EXPONENTS ASSIGNMENT

Know	App	Think	Comm
___ / 21	___ / 17	___ / 12	___ / 10

KNOWLEDGE & UNDERSTANDING

1. Write each expression as a **single power**. You DO NOT need to evaluate. [6 marks]

a) $5^2 \cdot 5^7 = 5^{2+7} = 5^9$

b) $8^2 \cdot 8^{-1} = 8^{2+(-1)} = 8^1$

c) $\left(7^2\right)^4 = 7^{2\cdot 4} = 7^8$

d) $\dfrac{9^{-5} \cdot 9^7}{9^{-1}} = \dfrac{9^{-5+7}}{9^{-1}} = \dfrac{9^2}{9^{-1}} = 9^{2-(-1)} = 9^3$

e) $\left(\left(8^{-2}\right)^3\right)^{-2} = \left(8^{-2\cdot 3}\right)^{-2} = \left(8^{-6}\right)^{-2} = 8^{-6\cdot -2} = 8^{12}$

f) $\left(5^{12} \cdot 5^9\right)^0 = \left(5^{12+9}\right)^0 = \left(5^{21}\right)^0 = 5^{21\cdot 0} = 5^0 = 1$

2. **Evaluate** each expression as a fraction or integer (NO DECIMALS). [6 marks]

a) $5^{-3} = \dfrac{1}{5^3} = \dfrac{1}{125}$

b) $\left(\dfrac{1}{6}\right)^{-2} = 6^2 = 36$

c) $\left(\dfrac{3}{2}\right)^{-3} \times \left(\dfrac{2}{3}\right) = \left(\dfrac{2}{3}\right)^3 \times \left(\dfrac{2}{3}\right) = \left(\dfrac{2}{3}\right)\cdot\left(\dfrac{2}{3}\right)\left(\dfrac{2}{3}\right)\left(\dfrac{2}{3}\right) = 16/81$

d) $\dfrac{6^{-1} \cdot 6^{-2}}{6^{-1}} = \dfrac{6^{-1+(-2)}}{6^{-1}} = \dfrac{6^{-3}}{6^{-1}} = 6^{-3-(-1)} = 6^{-3+1} = 6^{-2}$

e) $\left(\left(-2\right)^{-3}\right)^3 = (-2)^{-3\cdot 3} = (-2)^{-9} = \dfrac{1}{2^9} = \dfrac{1}{512}$

f) $\left(\dfrac{-3}{4}\right)^{-3} = \left(\dfrac{-4}{3}\right)^3 = \left(\dfrac{-4}{3}\right)\left(\dfrac{-4}{3}\right)\left(\dfrac{-4}{3}\right) = \dfrac{-64}{27}$

3. Indicate whether each of the following statements is TRUE or FALSE. [5 marks] $10/2$

a) ___F___ Doubling time is the time needed for a radioactive sample to decay by half

b) ___F___ In the relation $P = I(b)^t$, if $b>1$ the relation represents exponential decay $P = 1000(2)$

c) ___T___ The base of an exponential half-life decay relation is ALWAYS 0.5

d) ___F___ When you multiply powers with the same base you multiply the exponents $2^3 \cdot 2^4$

e) ___F___ An exponential relation has no y-intercept

4. Calculate the **growth rate** of a population which **increases** by 105%. [2 marks]

Step1 $105\% = 1.05$

Step2 $1 + 1.05 = 2.05$

∴ The growth rate is 2.05

5. Calculate the **decay rate** of a substance which **decreases** by 15%. [2 marks]

Step1 $15\% = 0.15$

Step2 $1 - 0.15 = 0.85$

∴ The decay rate is 0.85

APPLICATION – don't forget your concluding statements

6. A bacterial culture began with 1 000 bacteria. It's growth can be modeled using the formula $N = 1\,000(2)^{\frac{t}{5}}$, where N is the number of bacteria after t hours.

a) From the formula, what do the numbers 1 000, 2, and 5 represent? [3 marks]

1000 = Initial number of bacteria
2 = doubling rate
5 = how long it takes to double the number

b) How much bacteria is present after 1 day? [3 marks]

1 day = 24 hours

$N = 1000(2)^{24/5}$

$= 1000(2)^{4.8}$

$= 27857.6$

∴ There'll be 27857 bacteria in 1 day.

7. The half-life of sodium bicarbonate is 25 days. Find the amount of sodium bicarbonate that is left after 100 days if you started with 20 grams. [3 marks]

$M = M_0\left(\frac{1}{2}\right)^{t/h}$

$M = 20(0.5)^{100/25}$

$= 20(0.5)^4$

$= 1.25$

∴ There'll be 1.25g left after 100 days.

9. The energy produced by wind turbines in a region increased exponentially from 1980 to 1995. The amount of energy, E, in gigawatt-hours, can be modelled by the relation $E = 6.49(1.058)^t$, where t is the time in years.

a) How much energy was produced by wind turbines by 1992? [2 marks]

$E = 6.49(1.058)^{12}$ time(t) = 1992 − 1980

$= 12.77$ = 12 years.

∴ By 1992, 12.77 gigawatt-hours of energy were produced.

b) Assuming the same relation is still currently used to model the growth of wind turbines, how much energy is produced by wind turbines by **this year**? [2 marks]

$t = 2016 - 1980$

$= 36$ years

$E = 6.49(1.058)^{36}$

$= 49.4$

$\boxed{\wedge}$ or $\boxed{y^x}$

∴ By 2016, 49.4 gigawatt-hours of energy were produced.

THINKING

10. Given a **TABLE OF VALUES**, **explain** how you can determine if a relation is: [3 marks]

Linear: 1st differences are equal

Quadratic: 2nd DIFFERENCES ARE EQUAL

Exponential: Constant ratio between consecutive y values.

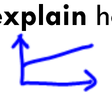
11. Given an **EQUATION**, **explain** how you can determine if a relation: [3 marks]

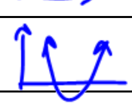
Linear: $y = 2x + 1$

Quadratic: $y = 2x^2 + 1$

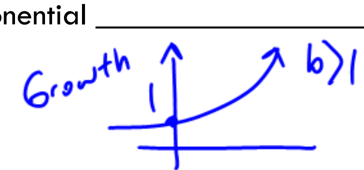
Exponential: $y = 2^x$

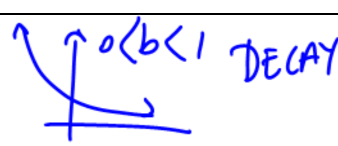
12. Given a **GRAPH**, **explain** how you can determine if a relation is: [3 marks]

Linear 

Quadratic 

Exponential





13. Give a **real-life example** of a linear relation. **Hint: Look in your notes and homework** [1 mark]

Driving at a constant speed, wage vs hours worked

14. Give a **real-life example** of a quadratic relation. [1 mark]

Falling object, rainbow, teeth

15. Give a **real-life example** of an exponential relation. [1 mark]

Ski slope, bacteria growth

COMMUNICATION

16. The relation for doubling uses 2 as the base of the power and the formula for half-life uses $\frac{1}{2}$ as the base. What do you think the base would be if a population is tripling? Explain. [2 marks]

17. Explain why population growth, such as a fox population that grows by 2% per year represents exponential growth. [2 marks]

18. **Describe** the steps you would take to evaluate $\left(\frac{2}{2^{-2}}\right)^{-2}$. You may use point form. [3 marks]

+ 3 Communication marks for proper Mathematical form THROUGHOUT the test.

0 **½** **1** **1 ½** **2** **2 ½** **3**