



St Ninian's High School



HEINEMANN HIGHER CHECKLIST

- I understand this part of the course = 
- I am unsure of this part of the course = 



Name _____ Class _____ Teacher _____

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- I do not understand this part of the course =

Topic 1 - Straight Line



1. Know gradient and distance formula
2. Know gradient of parallel lines are equal)
3. The Show points are collinear
4. Know $Tan\theta = m$
5. Area Know that lines with gradients m_1 and m_2 are perpendicular if $m_1 \times m_2 = -1$
6. Know the equation of the line $y - b = m(x - a)$ and $ax + by + c = 0$
7. Determine the equation of the line from 2-points or 1-point and gradient
8. Determine the equation of the Altitudes, Medians and Perpendicular Bisectors
9. Know concurrency properties of Altitudes, Medians and Perpendicular Bisectors
10. Solve problems using properties of Straight Lines

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Topic 2 – Functions & Graphs



1. Understand what the Domain and Range of a function are and how to get them)
2. Sheets Time Recognise a Composite Function as $h(x) = g(f(x))$ and be able to find $h(x)$ when given $g(x)$ and $f(x)$
3. Understand what the inverse of a function is and how to calculate it
4. Be able to graph an inverse function by reflection in the line
5. Know general features of the graphs of exponential and logarithmic functions
6. Solve problems using properties of functions
7. Given graphs of $f(x)$ draw and be able to recognise key features of graphs of $F(x) + a$, $F(x+a)$, $-F(x)$, $F(-x)$, $kF(x)$, $F(kx)$
8. Find the equation of the exponential function from 2-points on a graph
9. Find the equation of the logarithmic function from a graph
10. Mixed questions

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Topic 3 – Trigonometric Functions



1. Know the meaning of the word Amplitude and Period
2. Know the general features of Sine and Cosine graphs $\sin(ax+b)$, $\cos(ax+b)$, $a \sin bx$, $a \cos bx$
3. Know π radians = 180°
4. Know and be able to use the table of exact values
5. Solve problems using exact values
6. Solve equations of type $f(x)=g(x)$ graphically
7. Solve 3-types of equations algebraically in a given interval

 $2\sin 4x + \sqrt{3} = 0$, $\tan^2 x = 3$, $3\sin^2 x - 4\sin x + 1 = 0$
8. Solve compound angle equations algebraically
9. State Max/Min value of a function giving corresponding x-value
10. Solve mixed questions

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Topic 4 – Linear Recurrence Relations



1. Using Define/interpret a recurrence relation of the form

$$U_{n+1} = mU_n + C$$

2. Solve problems involving recurrence relations
3. State the condition for the limit of a recurrence relation to exist.
4. State whether a sequence will converge or diverge from its recurrence relation.
5. Find, where possible, and interpret the limit of a sequence resulting from a recurrence relation
6. Solve recurrence relations to find a and b.
7. Solving recurrence relation problems written in context.

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Topic 5 – Differentiation 1



1. Use the notation $\frac{dy}{dx}$ and $f'(x)$ for a derivative
2. Know that if $f(x) = ax^n$, then $f'(x) = anx^{n-1}$
if $f(x) = g(x) + h(x)$, then $f'(x) = g'(x) + h'(x)$
3. Know the meaning of Rate of Change and be able to solve problems involving applications of Derivatives.
4. Be able to find the derivatives of Products and Quotients.
5. Know that the gradient of a curve is equal to gradient of a tangent at tangent point.
6. Be able to find m of tangent to a curve $y = f(x)$ at $x=a$.
7. Find the equation of a tangent at any point on a curve.
8. Find points on a curve where gradient has particular values.
9. Understand Increasing and decreasing functions.
- If $f'(x) > 0$ then $f(x)$ is increasing
- If $f'(x) < 0$ then $f(x)$ is decreasing.
10. Find the stationary points and determine their nature.

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Topic 5 – Differentiation 1 Continued



11. Sketch curves by finding stationary points, nature, intersection with axes, behaviour of y for large +ve/-ve x -values.
12. Find the max/min value of a function in a closed interval
13. Graph the derived function $f'(x)$
14. Solve optimisation problems using Calculus.
15. Mixed questions.

