Exercise 1, 12 points:

This is the multiple choice exercise. The points are explained directly in the solution file.

Exercise 2, 6 points:

- For a completely correct proof 6 points are awarded.
- For an almost correct proof, one starts with 6 points and is deducted 1 point for each of the following: missing conclusion ($\int_0^{\pi/2} \cos(x)^3 dx = 2/3$), sign error (includes $\sqrt{1-\cos(x)^2} = \sin(x)$), missing a factor of "2", adding the wrong constant for the integral, wrong coefficients (e.g. when using trigonometric identities).
- For a computation that is not complete, there is a maximum of 3 points that can be awarded for the following: 1 point for the odd symmetry ($\int_{-\pi/2}^{\pi/2} \sin(x)^3 dx = 0$, must say odd explicitly somewhere and is not awarded if also used for cos to make that integral vanish), 1 point for even symmetry ($\int_{-\pi/2}^{\pi/2} \cos(x)^3 dx = 2\int_0^{\pi/2} \cos(x)^3 dx$), 2 points for attempting to compute the integral using $\cos(x)^3 = \cos(x)(1-\sin(x)^2)$ or $\cos(x)^3 = 1/4 \cdot (3\cos(x) + \cos(3x)$ (1 point only if there is no integration attempt), or correct integration by parts (1 point) and correctly combining the integrals (1 point), and 1 point for a nontrivial correct computation of boundary values (e.g. $[\sin(x)^3]_{-\pi/2}^{\pi/2} = 2$), but only if the context is logical.
- In all cases, there is a deduction of -2 points for inconsistencies, and - 1 point for wrong expressions, e.g. $\int_{-\pi/2}^{\pi/2} u^2 du$.

Exercise 3a, 2 Points :

- 1 point for the computation of $f'(x) = 5^x$ (either by fundamental theorem or explicitly). No points for nonsense (e.g. $f(x) = 5^t$).
- 1 point for f' is continuous (no justification), or something stronger: e.g. computing f'' or saying twice differentiable, computing $f(x) = 1/\ln(5)(5^x - 1/5)$ and arguing with that, via integral form... No points if only $f' \in C^1$ is stated, or f is differentiable and f continuous

Exercise 3b, 2 Points :

- 2 points for "$f' > 0 \implies f$ strictly monotone $\implies f$ injective", or using the explicit form of $f(x)$, injectivity of 5^x and a formal proof, or explaining intuitively (via integral) that f is strictly increasing, thus that f is monoton.

- -1 point if there is a missing conclusion, mistake in the argument, concluding using monotonicity (instead of strictly monotone), or any other wrong mathematical statement.

Exercise 4a, 3 Points :

- 3 points for correct result $1/10(e^4 - e^{-1})$. If the correct result has not been found, then
- 1 point for correct primitive $F(x) = 1/10e^{5x^2-1}$,
- 1 point for correct substitution (e.g. $u = 5x^2$, $u = 5x^2 - 1$, $u = x^2$...),
- 1 point for correct implementation of substitution (correct boundaries, derivatives...)
- -1 point if a constant is added at the end.

Exercise 4b, 3 Points :

- 3 points for correct result $-e^{1/x} + C$. If the correct result has not been found, then
- 1 point for correct substitution (e.g. $u = 1/x$...),
- 1 point for correct implementation of substitution (correct boundaries, derivatives...)
- -1 point if constant was not added, or did not write the solution as a function of x.

Exercise 5, 4 Points:

- 2 points for each result: a) $-1/2$ and b) 0.

Exercise 6, 6 Points:

- 2 points for correctly computing the derivative.
- 1 point for finding the critical point.
- 2 points for showing that it is a minimum.
- 1 point for showing that it is a global minimum.

- -1 point was deducted per mistake. No deduction for "Folgefehler" and thus showing that it is a maximum.

For the last 3 points the following grading scheme is in place:

1. Correctly argue that e is the global minimum by checking the sign of the derivative at each point (3 points).
2. Calculate the second derivative (1 point), conclude that e is a minimum (1 point) and check the boundary points to conclude that it is the global minimum (1 points).
3. Check the boundary points (1 point) and argue by uniqueness of the critical point that e must be the global minimum (2 points).
4. Calculate f on the points close to e on both sides to conclude that e is a minimum (2 points), and then check the boundary points to show globality (1 point).

Exercise 7, 6 Points :

- 1 point for the idea of using Sterling's formula.
- 1 point for the correct forumal, e.g. $n! \approx \sqrt{2\pi n} n^n / e^n$ or the equality with the o notation.
- 1 point for inserting the formula into the binomila coefficient.
- -0.5 point for *not* noticing that $(2n)! \approx \sqrt{2\pi 2n}(2n)^{2n}/e^{2n}$, or the analogue with the o notation.
- Start with 3 points for concluding and deduct points for imprecisions as explained below.

1. -1 point for not giving the right formula for the binomial coefficient.
2. -1 point for "simplifying" the binomial coefficient (e.g. $2/n!$).
3. -1 point for any other error in the development.
4. 1 point if there was a mistake in the previous part, but the development and endresult is consistent.
5. -1 point for not concluding properly and not making sure that the reader can understand what the desired result is.

Exercise 8a, 4 Points :

- 2 points for monotonicity, which are awarded as follows: either argue via properties of ln, or first compute the derivative (1 point) and show that the sign does not change (1 point).
- 2 points are awarded for writing down the correct inverse. Small imprecisions (e.g. confusion between variables x, y, sign mistakes...) are penalized (-1 point).

Exercise 8b, 4 Points :

- 2 points for monotonicity, which are awarded as follows either argue via properties of tan and x^2, or first compute the derivative (1 point) and show that the sign does not change (1 point).
- -1 point if only increasing (instead of strict) is deduced - note that the $x = 0$ with $f'(0) = 0$ does not break the strict monotonicity.
- 2 points for the inverse, which grading scheme as in 8a.

Exercise 9, 6 Points:

- 2 points: for claiming that 4/3 is a continuity point (1 point) and that it the only one (1 point).
- 2 points for proving continuity at 4/3.
- 2 points for proving that there are no other continuity points.
- -1 point for any mistake along the way.

Exercise 10, 6 Points :

Case 1: computed derivatives of $f', \dots, f^{(10)}$ explicitly, where $f(x) = \cos(x)^2 - \sin(x)^2$.

- 1 point for rewriting $f(x) = \cos(x)^2 - \sin(x)^2$ as $\cos(2x)$ or $1 - 2\sin(x)^2$.
- 1 point for computing $f'(x)$.
- 2 points maximum for the two points above if someone misunderstood the question and tried to compute the derivative of $(\cos(x)^2 - \sin(x)^2)^{10}$.
- 1 point for computing $f''(x)$.

- 3 points for the remainder of the exercises, with point deducted as described below.

1. -1 point for wrong sign(s).
2. -1 point for wrong parenthesis.
3. -1 point if only computed until $f^{(9)}$ or to $f^{(11)}$ (instead of $f^{(10)}$).
4. -2 points if the inner derivative was omitted repeatedly.

Case 2: attempt of computing the 10th derivative of either $\cos(x)^2$ or $\sin(x)^2$.

1. 3 points maximum for a correct computation of either $(\cos(x)^2)^{(10)}$ or $(\sin(x)^2)^{(10)}$.
2. points are deducted as in Case 1.