- 1. (a)  $(1/2) \stackrel{2}{=} 1/4$ 
  - (b) 2 = 4
  - (c)  $(5/2)^{-2} = (2/5)^2 = 4/25$
  - (d)  $(1/5)^{-2} = 5^2 = 25$

JE MATHS

JE MATHS

2. = 1/(1-2)+1/(1+2/3)= -1+3/5= -2/5

3. (a)  $x^{-2}$ 

JE MATHS

(b)  $-1/2 \times x^{-2}$ 

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4. (a)  $2^{2x} \times 2^{-4x} = 2^{-2x} = 1/(2^{2x})$ 

(b)  $2^{-2x} \div 2^{-x} = 2^{-x}$ 

JE MATHS

(c)  $8m^{-6} \times n^6$ 

JE MATHS

JE MATHS

(d)  $6m^4 \times n^{-6} \div (4m^{-4} \times n^6) = 3/2 \times m^8 \times n^{-12} = 3m^8/2n^{12}$ 

5. (a)  $2 \times 2^n = 2^{n+1}$ 

JE MATHS

(b)  $2^{-1} \times 2^{2n} = 2^{2n-1}$ 

(c)  $(4 \times 2^n - 2 \times 2^n)/2^n = 2 \times 2^n/2^n = 2$ 

JE MATHS

(d)  $2^{-n} \times 2^{4n} \div 2^{\mathbb{Z}_{n}^{\text{MATHS}}} = 2^{4n}$ 

6. (a)

x <sup>2</sup>2+1/x <sup>2</sup> JE MATHS (b)

x^4+2+1/x^4 JE MATHS

(c)

 $= 1/(x+1/y)^2$ 

 $= 1/(x^2+2x/y+1/y^2)$ 

(d)

 $= 1/(1/x+1/y)^2$ 

 $= 1/(1/x^2+2/xy+1/y^3)$ 

 $= x^{2}y^{2}(y^{2}+2xy+x^{2})$ 

=  $x^{2}y^{7}(x+y)^{2}$  (better leave like that)

7. (a) 
$$((3^n)^{\frac{n}{2}})/(3^n-1)=(3^n+1)(3^n-1)/(3^n-1)=3^n+1$$

JE MATHS

(b) 
$$(2^{n}-1)(2^{2n}+2^{n}+1)$$

8. (a) 
$$(2/3)^{x} = (2/3)^{-2}$$
  $x=-2$ 

(b) 
$$3/5$$
 (3/5)  $-3x = (3/5)^{-2}$   $-3x = -2$   $x = 2/3$ 

JE MATHS

JE MATHS

(c)  

$$2^{4-2n} = 2^3$$
  
 $4-2x=3$   
 $1=2x$   
 $x=1/2$ 

(d)  

$$(1/2)^{2x+4} = (1/2)^{3x-6}$$
  
 $2x+4=3x-6$   
 $10 = x$   
JB MATHS

9. (a)  

$$x - y = 0$$
  
 $x + y = 2$   
 $2x = 2$   
 $x = 1$   
 $y = 1$ 

(b)  

$$x+y=3$$
  
 $2(x-y) = 3 \rightarrow x-y=1.5$   
 $2x = 4.5$   
 $x = 9/4$   
 $y = 3-9/4=3/4$ 

JE MATHS

10. 
$$2^{2n+2} - 2^{2n-1} = 1792$$
  
 $2^{2n-1}(2^{\frac{3}{2}}1) = 1792$   
 $2^{2n-1} \times 8 = 1792$   
 $2^{2n-1} = 256$   
 $2^{2n-1} = 2^{8}$   
 $2n-1 = 8$   
 $n = 9/2$ 

