Answer scheme

1	**a**	$3(x-2)^2-11$	B1 B1	$3(x-2)^2$ -11
	b	Since $(x-2)^2 \geq 0$, Therefore, $3(x-2)^2-11 \geq -11$ Therefore, min value of $y=-11$ Or Min value occurs at $3(x-2)^2=0$ Therefore, $y=-11$	 M1 A1 M1 A1	
2	**a**	$f(3)=2(3)^3+p(3)^2-9(3)+q$ $54+9p-27+q=0$ $9p+q=-27$ $f(-1)=2(-1)^3+p(-1)^2-9(-1)+q$ $-2+p+9+q=20$ $p+q=13$ $p+(-9p-27)=13$ $-8p=40$ $p=-5$ $q=18$	 M1 M1 M1 A1 A1	 Obtain first equation Obtain second equation Equating of two simultaneous equations
	b	$(x-3)(2x^2+x-6)=0$ $(x-3)(2x-3)(x+2)=0$ $x=3, \frac{3}{2}, -2$	M1 M1 A1	Obtaining quadratic factor Factorisation of quad factor
3		$(2-3k)^2-4(1)(k^2)<0$ $4-12k+9k^2-4k^2<0$ $5k^2-12k+4<0$ $(5k-2)(k-2)<0$ $\frac{2}{5}<k<2$	M1 M1 M1 A1	Substitution into b^2-4ac <0 Factorisation of quadratic

4	**a**	$3^5+\binom{5}{1}(3^4)(-kx)+\binom{5}{2}(3^3)(-kx)^2+\binom{5}{3}(3^2)(-kx)^3+\ldots$ $=243-405kx+270k^2x^2-90k^3x^3+\ldots$	M1 A1 A1	Substitution into formula Coefficients
	b	$3(270k^2)+4(-405k)=0$ $810k^2-1620k=0$ $k^2-2k=0$ $k(k-2)=0$ $k=0(rej)$ $k=2$	M1 A1	
5		$\tan(45^\circ+60^\circ)$ $=\frac{\tan 45+\tan 60}{1-\tan 45 \tan 60}$ $=\frac{1+\sqrt{3}}{1-\sqrt{3}} \times \frac{1+\sqrt{3}}{1+\sqrt{3}}$ $=\frac{1+2\sqrt{3}+3}{1^2-3}$ $=-2-\sqrt{3}$	 M1 M1 M1 M1 A1	 Application of add form. $\tan 45=1, \tan 60=\sqrt{3}$ Rationalization Expansion of numerator
6		$\frac{3x^2+4x-5}{(x+1)^2(2x-1)}=\frac{A}{(x+1)}+\frac{B}{(x+1)^2}+\frac{C}{2x-1}$ $3x^2+4x-5=A(x+1)(2x-1)+B(2x-1)+C(x+1)^2$ $x=-1,$ $B=2$ $x=0.5,$ $C=-1$ $x=0,$ $A=2$ $\frac{3x^2+4x-5}{(x+1)^2(2x-1)}=\frac{2}{(x+1)}+\frac{2}{(x+1)^2}-\frac{1}{2x-1}$	M1 M1 M1 M1 M1 A1	Correct decomposition

7	a	$\frac{\cos\theta}{\sin\theta} - 2\sin\theta\cos\theta$ $= \frac{\cos\theta - 2\sin^2\theta\cos\theta}{\sin\theta}$ $= \frac{\cos\theta(1-2\sin^2\theta)}{\sin\theta}$ $= \frac{\cos\theta}{\sin\theta}(1-2\sin^2\theta)$ $= \cot\theta\cos 2\theta$	M1 M1 A1	$\sin 2\theta = 2\sin\theta\cos\theta$ **Combine to 1 fraction**
	b	$3\cot\theta\cos 2\theta = \cos 2\theta$ $\cos 2\theta(3\cot\theta - 1) = 0$ $\cos 2\theta = 0$ $\alpha_1 = \frac{\pi}{2}$ $2\theta = \frac{\pi}{2}, \frac{\pi}{2}+\pi, 2\pi+\frac{\pi}{2}, 2\pi+\pi+\frac{\pi}{2}$ $\theta = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$ $\cot\theta = \frac{1}{3}$ $\tan\theta = 3$ $\alpha_2 = 1.2490$ $\theta = 1.25, 4.39$	M1 M1 M1 A1	**apply (a) and factorise** **Solve** $\cos 2\theta = 0$ $\tan\theta = 3$
8	a	$\tan A = -\frac{4}{3}$	B1	
	b	$\text{cosec}B = \frac{1}{\sin B} = -\frac{13}{5}$	B1	
	c	$\sin(A+B)$ $\cos(90-A) = \sin A = -\frac{4}{5}$	B1	

