Department for Environment Food & Rural Affairs

C29314 - A Review of Plant Genetic Breeding Approaches for Field Grown Crops and Controlled Environment Agriculture (CEA) and their Role in the Delivery of Public Goods

Order Form – Contract for Research and Development Services

1. Purchase Order Number	To be confirmed
2. Customer	The Secretary of State for Environment, Food and Rural Affairs, of Seacole Building, 2 Marsham Street, London. SW1P 4DF. (acting as part of the Crown)"
3. Contractor(s)	NIAB registered at 93 Lawrence Weaver Road, Cambridge, United Kingdom, CB3 0LE; with company registration number 03395389
4. Co-Funder(s)	**N/A**
5. Defra Group Members	The following Defra Group members will receive the benefit of the Deliverables: Defra Food and Farming Strategy Innovation
6. The Agreement	This Order is part of the Agreement and is subject to the terms and conditions appended at Appendix 1 and shall come into effect on the Start Date. Unless the context otherwise requires, capitalised expressions used in this Order have the same meanings as in the terms and conditions. The following documents are incorporated into the Agreement. If there is any conflict, the following order of precedence applies (in descending order): a) this Order; b) the terms and conditions at Appendix 1; and c) the remaining Appendices (if any) in equal order of precedence.

7. Deliverables	**Goods: N/A**
	Services: As set out below in Appendix 2 – Authority's Specification and Contractor's submission. To be performed at NIAB registered at 93 Lawrence Weaver Road, Cambridge, United Kingdom, CB3 0LE (the Contractor's premises and/or a third party's premises and in each case the address) *Date(s) of Delivery: July 2025 to March 2026*
8. Milestone Delays (Clause 18.2.10)	**N/A**
9. Start Date	1st July 2025
10. Expiry Date	*2nd March 2026*
11. Extension Period (Clause 5.2)	Due to unknown situation and/or other factors beyond the control of both parties; an option for an extension may be executed if it is necessary. Any extension must be agreed with the Authority and will be processed via a Contract Change Note (CCN) issued by DGC.
12. Charges	The Charges for the Deliverables shall be as set out in Appendix 3 – Charges. Unless and to the extent otherwise expressly stated in Appendix 3, the Charges are fixed for the duration of the Agreement.
13. Payment including Payment by Co-funder(s)	[redacted]

14. Customer's Authorised Representative(s)	For general liaison your contact will continue to be [redacted]
15. Contractor's Authorised Representative	[redacted]
16. Co-funder's Authorised Representative	N/A
17. Optional Intellectual Property Rights ("IPR") Clauses	The Customer has chosen Option **B Default** in respect of intellectual property rights provisions for the Agreement as set out in the terms and conditions. **Default Option B: Customer (Defra) ownership of all New IPR with limited Contractor rights to all New IPR in order to deliver the Agreement.** ***NB: Commercial Exploitation - Where there is likelihood that the contract may involve commercial exploitation, a legal review will be required before proceeding.***
18. Contractor's general liability cap	[redacted]
19. Progress Meetings and Progress Reports	[redacted]

	[redacted]
20. Address for notices	[redacted]

21. Key Personnel of the Contractor	[redacted]
22. Procedures and Policies	For the purposes of the Agreement: The new Defra group open access policy for research publications can be viewed on gov.uk at Research at Defra: Research at Defra: open access policy for publications.
23. Commercial Exploitation (Clause 11)	Clause 11 (Commercial Exploitation) shall apply to this Agreement: **Yes:** ☐ **No:** ☐X
24. Special Terms	N/A
25. Additional Insurance	N/A
26. Further Data Protection Provisions	The further data protection provisions as contained at Annex 1 of the Terms and Conditions are applicable to this Agreement where indicated below: **Yes:** ☐ **No:** ☐ X

[redacted]

Appendix 1: R&D Terms and Conditions

The terms and conditions applicable to this requirement and which are called 'Research & Development Terms and Conditions (Core Defra) can be found on the website below

Defra terms and conditions for goods and services - GOV.UK (www.gov.uk)

Appendix 2
Tender Specification
Annex 1

This section sets out the Authority's Requirements

1. Introduction

1.1. Defra ("The Authority") has responsibility for delivering the Government's key strategic environmental aims, including the 25 Year Environment Plan, Environmental Improvement Plan 2023 and for its contribution to achieving Net Zero. Green choices, as described in these strategies, underpin the delivery of these aims and we have committed to "Enable all parts of society to play their part in line with our six principles for green choices" (Environmental Improvement Plan 2023).

1.2. Defra is responsible for policy regarding quality of life and natural resources – such as air, water, soil, plants and food. These issues will affect people locally, nationally and internationally. We aim to promote efficient business, protect communities from flooding and help rural communities to thrive. In all of our work we seek to strike the right balance between economic, social and environmental goals, for a sustainable future.

2. Overview

2.1. The contract opportunity is for a suitably experienced supplier to undertake a comprehensive review of existing data, activities, and initiatives related to breeding research programs, supported by conversations where needed with key national stakeholders, including research centres, universities, and seed companies. The focus of this review will be on major field grown and Controlled Environment Agriculture (including Controlled Environment Horticulture) crops outside the scope of the current Defra funded Genetic Improvement Network (GIN) Platform to provide evidence and knowledge regarding opportunities and current barriers associated with the development and implementation of crop breeding techniques to deliver public goods.

2.2. This will be a research and development (R&D) contract and is, as a result, exempt from Public Contract Regulations (PCR) 2015.

3. Requirement

3.1. Increasing yields per hectare and improving crop quality by reducing the impact of pathogens, pests and climate change are some of the main challenges currently facing agriculture to ensure food security. Additionally, there is a growing need to cultivate food with higher nutritional value to address diet deficiencies in the UK population. Open field farming (outdoor) and Controlled Environment Agriculture (CEA-indoor) approaches, of which Controlled Environment Horticulture (CEH) is a part and the most common sector, are two key production systems aimed at achieving these goals while simultaneously preserving the earth's natural resources to secure a sustainable food supply for future generations. Therefore, it is essential to develop approaches that promote sustainable land use through environmentally friendly practices.

3.2. CEA/CEH has revolutionised the indoor production of edible and non-edible crops in small spaces, however, several disadvantages associated with CEA/CEH have also been identified. These include the high initial economic input, and the ongoing

expenses required to maintain the desired environmental conditions (Defra, 2023). The reliance on non-renewable energy sources and the resulting release of greenhouse gases (GHGs) often diminish the sustainability of CEA/CEH. Therefore, exploring renewable energy sources and simultaneously developing crop varieties better suited to production under CEA/CEH is important. Such crops should be capable of using resources more efficiently, improving the effectiveness of factors such as light and temperature, as well as inputs like water and nutrients, and the optimisation of crop cycles.

3.3. The use of sustainable agricultural methods, such as plant breeding, is considered an environmentally friendly approach to improve production and food quality. Traditional or modern plant breeding techniques have brought benefits such as improved production yield through the development of pest and pathogen-resistant varieties, resistance to abiotic stress, and healthier or more nutritious foods (Ahmar et al., 2020).

3.4. Plant breeding also has a critical role to play in the delivery of public goods. In agriculture, public goods are derived from appropriate farming practices (OECD, 2015). Soil, water and air quality, biodiversity and reduced exposure to chemicals (e.g. fungicides, insecticides) are examples of environmental and social benefits derived from developing new crop varieties with improved traits. Specific public goods, such as reducing exposure to chemical inputs by decreasing pesticide use, minimising the environmental impact on soil, air, and water through the use of fewer agricultural inputs, reducing greenhouse gas emissions, and increasing crop production among others, are currently being investigated under the current Defra funded Genetic Improvement Network (GIN) Platform for wheat, oilseed rape, vegetables, pulse crops and soft fruit (Defra, 2022, 2024).

3.5. While traditional and modern breeding using molecular techniques has improved the agronomic traits of some crops, it has predominantly focused on certain elite crops (e.g., wheat and maize) and field-grown varieties. To date, less research and fewer breeding programs have been dedicated to crops intended for production within CEA, which for the purposes of this work includes the CEH sector. Traits temporarily enhanced by specific environmental factors in particular light-induced crop traits (e.g. photosynthetic efficiency and nutrient content), could be potentially addressed by permanent genetic modifications (Alrajhi et al., 2023; Avnee et al., 2023; Smith et al., 2023) that may as a result reduce energy requirements to produce the environmental conditions each time the crop is grown under controlled conditions.

3.6. Traditional breeding, which relies on natural techniques such as cross-hybridization (Acquaah, 2015), remains a widely employed approach in research centres and breeding companies. However, this method has limitations, including the lengthy process of phenotypic selection (Lamichhane and Thapa, 2022; Swarup et al., 2021) and the introduction of parental genetic material that, while enhancing certain traits, can make others vulnerable (Anand et al., 2023).

3.7. Genome editing, the latest technology in precision breeding (PB), has emerged as a tool that demands less effort and time than traditional breeding methods. This novel breeding technique introduces alterations at specific locations in the genome (Li et al., 2020; Liu et al., 2021; Nerkar et al., 2022; Veillet et al., 2020))in line with the ongoing goals of plant breeders (Nerkar et al., 2022).

3.8. In terms of regulation, in March 2023, the UK government introduced the Genetic Technology (Precision Breeding) Act 2023. This is a new regulatory framework in

England for precision bred plants and animals, which defines precision breeding as the use of modern biotechnology to produce genetic changes that could have arisen through traditional breeding. This Act establishes a more proportionate and science-based approach to regulation which is different from the existing regulation of Genetically Modified Organisms (GMOs). The implementation of this Act (within England only) for plants through the regulations should encourage crop improvement using precision breeding techniques such as genome editing.

3.9. Both field crops and CEA/CEH system have key roles to play in enhancing food security. In addition to the need for continual development of more sustainable practices, genetic improvement (utilising both traditional and modern breeding technologies, such as precision breeding) could be a valuable tool for enhancing public goods derived from improved crops, covering a broader range of field crops and CEA/CEH beyond the scope of the current Defra GIN Platform.

4. Aims and Objectives

4.1. The findings will update our understanding of how crop breeding techniques can contribute to delivery of public goods. For the purposes of this work, public goods include (but are not limited to) increased crop productivity, resilience to abiotic and biotic threats, biodiversity, enhanced resource use efficiency, environmental protection, soil, air and water quality, food security, improved sustainability, and the production of crops with lower inputs and GHG emissions. The selected field grown crops for consideration in this review may include, but are not limited to, barley, oats, sugar beet, orchard fruits, and potatoes. Within CEA/CEH, crops may include (for example) tomatoes, peppers, cucumbers, and other salad crops. This study should encompass both traditional and precision breeding approach. The project will address the following points:

a. Review both the production level and what agronomic traits have been temporarily improved in selected CEA/CEH crops in the UK.
b. Update and expand our knowledge framework on existing breeding initiatives – and their role in delivery of public goods - for those crops, both field grown and CEA/CEH outside the current GIN Platform.
c. Assess current barriers to limited or non-existing crop breeding initiatives in relation to the crops selected in both environments.
d. Explore the opportunities and challenges for the provision of public goods resulting from the development and implementation of genetic improvement in selected crops.
e. Understand how these public goods are measured, and the tools used for their assessment and application.
f. Identify support schemes to address the barriers and challenges associated with development (pre-breeding and breeding research) and implementation (production and commercialisation) of genetic improvements in selected crops in this study.

5. Project Work Packages

5.1. The findings will form the basis of future government research and policymaking in this area. To meet the objectives outlined in this proposal, the project will be organised into several work packages (WPs), each with specific objectives;

Work Package 1 (WP1): Criteria for selecting field-grown and CEA/CEH-grown crops

a) Identify field crops and crops growing under controlled environmental conditions that fall outside the scope of the current Defra GIN Platform.
b) Conduct a detailed literature review of crops in both environments to identify criteria for selecting the most relevant crops for the delivery of public goods, focusing on economic, environmental and social importance.
c) Collect data on current production levels, geographical distribution and market importance.
d) Draw up a list of crops with the potential to provide enhanced public goods through breeding initiatives.