JE MATHS

11. (a)  $\sqrt{4}=2$ 

JE MATHS

(b) 
$$\sqrt{(1/4)} = 1/2$$

(c)  $(3/2) \stackrel{?}{=} 9/4$ 

(d) (27/8)^(4/3)=(3/2)^4=81/16

JE MATHS

12. (a)  $15a^{1/2-1/3}$   $b^{1/3+1/2} = 15a^{1/6}b^{5/6}$ 

(b) 
$$64x^3 \times y^{-4} \div (x^{-2} \times y^{-1}) = 64x^5 \times y^{-3}$$

13. (a)  $-x^{3/2}_{JB MATHS}$ 

(b)  $3x^{-2/3}$ 

(c)  $xy^{-3/2}$ 

(d)  $x^{3/2}y^{-2/3}$ 

JE MATHS

JE MATHS

JE MATHS

JE MATHS

JE MATHS JE MATHS

14. (a) x-2+1/x

(b)  $x^{3}+2+1/x^{3}$ 

JE MATHS

JE MATHS

15. (a)  $x = 5^{1/5}$ 

> (c)  $x = \pm 81^{1/4}$  $x = \pm 3$

(b)

 $x = 243^{3/5} = 3 = 27$ JE MATH (d)

 $x = \pm 9^{3/2}$  $x = \pm 27$ 

JE MATHS

16. (a)  $2^{3x-3} = 2^{2}$ 3x-3=23x=5x = 5/3 JE MATHS

(b)  $(2/5)^{3x+6} = (2/5)^{-x}$ 3x+6 = -x4x = -6x = -3/2 MATERS

JE MATHS

(c)  $2^{2x} = 2^{3/2}$ 2x = 3/2x = 3/4JE MATHS

(d)  $3\sqrt{2} \times 3^{2x+2} = 9\sqrt{6}$  $(\div 3\sqrt{2})$  $3^{2x+2} = 3\sqrt{3}$  $3^{2x+2} = 3 \times 3^{1/2}$  $\text{JE MATHS} \, 3^{2x+2} = 3^{3/2}$ 

> 2x + 2 = 3/22x = -1/2x = -1/4

JE.Maths

- 17. (a)  $5\log_{x} x = 5$ 
  - (b)  $\log_{x} x^{-2} = -2\log_{x} x = -2$
  - (c)  $\log_x x^{1/2} = 1/2 \times \log_x x = 1/2$
  - (d)  $\log_{x}^{\text{MATHS}} x^{-1/2} = -1/2 \times \log_{x} x = -1/2$  JE MATHS

JE MATHS

- (e)  $\log_x x^{5/2} = 5/2 \times \log_x x = 5/2$
- (f)  $\log_x x^{-3/2} = -3/2 \times \log_x x = 3/2$

JE MATHS

- 18. (a)  $-\log_6 2 + \log_6 2 = 0$ 
  - (b)  $\log_2(96 \div 6) = \log_2 16 = \log_2 2^4 = 4\log_2 2 = 4$

JE MATHS

- (c)  $\log_3(4\times18\div8) = \log_39 = 2\log_33 = 2$
- (d)  $\log_2(4 \div 8 \div 16) = \log_2(1/32) = \log_2 2^{-5} = -5\log_2 2 = -5$

JE MATHS

19. (a)  $3/2\log_2 2 = 3/2$ 

JE MATHS

- (b)  $3/2\log_3 3 = 3/2$
- (c)  $-1/(1/2) \times \log_3 3 = -2$

JE MATHS

(d)  $3n/2n \times \log_2 2 = 3/2$ 

JE MATHS

- 20. (a) (5)
  - (b)(3)

JE MATHS

- (c) (a) R MATHS
- (d) (b)

