Paper 1

Answer **all** the questions.

1 The table shows the maximum and minimum temperatures of three cities in a day during the month of January.

| City | Beijing | Geneva | Helsinki |
|---|---|---|---|
| Maximum temperature | 2°C | 5°C | −1°C |
| Minimum temperature | −8°C | −1°C | −7°C |

(a) Find the average of the minimum temperatures of Beijing and Geneva.

$$\frac{-8 + -1}{2}$$

*Answer* ..... −4.5 °C [1]

(b) State the city with the biggest difference between its maximum and minimum temperatures. Show the calculations you make.

2 − (−8) = 10

*Answer* ..... Beijing [1]

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2 A bag contains only red, blue and yellow marbles.

$\frac{1}{6}$ of the marbles are yellow. The ratio of red and blue marbles is 2 : 3.

(a) Write the ratio of yellow marbles : blue marbles in its simplest form.

R : B : Y

2 : 3 : 1

*Answer* ..... 1 : 3 [1]

(b) If the bag contains 16 yellow marbles, how many blue marbles are there?

3 × 16 = 48

*Answer* ..... 48 [1]

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3 Express 71 km/h in m/s, giving your answer correct to 2 significant figures.

$\frac{71 \times 1000}{60 \times 60}$ M1

$= 19.722$

$\frac{71\ km}{1\ h} \rightarrow \frac{m}{s}$

$\frac{1}{}\ km \longrightarrow \frac{1000}{}\ m$

$\frac{1}{}\ h \longrightarrow \frac{60 \times 60 = 3600}{}\ sec$

*Answer* ..... 20 A1 ..... m/s [2]

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4 (a) Subtract the sum of $-3x^2 + 15 - 10x$ and $9x^2 + 3x - 14$ from $-7x + 15x^2 + 1$. — biggie

$-7x + 15x^2 + 1 - (-3x^2 + 15 - 10x + 9x^2 + 3x - 14)$

M1

$-7x + 15x^2 + 1 - 6x^2 - 1 + 7x$

Sum $= 6x^2 - 7x + 1$

*Answer* ..... $9x^2$ A1 ..... [2]

(b) The cube root of $r$ is equal to $24x$ divided by the square root of $9x^2$.
Find the value of $r$.

$\sqrt{9x^2}$

$\sqrt[3]{r} = \frac{24x}{\sqrt{9x^2}}$ M1

$= \frac{24x}{3x}$

$= 8$

$r = 8^3$

$= 512$

$\sqrt{x^2}$ $\sqrt{9}$

$= (x^2)^{\frac{1}{2}}$ $= 3$

$= x$

$\sqrt{4^2}$ or $(4^2)^{\frac{1}{2}}$

$= 4$

| $x^{\frac{1}{3}}$ | $x^{\frac{2}{3}}$ |
|---|---|
| $= \sqrt[3]{x}$ | $(\sqrt[3]{x})^2$ |
| $x^{\frac{1}{4}}$ | |
| $= \sqrt[4]{x}$ | |

*Answer* $r =$ ..... 512 A1 ..... [2]

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5 The body mass index, *BMI*, for a person with mass $m$ kg and height $h$ metres, is given by the formula

$$BMI = \frac{m}{h^2}$$

(a) The body mass index for a person in the healthy range is $18.5 \leq BMI < 23$.
If Belinda's height is 172cm, find the maximum mass of Belinda to stay within the healthy range. Give your answer as an integer.

$\frac{m}{1.72^2} < 23$ M1

$m < 68.0432$

or $m = 23 \times 1.72^2$
$m = 22.9 \times 1.72^2$

*Answer* 68 A1 kg [2]

(b) Rearrange the formula to make $h$ the subject.

$h^2 = \frac{m}{BMI}$

*Answer* $h = \pm\sqrt{\frac{m}{BMI}}$ [1]

6 A monitor cost $\frac{1}{5}$ as much as a laptop. The total cost of the monitor and laptop after a 30% discount is $2730. Find the cost of the laptop before discount.