Work Package 2 (WP2): Evaluation of current work on CEA/CEH-grown crops

a) Identify environmental conditions under which the selected crops are grown, and the improvements achieved through adjusted environmental conditions.
b) Describe the environmental modifications used to achieve the desired traits.
c) Recognise agronomic traits that have been temporarily altered by specifically (adjusted) controlled environmental conditions and that have also been modified using traditional or modern breeding techniques.
d) Assess agronomic traits that could be improved through breeding approaches, including precision breeding, and assess their potential for adoption within CEA/CEH and their role in public good delivery.

Work package 3 (WP3): Assessment of current breeding efforts and stakeholder map in selected crops

a) Assess the current level of breeding efforts, the type of stakeholders (private and public sector) involved and the proportion of their contribution to the genetic improvement of selected crops both in field production and CEA/CEH.
b) Identify which breeding initiatives have been carried out, highlighting both traditional and modern technologies such as precision breeding, on particular agronomic traits; which public goods have been addressed; and where there is potential for further delivery of public goods.
c) Compare the evolution of breeding of the selected crops within this study in the UK with that internationally.
d) Identify developments in the registration, marketing and production system of selected improved crops worldwide, including in the UK.
e) Summarise the status of breeding activities for selected crops.

Work Package 4 (WP4): Evaluation of current barriers to breeding initiatives for these selected crops

a) Explore why certain selected crops have not undergone significant genetic improvement.
b) Identify economic, social, technical (including research infrastructure) and regulatory barriers to genetic improvement of the selected crops and their commercialisation.
c) Analyse market failures, lack of incentives or policy constraints that have impeded the breeding efforts of the selected crops.
d) Summarise and describe the obstacles to limited or non-genetic improvement of the selected crops.
e) Propose strategies and solutions to overcome the obstacles identified.

Work Package 5 (WP5): Evaluation of opportunities and challenges for the development and implementation of genetic improvement in selected crops

a) Identify technical challenges and opportunities for the development of genetic improvement for both field production and CEA/CEH and commercialisation of improved varieties.
b) Assess relevant gaps in basic information (pre-breeding) or applicable science, including research infrastructure, that will support progress in crop improvement including gene editing technologies in England.
c) Determine the genetic traits that can be improved for the selected crops and evaluate the challenges specific to each environment (field grown and CEA/CEH).
d) Compare field crops with those of CEA/CEH to identify specific breeding challenges in both environments.
e) Engage with relevant stakeholders to understand the gaps in current breeding activities in the selected crops in both environments.
f) Summarise the opportunities and challenges for the development and implementation of genetic improvement in selected crops in the field and CEA/CEH.

Work Package 6 (WP6): Current and potential public goods derived from implementation of genetic improvement in selected crops

a) Identify and categorise the public goods derived from the improved selected crops (both field and CEA/CEH crops).
b) Analyse the potential public goods derived if the selected field-grown and CEA/CEH-grown crops are improved genetically.
c) Consider public goods such as food security, enhanced resilience to biotic and abiotic threats, soil, air and water quality, public health, biodiversity, sustainability and the production of crops with lower inputs and GHG impacts among others.
d) Integrate literature review and stakeholder discussions to offer a thorough understanding of plant breeding techniques and their related public goods.
e) Determine the potential public goods derived (or increased) from replacing specific controlled conditions to induce temporary physiological changes for more stable fixation using plant breeding including precision breeding within CEA/CEH.

Work Package 7 (WP7): Measurement and tools used to evaluate public goods at the global level

a) Identify the current measurement techniques and tools used for evaluating public goods derived from plant breeding on the major crops selected in this study.
b) Analyse the strengths, weaknesses and limitations of these existing tools and methodologies.
c) Suggest improvements to existing tools or create new tools tailored to the specific crops and objectives of this project.
d) Determine how the proposed tools could be tested and validated through pilot assessment to ensure their effectiveness and reliability.
e) Include recommendations for improving the assessment system in both environments (field and CEA/CEH).

Work Package 8 (WP8): Future direction(s)

a) Highlight within the crops selected in this study those that could be immediate targets for future studies.

b) Define areas and actions that could be taken to support the development and implementation of genetic improvement of the crops identified in this study.
c) Investigate international collaborations or networks that can facilitate crop improvement for the crops identified in this study.

6. Intellectual Property Rights

6.1. The Authority will require ownership of the Intellectual Property Rights (IPR) for all outputs developed under this Contract and other work produced by it (foreground IPR). All outputs and associated materials from this Contract shall not be for public dissemination without the express consent of the Authority.

6.2. The Authority does not expect to own any background IPR already owned or produced by the successful tenderer, however, may wish to discuss licensing if this is required. The Authority gives the successful tenderer a licence to use any Authority owned background IPR and the new IP which the successful tenderer reasonably requires for the purpose of fulfilling its obligations during the term of the Contract.

6.3. Option B of Clause 10 Intellectual Property Rights of the Research and Development Terms & Conditions shall apply.

7. Data Protection

7.1. The successful Tenderer will be compliant with data protection requirements (DPA 2018), and these will be set out in the Contract.

8. Reporting Requirements

8.1. To facilitate accessibility, the results of this review will be shared through open access databases, ensuring their free and unrestricted availability.

8.2. After the completion of each work package, and before the start of the next phase, a concise but rigorously structured report/update must be prepared and submitted to the Authority Project Officer. These deliverables will document the methodologies employed, the progress made in relation to the overall project, the difficulties encountered and the results. This reporting process ensures continuous monitoring, facilitates future decision-making and supports adaptive management of the project schedule and resources.

- All presentations and reports should be provided in draft format to Defra for comment initially. The Contractor should assume outputs will go through at least two rounds of comments prior to being peer reviewed and finalised. Defra will manage the peer review process, and the Contractor will be responsible for making the relevant edits.
- All reports will meet government requirements for accessible reports[1].
- All reports must be produced in accordance with the Authority's templates for reporting/publications. The report(s) should be of a publishable standard, revised in accordance with Defra and peer reviewer feedback.

8.3. At the conclusion of the project, a final report and a presentation (either in person at the Defra London offices or via MS Teams) will be required. These documents should

[1] https://www.gov.uk/guidance/publishing-accessible-documents

provide a comprehensive summary of the work carried out, the main findings, the problems encountered and the overall results. The report should be detailed and well-structured, while the presentation should effectively communicate the results of the project to different stakeholders.

- Defra will arrange for the final report to be independently peer reviewed (if deemed appropriate). Following peer review, the Contractor will be asked to make revisions prior to publication via the Defra Science Search website.
- All outputs should be fully Quality Assured.

9. Expertise and Skills Required

9.1. Expertise in crop production including controlled environment agriculture (incorporating glasshouses and vertical farming).

9.2. Expertise in crop breeding technologies, encompassing both traditional and modern technologies such as precision breeding.

9.3. Experience in agriculture, including knowledge of biotic and abiotic challenges and sustainable agricultural practices.

9.4. Experience in the crops covered by this study.

9.5. Experience in economic analysis.

9.6. Strong project management skills to ensure that deliverables are produced to time and quality.

9.7. The ability to synthesise existing literature and clearly summarise and describe key findings systematically.

9.8. The ability to critically analyse evidence and identify and explain the underlying limitations/drawbacks.

9.9. Strong drafting and report writing skills, including the ability to communicate complex technical information to a mixed audience.

10. Timetable

10.1. The work will commence in May 2025 and end in January 2026. The work packages will be delivered as milestones and payment will be made according to the signed off deliverables.

Task No.	Task and Deliverable	Completion Date	Payment Schedule
1	Work Package 1: Criteria for selecting field-grown and CEA/CEH-grown crops	TBC upon award	~8%
2	Work Package 2: Evaluation of current work on CEA/CEH-grown crops	TBC upon award	~8%
3	Work Package 3: Assessment of current breeding efforts and stakeholder map in selected crops	TBC upon award	~10%

4	Work Package 4: Evaluation of current barriers to breeding initiatives for these selected crops	TBC upon award	~8%
5	Work Package 5: Evaluation of opportunities and challenges for the development and implementation of genetic improvement in selected crops	TBC upon award	~8%
6	Work Package 6: Current and potential public goods derived from implementation of genetic improvement in selected crops	TBC upon award	~10%
7	Work Package 7: Measurement and tools used to evaluate public goods at the global level	TBC upon award	~10%
8	Work Package 8: Future direction(s)	TBC upon award	~8%
9	Final written report delivered to Defra	TBC upon award	~30%
10	Presentation to Defra (either in person in Defra's London offices or via MS Teams) setting out the key findings from the review	TBC upon award	~0%

11. Sustainability and Social Value

11.1. The Civil Society Strategy, launched in 2018, set out how government will use its buying power to drive social value. Following a review of its outsourcing processes in 2018, government committed to extend the requirements of the Public Services (Social Value) Act (2012) in central government to ensure that all above threshold procurements explicitly evaluate social value, where appropriate, rather than just consider it.

11.2. Social value has a lasting impact on individuals, communities, and the environment. Government has a huge opportunity and responsibility to maximise economic, social, and environmental wellbeing effectively and comprehensively through its commercial activity.

- **Theme 5 - Wellbeing**

  We use the Social Value Model, which sets out five priority themes linked to key policy outcomes, to drive economic, social and environmental benefits beyond core contractual deliverables. For this contract, **Theme 5 – Wellbeing, with a specific focus on Policy Outcome: Support health and wellbeing in the workforce** has been identified as the most relevant theme. Tenderers should consider and attempt to demonstrate action to support health and wellbeing, including physical and mental health, in the contract workforce.

  It is important to note that we are looking to see what **additional** activities (which do not increase contract costs) that your organisation will implement which are specific to this contract and generate value beyond the main project outputs. We are **not** looking for a description of activities that are already being delivered at a broader organisational level. You may deploy existing policy/programs, but you must demonstrate the specific commitment you will make to the contract (how it will be deployed). **Please do not include links to generic documents or websites**.

The Model Award Criteria and sub-criteria set out in the Evaluation Criteria will be used to evaluate the response; however, we are not expecting tenderers to deliver all the sub-criteria, and will be focusing on the quality, not quantity, of your response and your ability to:

- Demonstrate your understanding of the Model Award Criteria.
- Clearly show how your SMART commitments effectively meet the policy outcome.
- Provide the Authority with confidence of delivery.

The following are illustrative examples:

- Implementing the 6 standards in the Mental Health at Work commitment and, where appropriate, the mental health enhanced standards for companies with more than 500 employees in Thriving at Work with respect to the contract workforce, not just 'following the recommendations.
- Public reporting by the tenderer and its supply chain on the health and wellbeing of staff comprising the contract workforce, following the recommendations in the Voluntary Reporting Framework.
- Engagement plans to engage the contract workforce in deciding the most important issues to address.

Further information can be found via the following link: Social Value Model.

12. Performance Management and Key Performance Indicators

12.1. As part of the Authority's continuous drive to improve the performance of all Contractors, this PMF will be used to monitor, measure and control all aspects of the contractor's performance of Contract responsibilities. The PMF's purpose is to set out the obligations on the Contractor, to outline how the Contractor's performance will be evaluated and to detail the sanctions for performance failure.

12.2. The Authority may define any reasonable performance management indicators for the Contractor under the following categories:

- Communication and Collaboration
- Delivery
- Contract Management

12.3. The above categories are consistent with all Contract awards allowing the Authority to monitor the Contractor's performance at both individual level and at the enterprise level with the individual Contractor.

12.4. The Contractor will be responsible for the performance of members of its supply chain. Back-to-back performance arrangements between the Contractor and its supply chain partners should be considered. The Contractor will be liable for any non-performance from a supply chain member where this PMF would apply to a deliverable or requirement of that party.

12.5. The quality of the service provided will be regularly monitored by the Authority against the elements outlined below.

