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Research Innovation Action

Intelligent Portable Control System

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D3.3 Second version of all technological tools and subsystems for integration

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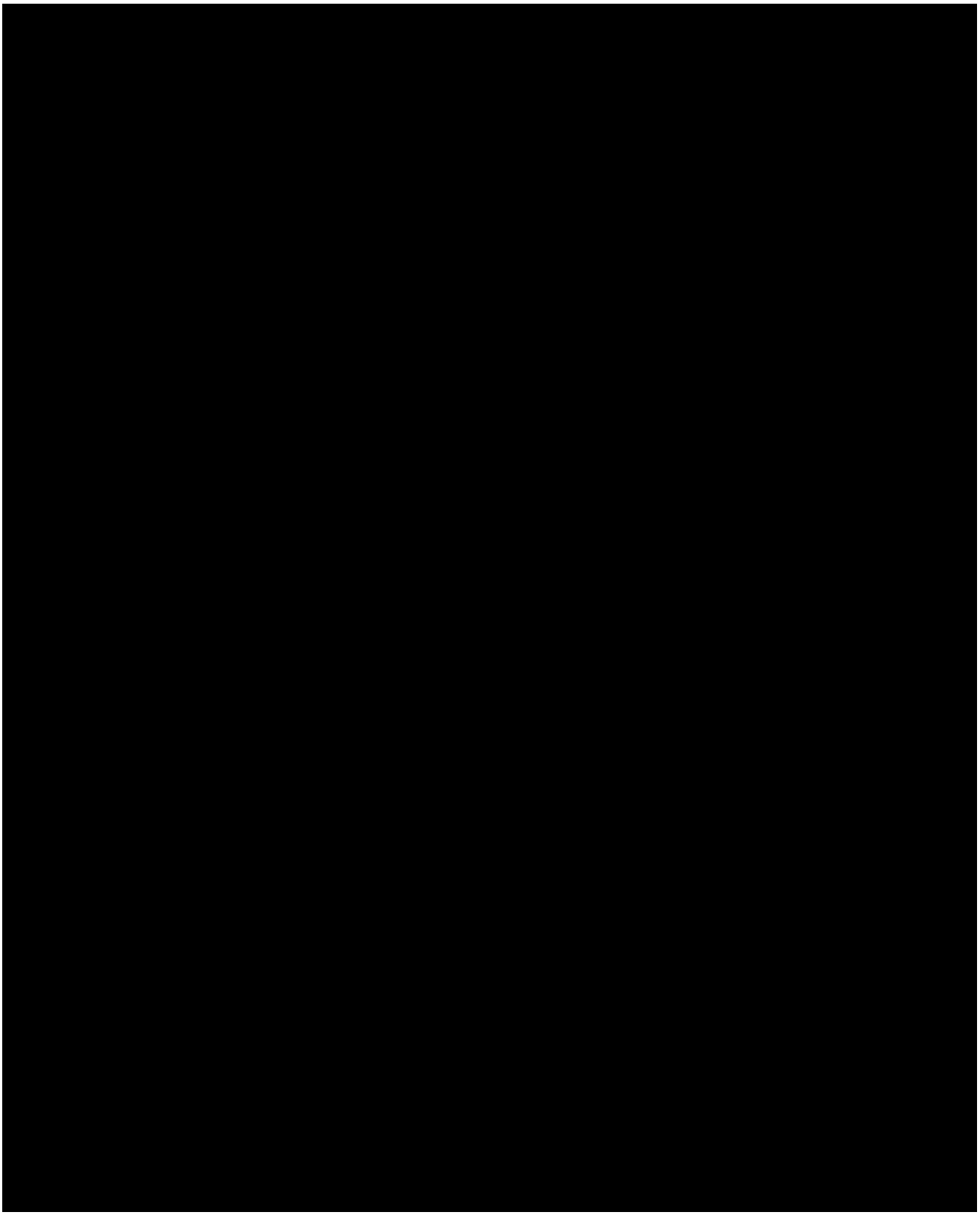

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Abbreviations

TUA	Traveller User Application
BGUA	Border Guard User Application
BMUA	Border Manager User Application
ADDS	Automated Deception Detection System
DAAT	Document Authenticity Analytics Tool
BIO	Biometrics
FMT	Face Matching Tool
HHD	Hidden Humans Detection Tool
RBAT	Risk Based Analytics Tool
BCAT	Border Control Analytics Tool
PU	Portable Unit

Executive Summary

This document describes the different subsystems and their applications that -combined with the physical sensors and hardware - provide the iBorderCtrl system with the appropriate routines to fulfil the expected checks and related processing of collected data.

The present report corresponds to the second version of the tools developed and completed as separate subsystems, while their integration and orchestration into an overall software and hardware prototype will follow.

Within this report, a thorough analysis of the developments and operation of the second and final version of these subsystems (ADDS, DAAT, BIO, FMT and HHD) is presented. For each system, a general overview followed by its technical description is given; however, the focus is on their performance results so that the individual risk scores are derived.

Thus, this document provides an extensive description of the work linked to Work Package 3, indicating its successful completion, along with a detailed analysis of the functionalities and operation characteristics of each technology tool.

The present deliverable D3.3 is the follow-up and updated version of D3.2 describing the performance and test results of these modules and indicating the work done within M18-M24 for the realisation of all their individual prototypes to finally constitute the iBorderCtrl system.

Then, the corresponding integration aspects of how all these subsystems are orchestrated together to formulate the overall iBorderCtrl prototype will be described in-depth within the following WP5 Deliverables, to provide the testing results and to finalise their communication with the iBorderCtrl system for the successful piloting conductance at the pilot sites BCPs.

1 Introduction

The present Deliverable D3.3 describes the second and final version of all the technological tools and their applications that are directly connected to the hardware components of the overall holistic iBorderCtrl system and correspond to the various scanners / sensors / readers that are implemented as technological modules. The present Deliverable provides a detailed analysis and overview of all the modules' technical development and the retrospective final outcomes in terms of performance.

The Deliverable D3.3 is the second version of the WP3 development phase and refers to all technological development Tasks 3.2 – 3.8, directly addressing the general WP3 objectives. To this respect, D3.3 is the logical sequence of the previous first version of the technological tools and subsystems which were presented in D3.2. Thus, following the specifications, technical features and the first, early versions of the related subsystems presented in D3.2, the present Deliverable D3.3 provides the development stages, the corresponding functionalities along with the performance tests and the final results delivered.

These specific hardware components and modules are: the automated real time deception detection system (ADDS) along with the associated avatars, the biometrics tools (fingerprints and palm vein – BIO tools), the travel document authenticity analytics tool (DAAT), the face matching tool (FMT), and functionalities related with hidden human detection during border crossing.

Concerning the description presented in the next Chapters, the following should be noted:

The present report, as the previous D3.2 one, highlights again the multi-disciplinary manner of the involved modules and the different level of maturity between them. The involved disciplines range from purely biometrics applications (such as the fingerprints checks already carried out at the BCPs) to the gesture and non-verbal behavior aspects of ADDS; also from purely algorithmic biometrics models (such as the face recognition module) along with document and OCR authentication (such as the DAAT tool) to basically hardware and signal processing aspects (as the HHD tool). Furthermore, the modules span from fully mature tools (like the palm vein and the fingerprints ones) in terms of use and application, to software development for their integration within the iBorderCtrl (like the ADDS, FMT and DAAT) and up to those developed as lab prototypes within the framework of the project (like the HHD tool).

To this respect, a full, complete and detailed description of the all the related software and hardware development aspects takes place in the following. In many cases, all the scientific and technical details are provided in order the reader to be able to understand all the analysis behind along with to justify the efforts required for concluding in the final results. Thus, the presentation that follows indicates the work carried out to transform the architectures and technical description of D3.2 into performance outcomes in the present D3.3.

Since this Deliverable indicates the successful completion of WP3 as a technical development WP, there would be no other opportunity to show the algorithms and the analysis that was carried out and corresponds to the "background" of what will be visible to the border guards and the travellers as final end users. So, the present report D3.3 indicates the end of separate and parallel developments of the respective modules. Then, the outcomes concerning the interconnections, communication aspects and the integration of all the above modules into an overall software and hardware prototype, the iBorderCtrl holistic system is transferred to WP5. To this respect, all testing, debugging and integration of all functionalities of the various tools from now on will be part of the WP5 framework and all the related outcomes concerning the technological components and subsystems will be reported in the respective WP5 Deliverables that follow. Moreover, based on the above, the iBorderCtrl Portable Unit will be also the single subject of Deliverable D5.3.

In this context, the iBorderCtrl radio network will be also part of WP5 (as in Task T5.4 concerning the radio network deployment at the pilot sites). In the previous Deliverable D3.2 all the issues concerning the architecture, technical requirements, specifications and adaptations of the radio network to the needs of the iBorderCtrl pilot sites were described. The radio network is part of WP3 as far as the above are concerned and they were described in detail in D3.2. Following D3.2 and until the end of WP3 further developments were made in terms of dimensioning, implementation and on site validation issues along with the purchase of the relevant equipment while the main radio network aspects have not changed in their concept and architecture. However, they depend a lot on the deployment that will be held at the pilot sites BCPs within WP5 and WP6. Thus, for the sake of a comprehensive presentation, all the developments concerning the radio network will be included within the respective WP5 deliverables along with the deployment results.

To this respect, the present Deliverable incorporates the main technological components that correspond to the peripheral sub-systems of the iBorderCtrl system and are interfacing with the users; either with the travellers at the preregistration phase (ADDS, DAAT and FMT) or at the border crossing phase at the BCPs (DAAT, BIO, FMT, HHD).

Following the above, the present report indicates the completion of the development works in WP3 and along with the Deliverable D4.2 fulfils the respective Milestone concerning the completion of the second iteration of all tools in M24.

In the following the description of the second version of the above tools is provided per module.

Then, the detailed description of all these tools orchestrated together into a holistic integrated prototype will be held within the related WP5 Deliverables.

2 ADDS and AVATAR overview

This section provides an overview of the final prototype version of the ADDS and Avatar combined module which will be referred to as the ADDS module in this section. There have been no major changes to the architecture of this module since D3.2 in terms of subsystems, however the final version described herein takes into consideration the points raised in the DPIA and the data privacy issues in MMU's role as joint Data Controller.

2.1.1 Technical Description Overview

ADDS will be used during the collection of traveller information during pre-registration as outlined in the Deliverable D2.2, Section 5.1 (Pre-registration general scenario).

Figure 1 shows the architecture of the ADDS module as it was first detailed in D3.2. In this stage, special attention has been focused on the authentication of a traveller between the TUA and ADDS modules and also looking at ways to ensure the integrity of data in the proof of concept system.

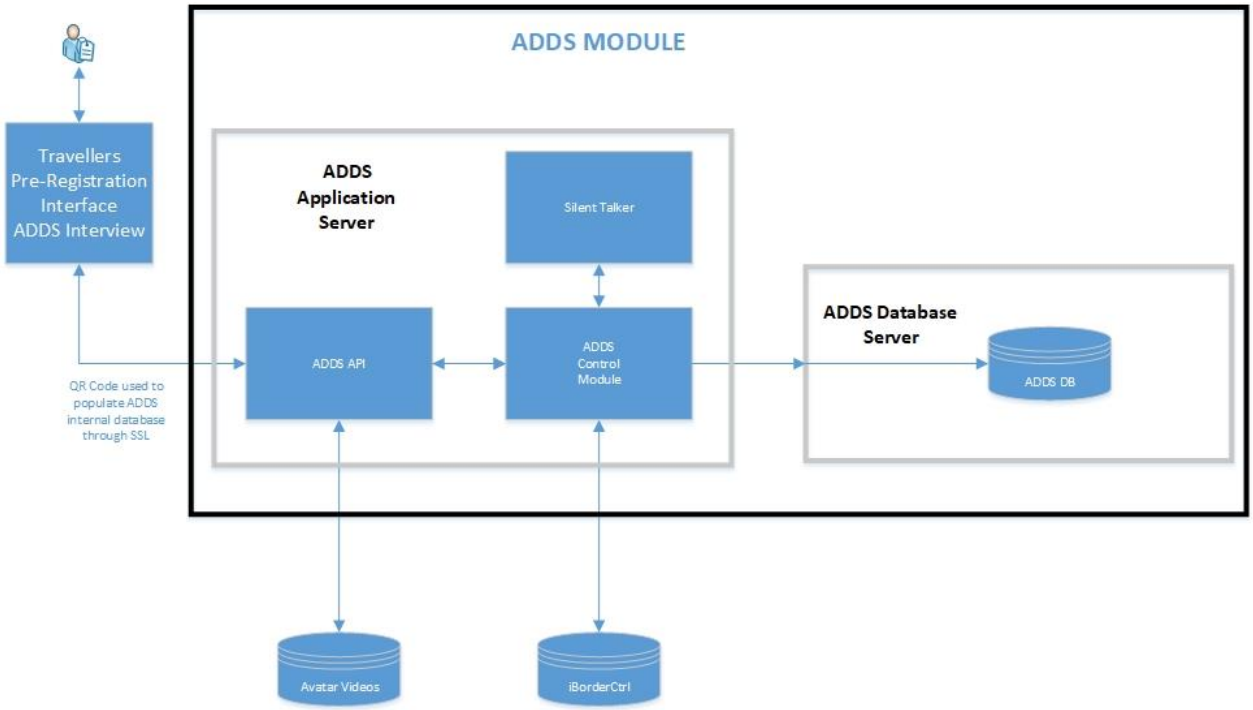
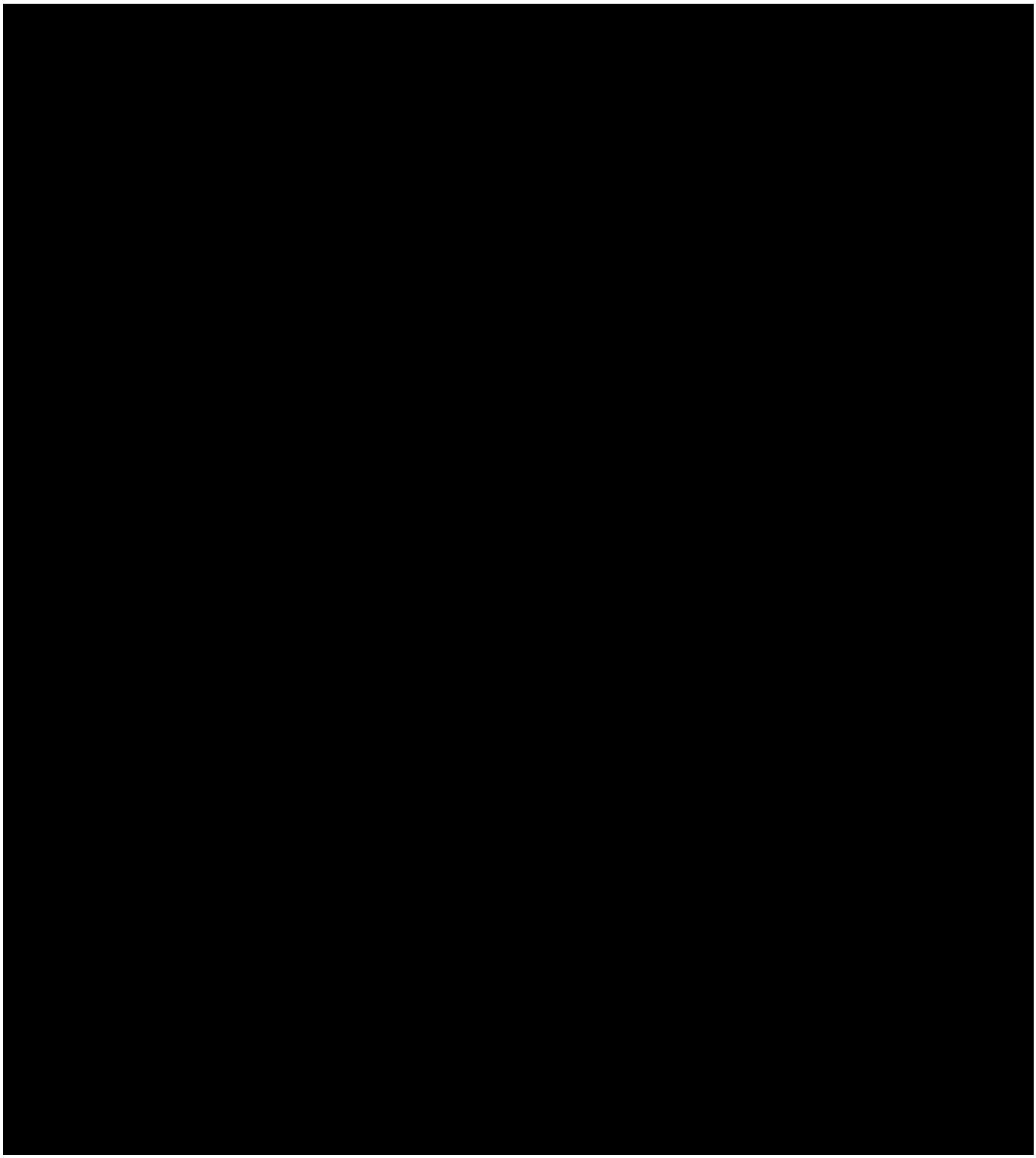


Figure 1 ADDS Architecture final prototype

Since D3.2, authentication between ADDS and the TUA has been confirmed. Authentication of the iframe is managed by the TUA while ADDS is responsible for the html content of the ADDS module within this iframe. Valid IP ranges have been agreed between the two modules. Other security measures were discussed such as Single Sign-on, but these will not be implemented as the project outcomes require a proof of concept model only.

To ensure integrity of data, ADDS/TUA needs to ensure that the traveller who does the interview is the same traveller who has accessed the TUA from the start. The processes performed by ADDS is called through the iframe for a specific QR-CODE, which is provided to the ADDS API as a URL "path parameter". TUA will then check to see if the QR-code has been processed.



2.1.2 Traveller Instructions

In Deliverable D3.2, it was identified that travellers needed to be provided with instructions on the best lighting environment and how to position themselves in order to conduct an effective interview with the Avatar Border Guard. A video was proposed in D3.2, however when this was created, it was

found that it was too long and would require professional editing. Therefore, a simplified version of the instructions was developed which is shown in Figure 3.

These instructions are to be validated during usability testing and updated by MMU. Once validated they will be translated into Russian and Hungarian.

