

國立臺北科技大學 102 學年度碩士班招生考試

系所組別：3721、3722 有機高分子研究所乙組

第一節 工程數學 試題

第一頁 共一頁

注意事項：

1. 本試題共 3 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Solve the following differential equations.

- (a) $yy'' - (y')^2 + (y')^3 = 0$ (10%)
- (b) $xy' = y \ln(y/x)$ (10%)
- (c) $y''' - 3y'' + 3y' - y = x^{1/2} e^x$ (10%)
- (d) $y'' - 4y' + 5y = e^{2x} \csc x$ (10%)
- (e) $y' - \cos(x+y) = \cos(x-y)$ (10%)
- (f) $x^3 y''' - 3x^2 y'' + 6xy' - 6y = x^4 \ln x$ (10%)

2. Use the Laplace transform to solve the following problems.

- (a) $y'' + y' - 2y = r(t)$
 $r(t) = 3 \sin t - \cos t$, if $0 < t < 2\pi$ and $r(t) = 3 \sin 2t - \cos 2t$, if $t > 2\pi$
 $y(0) = 0$, $y'(0) = -1$ (10%)
- (b) $y'' + y = 2t$
 $y(\pi/4) = \pi/2$, $y'(\pi/4) = 2 - \sqrt{2}$ (10%)
- (c) $\begin{cases} \dot{x}_1 = -\frac{13}{2}x_1 + \frac{5}{2}x_2 + 2(1 - u(t-3)) \\ \dot{x}_2 = \frac{5}{2}x_1 - \frac{13}{2}x_2 \end{cases}$

$$x_1(0) = x_2(0) = x_1'(0) = x_2'(0) = 0 \quad (10\%)$$

3. Solve the integral equation by means of Laplace transform

$$f(t) = 1 + t - \frac{8}{3} \int_0^t (\tau - t)^3 f(\tau) d\tau \quad (10\%)$$

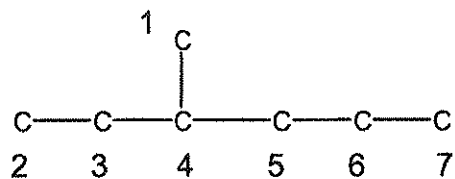
22. How many of these are greenhouse gases: oxygen, methane, nitrogen, ozone, water vapor?
a. 1 b. 2 c. 3 d. 4 e. 5

23. Greenhouse gases in the atmosphere contribute to global warming mainly by
a. absorbing ultraviolet light energy from the sun and emitting it as infrared radiation.
b. absorbing ultraviolet light energy from the sun and storing it as molecular vibrations.
c. absorbing infrared light energy from the sun and storing it as molecular vibrations.
d. absorbing ultraviolet light energy from the earth and storing it as molecular vibrations.
e. absorbing infrared light energy from the earth and storing it as molecular vibrations.

24. The synthesis of urea from ammonium cyanate was accomplished by Wohler in 1828. This is important because
a. urea is expensive to synthesize by other routes.
b. it disproved the Vital Force hypothesis
c. it provided an inexpensive route for nitrogen fixation.
d. it confirmed the biological mechanism of detoxification of this noted poison.
e. it demonstrated the ability of carbon to form stable C-C bonds.

25. Which of the following is not usually used as a starting material for the production of other products?
a. benzene b. gasoline c. ethylene d. acetylene e. propylene

26. Consider the carbon skeleton shown below. If a(n) _____ group is attached to carbon 2, a _____ alcohol will result; if the group is attached to carbon 3, a _____ alcohol will result.
a. hydroxyl; secondary; tertiary
b. carboxyl; primary; secondary
c. hydroxyl; primary; secondary
d. carbonyl; secondary; primary
e. hydroxyl; tertiary; secondary



27. All alcohols contain the functional group
a. $\text{-NH}_2\text{OH}$ b. $\text{-CH}_2\text{OH}$ c. $\text{-CO}_2\text{H}$ d. -CHO e. -OH

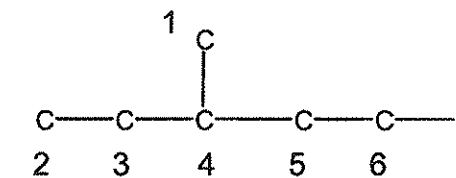
28. Which is not a use of alcohols?
a. solvent b. moisturizer c. fuel d. flavoring e. antifreeze

29. The major alcohol produced by fermentation of carbohydrates is

a. 1-butanol. b. ethanol. c. ethylene glycol. d. glycerol. e. methanol.

30. Consider the carbon skeleton shown below. To form a primary alcohol, the functional group can be bonded to which carbon atom(s)?

a. 4
b. 2 or 6
c. 3, 5, or 6
d. 1, 2, or 7
e. any of them



Part B (10 points)

I. An aliphatic compound $\text{C}_4\text{H}_9\text{Cl}$ gave the following ^1H NMR spectrum (in ppm):
multiplet, δ 4.6 (1H);
multiplet, δ 1.8;
doublet, δ 1.7;
triplet, δ 1.0 (3H)
What is the structure for the compound (please draw the structure)?