UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5046732294

MATHEMATICS **0580/21**

Paper 2 (Extended) **May/June 2013**

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator
Tracing paper (optional)
Geometrical instruments

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question it must be shown below that question.
Electronic calculators should be used.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 70.

For Examiner's Use

1 One January day in Munich, the temperature at noon was 3°C.
At midnight the temperature was –8°C.

Write down the difference between these two temperatures.

$\star\ \Delta T = T_2 - T_1$

$\Rightarrow \Delta T = (-8 - 3)°C = -11°C$

Answer ..... −11 ..... °C [1]

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2 **(a)** Calculate $\sqrt{5.7} - 1.03^2$.

Write down all the numbers displayed on your calculator.

Answer(a) ..... 1·3265672776 ..... [1]

(b) Write your answer to **part (a)** correct to 3 decimal places.

Answer(b) ..... 1·327 ..... [1]

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3 Pedro and Eva do their homework.
Pedro takes 84 minutes to do his homework.

The ratio Pedro's time : Eva's time = 7 : 6.

Work out the number of minutes Eva takes to do her homework.

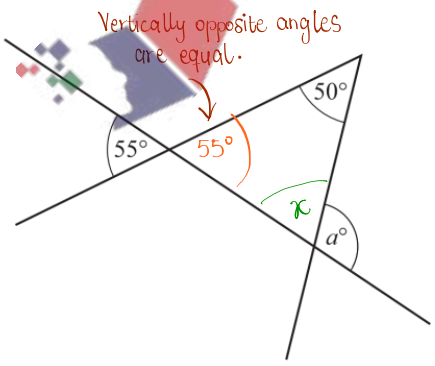
Pedro	Eva
7	6
84 mins	x

$\Rightarrow x = \frac{6}{7} \times 84$ mins

$\Rightarrow x = 72$ mins.

Answer ..... 72 ..... min [2]

4



NOT TO SCALE

Use the information in the diagram to find the value of a.

$\star\ x + a = 180°$

$\bullet\ x + 55° + 50° = 180°$

$\Rightarrow x = 75°$

$\Rightarrow a = 180° - 75°$

$\Rightarrow a = 105°$

Answer a = ... 105° ..... [2]

For Examiner's Use

5 Show that $1\frac{1}{2} \div \frac{3}{16} = 8$.

Do not use a calculator and show all the steps of your working.

Answer

$\star \; 1\frac{1}{2} \div \frac{3}{16}$

$\Rightarrow \frac{3}{2} \div \frac{3}{16}$

$\Rightarrow \frac{3}{2} \times \frac{16}{3}$

$\Rightarrow 8$

[2]

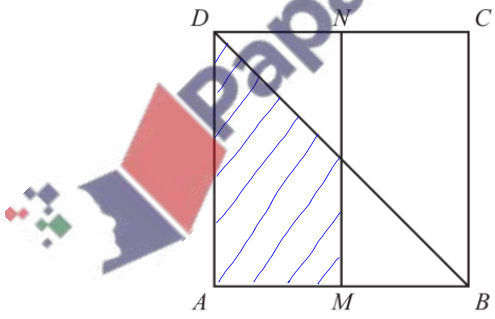
6 Factorise completely.

$12xy - 3x^2$

$\Rightarrow 3x(4y - x)$

Answer $3x(4y - x)$ [2]

7



The diagram shows a square $ABCD$.
M is the midpoint of AB and N is the midpoint of CD.

(a) Complete the statement.

The line MN is the locus of points inside the square which are

equidistant from A and B [1]

(b) Shade the region inside the square containing points which are nearer to AB than to BC **and** nearer to A than to B. [1]

For Examiner's Use

8 Solve the inequality.

$3x - 1 \leqslant 11x + 2$

$\Rightarrow -1 - 2 \leqslant 11x - 3x$

$\Rightarrow -3 \leqslant 8x$

$\Rightarrow -\frac{3}{8} \leqslant x$ OR $x \geqslant -\frac{3}{8}$

$x \geqslant -\frac{3}{8}$

Answer ..... [2]

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9 An equilateral triangle has sides of length 16.1 cm, correct to the nearest millimetre.

Find the lower and upper bounds of the perimeter of the triangle.