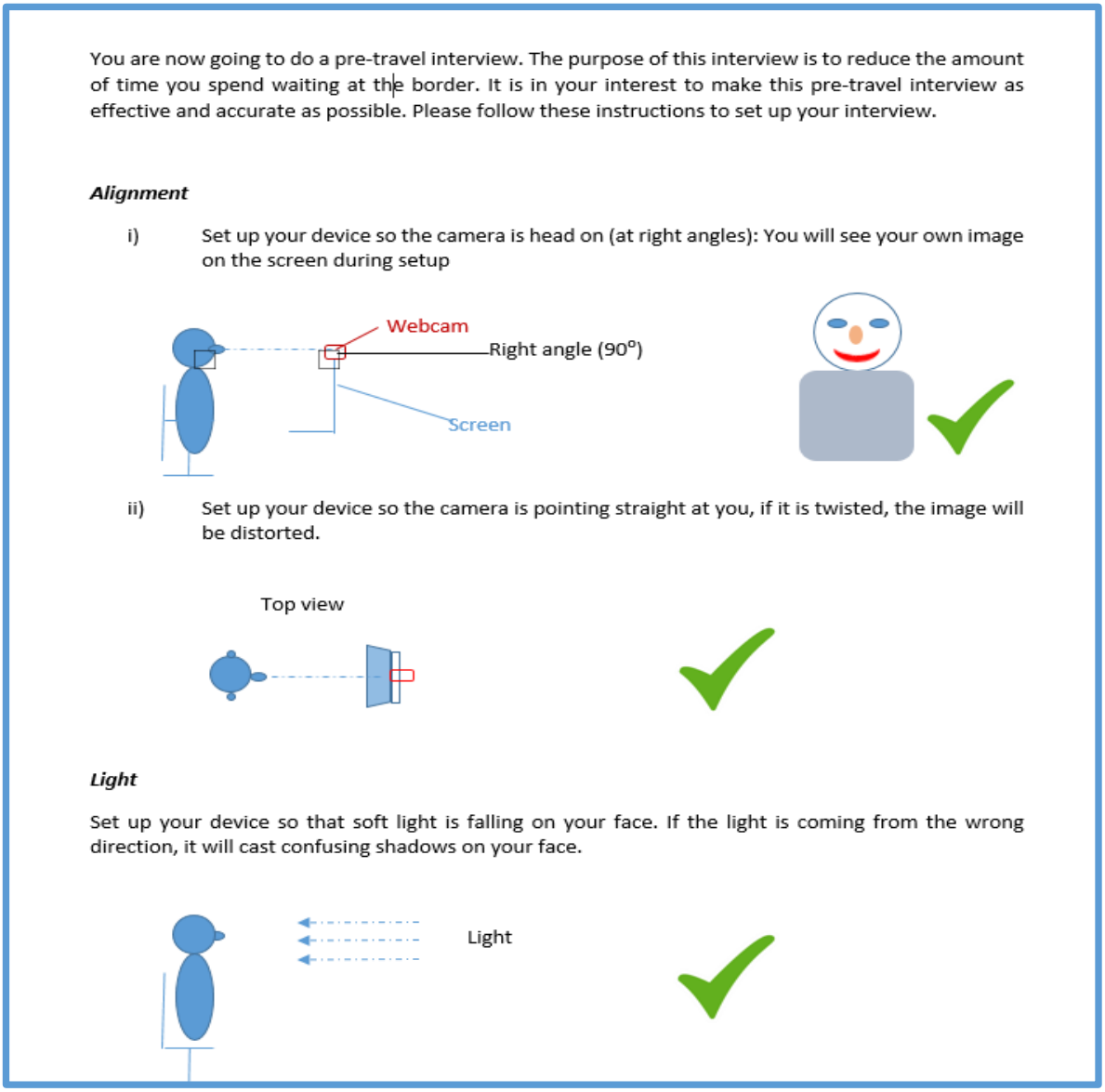


Figure 3 Instructions on how to conduct an Avatar interview

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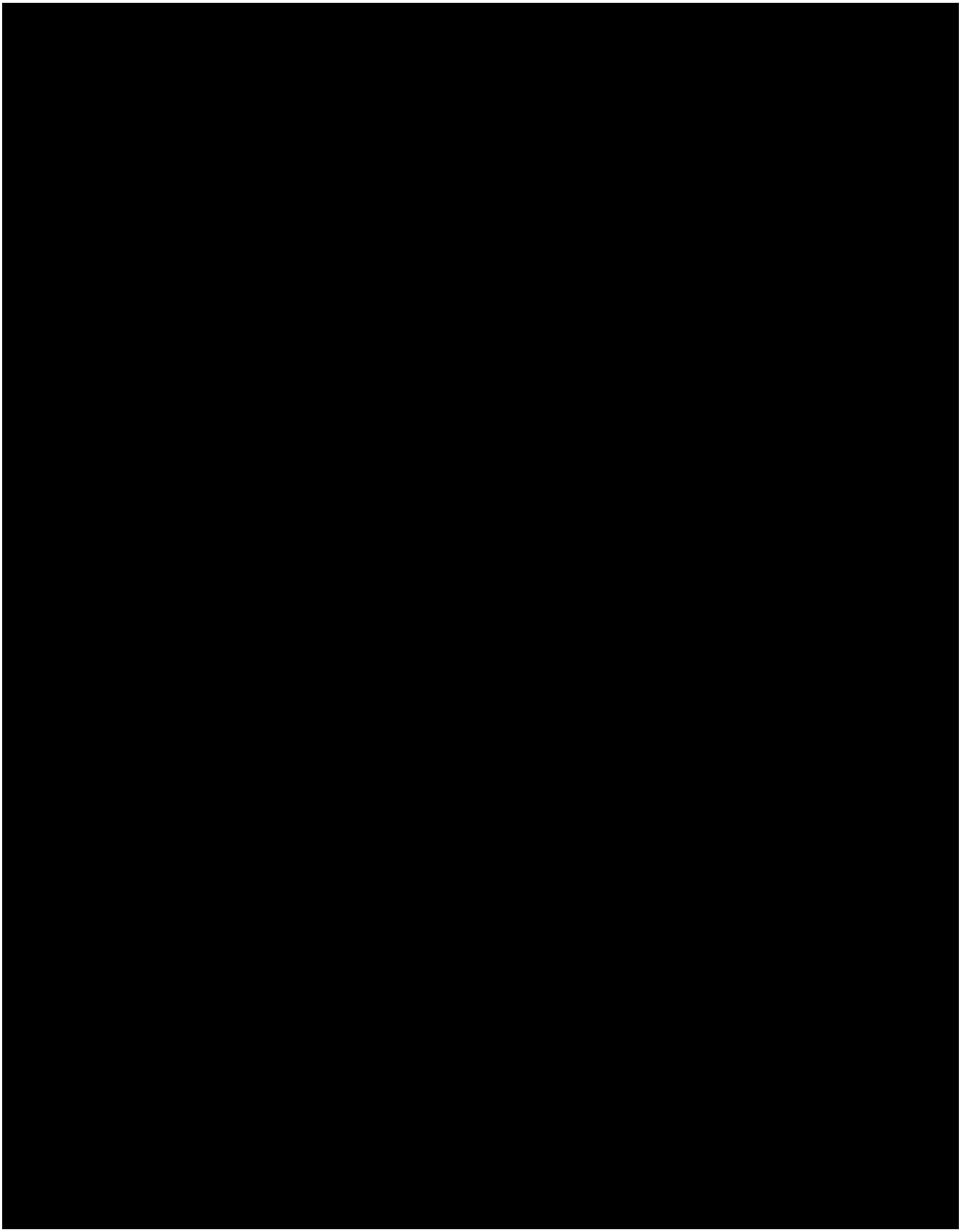
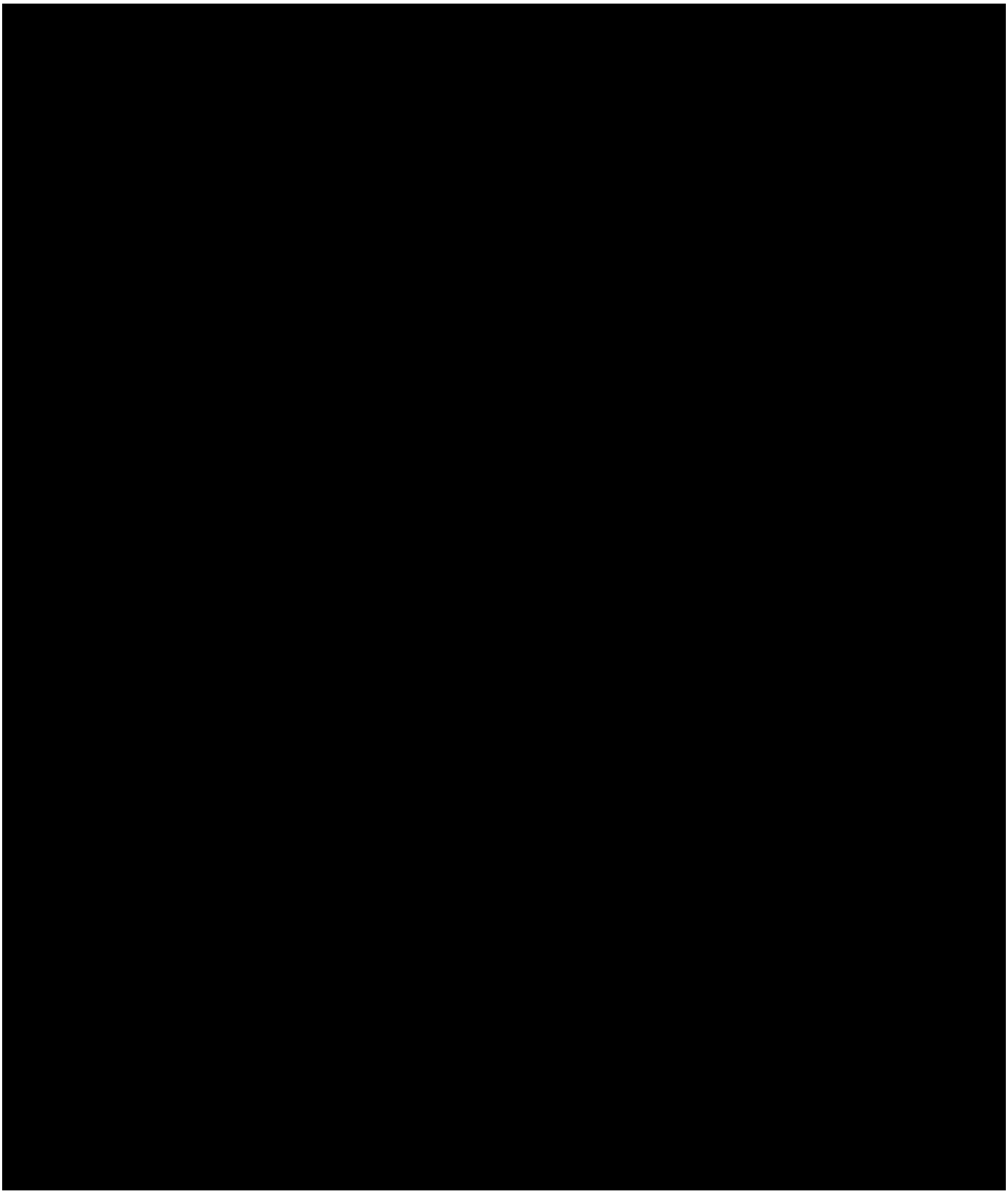
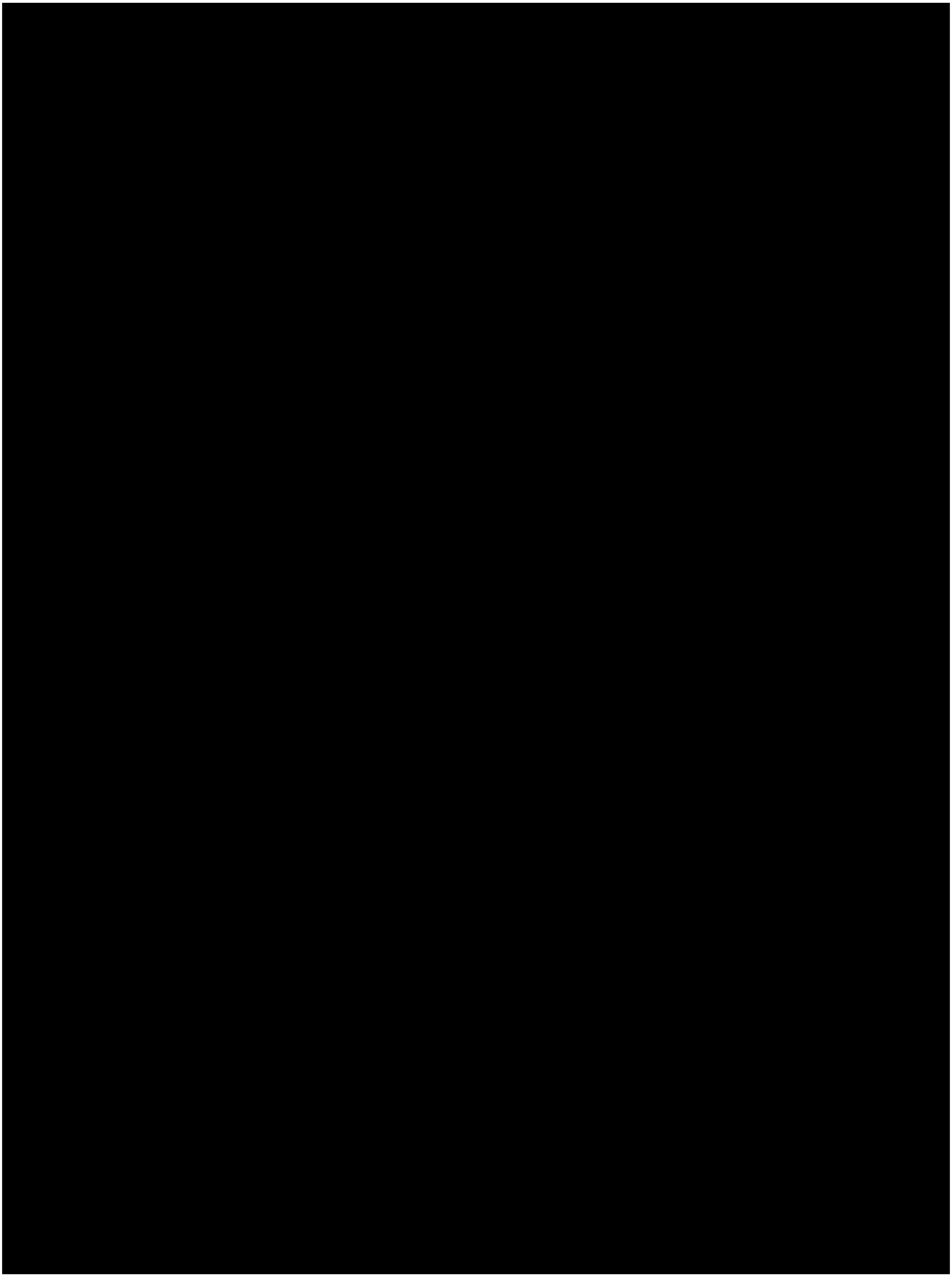
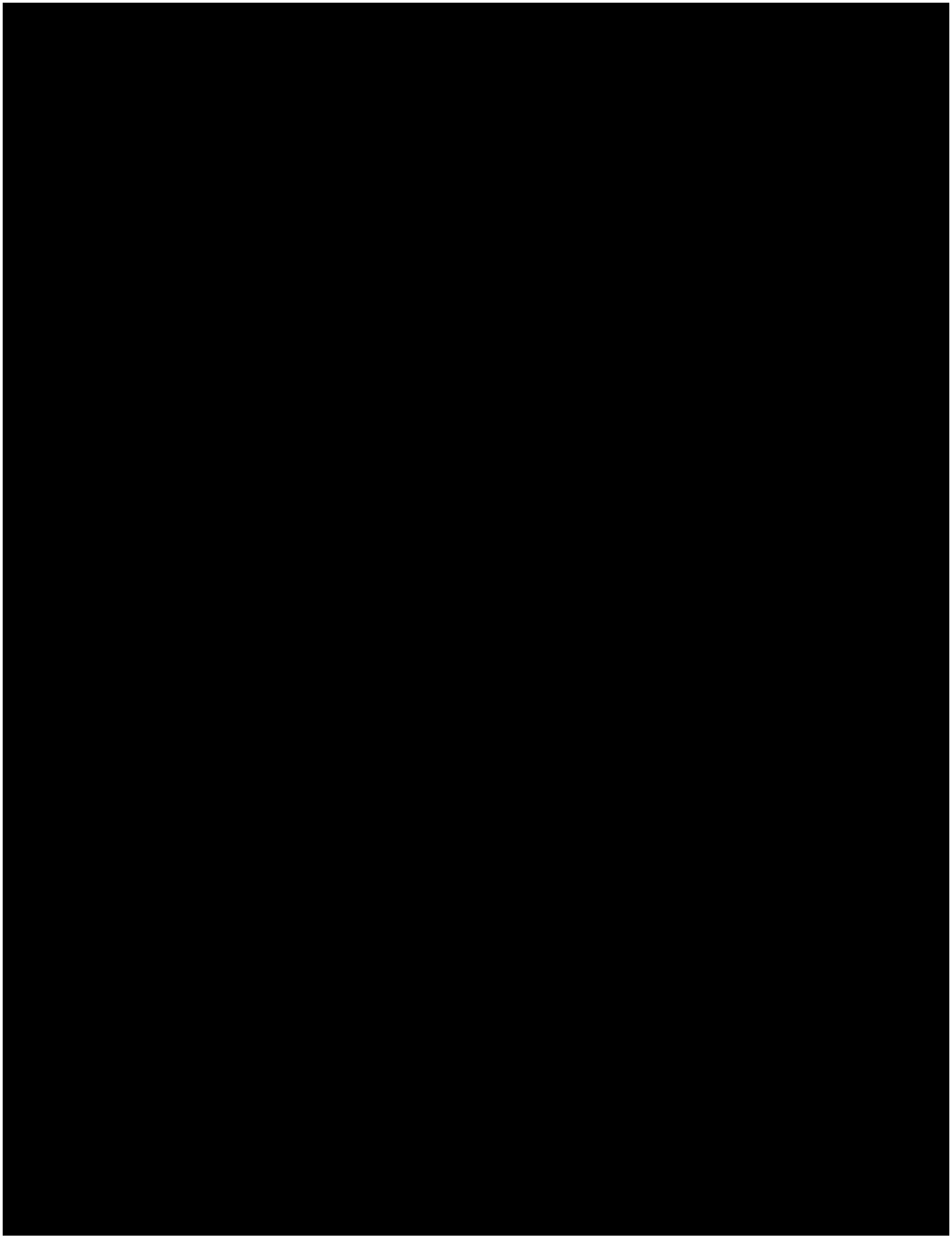
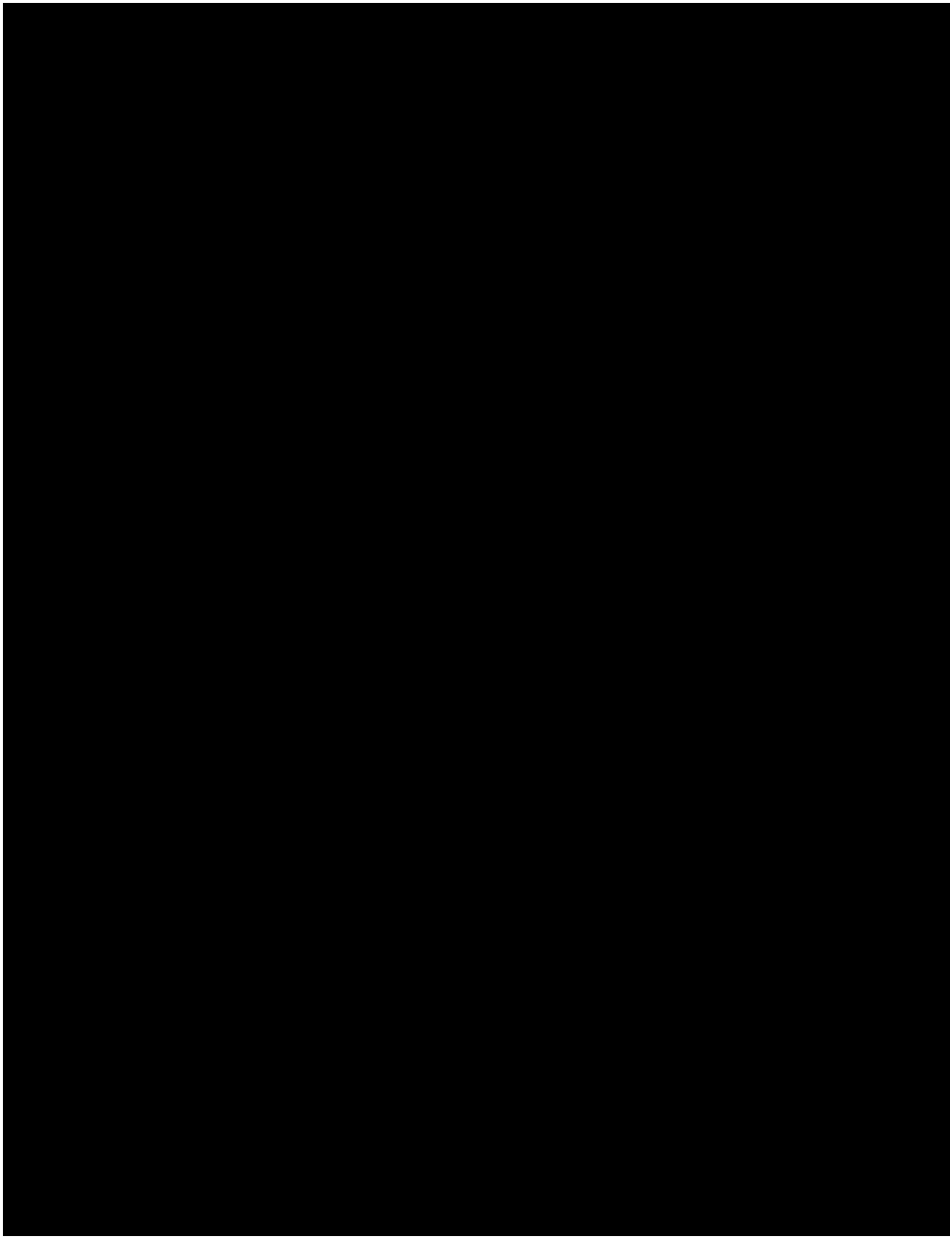
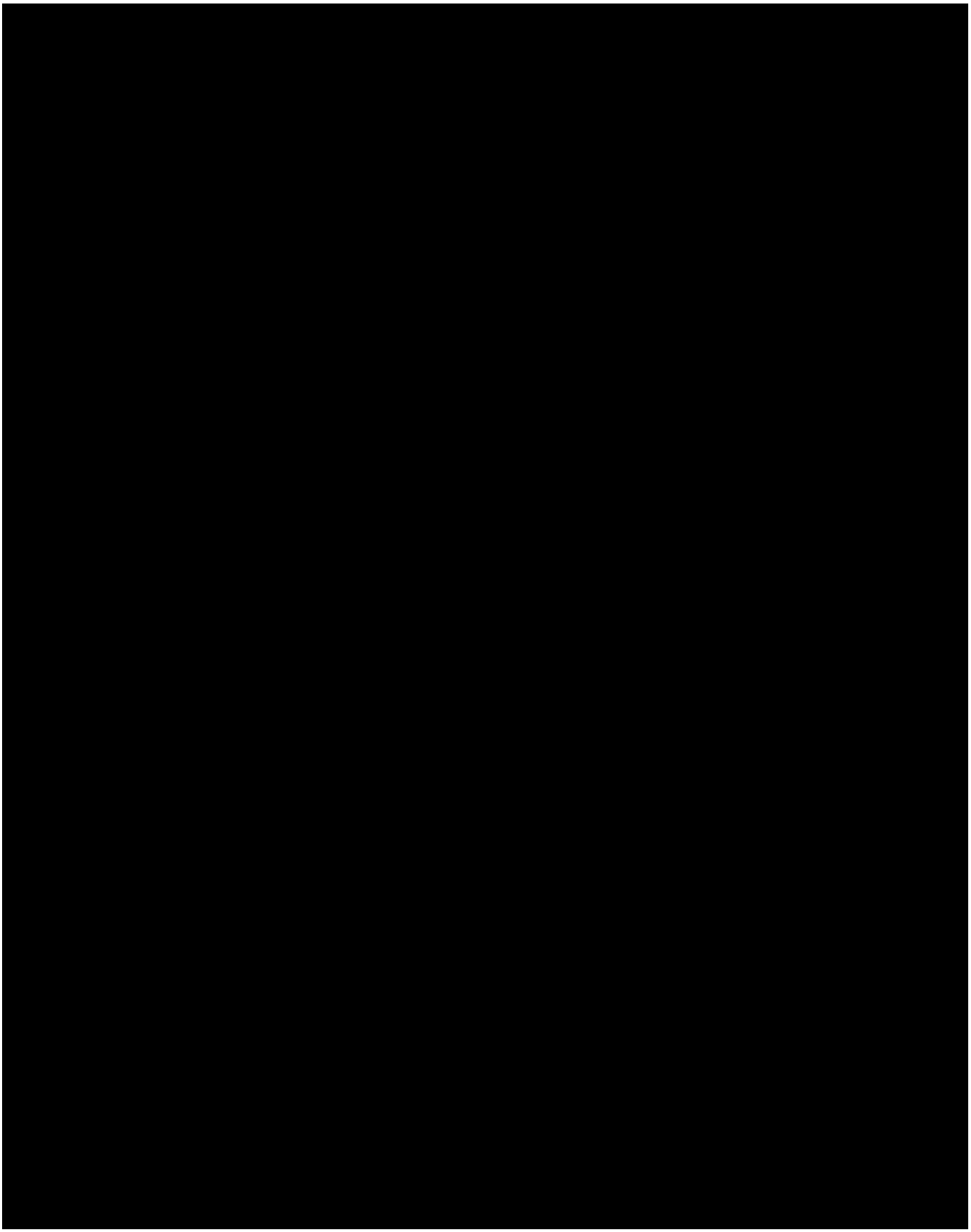


