ELITE MATHEMATICS

Modular Unit 1

Linear to Modular | Standard papers

Worked solutions

24 question entries | 91 marks

Linear questions reorganised for Modular practice. Not an original Pearson Modular examination.

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Student edition | June 2026 | Elite Mathematics

Question 1

3 marks

June 2026 | 4MA1/1H | Mixed-number subtraction

1 Show that $4\frac{1}{7} - 2\frac{3}{5} = 1\frac{19}{35}$

(Total for Question 1 is 3 marks)

Question 1 | Worked solution

3 marks

June 2026 | 4MA1/1H | Mixed-number subtraction

Solution

3 marks

STEP 1

$$4\frac{1}{7} = \frac{29}{7}, \qquad 2\frac{3}{5} = \frac{13}{5}.$$

Convert each mixed number to an improper fraction.

STEP 2

$$\frac{29}{7} - \frac{13}{5} = \frac{145 - 91}{35} = \frac{54}{35} = 1\frac{19}{35}.$$

Use the common denominator 35, subtract, then convert back to a mixed number.

Final answer

$1\frac{19}{35}$

Question 2

3 marks

June 2026 | 4MA1/1H | Right-triangle trigonometry

2

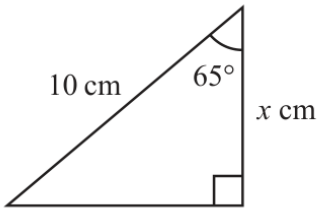


Diagram **NOT** accurately drawn

Work out the value of x
Give your answer correct to 3 significant figures.

$x =$ .....

(Total for Question 2 is 3 marks)

Question 2 | Worked solution

3 marks

June 2026 | 4MA1/1H | Right-triangle trigonometry

Solution

3 marks

STEP 1

$$\cos 65^\circ = \frac{x}{10}.$$

The side of length 10 cm is the hypotenuse and x is adjacent to the given angle.

STEP 2

$$x = 10\cos 65^\circ = 4.22618\ldots = 4.23 \text{ cm} \quad (3 \text{ s.f.}).$$

Multiply by 10 and round only the final value.

Final answer
$x = 4.23$ cm

Question 3

3 marks

June 2026 | 4MA1/1H | Set operations and counterexamples

3 $\mathscr{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19\}$

$A = \{\text{factors of } 20\}$

$B = \{\text{multiples of } 5\}$

(a) List the members of the set

(i) $A \cup B$

.....

(1)

(ii) $A \cap B'$

.....

(1)

$C = \{\text{prime numbers}\}$

Ana writes down the statement $A \cap C = \varnothing$
Ana's statement is wrong.

(b) Explain why.

.....

.....

(1)

(Total for Question 3 is 3 marks)

Question 3 | Worked solution

3 marks

June 2026 | 4MA1/1H | Set operations and counterexamples

Part (a(i))

1 marks

STEP 1

$A = \{1, 2, 4, 5, 10\}$ and $B = \{5, 10, 15\}$, so $A \cup B = \{1, 2, 4, 5, 10, 15\}$. Include every member of either set once; 20 lies outside the universal set.

Final answer

$\{1, 2, 4, 5, 10, 15\}$

Part (a(ii))

1 marks

STEP 1

$A \cap B' = \{1, 2, 4\}$. Retain the factors of 20 in the universal set which are not multiples of 5.

Final answer

$\{1, 2, 4\}$

Part (b)

1 marks

STEP 1

Both 2 and 5 are prime factors of 20, so $A \cap C = \{2, 5\} \neq \varnothing$. A shared member is enough to disprove the claim that the intersection is empty.

Final answer

$A \cap C = \{2, 5\}$, not the empty set.

Question 4

4 marks

June 2026 | 4MA1/1H | Average speed over a two-stage journey

4 Henri competes in a race.

For the first part of the race Henri cycles 60 km at an average speed of 24 km/h
For the remaining part of the race Henri runs for 1 hour and 15 minutes at an average speed of 12 km/h

Work out Henri's average speed for the whole race.
Give your answer in km/h
Show your working clearly.

..... km/h

(Total for Question 4 is 4 marks)

Question 4 | Worked solution

4 marks

June 2026 | 4MA1/1H | Average speed over a two-stage journey

Solution

4 marks

STEP 1

Cycling time: $60 \div 24 = 2.5$ hours. Running time: $1 + 15/60 = 1.25$ hours. Time equals distance divided by speed.

STEP 2

Running distance: $12 \times 1.25 = 15$ km. Total distance: $60 + 15 = 75$ km. Total time: $2.5 + 1.25 = 3.75$ hours. Combine the actual distances and times.

STEP 3

$$\text{Average speed} = \frac{75}{3.75} = 20 \text{ km/h}.$$

Average speed is total distance divided by total time, not the mean of the two speeds.

Final answer
20 km/h

Question 5 | parts a, b

3 marks

June 2026 | 4MA1/1H | Elementary algebra, formula rearrangement and inequalities

5 (a) Expand $4e(2e-3)$

.....

(1)

(b) Expand and simplify $(f+3)(f-6)$

.....

