Math 15a & 20a Placement Tests

The purpose of this placement test is to advise you on the appropriate Math courses for your success and help you make more informed course decisions. Students arrive at Brandeis with a wide range of prior experience in Math and Science. This assessment will help us recommend the best possible course placement for you making your transition to Brandeis smoother.

As you go through the assessment, just progress as far as you can and stop when you are no longer familiar with the material. It's more important to identify concepts that you may want to review than to focus on getting every answer right. Please remember that there's no pressure – if you don't know some answers, that's perfectly fine. Our goal is to recommend the math course that best fits your needs.

The assessment will give the most accurate recommendation if you do not use any calculators or other outside resources. You do not need to study for this; we're just getting a snapshot of what you have as working knowledge at this point in time.

Instructions:

1. Take the math placement tests in the Moodle Community "Math Assessment 2025" first (if you have not already done so).

2. If you scored 17-20 on Part A and 18-20 on Part B and 13-16 on Part C of the math placement tests on Moodle, then you should try the Math 15a and/or Math 20a placement tests below.

3. After you complete as much as you can of the tests below, check your answers against the answer keys at the end of this file and follow the guidelines based on your scores.

Math 15a Placement Test

This test will determine your working knowledge of material from Math 10b (integral calculus and infinite sequences & series). We are using this test to determine whether you should place yourself into Math 15a (Linear Algebra). While Math 15a does not have Math 10b as a prerequisite, we strongly recommend that you take Math 10b before taking Math 15a.

Do as much as you can of this test. If you feel comfortable with the material on this test, you should also try the Math 20a Placement Test below this. Then check your answers at the end of this file and follow the guidelines based on your scores.

1: Which of the following gives the area between the curves $y = x^2$ and $y = 2x$ over the interval $[-2, 2]$?

(a) $\displaystyle\int_{-2}^{2} (x^2 - 2x)\, dx$

(b) $\displaystyle\int_{-2}^{2} (2x - x^2)\, dx$

(c) $\displaystyle\int_{-2}^{0} (x^2 - 2x)\, dx + \int_{0}^{2} (2x - x^2)\, dx$

(d) $\displaystyle\left| \int_{-2}^{2} (x^2 - 2x)\, dx \right|$

(e) none of the above

2: Suppose that $f(x)$ is a continuous function with the following properties: $f''(x) = \cos x$, $f'(\pi) = 2$ and $f(0) = 4$. What is $f(\pi)$?

(a) 2

(b) 2π

(c) $\pi + 2$

(d) $6 + 2\pi$

(e) 0

3: Suppose that the function $f(x)$ is defined by $f(x) = \displaystyle\int_{1}^{x} \frac{e^t}{t}\, dt$. Find $f'(x)$.

(a) $f'(x) = e^x \ln x$

(b) $f'(x) = e^x \ln x - \dfrac{e^x}{x}$

(c) $f'(x) = \dfrac{e^x}{x}$

(d) $f'(x) = \dfrac{e^x}{x} - e$

(e) the integral can't be computed, so it's impossible to give the answer

4: Let $F(x) = \displaystyle\int_0^x f(t)\, dt$, where $f(t)$ is the function shown below.
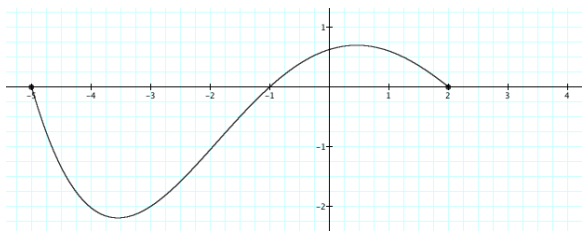
Which of the following statements are true?

I: $F(-2) > F(-4)$ **II:** $F(2) > F(1)$ **III:** $F(0) > 0$ **IV:** $F(-1) = 0$

(a) only I is true

(b) only II is true

(c) only III is true

(d) only I and II are true

(e) only II and IV are true

5: Suppose that $f(x) = \dfrac{x}{x^2+1}$. Find $\displaystyle\int_0^2 f'(x)\, dx$.

(a) $\dfrac{2}{5}$

(b) $-\dfrac{28}{25}$

(c) $\dfrac{28}{25}$

(d) 0

(e) none of the above

6: Which of the following statements about definite integrals are true?

I: $\displaystyle\int f(x) + g(x)\, dx = \int f(x)\, dx + \int g(x)\, dx$

II: $\displaystyle\int f(x)g(x)\, dx = \int f(x)\, dx \cdot \int g(x)\, dx$

III: $\displaystyle\int f'(g(x))g'(x)\, dx = f(g(x)) + C$

IV: $\displaystyle\int [f(x)]^n\, dx = \dfrac{[f(x)]^{n+1}}{n+1} + C$

(a) only I and II are true

(b) only I and III are true

(c) only I and IV are true

(d) only I, II and IV are true

(e) only I, III and IV are true

7: Find the volume of the solid obtained by rotating the region bounded by $y = x^2$ and $y = x$ over the interval $[0, 1]$ around the x-axis.