12.6. The Contractor shall participate in bi-monthly review meetings with the Authority to review the quality and performance of the services provided. The Contractor will be

responsible for agreeing dates and drafting the agenda for and producing a note of the review meetings The Contractor shall be appropriately represented at the review meetings which will usually be conducted via teleconference or held face to face where this can coincide with other meetings.

12.7. The Contractor will appoint a nominated person of appropriate grade to be the Contractor's Authorised Representative to manage the provision of the service and to liaise with the Authority as required. At any meeting it will be assumed the Contractor's Authorised Representative will be authorised to make critical decisions. It would be preferred that this is the Contractor's Project Manager.

Key Performance Indicators

12.8. Key Performance Indicators (KPIs) are essential in order to align contractor performance with the requirements of the Authority and to do so in a fair and practical way. KPIs have to be realistic and achievable; they also have to be met otherwise indicating that the service is failing to deliver. Without the use of service credits in such a situation, this service failure places strain on the relationship as delivery fall short of agreed levels. As a result, the only recourse would be to terminate and seek alternative supply.

12.9. The Authority reserves the right to amend the existing KPI's detailed in Annex A or add any new KPI's. Any changes to the KPI's shall be confirmed by way of a Contract Change Note.

12.10. The proposed KPIs are set out below (see Annex A).

References:

Acquaah, G. (2015). Conventional plant breeding principles and techniques. *In:* Al-Khayri, J. M., Jain, S. M. & Johnson, D. V. (eds.) *Advances in Plant Breeding Strategies: Breeding, Biotechnology and Molecular Tools.* Cham: Springer International Publishing.

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Nerkar, G., Devarumath, S., Purankar, M., Kumar, A., Valarmathi, R., Devarumath, R. & Appunu, C. (2022). Advances in crop breeding through precision genome editing. *Frontiers in Genetics,* **13:880195.**

OECD (2015). *Public Goods and Externalities*. Agri-environmental Policy Measures in Selected OECD Countries, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264239821-en

Smith, E. N., van Aalst, M., Tosens, T., Niinemets, Ü., Stich, B., Morosinotto, T., Alboresi, A., Erb, T. J., Gómez-Coronado, P. A., Tolleter, D., Finazzi, G., Curien, G., Heinemann, M., Ebenhöh, O., Hibberd, J. M., Schlüter, U., Sun, T. & Weber, A. P. M. (2023). Improving photosynthetic efficiency toward food security: Strategies, advances, and perspectives. *Molecular Plant,* **16, 1547**.

Swarup, S., Cargill, E., Crosby, K., Flagel, L., Kniskern, J. & Glenn, K. (2021). Genetic diversity is indispensable for plant breeding to improve crops. *Crop Science,* **61, 839**.

Veillet, F., Durand, M., Kroj, T., Cesari, S. & Gallois, J. L. (2020). Precision breeding made real with CRISPR: Illustra

Annex A – Key Performance Indicators (KPI's)

Metric	KPI	What is required to make this measurable	KPI Measurement	KPI Rating		
Communication and Collaboration	KPI 1 – Capacity of response and engagement	Response to e-mails and calls within 24 hours. -Reaction time to raise technical or non-technical issues (performance, quality, deadline). -Participation and engagement in meetings scheduled, agreed or organised urgently by the Authority. -Engagement in editing the amendments/changes made by the Authority or another peer reviewer as agreed by both parties.	-Track average response time to emails and calls. -Follow up on cases where the supplier proactively contacts the Authority to flag potential issues before they escalate. -Monitor attendance and active participation in scheduled and urgent meetings. -Monitor the number of cases where the supplier does not engage in improving the reports through modifications or changes.	The communication effort by the contractor exceeds 24 hours; contact is only made after the issues has been escalated; and there are obstacles or lack of commitment and involvement to attend scheduled or urgent meetings and to improve the report through modifications or changes.	The communication effort by the contractor is 6 hours later than requested (24 hours); the contact is made when the issue has not yet been escalated; finally, the lack of commitment could be due to external and uncontrollable factors on the part of the contractor.	Meets expectations. Verbal and written communication is sent on time; active participation in meetings and potential issues are flagged immediately to avoid affecting project's performance.

Delivery	KPI 2 – Deliverable Deadlines	Deliverables (Work Packages) will be presented by the Contractor to the Authority at the agreed date and quality as outlined in the Specification	Quality deliverables are presented to the Authority on the day/and or time (if appropriate) that has been agreed by both parties. The Authority's Project Officer deems the deliverables to of sufficient quality.	Deliverables sent to the Authority more than five (5) working days after the agreed deadline.	Deliverables sent to the Authority more than one (1) working day after the agreed deadline or less than one working day but later than the agreed time if a restricted timescale.	Meets expectations All deliverables sent to the Authority on time.
	KPI 3 – Quality of Deliverable: Error Free	Deliverables are accurate and error free, conducting a wide-ranging and exhaustive review supported with conversation with stakeholders.	Deliverables reviewed by the Authority for accuracy. The type and numbers of literature relevant to the topic and conversations with appropriate stakeholders.	A significant error or limited literature relevant to the topic reviewed is identified that results in published documents being amended by Defra. Or an error is identified that results in the Government incurring financial damages or significant reputational harm.	An error is identified that does not result in published documents or National Statistics being amended. Further literature can be added to improve the quality and accuracy of the results.	Meets expectations. No errors within deliverables and an extensive and exhaustive literature review carried out with sufficient stakeholder engagement.

Regulatory Compliance and Documentation	KPI 4 – Compliance with Intellectual Property (IP), data protection and Industry standard	All deliverables are prepared following structured and consistent processes based on the industry standard, respecting the IP and data protection.	-The Authority will review the deliverables to ensure that they conform to the established process and industry standards (e.g. creation, review and approval by the responsible team within the contract). -Monitor the percentage of deliverables that correctly reference and comply with IP ownership clauses in the contract.	All documents do not comply with the rules and breach intellectual property and data protection	Documents that do not comply with industry standards may be amended to ensure compliance; however, any breach of Intellectual Property (IP) or Data Protection regulations is classified as red due to serious legal and financial implications.	Meets expectations. All processes and documents comply with industry standards, fully respecting IP and data protection.
Contract Management	KPI 5 – Invoices	Invoices to be received within ten (10) working days of the agreed date. Invoices and associated deliverables should be clearly linked Partial payment for deliverables is not permissible: only completed deliverables are chargeable Invoice amount in line with payment schedule	Invoices quote the correct PO, Contract number, the Authority Contact, and qualitative description of the task delivered. Invoices must be clearly itemised: specific deliverables and relevant amount as agreed in payment schedule	Invoices received by the Authority which contains inaccuracies	Invoices received by the Authority greater than five (5) working days after the agreed deadline and/or contains some inaccuracies.	Meets expectations All invoices received by the Authority are accurate and on time, reflecting agreed deliverable.

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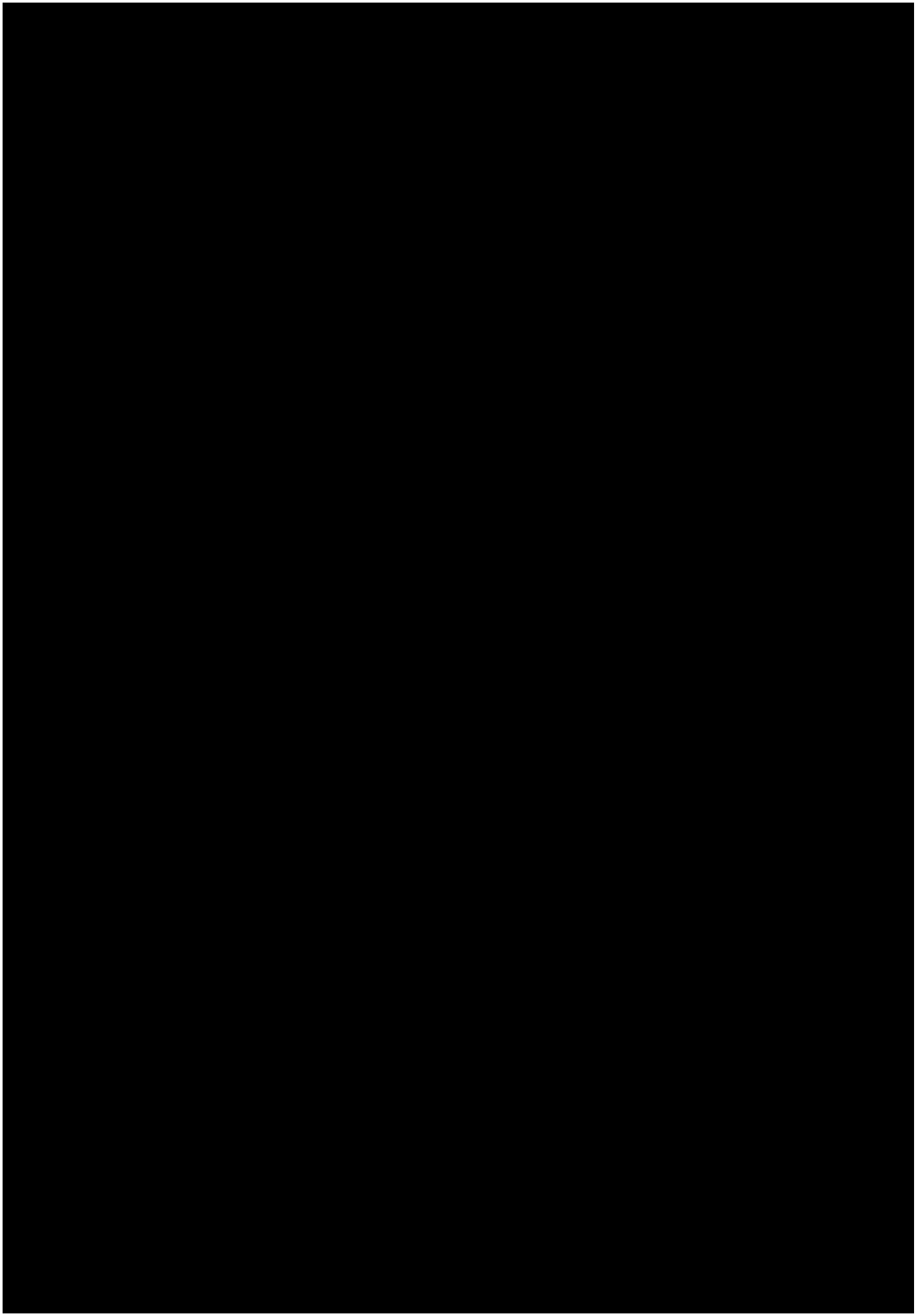