(2)

Question 5 | parts a, b | Worked solution

3 marks

June 2026 | 4MA1/1H | Elementary algebra, formula rearrangement and inequalities

Part (a)

1 marks

STEP 1

$$4e(2e-3) = 8e^2 - 12e.$$

Multiply 4e by both terms in the bracket.

Final answer
$8e^2 - 12e$

Part (b)

2 marks

STEP 1

$$(f+3)(f-6) = f^2 - 6f + 3f - 18 = f^2 - 3f - 18.$$

Multiply each term in the first bracket by each term in the second and collect like terms.

Final answer
$f^2 - 3f - 18$

Question 6

2 marks

June 2026 | 4MA1/1H | Algebraic index laws

6 Simplify $\left(4x^5y^6\right)^3$

.....

(Total for Question 6 is 2 marks)

Question 6 | Worked solution

2 marks

June 2026 | 4MA1/1H | Algebraic index laws

Solution

2 marks

STEP 1

$$(4x^5y^6)^3 = 4^3x^{5\times3}y^{6\times3} = 64x^{15}y^{18}.$$

Raise each factor to the third power and multiply exponents for a power of a power.

Final answer

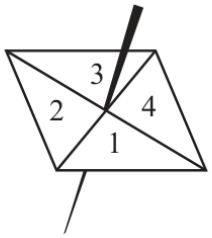
$64x^{15}y^{18}$

Question 7

4 marks

June 2026 | 4MA1/1H | Expected frequency for a biased spinner

7 Here is a biased 4-sided spinner.



The table gives information about the probability that, when the spinner is spun once, it will land on each number.

Number	1	2	3	4
Probability	0.12	x	$2x$	0.16

Nevan spins the spinner 500 times.

Work out the expected number of times that the spinner lands on an even number.

.....

(Total for Question 7 is 4 marks)

Question 7 | Worked solution

4 marks

June 2026 | 4MA1/1H | Expected frequency for a biased spinner

Solution

4 marks

STEP 1

$$0.12 + x + 2x + 0.16 = 1 \implies 3x = 0.72 \implies x = 0.24.$$

The four exhaustive outcome probabilities sum to 1.

STEP 2

$$P(\text{even}) = P(2) + P(4) = 0.24 + 0.16 = 0.40.$$

The events 2 and 4 are mutually exclusive.

STEP 3

$$\text{Expected number} = 500 \times 0.40 = 200.$$

Multiply the number of spins by the probability of an even result.

Final answer
200

Question 8

3 marks

June 2026 | 4MA1/1H | Converting speed units

8 Change a speed of 70 metres per second to a speed in kilometres per hour.
Show your working clearly.

..... km/h

(Total for Question 8 is 3 marks)

Question 8 | Worked solution

3 marks

June 2026 | 4MA1/1H | Converting speed units

Solution

3 marks

STEP 1

$$70 \text{ m/s} = 70 \times 3600 = 252000 \text{ m/h}.$$

There are 3600 seconds in one hour.

STEP 2

$$252000 \div 1000 = 252 \text{ km/h}.$$

There are 1000 metres in one kilometre.

Final answer
252 km/h

Question 11

5 marks

June 2026 | 4MA1/1H | Perimeter of a semicircle and two right triangles

11 The diagram shows a shaded shape $ABCDEO$ made from a semicircle BCD and two identical right-angled triangles ABO and EDO

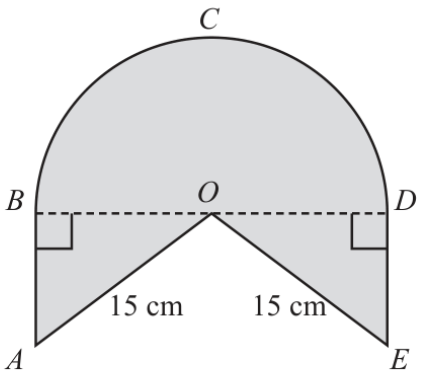


Diagram **NOT** accurately drawn

BD is the diameter of the semicircle.
O is the midpoint of BD

angle ABO = angle EDO = 90° $AO = EO = 15$ cm

The area of semicircle BCD is $227\ \text{cm}^2$

Work out the perimeter of the shaded shape.
Show your working clearly.
Give your answer correct to one decimal place.

..... cm

(Total for Question 11 is 5 marks)

Question 11 | Worked solution

5 marks

June 2026 | 4MA1/1H | Perimeter of a semicircle and two right triangles

Solution

5 marks

STEP 1

Let the radius be $r = OB = OD$. Then $\frac{1}{2}\pi r^2 = 227$, so $r = \sqrt{454/\pi} = 12.021343\ldots$ cm. The given area belongs to the semicircle.

STEP 2

$$AB = DE = \sqrt{15^2 - r^2} = 8.971472\ldots \text{ cm}.$$

The identical triangles have hypotenuse 15 cm and horizontal leg r.

STEP 3

$$P = \pi r + AB + DE + AO + EO = \pi r + 2\sqrt{225 - r^2} + 30 = 85.709107\ldots \text{ cm}.$$

The boundary contains the semicircular arc and the four outer triangle sides, but not the internal diameter.

