Advanced Functions – 4.5 WS: Power Function/Equation Name: Key (answers only)

I. Determine which are power functions, circle YES or NO. If YES, state value of k and p.

1.) $f(x) = 13\sqrt[3]{x}$ power function? Circle one: (YES) NO where k = 13 and p = $\frac{1}{3}$

2.) $3y = 9x^2$ power function? Circle one: (YES) NO where k = 3 and p = 2

3.) $f(x) = 2(x+5)^3$ power function? Circle one: YES (NO) where k = NA and p = NA

4.) $y - 1 = 2x^2 - 1$ power function? Circle one: (YES) NO where k = 2 and p = 2

5.) $f(x) = \sqrt{\frac{25}{x^3}}$ power function? Circle one: (YES) NO where k = 5 and p = $-\frac{3}{2}$

6.) $y = \sqrt[4]{81x^2}$ power function? Circle one: (YES) NO where k = 3 and p = $\frac{1}{2}$

7.) $f(x) = 6 \cdot 3^x$ power function? Circle one: YES (NO) where k = NA and p = NA

8.) $y = 4(x-2)(x+2) + 16$ power function? Circle one: (YES) NO where k = 4 and p = 2

9.) $y = 2x^3 + 5$ power function? Circle one: YES (NO) where k = NA and p = NA

10.) $y + 9 = (3 - 2x)(3 + 2x)$ power function? Circle one: (YES) NO where k = -4 and p = 2

II. Find an equation of a power function that goes through the given two points. SHOW WORK!!

11.) (3 , 30) and (1 , 5) $y = 5x^{1.631}$	12.) (7 , 8) and (1 , 0.7) $y = .7x^{1.252}$	13.) (6 , 17) and (1 , 2) $y = 2x^{1.194}$
14.) (4 , 3) and (9 , 4.5) $y = 1.5x^{.5}$ or $y = \frac{3\sqrt{x}}{2}$	15.) (6 , 162) and (8 , 384) $y = \frac{3}{4}x^3$	16.) $(2, \frac{64}{3})$ and (– 3 , 243) $y = \frac{1}{3}x^6$

III. Complete each variation problem. MUST SHOW WORK FOR CREDIT!!

17.) Suppose y is directly proportional to x. If y = 6 when x = 4, find the constant of proportionality (k). Write a formula for y then use it to find x when y = 8. $y = 1.5x \rightarrow x = \frac{16}{3}$	18.) Suppose y is inversely proportional to x. If y = 2 when x = 3, find the constant of proportionality (k). Write a formula for y then use it to find x when y = 8. $y = \frac{6}{x} \rightarrow x = \frac{3}{4}$
19.) Suppose c is directly proportional to the square of d. If c = 45 when d = 3, find the constant of proportionality (k). Write a formula for c then use it to find c when d = 5. $c = 5d^2 \rightarrow c = 125$	20.) Suppose h is inversely proportional to the cube of t. If h = .002 when t = 5, find the constant of proportionality (k). Write a formula for h then use it to find t when $h = \frac{-1}{108}$. $h = \frac{1}{4t^3} \rightarrow t = -3$

IV. Complete each application problem below. MUST SHOW WORK FOR CREDIT!!

21.) A 30-second commercial during Super Bowl XXXVI in 2002 cost advertisers 2 million dollars. For the first Super Bowl in 1967, an advertiser could have purchased approximately 22.989 minutes of advertising time for the same amount of money. Write a function that expresses the above situation. $y = 1449.97x^{1.077}$	22.) A person's weight, w, on a planet of radius d, is given by $w = k \cdot d^{-2}$ where the constant k depends on the masses of the person and the planet. A man weighs 180 lbs. on the surface of the earth. How much does he weigh on the surface of a planet whose mass is the same as the earth's, but whose radius is three times as large? 20 lbs

Adv Functions - 4.5 WS: Power Funct/Eq.

