FORM 3 EXAM
MATHEMATICS PAPER 231/2
MARKING SCHEME

<table>
<tr><td>No.</td><td></td><td></td><td></td></tr>
<tr><td>1.</td><td>Log 3.846 = 0.5850
(0.9834) = 0.9671
88.3 + 0.9671 = 89.2671
$\sqrt[3]{\frac{0.0485\ x\ 0.5850}{89.2671}}$
<table>
<tr><th>No.</th><th>Std form</th><th>Log</th></tr>
<tr><td>0.0489
0.5850

89.28</td><td>4.85 x 10^{-2}
5.850 x 10^{-1}

8.928 x 10^{1}</td><td>$\bar{2}.6857$ +
$\underline{\bar{1}.7672}$
$\bar{2}.4529$
$\underline{1.9501}$ -
$\bar{4}.5022$</td></tr>
</table></td><td>M1

M1</td><td></td></tr>
<tr><td></td><td>$= \frac{\bar{4}.5022}{3}$
$= \frac{\bar{6}+2.5022}{3}$
$\bar{2}+0.83406$
$= \bar{2}.83406$
Antilog = 6.824 x 10^{-2}
= 0.06824</td><td>M1

A1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>a = 2
r = 5
L = 1250
$S_n = a\left(\frac{r^n-1}{r-1}\right)$
$T_n = ar^{n-1}$
1250 = 2 x 5^{n-1}
125 x 10 = 2 x 5^{n-1}
5^3 x $5^1 = 5^{n-1}$
$5^4 = 5^{n-1}$
$\Rightarrow$ 4 = n – 1
5 = n
$S_5 = 2\left(\frac{5^5-1}{5-1}\right)$
$= 2\left(\frac{3125-1}{4}\right)$
= 2 x $\frac{3124}{4}$
= 1562</td><td>

M1

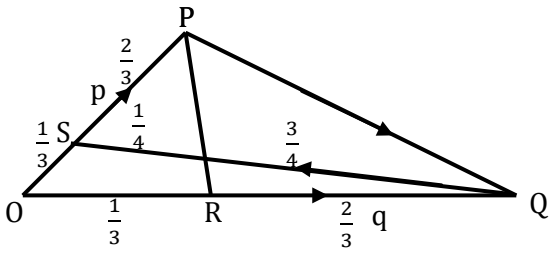
M1

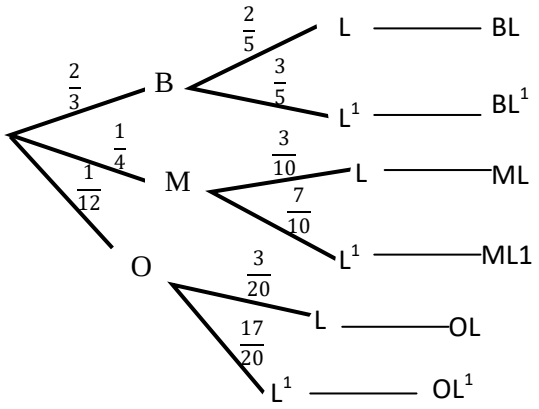
A1</td><td></td></tr>
<tr><td>3.</td><td>Make Q the subject of the formula
T = P $\sqrt{\frac{Q^2}{Q^2-1}}$</td><td></td><td></td></tr>
</table>