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Topic 6 – Polynomials



- 1a. Use the remainder theorem to divide a polynomial $f(x)$ by $(x - h)$
- b. Be able to state the answer in the form $f(x) = (ax - b)Q(x) + R$

2. Determine roots of a polynomial equation.

3. Factorise a polynomial using the remainder theorem.
Hence be able to solve
 - 1) any polynomial equation
 - 2) Sketch any polynomial

4. Find polynomials unknown coefficients using the factor theorem.

5. Be able to establish the equation of a polynomial from its graph or when given its roots.

6. Prove that an equation has a root between two given values and be able to improve on that.

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Chapter 8 – Quadratic Theory



1. Know that a quadratic function $y = ax^2 + bx + c = 0$ has a max turning point if $a > 0$, Min turning point if $a < 0$, that it has y intercept $(0, c)$, and can find the zeros of the function by solving $ax^2 + bx + c = 0$.
2. Write the equation $y = ax^2 + bx + c$ in the form $y = a(x + p)^2 + b$ and then be able to state that the axis of symmetry is $x = -p$, the turning point is at $(-p, q)$.
3. Sketch quadratic functions.
4. Solve quadratic equations by graphing, factorising, completing the square, using quadratic formula.
5. Solve quadratic inequations using a sketch of the function.
6. Know that the discriminant of $ax^2 + bx + c$ is $b^2 - 4ac$ and be able to use the discriminant to determine the nature of the roots of a quadratic.
7. Use the discriminant to find the condition that roots of a quadratic are real and equal or unequal.
8. Be able to determine whether a line cuts, touches or does not meet a curve by substituting the equation of the line into the equation of the curve.
9. Know the condition for tangency.
10. Mixed questions.

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Chapter 9 – Basic Integration



1. Know that $\int ax^n = a \int x^n dx = \frac{ax^{n+1}}{n+1} + C$, $C \neq -1$
where C is the constant of integration.
2. $\int (f(x) + g(x))dx = \int f(x)dx + \int g(x)dx$
3. Write all the integrals in the form ax^n , where a is a constant, before integrating.
4. Be able to write a shaded area as a definite integral.
Sketch a shaded area from a definite integral.
5. Evaluate definite Integrals
6. Determine the area between a curve $y = f(x)$,
x-axis and the lines $x=a$ and $x=b$.
7. Determine the area bounded by two curves
8. Solve differential equations of the form $\frac{dy}{dx} = f(x)$
9. Mixed Integration examples.

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Chapter 11 – Trig Formulae



1. Be able to solve trig equations using the addition formulae
2. Be able to prove complex trig identities using addition formulae
3. Solve more complex problems using the addition formulae
4. Be able to apply the Double Angle Formulae to simplify trig equations.
5. a. Solve trigonometric equations with Double Angles
b. Solve trigonometric equations involving $\sin^2 x$, $\cos^2 x$ or both using Double Angle formulae.
6. Mixed Questions

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Chapter 12 – The Circle



1. Know the Distance Formula and how to use it
2. Know the equation of a circle centre (0, 0) and radius r is $x^2 + y^2 = r^2$
3. Know the equation of a circle centre (a, b) and radius r is $(x - a)^2 + (y - b)^2 = r^2$
4. Know that $x^2 + y^2 + 2gx + 2fy + c = 0$ represents a circle centre (-g, -f) and radius $\sqrt{g^2 + f^2 - c}$ provided $g^2 + f^2 - c > 0$
5. Be able to find the points of intersection of a line and circle.
6. Prove a line is a tangent to a circle.
7. Determine whether a line and circle have 2, 1, or no points of intersection.
8. Be able to find the equation of a tangent to a circle
9. Mixed Questions
Practice paper etc - unit 2

