MARK SCHEME for the October/November 2008 question paper

4024 MATHEMATICS

4024/02 Paper 2, maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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<th>Sub (part) mark</th>
<th>Comments</th>
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<tr>
<td><strong>1</strong></td>
<td><strong>(a)</strong> (i) 16 cao</td>
<td>B1 [1]</td>
<td>E.g. 104.357 seen followed by ans 4%. Beware 4% from ((4 ÷ 95.8) \times 100 = 4.175)</td>
</tr>
<tr>
<td></td>
<td>(ii) (a) Figs (\frac{4}{91.8} \times (100)) oe soi = 4.357\ldots, 4.36 (%)</td>
<td>M1</td>
<td>A1 Here and elsewhere, accept ans rounding to the given 3 sig. fig. ans. unless a particular range is specified.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1 [2]</td>
<td>E.g. 104.357 seen followed by ans 4.36 (%). Beware 4% from ((4 ÷ 95.8) \times 100 = 4.175) Here and elsewhere, accept ans rounding to the given 3 sig. fig. ans. unless a particular range is specified.</td>
</tr>
<tr>
<td></td>
<td>(b) Figs (\frac{19200}{21}) \times 4 ( = 36.57) oe Ans. ($) 37 cao</td>
<td>M1</td>
<td>A1 [2]</td>
</tr>
<tr>
<td></td>
<td>(iii) Figs (\frac{100}{90}) \times 91.8 102 (cents)</td>
<td>A1 [2]</td>
<td>Accept $1.02</td>
</tr>
<tr>
<td><strong>(b)</strong> (i) 13 500</td>
<td>B1 [1]</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(ii) 4 500</td>
<td>B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After B0, 240(^\circ), 36 000 or 2/3 + 1/4 soi</td>
<td>B1 [2] [10]</td>
<td></td>
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<tr>
<td><strong>2</strong></td>
<td><strong>(a)</strong> (i) (\frac{5}{AB} = \cos 65) oe soi ((AB = ) 11.83, 11.8,(m))</td>
<td>M1</td>
<td>e.g. (\frac{\sin 65}{AB} = \frac{\sin 50}{10})</td>
</tr>
<tr>
<td></td>
<td>(ii) (\frac{1}{2} \times 10 \times 5 \times \tan 65) oe (53.3) to 53.7</td>
<td>M1</td>
<td>e.g. (\frac{1}{2} \times \text{their (a) (i)} \times 10 \times \sin 65) or (\frac{1}{2} \times \text{their (a) (i)}^2 \times \sin 50)</td>
</tr>
<tr>
<td></td>
<td>(iii) 4 × their (a) (ii) + 100</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>313.2 to 314.5 \ or 4 × their (a) (ii) + 100 ft (m²)</td>
<td>A1 ft</td>
<td>Accept 10(^2)</td>
</tr>
<tr>
<td></td>
<td>After M0, 100 seen</td>
<td>SC1 [2]</td>
<td></td>
</tr>
<tr>
<td><strong>(b)</strong> (i) 140 ((^\circ))</td>
<td>B2</td>
<td>Dep. on 180 – their (b) (i) (^\circ) ve.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After B0, 90 or 220((^\circ)) soi</td>
<td>B1 [2]</td>
<td></td>
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<tr>
<td></td>
<td>(ii) 40 or 180 – their (b) (i) ((^\circ)) ft</td>
<td>B1 ft [1]</td>
<td></td>
</tr>
<tr>
<td>Use of Grads (a) (i) 9.57 (ii) 40.8</td>
<td></td>
<td></td>
<td>Rads: both ans. negative, therefore A0. [9]</td>
</tr>
</tbody>
</table>
### Mark Scheme

#### 3

**a** \((p = -5)\)

After \(B0\) \(2(2p + 1) = k + 3(p - 3)\) soi \(M1\)

\[
4p + 2 = 6 + 3p - 9 \hspace{1cm} \text{cao soi} \hspace{1cm} A1
\]

\(p\) correctly evaluated ft \(A1ft\)

#### B3

Clear intention to deal correctly with the two fractions.
Correct solution of their linear equation clear of brackets and fractions

#### b

Final ans. \(\frac{2}{v + 1}\) \(B3\)

After \(B0\), \((v - 3)(v + 1)\) seen \(B1\)

\(B3\)

Not necessarily in the numerator
Not necessarily in the denominator

#### c

**i** Equation \((10y + x) - (10x + y) = \pm 63\) seen

+63 leading to \(y - x = 7\) nww \(AG\) \(A1\)

#### M1

\(A1\) [2]

**ii** \((10x + y) + (10y + x) = 99\) seen

leading to \(x + y = 9\) nww \(AG\)

#### M1

[1]

**iia** \(x = 1\)

**iib** \(y = 8\)

After \(B0\), \(M1\)

[2]

Reaches such as \(ky = 16\) or \(hx = 2\).

#### 4

**a** Histogram with

Columns to 3 4 5 6 4 0.5 vertically

and widths 5 5 5 5 5 20 at correct “heights”.

