

**Chapter 01: Mathematics**

1. How should 0.0000008 be expressed in proper scientific notation?

- a.  $8.00 \times 10^7$
- b.  $8.00 \times 10^{-7}$
- c.  $80.00 \times 10^{-8}$
- d.  $0.08 \times 10^{-5}$

**ANSWER:** b

2. Perform the following mathematical operation:  $(4.21 \times 10^{-8}) \div (4.21 \times 10^{-9})$ .

- a. 0.001
- b. 0.01
- c. 0.1
- d. 10.0

**ANSWER:** d

3. Multiply 2.41 cm by 1.421 cm.

- a.  $3.42461 \text{ cm}^2$
- b.  $3.42 \text{ cm}^2$
- c.  $3.425 \text{ cm}^2$
- d.  $3.4246 \text{ cm}^2$

**ANSWER:** b

4. How many significant digits are in the number  $4.12 \times 10^{-10}$ ?

- a. 7
- b. 5
- c. 3
- d. 1

**ANSWER:** c

5. What is the air:oxygen ratio for an air entrainment mask delivering 24% O<sub>2</sub>?

- a. 0.3:1
- b. 1.7:1
- c. 25:1
- d. 10:1

**ANSWER:** c

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6. Calculate the I:E ratio when the  $T_I$  is 1.20 seconds and the  $T_E$  is 1.45 seconds.

- a. 1: 1.21
- b. 1: 0.5
- c. 1:1
- d. 2:1

**ANSWER:** a

7. Calculate the  $\overline{P\dot{E}CO_2}$  given the following data.

$$V_T = 600 \text{ ml}$$

$$V_D = 160 \text{ ml}$$

$$PaCO_2 = 40 \text{ torr}$$

- a. 33 torr
- b. 29 torr
- c. 25 torr
- d. 21 torr

**ANSWER:** b

8. In the ratio  $a:b = x:y$ , which of the following factors represent the extremes?

- a.  $a$  and  $b$
- b.  $b$  and  $x$
- c.  $b$  and  $y$
- d.  $a$  and  $y$

**ANSWER:** d

9. What percent solution represents a solution that has a ratio of 1 part solute to 9 parts solvent?

- a. 11%
- b. 10%
- c. 9%
- d. 8%

**ANSWER:** b

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10. A 150 lb (IBW) patient is receiving volume-controlled, continuous mandatory ventilation with a  $V_T$  of 800 ml. The mandatory rate is 16 breaths/minute and the patient's  $PaCO_2$  is 30 mm Hg. The desired  $PaCO_2$  is 40 mm Hg. To what value must the rate setting be changed to achieve the desired  $PaCO_2$ ?

- a. 8 bpm
- b. 10 bpm
- c. 12 bpm
- d. 16 bpm

**ANSWER:** c

11. Calculate the percent relative humidity for a volume of air containing 20 g/m<sup>3</sup> of water at 37°C. The capacity for water at this temperature is 43.8 g/m<sup>3</sup>.

- a. 23.8%
- b. 45.7%
- c. 54.2%
- d. 63.8%

**ANSWER:** b

12. Calculate the percent shunt in a patient having a pulmonary artery catheter in place while breathing an  $F_{iO_2}$  of 0.60. The following data were obtained.

**Arterial Blood**

**Mixed-Venous Blood**

$PaO_2$  260 mm Hg

$P\bar{v}O_2$  79 mm Hg

$PaCO_2$  65 mm Hg

$P\bar{v}CO_2$  69 mm Hg

pH 7.33

pH 7.72

$SaO_2$  100%

$S\bar{v}O_2$  90%

[Hb] 14 g%

- a. 32%
- b. 23%
- c. 17%
- d. 12%

**ANSWER:** a

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13. Which units will cancel and what unit will result in the following calculation?

$$(1.34 \text{ ml O}_2/\text{g Hb})(15 \text{ g Hb}/100 \text{ ml})(90\%)$$

- a. cancel: ml O<sub>2</sub> and 100 ml result: g Hb
- b. cancel: g Hb and result: vol%
- c. cancel: g Hb and result: ml O<sub>2</sub>
- d. cancel: ml O<sub>2</sub> and 100 ml result: g%

**ANSWER:** b

14. Which of the following quantitative relationships produces a hyperbolic graphic representation?

- a.  $y = kx^2$
- b.  $k = x/y$
- c.  $y = k/x$
- d.  $k = x + y$

**ANSWER:** c

15. Which of the following exponents represents the prefix *nano*-?

- a.  $10^{-12}$
- b.  $10^{-10}$
- c.  $10^{-9}$
- d.  $10^{-6}$

**ANSWER:** c

16.  $2 \text{ \AA} =$  \_\_\_\_\_ mm.

- a.  $2 \times 10^{-7} \text{ mm}$
- b.  $2 \times 10^{-8} \text{ mm}$
- c.  $2 \times 10^{-9} \text{ mm}$
- d.  $2 \times 10^{-10} \text{ mm}$

**ANSWER:** a

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17. 840 mg = \_\_\_\_\_ kg.

