F.BF.B.5: Properties of Logarithms 1

1 Which expression is *not* equivalent to $\log_b 36$?
1) $6\log_b 2$
2) $\log_b 9 + \log_b 4$
3) $2\log_b 6$
4) $\log_b 72 - \log_b 2$

2 The expression $\log 12$ is equivalent to
1) $\log 6 + \log 6$
2) $\log 3 + 2\log 2$
3) $\log 3 - 2\log 2$
4) $\log 3 \cdot \log 4$

3 The expression $\log 4x$ is equivalent to
1) $\log x^4$
2) $4\log x$
3) $\log 4 + \log x$
4) $(\log 4)(\log x)$

4 The expression $\log 4m^2$ is equivalent to
1) $2(\log 4 + \log m)$
2) $2\log 4 + \log m$
3) $\log 4 + 2\log m$
4) $\log 16 + 2\log m$

5 If $A = \pi r^2$, $\log A$ equals
1) $2\log \pi + \log r$
2) $\log \pi + 2\log r$
3) $2\log \pi + 2\log r$
4) $2\pi \log r$

6 If $2x^3 = y$, then $\log y$ equals
1) $\log(2x) + \log 3$
2) $3\log(2x)$
3) $3\log 2 + 3\log x$
4) $\log 2 + 3\log x$

7 If $L = \frac{x^2}{k}$, then $\log L$ is equal to
1) $2\log\frac{x}{k}$
2) $2(\log x - \log k)$
3) $2\log x - \log k$
4) $\frac{2\log x}{\log k}$

8 The expression $\log\frac{b^3}{a}$ is equivalent to
1) $3(\log b - \log a)$
2) $\log 3b - \log a$
3) $3\log b - \log a$
4) $\frac{3\log b}{\log a}$

9 If $u = \frac{x}{y^2}$, which expression is equivalent to $\log u$?
1) $\log x + 2\log y$
2) $2(\log x - \log y)$
3) $2(\log x + \log y)$
4) $\log x - 2\log y$

10 If $T = \frac{10x^2}{y}$, then $\log T$ is equivalent to
1) $(1 + 2\log x) - \log y$
2) $\log(1 + 2x) - \log y$
3) $(1 - 2\log x) + \log y$
4) $2(1 - \log x) + \log y$

11 The expression $\log\sqrt{xy}$ is equivalent to
1) $2\log x \log y$
2) $2(\log x + \log y)$
3) $\frac{1}{2}\log x \log y$
4) $\frac{1}{2}(\log x + \log y)$

12 If $x = (8^2)(\sqrt{5})$, which expression is equivalent to $\log x$?

1) $2\log 8 + 2\log 5$
2) $2(\log 8 + \frac{1}{2}\log 5)$
3) $2\log 8 + \frac{1}{2}\log 5$
4) $(2\log 8)(\frac{1}{3}\log 5)$

13 If $x = \frac{a\sqrt{b}}{c}$, then $\log x$ is equal to

1) $\log a + \frac{1}{2}\log b - \log c$
2) $\log a + 2\log b - \log c$
3) $\log a - \frac{1}{2}\log b + \log c$
4) $\log a - 2\log b - \log c$

14 $\text{Log}\frac{\sqrt{xy}}{z}$ is equal to

1) $\frac{1}{2}\log x + \frac{1}{2}\log y - \log z$
2) $\frac{1}{2}\log x + \log y - \log z$
3) $\frac{1}{2}\left(\log x + \log y - \log z\right)$
4) $\frac{\frac{1}{2}\log xy}{\log z}$

15 The expression $\log\frac{\sqrt{xy}}{w}$ is equivalent to

1) $\frac{2\log xy}{\log w}$
2) $\log x + \log y - \log w$
3) $\frac{1}{2}(\log x + \log y) - \log w$
4) $\frac{1}{2}(\log xy - \log w)$

16 $\text{Log}\sqrt{\frac{a}{b}}$ is equivalent to

1) $\frac{1}{2}\log a - \log b$
2) $\frac{1}{2}(\log a - \log b)$
3) $\frac{1}{2}(\log a + \log b)$
4) $\frac{1}{2}\log a + \log b$

17 The expression $\log\left(\frac{x^n}{\sqrt{y}}\right)$ is equivalent to

1) $n\log x - \frac{1}{2}\log y$
2) $n\log x - 2\log y$
3) $\log(nx) - \log\left(\frac{1}{2}y\right)$
4) $\log(nx) - \log(2y)$

