**Question 1** **[Maximum mark: 14]** ***[Start on a new green sheet]***

(a) Differentiate with respect to $x$:

(i) $5-\dfrac{3}{x^2}$ **1**

(ii) $\sqrt{3x^2-2x}$ **2**

(iii) $\dfrac{3x+1}{x^2-1}$ **3**

(b) Consider $f(x)=\dfrac{1}{(3x-1)^2}$

(i) Show that $f'(x)=\dfrac{-6}{(3x-1)^3}$ **3**

(ii) Find the gradient of the tangent to the graph of $f(x)$

when $x=1$ **1**

(iii) Find the equation of the tangent to the curve $f(x)$ at the point

$\left(1,\dfrac{1}{4}\right)$. Write your answer in the form $ax+by+c=0$. **2**

(c) The curve $y=ax^2-2ax+3$ has a gradient of 8 when $x=-3$.

Find the value of $a$. **2**

**Question 2** **[Maximum mark: 14]** ***[Start on a new green sheet]***

(a) Find all real values of $x$ for which $4^x - 5(2^x) + 4 = 0$ **3**

(b) Consider the parabola $8y = x^2 - 2x - 7$

(i) Find the coordinates of the vertex.
[**Hint**: Write in the form $(x-h)^2 = 4a(y-k)$ ] **2**

(ii) Find the coordinates of the focus. **2**

(iii) Write down the equation of the directrix. **1**

(iv) Sketch the parabola showing all the important features **2**

(c) Given that $\alpha$ and $\beta$ are the roots of the quadratic equation $3x^2 - x + 5 = 0$, find the value of:

(i) $\alpha\beta$ **1**

(ii) $\alpha + \beta$ **1**

(iii) $\alpha^2 + \beta^2$ **2**

**Question 3 [Maximum mark : 12]** ***[Start on a new green sheet]***

(a) (i) For what values of $k$ is the expression $x^2 - 3kx + 9 = 0$ positive definite **2**

(ii) Find the values of $m$ for which $12 + 4m - m^2 > 0$. **2**

(b) The focus of a parabola is S(3, 4) and its directrix is the line $x = -3$ .

(i) Sketch the parabola and indicate the coordinates of the vertex, V. **2**

(ii) Write down the focal length of the parabola . **1**

(iii) Find the equation of the parabola. **2**

(c) Find the equation of the locus of a point P($x$, $y$) that moves so the line PA is perpendicular to the line PB where A = (– 4, 0) and B = (1, 1)

[**Hint**: Draw a diagram] **3**

## End of Assessment