- 1 mm = 0.1 cm

$\star$ $l = 16.1\text{ cm} \pm \frac{0.1\text{ cm}}{2}$

$\Rightarrow P(LB) = 3\left(16.1 - \frac{0.1}{2}\right)\text{cm} = 48.15\text{ cm}$

$\Rightarrow P(UB) = 3\left(16.1 + \frac{0.1}{2}\right)\text{cm} = 48.45\text{ cm}$

Answer Lower bound = 48.15 cm

Upper bound = 48.45 cm [2]

---

10 Factorise completely.

$ap + bp - 2a - 2b$

$\Rightarrow p(a+b) - 2(a+b)$

$\Rightarrow (a+b)(p-2)$

Answer $(a+b)(p-2)$ [2]

---

11 Write $(27x^{12})^{\frac{1}{3}}$ in its simplest form.

$\Rightarrow (3^3 x^{12})^{1/3}$

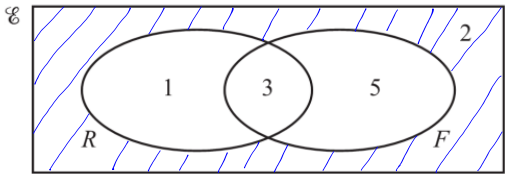
$\Rightarrow (3^3)^{1/3} (x^{12})^{1/3}$

$\Rightarrow 3x^4$

Answer $3x^4$ [2]

For Examiner's Use

12



11 students are asked if they like rugby (R) and if they like football (F).
The Venn diagram shows the results.

(a) A student is chosen at random.

What is the probability that the student likes rugby **and** football?

$\star\ P(R \cap F) = \frac{n(R \cap F)}{n(\mathcal{E})} = \frac{3}{11}$

Answer(a) $\frac{3}{11}$ [1]

(b) On the Venn diagram shade the region $R' \cap F'$. [1]

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13 Martina changed 200 Swiss francs (CHF) into euros (€).
The exchange rate was €1 = 1.14 CHF.

Calculate how much Martina received.
Give your answer correct to the nearest euro.

€1 = 1·14 CHF

x = 200 CHF

$\Rightarrow x = €175$ (nearest euro)

$\Rightarrow x = \frac{200\ \text{CHF}}{1{\cdot}14\ \text{CHF}} \times €1$

Answer € 175 [3]

---

14 Bruce invested $420 at a rate of 4% per year compound interest.

Calculate the **total** amount Bruce has after 2 years.
Give your answer correct to 2 decimal places.

$\star\ A = a\left(1 + \frac{r}{100}\right)^t$

$\Rightarrow A = \$420\left(1 + \frac{4}{100}\right)^2$

$\Rightarrow A = \$454{\cdot}27$ (2 dp)

Answer $ 454·27 [3]

For Examiner's Use

15 A sphere has a volume of $80\,cm^3$.

Calculate the radius of the sphere.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$\star\ V = \frac{4}{3}\pi r^3$

$\Rightarrow r^3 = \frac{3V}{4\pi}$

$\Rightarrow r = \left(\frac{3V}{4\pi}\right)^{1/3}$

$\Rightarrow r = \left(\frac{3 \times 80}{4\pi}\right)^{1/3}$ cm

$\Rightarrow r = 2.67$ cm (3 sig. figs.)

Answer 2.67 cm [3]

---

16 A water pipe has a circular cross section of radius 0.75 cm.
Water flows through the pipe at a rate of 16 cm/s.

Calculate the time taken for 1 litre of water to flow through the pipe.

$\star$ Volume rate = Across-section $\times$ length rate

$\Rightarrow$ Volume rate $= \pi(0.75\,cm)^2 \times 16\,\frac{cm}{s}$

$\Rightarrow$ Volume rate $= 9\pi\ cm^3/s$

• 1 litre $= 1000\,cm^3$

$9\pi\ cm^3 \rightarrow 1s$
$1000\,cm^3 \rightarrow x$

$\Rightarrow x = \frac{1000\,cm^3}{9\pi\,cm^3} \times 1s$

$\Rightarrow x = 35.4s$ (3 sig. figs.)

Answer 35.4 s [3]

For Examiner's Use

17 Find the equation of the line passing through the points (0, –1) and (3, 5).

$\star\ y = mx + c$

$\Rightarrow y = 2x + c$

Hence, $y = 2x - 1$

- $m = \frac{y_2 - y_1}{x_2 - x_1}$
- $5 = 2(3) + c$

$\Rightarrow m = \frac{5-(-1)}{3-0} = 2$

$\Rightarrow c = -1$

Answer $y = 2x - 1$ [3]

---

18 **(a)** Factorise $x^2 + x - 30$.

