1 Given that
$$\frac{3^x}{9^{3x}} = 81$$

find the value of *x*. Show clear algebraic working.

$$q^{32} = \left(3^{1}\right)^{32}$$

$$= 3^{62}$$

$$3^{\frac{3}{6}x} = 81 \longrightarrow \frac{3^{\frac{3}{6}x}}{3^{\frac{6}{6}x}} = 3^{\frac{1}{6}}$$

$$3^{\frac{3}{6}x} = 3^{\frac{1}{6}}$$

$$x - 6x = 4^{\frac{1}{6}}$$

$$-5x = 4^{\frac{1}{6}}$$

$$x = -0.8$$

$$x = -0.8$$
(Total for Question 1 is 3 marks)

$$2^{2y} \times 2^{3y+2} = \frac{8^{5y}}{4^n}$$

2 (b) Find an expression for *n* in terms of *y*. Show clear algebraic working and simplify your expression.

$$3 \quad \sqrt{2} \times 16 = 2^x$$

$$\sqrt{2} = 2^{\frac{1}{2}}$$

$$16 = 2^{\frac{4}{3}}$$

(a) Find the value of x. Show your working clearly.

$$2^{\frac{1}{2}} \times 2^{\frac{4}{3}} = 2^{\frac{1}{3}}$$

$$2^{\frac{1}{2}+\frac{4}{3}} = 2^{\frac{1}{3}}$$

$$2 = \frac{1}{4} + \frac{1}{2} = 4.5$$

$$x =$$
 (2)

$$\frac{(11^{-6})^5}{11^4} = 11^n$$

(b) Find the value of n. Show your working clearly.

$$\frac{11^{-6 \times 5}}{11^{4}} = 11^{n}$$

$$\frac{11^{-36}}{11^{4}} = 11^{n}$$

$$11^{-30-4} = 11^{n}$$

$$n =$$
 (2)

h = -30-4 = -34

(Total for Question 3 is 4 marks)

4 Simplify fully
$$\left(\frac{9x^4}{16y^{10}}\right)^{-\frac{1}{2}}$$

$$qx^{4} = 3^{3}x^{4}$$

$$16y^{10} = 2^{4}y^{10}$$

$$\left(\frac{qx^{4}}{16y^{10}}\right)^{-\frac{1}{2}} = \left(\frac{3^{2}x^{4}}{2^{4}y^{10}}\right)^{-\frac{1}{2}}$$

$$= \frac{3^{2(-\frac{1}{2})} \cdot x^{4(-\frac{1}{2})}}{\lambda^{4(-\frac{1}{2})} \cdot y^{10(-\frac{1}{2})}}$$

$$= 3^{-\frac{1}{2}} \cdot x^{-\frac{2}{2}} \left(1\right) = \frac{2^{2} \cdot y}{\lambda^{2}}$$

$$\frac{3^{-1} \cdot x^{-2}}{2^{-2} \cdot y^{-5}} = \frac{2^{2} \cdot y^{5}}{3 x^{2}}$$

$$= \frac{4y^{5}}{3 x^{2}}$$

4y⁵
3x²

(Total for Question 4 is 3 marks)

5 (a) Simplify $8^2 \times \sqrt[3]{4^6}$

Give your answer in the form 2^a where a is an integer.

Show each stage of your working clearly.

$$= 8^{2} \times \sqrt[3]{4^{6}}$$

$$= (2^{3})^{2} \times (4^{6})^{\frac{1}{3}}$$

$$= 2^{6} \times 4^{2} \text{ (1)}$$

$$= 2^{6} \times (2^{2})^{2}$$

$$= 2^{6} \times 2^{4} \text{ (1)}$$

$$= 2^{(6+4)}$$

$$= 2^{10} \text{ (1)}$$

Given that $n^{\left(-\frac{4}{5}\right)} = \left(\frac{1}{2}\right)^4$ where n > 0

(b) find the value of n.

