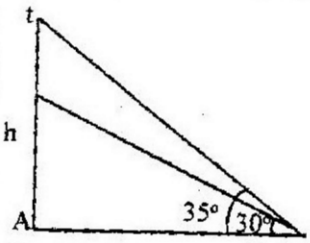
K.C.S.E 1998 MATHEMATICS PAPER 121/1 MARKING SCHEME

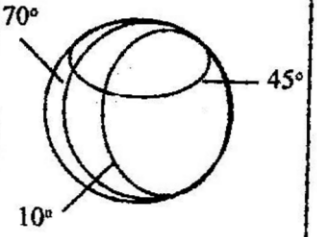
	SOLUTION	MARKS	ALTERNATIVE METHOD
1.	$100\sqrt{\frac{(0.0064)}{100}}$ $1000\left(\frac{0.08}{10}\right)$ ✓ 1000×0.008 $= 8$ ✓	M1 A1 2	
2.	$(a + b)(a-b)$ ✓ $(2557 + 2547)(2557 - 2547)$ ✓ 5104×10 51040 ✓	B1 M1 A1	
3.	$6a + 4b = 72$ ...(i) $2a + 3b = 3.4$ (ii) $6a + 4b = 7.2$ $6a + 9b = 10.2$ $5b = -3$ ✓ $b = \frac{3}{5}$ $\therefore 6a + \frac{4 \times 3}{5} = 7.2$ $6a = 4.8$ $a = 0.8$ One art book = 0.8 kg one Biology book = 0.6 kg ✓	M1 M1 A1 3	Forming inequalities Eliminating one variable Both answers correct
4.	(a) $\angle CDF = 110^\circ - 60^\circ = 50^\circ$	A1	Sum of two interior opposite angles add up to exterior angle. ALT. METHOD $(180-(60+(180-110)=(180-130)$
(b)	$\angle ABD = \angle BDE = 25^\circ$ ✓ Both reasoning given and ✓ Both reasoning given wrong - ow-1 One reason given (right or wrong) ow-1	B1 IF	(A0)

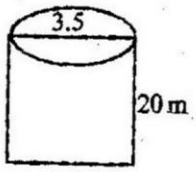
	SOLUTION	MARKS	ALTERNATIVE METHOD
5.	Commission $= \frac{2.4}{100} \times 100{,}000 + \frac{3.9}{100} \times 180{,}000$ $2400 + 70.20$ Sh. 5100 = Sh. 9420	M1	
6.	 $\text{Tan } 35^0 = \frac{(h+t)}{15}$ $h + t = 15 \tan 35^0$ 15×0.7002075 10.5031113 10.503 $\text{Tan } 30^0 = \frac{h}{15}$ $h = 15 \tan 30^0$ $h = 15 \times 0.5773502$ $= 8.660254$ $h = 8.611$ (c) 10.503 - 8.661 = 1.842m	B1 B1 B1 3	(Accept 8.66, 8.662) if log used (accept 1.84 1)
7.	$\begin{pmatrix} x & 0 \\ 5 & y \end{pmatrix}\begin{pmatrix} x & 0 \\ 5 & y \end{pmatrix}$ $\begin{bmatrix} x^2 & 0 \\ 5x + 5y & y^2 \end{bmatrix}$ $x^2 = 0 \quad 0 = 1 \quad 0 \; 5x + 5y = 0$ $5x + 5y \quad y2 = 0 \quad 1$ if $x = 1, y = 1$ if $x = -1, y = 1$ if $x = -1, y = 1$ then $x = 1, y = -1$ $x = -1, y = 1$	B1 B1 M1 A1 4	
8.	$\log y = \log (10^x)^n$ $= \log y = \log 10^{nx} \log x$ $n \log x = \log y - \log 10$ $n = \frac{\log y - \log 10}{\log x}$	M1 M1 A1	