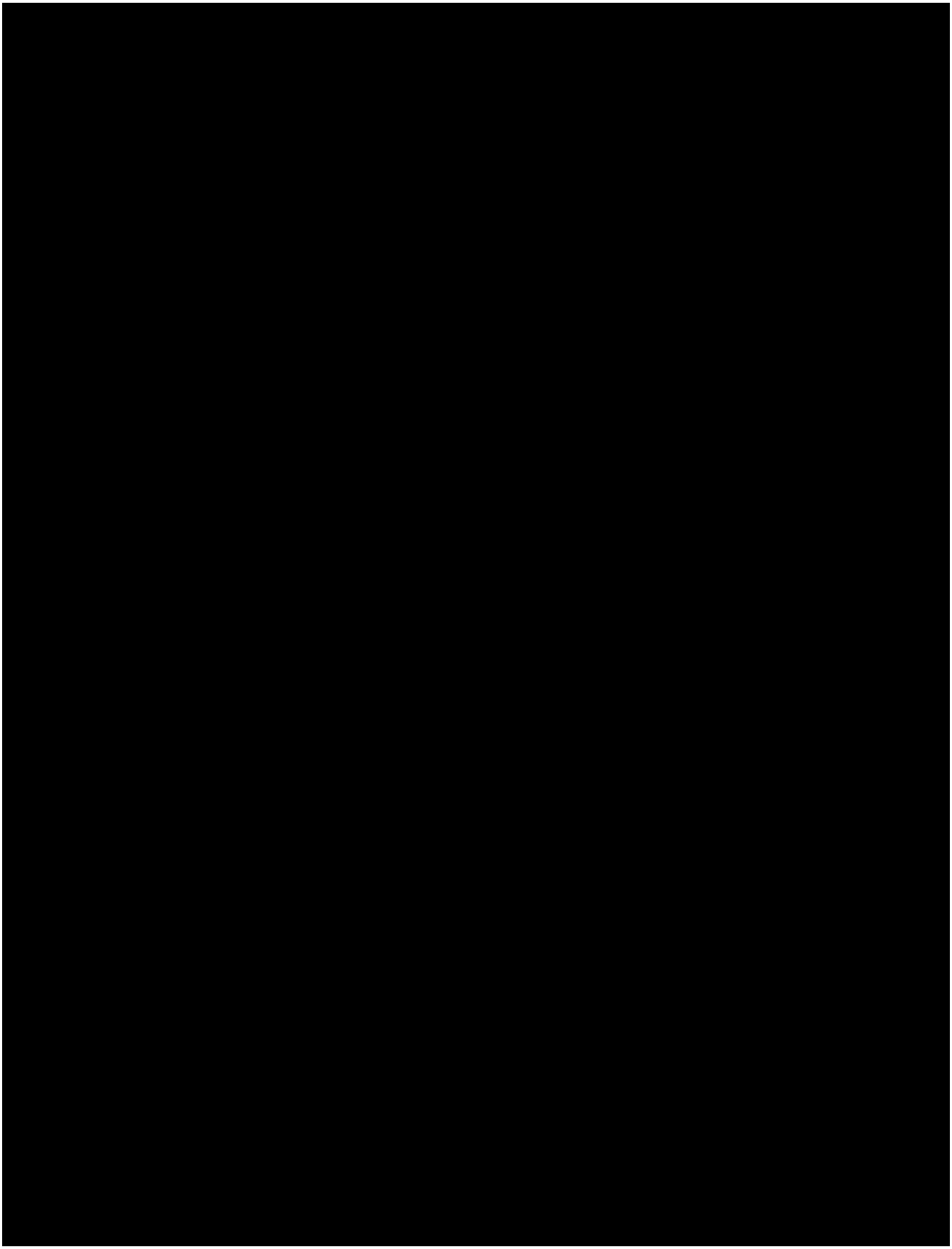


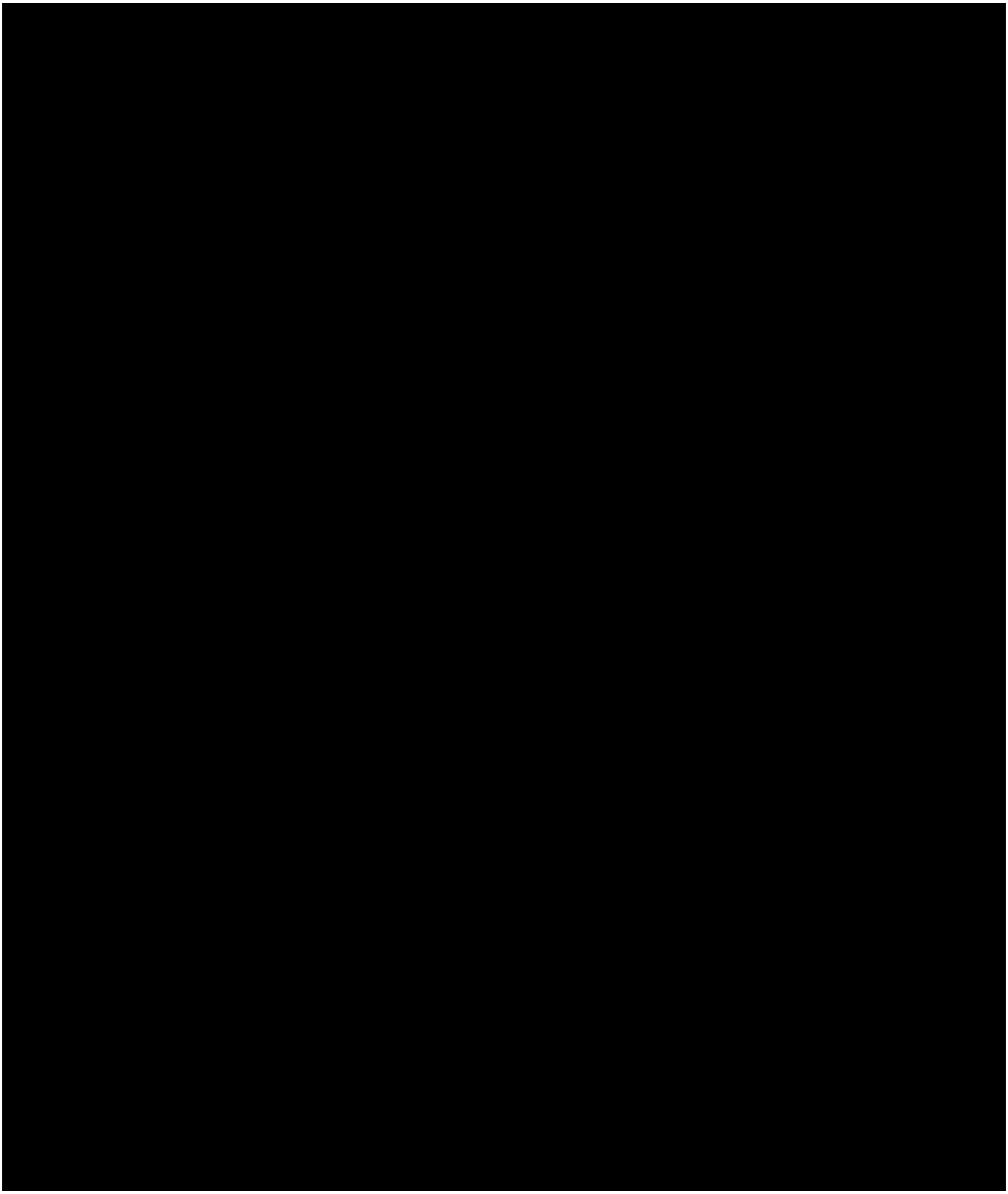


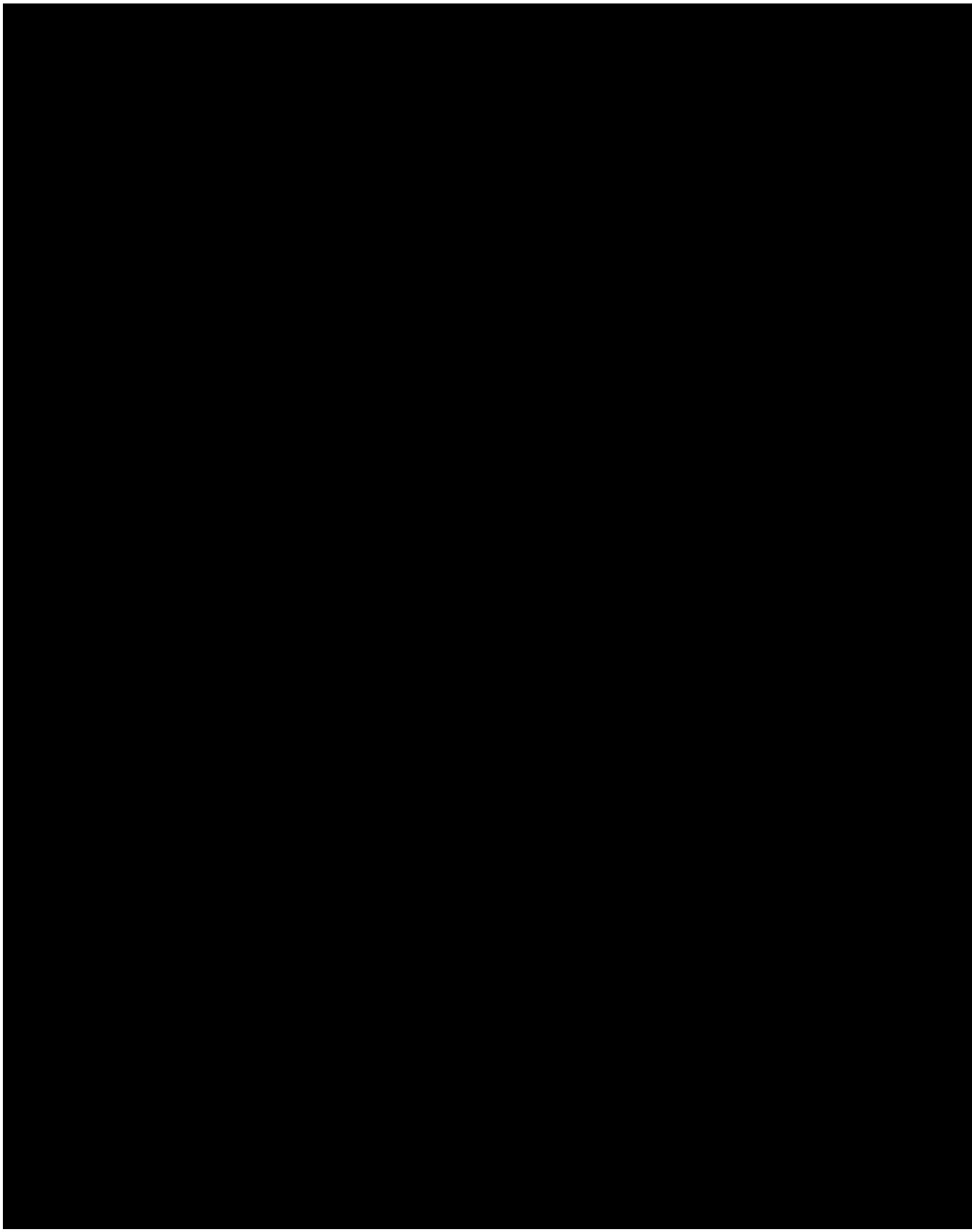


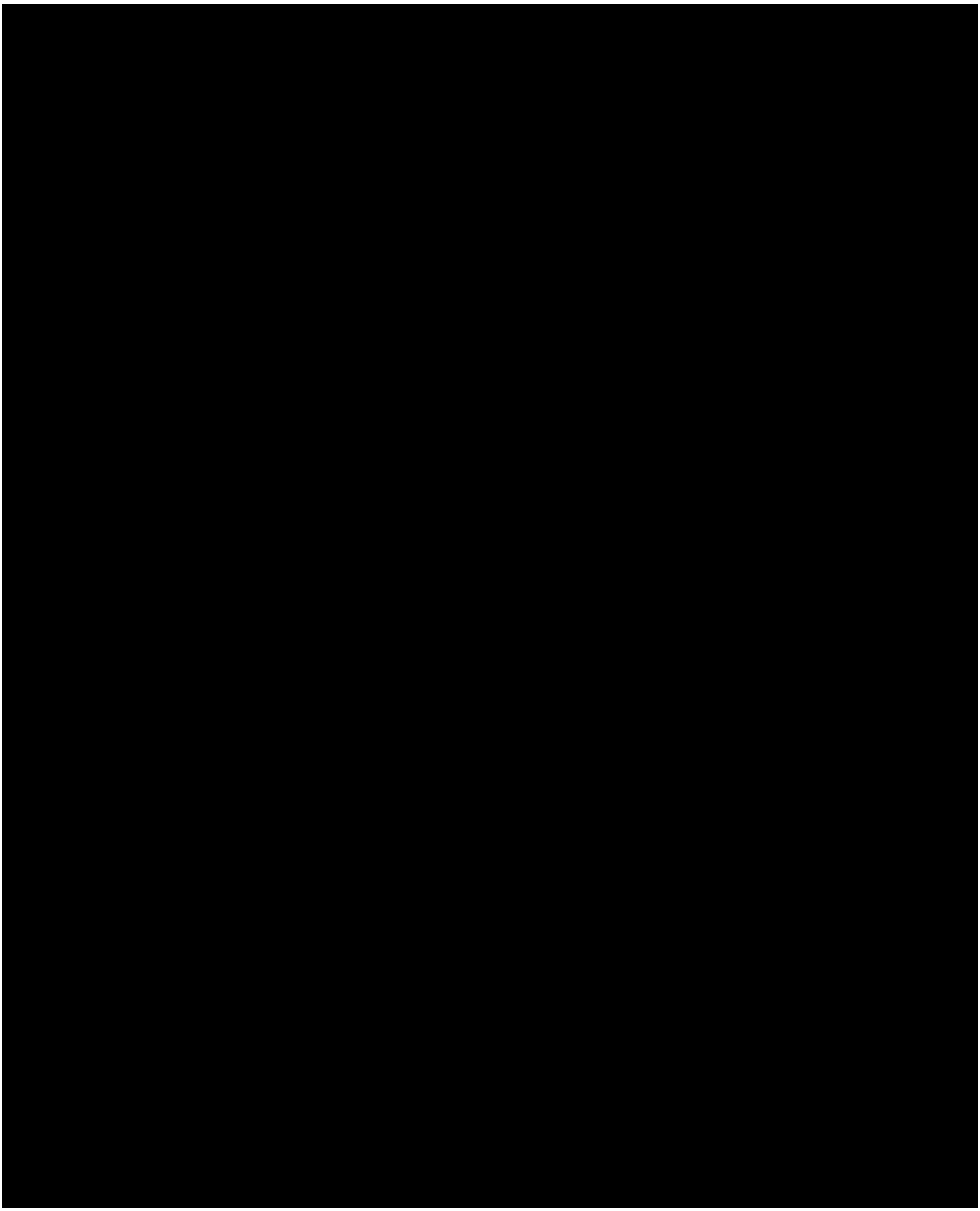


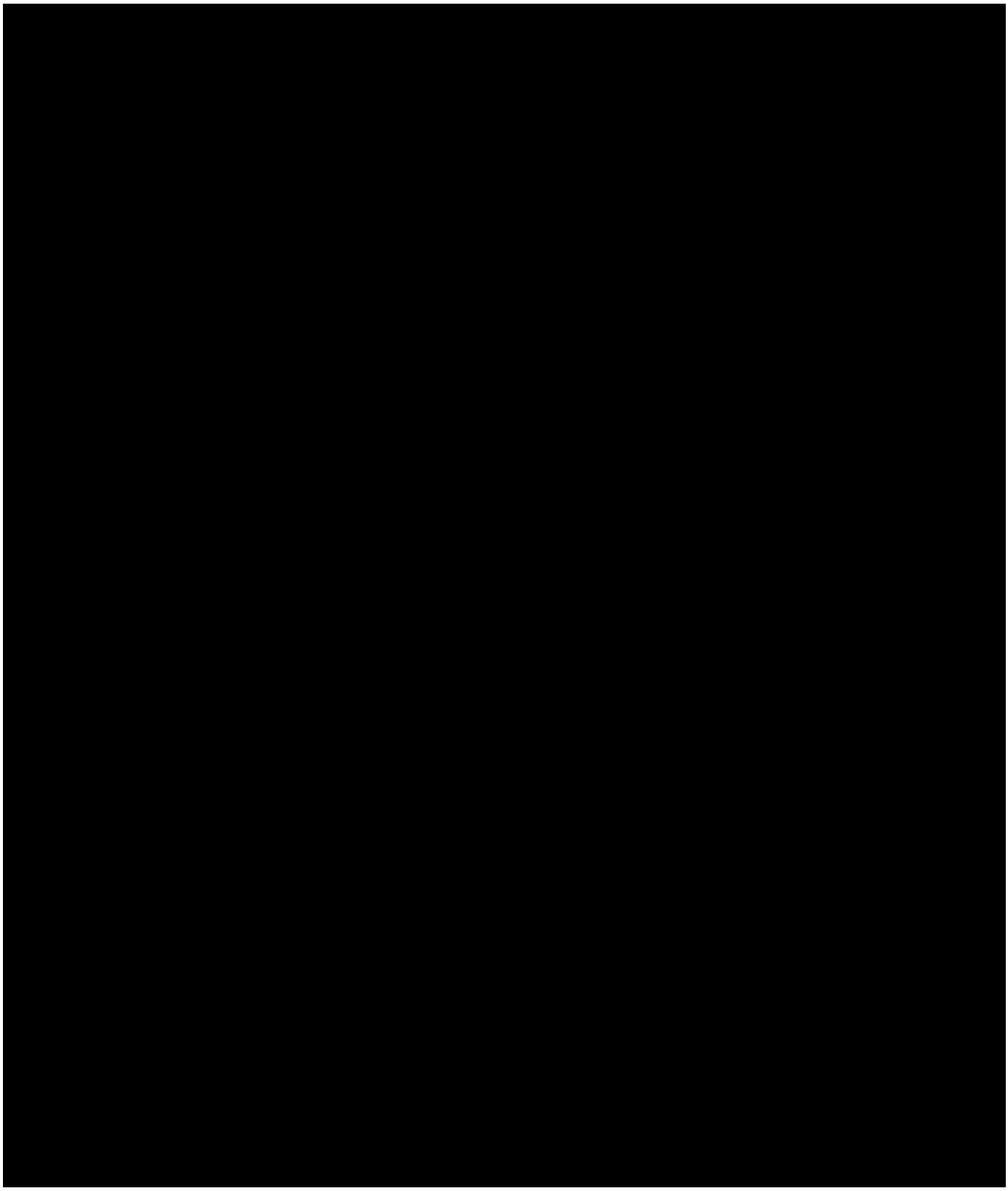


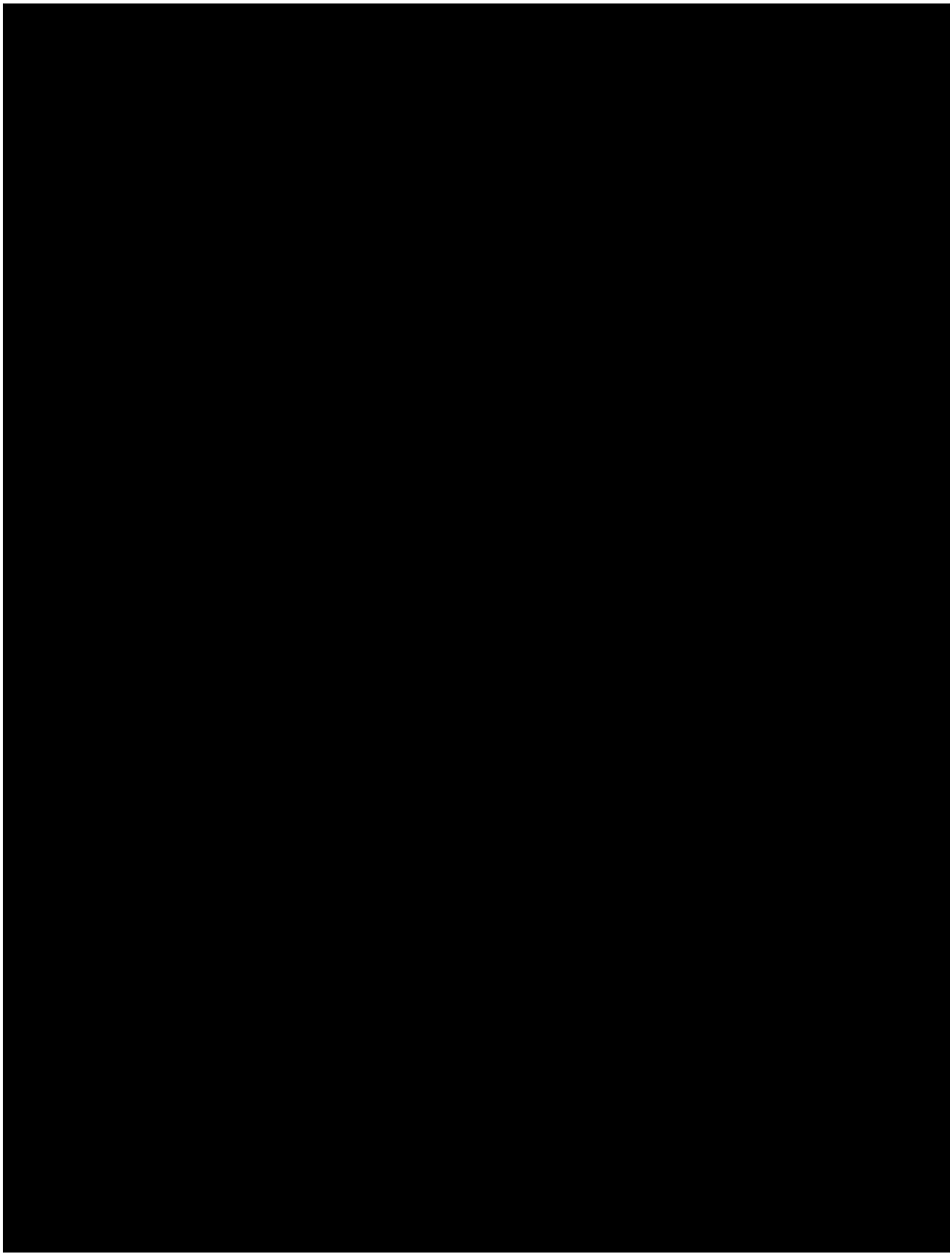


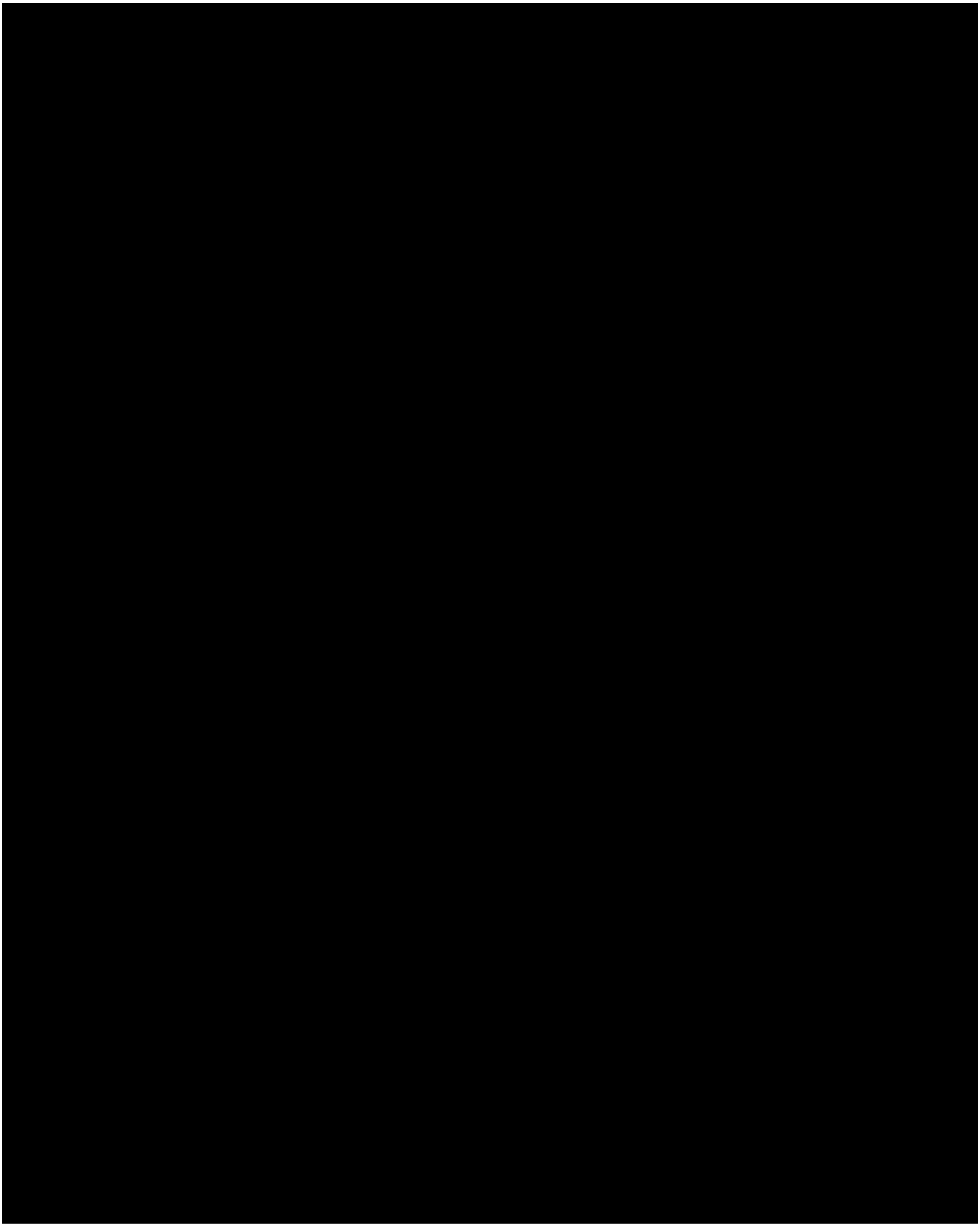


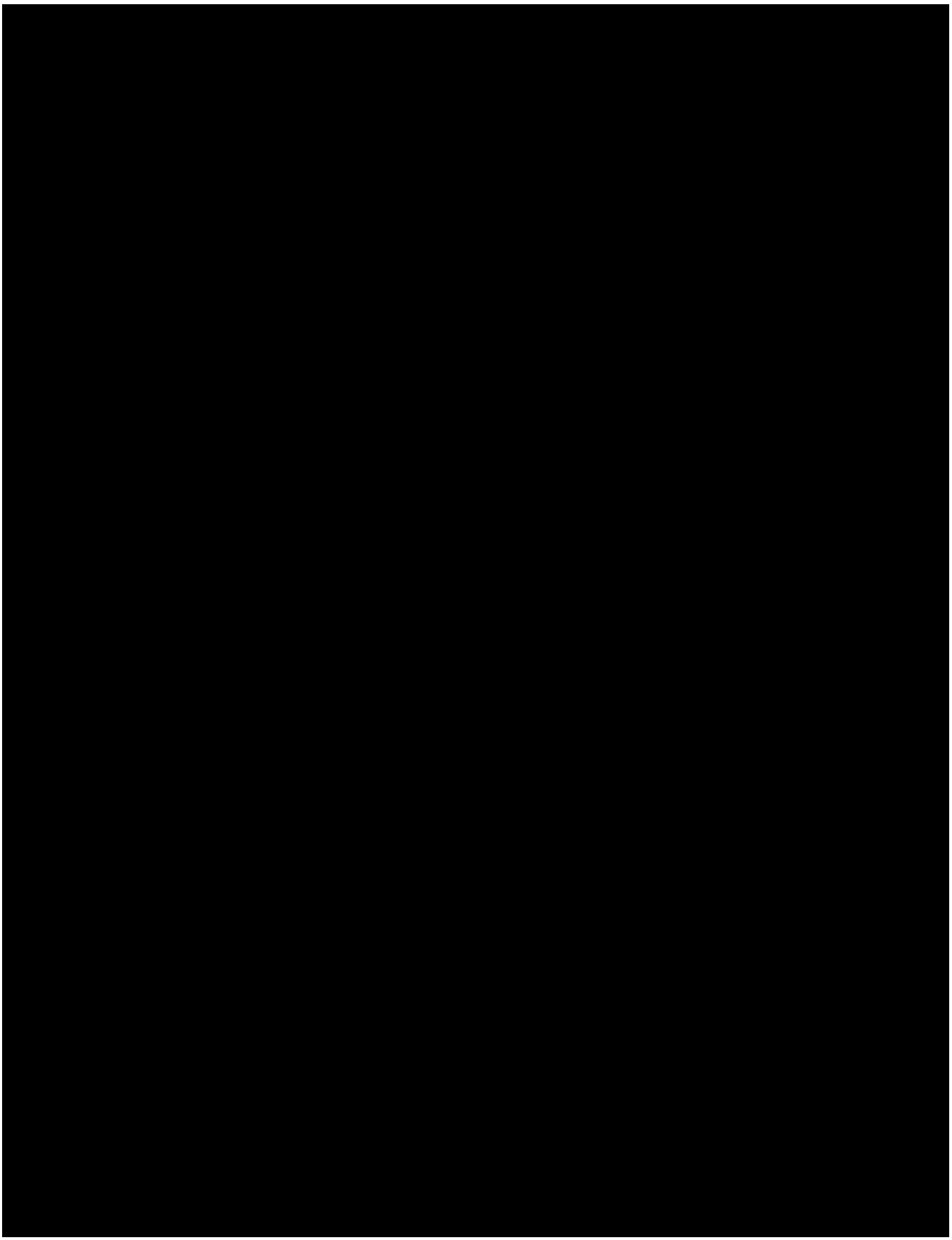