Before discount, total cost $= \frac{100}{70} \times 2730$
$= 3900$

monitor and laptop
M1

monitor $= \frac{1}{5} \times$ laptop

$\frac{\text{monitor}}{\text{laptop}} = \frac{1}{5}$

laptop $= \frac{5}{6} \times 3900$
$= 3250$

monitor : laptop
$= 1 : 5$

*Answer* $ 3250 A1 [2]

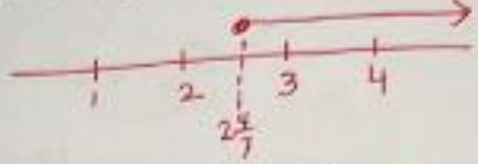
7 Find the smallest prime number satisfying the inequality $-2x \leq 5x - 18$.

$-7x \leq -18$

$x \geqslant \frac{18}{7}$ M1

No mark if $x \leq 2\frac{4}{7}$ and answer is 3

Solution → $x \geqslant 2\frac{4}{7}$




3 A1

*Answer* ..... [2]

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8 In a sequence, a constant number is subtracted from the previous number to obtain the next term. The first four terms of the sequence are 35, $p$, $q$ and 11.

(a) Find the values of $p$ and $q$.

↳ ↳ ↳

−8 −8 −8

$\frac{35-11}{3}$

$= 8$

*Answer* $p =$ 27

$q =$ 19 [1]

43 (−8n)

(b) Find an expression for the $n$th term of the sequence.

when $n=1$, $43 - 8n = 35$ (n = 1)

when $n=4$, $43 - 8(4) = 11$

*Answer* 43 − 8n [1]

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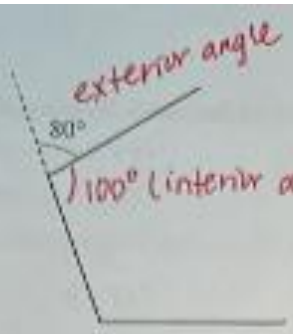
9 (a)




Award M1 for any use of angle properties to justify correctly

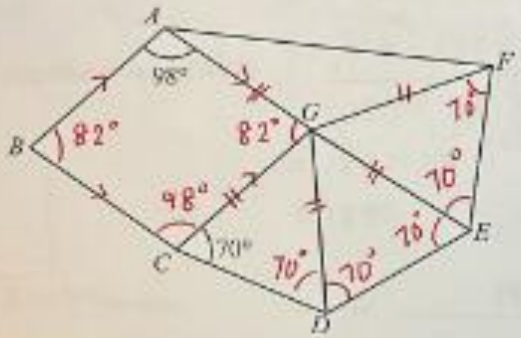
Benny says the diagram above is part of a regular polygon.
Is he correct? Explain your answer.

no. of sides ← $n = \frac{360°}{80} = 4.5$ M1

Answer Not correct because the number of sides is not an integer. A1

[2]

(b)




$ABCG$ is a rhombus and angle $GAB$ is 98°. $CGD$, $EGD$ and $FGE$ are congruent triangles whereby $GC = GD = GE = GF$ and angle $GCD$ is 70°.
Find angle $AGF$.

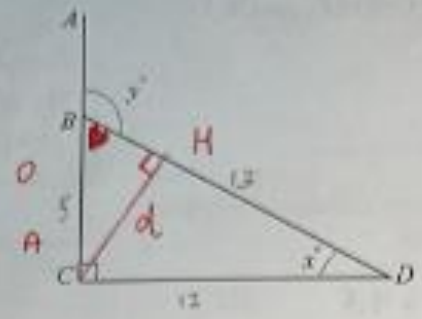
$\angle AGC = 180° - 98°$
$= 82°$

$\angle CGD = 180° - 70° - 70°$ M1
$= 40°$

$\angle AGF = 360° - 82° - 40° - 40° - 40°$
$= 158°$

Answer 158° A1 [2]

10 In the diagram, $ABC$ is a straight line, $CD = 12$cm, $BD = 13$cm and angle $BCD = 90°$.




TOA
CAH
SOH

(a) Find as a fraction in its simplest form, the value of

(i) $\sin x°$,

$BC = \sqrt{13^2 - 12^2}$

$= 5$ M1

Answer $\frac{5}{13}$ A1 [2]

(ii) $\cos y°$.