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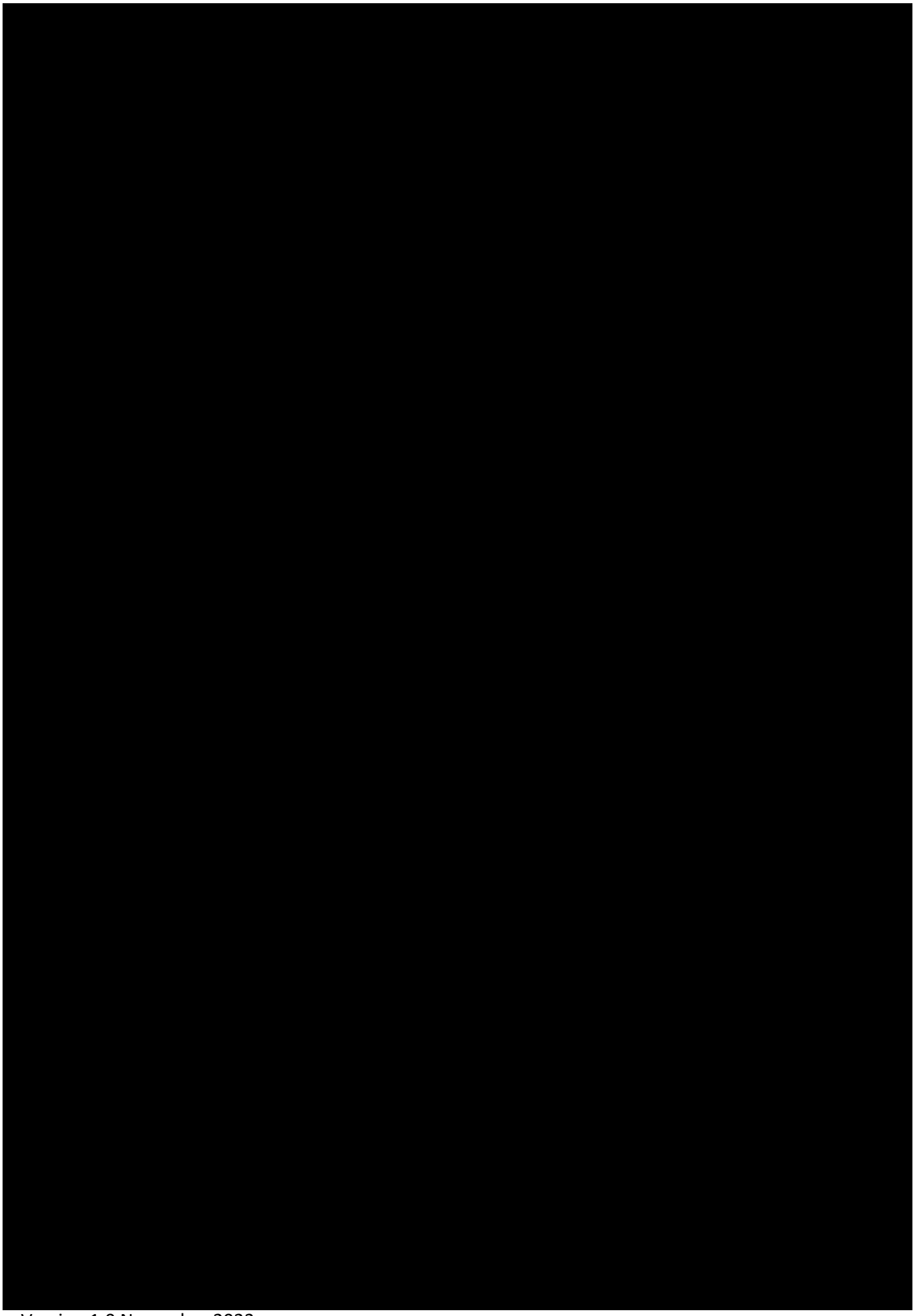

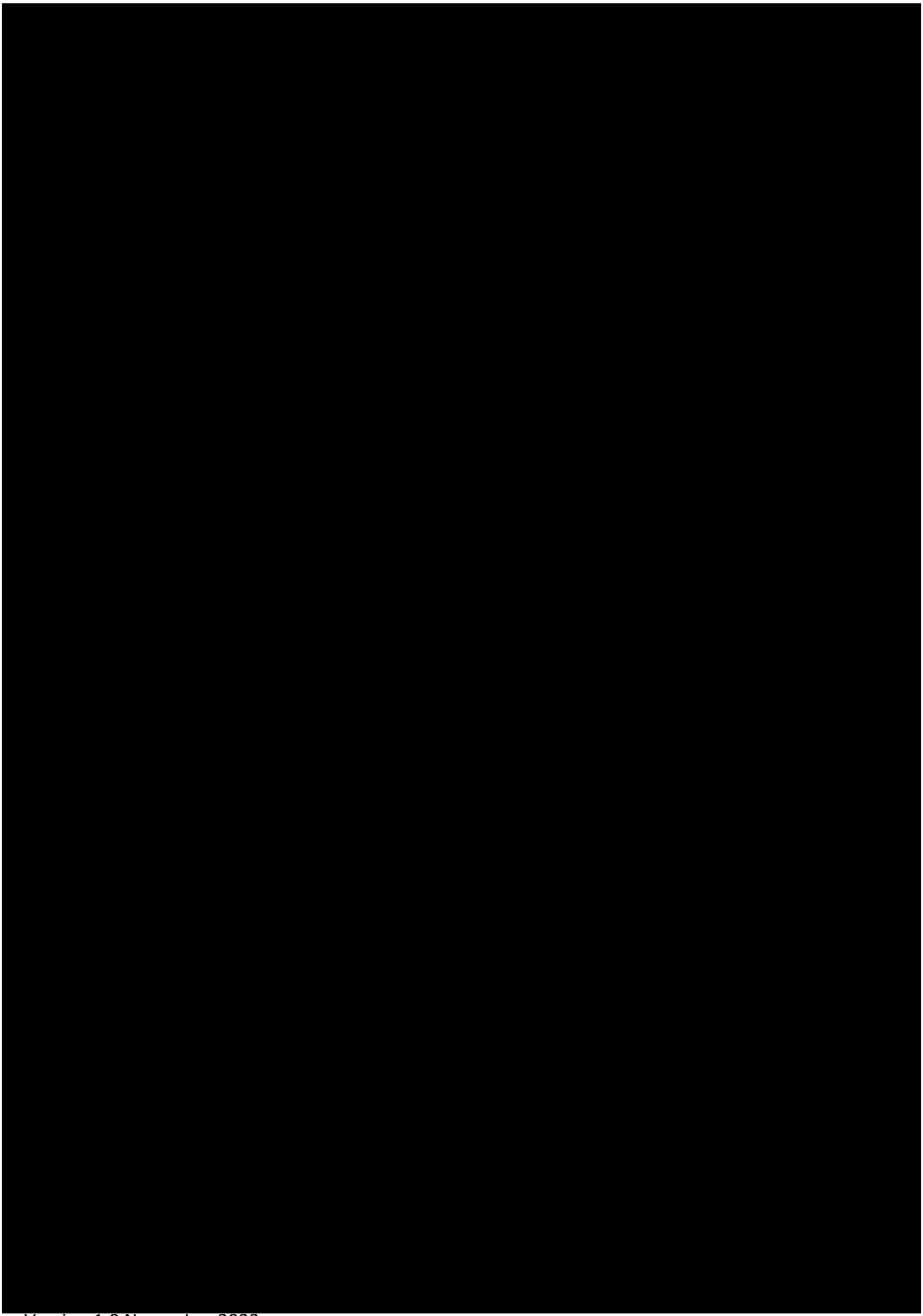

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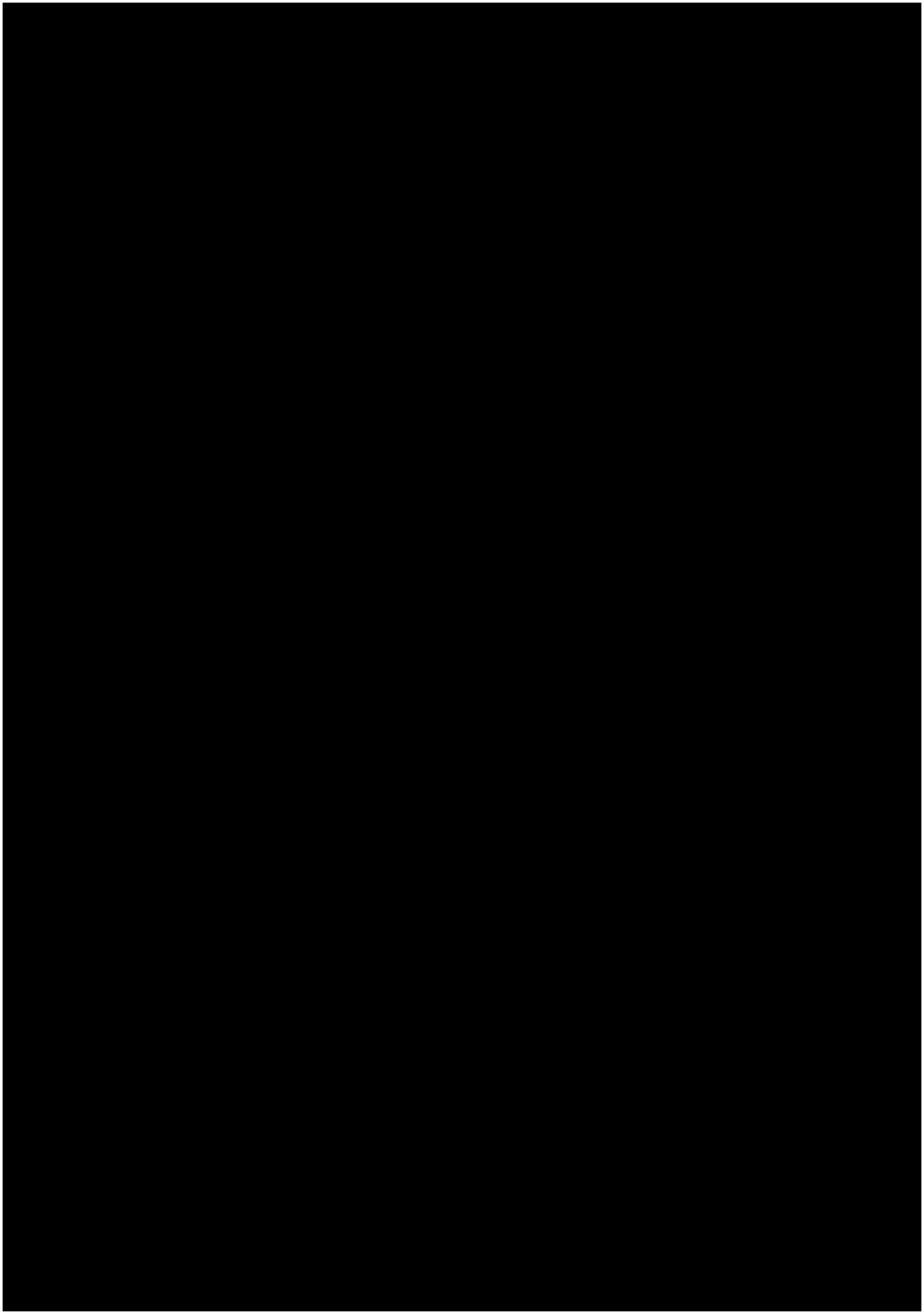