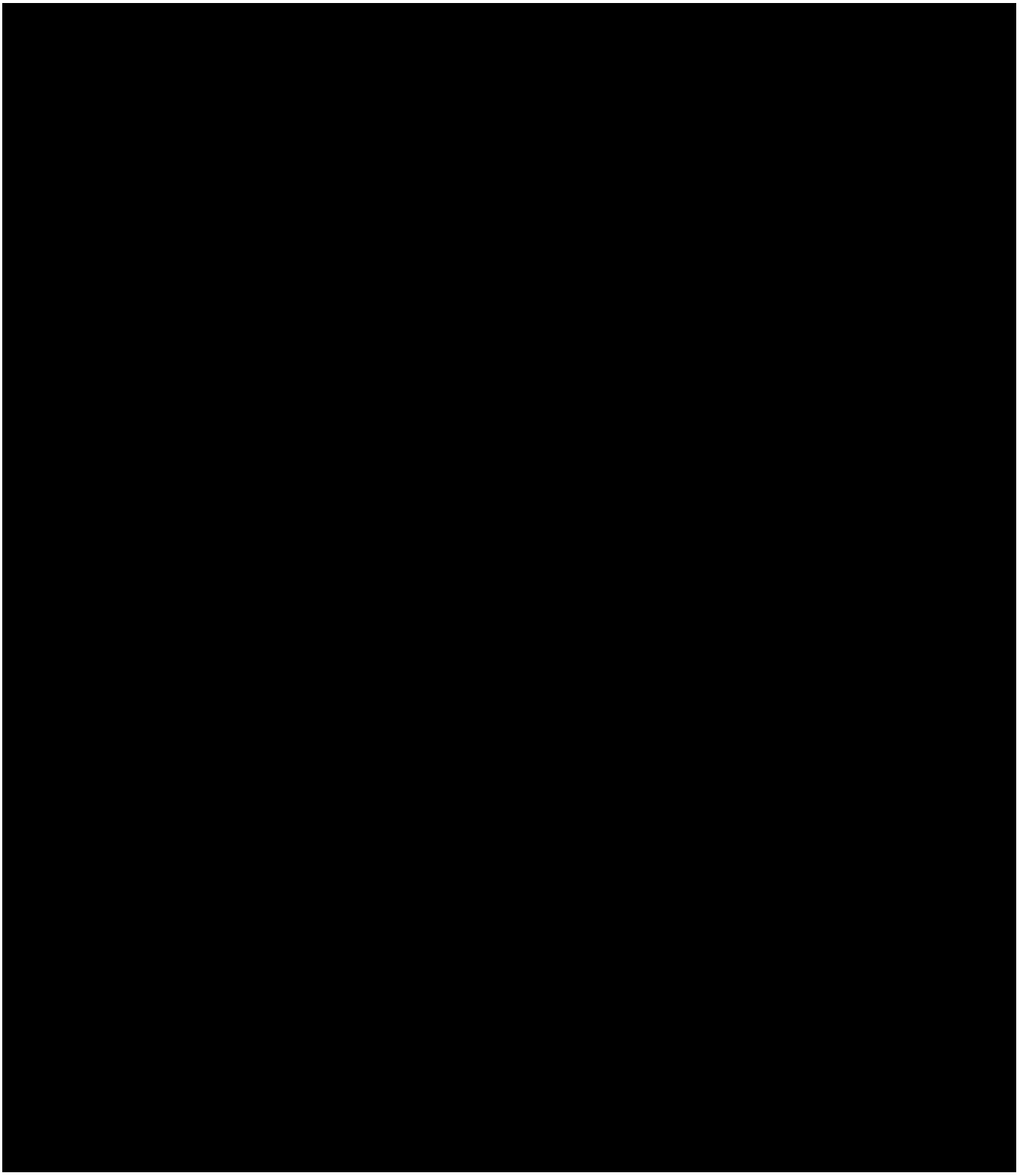


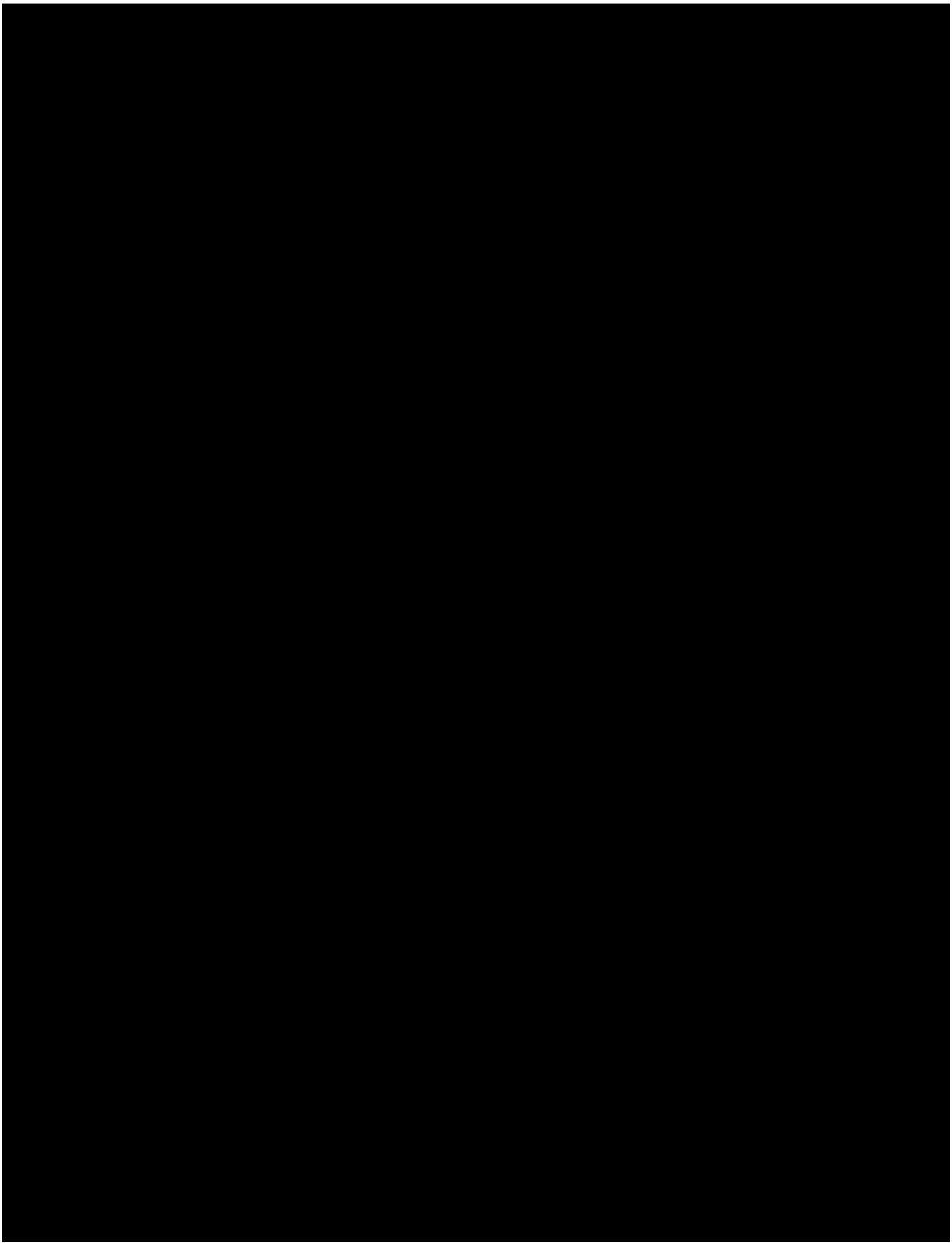


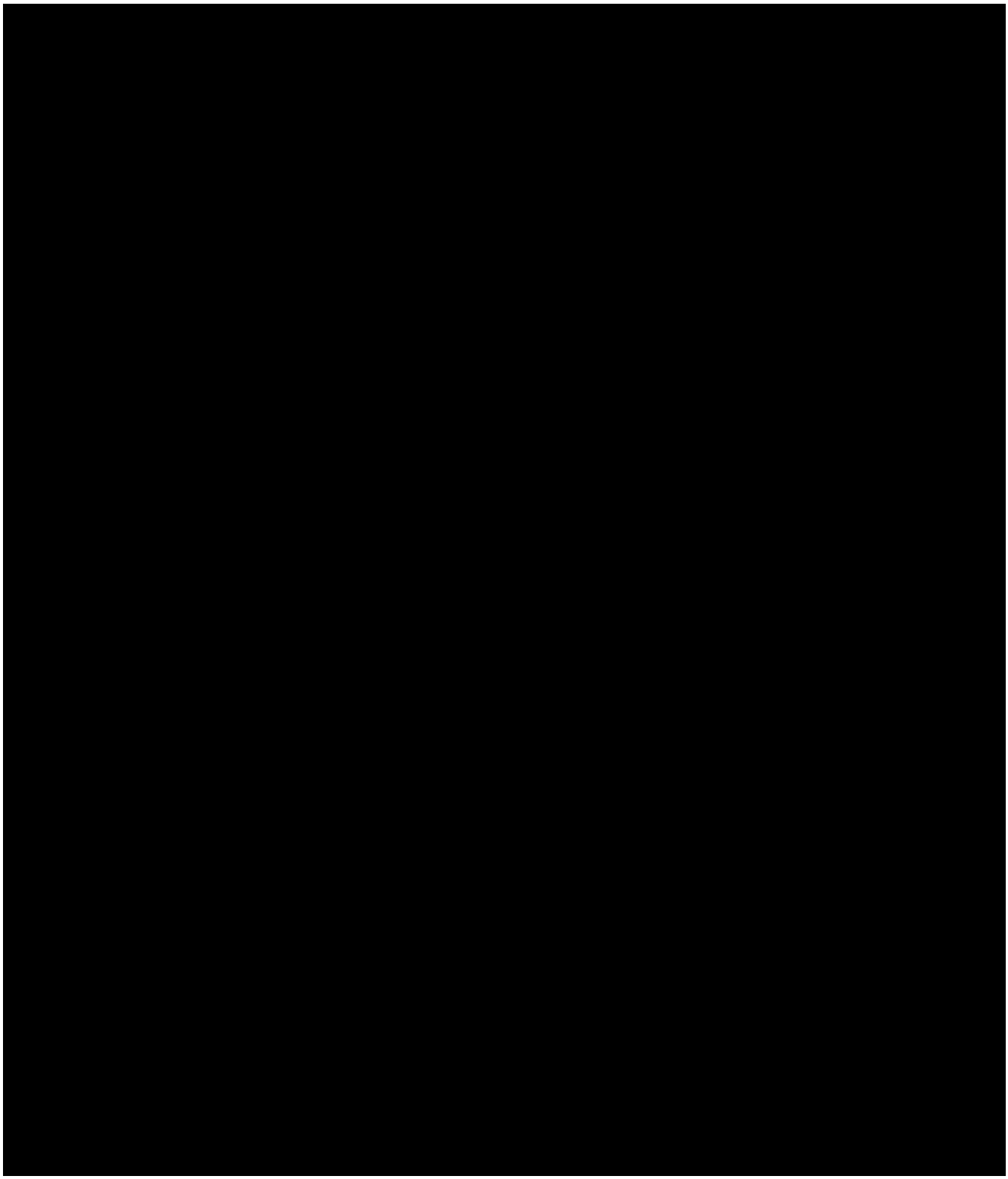


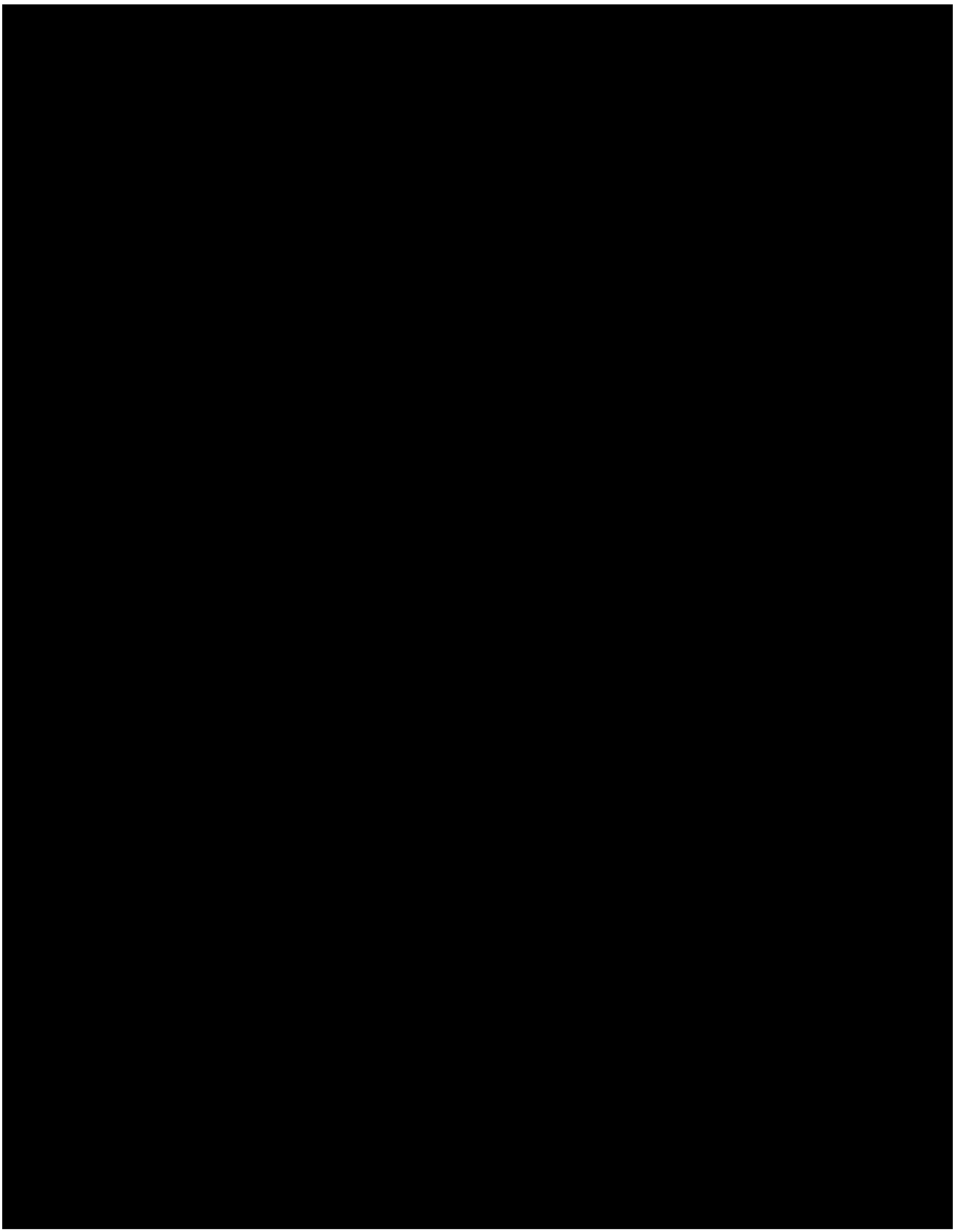


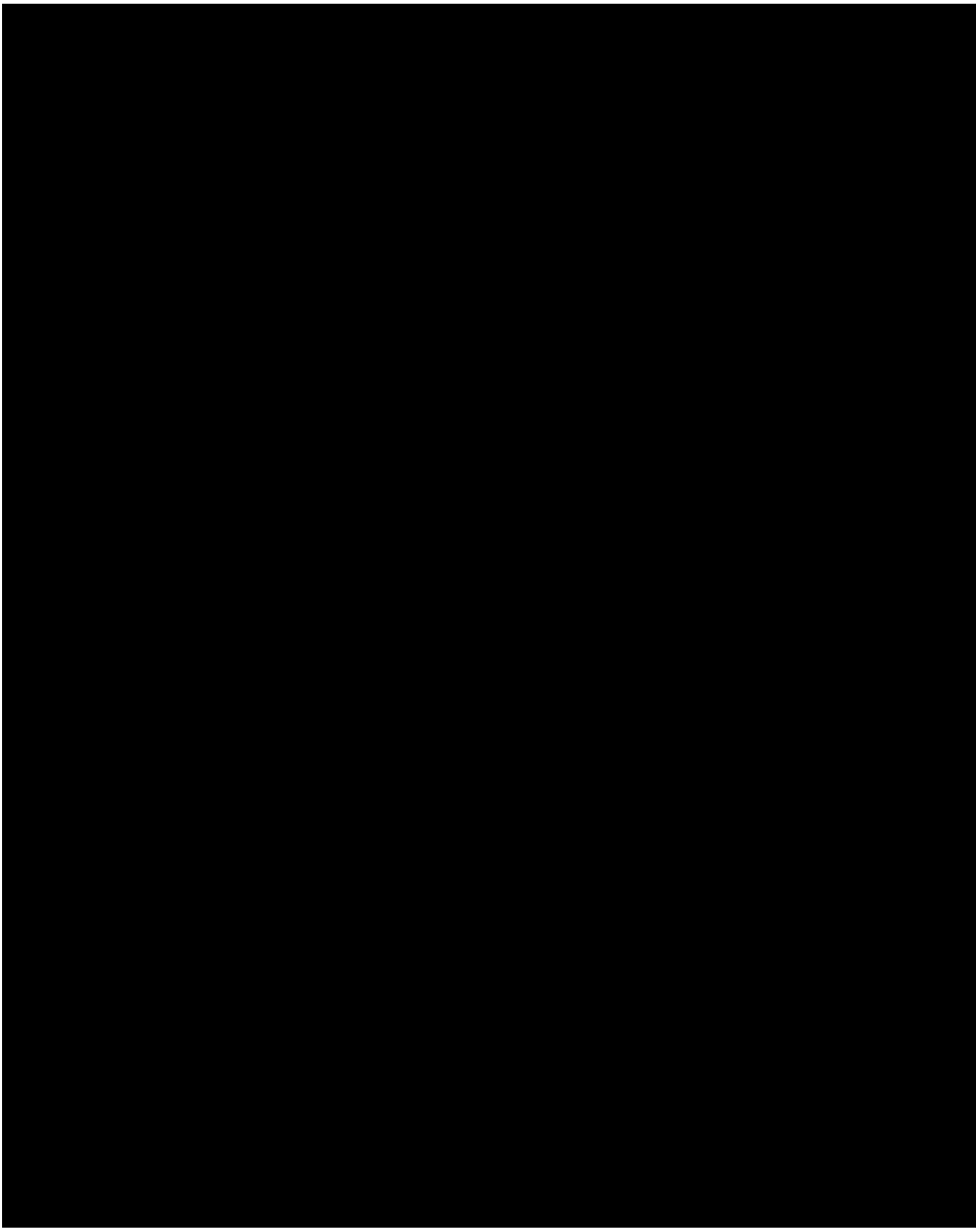


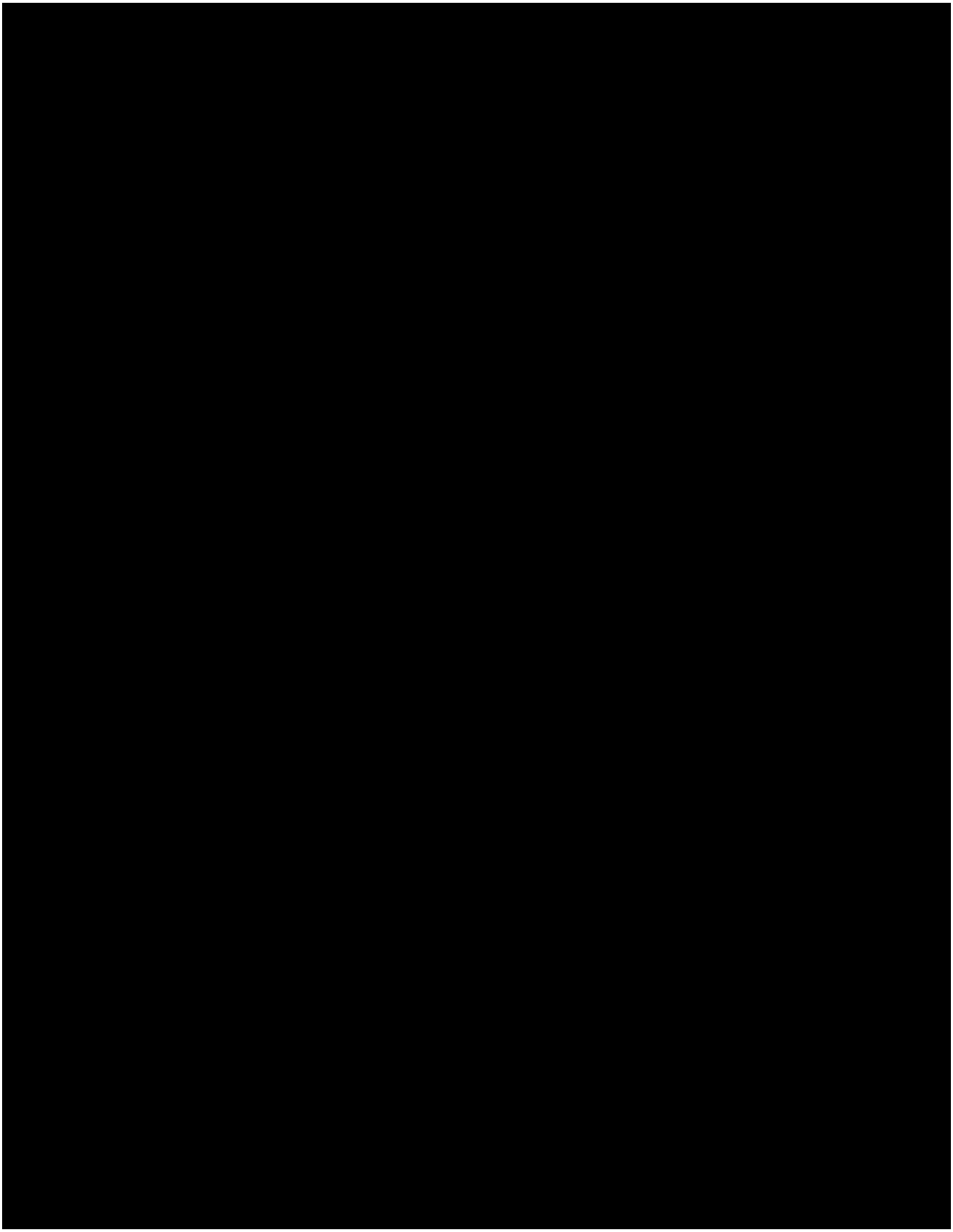


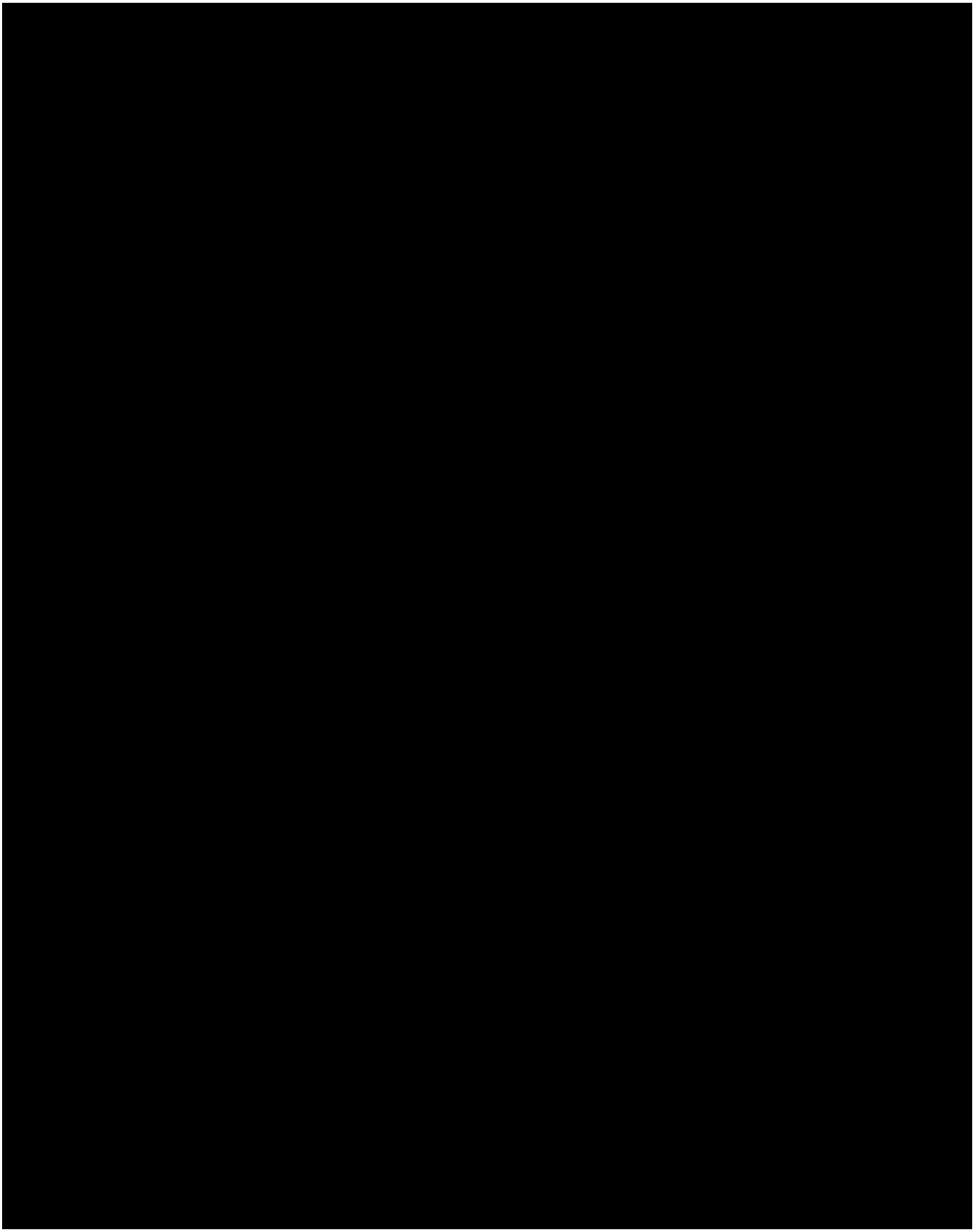


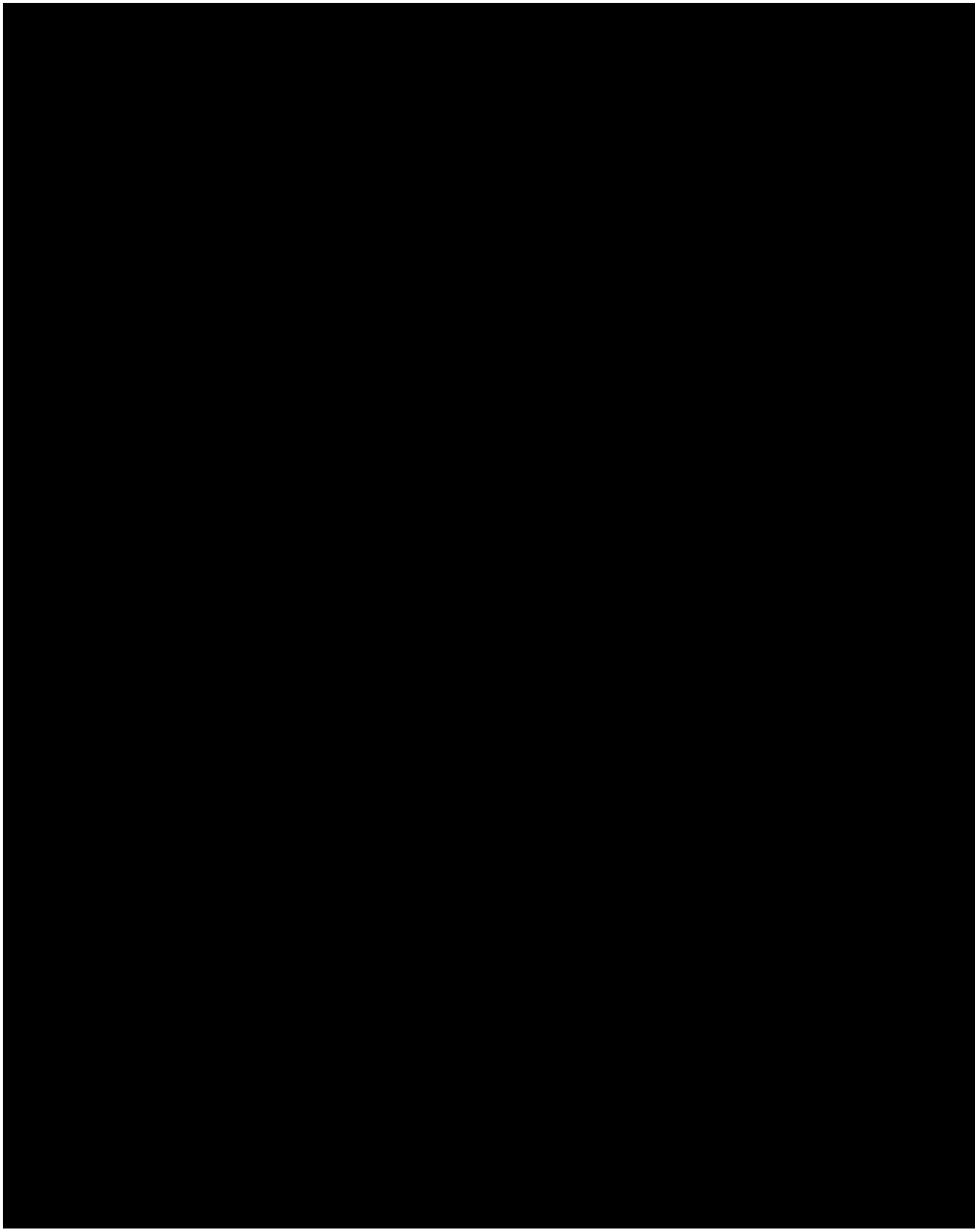


