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4MA1 June 2027 Paper 2H Best Guess Paper

Higher · Standard · Model Answers

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Model Answers

Step-by-step worked answers.
Use with the matching question paper.

Calculator allowed · 25 questions · 100 marks · Suggested time: 2 hours.

Paper 2H · Standard Higher · Model Answers

Question 1 · Compound interest and percentage profit · 4 marks

Part (a)

Value $= £5000 \times 1.024^3$.

This is £5368.70912, so the value to the nearest penny is £5368.71.

Answer: £5368.71

Part (b)

Profit $= £47.20 - £40 = £7.20$; use cost price as the denominator.

$$\text{Percentage profit} = \frac{7.20}{40} \times 100 = 18\%.$$

Answer: 18%

Question 2 · Currency exchange · 4 marks

Bureau A gives $1200 \times 0.92 = 1104$ euros.

Bureau B deducts its fee first: $1200 - 20 = 1180$ US dollars are converted.

Bureau B gives $1180 \times 0.95 = 1121$ euros.

$1121 - 1104 = 17$ euros, so Bureau B gives 17 more euros.

Answer: Bureau B; 17 more euros.

Question 3 · Regular polygons · 3 marks

Part (a)

The exterior angles of any convex polygon sum to 360°.

Number of sides $= 360^\circ \div 15^\circ = 24$.

Answer: 24 sides

Part (b)

Each interior angle is $180^\circ - 15^\circ = 165^\circ$.

Answer: 165°

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Question 4 · Standard form · 3 marks

Part (a)

A power of 10^{-4} moves the decimal point four places left: 0.00034.

Answer: 0.00034

Part (b)

Multiply coefficients and add powers: $4.5 \times 6 \times 10^{9} = 27 \times 10^{9}$.

Normalise the coefficient: $27 \times 10^{9} = 2.7 \times 10^{10}$.

Answer: 2.7×10^{10}

Question 5 · Factorisation and solving · 3 marks

Part (a)

Find two numbers with product -10 and sum 3: 5 and -2.

Factorise the quadratic: $x^2 + 3x - 10 = (x + 5)(x - 2)$.

Answer: $(x + 5)(x - 2)$

Part (b)

Set $x + 5 = 0$ or $x - 2 = 0$, giving $x = -5$ or $x = 2$.

Answer: $x = -5$ or $x = 2$

Question 6 · Index laws · 3 marks

Part (a)

Any non-zero number raised to the power zero is 1, so $7^{0} = 1$.

Answer: 1

Part (b)

Apply the power to each factor: $(p^3q^2)^2 = p^6q^4$.

Divide by p^2q^5: $p^{6-2}q^{4-5} = p^4q^{-1} = \dfrac{p^4}{q}$.

Answer: $\dfrac{p^4}{q}$

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Question 7 · Connected right-angled triangles · 4 marks

In right-angled triangle BCD, $\cos 57^\circ = \frac{BD}{12}$.

Therefore $BD = 12 \cos 57^\circ = 6.535668420\ldots$ cm. Keep the unrounded value.

In right-angled triangle ABD, $AB^2 = AD^2 - BD^2 = 10^2 - (12 \cos 57^\circ)^2$.

Taking the positive square root gives $AB = 7.568688017\ldots$ cm $= 7.57$ cm to 3 significant figures.

Answer: 7.57 cm (3 significant figures)

Question 8 · Regions and inequalities · 3 marks

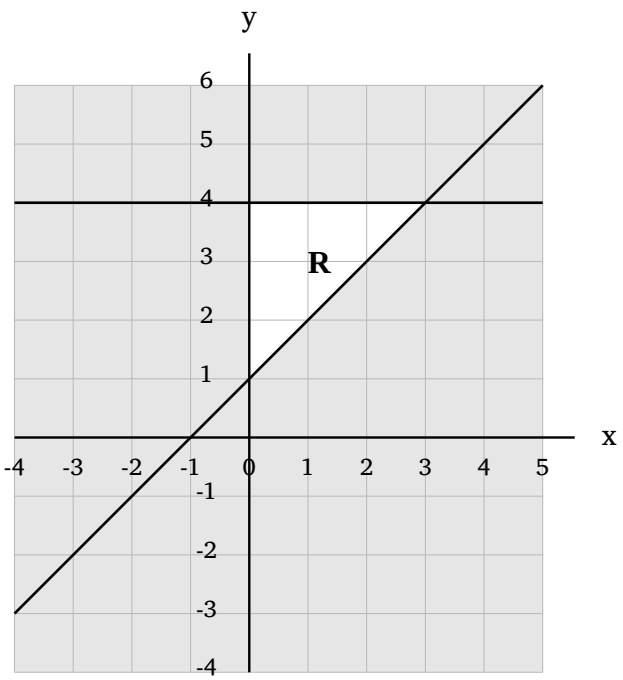
Draw the solid boundary line $y = x + 1$.

