

# Final Exam Study Guide

MA 261 · Fall 2023

The Final Exam will be 20 multiple choice questions. It is comprehensive, covering Lessons 1 – 37.

Past Exam Archive: <https://www.math.purdue.edu/academic/courses/oldexams.php?course=MA26100>

A breakdown of the learning objectives, with practice problems from the textbook and past exam problems is included in the table below.

#	Lesson:	Sec:	Quiz:	You should be able to:	You should know:	Practice Problems:	Past Exam Problems:
1	Review of Vectors	13.1 13.2 13.3 13.4	1	<ul style="list-style-type: none"> <li>- Compute vector operations</li> <li>- Find magnitude of a vector</li> <li>- Find a position vector</li> <li>- Find the equation of a sphere, ball, or circle</li> <li>- Find equations of simple planes</li> <li>- Compute dot products</li> <li>- Find angles between vectors</li> <li>- Calculate orthogonal projections</li> <li>- Compute cross products</li> <li>- Find areas of parallelograms and triangles</li> <li>- Find orthogonal vectors</li> </ul>	Vector, scalar, magnitude, zero vector, position vector, unit vector, parallel, sphere, ball, circle, plane, dot product, orthogonal, orthogonal projection, cross product, determinant, coordinate unit vectors ( $\mathbf{i}$ , $\mathbf{j}$ , $\mathbf{k}$ )	<b>13.1:</b> # 21, 23, 29, 43, 45, 47  <b>13.2:</b> # 31, 37, 41, 45, 71, 73  <b>13.3:</b> # 25, 27, 35, 37, 39, 41, 43, 47, 53, 55, 63, 65  <b>13.4:</b> # 13, 21, 25, 27, 29, 33, 43, 45, 49	Few exam questions test these concepts directly. However, you will need these concepts to complete the more difficult questions from the past exams.  S18E1#4 S18FE#1 S16E1#1
2	Lines & Planes in Space	13.5	1	<ul style="list-style-type: none"> <li>- Find equations of lines and line segments</li> <li>- Find equations of planes</li> <li>- Determine whether planes are parallel, intersecting, or identical</li> <li>- Find intersections between lines and/or planes</li> </ul>	Parallel, intersecting, skew, orthogonal planes	<b>13.5:</b> # 21, 23, 25, 49, 51, 55, 57, 65, 67, 69, 73, 75, 77, 79, 81, 90	S19E1#1 S19E1#2 S19FE#1 F19E1#1 F19FE#1 F18E1#1 F18FE#1
3 4	Quadratic Surfaces	13.6	2	<ul style="list-style-type: none"> <li>- Sketch graphs of cylinders and quadratic surfaces</li> <li>- Identify surfaces from equations</li> </ul>	Trace, elliptic paraboloid, ellipsoid, cylinder, elliptic cone, hyperboloid of one sheet, hyperboloid of two sheets, hyperbolic paraboloid	<b>13.6:</b> # 15, 17, 19, 21, 23, 25, 27, 31, 35, 37, 39, 43, 45, 47, 49, 51, 55, 57, 59	S19FE#2 F19E1#2 S18E1#1 F18E1#3 F18FE#2