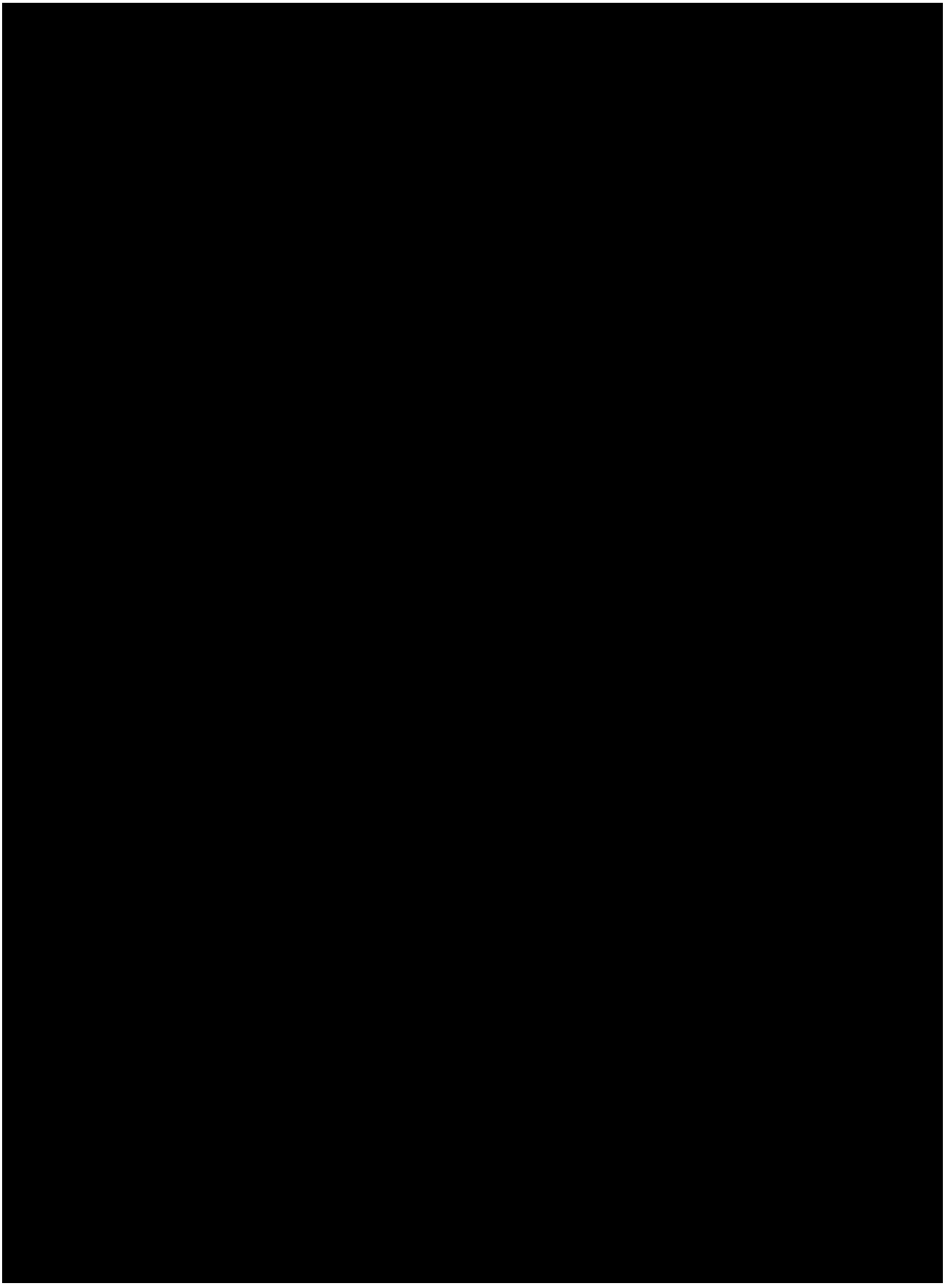


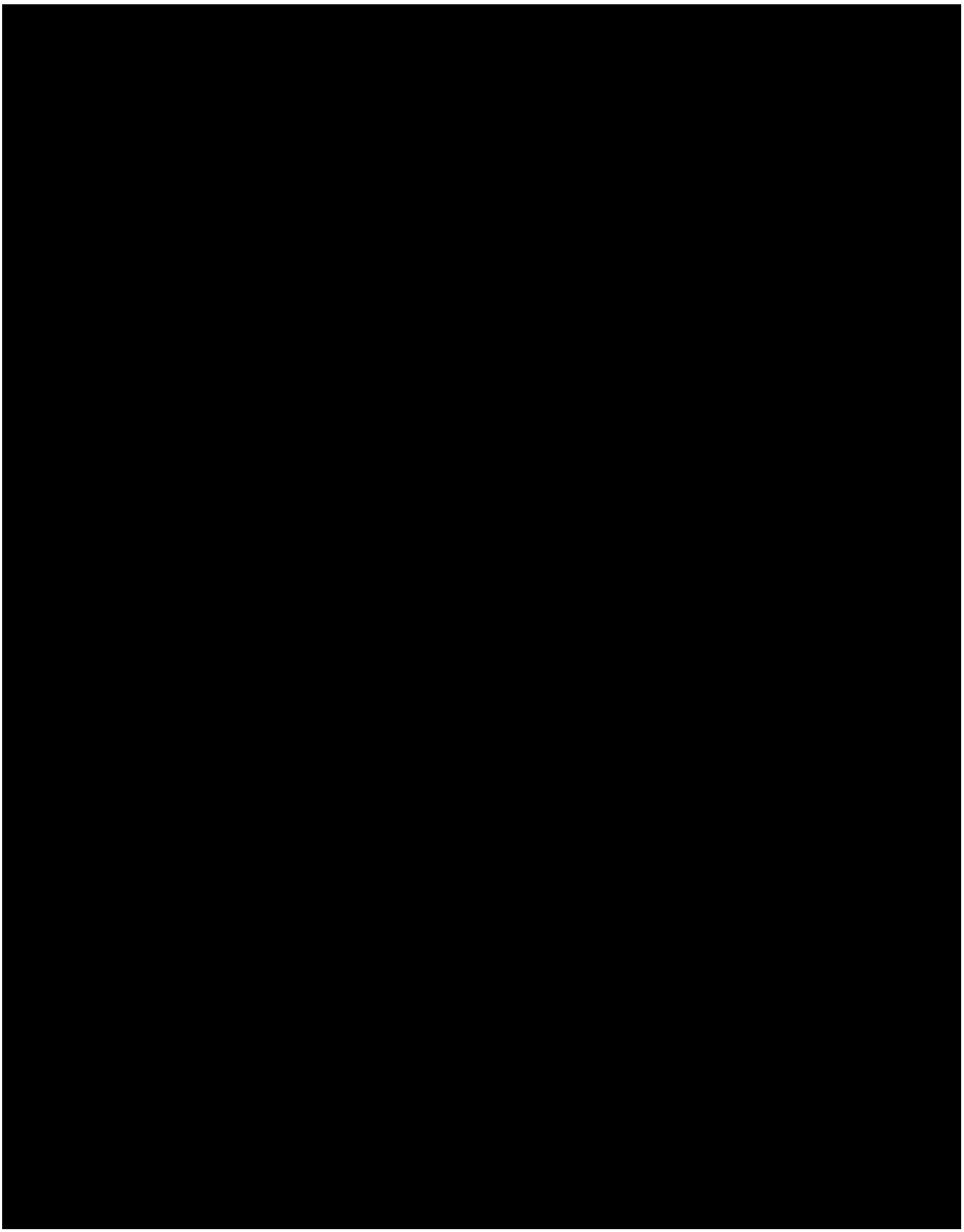


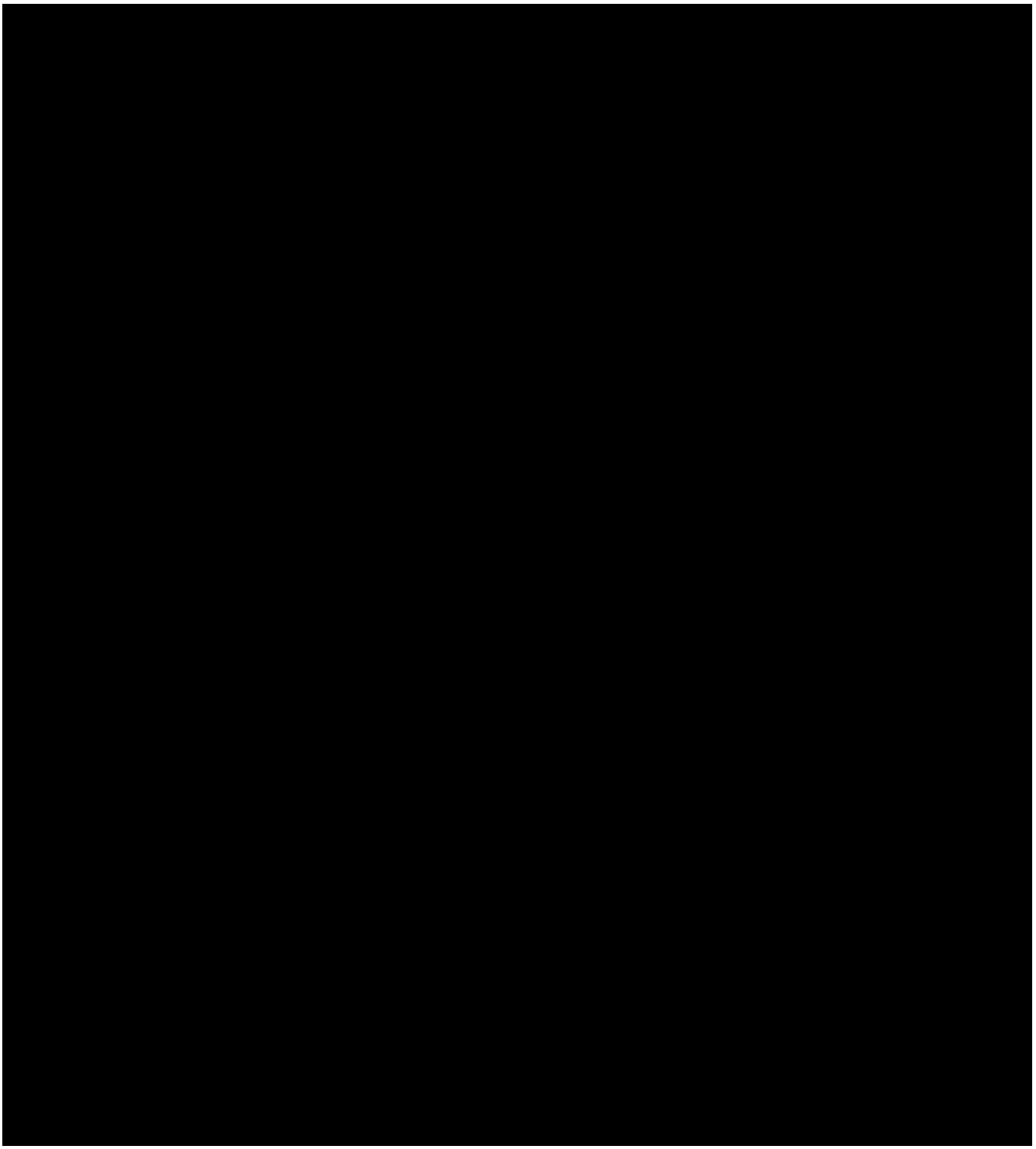


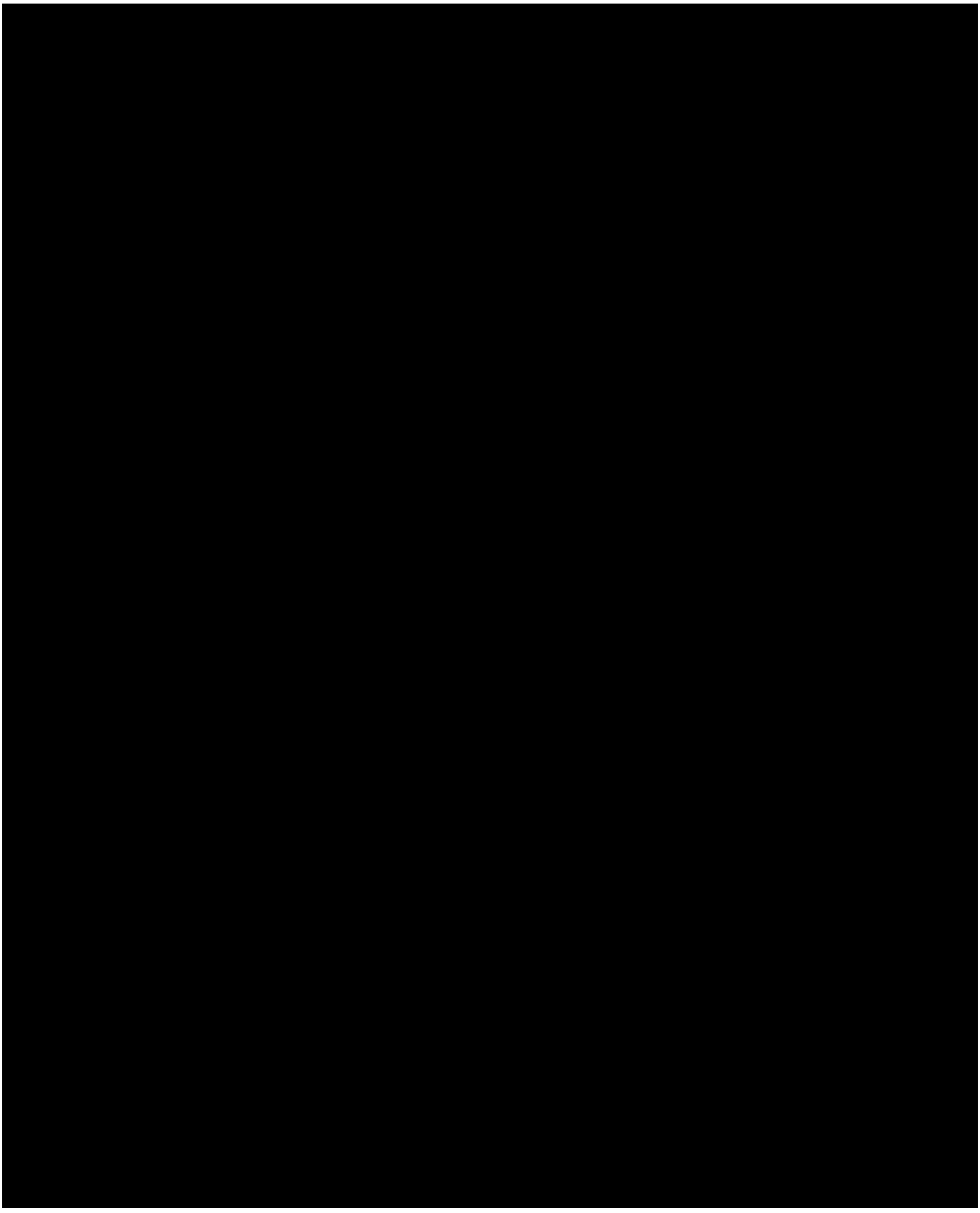


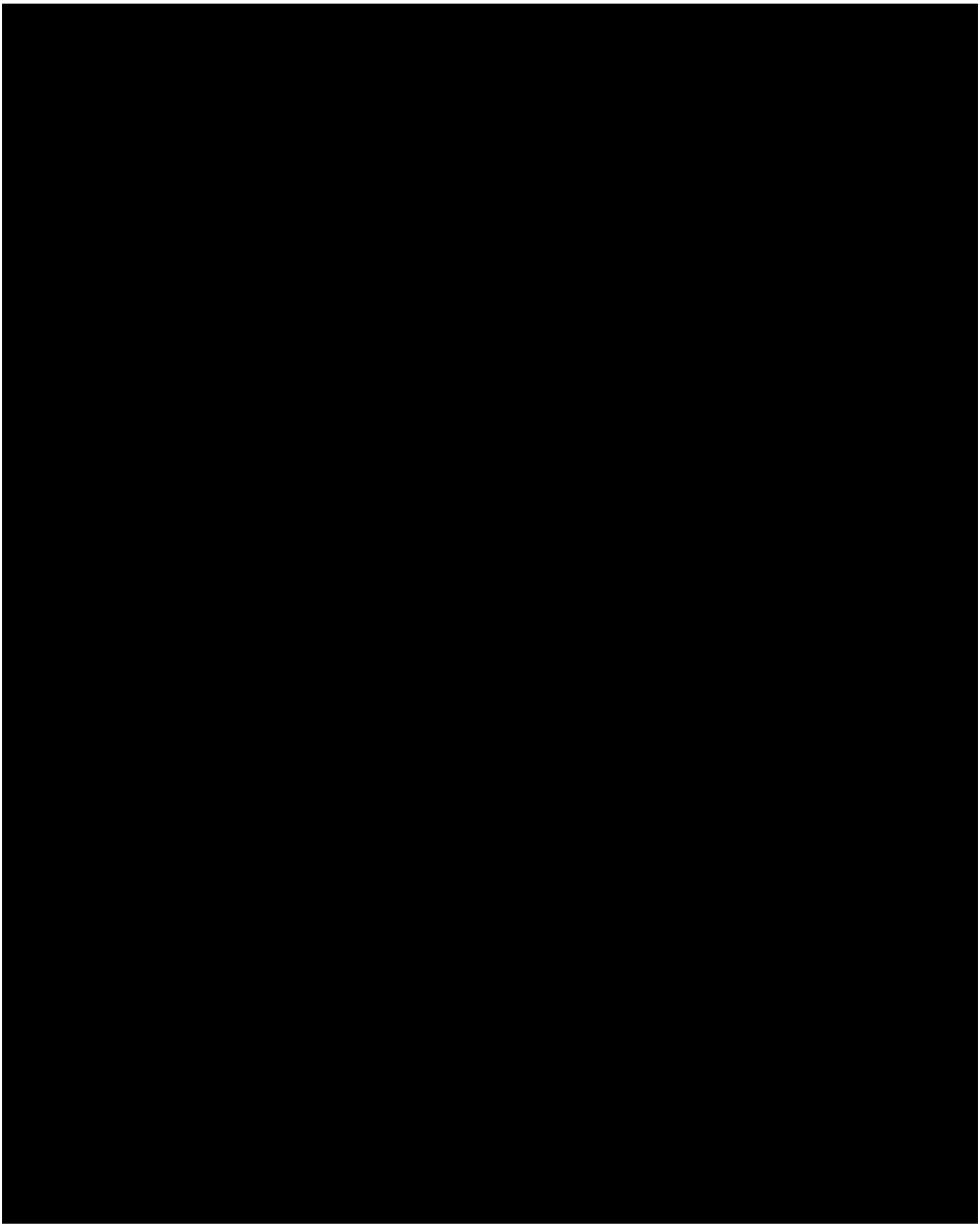












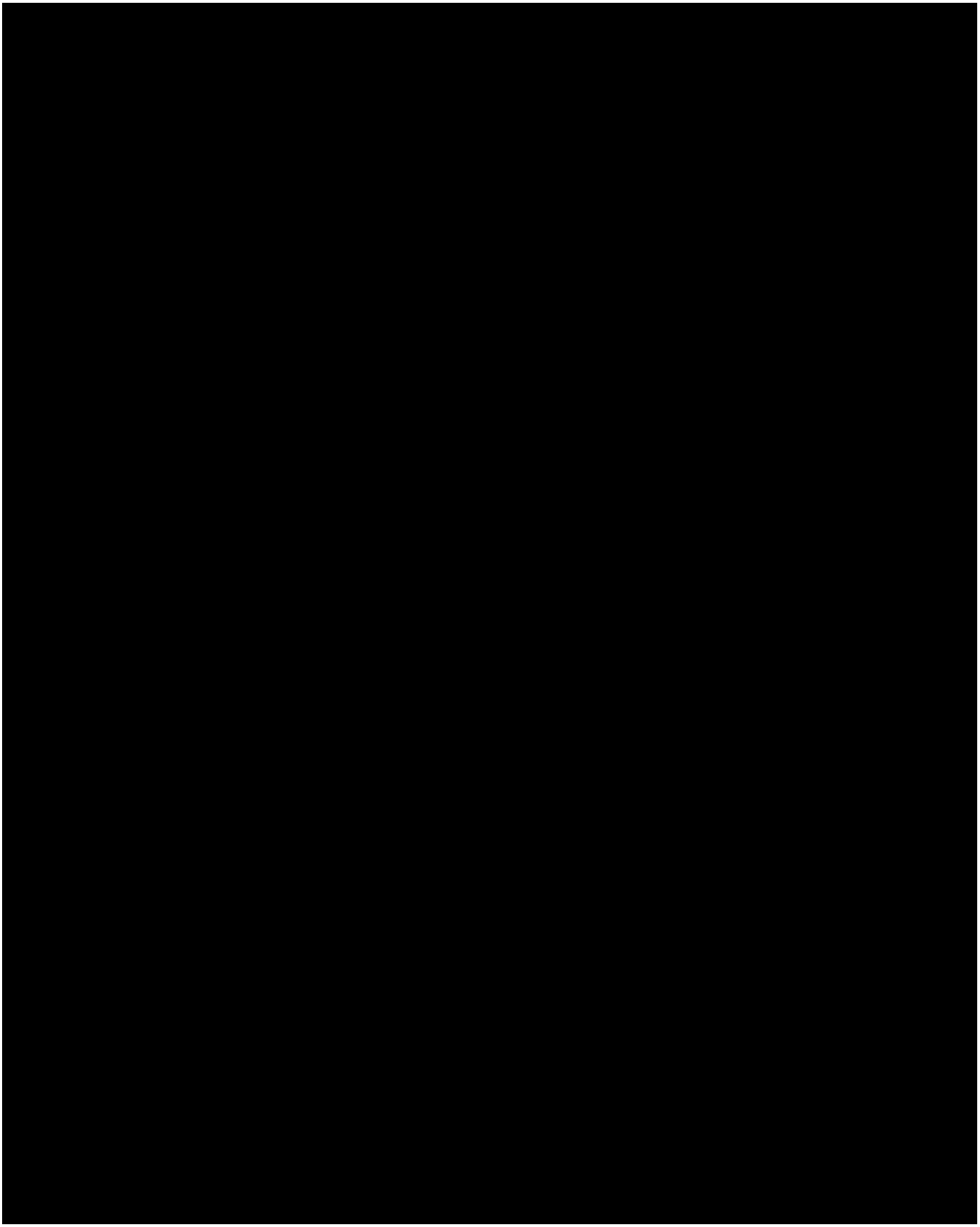
3 DAAT overview

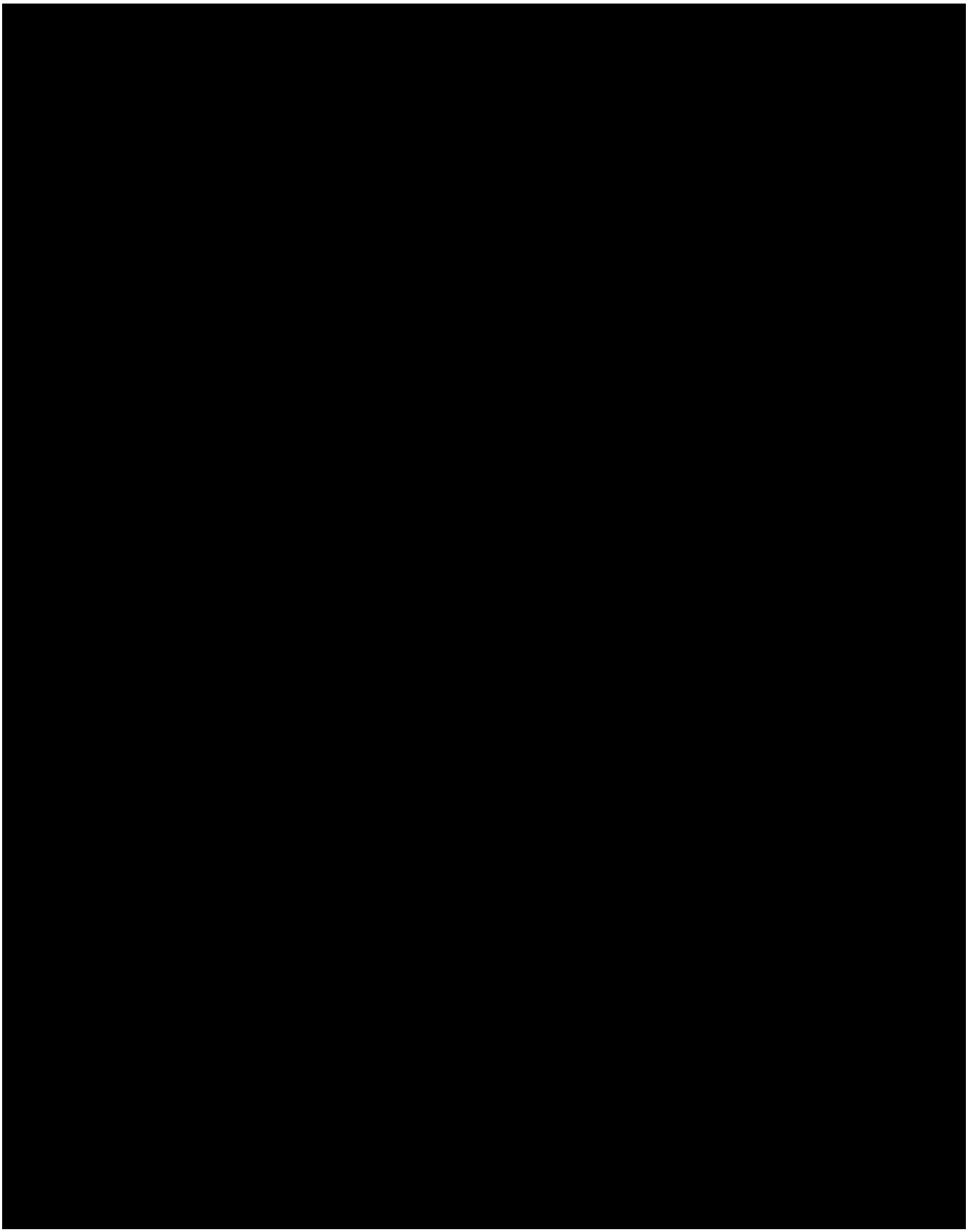