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Chapter 13 – Vectors



1. Know what the following terms are and be able to find them in 2-D and 3-D: vector, magnitude, direction, scalar, position vector, unit vector, zero vector, directed line segment, component, scalar product.
2. Know addition, subtraction and multiplication properties of vectors.
3. Determine the distance between two points in 3-D
4. Know that for parallel vectors $v = ku$.
5. Determine whether 3 points are collinear in 3-D.
6. Be able to divide a line in a given ratio using the section formula.
7. Know and apply the basis vectors i, j, k .
8. Know the scalar product facts and how to use them to find the angle between vectors.

$$a \cdot b = |a||b| \cos \theta$$

$$a \cdot b = a_1b_1 + a_2b_2 + a_3b_3$$
9. Know the properties of the scalar product
 - 2 vectors are perpendicular if $a \cdot b = 0$
 - For vector a and b , $a \cdot b = b \cdot a$
 - For vector a, b and c $a \cdot (b + c) = a \cdot b + a \cdot c$
10. Mixed questions

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Chapter 14 – Further Trig



1. Know and apply the facts that:-
 If $f(x) = \sin x$ $f'(x) = \cos x$
 If $f(x) = \cos x$ $f'(x) = -\sin x$

2. Know and apply the fact that:-
 $\int \cos x \, dx = \sin x + C$
 $\int \sin x \, dx = -\cos x + C$

3. Be able to differentiate functions of the form
 $(x + a)^n$ and $(ax + b)^n$

4. Be able to differentiate trig functions eg
 $\sin 3x, \cos^3 x, \cos(2x + \frac{\pi}{3}), \sin^2 x$ using the chain rule

5. Solve problems involving applications of differentiation

6. Be able to integrate functions of the form $(ax + b)^n$

7. Know and apply the rule that
 $\int \sin(ax + b) \, dx = \frac{-1}{a} \cos(ax + b) + C$
 $\int \cos(ax + b) \, dx = \frac{1}{a} \sin(ax + b) + C$

8. Mixed Questions

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Chapter 15 – Logs and Exponentials Functions



1. Know that a function of the form $y = a^x$ is an exponential function to the base a , $a \neq 0$.

2. Know that when we graph an exp function $y = a^x$
 - If $a > 1$ the graph is always positive,
never crosses the x-axis,
is increasing, passes through $(0, 1)$

 - If $0 < a < 1$, the graph is always positive,
never crosses the x-axis,
is decreasing, passes through $(0, 1)$.

3. Solve basic problems involving exp growth/decay.

4. Know that a function of the form $y = e^x$ is called the exponential function to the base e
Be familiar with the exp button on the calculator

5. Know that
 - If $y = a^x$ then $x = \log_a y$
 - $y = \log_a x$ then $x = a^y$

6. Know and be able to use the laws of logarithms.

7. Simplify numerical expressions using the laws of logs.

8. Know that logarithms to the base e are called natural Logarithms, written $\log_e x = \ln x$
 - b. Solve logarithmic and exponential equations eg.
 $\ln x = 9$ $e^{2x} = 16$ $7^x = 25$

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Chapter 15 – Logs and Exponentials continued



9. Know that we can express $y = kx^n$ in the form of the equation of the straight line
 - If $y = kx^n$ then $\log y = n \log x + \log k$
 and draw a graph of $\log y$ against $\log x$.
- b. Be able to deduce the values of k and n such that $y = kx^n$, using two points on the line.
- 10a. Know that if $y = ab^x$, then $\log y = \log a + x \log b$
- b. Be able to deduce the value of a and b such that $y = ab^x$, using two points on the line.
11. Know from the graphs of $y = e^x$ and $y = \ln x$ and techniques learned in chapter 3, graphs and functions, how to sketch related graphs.
12. Mixed questions.

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Chapter 16 – Logs and Exponentials continued

1. Be able to express $a \cos \theta + b \sin \theta$ in the form

$$k \cos(x \pm \alpha) \text{ or } k \sin(x \pm \alpha)$$

where k is the amplitude and α the phase angle

2. Be able to apply the wave function formula to multiple angles
3. Be able to find the max/min of a function of the form $a \cos x + b \sin x$ by expressing it as a single trig function
4. Be able to solve equations involving $a \cos x + b \sin x$ by using the wave function formula.

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Revision using Past Papers

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