$\Rightarrow x^2 + 6x - 5x - 30$

$\Rightarrow x(x+6) - 5(x+6)$

$\Rightarrow (x+6)(x-5)$

Answer(a) $(x+6)(x-5)$ [2]

(b) Simplify $\frac{(x-5)(x+4)}{x^2+x-30}$.

$\Rightarrow \frac{(x-5)(x+4)}{(x+6)(x-5)}$

$\Rightarrow \frac{x+4}{x+6}$

Answer(b) $\frac{x+4}{x+6}$ [1]

For Examiner's Use

19 t varies inversely as the square root of u.
$t = 3$ when $u = 4$.

Find t when $u = 49$.

$\star\ t \propto \frac{1}{\sqrt{u}}$ $\Rightarrow t = \frac{6}{\sqrt{u}}$

$\Rightarrow t = \frac{k}{\sqrt{u}}$ when $u = 49$,

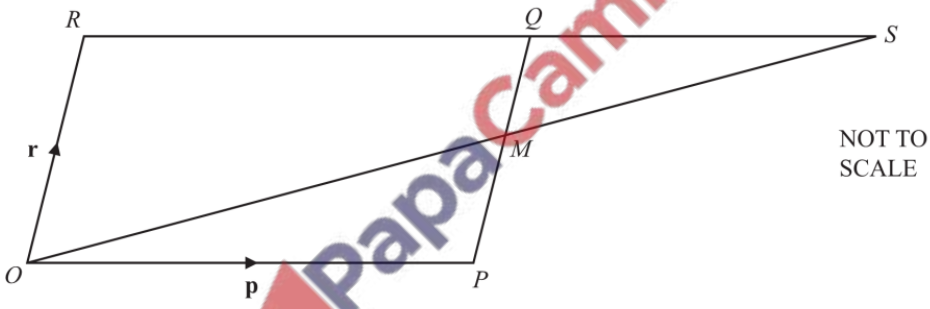
• Finding k:
when $t = 3$, $u = 4$ $\Rightarrow t = \frac{6}{\sqrt{49}}$

$\Rightarrow 3 = \frac{k}{\sqrt{4}}$ $\Rightarrow t = \frac{6}{7}$.

$\Rightarrow k = 6$.

Answer $t =$ $\frac{6}{7}$ [3]

20



NOT TO SCALE

$OPQR$ is a parallelogram, with O the origin.
M is the midpoint of PQ.
OM and RQ are extended to meet at S.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$.

(a) Find, in terms of **p** and **r**, in its simplest form,

(i) $\overrightarrow{OM}$, $\star\ \overrightarrow{OM} = \overrightarrow{OP} + \overrightarrow{PM}$ $\Rightarrow \overrightarrow{OM} = \mathbf{p} + \frac{1}{2}\mathbf{r}$

$\Rightarrow \overrightarrow{OM} = \overrightarrow{OP} + \frac{1}{2}\overrightarrow{PQ}$

Answer(a)(i) $\overrightarrow{OM} =$ $\mathbf{p} + \frac{1}{2}\mathbf{r}$ [1]

(ii) the position vector of S. $\Rightarrow \overrightarrow{OS} = 2\mathbf{p} + \mathbf{r}$

$\star\ \overrightarrow{OS} = 2 \times \overrightarrow{OM}$

$\Rightarrow \overrightarrow{OS} = 2(\mathbf{p} + \frac{1}{2}\mathbf{r})$

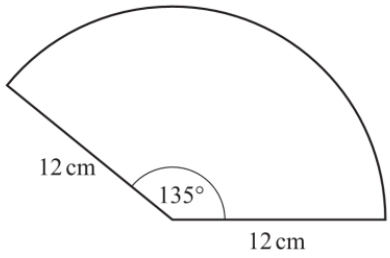
Answer(a)(ii) $2\mathbf{p} + \mathbf{r}$ [1]

(b) When $\overrightarrow{PT} = -\frac{1}{2}\mathbf{p} + \mathbf{r}$, what can you write down about the position of T?

Answer(b) T is the midpoint of RQ. [1]

For Examiner's Use

21



NOT TO SCALE

The diagram shows a sector of a circle of radius 12 cm with an angle of 135°.

Calculate the perimeter of the sector.

$\Rightarrow P = 12\text{cm} + 12\text{cm} + \left(\frac{135°}{360°} \times 2\pi \times 12\right)\text{cm}$

$\Rightarrow P = 52{\cdot}3\text{cm}$ (3 sig. figs.)