	$T^2 = P^2 \times \frac{Q^2}{Q^2-1}$ $(T^2 - P^2)(Q^2 - 1) = Q^2$ $(T^2 - P^2)Q^2 - Q^2 = T^2 - P^2$ $Q^2(T^2-P^2-1) = T^2 - P^2$ $Q^2 = \frac{T^2-P^2}{T^2-P^2-1}$ $Q = \sqrt{\frac{T^2-P^2}{T^2-P^2-1}}$	M1 M1 A1	
4.	QU x RU = SU x TU $SU = \frac{QU \times RU}{TU}$ $= \frac{11 \times 6}{4}$ = 16.5cm	M1 M1 A1	
5.	Det = 6 + 25 = 31 $M^{-1} = \frac{1}{31}\begin{bmatrix} 2 & 5 \\ -5 & 3 \end{bmatrix}$ $\begin{bmatrix} X \\ Y \end{bmatrix} = \frac{1}{31}\begin{bmatrix} 2 & 5 \\ -5 & 3 \end{bmatrix}\begin{bmatrix} -9 \\ 16 \end{bmatrix} = \frac{1}{31}\begin{bmatrix} 62 \\ 93 \end{bmatrix}$ $\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$	B1 M1 M1 A1	
		4 Marks	
6.	$3(0.6735)^{-1} + 13(0.156)^{-1}$ $\Rightarrow 3(1.485) + 13(6.41)$ = 4.455 + 83.333 = 87.785	M1 M1 A1	
		3 Marks	
7.	$\left(1 - \frac{x}{3}\right)^4$ $1^4 + 4 \times 1\left(\frac{-x}{3}\right)^1 + 6 \times 1^2 x\left(\frac{-x}{3}\right)^2 +$ $4.1\left(\frac{-x}{3}\right)^3 + \left(\frac{x}{3}\right)^4$ $1 - \frac{4x}{3} + \frac{6x^2}{9} - \frac{4x^3}{27} + \frac{x^4}{81}$ (a) $1 - \frac{4x}{3} + \frac{6x^2}{9}$ (b) $\left(1 - \frac{x}{3}\right)^4 = 0.99^4$ $\therefore 1 - \frac{x}{3} = 0.99$ 3 – x = 0.99 x 3 = 2.97 3 – 2.97 = x 0.03 = x $\therefore 1 - \frac{4x}{3} + \frac{6x^2}{9}$ $0.99^4 = 1 - \frac{4 \times 0.03}{3} + \frac{6 x(0.03)^2}{9}$	M1 For substitution of 1 and $-\frac{x}{3}$ A1 For simplification M1	

8.	h = $\frac{5\sqrt{3}}{2Sin60}$ = 5cm Arc length = $\frac{120}{360}$ x 2 x 3.142 x5 = 10.5cm		
9.	$\frac{P^2-2Pq+q^2}{P^3-Pq^2+P^2q-q^3} = \frac{(P-q)(P-q)}{(P-q)(P+q)(P+q)}$ $\frac{(P-q)(P-q)}{(P-q)(P+q)(P+q)}$ = $\frac{P-q}{(P+q)^2}$	M1 M1 A1	
10.	(i) ∠BAD 180 – (180 – 48) 180 – 132 = 48^0 (ii) ∠BDC = (180 – 132) x ½ = 24 (iii) ∠BEC = 180 – (48 + 114) = 180 – 162 = 18^0	B1 B1	
11.	5000 x 84.15 = KSh. 420,750 420 750 289 850 Money spent Sh. 130,900 Amount $\frac{130,900}{64.45}$ x 100 = 20,000 Japanese yen	B1 M1 A1	
12.	1cm rep 50,000cm $1cm^2$ rep 2500,000 $96cm^2$ = ? $\frac{96\ x\ 2500,000,000}{1}$ = $\frac{24000000000}{10000\ x\ 1000}$ km^2 Area = 2400 km^2	 M1 M1 A1	
13.	$\frac{2}{3} - \frac{1}{2}$ x $\frac{3}{4}$ + 1 x $\left(\frac{5}{7}+\frac{3}{4}\right)$ $\frac{2}{3} - \frac{3}{8} + 1$ x $\frac{20+21}{28}$ $\frac{2}{3} - \frac{3}{8} + \frac{41}{28}$ $\frac{448-252+984}{672}$ $\frac{1180}{672}$	 M1 A1 Simplified	

