UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2008 question paper

4024 MATHEMATICS

4024/02 Paper 2, maximum raw mark 100

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UNIVERSITY of CAMBRIDGE
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Question Number	Mark scheme details	Sub (part) mark	Comments
1	**(a) (i)** 16 cao	B1 [1]	
	(ii) (a) Figs $\frac{4}{91.8}$ ×(100) oe soi	M1	E.g. 104.357 seen followed by ans 4%. Beware 4% from (4÷95.8)×100 = 4.175
	= 4.357.., 4.36 (%)	A1	Here and elsewhere, accept ans rounding to the given 3 sig. fig. ans. unless a particular range is specified.
	After M0, 104.36 seen SC1	[2]	
	(b) Figs $\frac{19200}{21}$ × 4 (= 36.57) oe	M1	E.g. 914.28(95.8 – 91.8) Beware 1.04 × total cost for 2006.
	Ans. ($) 37 cao	A1 [2]	
	(iii) Figs $\frac{100}{90}$ × 91.8	M1	
	102 (cents)	A1 [2]	Accept **$**1.02
	(b) (i) 13 500	B1 [1]	
	(ii) 4 500	B2	
	After B0, 240°, 36 000 or 2/3 + 1/ 4soi B1	[2]	
		[10]	
2	**(a) (i)** $\frac{5}{AB}$ = cos65 oe soi	M1	e.g. $\frac{\sin 65}{AB} = \frac{\sin 50}{10}$
	(*AB* =) 11.83, 11.8(m)	A1 [2]	
	(ii) ½ × 10 × 5 × tan65 oe	M1	e.g. ½ × their **(a) (i)** × 10 × sin65 or
	53.3 to 53.7	A1 [2]	½ × their **(a) (i)**^{2} × sin50
	(iii) 4 × their **(a) (ii)** + 100	M1	
	313.2 to 314.5 or 4 × their **(a) (ii)** + 100 ft (m²)	A1ft	
	After M0, 100 seen SC1	[2]	Accept 10^2
	(b) (i) 140 (°)	B2	
	After B0, 90 or 220(°) soi B1	[2]	
	(ii) 40 or 180 – their **(b) (i)** (°) ft	B1 ft [1]	Dep. on 180 – their **(b) (i)** + ve.
	Use of Grads **(a) (i)** 9.57 **(ii)** 40.8 Rads: both ans. negative, therefore A0.	**[9]**	

3	**(a)** $(p =) -5$ After B0 $2(2p + 1) = k + 3(p – 3)$ soi M1 $4p + 2 = 6 + 3p – 9$ cao soi A1 p correctly evaluated ft A1ft	B3 [3]	Clear intention to deal correctly with the two fractions. Correct solution of their linear equation clear of brackets and fractions
	(b) Final ans. $\frac{2}{v+1}$ After B0, $2(v – 3)$ seen B1 $(v – 3)(v + 1)$ seen B1	B3 [3]	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**	M1 A1 [2]	
	(ii)(a) $(10x + y) + (10y + x) = 99$ seen leading to $x + y = 9$ nww **AG**	M1 [1]	
	(ii)(b) $x = 1$ $y = 8$ After B0, M1	B1 B1 [2]	Reaches such as $ky = 16$ or $hx = 2$.
		[11]	
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 [3]	Axes: ignore labels, but the vertical scale must give heights of 3, 4,..... No penalty for Histogram not our size. E.g. no vertical or horizontal scale, or the numbers are frequencies.
	(b) 5	B1 [1]	Accept 4
	(c) $\frac{1}{8}$ cao	C1 [1]	
	(d) $\frac{870}{14280}$ or $\frac{29k}{476k}$ or 0.061 After D0 $\frac{870}{14400}$ or $\frac{29k}{480k}$ or 0.0604. D1 or $\frac{30 \times 29}{120 \times 119}$ seen isw M1	D2 [2]	i.e. even if × 2.
		[7]	

5	**(a) (i)** Angle between tangent and radius	B1	[1]	Must mention **both** tangent and radius.
	(ii) ($R\hat{O}Q$ =) 140 (°)	B1	[1]	
	(b) (i) ($A\hat{E}D$ =) 40 (°)	B1	[1]	
	(ii) ($R\hat{O}S$ =) 60 (°) After B0, $D\hat{A}E$ = 80 (°) B1	B2	[2]	
	(iii) (BE =) 11 (cm) or 10.84 after sine rule.	B2		
	After B0, $\frac{BE+4}{17+3}=\frac{3}{4}$ oe M1		[2]	e.g. $\frac{BE+4}{20}=\frac{\sin 40}{\sin 60}$
			[7]	
6	**(a) (i)** (p =) 19	B1	[1]	
	(ii) (q =) 29	B1	[1]	
	(b) (i) (j =) 16	B1	[1]	
	(ii) (k =) 25	B1	[1]	
	(iii) (S_n =) n^2	B1	[1]	
	(c) (i) 3, 4	B1	[1]	Accept their **(a) (i)** – **(b) (i)** ft **and** their **(a) (ii)** – **(b) (ii)** ft
	(ii) n – 1 cao	B1	[1]	
	(iii) $n^2 + n$ – 1 oe or their **(b) (iii)** + **(c) (ii)** ft	B1	[1]	
			[8]	