Answer 52·3 cm [3]

22 Write as a single fraction in its simplest form.

$$\frac{2}{x+3} + \frac{3}{x+2}$$

$$\Rightarrow \frac{2(x+2)+3(x+3)}{(x+3)(x+2)}$$

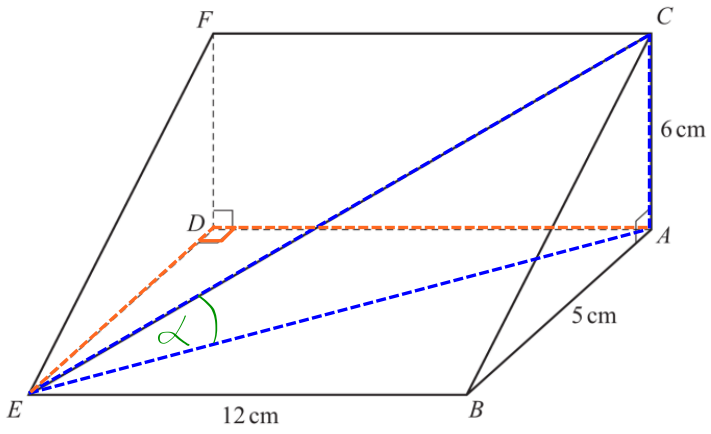
$$\Rightarrow \frac{2x+4+3x+9}{(x+3)(x+2)}$$

$$\Rightarrow \frac{5x+13}{(x+3)(x+2)}$$

Answer $\frac{5x+13}{(x+3)(x+2)}$ [3]

For Examiner's Use

23



NOT TO SCALE

The diagram shows a triangular prism of length 12 cm.
Triangle ABC is a cross section of the prism.
Angle $BAC = 90°$, $AC = 6$ cm and $AB = 5$ cm.

Calculate the angle between the line CE and the base $ABED$.

$\tan\alpha = \frac{6\text{cm}}{EA}$ $\Rightarrow \tan\alpha = \frac{6\text{cm}}{13\text{cm}}$

• Finding EA $\Rightarrow \alpha = \tan^{-1}\left(\frac{6}{13}\right)$

$EA^2 = ED^2 + DA^2$ $\Rightarrow \alpha = 24.8°$ (1dp)

$\Rightarrow EA = \left(\sqrt{12^2 + 5^2}\right)$ cm

$\Rightarrow EA = 13$cm

Answer 24.8° [4]

---

24 $\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 4 & 3 \\ 1 & 2 \end{pmatrix}$

Find

(a) AB,

$AB = \begin{pmatrix} (1\times4)+(2\times1) & (1\times3)+(2\times2) \\ (3\times4)+(4\times1) & (3\times3)+(4\times2) \end{pmatrix}$

$AB = \begin{pmatrix} 6 & 7 \\ 16 & 17 \end{pmatrix}$.

Answer(a) $\mathbf{AB} = \begin{pmatrix} 6 & 7 \\ 16 & 17 \end{pmatrix}$ [2]

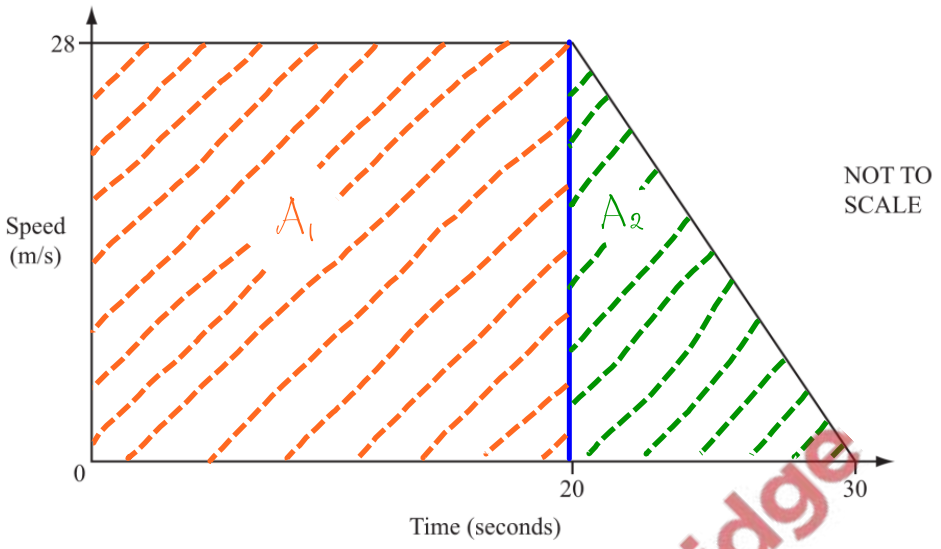
(b) $\mathbf{B}^{-1}$, the inverse of B.