Answer $-\frac{5}{13}$ [1]

(b) Find the shortest distance from $C$ to $BD$.

$\frac{1}{2} \times d \times 13 = \frac{1}{2} \times 5 \times 12$ M1

$d = 4.62$

Answer 4.62 A1 cm [2]

11 When written as the product of their prime numbers,

$588 = 2^2 \times 3 \times 7^2$

$140 = 2^2 \times 5 \times 7$

(a) Find the smallest integer $k$ such that $140k$ is a square number.

$5^2$ $7^2$

$5 \times 7$

$\frac{140}{K} = \frac{2^2 \times 5 \times 7}{K}$ $K = 5 \times 7$

$140K = 2^2 \times 5 \times 7 \times K$

square number

$K = 35$

Answer $k =$ 35 [1]

(b) Identical cubes are placed in a rectangular box measuring 504mm by 588mm by 140mm. Find the number of cubes to fit the box exactly.

least

$588 = 2^2 \times 3 \times 7^2$

$504 = 2^3 \times 3^2 \times 7$

M1

$140 = 2^2 \times 5 \times 7$

(HCF) side of cube $= 2^2 \times 7$

$= 28\text{mm}$

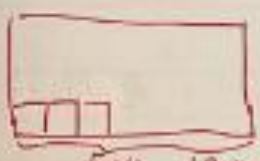
length breadth height

M1

Number of cubes $= \frac{504 \times 588 \times 140}{28 \times 28 \times 28}$ 414892

$= 18 \times 21 \times 5$

$= 1890$



504 18 cubes

Answer 1890 A1 cubes [3]

12 A number is selected randomly from 2-digit numbers that are less than 25.
Find the probability of selecting a prime number.

11, 13, 17, 19, 23

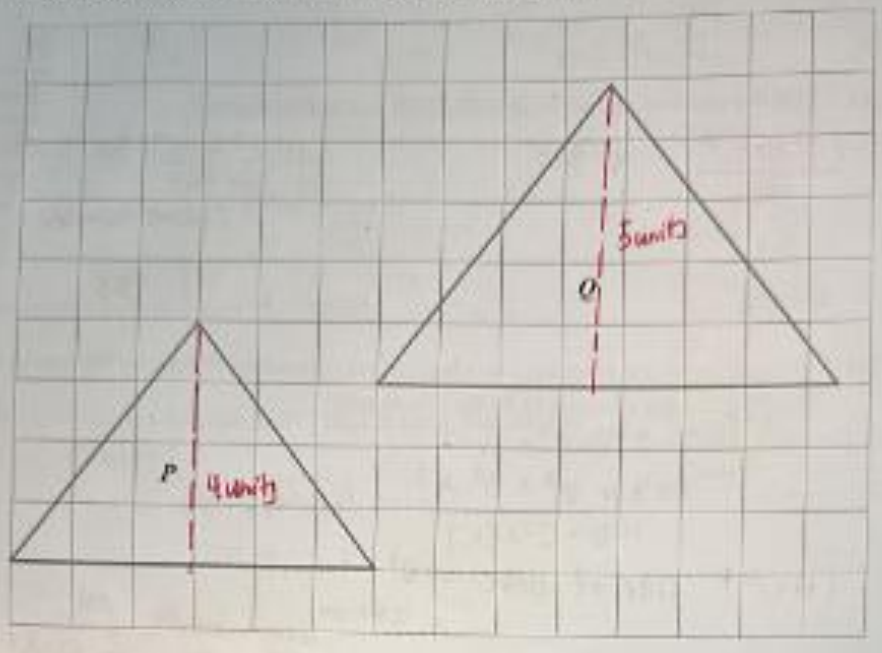
5 prime numbers

15 numbers

M1

Answer $\frac{1}{3}$ A1 [2]

13 Triangle $Q$ is an enlargement of Triangle $P$ on the 1-centimetre grid.




(a) Find the scale factor of the enlargement.

*Answer* ..... $\frac{5}{4}$ / 1.25 [1]

(b) Triangle $P$ is enlarged by a scale factor of 0.8 to Triangle $R$.
Find the area of Triangle $R$.

