solution of the equation $5x^2 - 11x = 3$?

A $\dfrac{11 \pm \sqrt{181}}{10}$ **B** $\dfrac{-11 \pm \sqrt{181}}{10}$ **C** $\dfrac{11 \pm \sqrt{61}}{10}$ **D** $\dfrac{-11 \pm \sqrt{61}}{10}$

24 Here is a pair of simultaneous equations.

$$6x - y = 17$$
$$4x + 3y = 4$$

Which **one** of the following describes their solution?

A   Both x and y are integers.

B x is an integer but y is not.

C y is an integer but x is not.

D   Neither x nor y is an integer.

25 You are given the vectors $\mathbf{a} = 5\mathbf{i} - 4\mathbf{j}$ and $\mathbf{b} = -4\mathbf{i} + 5\mathbf{j}$.

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

A   The vector $\mathbf{a}$ is a unit vector.

B   The angle between the vector $\mathbf{b}$ and the $\mathbf{i}$-direction is approximately $128.7°$.

C   The vectors $\mathbf{a}$ and $\mathbf{b}$ have the same magnitude.

D   The vector $\mathbf{a} + \mathbf{b}$ has equal $\mathbf{i}$ and $\mathbf{j}$ components.

26 In a right-angled triangle the length of the shortest side is x metres. The hypotenuse is 4 metres longer than the shortest side. The length of the third side is the mean of the lengths of the other two sides.

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

A   One side is of length $(x + 2)$ metres.

B   The perimeter of the triangle is $(3x + 6)$ metres.

C   The area of the triangle is $x(x + 2)$ square metres.

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

27 Which **one** of the following is the **correct** solution of $7 - 3x < x - 9$?

    A $x > 4$ **B** $x < 4$ **C** $x > -4$ **D** $x < -4$

28 School A and School B are the two secondary schools in a town. A survey of Year 11 students asking about what they planned to do after their GCSE examinations produced the following results.

	School A	School B
Stay on at school	80	100
Go to college	40	50
Go to work	50	50
Other	10	20
Undecided	20	30
Total	200	250

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

A   The same proportions of students from each school are planning to go to college.

B   The ratio of students planning to stay on at school to students planning to go to college is the same in each school.

C   If a pie chart is drawn for each school to display the plans of the Year 11 students then the angles of the sectors representing 'Go to work' will be the same.

D   If a pie chart is drawn for School A to display the plans of the Year 11 students then the angle representing 'Undecided' will be 36°.

29 Three of the following expressions can be factorised into the form $(x + p)(x + q)$ where p and q are integers (positive or negative) but one cannot.

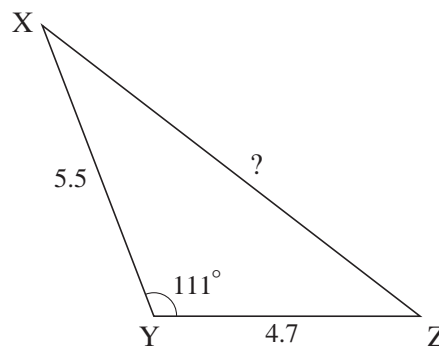Which **one** of the following **cannot** be factorised in this way?

A $x^2 - 3x - 4$

B $x^2 + 10x - 24$

C $x^2 + 9x + 8$

D $x^2 - x + 6$

30   Jessica and Kate are answering questions on the sine and cosine rules.
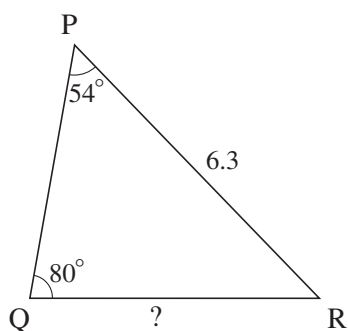
Jessica's question   Kate's question

Jessica calculates that QR is approximately 5.2.
Kate calculates that XZ is approximately 8.4.

