GSTDMB DYNAMICAL MODELLING FOR BIOLOGY AND MEDICINE

Introductory Quiz (Unassessed) May 2009

This quiz is purely for information, to help tailor the course to the audience. It will be most informative if you attempt the questions on your own, and try questions 11–14 without using a computer or graphing calculator. Please fill in your answers at

http://www.maths.nottingham.ac.uk/personal/pmzmro/gstdmb_intro_quiz.html

At the end of this document are some formulae that may be useful.

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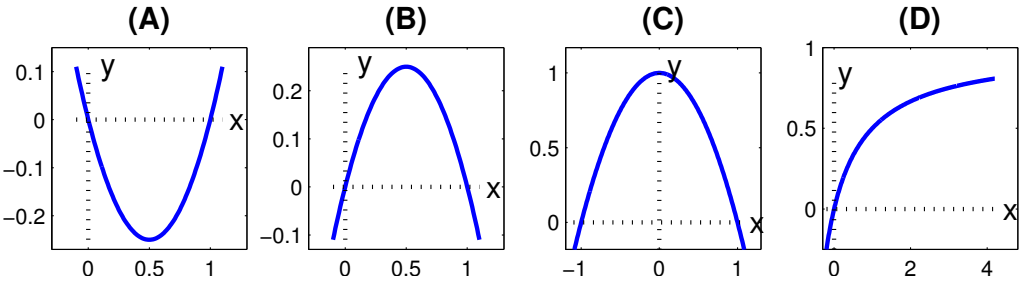
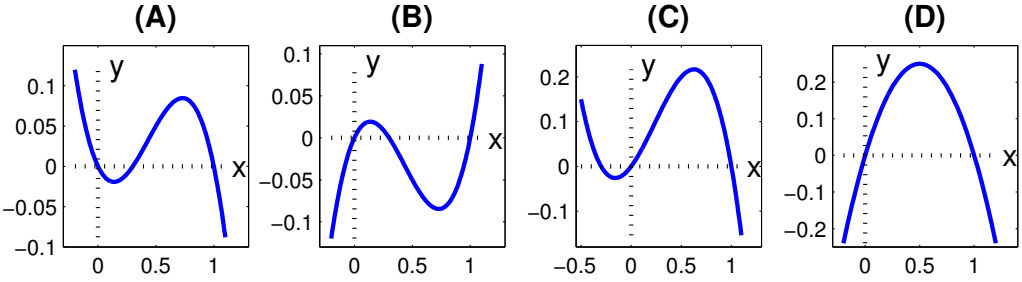
1. What is your mathematical background?
   (GCSE? A-Level? Undergraduate courses taken, if any?)
2. Describe your scientific background.
3. Briefly describe your experience, if any, of mathematical modelling and/or systems approaches to biomedical science.
4. Written as a single power, x^7/x^2 equals:
   A: x^9, **B:** x^5, **C:** x^{-5}, **D:** x^{14}.
5. Written as a single logarithm, $\log(a) + \log(b)$ equals:
   A: a/b, **B:** $\log(a/b)$, **C:** $\log(ab)$, **D:** $\log(a^b)$.
6. What is the solution to the equation $4x + 3 = 2x + 5$?
   A: $x = 0$, **B:** $x = 1$, **C:** $x = 2$, **D:** $x = 3$,
7. What are the two solutions to the quadratic equation $x^2 + 3x + 2 = 0$?
   A: $x = 1, 2$, **B:** $x = -1, -2$, **C:** $x = 2, 3$, **D:** $x = -1, 2$.
8. What is the solution to the following pair of simultaneous equations?