R is smaller than P

base = $6 \times 0.8$
= 4.8 cm

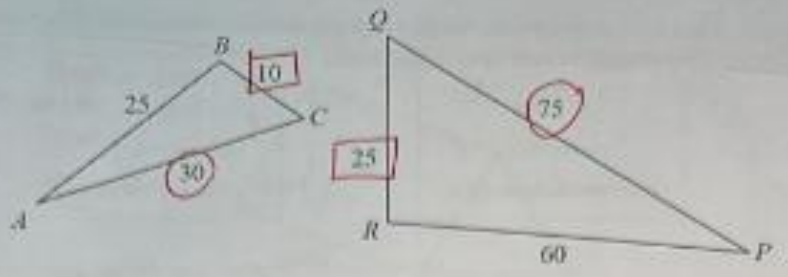
M1

height = $4 \times 0.8$
= 3.2 cm

area = $\frac{1}{2} \times 4.8 \times 3.2$
= $7.68\ cm^2$

*Answer* ..... 7.68 A1 ..... $cm^2$ [2]

14




All the lengths given are in centimetres.
Explain, with clear workings, why the two triangles are not similar.

$\frac{AB}{PR} = \frac{25}{60} = \frac{5}{12}$ $\quad \frac{BC}{QR} = \frac{10}{25} = \frac{2}{5}$ $\quad \frac{AC}{QR} = \frac{30}{75} = \frac{2}{5}$ M1

*Answer* The two triangles are not similar because the ratios of their corresponding lengths are not equal. A1

..... [2]

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15 $\frac{7x}{(x-6)^2} + \frac{2}{6-x} = \frac{ax+b}{(x-6)(x-6)}$

Find $a$ and $b$.

values of

$\frac{7x}{(x-6)^2} - \frac{2}{x-6} = \frac{ax+b}{(x-6)(x-6)}$ M1

$\frac{7x-2(x-6)}{(x-6)(x-6)} = \frac{ax+b}{(x-6)(x-6)}$

$\frac{5x+12}{(x-6)(x-6)} = \frac{ax+b}{(x-6)(x-6)}$

*Answer* $a =$ 5 A1

$b =$ 12 A1 [3]

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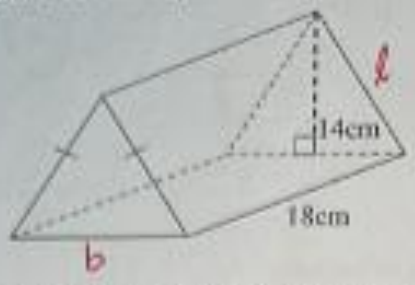
16 A right prism has a perpendicular height 14cm and uniform cross-sectional area of an isosceles triangle. The rectangular base has length 18cm.




vol. = cross section area × length

= △ × 18

Water is pumped into the prism at a constant rate of $12cm^3$ per second.
It takes approximately 1.4 minutes to fill the prism fully.

(a) (i) Calculate the volume of the prism.

$12cm^3$ — 1 sec

? — 1.4×60 sec

12×1.4×60 M1

*Answer* 1008 A1 $cm^3$ [2]

(ii) Hence, calculate the cross-sectional area of the prism.

$\frac{1008}{18}$

*Answer* 56 $cm^2$ [1]

(b) Calculate the total surface area of the prism.

$\frac{1}{2} \times b \times 14 = 56$

$b = 8$ M1

base area = 8×18
= 144

side of △, $l = \sqrt{14^2 + 4^2}$ M1
= 14.560...

Total area = 2×56 + 144 + 2(14.56×18)
= 780.16 ≈ 780

*Answer* 780 A1 $cm^2$ [3]

17 Benny has £5000 to invest for three years.
The offer in the saving accounts of two local banks for Singapore currency only is seen below.

| Bank *A* | Bank *B* |
|---|---|
| 2.75% per annum | 2.4 % per annum |
| Fixed for 3 years | Compounded annually |

The exchange rate for both banks is £1 for S$1.69.

Benny says Bank *B* gives more interest than Bank *A*.
Do you agree? Explain your answer.

