

Mathematical Constants in Human Biology

Mathematics · Answer Key · 10 Questions

1. The 'Golden Ratio' ($\phi \approx 1.618$) is often cited in anatomy. In a standard adult human, which anatomical ratio most closely approximates this value when measuring the distal phalanx of the middle finger relative to the proximal phalanx?

- A) The ratio of the total finger length to the metacarpal length
- B) The ratio of the middle phalanx to the distal phalanx
- C) The ratio of the total finger length to the proximal phalanx length**
- D) The ratio of the metacarpal to the proximal phalanx

2. In population genetics and epidemiology, the Hardy-Weinberg principle uses the equation $p^2 + 2pq + q^2 = 1$. If the frequency of a recessive allele (q) for a specific hereditary condition is 0.05, what is the expected frequency of the heterozygous carriers ($2pq$) in the population?

- A) 0.095**
- B) 0.0475
- C) 0.19
- D) 0.0025

3. The total surface area of the human lungs is roughly equivalent to the size of a tennis court. Mathematically, if we model the alveoli as spheres with an average radius of 0.1 mm, how many alveoli are approximately required to create a surface area of 75 square meters?

- A) 300 million**
- B) 500 million
- C) 750 million
- D) 1 billion

4. Human heart rate variability (HRV) is often analyzed using the RMSSD (Root Mean Square of Successive Differences). If an individual's RR intervals in milliseconds are 800, 820, and 790, what is the RMSSD value?

- A) 15.2 ms
- B) 21.6 ms**
- C) 25.5 ms
- D) 18.7 ms

5. The adult human body contains approximately 5 liters of blood. If the heart pumps at an average rate of 70 beats per minute with a stroke volume of 70 mL, approximately how many minutes does it take for the entire volume of blood to circulate once through the body?

- A) 1.0 minute**
- B) 1.5 minutes
- C) 2.0 minutes
- D) 0.7 minutes

6. In pharmacokinetics, the elimination half-life of a drug following first-order kinetics is calculated using the formula $t(1/2) = \ln(2) / k$. If the elimination rate constant (k) is $0.0693 \text{ hours}^{-1}$, what is the half-life of the drug?

- A) 1 hour
- B) 5 hours
- C) 10 hours**
- D) 20 hours

7. The volume of the human cranium is measured using geometric approximations. If a cranium is modeled as an ellipsoid with semi-axes $a=9\text{cm}$, $b=7\text{cm}$, and $c=8\text{cm}$, what is the approximate volume using the formula $V = 4/3 * \pi * a * b * c$?

- A) 1,894 cm³**
- B) 2,111 cm³
- C) 1,550 cm³
- D) 2,500 cm³

8. Based on the body mass index (BMI) formula $\text{weight}(\text{kg})/\text{height}(\text{m})^2$, if a person weighs 80 kg and has a BMI of 25.0, what is their height in meters?

- A) 1.75 m
- B) 1.79 m**
- C) 1.82 m
- D) 1.85 m

9. The glomerular filtration rate (GFR) can be estimated using the Cockcroft-Gault equation. For a 70 kg male, if the creatinine clearance calculation yields 100 mL/min, what is the standard mathematical conversion of this rate into liters per day?

- A) 100 L/day
- B) 144 L/day**
- C) 120 L/day
- D) 72 L/day

10. The human eye's refractive power is approximately 60 diopters. If the focal length (f) is calculated as $f = 1/D$ (in meters), what is the focal length of the human eye in millimeters?

A) 16.67 mm

B) 20.00 mm

C) 25.00 mm

D) 33.33 mm