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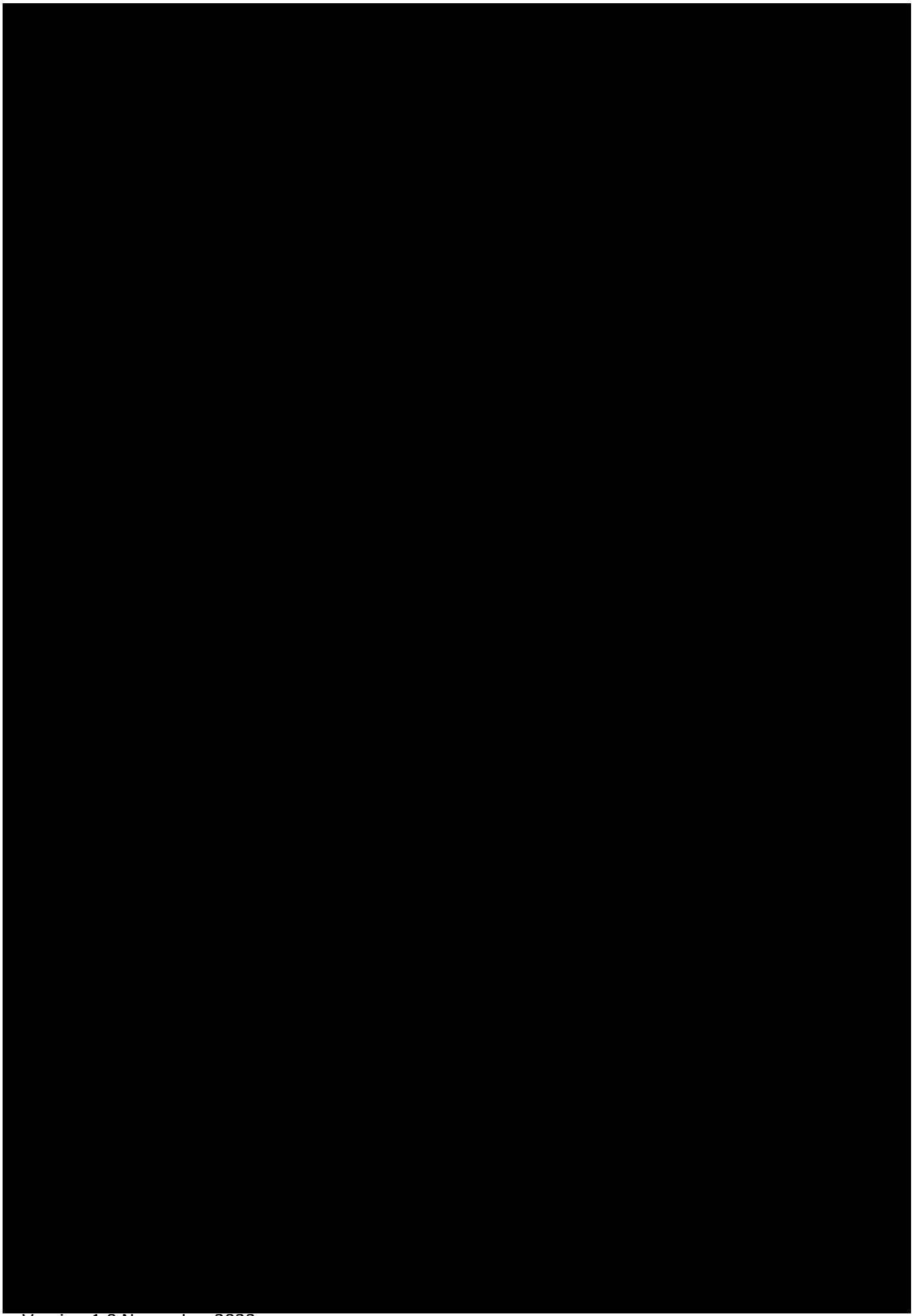

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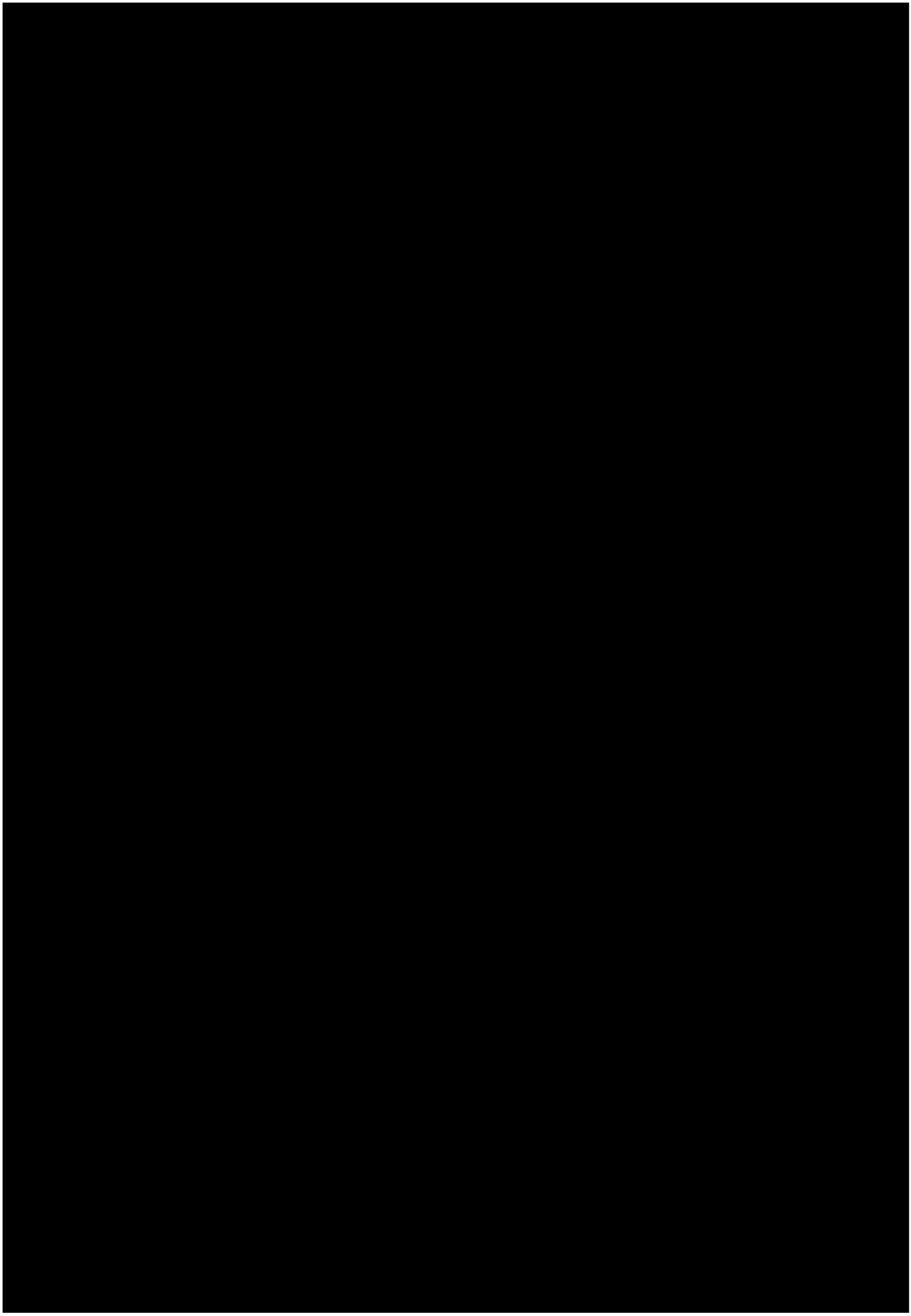

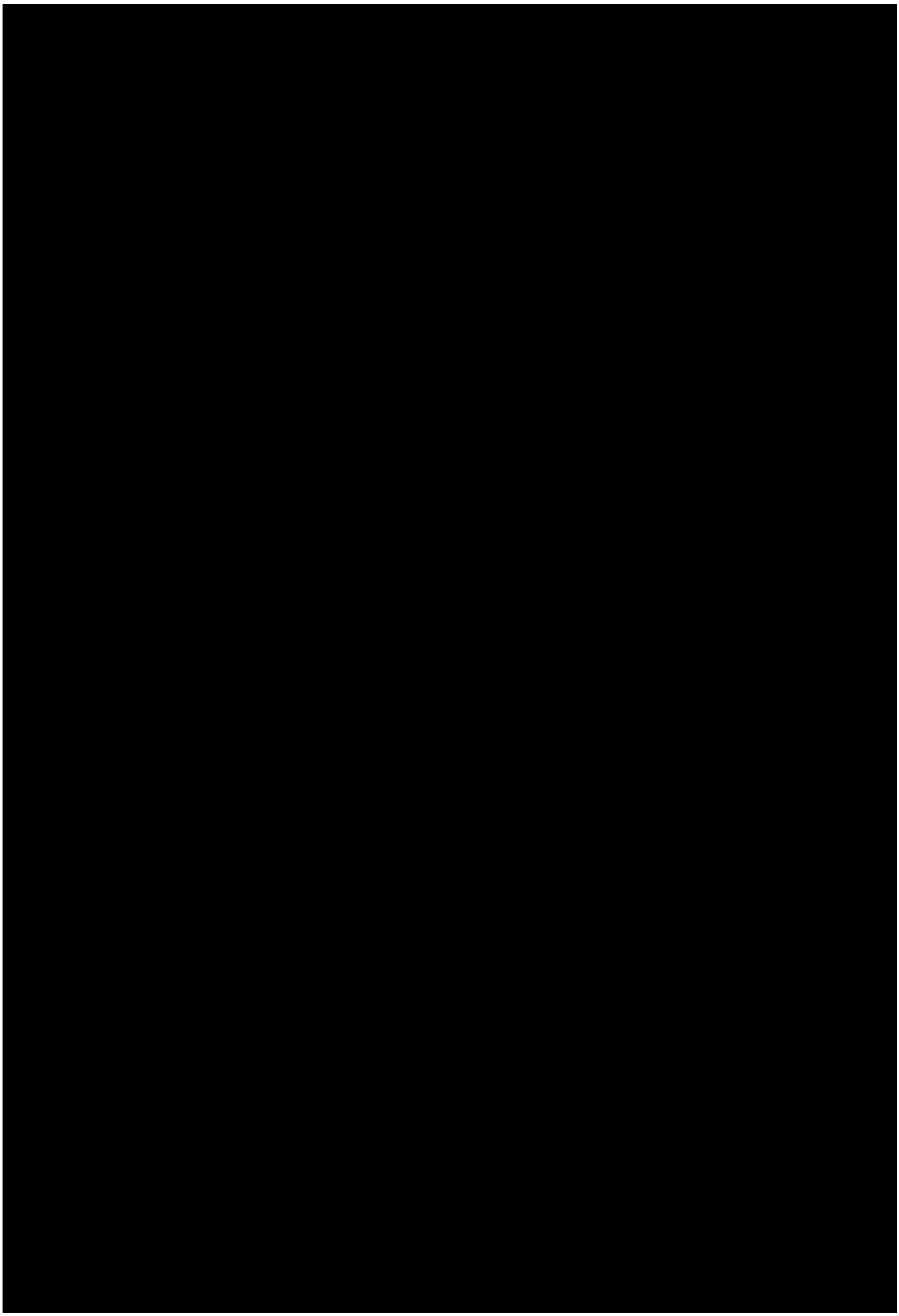

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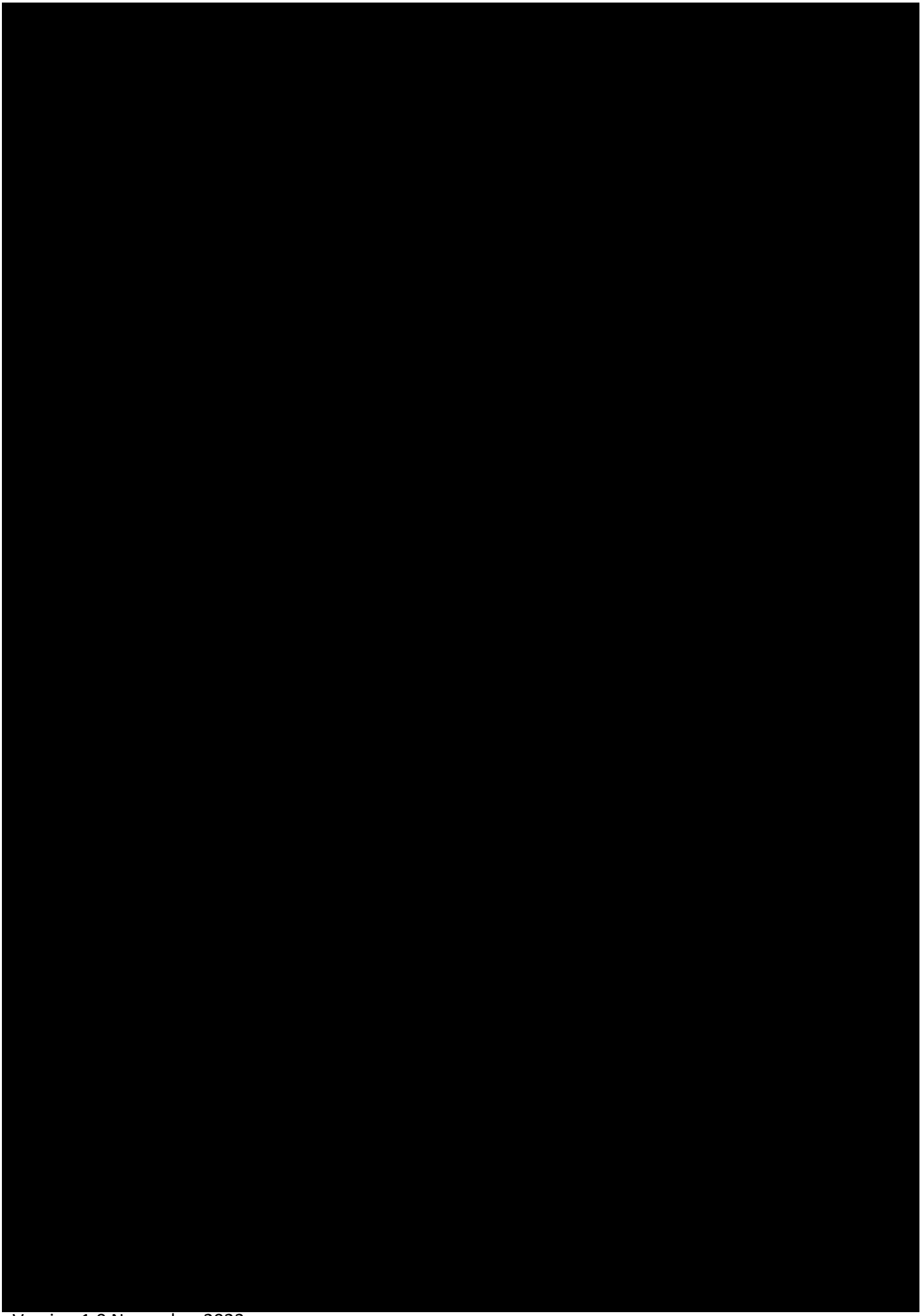