#	Lesson:	Sec:	Quiz:	You should be able to:	You should know:	Practice Problems:	Past Exam Problems:
5	Vector-Valued Functions	14.1	2	<ul style="list-style-type: none"> <li>- Graph curves described by vector-valued functions</li> <li>- Find domains of vector-valued functions</li> <li>- Find the intersection of planes and curves defined by vector-valued functions</li> </ul>	Vector-valued function, domain, limit of a vector-valued function	<b>14.1:</b> # 11, 12, 15, 17, 19, 21, 39, 41, 43, 45, 47, 49, 53, 55	S22E1#4 S19E1#3 F19FE#2 F18E1#2 F16E1#4 S14E1#9
6	Calculus of Vector-Valued Functions, Motion in Space	14.2 14.3	3	<ul style="list-style-type: none"> <li>- Find first derivatives of vector-valued functions</li> <li>- Find tangent vectors and tangent lines for vector-valued functions</li> <li>- Evaluate definite integrals of vector-valued functions</li> <li>- Find velocity, speed, and acceleration of objects</li> </ul>	Tangent vector, unit tangent vector, tangent line, derivative rules	<b>14.2:</b> # 11, 13, 15, 17, 19, 21, 25, 27, 29, 35, 37, 39, 47, 71, 73, 75, 77, 79, 81, 83  <b>14.3:</b> # 47, 49	S18E1#2 S18E1#3 S17E1#3 S16E1#5
7	Motion in Space	14.3	3	<ul style="list-style-type: none"> <li>- Compare trajectories of objects</li> <li>- Solve applications involving 2d and 3d motion</li> </ul>	Velocity, acceleration, trajectories	<b>14.3:</b> # 15, 17, 19, 29, 31, 47, 49, 57	S19E1#6 S19FE#20 F19E1#3 F19E1#6 S18FE#3 F18E1#5 F18E1#6
8	Length of Curves, Curvature	14.4 14.5	3	<ul style="list-style-type: none"> <li>- Find arc lengths of vector-valued functions</li> <li>- Parameterize curves by arc length</li> <li>- Find unit tangent vectors and curvatures</li> <li>- Use velocity to find curvature</li> </ul>	Arc length, curvature	<b>14.4:</b> # 9, 11, 13, 15, 17, 19, 23, 25, 33, 35, 37  <b>14.5:</b> # 11, 13, 15, 17, 21, 23, 25	<b>Arc Length</b> S19E1#5 F19E1#5 F19FE#3 S18FE#2  <b>Curvature</b> S19E1#4 F19E1#4 F18E1#4
9	Functions of Several Variables	15.1	4	<ul style="list-style-type: none"> <li>- Find domains of functions</li> <li>- Graph surfaces</li> <li>- Graph level curves of functions</li> </ul>	Function of several variables, level curves	<b>15.1:</b> # 15, 19, 21, 23, 27, 29, 31, 33, 35, 37, 39, 41, 57	S19E1#7 S18E1#5 F18E1#7

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10	Limits and Continuity	15.2	4	<ul style="list-style-type: none"> <li>- Evaluate limits of functions</li> <li>- Evaluate limits at boundary points</li> <li>- Determine where functions are continuous</li> </ul>	Limit laws, boundary point, interior point, two-path test, continuity	<b>15.2:</b> # 17, 19, 21, 23, 25, 27, 29, 31, 33, 39, 41, 49, 53, 61, 63, 65, 67, 69, 71, 77	F19E1#7 F18E1#8 S17E1#6
11	Partial Derivatives	15.3	4	<ul style="list-style-type: none"> <li>- Find first partial derivatives</li> <li>- Find second partial derivatives</li> </ul>	Partial derivative, differentiable,	<b>15.3:</b> # 17, 19, 21, 27, 33, 39, 41, 43, 45, 47, 55, 57, 79	S19E1#8 S19FE#7 F19E1#8 F19FE#6 F18FE#5
12	The Chain Rule	15.4	Practice	<ul style="list-style-type: none"> <li>- Use the chain rule to find derivatives</li> <li>- Differentiate implicitly</li> <li>- Evaluate partial derivatives at specified points</li> </ul>	Chain rule, implicit differentiation	<b>15.4:</b> # 15, 17, 19, 21, 23, 35, 37, 39,	S19E1#9 F19FE#7 S18FE#5 F18E1#10
13	Directional Derivatives and the Gradient	15.5	Practice	<ul style="list-style-type: none"> <li>- Compute gradients and/or directional derivatives</li> <li>- Find directions or paths of change</li> <li>- Compute slopes of lines tangent to level curves</li> </ul>	Gradient, directional derivative, directions of change, level curves, steepest descent	<b>15.5:</b> #17, 19, 25, 27, 29, 31, 33, 35, 61, 63, 65, 67	S19E1#10 S19FE#8 F19E1#9 F19FE#4 S18FE#7 F18E1#11 F18FE#4
14	Tangent Plane and Linear Approximation	15.6	5	<ul style="list-style-type: none"> <li>- Find equations of planes tangent to surfaces</li> <li>- Find linear approximations</li> <li>- Use differentials to approximate changes in functions</li> </ul>	Tangent plane, differential, linear approximation	<b>15.6:</b> #13, 15, 17, 19, 21, 25, 29, 33, 35, 37, 53	S19E1#11 S19FE#5 F19FE#5 S18FE#6 F18E1#9 F18FE#3
15 16	Maximum and Minimum Problems	15.7	5	<ul style="list-style-type: none"> <li>- Find and analyze critical points for functions</li> <li>- Find local and absolute extrema for functions</li> </ul>	Local extrema, critical point, saddle point, second derivative test, absolute extrema	<b>15.7:</b> #9, 11, 25, 27, 29, 31, 33, 35, 37, 39, 41, 47, 49, 51, 53, 55, 63, 67	S19E1#12 S19FE#9 F19E1#10 F19E1#11 F19FE#8 S18FE#9 F18FE#7 F18E1#12 F18E2#1