STEP 4

$$P = 85.7 \text{ cm} \quad (1 \text{ d.p.}).$$

Retain unrounded intermediate values.

Final answer
85.7 cm

Question 12

6 marks

June 2026 | 4MA1/1H | Index equations and expansion

12 $\dfrac{2^3}{8^x} = 64$

(a) Find the value of x
Show clear algebraic working.

$x =$ .....

(3)

(b) Expand and simplify $4t(t + 5)(2t - 3)$

.....

(3)

(Total for Question 12 is 6 marks)

Question 12 | Worked solution

6 marks

June 2026 | 4MA1/1H | Index equations and expansion

Part (a)

3 marks

STEP 1

$$\frac{2^{x/3}}{8^x} = \frac{2^{x/3}}{2^{3x}} = 2^{x/3-3x} = 2^{-8x/3}.$$

Write 8 as a power of 2 and subtract exponents when dividing.

STEP 2

$$2^{-8x/3} = 64 = 2^6 \implies -\frac{8x}{3} = 6 \implies x = -\frac{9}{4}.$$

Equal powers of base 2 have equal exponents.

Final answer

$x = -\frac{9}{4}$

Part (b)

3 marks

STEP 1

$$(t+5)(2t-3) = 2t^2 - 3t + 10t - 15 = 2t^2 + 7t - 15.$$

Expand the two brackets and collect like terms.

STEP 2

$$4t(t+5)(2t-3) = 4t(2t^2 + 7t - 15) = 8t^3 + 28t^2 - 60t.$$

Multiply every term by 4t.

Final answer

$8t^3 + 28t^2 - 60t$

Question 13

4 marks

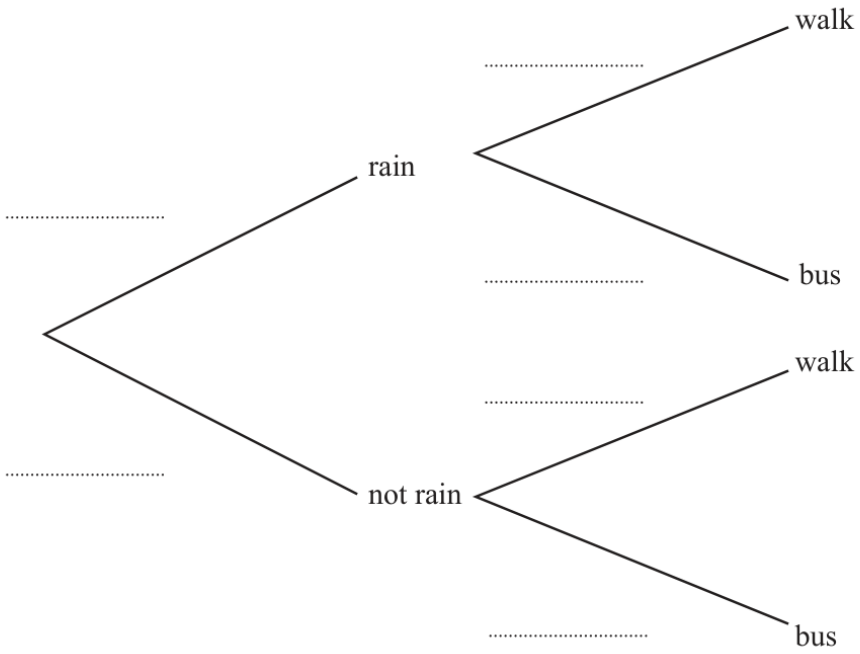
June 2026 | 4MA1/1H | Conditional probability tree

13 On any school day, Paulo either walks to school or travels by bus to school.

The probability that it rains on any school day is 0.15

If it rains on a school day, the probability that Paulo walks to school is 0.2
If it does not rain on a school day, the probability that Paulo walks to school is 0.75

(a) Complete the probability tree diagram for this information.



(2)

(b) Work out the probability that on a school day, it rains and Paulo walks to school.

.....

(2)

(Total for Question 13 is 4 marks)

Question 13 | Worked solution

4 marks

June 2026 | 4MA1/1H | Conditional probability tree

Part (a)