After \(H0\), at least 4 correct columns \(H2\)

at least 1 correct column \(H1\)

After 0, “correct” Histogram \(SC2\)

At least 4 “correct” cols. \(SC1\)

#### H3

Axes: ignore labels, but the vertical scale must give heights of 3, 4,.....

No penalty for Histogram not our size.

#### b

5 \(B1\)

#### c

\(\frac{1}{8}\) cao \(C1\)

#### d

\[
\frac{870}{14280} \text{ or } \frac{29k}{476k} \text{ or } 0.061 \hspace{1cm} D2
\]

After \(D0\) \(\frac{870}{14400} \text{ or } \frac{29k}{480k} \text{ or } 0.0604\). \(D1\)

\(\frac{30 \times 29}{120 \times 119}\) seen isw \(M1\)

[2]

i.e. even if \(\times 2\).

[7]
<p>| | | | | |</p>
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<tbody>
<tr>
<td>5</td>
<td>(a) (i) Angle between tangent and radius</td>
<td>B1 [1]</td>
<td>Must mention both tangent and radius.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) ( RÔQ = 140 ^\circ )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td>(b) (i) ( AEĐ = 40 ^\circ )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td></td>
<td>(ii) ( RÔS = 60 ^\circ ) After B0, ( ĐAE = 80 ^\circ )</td>
<td>B2</td>
<td></td>
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<tr>
<td></td>
<td>(iii) ( BE = 11 \text{ cm} ) or 10.84 after sine rule.</td>
<td>B2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>After B0, [ \frac{BE + 4}{17 + 3} = \frac{3}{4} ] oe M1</td>
<td></td>
<td>e.g. [ \frac{BE + 4}{20} = \frac{\sin 40 ^\circ}{\sin 60 ^\circ} ]</td>
<td></td>
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<tr>
<td>6</td>
<td>(a) (i) ( p = 19 )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td></td>
<td>(ii) ( q = 29 )</td>
<td>B1 [1]</td>
<td></td>
<td></td>
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<tr>
<td>(b) (i) ( j = 16 )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td></td>
<td>(ii) ( k = 25 )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td></td>
<td>(iii) ( S_\alpha = n^2 )</td>
<td>B1 [1]</td>
<td></td>
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<tr>
<td>(c) (i) 3, 4</td>
<td>B1 [1]</td>
<td>Accept their (a) (i) ( \rightarrow ) (b) (i) ft and their (a) (ii) ( \rightarrow ) (b) (ii) ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) ( n - 1 ) cao</td>
<td>B1 [1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) ( n^2 + n - 1 ) oe or their (b) (iii) + (c) (ii) ft</td>
<td>B1 [1]</td>
<td></td>
<td>[8]</td>
</tr>
</tbody>
</table>
7

(a) (i) \( \frac{1080}{x} \) seen

(ii) \( \frac{1080}{x + 30} \) seen

(b) Their \( \frac{1080}{x} - \frac{1080}{x + 30} = \pm \) their \( \frac{1}{2} \) hr

\[
\frac{1080}{x} - \frac{1080}{x + 30} = \frac{1}{2}
\]

further

leading to \( x^2 + 30x - 64800 = 0 \) nww AG

(c) \( x = \) 240 and -270

After B0, one correct root B3

Signs reversed with correct factors seen SC2

Signs reversed SC1

or for numerical \( \frac{p \pm \sqrt{q}}{r} \) seen or used

\( p = -30 \) and \( r = 2 \) B1

\( q = 260 \) 100 or \( \sqrt{q} = 510 \) B1

or \( (x + \frac{30}{2})^2 \) seen B1

65 025 or (±)255 seen B1 [4]

(d) (i) 4½ or \( \frac{1080}{\text{their (+ve)x}} \) ft isw B1 [1]

(ii) \[ 2 \times \frac{1080}{84 + 4.5} \text{ or } \frac{2 \times 1080}{2 \times \text{their (d)(i)} - \frac{1}{2}} \]

\[ 254.1, 254 \text{ or } \frac{2 \times 1080}{2 \times \text{their (d)(i)} - \frac{1}{2}} \text{ (km/h)} \]

B1 ft [2]

M1

A1 ft [2]

[12]
Here and elsewhere in Trigonometry questions, nonsense in one part may be used to earn M marks in any other part of the question. Throughout, accept equivalent complete methods and decimal angles without degree sign, but degree sign essential if answer given in degrees and minutes.