£5000 = 1.69 × 5000
= S$8450

Award M1 if £5000 is used instead of S$

Bank A

$S.I. = \frac{8450 \times 2.75 \times 3}{100}$

= S$697.125

M1

or total = S$9147.125

Bank B

$C.I. = 8450\left(1+\frac{2.4}{100}\right)^3 - 8450$

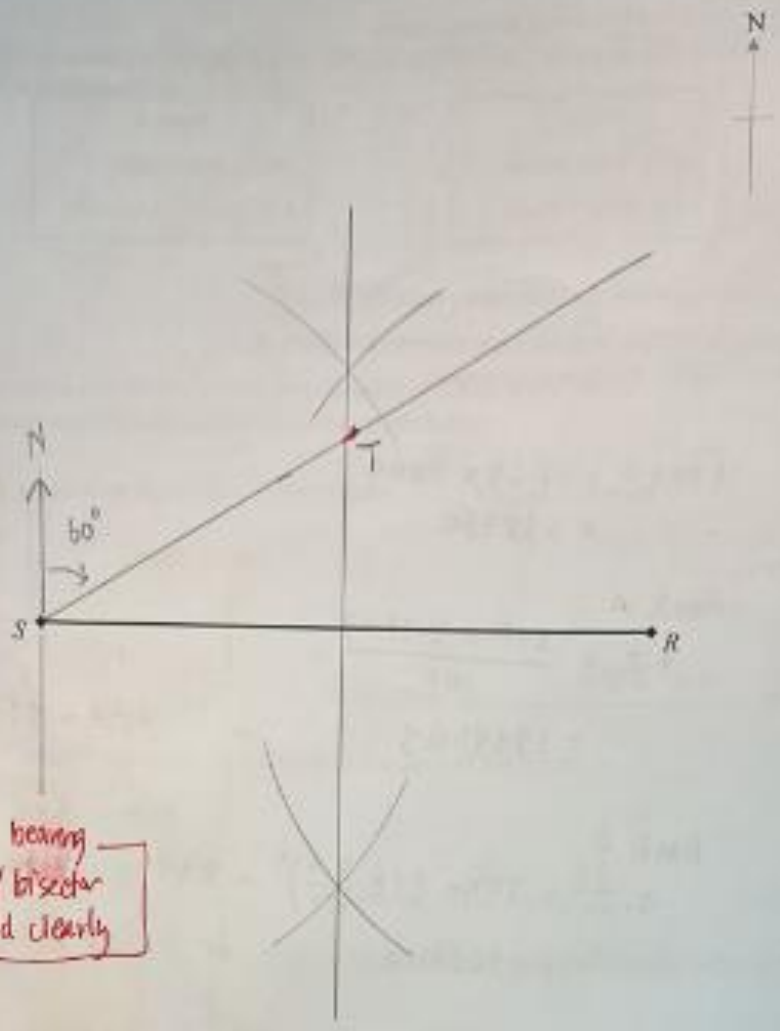
= S$623.12

or total = S$9073.12

Answer Disagree because the interest given by Bank A is A1 S$74.01 more than Bank B

[3]

18




Award M1 if bearing not accurate / bisector not constructed clearly

$S$, $T$ and $R$ are the positions of three schools on the map.
$S$ and $R$ are already indicated on the line above.
The bearing of $T$ from $S$ is 060° and intersects the perpendicular bisector of $SR$.

**(a)** By using constructions, find and label $T$. [2]

**(b)** Using a scale of 1cm to represent 2.5km, find the actual distance of $ST$.

5.8 cm x 2.5 = 14.5 km  or  5.9 cm x 2.5 = 14.75km

*Answer* .....km [1]

19 (a) By completing the square, express $x^2 - 8x + 5$ in the form of $(x + p)^2 + q$.

$= x^2 - 2(4)x + 4^2 - 4^2 + 5$ M1

$= (x-4)^2 - 11$

Answer $(x-4)^2 - 11$ [2]

(b) Hence, solve $2x^2 - 16x + 10 = 0$, giving your answers correct to 2 decimal places.