18 The expression $\log\left(\frac{x^2y^3}{\sqrt{z}}\right)$ is equivalent to

1) $\frac{(2x)(3y)}{\frac{1}{2}z}$
2) $2\log x + 3\log y + \frac{1}{2}\log z$
3) $\log 2x + \log 3y - \log\frac{1}{2}z$
4) $2\log x + 3\log y - \frac{1}{2}\log z$

19 The expression $\log\frac{\sqrt{x^2y^3}}{z}$ is equivalent to

1) $\frac{1}{2}(2\log x + 3\log y - \log z)$
2) $\frac{1}{2}(2\log x + 3\log y) - \log z$
3) $2\log x + 3\log y - \log z$
4) $\frac{x^2y^3}{z}$

20 The expression $\log\frac{\sqrt[3]{a}}{b}$ is equivalent to

1) $\frac{1}{3}\log a - \log b$
2) $\frac{1}{3}\log(a-b)$
3) $3\log a - \log b$
4) $3\log(a-b)$

21 If $r = \sqrt[3]{\frac{A^2B}{C}}$, then $\log r$ can be represented by

1) $\frac{1}{6}\log A + \frac{1}{3}\log B - \log C$
2) $3(\log A^2 + \log B - \log C)$
3) $\frac{1}{3}\log(A^2 + B) - C$
4) $\frac{2}{3}\log A + \frac{1}{3}\log B - \frac{1}{3}\log C$

22 The equation $N = \frac{\sqrt[4]{x^2y}}{z}$ is equivalent to

1) $\log N = \frac{1}{4}(2\log x + \log y - \log z)$
2) $\log N = \frac{1}{4}(2\log x + \log y) - \log z$
3) $\log N = \frac{1}{4}\log 2x + \frac{1}{4}\log y - \log z$
4) $\log N = \frac{2}{4}\log x + \frac{1}{4}\log(y-z)$

23 The expression $\log\sqrt[4]{\frac{a^2}{b}}$ is equivalent to

1) $\frac{1}{4}\left(\frac{\log a^2}{\log b}\right)$
2) $4(\log a^2 - \log b)$
3) $\frac{1}{2}(4\log a - \log b)$
4) $\frac{1}{4}(2\log a - \log b)$

24 If $\log x^2 - \log 2a = \log 3a$, then $\log x$ expressed in terms of $\log a$ is equivalent to

1) $\frac{1}{2}\log 5a$
2) $\frac{1}{2}\log 6 + \log a$
3) $\log 6 + \log a$
4) $\log 6 + 2\log a$

25 $\text{Log}\cot A$ is equivalent to

1) $\log\sin A + \log\cos A$
2) $\log\sin A - \log\cos A$
3) $\log\cos A + \log\sin A$
4) $\log\cos A - \log\sin A$

26 The magnitude (R) of an earthquake is related to its intensity (I) by $R = \log\left(\frac{I}{T}\right)$, where T is the threshold below which the earthquake is not noticed. If the intensity is doubled, its magnitude can be represented by

1) $2(\log I - \log T)$
2) $\log I - \log T$
3) $2\log I - \log T$
4) $\log 2 + \log I - \log T$

27 The speed of sound, v, at temperature T, in degrees Kelvin, is represented by the equation $v = 1087\sqrt{\frac{T}{273}}$. Which expression is equivalent to $\log v$?

1) $1087 + \frac{1}{2}\log T - \log 273$
2) $1087\left(\frac{1}{2}\log T - \frac{1}{2}\log 273\right)$
3) $\log 1087 + \frac{1}{2}\log T - \frac{1}{2}\log 273$
4) $\log 1087 + 2\log(T + 273)$

28 A black hole is a region in space where objects seem to disappear. A formula used in the study of black holes is the Schwarzschild formula, $R = \frac{2GM}{c^2}$. Based on the laws of logarithms, $\log R$ can be represented by

1) $2\log G + \log M - \log 2c$
2) $\log 2G + \log M - \log 2c$
3) $\log 2 + \log G + \log M - 2\log c$
4) $2\log GM - 2\log c$

29 Banks use the formula $A = P(1 + r)^x$ when they compound interest annually. If P represents the amount of money invested and r represents the rate of interest, which expression represents $\log A$, where A represents the amount of money in the account after x years?