The DAAT system, developed and provided by ED, serves the purpose of assisting with the verification of travel documents, in a twofold manner:

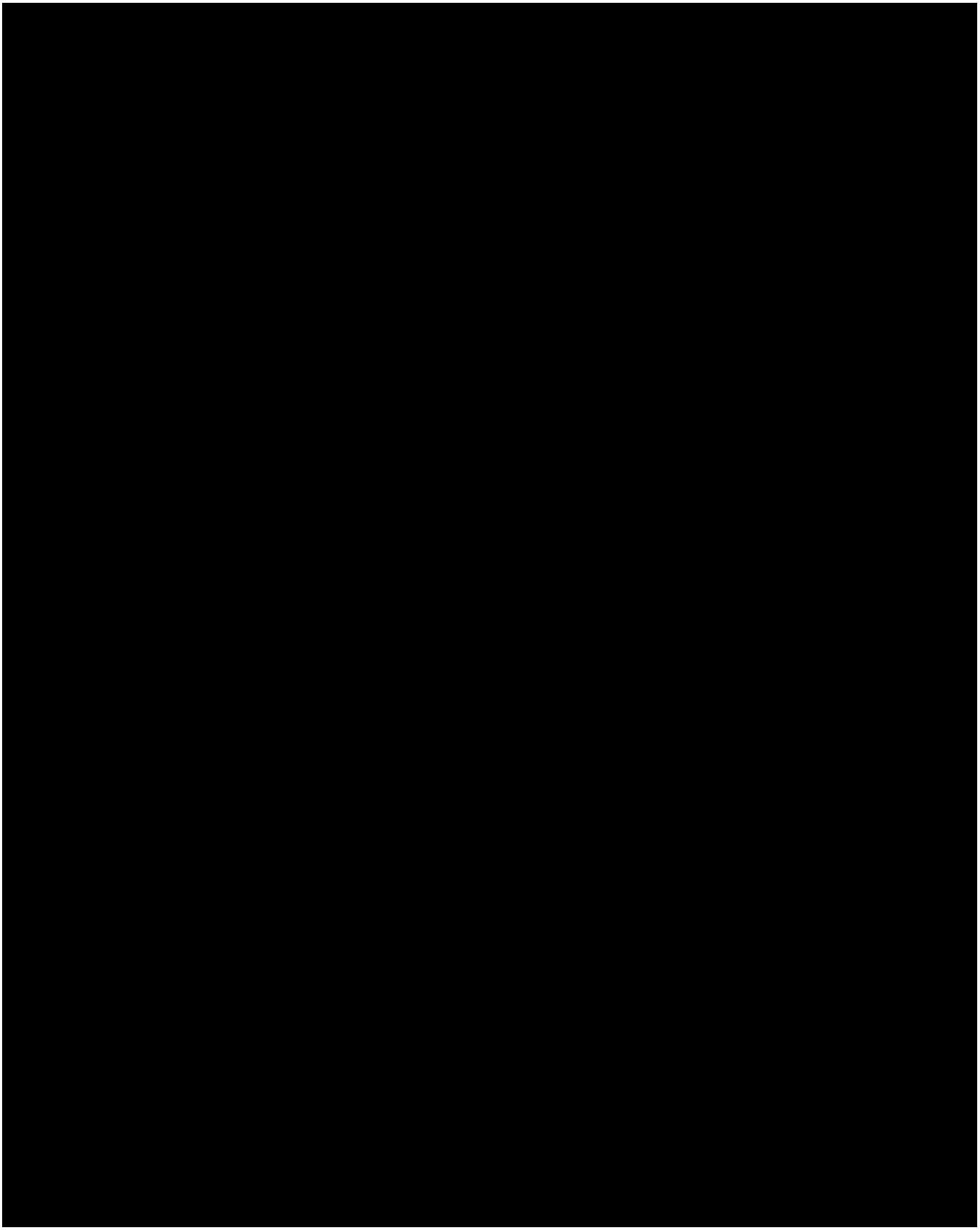
1. Assesses the risk associated with the provided passports in both pre-registration (1st phase) and the border crossing (2nd phase) stages.