(a) (i) $15^\circ$ cao

(ii) $(AC^2 =) 15^2 + 10^2 \pm 2 \cdot 15 \cdot 10 \cos 105$

$(AC =) \sqrt{15^2 + 10^2 - 2 \cdot 15 \cdot 10 \cos 105}$

$(AC =) 20.06, 20.1$ (m)

After A0, 402.6, 403 or 15.72 (from $\sqrt{247.35}$ ) A1

(Alternative complete methods get M2 A2)

(b) $\frac{\sin ADB}{15} = \frac{\sin 105}{30}$ oe soi

$\sin ADB = \frac{15 \sin 105}{30} = 0.4829$

$(ADB =) 28.87, 28.9^\circ$

(c) (i) $BF^2 + 15^2 = 27^2$ soi

$(EF =) 10.05$ to $10.20$

(ii) $\sin \theta = \frac{15}{27}$ oe

Final Ans 33.748, 33.7 $(^\circ)$

Grads (a) (ii) 18.7 (A2)

348.5 or 17.4 (A1)

(b) 33.2 (from 0.4984)

(c) (ii) 37.5

Rads (a) (ii) 1.99

397.3 or 15.9

(b) negative (A0)

(c) (ii) 0.589

NB. This M1 requires an attempt to evaluate the expression using the correct processes, followed by the intention to take $\sqrt{\ldots}$

$+2 \cdot 15 \cdot 10 \cos 105$ has been used.

e.g. $\sqrt{(10 \sin 75)^2 + (15 + 10 \sin 15)^2}$
### Question 9

**Part (a)**

(i) \( \pi a^2 - \pi b^2 \)

\[ 2510 \text{ cm}^2 \]

(ii) Figs their \( 2513.27 \times 200 = 502654.82 \) \( \text{ft} \), or \( \frac{2513.27 \times 200}{10^6} \) ft \( (\text{m}^2) \)

(iii) Figs \( \frac{\text{their(a)(ii)}}{150 \times 2} \) or Figs \( \frac{\text{their(a)(i)}}{150 \times 100} \)

\[ \frac{1.676 \times 10^3}{150 \times 2} \times 10 \text{ft (mm)} \]

**Part (b)**

(i) \( 2\pi \frac{3.5}{2} \) oe seen

\( \frac{\theta}{360} \) oe seen

\[ 2\pi \frac{3.5}{2} = \frac{\theta}{360} \]

\( 2\pi \frac{3.5}{2} \) oe leading to \( \theta = 210 \)

AG

(ii) \( 3\cos 75 \) oe

Their \( (3\cos 75) + 3 \) (= 3.776)

Final ans. 4

**Part (b)**

(ii) Grads 5 (from 4.148)

Rads 6 (from 5.765)

[12]

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<td><strong>4024</strong></td>
<td><strong>02</strong></td>
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10 Condone inaccuracies of up to 1 mm in plotting and drawing. If plots are not visible, allow P marks if curve passes within 1 mm of correct plot.

Both P and dependent C marks can be recovered following a grossly wrong plot if the plot is ignored and the curve passes within 1 mm of the correct point.

Lined or plain paper used: no penalty, extend tolerances to 2 mm.

**Penalties deducted from P and C marks only:**

- Wrong scale(s) –1 once
- Interchanged axes no penalty if labelled, –1 otherwise
- Non-uniform scale –2 after marking as generously as possible.

(a) All points plotted

After P0, at least 4 correct plots P1

Smooth curve, dep on at least P1 C1 [3]

(b) 2200 to 2400 N1 [1]

(c) (i) Drawing tangent at \( t = 2.5 \) and \( \frac{\Delta y}{\Delta x} \) seen

1800 to 2800 (bacteria per hour) M1

(ii) Rate of change (of number of bacteria per hour) A1 [2]

(d) (i) Ruled straight line (2,4500) to (3,3500) extended to cut the curve.

After L0, freehand or shorter line L1

(ii) 3.025 to 3.075 (hrs) or ft from their graph T1ft [1]

Their line must be straight, but not horizontal.

(e) (i) \( k = 50 \) cao

(ii) \( a = 4 \) K1 [1]

Table value

E1 [1]

Accept \( \frac{200}{\text{their} k} \) [12]

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</table>
| 11 | (a) (i) (a) | 37 | (b) | \[
|   | \begin{pmatrix} 16 \\ -21 \end{pmatrix} | B1 [1] | (ii) | \[
|   | \begin{pmatrix} PT \end{pmatrix} = \begin{pmatrix} 14 \\ -28 \end{pmatrix} | B2 | After B0, | \[
|   | \begin{pmatrix} \overrightarrow{QT} \end{pmatrix} = \begin{pmatrix} 2 \\ 7 \end{pmatrix} soi | M1 [2] | (iii) | (−6, 51) | B2 |
|   | After B0, uses | \[
|   | \overrightarrow{RS} = \overrightarrow{QP} M1 | [2] | \[
|   | \overrightarrow{RS} = \begin{pmatrix} -12 \\ 35 \end{pmatrix} soi | eg | | | |
| (b) (i) | 2 (units²) | B1 [1] | (ii) | (a) (−2, 3) | B1 [1] |
|   | (b) 32 (units²) or 16 × their (b) (i) ft | B1 [1] | (iii) | (a) (3, 1) | B1 [1] |
|   | After B0, shear factor 2 | B2 | or (h, 1) | M1 [2] | Accept such as \[
|   | or (h, 1) | M1 | (b) 2 (units²) or their (b) (i) ft | B1 [1] | \[
|   | B1 [1] | [12] |}