(a) $\displaystyle\int_0^1 \pi(x^2 - x^4)\, dx$

(b) $\displaystyle\int_0^1 \pi(x - x^2)^2\, dx$

(c) $\displaystyle\int_0^1 \pi(x^2 - x^4)^2\, dx$

(d) $\displaystyle\int_0^1 \pi(\sqrt{y} - y)\, dy$

(e) $\displaystyle\int_0^1 \pi(y - y^2)\, dy$

8: The integral $\displaystyle\int \frac{1}{x \ln x}\, dx$ can be found by

    (a) making the substitution $u = \ln x$

    (b) making the substitution $u = \frac{1}{x}$

    (c) using integration by parts with $u = \ln x$ and $dv = x\, dx$

    (d) taking the reciprocal of $\displaystyle\int x \ln x\, dx$

    (e) none of the above

9: The integral $x \sin x\, dx$ can be found by

    (a) making the substitution $u = x$

    (b) making the substitution $u = \sin x$

    (c) using integration by parts with $u = \sin x$ and $dv = x\, dx$

    (d) using integration by parts with $u = x$ and $dv = \sin x\, dx$

    (e) none of the above

10: Find $\displaystyle\int_0^{\ln \sqrt{3}} \frac{e^x}{1 + e^{2x}}\, dx$.

    (a) $\ln 2$ (c) $\dfrac{\pi}{12}$ (d) $\dfrac{\pi}{4}$

    (b) 1 (e) 0

11: Find $\displaystyle\lim_{x \to 0} \frac{x - \sin x}{x^3}\, dx$.

    (a) 0 (c) $\dfrac{1}{6}$ (d) $\dfrac{1}{3}$

    (b) 1 (e) does not exist

12: Find $\displaystyle\int_1^\infty \frac{1}{x^2}\, dx$.

    (a) 1 (c) 10 (e) the integral diverges

    (b) 2 (d) 20

13: Which of the following improper integrals converge to a finite value?

    I: $\displaystyle\int_1^\infty e^{-x}\, dx$ **II:** $\displaystyle\int_{-\infty}^\infty x^3\, dx$ **III:** $\displaystyle\int_{-\infty}^\infty \frac{1}{1 + x^2}\, dx$

    (a) I only   (c) I and II only   (e) all of them

    (b) III only   (d) I and III only

14: The second order Taylor polynomial at $x = 0$ for $f(x) = e^{-x}$ is

(a) $1 - \dfrac{x^2}{2}$

(c) $1 + x + \dfrac{x^2}{2}$

(e) $1 - x + \dfrac{x^2}{2}$

(b) $1 + \dfrac{x^2}{2}$

(d) $1 - x + x^2$

15: Which of the following series converge?

I: $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2}$

II: $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n}$

III: $\displaystyle\sum_{n=1}^{\infty} \frac{n}{2^n}$

(a) I only

(c) I and II only

(e) all of them

(b) III only

(d) I and III only

16: The radius of convergence of the power series $\displaystyle\sum_{n=0}^{\infty} x^n$ is

(a) 0

(c) 2

(e) ∞

(b) 1

(d) 3

Math 20a Placement Test

This test will determine your working knowledge of some material from Math 15a (Linear Algebra). We are using this test to determine whether you should place yourself into Math 20a (Multi-variable Calculus).

Do as much as you can of this test. Then check your answers at the end of this file and follow the guidelines based on your scores.

1: Consider the linear system

$$\begin{array}{rrrcr} 3x & +y & & = & 1 \\ & -2y & -6z & = & -8 \\ -2x & & +2z & = & 2 \end{array}$$

The solution set to this system in vector form is given by:

(a) $\left\{ \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -1 \\ 4 \\ 0 \end{pmatrix} + \begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix} z \right\}$
(b) $\left\{ \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix} + \begin{pmatrix} -1 \\ 4 \\ 0 \end{pmatrix} z \right\}$

(c) $\left\{ \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix} z \right\}$

2: Compute the following determinants.

(a) $\begin{pmatrix} 6 & 1 \\ 2 & 3 \end{pmatrix}$

    i. 20   ii. 18   iii. 6   iv. 12

(b) $\begin{pmatrix} 3 & 1 & 2 \\ 3 & 1 & 0 \\ 0 & 1 & 4 \end{pmatrix}$

    i. 3   ii. -6   iii. 0   iv. 6

3: Let S be the plane given in parametric form by

$$\left\{ \begin{pmatrix} 1 \\ 1 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} y + \begin{pmatrix} -4 \\ 0 \\ 1 \end{pmatrix} z \mid y, z \in \mathbb{R} \right\}.$$

Does the vector $\begin{pmatrix} -4 \\ 1 \\ 4 \end{pmatrix}$ lie on the plane S?