- a.  $8.4 \times 10^{-10}$  kg
- b.  $8.4 \times 10^{-8}$  kg
- c.  $8.4 \times 10^{-6}$  kg
- d.  $8.4 \times 10^{-4}$  kg

**ANSWER:** d

18. 150 lb = \_\_\_\_\_ kg.

- a. 330 kg
- b. 96 kg
- c. 75 kg
- d. 68 kg

**ANSWER:** d

19. Which of the following terms is synonymous with the word *logarithm*?

- a. base
- b. mantissa
- c. characteristic
- d. exponent

**ANSWER:** d

20. Which of the following formulas is used to determine the positive characteristic of a logarithm?

- a.  $(x + 1)$
- b.  $(x^2 - 1)$
- c.  $(x - 1)^2$
- d.  $(x - 1)$

**ANSWER:** d

21. What is the characteristic of the logarithm of 20,000?

- a. 24
- b. 16
- c. 6
- d. 4

**ANSWER:** d

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22. What is the formula used for calculating the negative characteristic of a logarithm?

- a.  $(n + 10) - 10$
- b.  $(10 - n) - 10$
- c.  $(10 + n) - 10$
- d.  $(10 - n) + 10$

**ANSWER:** b

23. Which of the following descriptions best describes an antilogarithm?

- a. finding the opposite logarithm of a number
- b. determining the negative exponent of the logarithm
- c. obtaining the number of the logarithm
- d. finding the opposite logarithm of the exponent

**ANSWER:** c

24. Perform the following calculation.

$$(\log 10^{-2} \times \log 10^5 \times \log 10^2) \div \log 10^{-5}$$

- a. 5
- b. 1
- c. -1
- d. -5

**ANSWER:** c

25. Given the following data, compute the pressure generated to overcome airway resistance during mechanical ventilation.

PIP 55 cm H<sub>2</sub>O

PEEP 10 cm H<sub>2</sub>O

$P_{\text{plateau}}$  25 cm H<sub>2</sub>O

- a. 45 cm H<sub>2</sub>O
- b. 35 cm H<sub>2</sub>O
- c. 25 cm H<sub>2</sub>O
- d. 30 cm H<sub>2</sub>O

**ANSWER:** d

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26. Calculate the static compliance, given the following information.

$$V_T \text{ 600 ml}$$

$$\text{PIP 30 cm H}_2\text{O}$$

$$P_{\text{plateau}} \text{ 20 cm H}_2\text{O}$$

$$\text{PEEP 10 cm H}_2\text{O}$$

- a. 0.015 L/cm H<sub>2</sub>O
- b. 0.02 L/cm H<sub>2</sub>O
- c. 0.03 L/cm H<sub>2</sub>O
- d. 0.06 L/cm H<sub>2</sub>O

**ANSWER:** d

27. Which of the following formulas creates a straight line that does *not* pass through the origin?

- a.  $y = mx + b$
- b.  $xy = k$
- c.  $2n^2 + x = k$
- d.  $kx^2 = y$

**ANSWER:** a

28. If a solution undergoes a pH change from 6 to 7, by what fold does the [H<sup>+</sup>] of that solution change?

- a. 1-fold
- b. 2-fold
- c. 10-fold
- d. 100-fold

**ANSWER:** c

29. Which of the following measurements represent the point where a straight line drawn along the steep portion of a volume-pressure curve intersects with another straight line drawn along the flat segment of the same curve?

- a. static compliance
- b. lower inflection point
- c. dynamic compliance
- d. upper inflection point

**ANSWER:** d

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30. Which of the following terms best describes the  $x$ -axis of a Cartesian coordinate system?

- a. origin
- b. abscissa
- c. ordinate
- d. quadrant II

**ANSWER:** b

31. Why cannot the following mathematical operation be performed?

$$(9.08 \times 10^5) + (5.67 \times 10^8)$$

- a. because the coefficients are not the same
- b. because the exponents are different
- c. because irrational numbers cannot be added
- d. because the value of “ $x$ ” is unknown

**ANSWER:** b

32. What is incorrect about the mathematical operation presented below?

$$(4.80 \times 10^6) \times (5.30 \times 10^{-8}) = (4.80 \times 5.30)10^{6+8}$$

- a. The exponents are not equal
- b. The coefficients should be added
- c. The exponents in the product should be  $10^{6+(-8)}$
- d. The number  $5.30 \times 10^{-8}$  should be changed to  $0.0530 \times 10^{-6}$ .

