MATH 2043: Recmmended Homework Problems Fall 2023

1. Text: **James Stewart**, *Calculus, Early Transcendentals,* **8**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://math.temple.edu/ugrad/learning_tools/videos2043/

Chapter12: Vector and the Geometry of Space

12.1: 9, 13, 15

12.2: 2, 3, 4, 6, 7, 8, 9, 13, 15, 17, 19, 21, 23, 25, 26, 29, 43, 44, 47. Also do **A12: 1**

12.3: 1, 2, 4, 7, 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, 27, 26, 39, 41, 43, 64. Also do **A12: 2, 3, 4**.

12.4: 1, 3, 5, 13, 14, 15 (in problems 14 and 15, find only $|\mathbf{u}\times\mathbf{v}|$), 17, 19, 20, 27, 28, 29, 31, 43, 44. Also do **A12: 5, 6**

12.5: 3, 4, 5, 6, 7, 9, 10, 11, 13, 15, 16, 17, 18, 23, 25, 26, 27, 29, 30, 31, 33, 34, 35, 45, 47, 48. Also do **A12: 7**

Chapter 13: Vector Functions

13.1: 1, 7, 9

13.2: 3, 5, 7, 9, 11, 12, 13, 18, 19, 20, 23, 25, 35, 36, 37, 38, 39, 40, 41, 42. Also do **A13: 1**

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

13.3: 1- 6 (in problems 1, 2, 3, 5, and 6, also find the mass of a thin wire in the shape of the given curve if the density at t is $\rho(t)=t^2$), 14 (in problem 14, find only the length of the curve for $0\le t\le \ln 2$).

Chapter 14: Partial Derivatives

14.1: 9, 10, 11, 13, 14, 15, 17, 18, 19, 47, 49

16.2: 1, 2, 4, 9, 10, 11, 33, 34, 36 (in Problems 33, 34, 36, find only the mass of the wire). Also do **A13: 2** & **A16: 1**

14.3: 15, 16, 19-22, 24, 25, 27, 31, 32, 33, 34, 42, 43, 53, 55, 59, 61, 62, 63, 65, 67, 69

14.4: 1, 3, 4, 5, 11, 14, 15, 16 (In 11-16, do not explain why the function is differentiable), 19, 20 (No graphing), 21. Also do **A14: 1, 2**

14.5: 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 21, 22, 23, 24, 25, 35

14.6: 5, 6, 7, 9, 10, 11, 12, 15, 17, 19, 20, 21, 23, 24, 25, 26, 27b, 28, 29, 31, 32

Chapter 15: Multiple Integrals

15.1: 15, 17, 19, 20, 21, 22, 23, 25, 27, 29, 31, 32, 33, 37, 39. Also do **A15: 1**

15.2: 2, 3, 4, 5, 7, 8, 9, 13, 16, 17, 18, 19, 20, 21, 23, 24, 25, 27, 31, 45-53, 55, 56

15.3: 5, 6, 7, 8, 9, 11, 12, 13, 14, 19, 20, 22, 24, 25, 29, 31

15.5: 2, 3, 4, 5, 6, 7, 8, 9. Also solve **16.7**: 10-13

15.6: 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 19, 21

15.7: 17, 18, 19, 20, 21, 22, 23, 25a, 29, 30. Also do **A15: 2**

15.8: 5, 6, 9a, 10a, 22, 23, 24, 25, 26, 27, 30 (in 23-27 & 30, convert triple integrals into spherical coordinates but DONOT evaluate integrals), 41, 42, 43. Also do **A15: 3, 4**

Chapter 16: Vector Calculus

16.1: 21, 23, 24

16.2: 5, 7, 10, 12, 19, 20, 21, 22

16.3: 3, 5, 7, 9, 11, 13, 14, 15, 16, 17, 18, 19. Also do **A16: 2, 3, 4**

16.4: 1, 2, 3, 6, 7, 9, 11, 13

16.5: 1, 3, 4, 5, 7, 13, 15, 17, 18

16.7: 23, 24, 26, 28

16.8: 2, 3, 7, 8, 9, 11a, 12a, 13, 14

16.9: 2, 5, 7, 8, 9, 11, 13

"Additional Homework Problems" are on next pages.

MATH 2043 Additional Homework Problems

A12: Vectors and the Geometry of Space

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

2. Let $\mathbf{a} \cdot \mathbf{b} = 3$ and $\mathbf{a} \cdot \mathbf{c} = 7$. Find $\mathbf{a} \cdot (3\mathbf{b} - \mathbf{c})$.

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

4. Let $\mathbf{a} = \langle x, y, 1 \rangle$, $\mathbf{b} = \langle 1, -1, 3 \rangle$. Assume that $|\mathbf{a}| = \sqrt{14}/2$ and $\mathbf{a} \cdot \mathbf{b} = 5$. Find all possible values of x and y.

5. 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 $\mathbf{a}$.

6. 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 $\mathbf{b}$.

7. Let Q be the foot of the perpendicular from the point $P(1, 0, -3)$ to the plane $x + 2y + 3z = 2$ (*i.e.*, the point Q lies in the plane and the line through P and Q is perpendicular to the plane). Find the coordinates of the point Q.

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. Use cylinderical coordinates to find the volume of the solid that lies in the first octant above the cone $z = \sqrt{x^2 + y^2}$ and below the paraboloid $z = 2 - x^2 - y^2$.

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

4. 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 $\displaystyle\int_C f(t)ds$ 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 $\displaystyle\int_C \mathbf{F} \cdot d\mathbf{r}$ 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 $\displaystyle\int_C \mathbf{F} \cdot d\mathbf{r}$ 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 $\displaystyle\int_C \mathbf{F} \cdot d\mathbf{r}$ along the given curve C.