$B^{-1} = \frac{1}{(4\times2)-(3\times1)}\begin{pmatrix} 2 & -3 \\ -1 & 4 \end{pmatrix}$

$B^{-1} = \frac{1}{5}\begin{pmatrix} 2 & -3 \\ -1 & 4 \end{pmatrix}$ OR $\begin{pmatrix} 2/5 & -3/5 \\ -1/5 & 4/5 \end{pmatrix}$

Answer(b) $\mathbf{B}^{-1} = \frac{1}{5}\begin{pmatrix} 2 & -3 \\ -1 & 4 \end{pmatrix}$ [2]

25



The diagram shows the speed-time graph of a car.
It travels at 28 m/s for 20 seconds and then decelerates until it stops after a further 10 seconds.

(a) Calculate the deceleration of the car.

$\star\ \Delta a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$

$\Rightarrow \Delta a = \frac{(28-0)\ m/s}{(30-20)\ s} = 2.8\ m/s^2$

Answer(a) ..... 2.8 ..... m/s^2 [1]

(b) Calculate the distance travelled during the 30 seconds.

$\star$ Total Distance (D) = Area under the graph

$\Rightarrow D = A_1 + A_2$

$\Rightarrow D = (l \times b) + \left(\frac{1}{2} \times b \times h\right)$

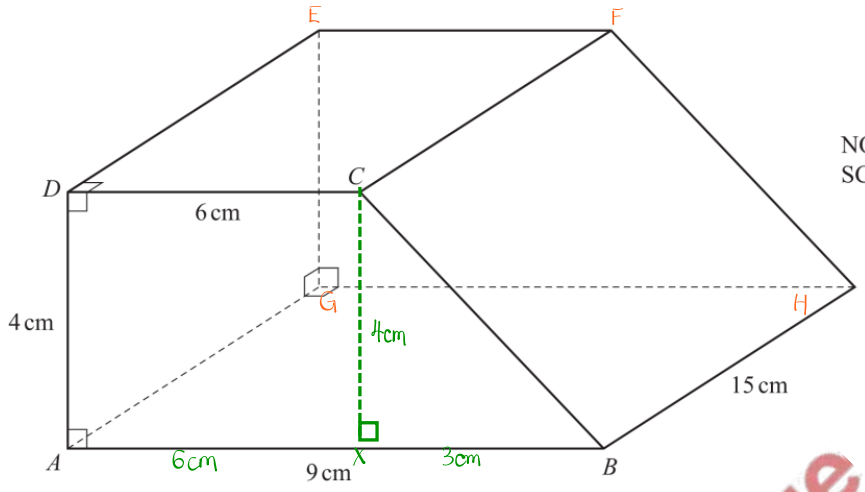
$\Rightarrow D = (20 \times 28)\ m + \left(\frac{1}{2} \times 10 \times 28\right) m$

$\Rightarrow D = 700\ m$

Answer(b) ..... 700 ..... m [3]

Question 26 is printed on the next page.

26



NOT TO SCALE

For Examiner's Use

The diagram shows a solid prism of length 15 cm.
The cross section of the prism is the trapezium $ABCD$.
Angle DAB = angle CDA = 90°.
AB = 9 cm, DC = 6 cm and AD = 4 cm.

Calculate the **total** surface area of the prism.

$\star\ T_{SA} = (2 \times A_{ABCD}) + A_{ADEG} + A_{DCFE} + A_{ABHG} + A_{BCFH}$

- $A_{ABCD} = \left(\frac{1}{2}(6+9) \times 4\right) cm^2 = 30 cm^2$
- $A_{ADEG} = (15 \times 4)\, cm^2 = 60 cm^2$
- $A_{DCFE} = (15 \times 6)\, cm^2 = 90 cm^2$
- $A_{ABHG} = (15 \times 9)\, cm^2 = 135 cm^2$
- $A_{BCFH} = \left(15 \times \left(\sqrt{4^2+3^2}\right)\right) cm^2 = 75 cm^2$

Hence,

$\Rightarrow T_{SA} = \left[(2 \times 30) + 60 + 90 + 135 + 75\right] cm^2$

$\Rightarrow T_{SA} = 420 cm^2$

420

Answer ..... cm^2 [5]