1) $x\log P + \log(1 + r)$
2) $\log P + x\log(1 + r)$
3) $\log P + x\log 1 + r$
4) $\log P + \log x + \log(1 + r)$

30 The equation used to determine the time it takes a swinging pendulum to return to its starting point is $T = 2\pi\sqrt{\frac{\ell}{g}}$, where T represents time, in seconds, ℓ represents the length of the pendulum, in feet, and g equals $32\ \text{ft}/\text{sec}^2$. How is this equation expressed in logarithmic form?

1) $\log T = \log 2 + \log \pi + \log\sqrt{\ell - 32}$
2) $\log T = \log 2 + \log \pi + \frac{1}{2}\log \ell - \frac{1}{2}\log 32$
3) $\log T = \log 2 + \log \pi + \frac{1}{2}\log \ell - \log 16$
4) $\log T = 2 + \log \pi + \frac{1}{2}\log \ell - 16$

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Answer Section

1 ANS: 1

$6 \log_b 2$

$\log_b 2^6$

$\log_b 64 \neq \log_b 36$

REF: 010208b

2 ANS: 2 REF: 060029siii

3 ANS: 3 REF: 080022siii

4 ANS: 3

$\log 4m^2 = \log 4 + \log m^2 = \log 4 + 2\log m$

REF: 061321a2

5 ANS: 2 REF: 010220siii

6 ANS: 4

$\log 2x^3 = \log 2 + \log x^3 = \log 2 + 3\log x$

REF: 061426a2

7 ANS: 3 REF: 068529siii

8 ANS: 3 REF: 060319siii

9 ANS: 4 REF: 089315siii

10 ANS: 1

$\log T = \log \frac{10x^2}{y} = \log 10 + \log x^2 - \log y = 1 + 2\log x - \log y$

REF: 011615a2

11 ANS: 4 REF: 068122siii

12 ANS: 3 REF: 068918siii

13 ANS: 1 REF: 068023siii

14 ANS: 1 REF: 019025siii

15 ANS: 3 REF: 010124siii

16 ANS: 2 REF: 069519siii

17 ANS: 1 REF: 089718siii

18 ANS: 4 REF: 069917siii

19 ANS: 2 REF: 080122siii

20 ANS: 1 REF: 068821siii

21 ANS: 4 REF: 061120a2

22 ANS: 2 REF: 069420siii

23 ANS: 4 REF: 019619siii

24 ANS: 2

$\log x^2 = \log 3a + \log 2a$

$2\log x = \log 6a^2$

$\log x = \frac{\log 6}{2} + \frac{\log a^2}{2}$

$\log x = \frac{1}{2}\log 6 + \frac{2\log a}{2}$

$\log x = \frac{1}{2}\log 6 + \log a$

REF: 011224a2

25 ANS: 4 REF: 018625siii

26 ANS: 4

$\log \frac{2I}{T} = \log 2 + \log I - \log T$

REF: 060102b

27 ANS: 3

$\log v = \log 1087\sqrt{\frac{T}{273}}$

$= \log 1087 \cdot (\frac{T}{273})^{\frac{1}{2}}$

$= \log 1087 + \log(\frac{T}{273})^{\frac{1}{2}}$

$= \log 1087 + \frac{1}{2}\log \frac{T}{273}$

$= \log 1087 + \frac{1}{2}\log T - \frac{1}{2}\log 273$

REF: 010611b

28 ANS: 3

$\log R = \log \frac{2GM}{c^2} = \log 2 + \log G + \log M - \log c^2 = \log 2 + \log G + \log M - 2\log c$

REF: 010717b

29 ANS: 2

$\log A = \log P(1+r)^x = \log P + \log(1+r)^x = \log P + x\log(1+r)$

REF: 080911b

30 ANS: 2

$$\log T = \log\left(2\pi\sqrt{\frac{\ell}{32}}\right)$$

$$= \log\left(2\pi\left(\frac{\ell}{32}\right)^{\frac{1}{2}}\right)$$

$$= \log 2 + \log \pi + \log\left(\frac{\ell}{32}\right)^{\frac{1}{2}}$$

$$= \log 2 + \log \pi + \frac{1}{2}\log\frac{\ell}{32}$$

$$= \log 2 = \log \pi + \frac{1}{2}(\log \ell - \log 32)$$

$$= \log 2 + \log \pi + \frac{1}{2}\log \ell - \frac{1}{2}\log 32$$

REF: 080709b