11) $(3, 30)$ and $(1, 5) \rightarrow k = 5$

$y = 5x^p$

$\frac{30}{5} = \frac{5 \cdot 3^p}{5}$

$6 = 3^p$

$\frac{\log 6}{\log 3} = \frac{p \log 3}{\log 3}$

$p = 1.631$

$\boxed{y = 5x^{1.631}}$

12) $(7, 8)$ and $(1, 0.7) \rightarrow k = .7$

$y = .7x^p$

$\frac{8}{.7} = \frac{.7 \cdot 7^p}{.7}$

$\frac{80}{7} = 7^p$

$\frac{\log(\frac{80}{7})}{\log 7} = \frac{p \log 7}{\log 7}$

$p = 1.252$

$\boxed{y = .7x^{1.252}}$

13) $(6, 17)$ and $(1, 2) \rightarrow k = 2$

$y = 2x^p$

$\frac{17}{2} = \frac{2 \cdot 6^p}{2}$

$8.5 = 6^p$

$\frac{\log 8.5}{\log 6} = \frac{p \log 6}{\log 6}$

$p = 1.194$

$\boxed{y = 2x^{1.194}}$

14) $(4, 3)$ and $(9, 4.5)$

$\frac{3}{4^p} = \frac{k \cdot 4^p}{4^p}$

$k = \frac{3}{4^p}$

$k = \frac{3}{4.5}$

$k = 1.5$

$4.5 = k \, 9^p$

$4.5 = \frac{3}{4^p} \cdot 9^p$

$\frac{4.5}{3} = \frac{3(\frac{9}{4})^p}{3}$

$1.5 = (\frac{9}{4})^p$

$\frac{\log 1.5}{\log(9/4)} = \frac{p \log(\frac{9}{4})}{\log(9/4)}$

$p = .5$ or $\frac{1}{2}$

$\boxed{y = 1.5x^{.5} \text{ or } y = \frac{3\sqrt{x}}{2}}$

15) $(6, 162)$ and $(8, 384)$

$\frac{162}{6^p} = \frac{k \cdot 6^p}{6^p}$

$k = \frac{162}{6^p}$

$k = \frac{162}{6^3}$

$k = .75$ or $3/4$

$\boxed{y = \frac{3}{4}x^3}$

$384 = k \cdot 8^p$

$384 = \frac{162}{6^p} \cdot 8^p$

$\frac{384}{162} = \frac{162(\frac{4}{3})^p}{162}$

$\frac{64}{27} = \frac{4^p}{3^p}$

$\frac{4^3}{3^3} = \frac{4^p}{3^p}$ so $p = 3$

16) $(2, \frac{64}{3})$ and $(-3, 243)$ $\rightarrow \boxed{y = \frac{1}{3}x^6}$

$\frac{\frac{64}{3}}{2^p} = \frac{k \cdot 2^p}{2^p}$

$k = \frac{\frac{64}{3}}{2^p} = \frac{64}{3 \cdot 2^p}$

$k = \frac{64}{3 \cdot 2^6}$

$k = 1/3$

$243 = k(-3)^p$

$243 = \frac{64}{3 \cdot 2^p} \cdot (-3)^p$

$243 = \frac{64}{3}(\frac{-3}{2})^p$

$\frac{729}{64} = \frac{(-3)^p}{2^p}$

$\frac{(-3)^6}{2^6} = \frac{(-3)^p}{2^p}$ so $p = 6$

17) $y = k \cdot x \rightarrow$ **$y = 1.5x$ or $y = \frac{3}{2}x$**

$\frac{6}{4} = \frac{k \cdot 4}{4}$

$k = 1.5$

$\frac{8}{1.5} = \frac{1.5x}{1.5}$

$x = 5.\overline{3}$ or $\frac{16}{3}$

18) $y = \frac{k}{x} \rightarrow$ **$y = \frac{6}{x}$**

$2 = \frac{k}{3}$

$k = 6$

$8 = \frac{6}{x}$

$\frac{8x}{8} = \frac{6}{8}$

$x = .75$ or $\frac{3}{4}$

19) $c = kd^2 \rightarrow$ **$c = 5d^2$**

$45 = k \cdot (3)^2$

$\frac{45}{9} = \frac{k \cdot 9}{9}$

$k = 5$

$C = 5 \cdot (5)^2$

$C = 125$

20) $h = \frac{k}{t^3} \rightarrow$ **$h = \frac{1}{4t^3}$**

$.062 = \frac{k}{(5)^3}$

$k = .250$ or $\frac{1}{4}$

$-\frac{1}{108} = \frac{1}{4t^3}$

$\frac{-4t^3}{-4} = \frac{108}{-4}$

$t^3 = -27$

$\sqrt[3]{t^3} = \sqrt[3]{-27}$

$t = -3$

21) For 2 oz $\rightarrow \frac{\text{cost}}{\text{sec}} = \frac{2{,}000{,}000}{30} = \$66{,}666.67$ per second

For 1967 $\rightarrow$ 22.989 min

$\times 60 = 1379.34$ seconds.

$\frac{\text{cost}}{\text{sec}} = \frac{2{,}000{,}000}{1379.34} = \$1449.97$ per second

$(1, 1449.97)$ and $(35, 66{,}666.67)$

$y = 1449.97x^p$

$\frac{66{,}666.67}{1449.97} = \frac{1449.97(35)^p}{1449.97}$

$\log 45.97796506 = p \log 35$

$\frac{\log 45.97796506}{\log 35} = \frac{p \log 35}{\log 35}$

$p = 1.077$

$y = 1449.97x^{1.077}$

22) On earth $\rightarrow 180 = \frac{k}{d^2}$

$k = 180d^2$

On other planet $\rightarrow w = \frac{k}{(3d)^2}$

$k = 9wd^2$

$\frac{180d^2}{9d^2} = \frac{9wd^2}{9d^2}$

$20 = w$ so **20 lbs**