MATH 2043: Recmmended Homework Problems Fall 2025

1. Text: **James Stewart**, *Calculus, Early Transcendentals,* **9**th Edition, Cengage Learning

2. *MATH 2043: Additional Homework Problems* (consists of **A12, A13, A14, A15, & A16**)

Video solutions of some homework problems can be found at

https://cst.temple.edu/department-mathematics/undergraduate/courses/supplementary-videos

Chapter12: Vector and the Geometry of Space

12.1: 11, 15, 17

12.2: 2, 3, 4, 6, 7, 9, 13, 15, 17, 19, 21, 22, 23, 25, 26, 43, 44; Also do **A12: 1, 2**

12.3: 2, 4, 7, 9(in 9 also find $\mathbf{a}\cdot(\mathbf{a}+2\mathbf{b})$), 11, 12(in Problems 11 and 12, also find $\mathbf{u}\cdot(\mathbf{u}+2\mathbf{v}+3\mathbf{w})$), 15, 17, 19, 22, 23, 25, 39, 41, 43, 64; Also do **A12: 3, 4, & 5**.

12.4: 1, 3, 5, 14, 15 (in problems 14 and 15, find only $|\mathbf{u}\times\mathbf{v}|$), 17, 19, 20, 27, 28, 29, 31, 43; Also do **A12: 6, 7, & 8**

12.5: 2, 3, 4, 5, 6, 7, 9, 10, 11, 15, 16, 17, 23, 25, 26, 27, 28, 31, 33, 35, 45, 47, 48

Chapter 13: Vector Functions

13.1: 1, 7, 9, 11

13.2: 3, 5, 7, 9, 10, 11, 12, 13, 18, 19, 20, 25, 27, 37, 38, 39, 40, 41, 42, 43, 44; Also do **A13: 1**

13.4: 3, 4, 5, 6, 10, 11, 12, 14, 15, 17a, 18a

13.3: 3, 4, 5, 6, 7, 8(in problems 3, 4, 5, 7, and 8 also find the mass of a thin wire in the shape of the given curve if the density at t is $\rho(t)=t^2$), 16 (in problem 16, find only the length of the curve for $0\le t\le \ln 2$)

Chapter 14: Partial Derivatives

14.1: 2ab, 3, 4, 7, 8, 9, 10, 11, 12, 13, 47, 49

16.2: 1, 2, 3, 4, 9, 11, 12, 13, 35, 36(in Problems 35 & 36, find only the mass of the wire); Also do **A16: 1 & 2**

14.3: 9, 11, 13, 14, 15, 16, 18, 21, 22, 23, 27, 28, 29, 30, 31, 38, 47, 49, 53, 55, 56, 57, 59, 61 62, 63

14.4: 3, 5, 9, 17, 20, 21, 22(In 17-22, do not explain why the function is differentiable), 25, 26(No graphing), 27; Also do **A14: 1, 2**

14.5: 3, 4, 6, 7, 8, 11, 13, 14, 16, 25, 26, 27, 29, 39

14.6: 9, 11, 13, 14, 17, 19, 22, 25, 27, 29, 30, 31, 33b, 35, 39

Chapter 15: Multiple Integrals

15.1: 15, 17, 19, 20, 21, 22, 25, 27, 29, 32, 33, 41, 42, 43, 45, 47; Also do **A15: 1**

15.2: 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 17, 18, 20, 21, 23, 24, 25, 26, 28, 31, 32, 33, 35, 55, 56, 57, 58, 59, 60, 61, 62, 63, 65, 66

15.3: 7, 8, 9, 10, 11, 12 (in 10 take $a = 2$ and $b = 3$), 13, 14, 15, 16, 24, 26, 29, 30, 32, 34, 39, 41

15.5: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12

16.7: 9, 10, 11, 12

15.6: 3, 5, 7, 10, 13, 14, 15, 17, 19 (in 19 set up the iterated triple integral only; do not evaluate.), 23

15.7: 15, 16, 19, 20, 23, 24, 25, 27a, 31, 32

15.8: 5, 9a, 10a, 22, 24, 25, 26, 27(in 24-27, convert the integral to spherical coordinates; do not evaluate the integral), 28, 29, 32, 43, 44; Also do **A15: 2, 3**

Chapter 16: Vector Calculus

16.1: 25, 26, 27, 28

16.2: 5, 7, 15, 21, 22, 23, 24

16.3: 3, 5, 6, 7, 9, 11, 19, 20, 21, 23, 24, 25; Also do **A16: 3, 4, & 5**

16.4: 1, 2, 3, 5, 6, 8, 9, 11, 13, 14, 15, 17

16.5: 1, 3, 4, 5, 7

16.7: 23, 24, 26, 28

16.8: 2, 3, 7, 8, 9, 15a, 16a, 17; Also do **A16: 6, 7**

16.9: 2, 4, 5, 7, 8, 9, 11, 12; Also do **A16: 8**

Next pages have "Additional Homework Problems"

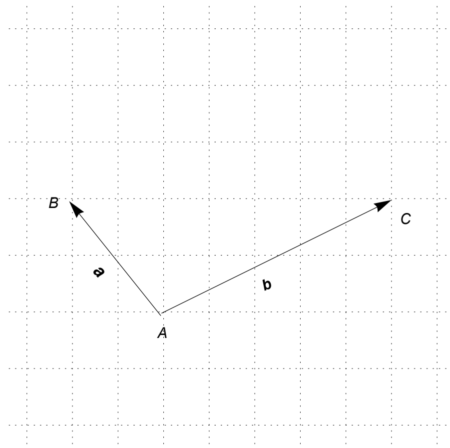
A12, A13, A14, A15, and A16.