#	Lesson:	Sec:	Quiz:	You should be able to:	You should know:	Practice Problems:	Past Exam Problems:
17	Lagrange Multipliers	15.8	6	- Use Lagrange multipliers to find extreme values	Lagrange multiplier	<b>15.8:</b> #7, 9, 11, 13, 15, 17, 21, 23, 25, 35 41	S19E2#1 F19E2#1 F18FE#6 F18E2#2
18	Double Integrals in Rectangular Regions	16.1	6	- Evaluate iterated integrals - Evaluate double integrals over rectangular regions - Compute average values of functions over plane regions	Double integral, average value	<b>16.1:</b> #5, 27, 29, 31, 33, 35, 45, 47	F19E2#2 S18E2#2 F18E2#3
19	Double Integrals over General Regions	16.2	6	- Evaluate double integrals over general regions - Change the order of integration	Order of integration	<b>16.2:</b> #43, 47, 51, 55, 57, 59, 61, 63, 65, 67	S19E2#2 <del>S19E2#4</del> S19FE#10 F19E2#3 F19FE#9 F18E2#4
20	Double Integrals in Polar Coordinates	16.3	6	- Find volumes of solids using polar coordinates - Evaluate double integrals using polar coordinates	Polar coordinates	<b>16.3:</b> #15, 17, 21, 23, 25, 27, 29, 31, 33, 41, 51, 55	S19E2#3 S19FE#11 F18FE#8 F18E2#5
21	Triple Integrals	16.4	7	- Find volumes of solids using triple integrals - Evaluate triple integrals - Change the order of integration	Triple integrals	<b>16.4:</b> #15, 17, 19, 21, 25, 31, 37, 39, 41, 45, 47, 49, 55	S19E2#5 S19FE#12 F19E2#4 F18FE#9 F18E2#7
22 23	Triple Integrals in Cylindrical and Spherical Coordinates	16.5	7	- Evaluate triple integrals in cylindrical and spherical coordinates	Cylindrical coordinates, spherical coordinates	<b>16.5:</b> #15, 17, 19, 21, 25, 29, 31, 33, 41, 43, 45, 47, 49, 51, 53, 55	<b>Cylindrical</b> S19E2#6 S19FE#13 F19E2#5 F19FE#10 S18FE#8 F18E2#9 F18E2#8  <b>Spherical</b> S19E2#7 S19FE#14