(a) YES   (b) No

4: Find the dot product and cross product of the vectors $\mathbf{a} = \mathbf{i} + 2\mathbf{j} - 2\mathbf{k}$ and $\mathbf{b} = 4\mathbf{i} - 3\mathbf{k}$.

(a) $\mathbf{a} \cdot \mathbf{b} =$

    i. 10   ii. $4\mathbf{i} - 2\mathbf{j} + 1\mathbf{k}$ iii. -2   iv. $(6, 5, 8)$

(b) $\mathbf{a} \times \mathbf{b} =$

    i. $-6\mathbf{i} - 5\mathbf{j} - 8\mathbf{k}$ ii. $(6, 5, 8)$ iii. 10   iv. -2

5: Let $\mathbf{v} = \langle 1, \sqrt{3} \rangle$ and $\mathbf{w} = \langle 3, \sqrt{3} \rangle$.

(a) The length of $\mathbf{v}$, $\|\mathbf{v}\| =$

    i. 4   ii. $\sqrt{4}$

(b) Compute the dot product $\mathbf{v} \cdot \mathbf{w}$.

    i. 10   ii. 6

(c) Compute the interior angle between $\mathbf{v}$ and $\mathbf{w}$.

    i. $\pi/6$ ii. $\pi/4$ iii. $\pi/3$ iv. $\pi/2$

6: Write the parametric equation of the line passing through $P = (5, 0, -2)$ and $Q = (1, 1, 7)$.

(a) $\begin{cases} x = 1 + 4t \\ y = 1 - t \\ z = 7 - 9t \end{cases}$ (b) $\begin{cases} x = 5 - 2t \\ y = \frac{t}{2} \\ z = -2 + \frac{9}{2}t \end{cases}$

(c) BOTH OF THE ABOVE   (d) NONE OF THE ABOVE

7: Find the equation of the plane containing the three points $P = (-1, 2, 3)$, $Q = (0, 4, 1)$, and $R = (-1, 3, 2)$.

(a) $-x + y - z = 0$ (b) $y + z = 5$

8: For which value(s) of k are the vectors $\begin{pmatrix} 3 \\ -1 \\ 2 \end{pmatrix}$, $\begin{pmatrix} 1 \\ k \\ 2 \end{pmatrix}$ perpendicular?

(a) 7   (b) 0   (c) 7 & 0   (d) -2

9: (a) Find the orthogonal projection of $\langle 4, 1, 0 \rangle$ onto the plane $2x - 2y + 2z = 0$.

    i. $\langle 2, 2, 0 \rangle$ ii. $\langle 1, -1, 1 \rangle$ iii. $\langle 3, 2, -1 \rangle$

(b) Find the point on the plane $x - y + z = 0$ which is closest to the point $P = (4, 1, 0)$.

i. $(2, 2, 0)$ ii. $(1, -1, 1)$ iii. $(3, 2, -1)$

(c) Compute the distance between $P = (4, 1, 0)$ and the plane $x - y + z = 0$.

i. 1 ii. $\sqrt{17}$ iii. $\sqrt{3}$

Answer Keys & Score Guidelines

Math 15a Placement Test Answers

1. c	7. a	13. d
2. d	8. a	
3. c	9. d	14. e
4. b	10. c	
5. a	11. c	15. d
6. b	12. a	16. b

Math 20a Placement Test Answers

Give yourself one point for each correct answer (including parts of questions), e.g., if you got both 2(a) and 2(b) correct, you would give yourself two points for those. The total score is out of 15 points.

1. a	(b) i	7. b
2. (a) iii	5. (a) ii	8. a
(b) iv	(b) ii	9. (a) iii
3. No	(c) i	(b) iii
4. (a) i	6. c	(c) iii

Score Guidelines

If you scored 17–20 on Part A and 18–20 on Part B and 13–16 on Part C of the math placement tests on Moodle you should use the following recommendations. (If any of those scores were lower, follow the guidelines on Moodle.)

We recommend:

- Math 10b – Techniques of Calculus (b)

    – if you scored 0–11 on the Math 15a Placement Test

- Math 15a – Linear Algebra (or try the Math 22a Placement Test)

    – if you scored 12–16 on the Math 15a Placement Test *and*
    – you scored 0–9 on the Math 20a Placement Test

- Your choice of Math 15a – Linear Algebra or Math 20a – Multi-variable Calculus (or try the Math 22a Placement Test)

    – if you scored 12–16 on the Math 15a Placement Test *and*
    – you scored 10–15 on the Math 20a Placement Test