	SOLUTION	MARKS	ALTERNATIVE METHOD
9.	$T = a + b\sqrt{S}$ or $T = b + a\sqrt{S}$ ✓ $a + b\sqrt{16} = 24$ $a + b\sqrt{36} = 32$ ✓ $a + 4b = 24$ $\quad a + 2 \times -10 = 10$ $a + 6b = 32$ ✓ $\quad a - 20 = 10$ $-2b = -8$ $b = 4$ $\quad a = 30$ ✓	B1 B1 M1 A1	For substitution & elimination Both answers correct
10.	$S_{14} = \frac{15}{2}(2a + (n-1)d$ $= \frac{15}{2}(2 \times 30 + (14 \times -10)$ ✓ $\frac{15}{2}(60 - 140)$ -600 ✓	M1 A1 A1	(a) a, a + d, a + 3d, a + d $\quad a + 2r - 10 = 10$ $a + 2d = 10$ } $\quad a = 30$ $a + 4d = -10$ } ml $-2d = 20$ $d = -10$ 1st tan = 30 $\quad d = -10$
11.	Volume = $\Pi r2h = \Pi 15 \times 15 \times 1.2$ ✓ 270Π ✓ (b) $\frac{1}{3}\Pi \times r \times 9 = 270\pi$ ✓ $\frac{1}{3}\Pi \times r^2 = 270$ $r^2 = \frac{270 \times 3}{9} = 90$ $r = \sqrt{90} = 9.49$ ✓	M1 A1 M1 A1	
12.	cum.freq 3 11 30 44 50 ✓ $M = \frac{L1 + (n/2 - cfa)i}{f_m}$ $8 + \frac{(25 - 11)}{19} \times 4 = 10.947$ ✓	B1 A1 3	$mdn = L + \frac{(n - 1 - fc)i}{fn}$ ml $7.5 + \frac{(255 - 11)}{19} \times 4$ $= 10.553$ A1

	SOLUTION	MARKS	ALTERNATIVE METHOD
13.	$1600(1 + \frac{r}{100})^2 = 2,5000$ ✓ $(1+\frac{r}{100})^2 = \frac{25000}{16000}$ $1 + \frac{r}{100} = \sqrt{1.5625} = 1.25$ ✓ $\frac{r}{100} = 0.25$ ✓ $r = 25\%$ ✓	m1 m1 m1 m1	$\frac{25}{16} = 1 + \frac{2R}{100} + \frac{R2}{10,000}$ m1 $16r2 + 13200r + 90,000 = 0$ $r2 + 200r + 5625 = 0$ m1 $r = \frac{200 + 250}{2}$ m $r = \frac{50}{2} = 25\%$ m
14.	$\text{Cos}(30\theta + 120^\circ) - \frac{1.732}{2} = 0.8660$ $3\theta + 120^\circ = 390 \quad 3\theta + 120 = 330$ ✓ $3\theta = 270 \qquad 3\theta = 210$ ✓ $\theta = 90$ ✓ $\qquad \theta = 70^\circ$ ✓	B1 B1 B1 A1	Both answers correct
15.	$C = 2 \times 2.8 \times \frac{22}{7} = 17.6$ cm $\frac{C}{\Pi} = 17.6 \times \frac{7}{22} = 5.6$ ✓ $3.142 \times 2.8 \times 2 = 17.595$ $3.142 \times 5.5 = 17.281$ ✓ $3.142 \times 5.7 = 19.909$ Limits : 17.28 + 17.91 ✓	M1 M1 A1	working limit Lower limit Upper limit 17. 27 - 17.91 logs used
16.	A ← 180 km → 72 P 72 N 72 M 9.17 75km B Distance covered by Bus A at 10 a.m. $= 90 \times 2 = 180$ km Bus B Time between 2 stops 72 = 1.2 hrs (1hr 12 min) Bus B leaves L at 9.17 a.m. Distance between 9.17 - 10 a.m. = $60 \times \frac{43}{60} = 43$ km At 10 a.m. Bus B has covered (72 + 43)=115 km Distance between Bus A & B at 10 a.m. 360 - (180 + 115) = 65 km	 B1 B1 B1	