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

A   Jessica and Kate are both correct.

B   Jessica is correct and Kate is incorrect.

C   Jessica is incorrect and Kate is correct.

D   Jessica and Kate are both incorrect.

31   A bag contains 10 balls. 4 are white and 6 are blue. A ball is taken at random from the bag and then a second ball is taken at random from the bag.

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

A   If the first ball is replaced before the second ball is taken then the probability that both are blue is $\frac{9}{25}$.

B   If the first ball is **not** replaced before the second ball is taken then the probability that both are white is $\frac{2}{15}$.

C   If the first ball is replaced before the second ball is taken then the probability that the balls are different colours is $\frac{6}{25}$.

D   If the first ball is **not** replaced before the second ball is taken then the probability that the first ball is blue and the second is white is $\frac{4}{15}$.

32 The map below shows the sea and a cliff top. There is a fence on the cliff top to keep people away from an unsafe region (shaded). The map is drawn on a centimetre square grid and 1 centimetre represents 20 metres.
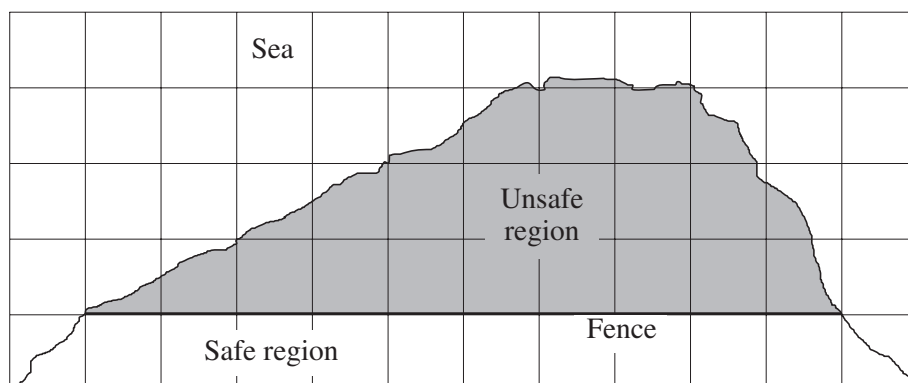
Three of the following statements are true and **one** is false. Which one is **false**?

A The actual length of the fence is 200 m.

B The scale can be written as 1 : 20.

C On the map the unsafe region has an area between 16 and 20 cm^2.

D An area of 1 cm^2 on the map corresponds to an actual area of 400 m^2.

33 The cost, £C, of producing n items in a factory is given by

$$C = 2000 + 0.1n.$$

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

A The cost of producing 1000 items is £2100.

B Each extra item produced increases the cost by 10 pence.

C A way of calculating the total cost, in £, of n items is to divide n by 10 and add the result to 2000.

D As the number of items produced increases the average cost per item increases.