$2(x^2 - 8x + 5) = 0$ $\quad x^2 - 8x + 5 = \frac{0}{2}$

$x^2 - 8x + 5 = 0$ ←

$(x-4)^2 - 11 = 0$

$(x-4)^2 = 11$

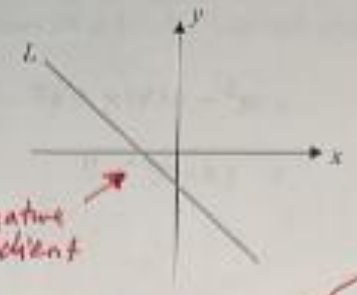
$x - 4 = \pm\sqrt{11}$ M1

$x = 4 \pm \sqrt{11}$

$= 7.32$ or $0.68$ A1 for both correct

Answer $x =$ 7.32 or 0.68 [2]

20 (a)




negative gradient

Benny says a possible equation for the line $L$ is $3x - 2y - 5 = 0$.

Is he correct? Explain your answer.

$2y = 3x - 5$

$y = \frac{3}{2}x - \frac{5}{2}$ M1

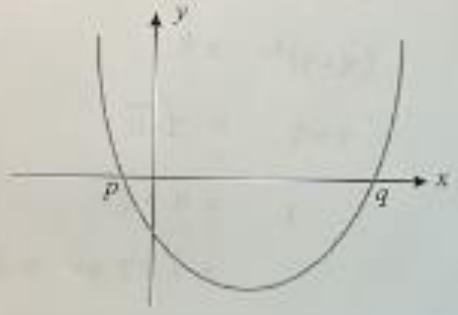
gradient

*Answer* Not correct because equation L should have negative M1

gradient but the given equation has positive gradient

[2]

(b)




The equation of the curve is $y = 2x^2 - 12x - 14$.

Find the values of $p$ and $q$.

or $2x^2 - 12x - 14 =$

$y = 2(x^2 - 6x - 7)$

$= 2(x+1)(x-7)$ $2(x+1)(x-7) =$

$2(x+1)(x-7) = 0$

$x = -1$ or $7$

*Answer* $p =$ $-1$ A1

$q =$ $7$ A1 [2]

21

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | | | | | | |
| 2 | 3 | 6 | 8 | 9 | | | | |
| 3 | 0 | 0 | [1] | 1 | 2 | 3 | 5 | 5 |
| 4 | 5 | 9 | | | | | | |

median

Key : 3 | 0 means 30 minutes

The stem and leaf diagram shows the amount of time (in minutes) taken by 15 students to complete an assignment.

(a) Find the angle of sector in a pie chart represented by students who took at least 30 minutes to complete an assignment. 30 or more

$\frac{9}{15} \times 360°$ M1

*Answer* 216° A1 [2]

(b) (i) Find the mean time.

$\frac{450}{15}$

*Answer* 30 minutes [1]

(ii) The time taken by a student to complete an assignment is missing from the stem and leaf diagram. When added to the data set, the median time remains unchanged. Find the largest possible time taken by the student.

*Answer* 30 minutes [1]

22 $A$ is the point $(k, -4)$.
$B$ is the point such that the $x$-coordinate is 3 less than the $x$-coordinate of point $A$ and the $y$-coordinate is 8 more than the $y$-coordinate of point $A$.

(a) Find the gradient of line $AB$.

$-4 + 8$

B is $(k-3, 4)$

gradient $= \frac{-4-4}{k-(k-3)}$

$= -\frac{8}{3}$

Answer $-\frac{8}{3}$ [1]

(b) Calculate the length of line $AB$.

$\sqrt{(-4-4)^2 + [k-(k-3)]^2}$

$= \sqrt{8^2+3^2}$

$= \sqrt{73}$

Answer 8.54 units [1]

(c) $C$ is the point $(3, -5)$ and lies on the line $AB$. Find the equation of line $AB$.

$y = -\frac{8}{3}x + c$

$-5 = -\frac{8}{3}(3) + c$ M1

$c = 3$

$y = -\frac{8}{3}x + 3$ A1

Answer $y = -\frac{8}{3}x + 3$ A1 [2]