Draw the solid boundary line $y = 4$.

The third boundary is the given y-axis, $x = 0$. Shade the right of the y-axis, above $y = x + 1$ and below $y = 4$. Label the required triangle R; its boundaries are included.

Answer: The triangular region with vertices (0, 1), (0, 4), (3, 4), including its boundaries.

Diagram for Q8



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Question 9 · Cumulative frequency · 5 marks

Part (a)

Add successive frequencies: 14; 14 + 28 = 42; 42 + 22 = 64; 64 + 12 = 76; 76 + 4 = 80.

Answer: 14, 42, 64, 76, 80

Part (b)

Plot cumulative totals against upper class boundaries: (10, 14), (20, 42), (30, 64), (40, 76), (50, 80).

Include (0, 0) and join the points with a smooth increasing curve or sensible straight segments.

Answer: Graph through (0, 0), (10, 14), (20, 42), (30, 64), (40, 76), (50, 80).

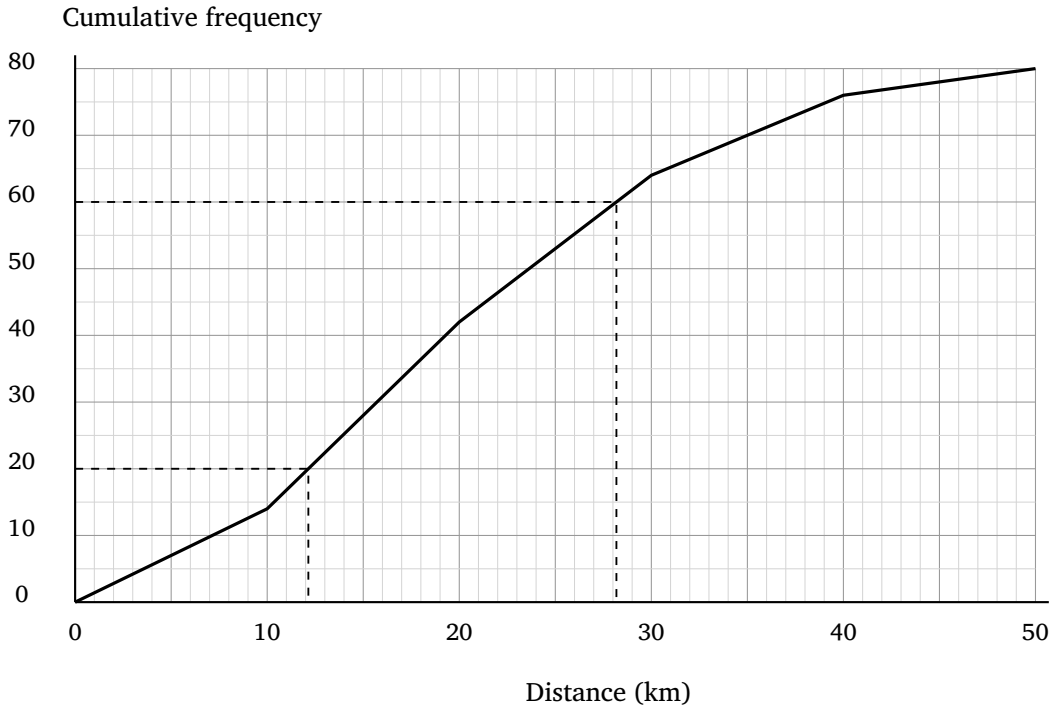
Part (c)

For 80 workers, read Q1 at cumulative frequency 20 and Q3 at cumulative frequency 60.
Straight-segment readings give Q1 ≈ 12.14 km and Q3 ≈ 28.18 km.

IQR = Q3 − Q1 ≈ 28.18 − 12.14 = 16.04 km, about 16 km.

Answer: Approximately 16 km

Diagram for Q9



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Question 10 · Loci and regions: area of sectors · 4 marks

The square shed blocks 90°, leaving a 270° main sector: $\frac{270}{360}\pi(4a)^2 = 12\pi a^2$.

Around either adjacent corner, the remaining cable is $4a - 2a = 2a$.

The two additional 90° sectors have combined area $2 \times \frac{90}{360}\pi(2a)^2 = 2\pi a^2$. They do not overlap.

The maximum area the mower can cut is $12\pi a^2 + 2\pi a^2 = 14\pi a^2$.

Answer: $14\pi a^2$

Question 11 · Upper bound of speed · 4 marks

230 km correct to the nearest 10 km gives an upper distance bound of 235 km.

4.5 hours correct to 1 decimal place gives a lower time bound of 4.45 hours.

An upper speed bound uses the largest distance divided by the smallest time: $235 \div 4.45$.