2. Provides the border guard with visual information regarding the security features of the passport being processed, thus greatly assisting with the manual check.

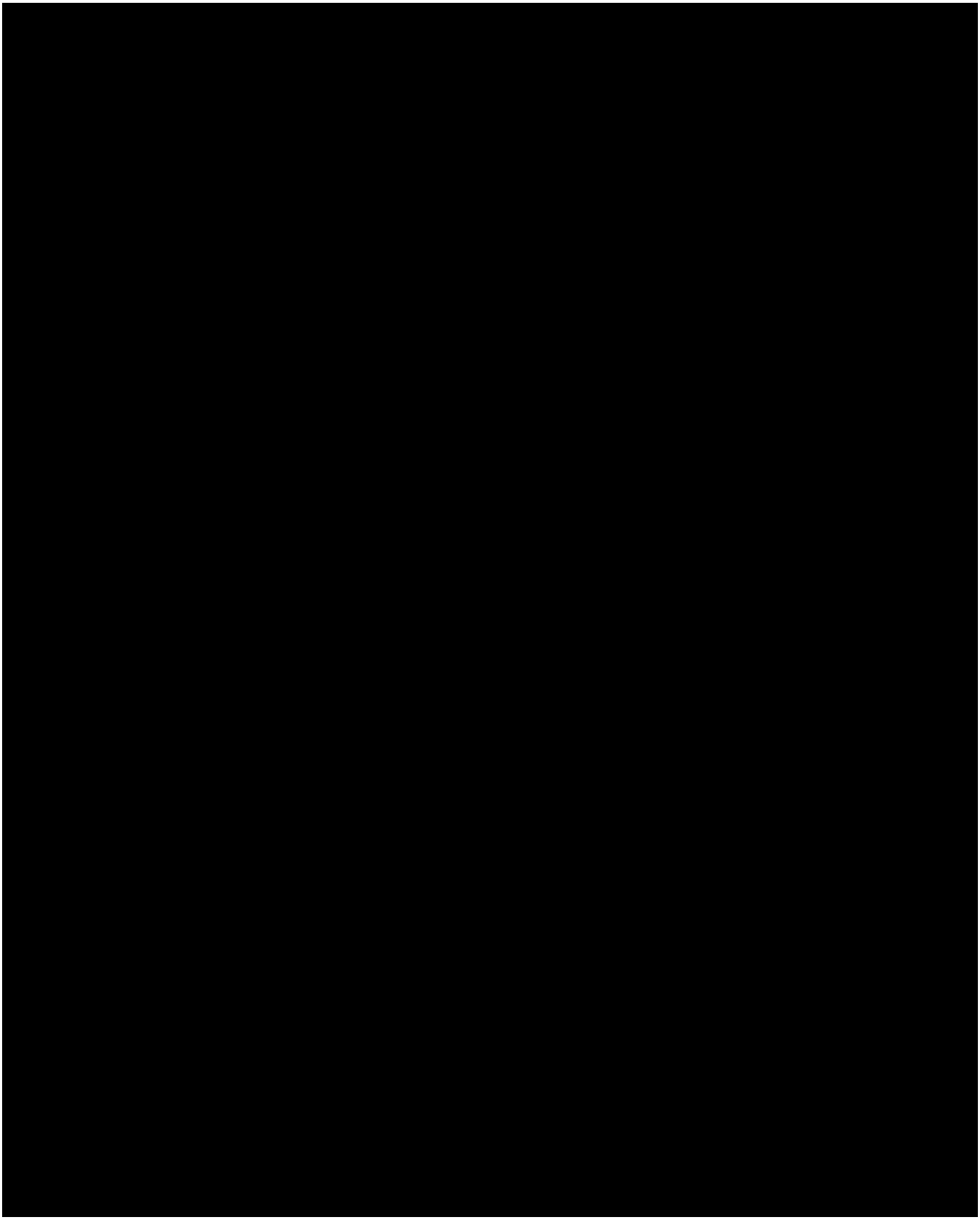
The above are performed in a fully-automated fashion, and the results/responses are generated within seconds of passport processing.