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9	a	$2^{2x} - 2^x = 2^x.4 + 6$ $u = 2^x$ $u^2 - u = 4u + 6$ $u^2 - 5u - 6 = 0$ $(u-6)(u+1) = 0$ $2^x = 6$ $x = \frac{\lg 6}{\lg 2} = 2.58$ $2^x = -1 (rej)$	M1 M1 A1 A1	**Substitution of u** **factorisation**
	b	$\log_3 x + \frac{\log_3 y}{\log_3 9} = \log_3 2$ $\log_3 x + \log_3 y^{\frac{1}{2}} = \log_3 2$ $\log_3 xy^{\frac{1}{2}} = \log_3 2$ $xy^{\frac{1}{2}} = 2$ $x = \frac{2}{\sqrt{y}}$	M1 M1 A1	**Change of base of one** **Product law**
10	a	$-10 = 30 - Ae^{-k(0)}$ $-10 = 30 - A(1)$ $A = 40$	A1	
	b	$23.4 = 30 - 40e^{-k(60)}$ $e^{-k(60)} = \frac{23.4-30}{-40}$ $-60k = \ln\left(\frac{23.4-30}{-40}\right)$ $k = 0.03$	M1 A1	**K = 0.0300 (3sf)**
	c	$20 = 30 - 40e^{-0.03003t}$ $e^{-0.03003t} = 0.25$ $t = 46.2\text{min}$	M1 M1 A1	
	d	As t tends to infinity, $e^{-0.03003t}$ tends to 0 $40e^{-0.03003t}$ tends to 0 And hence the temperature of the meat will approach30 degree celsius.	A1	

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11	a	$(0,-2)$	B2	
	b	$\text{Grad}_{BC} = -\frac{4}{3}$ Eqn_{BC}: $y-2=-\frac{4}{3}(x-12)$ $y=-\frac{4}{3}x+18$ Sub into Eqn_{AB} $4\left(-\frac{4}{3}x+18\right)=3x-8$ $-\frac{16}{3}x+72=3x-8$ $\frac{25}{3}x=80$ $x=9.6, y=5.2$ $B(9.6,5.2)$	M1 M1 A1A1	Eqn of BC Substitution into Eqn of AB
	c	$\frac{1}{2}\begin{vmatrix} 0 & 6 & 12 & 0 \\ -2 & -8 & 2 & -2 \end{vmatrix}$ $=\frac{1}{2}\left[(12-24)-(-96-12)\right]=48 \text{ units}^2$	M1 A1	Any correct method to find area of triangle ECF from coordinates of A

12	a	Midpoint PQ: $\left(\frac{1+5}{2},\frac{-6+2}{2}\right)$ $=(3,-2)$	B1B1	
	b	Grad PQ $=\frac{-6-2}{5-1}$ Grad PQ (Perpendicular bisector) $=-\frac{1}{2}$ Equation: $(y+2)=-\frac{1}{2}(x-3)$ $y=-\frac{1}{2}x-\frac{1}{2}$	M1 M1 A1	
	c	Centre: $-\frac{1}{2}x-\frac{1}{2}=x-8$ $x=5$ $y=-3$ $C(5,-3)$ Radius = 5 Eqn of circle: $(x-5)^2+(y+3)^2=25$	M1 M1 M1 A1	**Equating (a) ans and line passing through centre**

13 a Annex A

x	1	2	3	4	5	6
$\frac{y}{x}$	14	25	22	26	30	34.2

B1 axis labelled correctly
B1 points plotted correctly
B1 line of best fit passing through points except incorrect point.

b $y = 50$ incorrect, — **M1**
correct value: $y = 36$ — **A1**

c $y = px(x+k)$

$\frac{y}{x} = px + kp$ — **B1**

p : gradient

$p = \frac{38-18.4}{7-2} = 3.92(\pm 0.1)$ — **B1**

y-intercept: kp

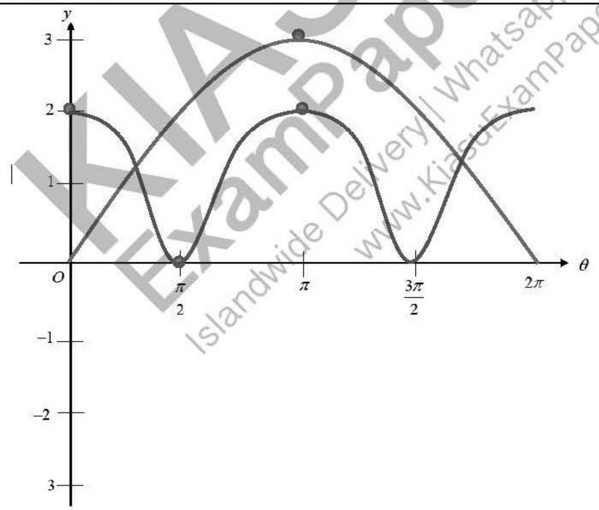
$kp = 10.4$

$k = \frac{10.4}{3.92} = 2.65$ — **B1**

14 a Amplitude: 3 — **B1**
Period: 720° — **B1**

b Maximum: 2 — **B1**
Minimum: 0 — **B1**

c



B1 **Shape of sine curve**
B1 **Shape of cosine curve**
B1 **Critical points of sine curve**
B1 **Critical points of cosine curve**