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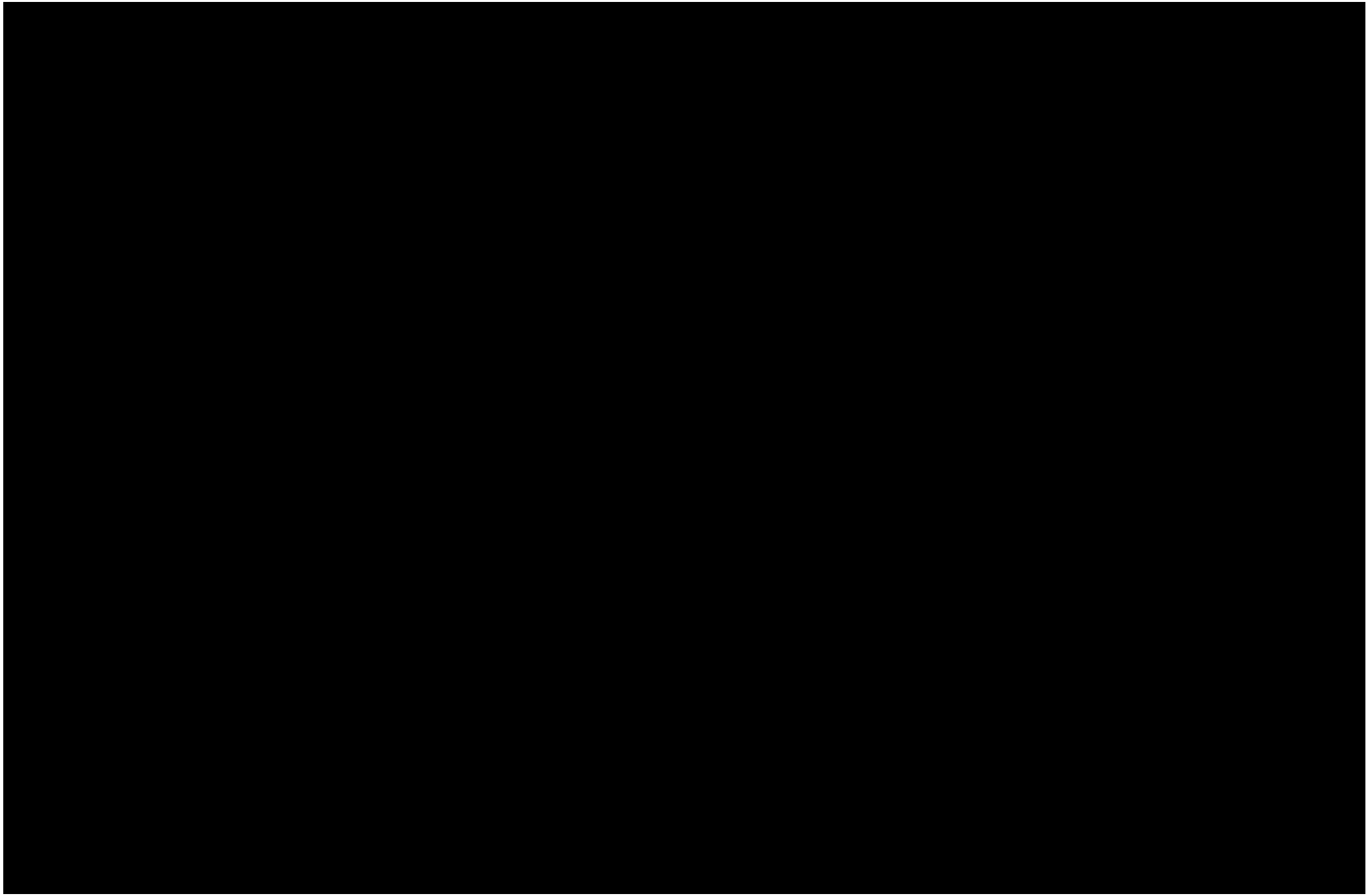

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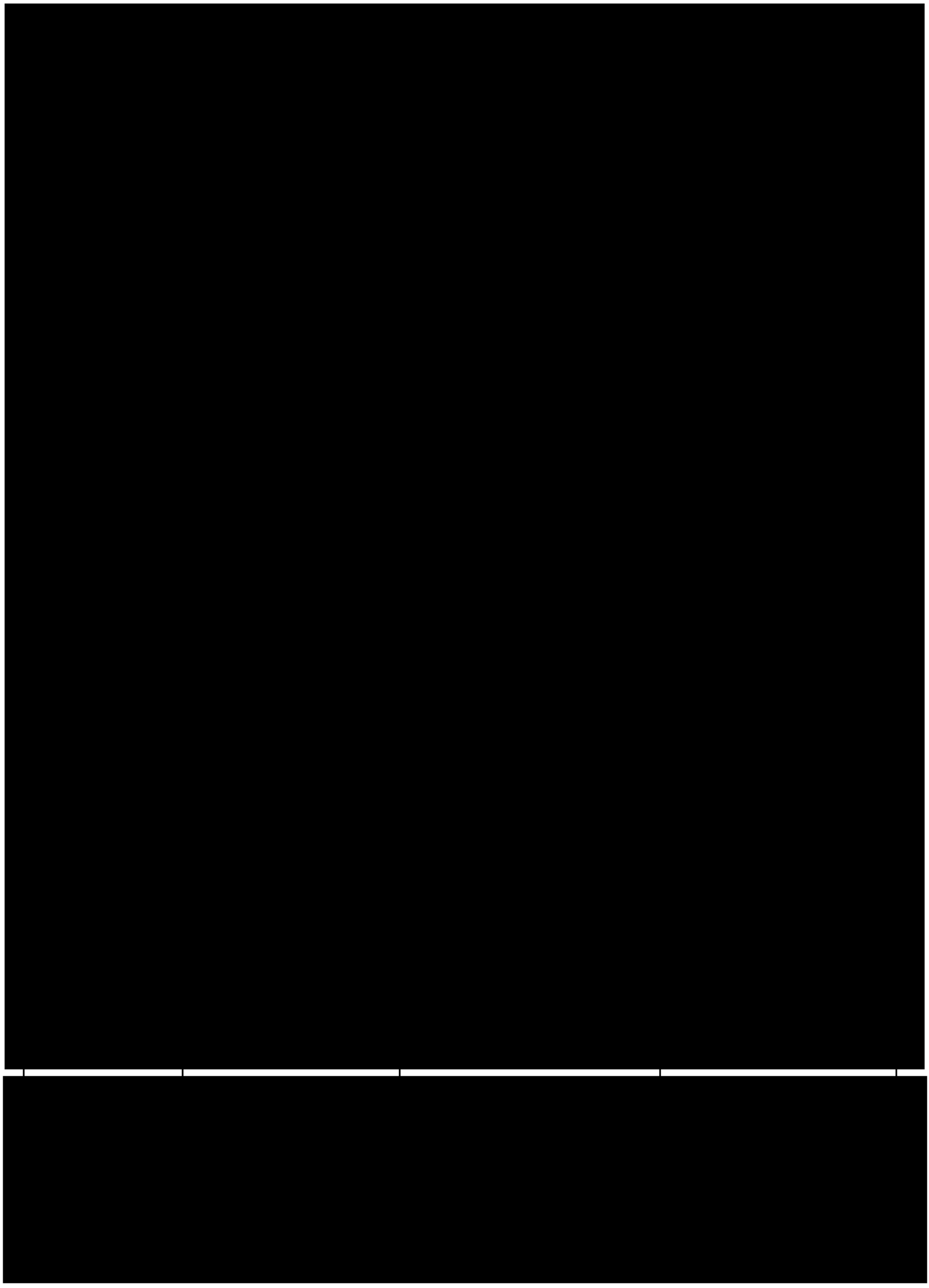

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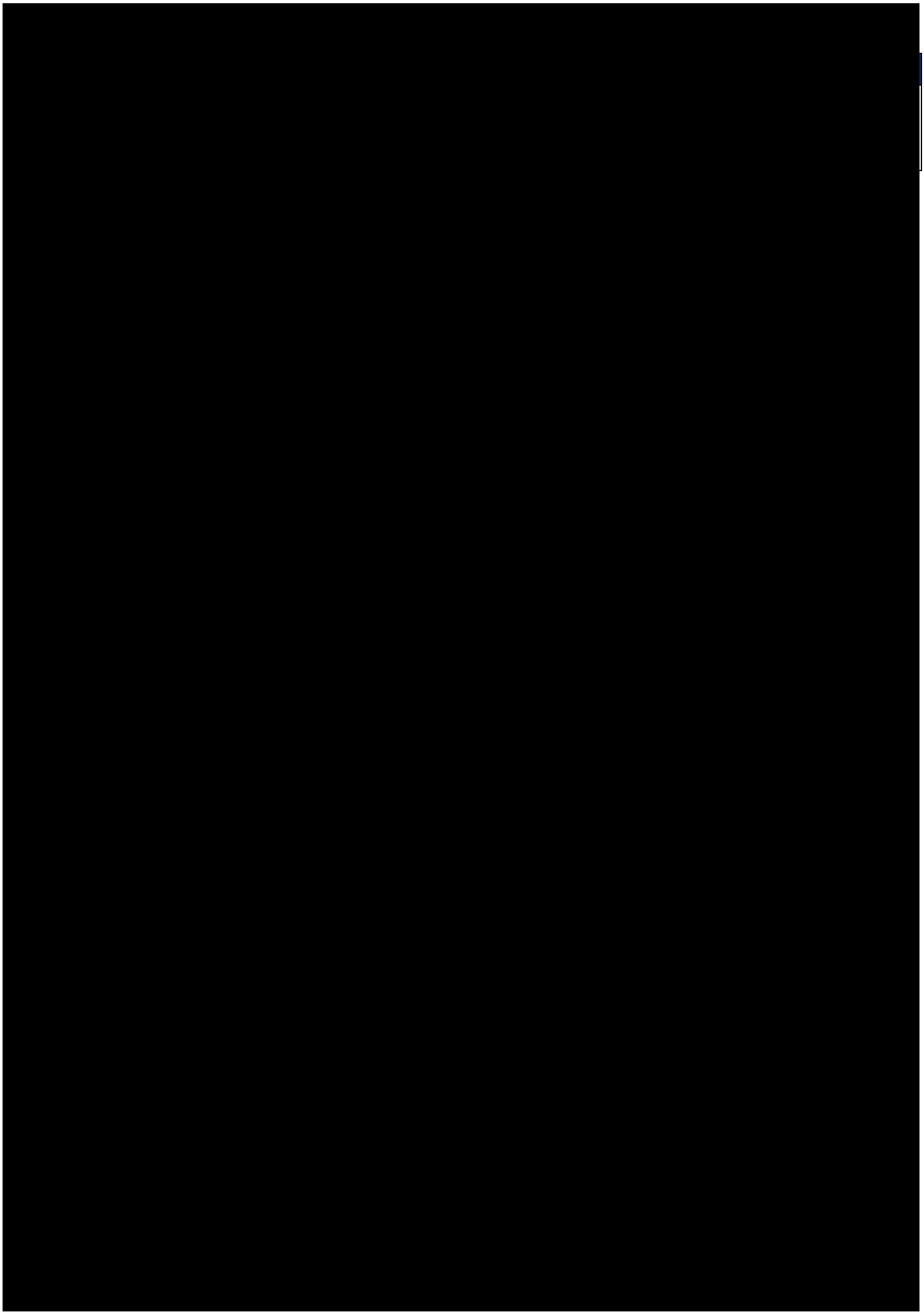