14.	$4x^2 - 32X - 20 + K = (2x - a)^2$ $4x^2 - 32x - 20 + k = 4x^2 - 4ax + a^2$ $-32 = -4ax \Rightarrow a = 8$ $-20 + k = 64 \Rightarrow k = 84$	M1 M1 A1	
15.	$\frac{9.2}{Sin\ C} = \frac{7.9}{Sin\ 48}$ $\text{Sin C} = \frac{9.2\ Sin\ 48}{7.9}$ Sin C = 0.8654 C = 59.93 = 59.9 A1	 M1	
16.	Gradient of AB = $\frac{\Delta y}{Ax}$ $= \frac{8-4}{-3-3} = -2$ Eqn of the line $\Rightarrow \frac{y-4}{x-3} = 2$ $\Rightarrow y = -2x + 10$		
17.	(i) PAYE = Sh. 4000 Personal relief = Sh. 1100 Gross Tax = 4000 + 1100/= = Sh. 5100 p.m. Gross Tax P.A. = Sh. 5100 x 12 = Sh. 61,200 (ii) Taxable income in K£P,.A. 1st 4200 x 2 = 8400 3800 x 3 = 11,400 $\frac{4600}{12600}$x 5 = $\frac{23000}{42800}$ Balance 61,200 Tax -42,800 18,400 Taxable income remaining x x 6 = 18,400 $x = \frac{18,400}{6} = 3066.67$ Taxable income = 12600 + 3066.67 = £15666.67 p.a (iii) Taxable income in KSh. p.m $\frac{15666.67\ x\ 20}{12}$ = Sh. 26110.10 B. Salary p.m. = 26110.10 - 10800 = Sh. 15311.10 (iv) Net salary p.m N.S – All deductions = Sh. 26110.10 – 4000 Sh. 22111.10	 M1 A1 M1 A1 M1A1 M1 A1	

18.	(i) $\underset{\sim}{SR} = \underset{\sim}{SO} + \underset{\sim}{QR}$ $= -\frac{1}{3}\underset{\sim}{p} + \frac{1}{3}\underset{\sim}{q}$  		A1
	(ii) $\underset{\sim}{QS} = \underset{\sim}{QO} + \underset{\sim}{OS}$ $= -\underset{\sim}{q} + \frac{1}{3}\underset{\sim}{p}$		
	$\underset{\sim}{PT} = \underset{\sim}{PQ} + \underset{\sim}{QT}$ but $\underset{\sim}{PQ} = \underset{\sim}{PO} + \underset{\sim}{OQ}$ $= \frac{1}{4}\underset{\sim}{q} - \frac{3}{4}\underset{\sim}{p}$	M1 A1	
(iv)	$\underset{\sim}{TR} = \underset{\sim}{TQ} + \underset{\sim}{QR}$ $= \frac{1}{12}\underset{\sim}{q} - \frac{1}{4}\underset{\sim}{p}$ (b) $\underset{\sim}{PT} = \frac{1}{4}\underset{\sim}{q} - \frac{3}{4}\underset{\sim}{p}$ $TR = \frac{1}{12}\underset{\sim}{q} - \frac{1}{4}\underset{\sim}{p}$ Also $PR = \frac{1}{3}\underset{\sim}{q} - \underset{\sim}{p}$ $\therefore TR = \frac{1}{4}PR$ and R is common Hence p, t and R are collinear	M1 M1 A1	
19.	Let the No. of goats be x Let the No. of bulls be y $\frac{2000}{1000}x + \frac{15000}{1000}y = \frac{190000}{1000}$ 2x + 15y = 190……(i) 2(2000x) + (y – 3)15000 = 190,000-5000 4000x + 15000y – 45600 = 185,000 $\frac{4000}{1000}x + \frac{15000}{100}y = \frac{230,000}{100}$ 4x + 15y = 230 ……(ii) 4x + 15y = 230 (Elimination substitution 2x + 15y = 190 2x = 40 x = 20 2x + 15y = 190 but x = 20 2(20) + 15y = 190 15y = 190 – 40 15y = 150 15 15 y = 10 $\therefore$ x = 20 goats and y = 10 bulls (b) Profit per goat $\frac{25}{100}$ x 2000 = 500 Profit per bull $\frac{30}{100}$ x 15000 = 4,500 Goat 20 x 500 = 10,000 Bulls 10 x 4500 = 45,000 Total profit = 10,000 + 45,000 = 55,000/=		M1 M1 A1 M1 M1 M1 M1 M1 A1