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							F19E2#6 F19E2#7 F18E2#10 F18FE#10 F18FE#11
24	Integrals for Mass Calculation	16.6	Practice	<ul style="list-style-type: none"> <li>- Find centers of mass of 2D and 3D objects</li> <li>- Calculate the mass of variable density solids</li> </ul>	Center of mass, variable density	<b>16.6:</b> #21, 23, 25, 29, 31, 33, 35, 37, 39	F19E2#8 S18FE#10 F18E2#6
25	Vector Fields	17.1	Practice	<ul style="list-style-type: none"> <li>- Graph vector fields</li> <li>- Find gradient fields for a given potential function</li> </ul>	Vector field, radial vector field, potential function, equipotential curves, flow curves, streamlines.	<b>17.1:</b> #11, 13, 15, 24, 37, 39, 41, 43, 47, 53	S19E2#8 F19E2#9 F18E2#11 F18E2#12
26 27	Line Integrals of Functions and Vector Fields	17.2	8	<ul style="list-style-type: none"> <li>- Evaluate line integrals</li> <li>- Find the work required to move an object on an oriented curve</li> <li>- Find the circulation and flux of a vector field on a plane curve</li> </ul>	Line integral, work, circulation, flux	<b>17.2:</b> #17, 19, 21, 23, 25, 27, 29, 31, 33, 41, 43, 45, 49, 51, 53, 57	<b>Scalar:</b> S19E2#10 F19E2#10 F19E2#11 F19FE#11  <b>Vector:</b> S19E2#9 S19FE#15 S18FE#12 F18FE#12
28	Conservative Vector Fields & the Fundamental Theorem of Line Integrals	17.3	8	<ul style="list-style-type: none"> <li>- Determine whether a vector field is conservative and find potential functions</li> <li>- Evaluate line integrals</li> <li>- Compute the work done in force fields</li> </ul>	Conservative vector field, potential function, Fundamental Theorem for Line Integrals, independent of path	<b>17.3:</b> #17, 19, 23, 25, 35, 37, 39, 41, 43, 53, 55, 57, 59, 61	S19FE#3 F19FE#12 F18FE#13
29	Green's Theorem	17.4	9	<ul style="list-style-type: none"> <li>- Use a line integral to determine the area of a region</li> <li>- Use Green's theorem to evaluate line integrals</li> <li>- Find the circulation and flux across the boundary of a region</li> </ul>	Green's Theorem, two-dimensional curl, two-dimensional divergence, stream function, Laplace's equation	<b>17.4:</b> #21, 27, 29, 31, 33, 35, 37, 41, 49	S19FE#4 F19FE#13 F19FE#14 S18FE#13 F18FE#16 F18FE#14

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30	Divergence & Curl	17.5	9	<ul style="list-style-type: none"> <li>- Find the divergence of vector fields</li> <li>- Find the curl of vector fields</li> </ul>	Divergence, Curl, source-free, irrotational	<b>17.5:</b> #13, 15, 17, 21, 25, 27, 29, 31, 33, 39, 41	S19FE#6 F19FE#15 S18FE#14 F18FE#15
31 32 33	Surface Integrals	17.6	10	<ul style="list-style-type: none"> <li>- Find a parametric description of a surface and describe surfaces parametrically</li> <li>- Find the surface area using the parametric description of a surface</li> <li>- Evaluate surface integrals</li> <li>- Evaluate flux integrals</li> </ul>	Surface integral	<b>17.6:</b> #19, 21, 23, 25, 27, 29, 31, 33, 43, 45, 47, 49, 51	<b>Scalar</b> S19E2#4 S19FE#16 S19FE#17 S18FE#15 S18FE#16 S18FE#17 F19FE#16 F18FE#17  <b>Vector</b> S18FE#18 F19FE#17 F18FE#18
34 35	Stokes' Theorem	17.7	Practice	<ul style="list-style-type: none"> <li>- Use Stokes' Theorem to evaluate line integrals and surface integrals</li> <li>- Use Stokes' Theorem to find circulation</li> </ul>	Stokes' Theorem	<b>17.7:</b> #11, 13, 15, 17, 19, 21, 23, 29, 41	S19FE#18 F19FE#19 S18FE#19 F18FE#19
36 37	The Divergence Theorem	17.8	Practice	<ul style="list-style-type: none"> <li>- Use the Divergence Theorem to compute net outward flux</li> </ul>	Divergence Theorem	<b>17.8:</b> #13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35,	S19FE#19 F19FE#18 F19FE#20 S18FE#20 F18FE#20

\*Answers to the practice problems are included in the textbook starting on page A-61.