The bound is 52.80898… km/h, or 52.8 km/h to 3 significant figures.

Answer: 52.8 km/h

Question 12 · Rearranging a formula · 3 marks

Multiply by $x - 3$: $y(x - 3) = 2x + 5$, so $xy - 3y = 2x + 5$.

Collect and factor the x terms: $xy - 2x = 3y + 5$, so $x(y - 2) = 3y + 5$.

Divide by $y - 2$: $x = \frac{3y + 5}{y - 2}$. The restriction is not a separate marking point.

Answer: $x = \frac{3y + 5}{y - 2}$, $y \neq 2$.

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Question 13 · Rationalising surds · 4 marks

Part (a)

Multiply numerator and denominator by the conjugate $3 + \sqrt{5}$.

$$\frac{14}{3 - \sqrt{5}} = \frac{14(3 + \sqrt{5})}{(3 - \sqrt{5})(3 + \sqrt{5})} = \frac{14(3 + \sqrt{5})}{9 - 5}.$$

Simplify to $\frac{21 + 7\sqrt{5}}{2}$. Hence $a = 21$ and $b = 7$, both integers.

Answer: $\frac{21 + 7\sqrt{5}}{2}$, so $a = 21$ and $b = 7$.

Part (b)

Change the conjugate sign: $\frac{14}{3 + \sqrt{5}} = \frac{21 - 7\sqrt{5}}{2}$. This has the same denominator 2.

Answer: $\frac{21 - 7\sqrt{5}}{2}$

Question 14 · Similar solids · 4 marks

Surface-area ratio $B : A = 90 : 40 = 9 : 4$.

The linear scale factor from A to B is $\sqrt{(9 \div 4)} = \frac{3}{2}$.

The volume scale factor is $\frac{27}{8}$.

Volume of $B = 120 \times \frac{27}{8} = 405\ \text{cm}^3$.

Answer: $405\ \text{cm}^3$

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Question 15 · Differentiation and kinematics · 5 marks

Part (a)

Velocity is the derivative of displacement with respect to time.

Differentiate $s = 2t^3 - 9t^2 + 12t + 5$: $v = 6t^2 - 18t + 12$.

Answer: $v = 6t^2 - 18t + 12$ m/s

Part (b)

At rest, $v = 0$, so $6t^2 - 18t + 12 = 0$.

Divide by 6 and factorise: $t^2 - 3t + 2 = (t - 1)(t - 2) = 0$.

Therefore $t = 1$ or $t = 2$ seconds. Both satisfy $t \geq 0$.

Answer: $t = 1$ s or $t = 2$ s

Question 16 · Recurring decimals and fractions · 4 marks

$x = 0.222\ldots$ gives $10x - x = 2$, so $9x = 2$ and $x = \frac{2}{9}$.

For $y = 0.681818\ldots$, subtract $10y = 6.81818\ldots$ from $1000y = 681.81818\ldots$ to obtain $990y = 675$.

Therefore $y = \frac{675}{990} = \frac{15}{22}$.

Multiply: $xy = \frac{2}{9} \times \frac{15}{22} = \frac{30}{198} = \frac{5}{33}$, as required.

Answer: $\frac{5}{33}$, as required.

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Question 17 · Histogram and median · 3 marks

Part (a)

The missing frequencies total $160 - 30 - 60 = 70$, so $a + b = 70$. Frequency density is frequency divided by class width. The height ratio gives $\frac{a}{5} = 2 \times \frac{b}{15}$, so $3a = 2b$.

Solving gives $a = 28$ and $b = 42$. Award M1 for the density relation and A1 for both values.

Answer: $a = 28$, $b = 42$

Part (b)

The median is at cumulative frequency $160 \div 2 = 80$. The cumulative frequencies are 30, 58, 118, 160. Since $58 < 80 \leq 118$, the class interval which contains the median is $15 < w \leq 25$. Award B1 for the correct class interval.

Answer: $15 < w \leq 25$

Question 18 · Non-linear simultaneous equations · 5 marks

Substitute $y = 2x - 3$ into $2x^2 + y^2 = 30$: $2x^2 + (2x - 3)^2 = 30$.

Expand and simplify: $6x^2 - 12x - 21 = 0$, so $2x^2 - 4x - 7 = 0$.

Use the quadratic formula: $x = \frac{4 \pm \sqrt{72}}{4}$.

Simplify: $x = 1 \pm \frac{3\sqrt{2}}{2}$.

Substitute each value into $y = 2x - 3$ to obtain $y = -1 \pm 3\sqrt{2}$, with matching signs.

Answer: $x = 1 + \frac{3\sqrt{2}}{2}$, $y = -1 + 3\sqrt{2}$; or $x = 1 - \frac{3\sqrt{2}}{2}$, $y = -1 - 3\sqrt{2}$.