MATH 2043: Additional Homework Problems

A12: Vectors and the Geometry of Space

1. Let $\overrightarrow{AB} = \langle 2, 3, 1 \rangle$. What are the coordinates of the point B, if the coordinates of point A are $(2, 1, 5)$?

2. In all parts use the figure, given below.



   (a) In the given figure draw the vectors $\mathbf{a}+\mathbf{b}$, $\mathbf{b}-\mathbf{a}$, $\mathbf{a}-\mathbf{b}$, $2\,\mathbf{a}+\mathbf{b}$, and $-\dfrac{1}{2}\mathbf{b}$ with the initial point at A. Also sketch $\mathbf{b}-\mathbf{a}$ with the initial point at B.

   Label each vector.

   (b) Suppose $\mathbf{b} = \overrightarrow{AC} = \langle -3,\ 2,\ -1 \rangle$ and point A is $(5,\ 1,\ -3)$.

   Find the coordinates of the point C.

   (c) Find a vector that has the opposite direction as $\mathbf{b} = \overrightarrow{AC} = \langle -3,\ 2,\ -1 \rangle$ but has length 3.

   (d) Suppose point A is $(5,\ 1,\ -3)$ and point B is $(3,\ 2,\ -4)$. Find vectors $\overrightarrow{AB}$ and $\overrightarrow{BA}$.

3. Let $\mathbf{a} \cdot \mathbf{b} = 3$ and $\mathbf{a} \cdot \mathbf{c} = 7$. Find $\mathbf{a} \cdot (3\mathbf{b} - \mathbf{c})$. Show all your work.

4. Let $\mathbf{a} \cdot \mathbf{b} = 3$ and $|\mathbf{a}| = 4$, $|\mathbf{b}| = 2$. Find $|\mathbf{a} - 2\mathbf{b}|$. Show all your work.

5. Let $\mathbf{a} = \langle h,\ -3,\ 1 \rangle$, $\mathbf{b} = \langle h+1,\ h,\ -15 \rangle$. Find all possible values of h if vectors $\mathbf{a}$ and $\mathbf{b}$ are orthogonal.

6. Let $\mathbf{a} \times \mathbf{b} = \langle 2, -1, 5 \rangle$ and $\mathbf{a} \times \mathbf{c} = \langle 1, 4, 2 \rangle$.

   (a) Find $\mathbf{a} \times (\mathbf{a} + \mathbf{b} - \mathbf{c})$.

   (b) Find $\mathbf{a} \cdot \langle 2, -1, 5 \rangle$ and $\mathbf{a} \cdot \langle 1, 4, 2 \rangle$.

   (c) Find a unit vector parallel to $\mathbf{a}$.

7. Find a value of c if $\mathbf{a} \times \mathbf{b} = \langle 4,\ 3,\ c \rangle$, $\mathbf{b} = \langle 1,\ -2,\ 3 \rangle$.

8. Let $\mathbf{a} \times \mathbf{b} = \langle 1, 2, 3 \rangle$ and let $|\mathbf{a}| = \sqrt{7}$, $|\mathbf{b}| = 2\sqrt{2}$. Find all possible values of the angle θ between $\mathbf{a}$ and $\mathbf{b}$.

A13: Vector Functions

1. Find $\mathbf{r}(t)$ if $\mathbf{r}'(t) = t\sqrt{t-1}\,\mathbf{i} + t\sin(\pi t)\,\mathbf{j} + \ln t\,\mathbf{k}$ and $\mathbf{r}(2) = \mathbf{i} + 3\mathbf{k}$

A14: Partial Derivatives

1. Let $f(x,\, y) = y\, e^{x^2+2y-3}$.

   (a) Find f_x and f_y.

   (b) Find the linearization $L(x, y)$ of f at the point $(-1, 1)$.

   (c) Use your answer to part (b) to approximate $f(-1.04, 0.95)$.

2. Let $f(x,\, y,\, z) = x\,\sqrt{y + 4z}$.

   (a) Find $f_x,\;\; f_y,\;$ and f_z.

   (b) Find the linearization $L(x,\, y,\, z)$ of f at the point $(3,\, 1,\, 2)$.

   (c) Use your answer to part (b) to approximate $f(3.02,\, 0.9,\, 2.1)$.