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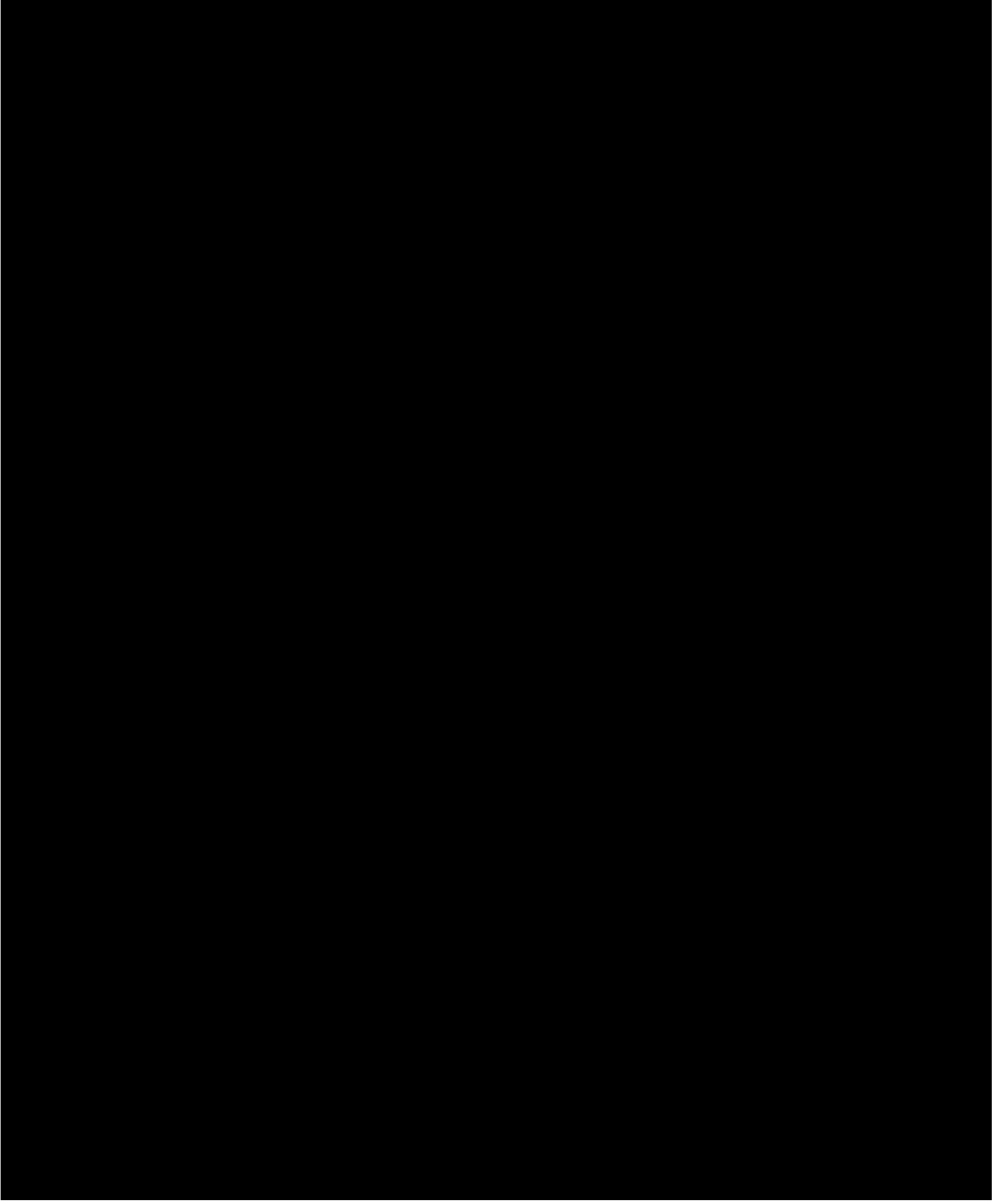

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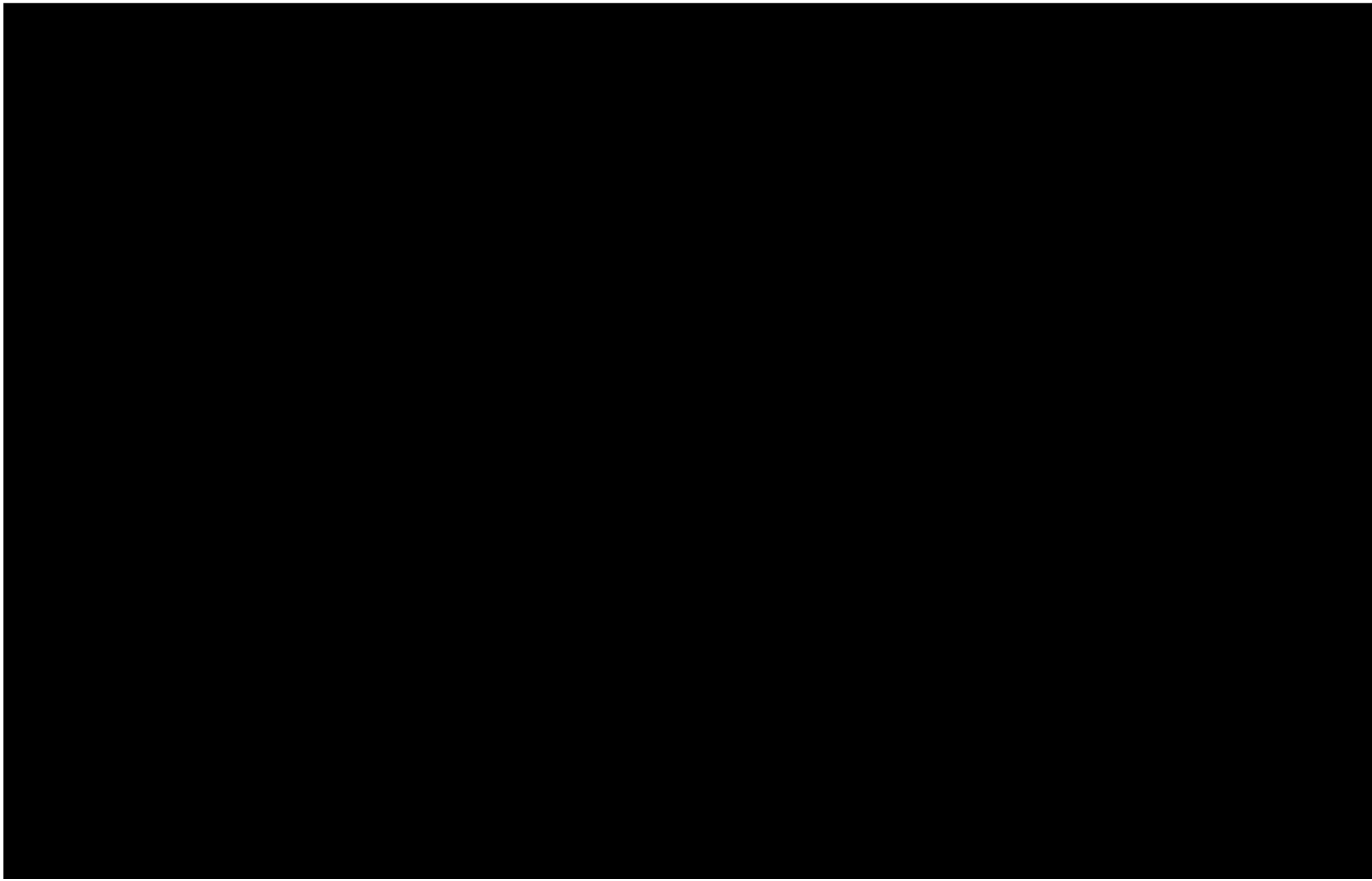

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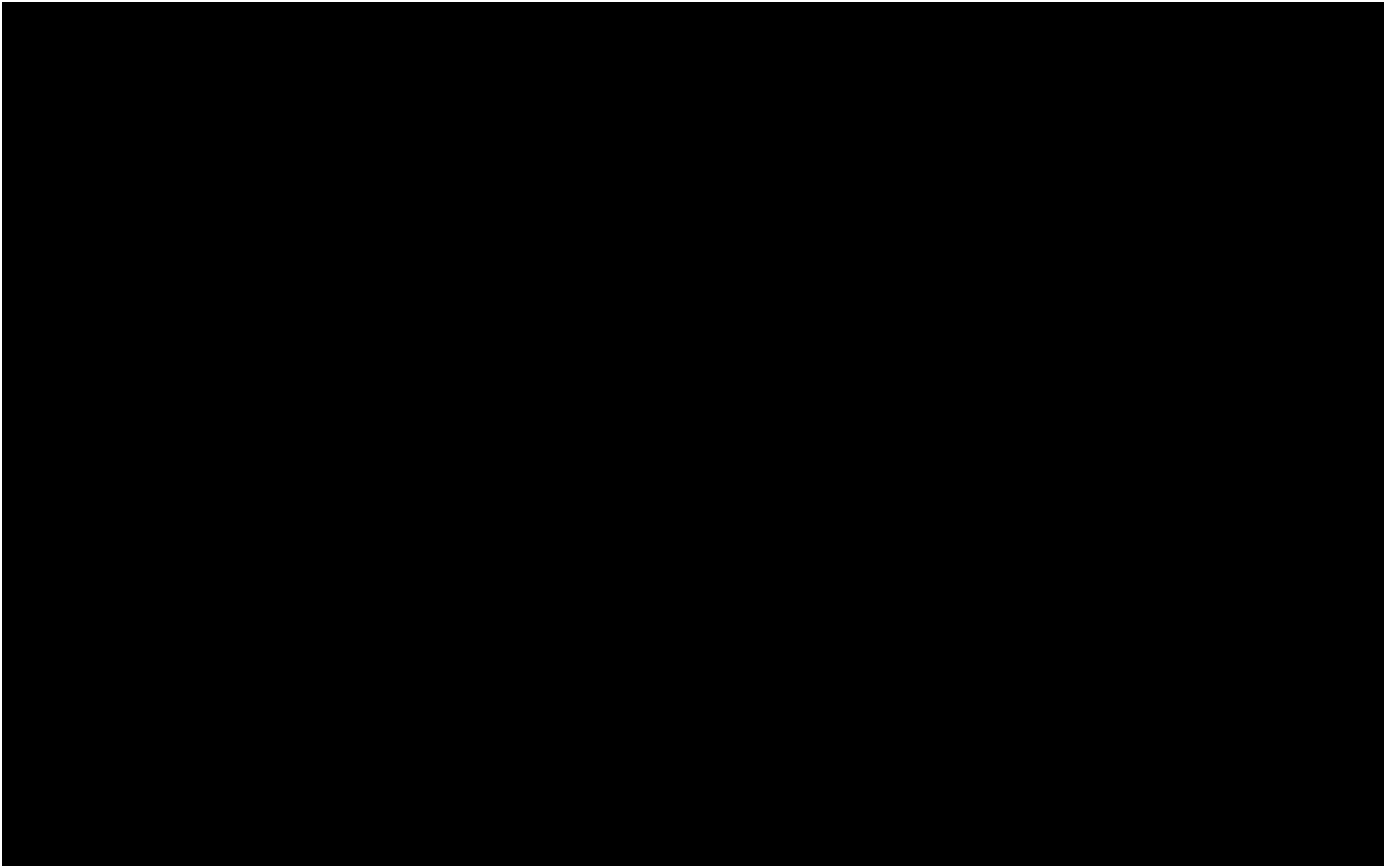