34 Ramandeep is trying to solve the following simultaneous equations.

$$2y = x + 6 \qquad (1)$$
$$2x + y = 7 \qquad (2)$$

He draws line 1 to represent equation (1) and line 2 to represent equation (2).
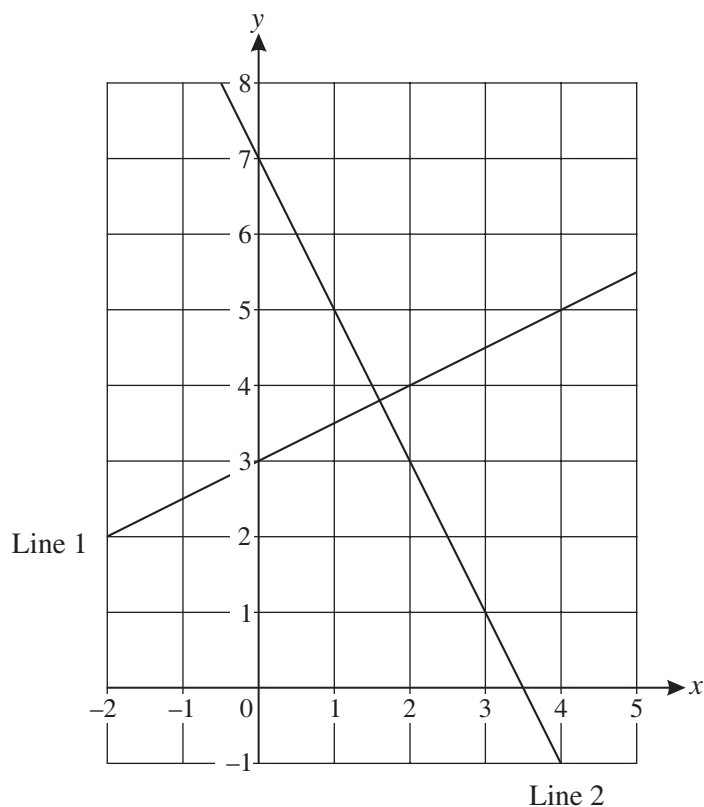
Three of the following statements are true and **one** is false. Which one is **false**?

A   Line 1 is correctly drawn.

B   Line 2 is correctly drawn.

C   The coordinates of the point of intersection of two correctly drawn lines give the solution of the simultaneous equations.

D   The solution is $x = 3.8$, $y = 1.6$.

35 The diagram shows a pyramid with a square base. The vertex, V, is directly above the centre, C, of the base JKLM.

JK = KL = LM = MJ = 32 cm and VJ = VK = VL = VM = 34 cm.
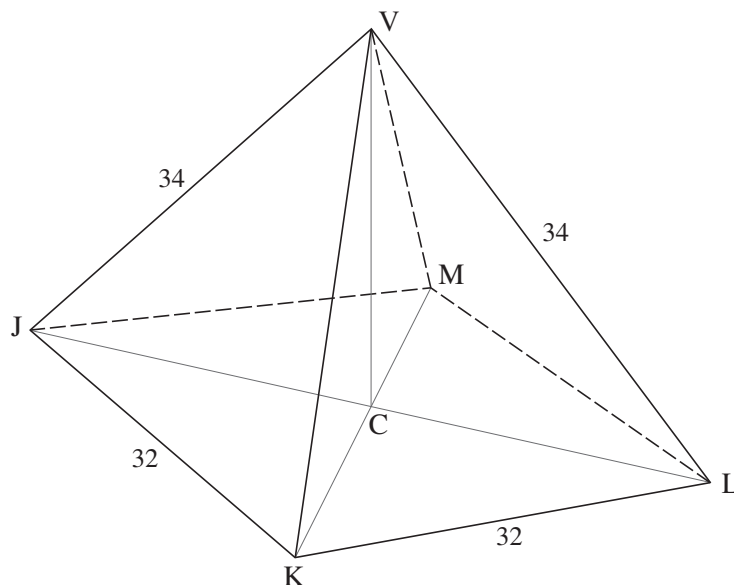
Three of the following statements are true and **one** is false. Which one is **false**?

A   JL is approximately 45.3 cm.

B   The distance from V to the midpoint of JK is 30 cm.

C   Angle JVK = 56°, correct to the nearest degree.

D   The angle between VJ and the base is 62°, correct to the nearest degree.

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

A $A = 4\pi r^2$ may be rearranged to give $r = \dfrac{\sqrt{A}}{4\pi}$.

B $N = \dfrac{D}{Q}$ may be rearranged to give $Q = \dfrac{D}{N}$.

C $T = a + (n-1)d$ may be rearranged to give $n = \dfrac{T-a}{d} + 1$.

D $x = \frac{1}{8}\sqrt[3]{V}$ may be rearranged to give $V = 512x^3$.