	SOLUTION	MARKS	ALTERNATIVE METHOD
17.	(a) $3.5 \times 50 = 1.75$ 100		
	$4.75 \times 30 = 1.425$ ✓	M1	
	Total = 3.175 kg. ✓	A1	
	$3.175 \times 100 = 3.9688$ ✓	M1	
	3.969 ✓	A1	
	No of fat Kg = $\frac{x}{50} \times 100 = 4$		
	x = 2 kg fat	M1	
	Kg of A $\frac{3.5}{100} y + 4.75 \frac{(50 - y)}{100} = 2$		
	(50-y) Kg of B: $3y + 237.5 - 4.75y = 200$ $1.25 = 37.5$	M1	
	$Y = \frac{37.5}{1.25}$		
	y = 30		
	A = 30 Kg	B1	
	B = 20 Kg		
	B≥20 Kg	B1 8	
18.	(a) Taxable pay = $\frac{2000}{20} \times \frac{115}{100} - \frac{700}{20}$ ✓	M1	
	$1000 \times \frac{115}{100} - 35$ ✓	M1	
	1150 - 35 = £1115	M1	
	Taxable income $342 \times 2 + 342 \times 3 + 342 \times 4 + 39 \times 5$	M1	
	$34.2 + 51.3 + 68.4 + 22.25 = 176.15$	M1 A1	M1 must mult. by 39
	Net tax = 35.23 - 600 Sh. 2923 (£146.15)	B1/8	

SOLUTION	MARKS	ALTERNATIVE METHOD
19. (B) $\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}\begin{bmatrix}4 & 2 & 6 & 4\\-4 & -2 & -6 & 12\end{bmatrix} = \begin{bmatrix}4 & 4 & 6 & 2\\4 & 2 & 6 & 4\end{bmatrix}$ A'(4,4) B'(4,2) C'(6,6) D'(2,5)	B1	
C) (i) $\begin{pmatrix}1 & -2\\0 & 1\end{pmatrix}\begin{pmatrix}4 & 4 & 6 & 2\\4 & 2 & 6 & 4\end{pmatrix} = \begin{pmatrix}-4 & 0 & -6 & -6\\4 & 2 & 6 & 4\end{pmatrix}$ A"(-4,4), B"(0,2) C"(-6,6) D"(-6,4)	M1 A1	
d) $\begin{bmatrix}1 & -2\\0 & 1\end{bmatrix}\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix} = \begin{bmatrix}-2 & -1\\1 & 0\end{bmatrix}$	M1 A1	
20. Longitudinal difference 70 - 10 = 60°	B1	
(b) Dii betw x and y $\frac{60}{360} \times 22 \times 2\,6371 \cos 45°$ $\frac{1}{6} \times \frac{22}{7} \times 26371 \times 0.7071$ 4718 km	M1 A1	r = 6371 cos 45 (Accept 4719, 4720, 4715)
(ii) Distance between x and y $\frac{4919.45}{1.85} = 2551.05$ mm		
(c) Time diff = 60 x 4 = 240 min = 4 hrs Local time at x = 6 pm	B1 B1/8	

SOLUTION	MARKS	ALTERNATIVE METHOD
21. (a) Area of the circular based $\frac{22}{7} \times 3.5 \times 3.5 = 38.5$ ✓	A1	
(b) Area of thecurved S.A. $\frac{22}{7} \times 2 \times 3 \times 3.5 \times 20$ ✓		
440 cm² ✓	M1 A1	
(c) $^4/_2 \Pi r^2 = 2x^{22}/_7 \times 3.5^2$ ✓	M1	
44 X 0.5 X 3.5		
22 X 3.5		
77 cm² ✓		
(d) 38.5 + 440 + 77 ✓	A1 M1	
555.5 cm²	M1	
	A1	
	8	
22. (i) a + b ✓	B1	
AD = AB + BD ✓	M1	
$a + (\frac{-2}{3})b$	A1	
$a - \frac{2}{3}a$ ✓		
(b) $\frac{-2}{3}$ AD + $(\frac{-4H}{3})$ ✓	M1	
$^2/_3 (a - \frac{2b}{3} + \frac{-4b}{3})$		
$\frac{2a}{3} - \frac{4b}{9} - \frac{4b}{3}$		
$\frac{-2a}{3} - \frac{8a}{9} = \frac{2}{3}(-a - \frac{4b}{3})$ ✓	A1	

