1. (i) Show how equation A below can be re-arranged to give equation B:

[6]

(A) $$\left(P+\frac{an^2}{V^2}\right)\left(\frac{1}{V}-n^{3/2}\right)=nRT$$

(B) $$a=\left(\frac{nRTV^3}{n^2-Vn^{7/2}}-\frac{PV^2}{n^2}\right)$$

2. (i) Solve the simultaneous equations

[5]

$$2x+y=5$$

$$\frac{y}{2}+6x=7.5$$

3. Combine the two functions *f(x)* and *g(x)* to give expressions for *f(g(x))* and *g(f(x))*.

[5]

$$f(x)=8\cos^3(1-x^3)$$

$$g(x)=\sqrt[3]{x}$$

4. (i) Solve the following quadratic equation by factorising or using the formula given at the top of this exam paper: [7]

$$x^2 - 4x - 12 = 0$$

(ii) Sketch the function below marking the points at which it crosses both axes **and** the coordinates of the maxima/minima. [6]

$$y = x^2 - 4x - 12$$

5. (i) Evaluate: $\lim_{x \to \infty} 2e^{-\left(\frac{1}{x^2}\right)}$

[4]

(ii) In practice this limit is never reached. For what value of x would this function be within 90% of the limiting value given in part (i).

[4]

(iii) Evaluate: $\lim_{x \to 0} \left(\frac{x + 3x^2}{x} \right)$ [4]

6. (i) Change the base of the following logarithmic expression from *e* to base 10 and simplify as far as possible: [5]

$$\ln\left(\frac{x^3}{100} \right)$$

(ii) Expand and simplify: [5]

$$\log_4\left(\frac{256}{x^3} \right)$$

7. What is the derivative of *y* for each of the following functions? [4x4]

(i) $y = (x - 1)(x + 1)$

(ii) $y = \frac{4}{x} + x^3 - 1$

(iii) $y = x^2 e^{(x+2)}$

(v) $y = \cos(3x - x^2)$