Application of Integrals

Standard difficulty · 20 questions · 40 marks · Time: 44 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. The area bounded by $y = x^2$, the x-axis and the line $x = 3$ is:

(a) 9/2 square units **(b)** 27 square units

(c) 27/2 square units **(d)** 9 square units

2. The area enclosed by the ellipse $x^2/81 + y^2/64 = 1$ is:

(a) 5184π square units **(b)** 145π square units

(c) 72π square units **(d)** 18π square units

3. The area of the region bounded by the parabola $y^2 = 4x$ and the line $x = 1$ is:

(a) 8 square units **(b)** 16/3 square units

(c) 4/3 square units **(d)** 8/3 square units

4. The area enclosed by the parabola $y = x^2$ and the line $y = 36$ is:

(a) 288 square units **(b)** 144 square units

(c) 1296 square units **(d)** 576 square units

5. The area bounded by $y = f(x) \geq 0$, the x-axis and $x = a$, $x = b$ is:

(a) $\int$ from a to b of f(x) dx **(b)** $\int$ from a to b of x dx

(c) f′(b) − f′(a) **(d)** f(b) − f(a)

6. The area of the region in the first quadrant enclosed by the circle $x^2 + y^2 = 36$ and the coordinate axes is:

(a) 36π square units **(b)** 9π square units

(c) 18π square units **(d)** 9 square units

7. The area bounded by $y = x^3$, the x-axis and the lines $x = 0$ and $x = 5$ is:

(a) 625/4 square units **(b)** 625/3 square units

(c) 125/3 square units **(d)** 625 square units

8. Assertion (A): The area enclosed by the ellipse $x^2/16 + y^2/49 = 1$ is 28π square units.
Reason (R): The area enclosed by an ellipse with semi-axes a and b is $\pi(a^2 + b^2)$.

(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. Find the area bounded by the curve $y = x^2 + 6x + 15$, the x-axis and the lines $x = -5$ and $x = -1$.

10. Find the area of the region bounded by the parabola $y^2 = 64x$ and the line $x = 16$.

11. Find the area enclosed by the ellipse $x^2/81 + y^2/64 = 1$.

12. Find the area of the region bounded by the line $y = x$, the x-axis and the line $x = 7$.

13. Find the area bounded by $y = |x - 5|$, the x-axis and the lines $x = 0$ and $x = 6$.

14. Find the area of the region above the x-axis enclosed by the circle $x^2 + y^2 = 64$.

15. Find the area bounded by $y = \sqrt{(9x)}$, the x-axis and the line $x = 1$.

16. Find the area bounded by $y = x^3$, the x-axis and the lines $x = 2$ and $x = 4$.

Section C — Word problems — 4 × 4 = 16 marks

17. Using integration, find the area of the triangle with vertices $(-2, 0)$, $(4, 1)$, $(5, 6)$.

18. Find the area of the region enclosed by the parabola $y = x^2$ and the line $y = x + 6$.

19. Find the area of the smaller region bounded by the ellipse $x^2/81 + y^2/9 = 1$ and the line $x/9 + y/3 = 1$.

20. Find the area of the region in the first quadrant enclosed by the x-axis, the line $y = x$ and the circle $x^2 + y^2 = 4$.

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Answer key

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Q	Answer	Working
1	**(d) 9 square units**	$\int_0^3 x^2\,dx = 1 \times 27/3$
2	**(c) 72π square units**	πab with a = 9, b = 8
3	**(d) 8/3 square units**	$2\int_0^1 2\sqrt{x}\,dx = (8/3) \times 1 \times 1$
4	**(a) 288 square units**	$2\int_0^6 (36 - x^2)\,dx$
5	**(a) ∫ from a to b of f(x) dx**	—
6	**(b) 9π square units**	a quarter of π × 6 × 6
7	**(a) 625/4 square units**	$[x^4/4]$ from 0 to 5
8	**(c) A is true, but R is false.**	A is true: πab = π × 4 × 7 = 28π. R is false.
9	**88/3 square units**	the curve stays above the x-axis; $\int_{-5}^{-1} (x^2 + 6x + 15)\,dx$
10	**2048/3 square units**	$2\int_0^{16} 8\sqrt{x}\,dx = (8/3) \times 4 \times 64$
11	**72π square units**	$4 \times (8/9)\int_0^9 \sqrt{(81 - x^2)}\,dx = 4 \times (8/9) \times 81\pi/4$
12	**49/2 square units**	$\int_0^7 x\,dx$
13	**13 square units**	two triangles: 25/2 + 1/2
14	**32π square units**	$2\int_0^8 \sqrt{(64 - x^2)}\,dx$ = half of π × 64
15	**2 square units**	$\int_0^1 \sqrt{(9x)}\,dx = (2/3) \times \sqrt{9} \times 1\sqrt{1} = (2/3) \times 3$
16	**60 square units**	$[x^4/4]$ from 2 to 4
17	**29/2 square units**	write the equation of each side, integrate between the vertices' x-values, and add or subtract the areas
18	**125/6 square units**	they meet at x = −2 and x = 3; $\int_{-2}^3 (x + 6 - x^2)\,dx$
19	**(27/4)(π − 2) square units**	quarter ellipse 27π/4 minus the triangle 27/2
20	**π/2 square units**	the line meets the circle at $x = 2/\sqrt{2}$; the region is an eighth of the circle