SOLUTION	MARKS	ALTERNATIVE METHOD
19. a) <BAR = 80° b) <STR = 30° c) <BSU = 45° d) <BRS = 45°	B1 B1 B1 B1 B1 B1 B1 B1 8 marks	Cyclic qualdrilateral and supplement of equivalent
20. (a) x: -2, -1.5, -1, 0, 1, 2, 3, 4, 5 x1: -8, -3.4, -1, 0, 1, 8, 27, 64, 175 -5x2: -20, -11.3, -5, 0, -5, -20, -45, -80, -125 2x: -4, -3, -2, 0, 2, 4, 6, 8, 10 9: 9, 9, 9, 9, 9, 9, 9, 9, 9, 99 y: -23, -8.7, 1, 9, 7, 1, -3, 1, 19, 109 (b) On the graph: Scale Plotting Curve (c) 2.15 ± 0.1 (d) y = 4- 4x drawn x = -0.55 ± 0.1	B2 S1 P1 C1 B1 B1 L1 B1 8 Marks	For the 10 numerical pints B1 for at least 6 points Accommodates all values and uniform Can score from the graph (Reject coordinate form)
21. (a) (i) AB = b - a (ii) AP = $^3/_8$ (b - a) (iii) BP = $^5/_8$ (a-b) (iv) OP = OA + AP or OB + BP $\Rightarrow$ a = $^5/_8$ (b - a) = $^5/_8$ a + $^5/_8$b (b) OP = $^5/_8$ a + $^5/_8$b OQ = a - $^5/_8$ a + $^9/_{40}$ b = $^3/_8$ a + $^9/_{40}$b OQ : OP = $^3/_8$ a + $^9/_{40}$b : $^5/_8$ a + $^3/_8$b = $^3/_8$ (a + $^3/_5$b) : $^5/_8$ (a + $^3/_5$b) = 3:5 ∴ OQ: Qp =3:2	 B1 B1 B1 m1 A1 m1 M1 A1 8 marks	Ow - 1 vector sign missing Direct use of ratio theorem OP = 5/8a + 1/8b m1 A1 OQ or Op or AQ QP = 2/8a + 6/40b OQ: QP = 3/8a + 9/40b: 2/8a + 6/40b =3/8(a+3/5b): 2/8a + 3/5b = 3.2

