1.

(i)
$$\frac{(1-x)^{\frac{1}{2}} - (1-x)^{-\frac{1}{2}}}{(1+x)^{\frac{1}{2}}}$$

(ii) $\frac{\log 125 - \log 25 + \log 5}{\log 625 + \frac{1}{2} \log 25} \frac{b}{b}$

(b) Solve the equation:

$$4^x + 1 = 3 + 2^x$$

00-42-0 (5 marks)

(c) The application of Kirchoff's laws to a d.c. circuit yielded the simultaneous equations:

$$I_1 - 2I_2 + I_3 = 0$$

 $-2I_1 + 3I_2 + 2I_3 = 2$
 $3I_1 + 4I_2 - 3I_3 = 14$

Where I_1 , I_2 and I_3 are currents in amperes. Use elimination method to solve the equations. (8 marks)

- 2. (a) Find the coefficient of x^6 in the binomial expansion of $(3x + 2y)^{10}$, and determine its value when $x = \frac{1}{2}$ and $y = \frac{1}{2}$. (5 marks)
 - (b) (i) Determine the first four terms in the binomial expansion of $(3+4x)^{-\frac{1}{2}}$, and state the values of x for which the expansion is valid.
 - (ii) Use the binomial theorem to expand $\left(1 + \frac{1}{4}x\right)^{\frac{1}{3}}$ as far as the term in x^3 . Hence determine the value of $\sqrt[3]{65}$, correct to four decimal places. (9 marks)
 - (c) Solve the equation:

$$3^{2x+1} - 7(3^x) + 2 = 0$$

(6 marks)

3. (a) Given the complex numbers $z_1 = 2 + 3j$, $z_2 = 1 + 2j$ and $z_3 = 3 - 4j$, express

$$\frac{z_1 + \frac{z_2 z_3}{z_2 + z_3}}{z_3}$$
 in polar form.

(8 marks)

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- (b) One root of the equation $z^3 + 4z^2 + kz + 8 = 0$ is $-1 + j\sqrt{3}$. Determine the:
 - (i) value of k;
 - (ii) other roots.

(6 marks)

(c) Solve the equation:

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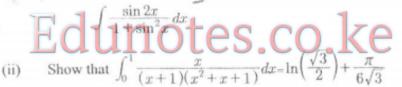
$$z^3 - 1 + j\sqrt{3} = 0$$

(6 marks)

- 4. (a) Given $y = \frac{x}{1-x}$, find $\frac{dy}{dx}$ from first principles. (5 marks)
 - (b) Use implicit differentiation to determine the equations of the:
 - (i) tangent;
 - (ii) normal

te the curve $x^3 + y^2 + 3xy - 2x + 6y + 9 = 0$ at the point (1, -1). (10 marks)

- (c) Determine the stationary points of the curve $f(x) = x^3 + 15x^2 + 27x + 2$, and state their nature. (5 marks)
- 5. (a) (i) Evaluate the indefinite integral



(12 marks)

- (b) Use the integration to determine the length of the curve $y = \frac{1}{3}x^{\frac{3}{2}}$ between the points x = 0 and x = 4. (8 marks)
- 6. (a) Prove the trigonometric identities:

(i)
$$\frac{1 - \sin \theta}{\cos \theta} + \frac{\cos \theta}{1 - \sin \theta} = 2 \sec \theta$$

(ii)
$$\frac{1-\cos\theta}{1+\cos\theta} = (\csc\theta - \cot\theta)^2$$

(9 marks)

(b) Solve the equation:

 $3\sin^2\theta + 5\cos\theta = 5$, for values of θ between 0° and 360° inclusive.

(5 marks)

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Turn over

- (c) (i) Express $4\cos\theta + 3\sin\theta$ in the form $R\cos(\theta \alpha)$, where R > 0 and $0^{\circ} \le \alpha \le 90^{\circ}$.
 - (ii) Hence solve the equation:

 $4\cos\theta + 3\sin\theta = 5$ for values of θ between 0° and 180° inclusive.

(6 marks)

7. (a) Given
$$u = \frac{x - 3y}{x + 3y}$$
, show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$

(5 marks)

- (b) The radius of a right circular cone is increasing at a rate of 18 cm/s while its height is decreasing at a rate of 25 cm/s. Determine the rate of change of the volume of the cone when the radius is 120 cm and the height is 140 cm. (4 marks)
- (c) Locate the stationary points of the function $z = x^3y + 12x^2 8y + 2$, and determine their nature. (11 marks)
- 8. (a) Prove the identities:
 - (i) $\sinh(x+y) = \sinh x \cosh y + \cosh x \sinh y$;
 - (ii) $\tanh 2x = \frac{2 \tanh x}{1 + \tanh^2 x}$

(7 marks)

- (b) (i) Express tanh⁻¹x in logarithmic form.
 - (ii) Hence determine the value of Earth (1), correct to four decimal places.
 (8 marks)
- (c) Solve the equation $3\cosh^2 x 7\sinh x 1 = 0$. (5 marks)

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