7	**(a) (i)** $\frac{1080}{x}$ seen	B1 [1]	
	(ii) $\frac{1080}{x+30}$ seen	B1 [1]	
	(b) their $\frac{1080}{x}$ – their $\frac{1080}{x+30}$ = ± their ($\frac{1}{2}$ hr)	M1	Their **(a) (i)** and **(ii)** must contain x. Their ½ hr could be 30 (min).
	$\frac{1080}{x} - \frac{1080}{x+30} = \frac{1}{2}$ further	M1	
	leading to $x^2 + 30x - 64\,800 = 0$ nww **AG**	A1 [3]	
	(c) (x =) 240 and – 270	B4	Ignore "rejected" at this stage. Accept ans. rounding to 240, –270, but **nww**
	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 ft [1]	Ignore incorrect attempts to convert such as 4.5 hr to hr and min.
	(ii) $\frac{2\times1080}{84+4.5}$ or $\frac{2\times1080}{2\times\text{their }\textbf{(d)(i)} - \frac{1}{2}}$	M1	
	254.1, 254 or $\frac{2\times1080}{2\times\text{their }\textbf{(d)(i)} - \frac{1}{2}}$ (km/h)	A1 ft [2]	
		[12]	

8	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(º) cao	B1 [1]	
	(ii) $(AC^2 =)\ 15^2 + 10^2 \pm 2.15.10\cos 105$	M1	
	$(AC =)\ \sqrt{15^2 + 10^2 - 2.15.10\cos 105}$ ($\sqrt{402.6}$)	M1	NB. This M1 requires an attempt to evaluate the expression using the correct processes, followed by the intention to take the $\sqrt{\ }$.
	$(AC =)$ 20.06, 20.1 (m) After A0, 402.6 , 403 or 15.72 (from $\sqrt{247.35}$) A1	A2	+2.15.10cos105 has been used. e.g. $\sqrt{(10\sin 75)^2 + (15 + 10\sin 15)^2}$
	(Alternative complete methods get M2 A2)	[4]	
	(b) $\frac{\sin A\hat{D}B}{15} = \frac{\sin 105}{30}$ oe soi	M1	
	$\sin A\hat{D}B = \frac{15\sin 105}{30}$ (= 0.4829)	M1	
	$(A\hat{D}B =)$ 28.87, 28.9 (º)	A1 [3]	
	(c) (i) $BF^2 + 15^2 = 27^2$ soi	M1	e.g. by $\sqrt{27^2 - 15^2 - 20^2}$
	$(EF =)$ 10.05 to 10.20	A1 [2]	
	(ii) $\sin\theta = \frac{15}{27}$ oe	M1	
	Final Ans 33.748, 33.7 (º)	A1 [2]	
	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)** 19.9 397.3 or 15.9 **(b)** negative (A0) **(c) (ii)** 0.589	**[12]**	

9	**(a) (i)**	$\pi a^2 - \pi b^2$	M1	With a = 30 or b = 10
		2510 cm^2	A1 [2]	(Accept answers correcting to 2510)
	(ii)	Figs their2513.27 × 200 (= 502654.82..)	M1	
		0.503, or $\frac{their 2513.27 \times 200}{10^6}$ ft (m^2)	A1ft [2]	
	(iii)	Figs $\frac{\text{their}\mathbf{(a)(ii)}}{150 \times 2}$ or Figs $\frac{\text{their}\mathbf{(a)(i)}}{150 \times 100}$	M1	The volume version is shown in metres and the area version in cm. Figs allows the units to be inconsistent.
		1.676 or $\frac{\text{their}\mathbf{(a)(ii)}}{150 \times 2} \times 10^3$ or $\frac{\text{their}\mathbf{(a)(i)}}{150 \times 100} \times 10$ ft (mm)	A1ft [2]	
	(b) (i)	$2\pi\frac{3.5}{2}$ oe seen	M1	e.g. (curved SA of cone =) $\pi \times \frac{3.5}{2} \times 3$
		$\frac{\theta}{360}\ 2\pi 3$ oe seen	M1	e.g. (area of sector =) $\theta/(360) \times \pi \times 3^2$ Accept with θ = 210.
		$2\pi\frac{3.5}{2} = \frac{\theta}{360} 2\pi 3$ oe leading to $\theta = 210$ **AG**	A1 [3]	Condone methods reaching the range 209.5 to 210.5
	(ii)	3cos75 oe	M1	
		Their(3cos75) + 3 (= 3.776)	M1	This M is independent of the first.
		Final ans. 4	A1 [3]	
	(b) (ii)	Grads 5 (from 4.148) Rads 6 (from 5.765)	**[12]**	

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. <u>Penalties</u> 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	P2 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 A1 [2]	
	(ii) Rate of change (of number of bacteria per hour)	R1 [1]	Not just "increase": need idea of rate. E.g. accept Speed bacteria produced, but not number of bacteria per hour.
	(d) (i) Ruled straight line (2,4500) to (3,3500) extended to cut the curve. After L0, freehand or shorter line L1	L2 [2]	
	(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	K1 [1]	Table value
	(ii) (a =) 4	E1 [1] **[12]**	Accept $\frac{200}{\text{their}k}$

11	**(a) (i)** **(a)** 37	B1	[1]	Throughout this question, condone missing brackets if clear.
	(b) $\begin{pmatrix} 16 \\ -21 \end{pmatrix}$	B1	[1]	In **(a)**, condone fraction lines, but confusion between column vectors and coordinates is –1 once.
	(ii) $(\overrightarrow{PT} =) \begin{pmatrix} 14 \\ -28 \end{pmatrix}$	B2		
	After B0, $\overrightarrow{QT} = \begin{pmatrix} 2 \\ 7 \end{pmatrix}$ soi M1		[2]	
	(iii) (–6, 51)	B2		
	After B0, uses $\overrightarrow{RS} == \overrightarrow{QP}$ M1		[2]	eg $\overrightarrow{RS} = \begin{pmatrix} -12 \\ 35 \end{pmatrix}$ soi
	(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) After B0, shear factor 2	B2		Accept such as $\frac{6}{3}$
	or (h, 1) M1		[2]	
	(b) 2 (units²) or their **(b) (i)** ft	B1	[1]	
			[12]	