SOLUTION	MARKS	ALTERNATIVE METHOD
b) $OQ = a - {}^{5}/_{8}a + {}^{9}/_{40}b$ $= {}^{3}/_{8}a + {}^{9}/_{40}b$ $OQ + k\,OP = K({}^{5}/_{8}a + {}^{3}/_{8}\,b)$ ${}^{5}/_{8}a + {}^{9}/_{40}b = K({}^{5}/_{8}a + {}^{3}/8b)$ $3({}^{5}/_{40}a + {}^{3}/_{40}b) = 5k\,({}^{5}/_{40}a + {}^{3}/_{40}b)$ $3 = 5k$ $k = 3/5$ $OQ: QP = 3.2$		(b1) $OQ = OP + BP + PQ$ $OP = QA + AP$ $= {}^{5}/_{8}a + {}^{9}/_{40}b$ $OQ: QP = ({}^{5}/_{8}a + {}^{9}/_{40}b) : ({}^{2}/_{8}a + {}^{6}/_{40}b)$ $= 3:2$ (b2) $OA = QA + AO/PQ + PA + AQ$ $OQ = {}^{5}/_{8}a + {}^{9}/_{40}b - a$ $= {}^{5}/_{8}\,(a + {}^{3}/_{5}b)$ $PQ = {}^{3}/_{8}(b - a)\ {}^{5}/_{8}a + {}^{9}/_{40}b)$ $= {}^{-3}/_{8}b + {}^{3}/_{8}a - {}^{5}/_{8}a + {}^{9}/_{40}b$ $= {}^{-1}/_{4}a - {}^{6}/_{40}b$ $= {}^{-1}/_{4}\,(a + {}^{3}/_{5}b)$ $OQ:QP = {}^{3}/_{8}(a + {}^{3}/_{5}b) : {}^{1}/_{4}(a + {}^{3}/_{5}b)$ $= 3:2$
22. (a) (i) $(x+y)^2 = x^2 + 2xy = y + y^2 = 3^2$ $\therefore x^2 + 2xy + y^2 = 9$ (ii) $2xy = 9 - (x^2 + y^2)$ $= 9 - 29$ $= -20$ (iii) $(x - y)^2 = x^2 + y^2 - 2xy$ $= 29 - 20$ $= 49$ (iv) $x - y = \pm\sqrt{49}$ $= +7$ or -7 (b) $x + y = 3$ $\quad x + y = 3$ $x - y = 7$ $\quad x - y = -7$ $2x = 10$ $\quad 2x = -4$ $x = 5$ $\quad x = -2$ $y = -2$ $\quad y = 5$	B1 B1 B1 B1 B1 B1 B1 B1 8 mark	When x or y is substituted $x^2 + y^2 = 29$ ..... (1) $x = Y = 3$ ..... (2) $y = 3 - x$ or $x = 3$ $x = 5$ when $y = -2$ $x = 5$ when $y = -2$ 22(b) can be done at a (i)

SOLUTION		
23. (a) Volume of hemishere $\frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 5.2^3$ 10.4 : 10:4 : : 11: h -H = 3h Big cone V1 = $\frac{1}{3} \times \frac{22}{7} \times \frac{5.2}{3}^2 \times h$ Small cone $V_2 = \frac{1}{3} \times \frac{22}{7} \times \left(\frac{5.2}{3}\right) \times h$ V1 - V2 - $\frac{1}{3} \times \frac{22}{7} \times 5.2^2 \times \left(3 - \frac{1}{9}\right)h$ $\therefore \frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 5.2^2 \times \frac{26}{9} h$ $\frac{26}{9} h = 10.4$ $h = \frac{10.4 \times 9}{26} = 3.6$ Therefore height of the frustum = 2h = 7.2 cm (b) $L = \sqrt{3.62 + \left(\frac{5.2}{3}\right)^2} = 3.995$ $L = \sqrt{10.8^2 + 5.2^2} = 11.98$ Area = $\pi r^2 + \pi RL - \pi rl$ $= \frac{22}{7} \times 3 + \frac{22}{7} \times 5.2 \times 11.98 - \frac{22}{7} \times \frac{5.2}{3} \times 3.995$ = 9.429 + 195.8 - 21.76 = 183.469 = 183.5 cm^2	ml ml ml A1 ml ml A1 8 marks	
24. (a) x 2 3 4 5 6 7 8 y 3 5 9 15 23 33 45 (b) A = 1 x 1 x {(3 + 45) + 2(5+9+15+23+33)} $= \frac{1}{2}(48 + 170)$ = 109 (109.25) (c) $\int_2^8 (x^2 - 3x + 5)dx$ $= \frac{x^3}{3} - \frac{3x^2}{2} + 5x \Big|_2^8$ $= \left(\frac{8^3}{3} - \frac{3 \times 8^2}{2} + 5 \times 5\right) - \left(\frac{2^3}{3} - \frac{3 \times 2^2}{2} + 5 \times 2\right)$ = 108 (d) it would given an underestimate because the line for the trapezia run below the curve in the region	B1 ml ml A1 ml ml A1 B1 8 marks	Accept 23,75, 33, 25 (graph)