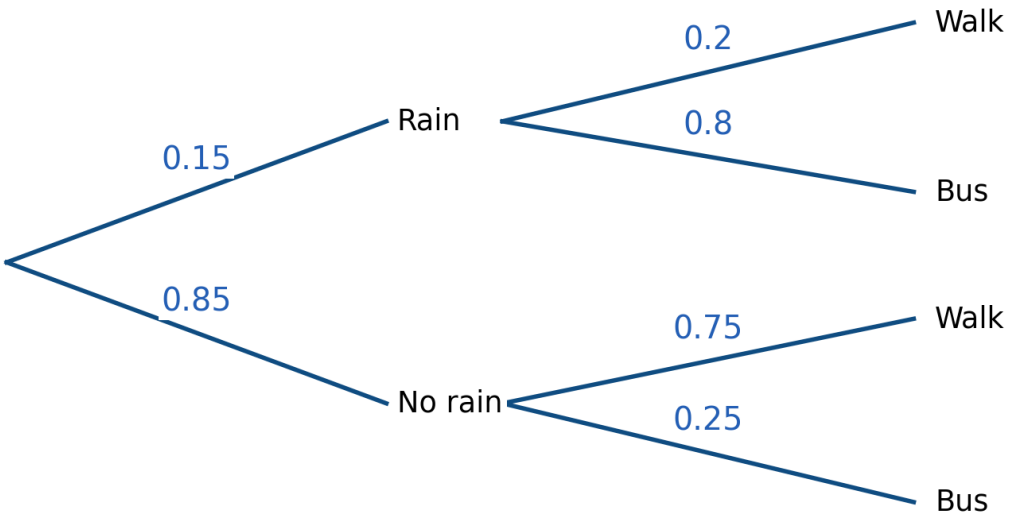
2 marks

STEP 1

First split: rain 0.15, not rain 0.85. Complementary branches sum to 1.

STEP 2

After rain: walk 0.20, bus 0.80. After not rain: walk 0.75, bus 0.25. Use the stated conditional probabilities and their complements on the corresponding branches.



Final answer

Rain/not rain: $0.15, 0.85$; walk/bus after rain: $0.2, 0.8$; walk/bus after no rain: $0.75, 0.25$.

Part (b)

2 marks

STEP 1

$$P(\text{rain and walk}) = P(\text{rain})P(\text{walk} \mid \text{rain}) = 0.15 \times 0.2 = 0.03.$$

Multiply the probabilities along the rain-then-walk path; independence is not assumed.

Final answer

0.03

Question 15

2 marks

June 2026 | 4MA1/1H | Gradient from coordinates

15 Point A has coordinates $(-3, 4)$
Point B has coordinates $(2, -6)$

Work out the gradient of the line AB

.....

(Total for Question 15 is 2 marks)

Question 15 | Worked solution

2 marks

June 2026 | 4MA1/1H | Gradient from coordinates

Solution

2 marks

STEP 1

$$m = \frac{-6-4}{2-(-3)} = \frac{-10}{5} = -2.$$

Use change in y divided by the corresponding change in x.

Final answer

-2

Question 16

5 marks

June 2026 | 4MA1/1H | Non-right-triangle trigonometry

16 The diagram shows triangle ABC

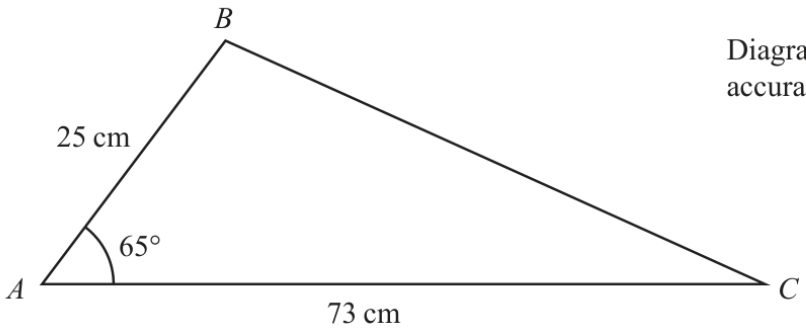


Diagram **NOT** accurately drawn

$AB = 25$ cm $\quad AC = 73$ cm $\quad$ angle $BAC = 65°$

(a) Work out the length of BC
Give your answer correct to 3 significant figures.

..... cm

(3)

(b) Work out the area of the triangle.
Give your answer correct to 3 significant figures.

..... cm^2

(2)

(Total for Question 16 is 5 marks)

Question 16 | Worked solution

5 marks

June 2026 | 4MA1/1H | Non-right-triangle trigonometry

Part (a)

3 marks

STEP 1

$$BC^2 = 25^2 + 73^2 - 2(25)(73)\cos 65^\circ.$$

The included angle is between the two given sides.

STEP 2

$$BC^2 = 4411.443344\ldots, \quad BC = \sqrt{4411.443344\ldots} = 66.418697\ldots = 66.4 \text{ cm} \quad (3 \text{ s.f.}).$$

Take the positive square root for a length.

Final answer
66.4 cm

Part (b)

2 marks

STEP 1

$$\text{Area} = \frac{1}{2}(25)(73)\sin 65^\circ = 827.005855\ldots = 827 \text{ cm}^2 \quad (3 \text{ s.f.}).$$

Use half the product of the two sides and the sine of their included angle.

Final answer
827 cm^2

Question 17

3 marks

June 2026 | 4MA1/1H | Surd expansion in a specified form

17 Show that $\left(4-\sqrt{20}\right)\left(5-2\sqrt{5}\right)$ can be written in the form $a-\sqrt{b}$

where a and b are integers.

(Total for Question 17 is 3 marks)

Question 17 | Worked solution

3 marks

June 2026 | 4MA1/1H | Surd expansion in a specified form

Solution

3 marks

STEP 1

$$\sqrt{20} = 2\sqrt{5}, \qquad (4 - \sqrt{20})(5 - 2\sqrt{5}) = (4 - 2\sqrt{5})(5 - 2\sqrt{5}).$$

Simplify the surd first.

