# University of Ottawa

## Department of Mathematics and Statistics

### MAT 1341C: Introduction to Linear Algebra
### Instructor: Erhard Neher

### Diagnostic Test Jan. 17, 2009

**Family Name:** ______________________________

**First Name:** ______________________________

**Student number:** ___________________________

### Please read these instructions carefully:

- Enter your name on this page and the next, but your student number only on this page. You will get back the exam without this first page.
- You have 80 minutes to complete this test.
- This is a closed book exam, and no notes of any kind are allowed. The use of calculators, cell phones, pagers or any text storage or communication device is not permitted.
- Read each question carefully - you will save yourself time and unnecessary grief later on.
- All 12 questions are multiple choice, are worth 1 point each and no part marks will be given. Please record your answers in the space provided.
- Where it is possible to check your work, do so.

**Good luck! Bonne chance!**

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**1.** Find the scalar equations of the line passing through $P(2, -5, 7)$ and parallel to the line through $Q(-1, 1, -1)$ and $R(1, -1, 1)$.

A. $x = 9 + 2t$, $y = -7 - 2t$, $z = 4 + 2t$, $t$ scalar.
B. $x = -2 + 2t$, $y = -5 - 2t$, $z = 5 + 2t$, $t$ scalar.
C. $x = 2 + 3t$, $y = -3 - 2t$, $z = 7 + 2t$, $t$ scalar.
D. $x = 2 + 2t$, $y = -5 - 2t$, $z = 7 + 2t$, $t$ scalar.
E. $x = 2 + 2t$, $y = -5 - 2t$, $z = 7 - 2t$, $t$ scalar.
F. $x = 2 + t$, $y = -5 + 9t$, $z = 1 + t$, $t$ scalar.

**My answer:**________________

**2.** Find the direction vector of the line passing through $P(3, -3, 3)$, intersecting the line $[x \quad y \quad z]^T = [9 \quad -5 \quad 7]^T + t\,[-1 \quad 2 \quad -1]^T$ and perpendicular to it.

A. $[-1 \quad 2 \quad -1]^T$
B. $[9 \quad -5 \quad 7]^T$
C. Such a line does not exist.
D. $[0 \quad -4 \quad -9]^T$
E. $[-11 \quad -8 \quad -5]^T$
F. $[1 \quad 4 \quad 7]^T$.

**My answer:**________________

**3.** Find the scalar equation of the line passing through $P(3,-9,0)$ and $Q(-1,2,7)$.

A. $x = 1 + 2t$, $y = -9 + t$, $z = 2t$, $t$ scalar.

B. $x = 3 - 4t$, $y = -9 + 11t$, $z = 7t$, $t$ scalar.

C. $x = 1 - 3t$, $y = 4 + 11t$, $z = 1 + 2t$, $t$ scalar.

D. $x = 1 + 2t$, $y = 1 + 4t$, $z = 2t$, $t$ scalar.

E. $x = 3 + 4t$, $y = -4 + t$, $z = 1 + 7t$, $t$ scalar.

F. $x = -3 + 4t$, $y = 9 + 11t$, $z = 7t$, $t$ scalar.

**My answer:**_______________

**4.** Find the equation of the plane passing through $A(1,0,-7)$ and perpendicular to the line $[\,x \quad y \quad z\,]^T = [\,5 \quad 0 \quad 5\,]^T + t\,[\,2 \quad -1 \quad 7\,]^T$.

A. $2x + 3y + 6z = -1$

B. $x - 2y + 4z = 2$

C. $2x - y + 7z = -47$

D. $4x - y + 2z = -4$

E. $2x + y + z = -41$

F. $6x - y + 2z = -40$

**My answer:**_______________

**5.** Find the equation of the plane containing the point $P(1, 2, -3)$ and also containing the line through $Q(2, 0, 1)$ with direction vector $[1 \quad 1 \quad 1]^T$.

A. $2x - y - z = 3$

B. $2x - y - z = 0$

C. $x + y + z = 3$

D. $x + y + z = 0$

E. $6x + 3y + z = 9$

F. $6x + 3y + z = 0$

**My answer:**________________

**6.** What is the distance between the point $P(1, 1, 1)$ and the plane $2x - 2y + z = 0$?

A. $\frac{1}{3}$

B. $\frac{1}{9}$

C. $\frac{1}{\sqrt{3}}$

D. 9

E. 3

F. $\sqrt{3}$.

**My answer:**________________

**7.** Let $u = [1 \quad 1 \quad 1]^T$ and $v = [2 \quad -2 \quad 1]^T$. Suppose $w$ and $x$ are vectors satisfying the following three conditions:

- $u = w + x$,
- $w$ is a scalar multiple of $v$, i.e., $w = sv$ for some scalar $s \in \mathbb{R}$,
- $x$ is orthogonal to $v$.

Then $x$ is

A. $\frac{1}{9}(7, 11, 8)$

B. $-\frac{1}{3}(7, 11, 8)$

C. $\frac{1}{9}(1, -1, -4)$

D. $-\frac{1}{3}(1, -1, -4)$

E. $\frac{1}{9}(8, 10, 4)$

F. $-\frac{1}{3}(8, 10, 4)$.

**My answer:**________________

**8.** Find the area of the triangle with vertices $A(2, 0, 1)$, $B(0, 1, 2)$ and $C(1, 1, -1)$.

A. $\frac{1}{2}\sqrt{35}$

B. $\sqrt{35}$

C. 25

D. 25/2

E. 5/2

F. $\frac{1}{2}\sqrt{5}$

**My answer:**________________

**9.** Find the distance from the point $P(1,0,1)$ to the line through $P_0(0,0,0)$ with direction vector $d = [1 \quad 1 \quad 1]^T$.

A. $\frac{2}{3}$

B. $2\sqrt{5}$

C. $0$

D. $\frac{1}{4}$

E. $\frac{1}{7}\sqrt{5}$

F. $\frac{1}{3}\sqrt{6}$

**My answer:**_______________

**10.** Write

$$\frac{1+i}{2-i} - \frac{3-4i}{1+2i}$$

in the form $a + ib$ with $a, b, \in \mathbb{R}$.

A. $\frac{1}{4}(7-8i)$

B. $-\frac{1}{2}(9-5i)$

C. $\frac{3}{7}(2-8i)$

D. $\frac{4}{5}(6+i)$

E. $\frac{1}{5}(6+13i)$

F. $-\frac{2}{3}(5-11i)$.

**My answer:**_______________

**11.** The roots of $3x^2 + 2x + 1$ are

A. $\frac{3}{4}(1 \pm 2i)$
B. $\frac{1}{3}(-1 \pm \sqrt{2}i)$
C. This polynomial does not have complex roots
D. $\frac{1}{6}(-4 \pm \sqrt{11}i)$
E. $\frac{2}{3}(1 \pm \sqrt{5})$
F. $\frac{1}{7}(2 \pm \sqrt{5}i)$

**My answer:**_______________

**12.** Find the correct combination of true/false for the following three statements.

- For a complex number $z$ and its complex conjugate $\bar{z}$ we always have $z\bar{z} \geq 0$.
- The equation $x^3 - 7x^2 + 43x - 13 = 0$ has a solution in the complex numbers.
- For a complex number $z$ and a real number $r$ we always have $|rz| = |r||z|$.

A. true/true/true
B. false/true/true
C. true/false/true
D. true/true/false
D. false/false/true
E. false/true/false
F. false/false /false

**My answer:**_______________