IE MATHS

JE MATHS

## 21. (a) log<sub>2</sub>3+log<sub>2</sub>5

(b) 
$$-\log_2 3 \times 5$$
  
=  $-\log_2 3 - \log_2 5$ 

(c) 
$$\log_2 8 - \log_2 5$$
  
=  $3\log_2 2 - \log_2 5$   
=  $3 - \log_2 5$ 

JE MATHS

## JE MATHS

JE MATHS

(d) 
$$log_2 10 - log_2 3$$
  
=  $log_2 2 + log_2 5 - log_2 3$  JE MATHS  
=  $1 + log_2 5 - log_2 3$ 

(e) 
$$\log_2 2 + \log_2 3 + \log_2 5$$
  
=  $1 + \log_2 3 + \log_2 5$ 

JE MATHS

$$(f)\log_2 27 - \log_2 501$$

$$= 3\log_2 3 - \log_2 25 \times 2$$

$$= 3\log_2 3 - 2\log_2 5 - \log_2 2$$

$$= 3\log_2 3 - 2\log_2 5 - 1$$

$$= 3\log_2 3 - 2\log_2 5 - 1$$

JE MATHS

JE MATHS

22. (a)  
= 
$$\log_{10} 10 + \log_{10} x^2$$
  
=  $1 + 2\log_{10} x$ 

(b) =  $log_3x - log_33$ =  $log_3x - 1$ 

JE MATHS

JE MATHS

(c)  
= 
$$3\log_2 2 + 3\log_2 x$$
  
=  $3 + 3\log_2 x$ 

(d) =  $\log_3(1/3x)$  (9/27=1/3) =  $-(\log_3 3 - \log_3 x)$ =  $-1 + \log_3 x$ 

23. (a) 
$$4^{\log_4(5/6)} = 5/6$$

JE MATHS

(b) 
$$t^{log_t(b^*a)} = {}^{\parallel B} b^{\text{MATHS}}$$

(c) 
$$a^{log_a(x^*x)} = x^x$$

(d) 
$$a^{1/x \times log_a x} = a^{log_a(x^{\wedge}1/x)} = x^{1/x}$$

JE MATHS

JE MATHS

JE MATHS

JE MATHS

JE MATHS

24. (a)

LHS = 
$$\log_2 5 + \log_2 2 + \log_2 3 + \log_2 \sqrt{3}$$
  
=  $\log_2 5 + \log_2 2 + \log_2 3 + 1/2 \times \log_2 3$   
=  $\log_2 5 + 1 + 3/2 \times \log_2 3 = RHS$ 

(b) LHS = 
$$\log_2 8 - \log_2 25 - \log_2 \sqrt{30}$$
  
=  $3\log_2 2 - 2\log_2 5 - 1/2\log_2 3 \times 5$   
=  $3\log_2 2 - 2\log_2 5 - 1/2 \times (\log_2 3 + \log_2 5)$   
=  $3 - 2\log_2 5 - 1/2 \times (\log_2 3 + \log_2 5)$   
=  $3 - 2\log_2 5 - 1/2 \times \log_2 3 + \log_2 5$   
=  $3 - 5/2 \times \log_2 5 - 1/2 \times \log_2 3 = RHS$ 

25. (a)

LHS= 
$$log_x 8 - log_x 5 - log_x x^3$$
 (simplify 24/15=8/5)  
=  $3log_x 2 - log_x 5 - 3$   
=  $3p - r - 3 = RHS$ 

(b)

LHS= 
$$\log_{x} 36 - \log_{x} 25 - \log_{x} x$$
  
=  $2\log_{x} 6 - 2\log_{x} 5 - 1$   
=  $2\log_{x} 2 \times 3 - 2\log_{x} 5 - 1$   
=  $2\log_{x} 2 + 2\log_{x} 3 - 2\log_{x} 5 - 1$   
=  $2p + 2q - 2r - 1 = RHS$ 

26. LHS =  $log_{an}x$ 

= log<sub>a</sub>x/log<sub>a</sub>an  $= \log_a x/(\log_a a + \log_a n) \times MATHS$ 

 $= \log_a x/(1 + \log_a n)$ 

= RHS

27. (a) 3log<sub>3</sub>5

(b)  $3^{log_3m}$ JE MATHS

(c)  $2^{log_20.4}$ 

(d)  $x^{log_xy}$ 

28. (a) JB MATHS
$$log_2 \sqrt{x + log_2} 2 = log_2 y^3$$

$$log_2 2\sqrt{x} = log_2 y^3$$

$$2\sqrt{x} = y^3$$

IE MA(b)

(b) 
$$log_5(2x-1)^3 = log_5(2x+1)^2 + log_55$$
$$log_5(2x-1)^3 = log_55(2x+1)^2$$
$$(2x-1)^3 = 5(2x+1)^2$$