**ANSWER:** c

33. Identify the quotient in the following mathematical operation:

$$(4.80 \times 10^6) \div (5.30 \times 10^8) = 9.06 \times 10^{-3}$$

- a.  $4.80 \times 10^6$
- b.  $5.30 \times 10^8$
- c. 5.30
- d.  $9.06 \times 10^{-3}$

**ANSWER:** d

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34. Express the following number in proper scientific notation:

$$8,562 \times 10^{10}$$

a.  $8.562 \times 10^7$

b.  $8.562 \times 10^{-7}$

c.  $8.562 \times 10^{13}$

d.  $8.562 \times 10^3$

**ANSWER:** c

35. Calculate  $(6.78 \times 10^3) \times (8.76 \times 10^{-3}) =$

a.  $5.94 \times 10^{-1}$

b.  $5.94 \times 10^1$

c.  $5.94 \times 10^0$

d. 5.94

**ANSWER:** b

36. The definition: “The extent to which a measurement agrees with a standard or an accepted value” applies to which of the following terms?

a. precision

b. sample error

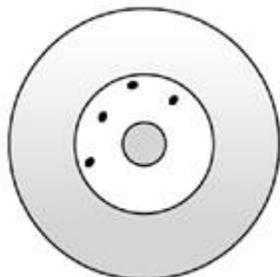
c. accuracy

d. random error

**ANSWER:** c

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37. Which of the terms presented here describes the illustration below?



- a. accuracy
- b. precision
- c. sample error
- d. accuracy and precision

**ANSWER:** a

38. If a measurement is accurate to 0.1 cm, it is also accurate to \_\_\_\_\_ .

- a. 0.01 mm
- b. 0.1  $\mu$
- c. 1.0 mm
- d. 0.01 m

**ANSWER:** c

39. Which of the following statements is true concerning significant digits?

- I. All zeros are significant.
- II. Zeros used exclusively for placing the decimal points are significant.
- III. All digits preceding the power of 10 in scientific notation are significant.
- IV. Nonzero digits are always significant.

- a. I, III only
- b. II, III only
- c. III, IV only
- d. I, II, IV only

**ANSWER:** c

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40. When adding 24.456 and 78.89 to get the sum 103.346, how should the answer (i.e., the sum) be expressed?
- a. 103.3
  - b. 103.34
  - c. 103.35
  - d. 103.346

**ANSWER:** c

41. In which of the following circumstances does parallax not pose a problem?
- a. when the numerical display is analog
  - b. when the numerical display is digital
  - c. when the numerical display is horizontal
  - d. when the numerical display is vertical

**ANSWER:** b

42. Which of the following expressions describe anatomical dead space?
- a. gas exchange units
  - b. regions of the lung receiving perfusion, but not ventilation
  - c. regions of the lung devoid of both ventilation and perfusion
  - d. gas conducting airways

**ANSWER:** d

43. What form of dead space is calculated using the Bohr equation?
- a. anatomical dead space
  - b. alveolar dead space
  - c. lower airway dead space
  - d. physiological dead space

**ANSWER:** d

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44. Which of the following statements accurately refer to the  $P\bar{E}CO_2$ ?

- I. It can also be depicted as  $PETCO_2$ .
- II. The  $P\bar{E}CO_2$  is normally about 34 to 38 mm Hg.
- III. The  $P\bar{E}CO_2$  is the average  $CO_2$  gas tension in an exhaled tidal breath.
- IV. If the  $V_D/V_T$  ratio equaled one, the  $P\bar{E}CO_2$  would be 0 mm Hg.

- a. I, II only
- b. II, III only
- c. I, III, IV only
- d. II, III, IV only

**ANSWER:** d

45. Which of the following formulas is depicted correctly?

- a.  $V_T = V_D - V_A$
- b.  $V_D = V_T + V_A$
- c.  $V_T = V_D + V_A$
- d.  $V_A = V_D - V_T$

**ANSWER:** c

46. Which of the following definitions describes the term *solute*?

- a. the substance that performs the dissolving
- b. the substance that dissolves
- c. the concentration of the solution
- d. the substance added to dilute a solution

**ANSWER:** b

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47. If a patient, receiving full ventilator support, has a PaCO<sub>2</sub> of 60 mm Hg, which of the following ventilator setting changes can be made to lower the patient's PaCO<sub>2</sub>?

- I. decreasing the  $V_T$
- II. increasing the  $V_T$
- III. decreasing the  $f$
- IV. increasing the  $f$

- a. I only
- b. IV only
- c. I, III only
- d. II, IV only

**ANSWER:** d

48. If a person is inspiring air that is 50% humidified at body temperature, what will be the humidity deficit?

- a. 21.9 mm Hg
- b. 23.5 mm Hg
- c. 43.8 mm Hg
- d. 47 mm Hg

**ANSWER:** b

49. Given the spirometry data presented here, calculate this patient's actual FEV<sub>1</sub>%.

	<u><i>Predicted</i></u>	<u><i>Actual</i></u>
FVC	5.43 L	6.44 L
FEV <sub>1</sub>	4.43 L	5.02 L

- a. 92%
- b. 88%
- c. 78%
- d. 69%

**ANSWER:** c

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50. Which of the following coordinates correspond with those characteristic of quadrant III?

- a.  $(-3, -6)$
- b.  $(5, -9)$
- c.  $(4, 7)$
- d.  $(-2, 8)$

**ANSWER:** a