37 Which **one** of the following is the **correct** simplification of $\dfrac{3a + 5b}{6} - \dfrac{a + 4b}{3}$?

A $\quad \dfrac{2a + b}{3}$

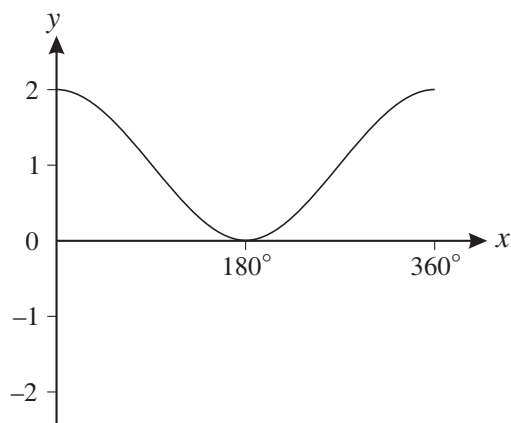**B** $\quad \dfrac{a - 3b}{6}$

C $\quad \dfrac{3a - b}{2}$

D $\quad \dfrac{3a + 39b}{18}$

38 Look at the graphs of the trigonometrical functions in the range $0°$ to $360°$ below.

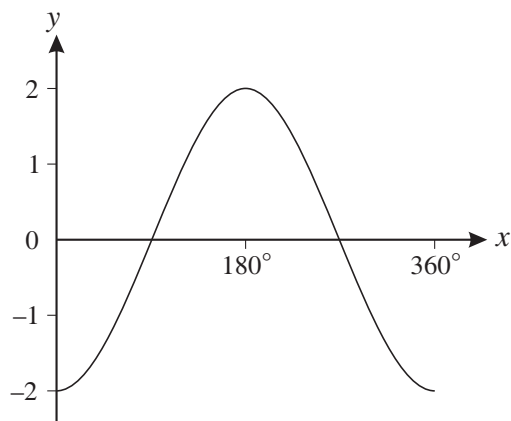Three of the graphs are correct and **one** is incorrect. Which graph is **incorrect**?
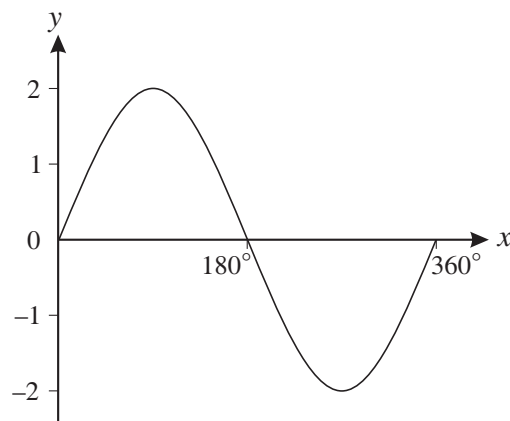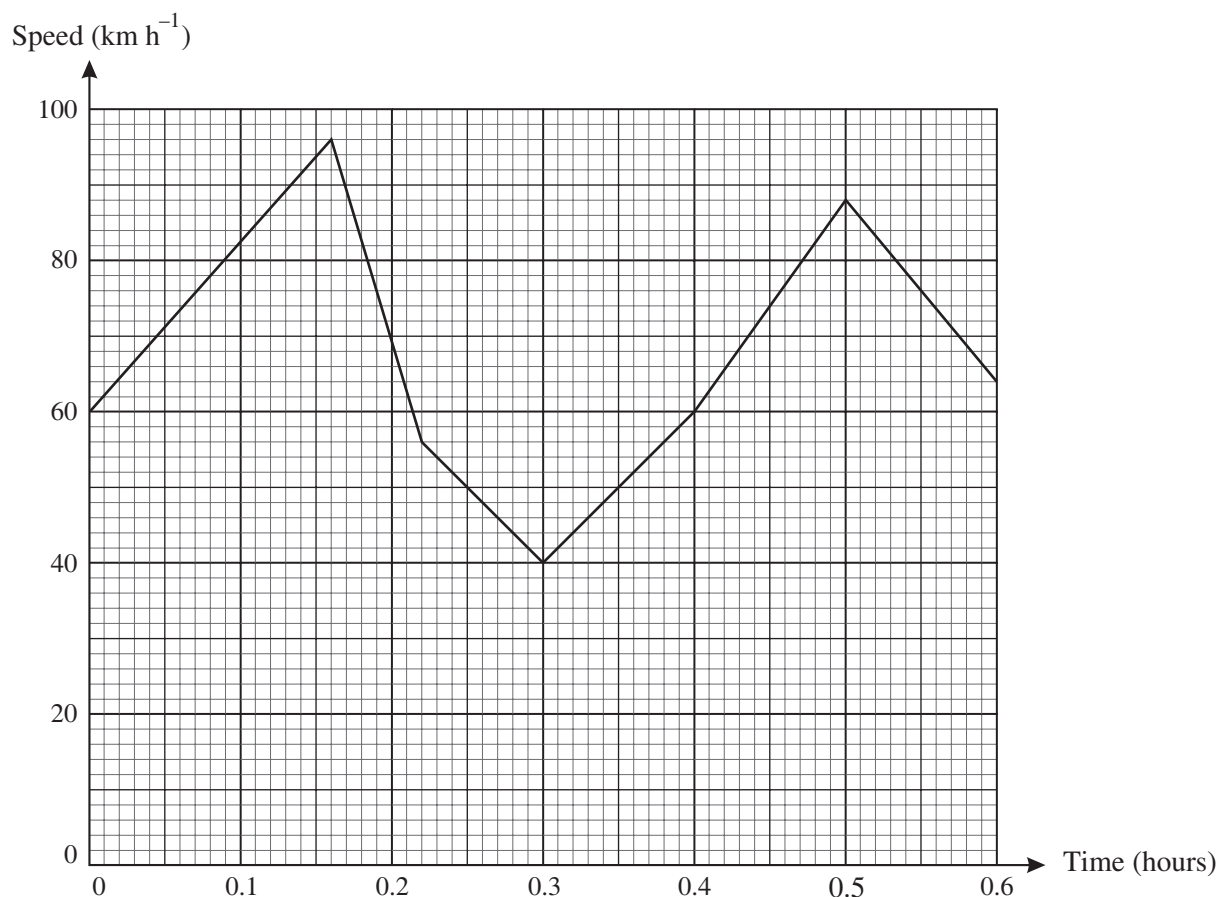
A