STEP 2

$$20 - 8\sqrt{5} - 10\sqrt{5} + 20 = 40 - 18\sqrt{5}.$$

Expand; the product of the two surd terms is positive 20.

STEP 3

$$18\sqrt{5} = \sqrt{18^2 \times 5} = \sqrt{1620}, \quad (4 - \sqrt{20})(5 - 2\sqrt{5}) = 40 - \sqrt{1620}.$$

Thus the required integer values are a=40 and b=1620.

Final answer

$40 - \sqrt{1620}$, so $a = 40,\ b = 1620$.

Question 18

3 marks

June 2026 | 4MA1/1H | Simplifying an algebraic fraction

18 Simplify fully $\dfrac{4x^2 - 9}{2x^2 - 5x - 12}$

Show clear algebraic working.

.....

(Total for Question 18 is 3 marks)

Question 18 | Worked solution

3 marks

June 2026 | 4MA1/1H | Simplifying an algebraic fraction

Solution

3 marks

STEP 1

$$4x^2 - 9 = (2x - 3)(2x + 3), \qquad 2x^2 - 5x - 12 = (2x + 3)(x - 4).$$

Use difference of squares for the numerator and factorise the denominator.

STEP 2

$$\frac{4x^2 - 9}{2x^2 - 5x - 12} = \frac{(2x - 3)(2x + 3)}{(2x + 3)(x - 4)} = \frac{2x - 3}{x - 4}.$$

Cancel the common factor, not individual terms.

STEP 3

The original fraction requires $x \neq -\frac{3}{2}$ and $x \neq 4$. Cancellation does not restore excluded values.

Final answer

$\frac{2x-3}{x-4}$, $x \neq -\frac{3}{2}, 4$.

Question 20

5 marks

June 2026 | 4MA1/1H | Bounds and justified accuracy

20 The final velocity, v m/s, of an object is given by

$$v = 2\left(\frac{s}{t}\right) - u$$

where

$s = 100$ correct to the nearest integer
$t = 1.68$ correct to 2 decimal places
$u = 0.5$ correct to 1 decimal place

By considering bounds, work out the value of v to a suitable degree of accuracy.
Show your working clearly.

.....

(Total for Question 20 is 5 marks)

Question 20 | Worked solution

5 marks

June 2026 | 4MA1/1H | Bounds and justified accuracy

Solution

5 marks

STEP 1

$$99.5 \le s < 100.5, \quad 1.675 \le t < 1.685, \quad 0.45 \le u < 0.55.$$

Use half a rounding unit on each side of the stated value.

STEP 2

For $v = 2s/t - u$, the lower limiting value is

$$v_L = \frac{2(99.5)}{1.685} - 0.55 = 117.550890\ldots \text{ m/s}.$$

Decrease the numerator, increase the positive denominator and subtract the largest u.

STEP 3

The upper limiting value is

$$v_U = \frac{2(100.5)}{1.675} - 0.45 = 119.55 \text{ m/s}.$$

Increase the numerator, decrease the denominator and subtract the smallest u.

STEP 4

Both limiting values round to 120 m/s to 2 significant figures. They do not round to the same integer, so

$$v = 120 \text{ m/s} \quad (2 \text{ s.f.}).$$

This is the greatest common significant-figure accuracy justified throughout the interval.

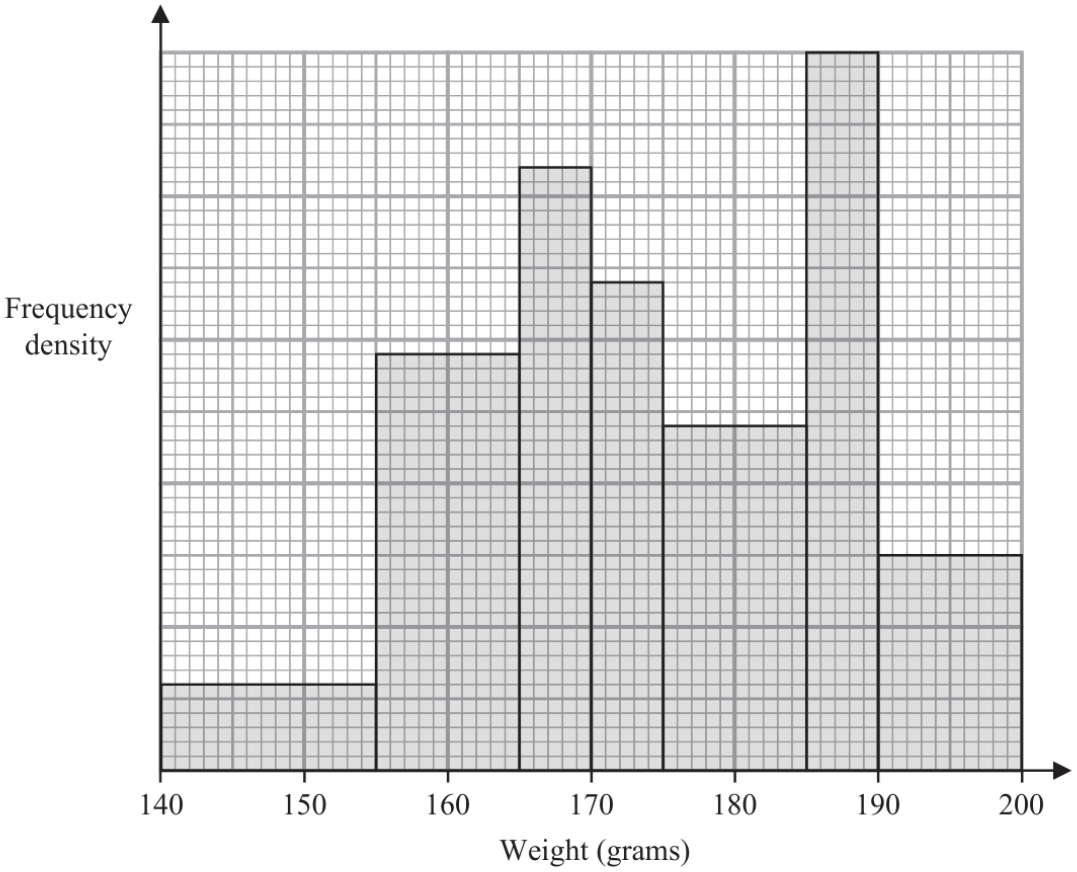
Final answer
120 m/s to 2 significant figures.