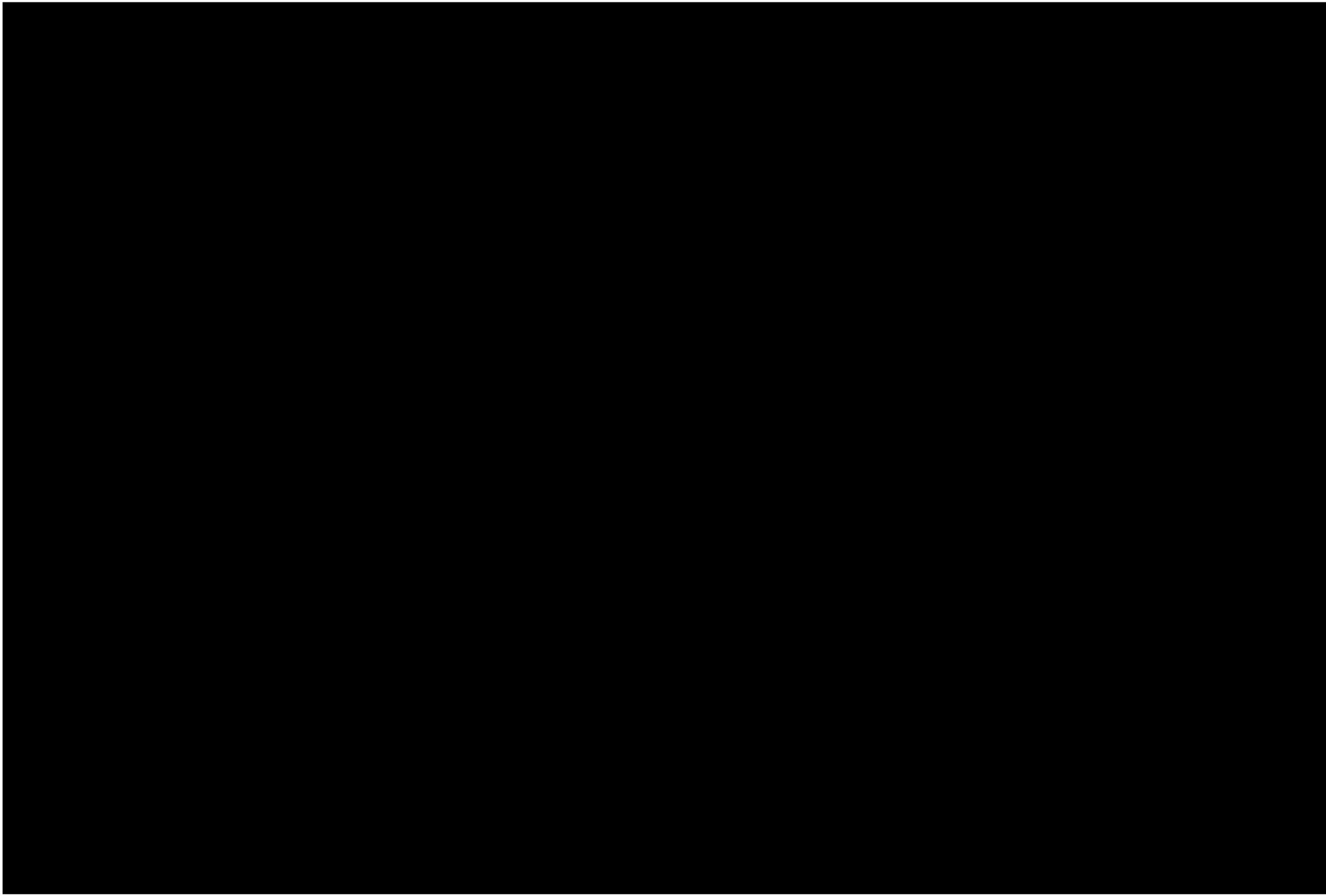

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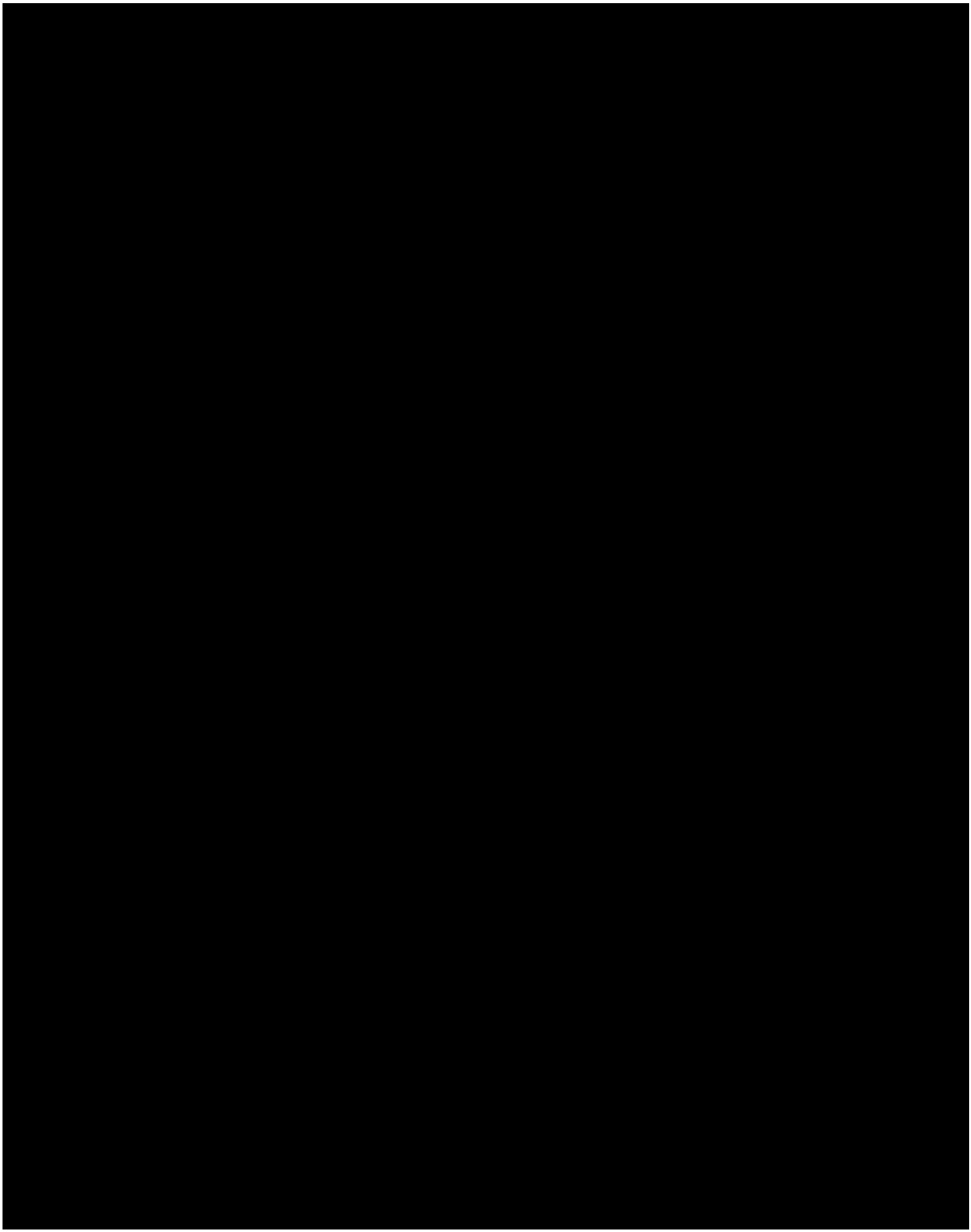

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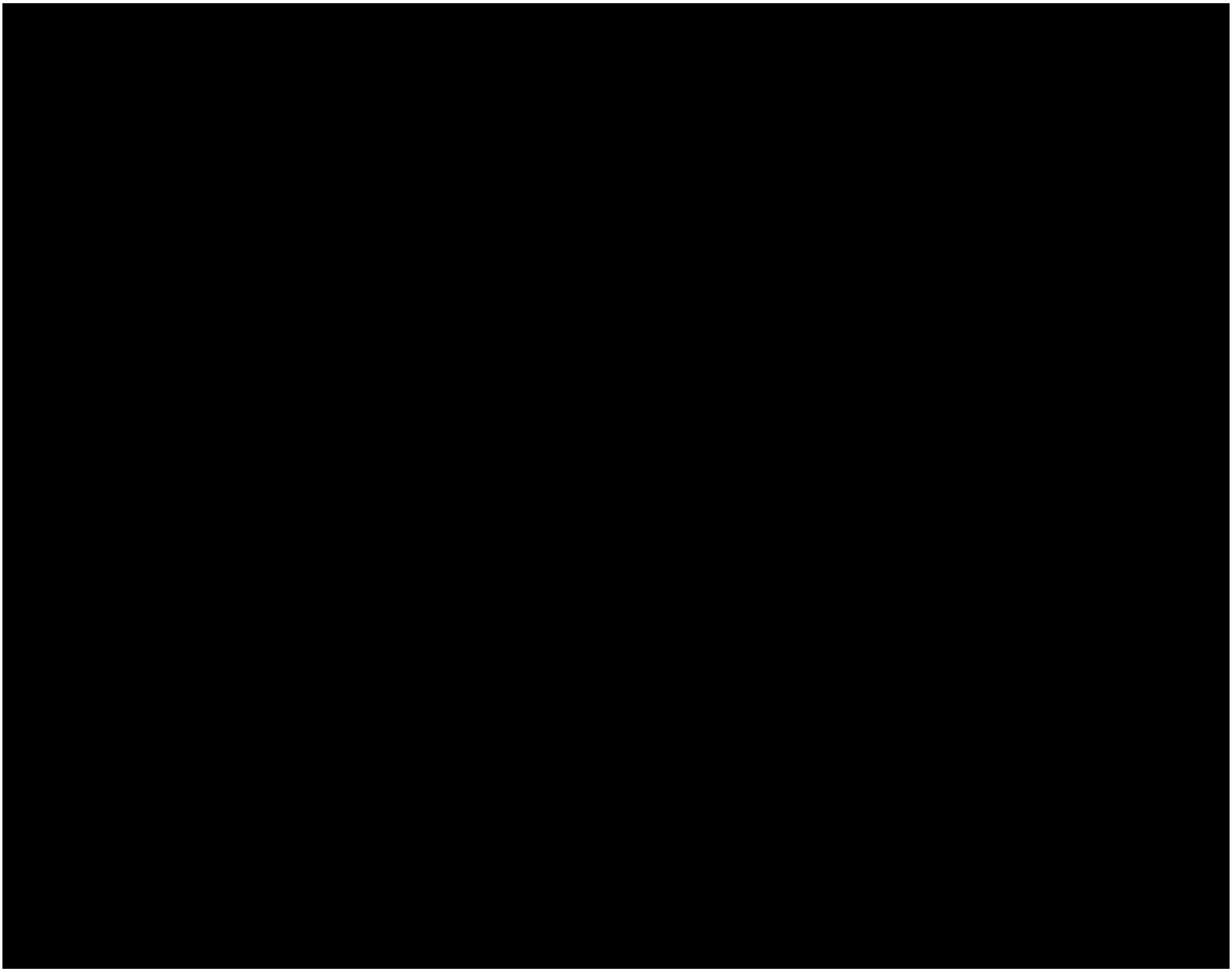

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