20.	(a) 		
	(b) P (BL) or P(ML) or P(OL) $\left(\frac{2}{3}\ x\ \frac{2}{5}\right) + \left(\frac{1}{4}\ x\ \frac{3}{10}\right) + \left(\frac{1}{12}\ x\ \frac{3}{20}\right)$ $\frac{4}{15} + \frac{3}{40} + \frac{1}{80}$ $= \frac{17}{48}$ (c) P(BL) or P(OL) $\left(\frac{2}{3}\ x\ \frac{2}{5}\right) + \left(\frac{1}{12}\ x\ \frac{3}{20}\right)$ $\frac{4}{15} + \frac{1}{80}$ $= \frac{67}{240}$ (d) P (Not late for school) 1 – P(Late for school) $= 1 - \frac{17}{48}$ $= \frac{31}{48}$	M1 M1 A1 M1 A1 M1 A1	
21.	(a) Time to fill the tank wih (i) Taps x and y opened and z closed. Rate of x = $\frac{1}{9}$ Rate of y = $\frac{1}{6}$ Rate of x and y = $\frac{1}{9} + \frac{1}{6} = \frac{5}{18}$ Time taken = $\frac{18}{5}$ = $\frac{18}{5}$ x 60 = 3 Hours 36 min (ii) Time to fill the tank with the three taps opened at the same time. Rate of x + y – 2 $\Rightarrow \frac{1}{9} + \frac{1}{6} - \frac{1}{4}$ $= \frac{5}{18} - \frac{1}{4} = \frac{1}{36}$ Time = $1 \div \frac{1}{36}$ = 36 hours	M1 A1 A1	

	(b) (i) x runs for 1 hr $\Rightarrow$ 1 x $\frac{1}{9} = \frac{1}{9}$ y runs for 15 min $\Rightarrow \frac{1}{4} \; x \; \frac{1}{6} = \frac{1}{24}$ z runs for 0hrs. The fraction filled will be given by x + y $\Rightarrow \frac{1}{9} + \frac{1}{24} = \frac{11}{72}$ (ii) Remaining fraction = 1 - $\frac{11}{72}$ $= \frac{61}{72}$ Time taken $\frac{61}{72} \div \frac{1}{36}$ (Rate at which the tank is emptied) = 30.5 hrs $\approx$ 30 hrs 30 min	B1 M1 A1 B1 M1 A1	
22.	(a) A ⟵ 360km ⟶ A (i) D = S x T = 60km/h x $\frac{3}{2}$ hrs = 90 km (ii) Distance travelled between them = 90 km Relative speed $\Rightarrow$ (100 – 60)km 40 km Time taken by car to catch up the bus. $\Rightarrow \frac{Distance}{R.Speed}$ $\frac{90}{40} = \frac{9}{4}$ hours Distance travelled by the car to catch up the bus $\Rightarrow$ S x T = 100 x $\frac{9}{4}$ hrs = 225 km (b) Let the original speed be x km/h Initial time taken $= \frac{160}{x}$ hrs Slower speed (x – 60) Time taken = $\left(\frac{160}{x-16}\right)$ hrs $\frac{160}{x-16} - \frac{160}{x} = \frac{20}{60}$ $x^2 - 16x - 76080 = 0$ x = -80 or 96 x = 96km/h	M1 A1 B1 B1 A1 B1 B1 A1	

23.	(a) $\begin{pmatrix}30 & 10\\50 & 20\end{pmatrix}$ Det = 600 – 500 =100 $\frac{1}{100}\begin{pmatrix}20 & -10\\-50 & 30\end{pmatrix}$ $\begin{pmatrix}0.2 & -0.1\\-0.5 & 0.3\end{pmatrix}$ or $\begin{pmatrix}\frac{1}{5} & -\frac{1}{10}\\-\frac{1}{2} & \frac{3}{10}\end{pmatrix}$ (b) (i) 30x + 10y = 70 50x + 20y = 120	M1 M1 A1 B1 B1	
	(ii) $\begin{pmatrix}30 & 10\\50 & 20\end{pmatrix}\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}70\\120\end{pmatrix}$ $\begin{pmatrix}\frac{1}{5} & -\frac{1}{10}\\-\frac{1}{2} & \frac{3}{10}\end{pmatrix}\begin{pmatrix}30 & 10\\50 & 20\end{pmatrix}\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}\frac{1}{5} & -\frac{1}{10}\\-\frac{1}{2} & \frac{3}{10}\end{pmatrix}\begin{pmatrix}70\\120\end{pmatrix}$ $\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}14 & -12\\-35 & +36\end{pmatrix}$ $\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}2\\1\end{pmatrix}$ x = 2 y = 1	M1 M1 A1A1	
24.