Question 22

5 marks

June 2026 | 4MA1/1H | Histogram frequency and conditional proportion

22 The histogram gives information about the weights, in grams, of all the apples in a shop.



There are 9 apples with a weight between 140 grams and 155 grams.

(a) Work out the number of apples with a weight less than 175 grams.

.....

(3)

An apple is classified as a large apple if it has a weight of more than 180 grams.
One of the large apples is chosen at random.

(b) Work out the probability that it has a weight of more than 190 grams.

.....

(2)

(Total for Question 22 is 5 marks)

Question 22 | Worked solution

5 marks

June 2026 | 4MA1/1H | Histogram frequency and conditional proportion

Part (a)

3 marks

STEP 1

The first class has width 15 g and frequency 9, so its density is $9/15 = 0.6$. Its height is 6 small grid squares, so each vertical square represents density 0.1. Frequency is class width multiplied by frequency density.

STEP 2

The classes below 175 g have densities $0.6, 2.9, 4.2, 3.4$ and widths $15, 10, 5, 5$, respectively. Read the bar heights using the calibrated vertical scale.

STEP 3

$$N = 15(0.6) + 10(2.9) + 5(4.2) + 5(3.4) = 9 + 29 + 21 + 17 = 76.$$

Add the frequencies, not the heights.

Final answer
76 apples

Part (b)

2 marks

STEP 1

Above 180 g, the frequency from 180 to 185 is $5(2.4) = 12$, from 185 to 190 is $5(5) = 25$, and from 190 to 200 is $10(1.5) = 15$. Use only half of the 175-185 bar and all of the two heavier classes.

STEP 2

$$P(W > 190 \mid W > 180) = \frac{15}{12 + 25 + 15} = \frac{15}{52}.$$

Restrict the denominator to the large apples.

Final answer
15/52

Question 23

5 marks

June 2026 | 4MA1/1H | Probability without replacement leading to a quadratic

23 A bag contains x marbles.
12 of the marbles are pink and the rest are yellow.

Greta takes at random 2 marbles from the bag.

The probability that Greta takes a pink marble and a yellow marble is $\frac{18}{47}$

Work out the value of x
Show clear algebraic working.

$x =$ .....

(Total for Question 23 is 5 marks)

Question 23 | Worked solution

5 marks

June 2026 | 4MA1/1H | Probability without replacement leading to a quadratic

Solution

5 marks

STEP 1

$$P(\text{one pink, one yellow}) = \frac{12}{x}\frac{x-12}{x-1} + \frac{x-12}{x}\frac{12}{x-1} = \frac{24(x-12)}{x(x-1)}.$$

Include pink-then-yellow and yellow-then-pink, without replacement.

STEP 2

$$\frac{24(x-12)}{x(x-1)} = \frac{18}{47} \implies 1128(x-12) = 18x(x-1).$$

Equate to the given probability and cross-multiply.

STEP 3

$$18x^2 - 1146x + 13536 = 0 \implies 3x^2 - 191x + 2256 = 0.$$

Rearrange and divide by 6.

STEP 4

$$(x-48)(3x-47) = 0 \implies x = 48 \text{ or } x = \frac{47}{3}.$$

Factorise the quadratic.

STEP 5

The number of marbles must be an integer, so $x = 48$. Reject the non-integer root.