$y = 1 + \cos x$

B
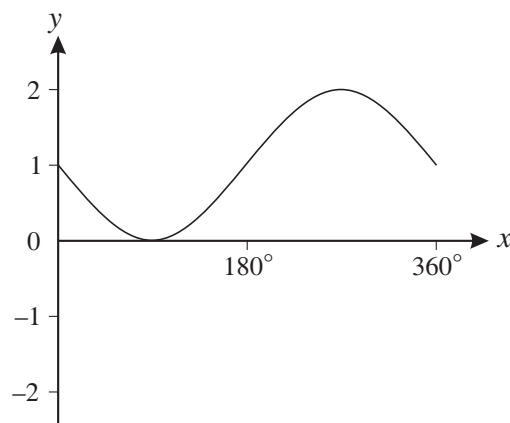
$y = 1 - \sin x$

C

$y = -\cos x$

D

$y = 2\sin x$

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

A The sequence 2, 5, 8, 11, … has nth term equal to $3n - 1$.

B The sequence 6, 12, 24, 48, … has nth term equal to 3×2^n.

C The sequence 2, 5, 10, 17, … has nth term equal to $n^2 + 1$.

D The sequence 1, −1, 1, −1, … has nth term equal to $(-1)^n$.

40 The graph below shows the speed of a car after it joins a motorway.

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

A The car's greatest speed is $96\,\mathrm{km\,h}^{-1}$.

B The car's least speed occurs after 30 minutes.

C The slope of the graph represents acceleration.

D The area under the graph represents distance travelled.

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