$$\begin{aligned} x + 2y &= 3 \\ 2x - y &= 1 \end{aligned}$$

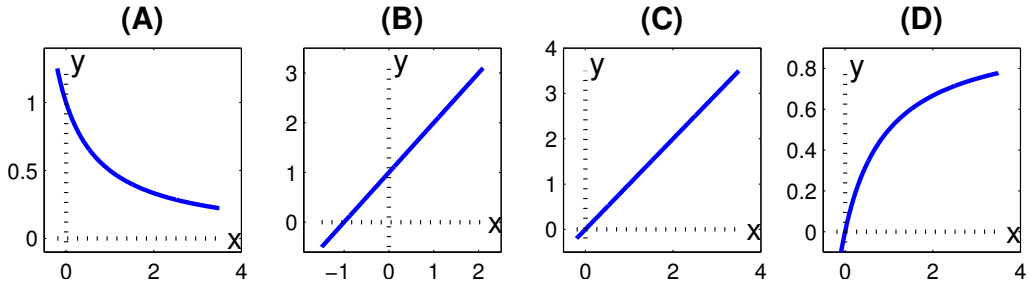
   A: $x = 2, y = 2$, **B:** $x = 3, y = 1$, **C:** $x = 1, y = 3$, **D:** $x = 1, y = 1$.
9. Which is the correct graph of $y = x(1 - x)$?



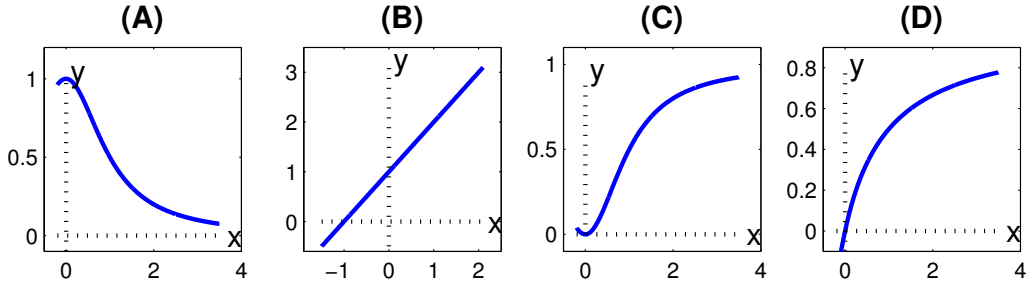
10. Which is the correct graph of $y = x(1 - x)(x - 0.25)$?



11. Which is the correct graph of $y = \frac{x}{1+x}$?



12. Which is the correct graph of $y = \frac{x^2}{1+x^2}$?



13. The population of an organism, x, obeys an exponential law of the form $x = Ae^{kt}$, where t is a variable, and A and k are constants.
If $x = 2$ when $t = 0$, and $x = 8$ when $t = 2$, what are the values of A and k?

A: $A = 2, k = 2$, **B:** $A = 1, k = 1$, **C:** $A = 2, k = \ln(2)$, **D:** $A = 1, k = 2\ln(2)$.

14. Differentiating $y = 2x^3 - 3x^2 - 12x + 4$ gives

A: $\frac{dy}{dx} = 6x^2 - 6x - 12$, **B:** $\frac{dy}{dx} = 2x^4 - 3x^3 - 12x^2 + 4x$,
C: $\frac{dy}{dx} = 2x^2 - 3x - 12$, **D:** $\frac{dy}{dx} = 6x^2$.

15. Differentiating $y = 3x^4e^{2x}$ gives

A: $\frac{dy}{dx} = 12x^3e^{2x} + 3x^4e^{2x}$, **B:** $\frac{dy}{dx} = 12x^3e^{2x}$,
C: $\frac{dy}{dx} = 12x^3e^{2x} + 6x^4e^{2x}$, **D:** $\frac{dy}{dx} = 6x^4e^{2x}$,

16. What is the solution to the Ordinary Differential Equation: $\frac{du}{dt} = \lambda u$ with $u(0) = A$?

A: $u(t) = Ae^{\lambda t}$, **B:** $u(t) = \lambda t + A$, **C:** $u(t) = \lambda$, **D:** $u(t) = u + \lambda$.

Useful formulae:

- If $y = x^n$ then the **derivative** of y with respect to x is $\frac{dy}{dx} = nx^{n-1}$.
- If $y = e^{ax}$ then the **derivative** of y with respect to x is $\frac{dy}{dx} = ae^{ax}$.

Markus Owen, May 2009.