Final answer

$x = 48$

Question 25

5 marks

June 2026 | 4MA1/1H | Angle between a line and a plane

25 The diagram shows a triangular prism $ABCDEF$ with horizontal rectangular base $ABCD$
F is vertically above A

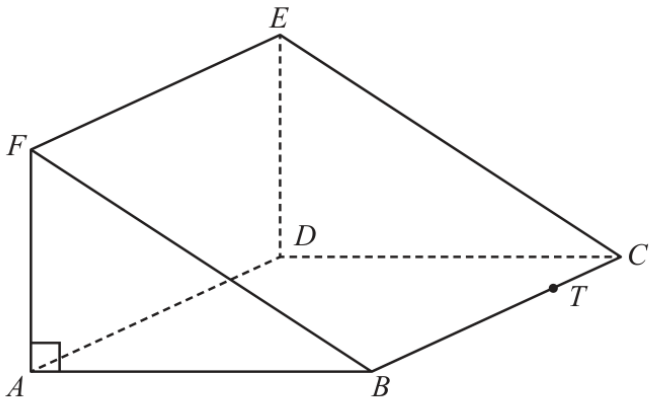


Diagram **NOT** accurately drawn

$AF = 12\,\text{cm}$ angle $ABF = 30°$ angle $BAF = 90°$

T is the point on the line BC such that $BF : BT = 3 : 2$

Work out the size of the angle between the line FT and the plane $ABCD$
Give your answer correct to one decimal place.
Show your working clearly.

..... °

(Total for Question 25 is 5 marks)

Question 25 | Worked solution

5 marks

June 2026 | 4MA1/1H | Angle between a line and a plane

Solution

5 marks

STEP 1

$$BF = \frac{12}{\sin 30^\circ} = 24 \text{ cm}, \qquad AB = \frac{12}{\tan 30^\circ} = 12\sqrt{3} \text{ cm}.$$

Use right triangle ABF.

STEP 2

$$BT = \frac{2}{3}BF = 16 \text{ cm}.$$

Apply the given BF:BT ratio.

STEP 3

$$AT = \sqrt{AB^2 + BT^2} = \sqrt{432 + 256} = \sqrt{688} = 4\sqrt{43} \text{ cm}.$$

AB is perpendicular to BC in the rectangular base, so triangle ABT is right-angled at B.

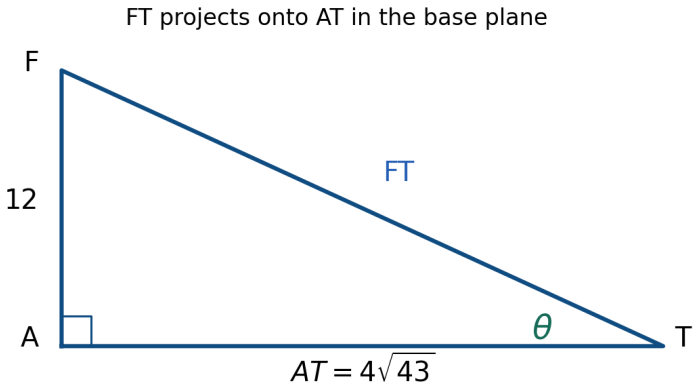
STEP 4

The projection of FT onto plane ABCD is AT because F lies vertically above A. Therefore the required angle is $\theta = \angle FTA$. A line-plane angle is the angle between the line and its perpendicular projection onto the plane.

STEP 5

$$\tan\theta = \frac{AF}{AT} = \frac{12}{4\sqrt{43}} = \frac{3}{\sqrt{43}}, \quad \theta = 24.583891\ldots^\circ = 24.6^\circ.$$

Use right triangle FAT and round to one decimal place.



Final answer
24.6°

Question 9

7 marks

June 2026 | 4MA1/2H | Indices and factorisation

9 (a) Find the value of $7n^0$ where $n > 0$

.....

(1)

(b) Simplify fully $\left(2m^5p^4\right)^3$

.....

(2)

(c) Factorise fully $18c^5w^2 + 30cw^3$

.....

(2)

(d) Factorise $x^2 + 6x - 27$

.....

(2)

(Total for Question 9 is 7 marks)

Question 9 | Worked solution

7 marks

June 2026 | 4MA1/2H | Indices and factorisation

Part (a)

1 marks

STEP 1

Since $n > 0$, $n^0 = 1$. Hence $7n^0 = 7(1) = 7$. A nonzero number raised to power zero equals 1; only n is raised to zero.

Final answer
7

Part (b)

2 marks

STEP 1

$$(2m^5p^4)^3 = 2^3m^{5\times3}p^{4\times3} = 8m^{15}p^{12}.$$

Cube the coefficient and multiply each exponent by 3.

Final answer
$8m^{15}p^{12}$

Part (c)

2 marks

STEP 1

The highest common factor of $18c^5w^2$ and $30cw^3$ is $6cw^2$. Take the numerical HCF and the smallest power of each shared variable.

STEP 2

$$18c^5w^2 + 30cw^3 = 6cw^2(3c^4 + 5w).$$

Divide each original term by the common factor.

Final answer
$6cw^2(3c^4 + 5w)$

Part (d)

2 marks

STEP 1

Two numbers with product -27 and sum 6 are 9 and -3. For a monic quadratic, find a factor pair with the required sum.

STEP 2

$$x^2 + 6x - 27 = (x + 9)(x - 3).$$

The cross terms are -3x+9x=6x.

Final answer
$(x + 9)(x - 3)$

Question 12

2 marks

June 2026 | 4MA1/2H | Set operations

12 $\mathscr{E} = \{\text{integers } x \text{ such that } 20 \leqslant x \leqslant 32\}$

$A = \{x \text{ such that } x < 27\}$

$B = \{x \text{ such that } 25 \leqslant x \leqslant 30\}$

(a) List the members of the set $A \cap B$

.....

