Homework — Part 2: Exam practice (IB past papers)

10 real IB questions: Paper 1 (no calculator) and Paper 2 (calculator), mixed. Total: **58 marks**. Use the formula booklet. Some questions use only one part of the original question.

1. Paper 1 IB May 2026

A particle P is travelling along a straight line, with displacement measured relative to a point O on the line. The velocity, v m s^{-1}, of the particle at time t seconds is given by $v = \frac{1}{t+1} + e^{-t}$, where $t \geq 0$.

(a) **Find** $\int \left(\frac{1}{t+1} + e^{-t} \right) dt$. **[2]**

(b) **Find** an expression for the displacement, s metres, in terms of t. **[3]**

2. Paper 2 IB May 2024

The functions f and g are both defined for $-1 \leq x \leq 0$ by $f(x) = 1 - x^2$ and $g(x) = e^{2x}$. The graphs of f and g intersect at $x = a$ and $x = b$, where $a < b$.

(a) **Find** the value of a and the value of b. **[3]**

(b) **Find** the area of the region enclosed by the graphs of f and g. **[3]**

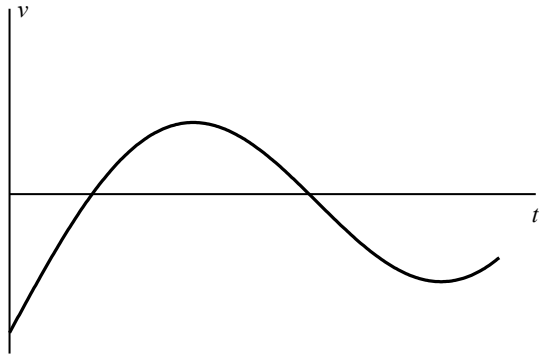
3. Paper 1 IB May 2025

Find the area completely enclosed by the curves $y = e^x$, $y = -e^x$, and the lines $x = -1$ and $x = 1$.

[4]

4. Paper 2 IB May 2024

A particle moves in a straight line such that it passes through a fixed point O at time $t = 0$, where t represents time measured in seconds after passing O. For $0 \leq t \leq 10$ its velocity, v metres per second, is given by $v = 2\sin(0.5t) + 0.3t - 2$. The graph of v is shown in the following diagram.



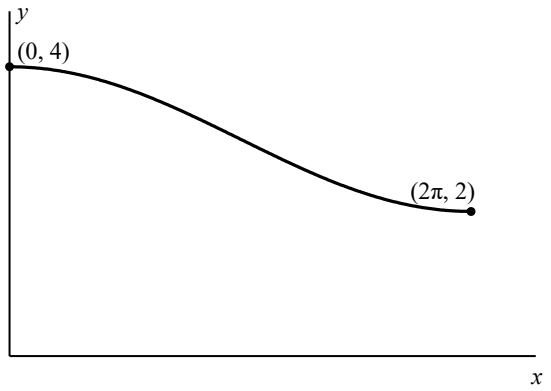
(a) **Find** the smallest value of t when the particle changes direction. **[2]**

(b) **Find** the range of values of t for which the velocity is positive. **[2]**

(c) **Find** the displacement of the particle relative to O when $t = 10$. **[2]**

5. Paper 1 IB May 2026

Consider the function $f(x) = 3 + \cos bx$ for $0 \leq x \leq 2\pi$, where $b \in \mathbb{R}^+$. The graph of $y = f(x)$ is shown in the following diagram. The points $(0, 4)$ and $(2\pi, 2)$ are the maximum and minimum points, respectively, on the graph of $y = f(x)$.

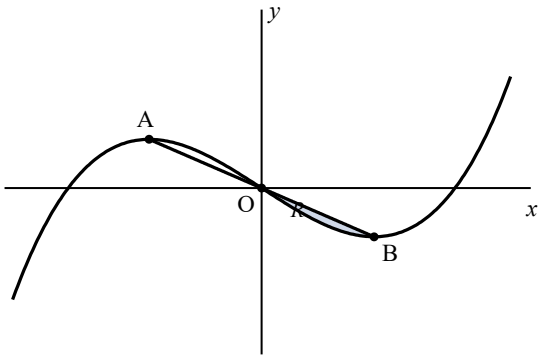


Show that $b = \frac{1}{2}$. **[1]**

(b) **Find** the area enclosed by the graph of $y = f(x)$, the coordinate axes and the line $x = 2\pi$. **[5]**

6. Paper 2 IB May 2026

Consider the function g defined as $g(x) = x^3 - 3x + 2\sin x$, where $x \in \mathbb{R}$. The graph of g has a local maximum at point A and a local minimum at point B. The line (AB) passes through the origin O at $(0, 0)$. The region R is enclosed by the graph of g and the line segment $[OB]$, as shown on the following diagram.

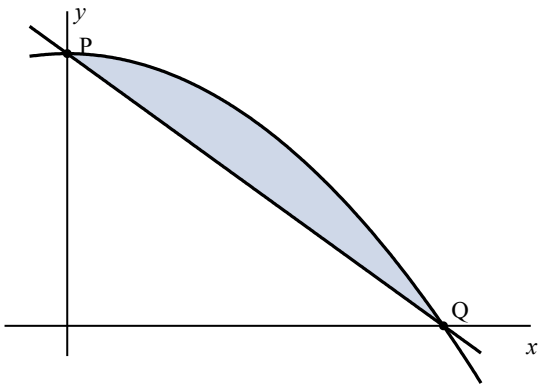


(a) **Find** the coordinates of point A and the coordinates of point B. **[2]**

(b) **Find** the area of R. **[5]**

7. Paper 1 IB November 2025

A line with equation $y = -3x + 9$ intersects the axes at the points $P(0, 9)$ and $Q(3, 0)$. A parabola of the form $y = ax^2 + c$, where $a,\ c \in \mathbb{Z}$, also passes through the points P and Q. This is shown in the following diagram.



(a) (i) **Write down** the value of c. [1]

(ii) **Find** the value of a. [2]

(b) **Find** the area of the shaded region. [4]

8. Paper 2 IB May 2025 (one part, introduction shortened)

The function f is defined by $f(t) = kte^{-3t}$ for $t \geq 0$, where $k \in \mathbb{Z}^+$.

Show that $\int_0^a f(t)\,dt = \frac{k}{9}\left[1 - (3a+1)e^{-3a}\right]$, where $a \in \mathbb{R}^+$. [4]

9. Paper 1 IB May 2023 (one part)

By using an appropriate substitution, **show that** $\int \cos\sqrt{x}\,dx = 2\sqrt{x}\sin\sqrt{x} + 2\cos\sqrt{x} + C$.

[6]

10. Paper 1 IB May 2021

By using the substitution $u = \sin x$, **find** $\int \frac{\sin x \cos x}{\sin^2 x - \sin x - 2}\,dx$.

[7]

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