Farmer Olympiad 2022 Round I

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You have 30 minutes to complete this exam. Circle the choice you believe is correct on this paper. No certain rabbits allowed! There is a total of 49 marks available. Good luck!

Candidate Name: _____

1. (3 marks) Which of the following is not a conic section?

   A. Circle B. Parabola C. Quartic D. Ellipse E. Hyperbola

2. (4 marks) A certain rabbit starts walking in infinitesimal increments at forward initial velocity $2ms^{-1}$. Every second he walks his velocity halves, with constant direction. Exactly how many metres does he travel in total?

   A. $1.38m$ B. $\frac{1}{ln(2)}m$ C. $4m$ D. $\frac{2}{ln(2)}m$ E. $\sqrt{2}m$

3. (4 marks) Let $f(x) = \frac{e^x - e^{-x}}{2}$. What would $\frac{d^3f}{dx^3}$ equal?

   A. $\frac{e^x - e^{-x}}{e^x + e^{-x}}$ B. $\frac{e^x + e^{-x}}{2}$ C. $\frac{e^x + e^{-x}}{e^x - e^{-x}}$ D. $e^{x - \frac{1}{x}}$ E. $\frac{e^x - e^{-x}}{2}$

4. (4 marks) Which of the following is indeterminate?

   A. $sin^{-1}(sin(\frac{5\pi}{4}))$ B. $sin^{-1}(sin^{-1}(\frac{\pi}{4}))$ C. $sin^{-1}(sin(\frac{-9\pi}{4}))$ D. $sin^{-1}(sin(e))$ E. $sin(sin^{-1}(e))$

5. (4 marks) A certain rabbit pulls peppers from a bag. The bag contains 7 chilli peppers and 8 sweet peppers. If the certain rabbit picks 6 random peppers from the bag without replacement, what is the probability that 4 of them are chilli to 3 significant figures?

   A. 0.272 B. 0.196 C. 0.777 D. 0.152 E. 0.383

6. (4 marks) Which of the following is not a root of $1000x^3 - 8500x^2 + 2063x - 14651 = 0$?

   A. 1.3 B. 2.3 C. 3.5 D. 4.9

7. (4 marks) In a ship with 10 crewmates, each crewmate has a 0.3 probability of being an impostor. There is a 0.1029 probability of the nth crewmate selected with replacement being the first found impostor. Find n.

   A. 3 B. 4 C. 5 D. 6 E. 7 F. 8

8. (4 marks) A certain farmer throws 49 electron-ohms per nanocoulomb per hour per meganewton per femtovolt per gigawatt per zetaradian per terabyte. Give the SI units of this expression.

   A. $A^{-4}kg^{-4}m^{-2}s^{-3}$ B. $eA^{-4}kg^{-4}m^{-2}s^{-3}B^{-1}$ C. $eA^{-4}kg^{-2}m^{-2}s^{3}B^{-1}$ D. $A^{-4}kg^{-2}m^{-2}s^{3}$

9. (4 marks) A bowman fires an arrow at $30\sqrt{2}ms^{-1}$ inclined by $\frac{\pi}{4}rad$ to the horizontal from ground level. How far away from the bowman would the arrow land?

   A. $\frac{60}{g}m$ B. $\frac{120}{g}m$ C. $\frac{1200\sqrt{2}}{g}m$ D. $\frac{1800}{g}m$

10. (4 marks) Vector $u = (4, 9)$ is projected onto vector $v = (6, 8)$ to form vector w. Find $\hat{w}$.

    A. $\frac{96}{100}(6, 8)$ B. $\frac{96}{100}(4, 9)$ C. $(0.6, 0.8)$ D. $(\frac{10}{\sqrt{97}}, \frac{17}{\sqrt{97}})$

11. (4 marks) The certain rabbit wants to know $gcd(9198, 2128)$. Help him!

    A. 8 B. 14 C. 16 D. 24 E. 38

12. (6 marks) Evaluate $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}(\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}}(sec^2(x) - cot(y)csc(y))dx)dy$

    A. π B. 2π C. 4π D. 8π E. 16π

Good luck!