(1)

(b) List the members of the set $(A \cup B)'$

.....

(1)

(Total for Question 12 is 2 marks)

Question 12 | Worked solution

2 marks

June 2026 | 4MA1/2H | Set operations

Part (a)

1 marks

STEP 1

Within the universal set, $A = \{20, 21, 22, 23, 24, 25, 26\}$ and $B = \{25, 26, 27, 28, 29, 30\}$. Their common members are 25 and 26. Intersection consists of elements in both sets.

Final answer

$A \cap B = \{25, 26\}$

Part (b)

1 marks

STEP 1

$A \cup B = \{20, 21, \ldots, 30\}$. The members of $\mathcal{E} = \{20, 21, \ldots, 32\}$ outside this union are 31 and 32. Take the complement relative to the stated universal set, not all integers.

Final answer

$(A \cup B)' = \{31, 32\}$

Question 15

4 marks

June 2026 | 4MA1/2H | Sector area and perimeter

15 The diagram shows a sector $OABC$ of a circle, centre O

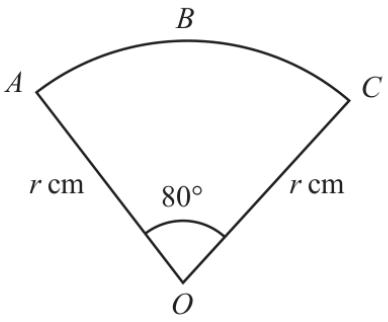


Diagram **NOT** accurately drawn

$OA = OC = r$ cm angle $AOC = 80^\circ$

The area of the sector $OABC$ is 32π cm^2

Work out the perimeter of the sector $OABC$
Give your answer correct to one decimal place.

..... cm

(Total for Question 15 is 4 marks)

Question 15 | Worked solution

4 marks

June 2026 | 4MA1/2H | Sector area and perimeter

Solution

4 marks

STEP 1

$$\frac{80}{360}\pi r^2 = 32\pi \quad \Rightarrow \quad r^2 = 32\frac{360}{80} = 144 \quad \Rightarrow \quad r = 12 \text{ cm}.$$

Use the fraction of the full circle and choose the positive radius.

STEP 2

$$\text{Arc length} = \frac{80}{360}(2\pi \times 12) = \frac{16\pi}{3} \text{ cm}.$$

The same central-angle fraction applies to the circumference.

STEP 3

$$P = 12 + 12 + \frac{16\pi}{3} = 40.7551608\ldots \text{ cm}.$$

The sector perimeter contains both radii as well as the arc.

Final answer
40.8 cm (1 decimal place).

Question 17

2 marks

June 2026 | 4MA1/2H | Recurring decimal proof

17 Use algebra to show that $0.5\dot{3}\dot{9} = \frac{89}{165}$

(Total for Question 17 is 2 marks)

Question 17 | Worked solution

2 marks

June 2026 | 4MA1/2H | Recurring decimal proof

Solution

2 marks

STEP 1

Let $x = 0.5\overline{39} = 0.5393939\ldots$. Then $10x = 5.393939\ldots$ and $1000x = 539.393939\ldots$. Shift past the non-recurring digit and then one complete two-digit recurring block.

STEP 2

Subtract:

$$1000x - 10x = 539.393939\ldots - 5.393939\ldots = 534.$$

$$990x = 534 \quad \Rightarrow \quad x = \frac{534}{990} = \frac{89}{165}.$$

Identical infinite decimal tails cancel exactly; reduce the resulting fraction by 6.

Final answer

$0.5\overline{39} = \dfrac{89}{165}$.

Question 20

3 marks

June 2026 | 4MA1/2H | Independent events

20 A box only contains green counters and red counters.

Nuno chooses at random a counter from the box.
He puts the counter back into the box.

Nuno then chooses at random a second counter from the box.

The probability that Nuno chooses at least one red counter is $\frac{39}{64}$

Work out the probability that Nuno chooses exactly one red counter.

.....

(Total for Question 20 is 3 marks)

Question 20 | Worked solution

3 marks

June 2026 | 4MA1/2H | Independent events

Solution

3 marks

STEP 1

Let $g = P(G)$. With replacement, the draws are independent.

$$P(GG) = 1 - P(\text{at least one red}) = 1 - \frac{39}{64} = \frac{25}{64}.$$

The complementary event to at least one red is two greens.

STEP 2

$$g^2 = \frac{25}{64} \quad \Rightarrow \quad g = \frac{5}{8}, \qquad P(R) = 1 - \frac{5}{8} = \frac{3}{8}.$$

Multiply identical independent green probabilities and take the nonnegative root.

STEP 3

$$P(\text{exactly one red}) = P(RG) + P(GR) = \frac{3}{8}\frac{5}{8} + \frac{5}{8}\frac{3}{8} = \frac{30}{64} = \frac{15}{32}.$$

The two possible orders are mutually exclusive and must both be included.

Final answer

$$\frac{15}{32}$$