5 **(i)** Express $\dfrac{3}{(y-2)(y+1)}$ in partial fractions. **[3]**

(ii) Hence, given that x and y satisfy the differential equation

$$\frac{dy}{dx} = x^2(y-2)(y+1),$$

show that $\dfrac{y-2}{y+1} = Ae^{x^3}$, where A is a constant. **[5]**

6 Solve the equation $\tan(\theta + 45^\circ) = 1 - 2\tan\theta$, for $0^\circ \leqslant \theta \leqslant 90^\circ$. **[7]**

Section B (36 marks)

7 A straight pipeline AB passes through a mountain. With respect to axes Oxyz, with Ox due East, Oy due North and Oz vertically upwards, A has coordinates $(-200, 100, 0)$ and B has coordinates $(100, 200, 100)$, where units are metres.

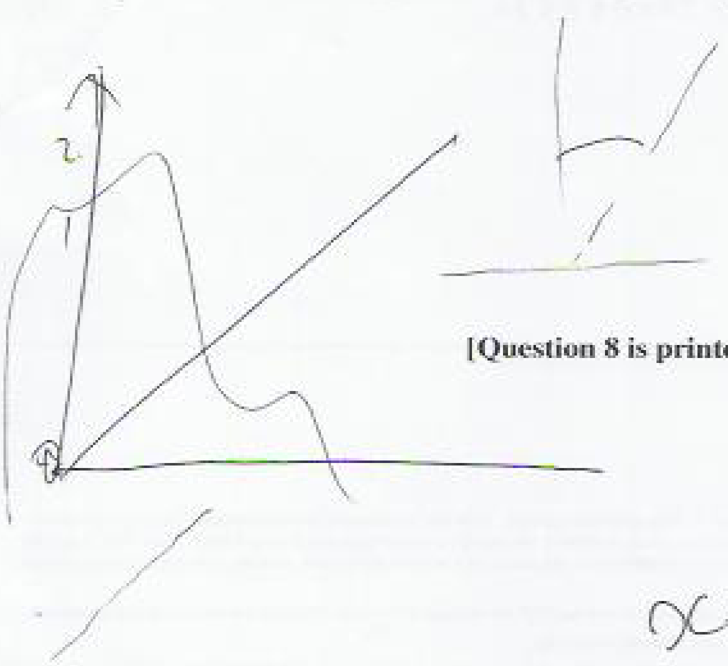
(i) Verify that $\overrightarrow{AB} = \begin{pmatrix} 300 \\ 100 \\ 100 \end{pmatrix}$ and find the length of the pipeline. **[3]**

(ii) Write down a vector equation of the line AB, and calculate the angle it makes with the vertical. **[6]**

A thin flat layer of hard rock runs through the mountain. The equation of the plane containing this layer is $x + 2y + 3z = 320$.

(iii) Find the coordinates of the point where the pipeline meets the layer of rock. **[4]**

(iv) By calculating the angle between the line AB and the normal to the plane of the layer, find the angle at which the pipeline cuts through the layer. **[5]**



$1 - 2\tan\theta$

$\tan\theta = x$

$(1-2x)(1-x)$

$1 - x - 2x + 2x^2$

$x + 1 = 2x^2 - 3x + 1$

[Question 8 is printed overleaf.]