$$n^{\left(-\frac{4}{5}\right)} = \left(\frac{1}{2}\right)^{4}$$

$$\frac{1}{n^{\frac{4}{5}}} = \frac{1}{16} \text{ (1)}$$

$$16 = n^{\frac{4}{5}}$$

$$16^{\frac{5}{4}} = n \text{ (2)}$$

$$n = 32 \text{ (1)}$$

$$n = \frac{32}{(4)}$$

$$6 \quad \frac{2^k}{4^n} = 2^x$$

Find an expression for x in terms of k and n

$$\frac{2^{k}}{2^{2n}} = 2^{k}$$

$$2^{k-2n} = 2^{k}$$

$$x = \frac{\mathbf{k} - 2\mathbf{n}}{\mathbf{k} - 2\mathbf{n}}$$

(Total for Question 6 is 2 marks)

7 Given that
$$\left(\sqrt[3]{\frac{1}{x}}\right)^4 = x^m$$

(a) find the value of m

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

$$M = -\frac{4}{3}$$

$$M = -\frac{4}{3}$$

$$m = \frac{-\frac{4}{3}}{(1)}$$

8
$$a = 6 \times 10^{40}$$

Work out the value of a^3 Give your answer in standard form.

$$a^{3} = 6^{3} \times (10^{40})^{3}$$

$$= 2.16 \times 10^{120} (1)$$

$$= 2.16 \times 10^{122}$$

(Total for Question 8 is 3 marks)

9 Solve
$$2^{-4x} = 32$$

(Total for Question 9 is 2 marks)

10 Given that

$$2^n = 2^{x^2} \times 16^x \times 8$$

and

find an expression for x in terms of n State any restrictions on n

$$2^{9} = 2^{\frac{1}{2}} \times 2^{\frac{4^{2}}{4}} \times 3$$

$$n = \chi^2 + 4\pi + 3$$

$$\chi = -2 \pm \sqrt{n+1}$$

let
$$\kappa = 0$$
, $0 = -2 + \sqrt{n+1}$

$$x = -2 + \sqrt{n+1} \quad \text{and} \quad n > 3.$$

11 Express
$$\left(\frac{m^6k^{10}}{25}\right)^{\frac{3}{2}}$$
 in the form $\frac{m^ak^b}{c}$ where a, b and c are integers to be found.

$$\frac{m^6\left(\frac{3}{2}\right) \times k^{10}\left(\frac{3}{2}\right)}{25^{\frac{3}{2}}} = \frac{m^9 \times k^{\frac{15}{2}}}{125}$$

$$= \frac{m^9 k^{\frac{15}{2}}}{125}$$

(Total for Question 11 is 2 marks)

12 (a)
$$\sqrt{2} \div \frac{8^3}{16^{\frac{3}{2}}} = 2^n$$

Work out the value of *n* Show your working clearly.

$$\sqrt{\lambda} = 2^{1/2}$$

$$8^{3} = (2^{3})^{3} = 2^{9}$$

$$16^{\frac{3}{2}} = (2^{4})^{\frac{3}{2}} = 2^{6}$$

$$2^{1/2} \div \frac{2^{9}}{2^{6}} = 2^{n}$$

$$2^{\frac{1}{2} - (9 - 6)} = 2^{n}$$

$$\frac{1}{2} - 3 = n$$

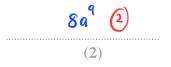
$$n = -2.5$$

$$n = \dots$$
 (3)

(b) Find 4% of 4.5×10^{157} Give your answer in standard form.

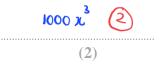
(Total for Question 12 is 6 marks)

13 (a) Simplify fully $(32a^{15})^{\frac{3}{5}}$ $32^{\frac{3}{5}} \times q^{15}(\frac{3}{5})$ $= 8 \times q^{9}$



(b) Express $\left(\frac{1}{10x}\right)^{-3}$ in the form px^n where p and n are integers.

$$((10x)^{-1})^{-3} = (10x)^{3}$$



(c) Solve $\frac{1-2y}{3} = \frac{4}{5} - \frac{2y-1}{2}$

Show clear algebraic working.

$$(5)(2)(1-2y) = 4(3)(2) - (3)(5)(2y-1)$$
 $10 - 20y = 24 - 30y + 15$
 $10y = 29$
 $y = 2.9$

$$y = \dots$$
 (3)

(Total for Question 13 is 7 marks)