Question 19 · Angle between line and plane · 4 marks

The projection of BH onto plane ABCD is BD. The required angle is HBD.

$BD = \sqrt{(10^2 + 6^2)} = \sqrt{136}$ cm.

In right triangle BDH, $\tan\theta = \frac{DH}{BD} = \frac{5}{\sqrt{136}}$.

$\theta = \tan^{-1}(5 \div \sqrt{136}) = 23.20706\ldots°$, which rounds to 23.2°.

Answer: 23.2°

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Question 20 · Vectors in a triangle · 4 marks

Since M is the midpoint, $\mathrm{OM} = \frac{1}{2}(\mathrm{a} + \mathrm{b})$.

$\mathrm{ON} : \mathrm{NB} = 1 : 2$, so $\mathrm{ON} = \frac{1}{3}\mathrm{b}$.

$\mathrm{MN} = \mathrm{ON} - \mathrm{OM} = \frac{1}{3}\mathrm{b} - \frac{1}{2}(\mathrm{a} + \mathrm{b})$.

Collect terms: $\mathrm{MN} = -\frac{1}{2}\mathrm{a} - \frac{1}{6}\mathrm{b}$.

Answer: $-\frac{1}{2}\mathrm{a} - \frac{1}{6}\mathrm{b}$

Question 21 · Turning points · 5 marks

Differentiate: $\mathrm{dy/dx} = 6\mathrm{x}^2 - 6\mathrm{x} - 12$.

At a stationary point, $6\mathrm{x}^2 - 6\mathrm{x} - 12 = 0$, so $(\mathrm{x} - 2)(\mathrm{x} + 1) = 0$.

Thus the two x-coordinates are $\mathrm{x} = -1$ and $\mathrm{x} = 2$.

Substitute into the original cubic: $\mathrm{y}(-1) = -2 - 3 + 12 + 5 = 12$; $\mathrm{y}(2) = 16 - 12 - 24 + 5 = -15$.

The coordinates are $(-1, 12)$ and $(2, -15)$. They are respectively a maximum and minimum; classification is not required for a mark.

Answer: $(-1, 12)$ and $(2, -15)$

Question 22 · Transformations of functions · 4 marks

g(x)

A translation 4 units right replaces x by $\mathrm{x} - 4$ inside f.

A translation 3 units down subtracts 3 outside f: $\mathrm{g(x)} = \mathrm{f(x} - 4) - 3$.

Answer: $\mathrm{g(x)} = \mathrm{f(x} - 4) - 3$

h(x)

A stretch parallel to the x-axis with scale factor 2 doubles each x-coordinate.

Replace the input x by x/2: $\mathrm{h(x)} = \mathrm{f}(\frac{\mathrm{x}}{2})$. Accept f(0.5x).

Answer: $\mathrm{h(x)} = \mathrm{f}(\frac{\mathrm{x}}{2})$

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Question 23 · Algebraic probability · 5 marks

Let the total number of counters be N. Probability of two red counters is $\frac{5}{N} \times \frac{4}{N-1}$.

Set this equal to $\frac{5}{14} : \frac{20}{N(N-1)} = \frac{5}{14}$.

Cross-multiply and simplify: $N(N-1) = 56$, so $N^2 - N - 56 = 0$.

Factorise: $(N-8)(N+7) = 0$.

Reject $N = -7$ because a number of counters must be positive. $N = 8$ gives $\frac{5}{8} \times \frac{4}{7} = \frac{5}{14}$, as required.

Answer: 8 counters

Question 24 · Cosine rule and exact values · 5 marks

Cosine rule gives $7^2 = x^2 + (x+2)^2 - 2x(x+2)\cos 60°$.

Use $\cos 60° = \frac{1}{2}$ and expand: $49 = x^2 + 2x + 4$.

Rearrange to $x^2 + 2x - 45 = 0$, or $(x+1)^2 = 46$.

Take square roots: $x = -1 \pm \sqrt{46}$.

Reject the negative value because x is a length. The exact answer is $x = \sqrt{46} - 1$.

Answer: $x = \sqrt{46} - 1$

Question 25 · Arithmetic series · 5 marks

Let the first term be a and the common difference be d. From $S_{60} = 528$, $30(2a + 59d) = 528$, so $2a + 59d = 17.6$.

The 55th term gives $a + 54d = 18.6$. Double this and subtract the sum equation: $49d = 19.6$, so $d = 0.4$ and $a = -3$.

Use $S_X = 261$: $\frac{X}{2}[-6 + 0.4(X-1)] = 261$, giving $X^2 - 16X - 1305 = 0$.

Factorise: $(X-45)(X+29) = 0$, so $X = 45$ or $X = -29$.

X counts terms and must be a positive integer, so $X = 45$. Check: $\frac{45}{2}[-6 + 44(0.4)] = 261$.

Answer: $X = 45$