A15: Multiple Integrals

1. Calculate the double integral over a given rectangle R.

   (a) $\displaystyle\iint_R x^2 \cos y e^{x \sin y}\, dA, \quad R = \{(x, y) | 1 \le x \le 2, 0 \le y \le \pi/2\}.$

   (b) $\displaystyle\iint_R \frac{x+y}{1+y^2}\, dA, \quad R = \{(x, y) | 0 \le x \le 2, 0 \le y \le 1\}.$

2. Convert to spherical coordinates and evaluate: $\displaystyle\int_{-2}^{2}\int_{0}^{\sqrt{4-x^2}}\int_{0}^{\sqrt{4-x^2-y^2}} z\sqrt{x^2+y^2+z^2}\, dzdydx.$

3. Evaluate $\displaystyle\iiint_D e^{-(x^2+y^2+z^2)^{3/2}} dV$, where D is the region that lies below the sphere $x^2 + y^2 + z^2 = 4$ and above the cone $z = \sqrt{x^2 + y^2}$.

A16: Vector Calculus

1. Find the mass of a thin wire bent into the shape of the curve

   $\mathbf{r}(t) = \langle \sin(2t), \sin t, \cos t\rangle,\ \ 0 \le t \le \pi/4$, if the linear density is $\rho(x, y, z) = x(z^2 - y^2)$.

2. Let C be the curve $\mathbf{r}(t) = \langle t^2,\ \sin t,\ \cos t\rangle,\ \ 0 \le t \le 1$. Find $\int_C f(t)ds$ where $f(t) = \dfrac{t}{4t^2+1}$.

3. $\mathbf{F}(x, y) = (xy^2 + 1)\mathbf{i} + (x^2y - 2y)\mathbf{j},\quad C : \mathbf{r}(t) = \langle t + \sin(\frac{1}{2}\pi t), t + \cos(\frac{1}{2}\pi t)\rangle,\ \ 0 \le t \le 1.$

   (a) Verify that $\mathbf{F}$ is a conservative vector field.

   (b) Find a function f such that $\mathbf{F} = \nabla f$.

   (c) Use part (**b**) and **the Fundamental Theorem for Line Integrals** to evaluate the integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ along the given curve C.

4. $\mathbf{F}(x, y, z) = y^2z\mathbf{i} + \left(2xyz - \dfrac{z}{y^2}\right)\mathbf{j} + \left(xy^2 + \dfrac{1}{y} - 2z\right)\mathbf{k}.\quad C : \mathbf{r}(t) = \langle \sqrt{t}, t + 1, t^2\rangle,\ \ 0 \le t \le 1$

   (a) Verify that $\mathbf{F}$ is a conservative vector field.

   (b) Find a function f such that $\mathbf{F} = \nabla f$.

   (c) Use part (**b**) and **the Fundamental Theorem for Line Integrals** to evaluate the integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ along the given curve C.

5. $\mathbf{F}(x, y, z) = (yze^{xyz} + 3x^2z)\mathbf{i} + (xze^{xyz} + z\cos(yz) + 2)\mathbf{j} + (xye^{xyz} + y\cos(yz) + x^3 - 2z)\mathbf{k},$

   $C : \mathbf{r}(t) = \langle t + 1, t^2, t^3 + 2\rangle,\ \ 0 \le t \le 1.$

   (a) Verify that $\mathbf{F}$ is a conservative vector field.

   (b) Find a function f such that $\mathbf{F} = \nabla f$.

   (c) Use part (**b**) and **the Fundamental Theorem for Line Integrals** to evaluate the integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ along the given curve C.

6. Let $\mathbf{F} = 3z\,\mathbf{i} + 5x\mathbf{j} - 2y\,\mathbf{k}$. Use the Stokes' Theorem to evaluate $\iint_{\mathbf{S}} curl\mathbf{F} \cdot d\mathbf{S}$, where $\mathbf{S}$ is the part of the surface $z = x^2 + y^2$ that lies below the plane $z = 4$, oriented upward.

7. Let $\mathbf{F} = (y - x)\,\mathbf{i} + (x - z)\mathbf{j} + (x - y)\,\mathbf{k}$.

   Use the Stokes' Theorem to evaluate $\oint_C \mathbf{F} \cdot d\mathbf{r}$, where C is the boundary of the part of the plane $x + 2y + z = 2$ that lies in the first octant, oriented counterclockwise as viewed from above.

8. Use the Divergence Theorem to evaluate the surface integral $\iint_{\mathbf{S}} \mathbf{F} \cdot d\mathbf{S}$ (that is, calculate the flux of $\mathbf{F}$ across $\mathbf{S}$).

   (a) $\mathbf{F}(x, y, z) = (x + \cos y)\mathbf{i} + (y + \sin z)\mathbf{j} + (z + e^x)\mathbf{k}$ and $\mathbf{S}$ is the surface of the solid bounded by the paraboloid $z = 1 - x^2$ and by the planes $z = 0$, $y = 0$, and $y = 2$.

   (b) $\mathbf{F}(x, y, z) = (x^2 + e^{-yz})\mathbf{i} + (y + \sin xz)\mathbf{j} + (\cos xy)\mathbf{k}$ and $\mathbf{S}$ is the surface of the tetrahedron bounded by the plane $x + y + z = 1$ and the coordinate planes.