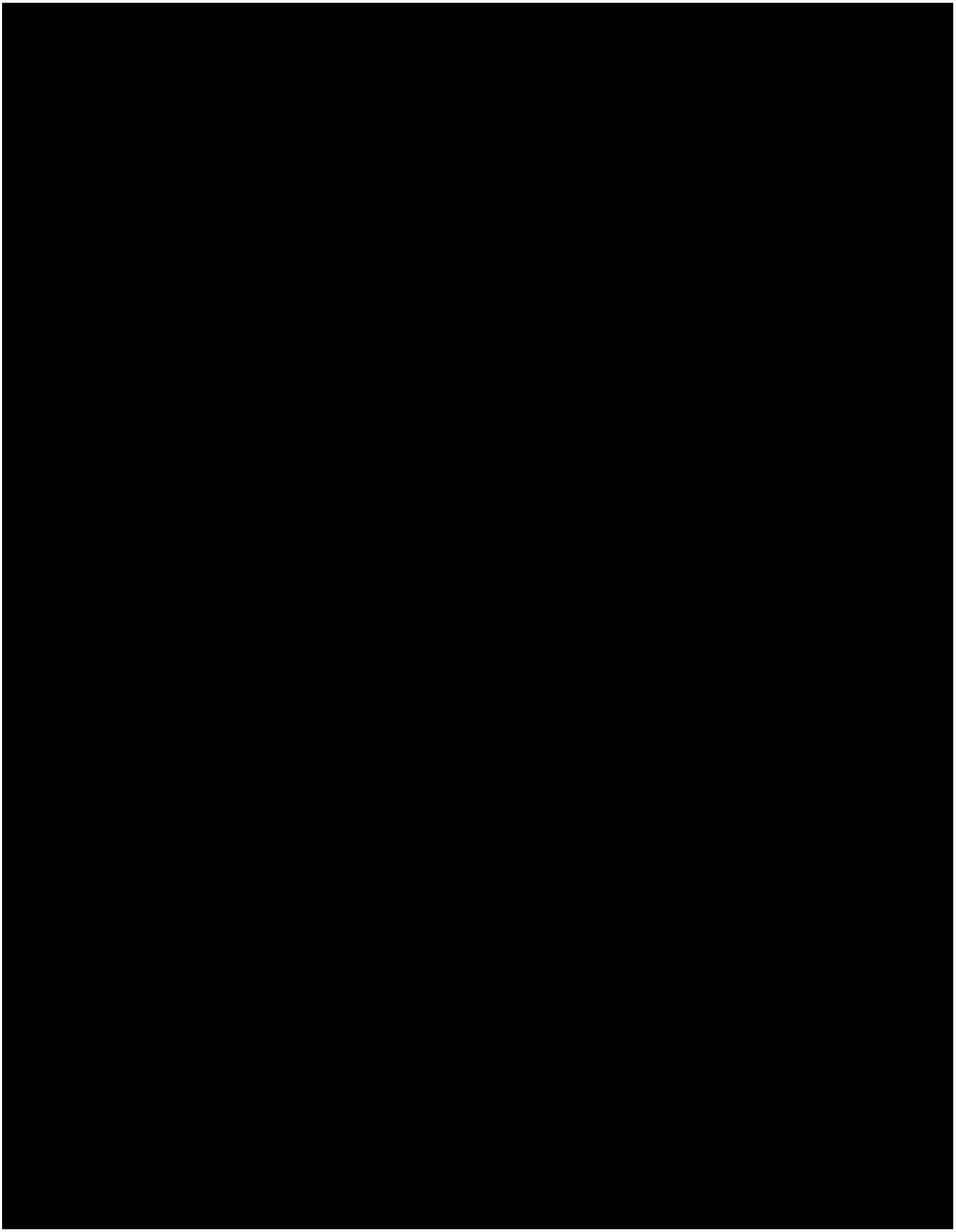
In the pre-registration phase the system employs OCR technology while during the check phase, document scanners/readers will be used, in order to achieve unparalleled scrutiny of travel documents for signs of falsification or counterfeiting.

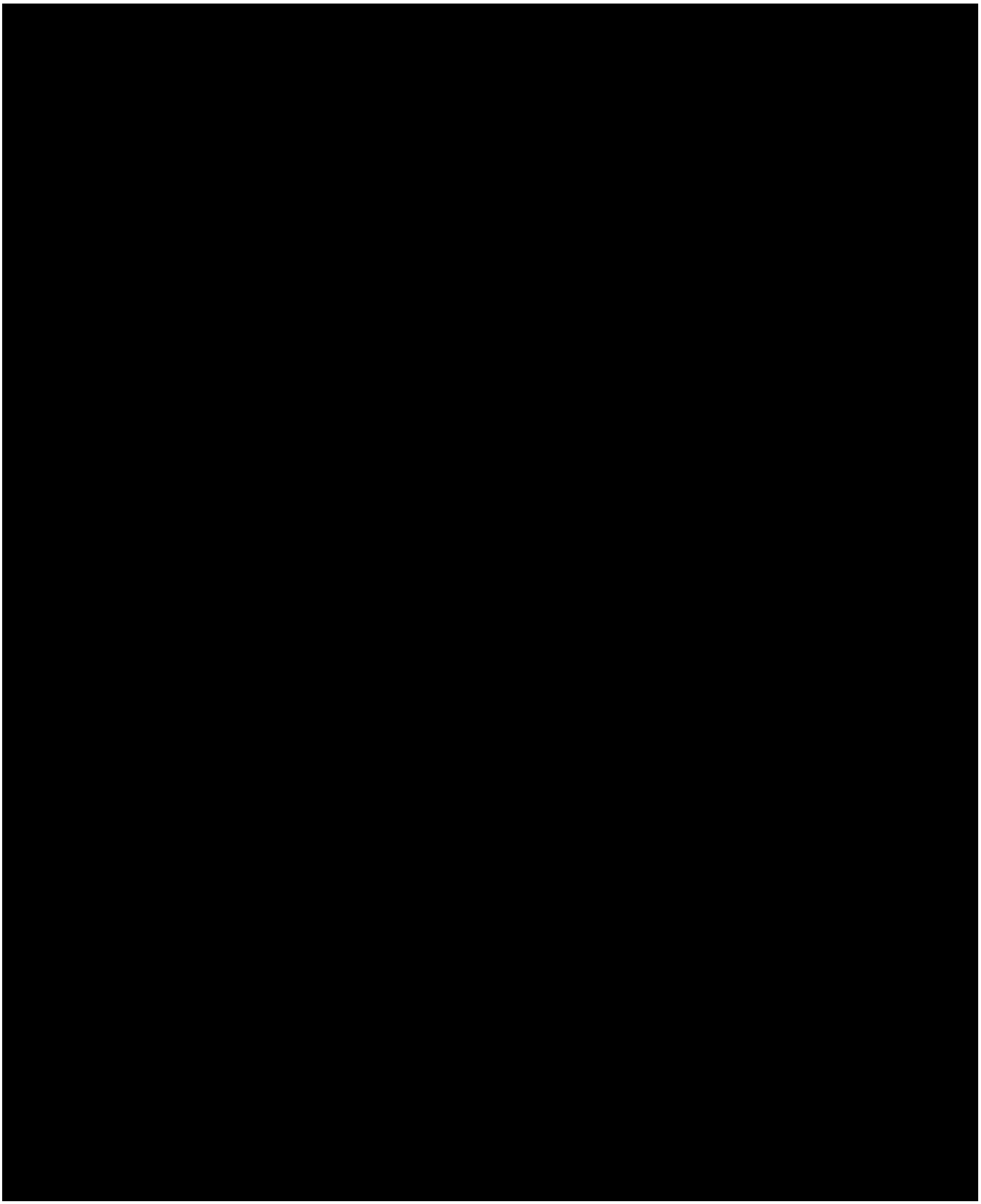


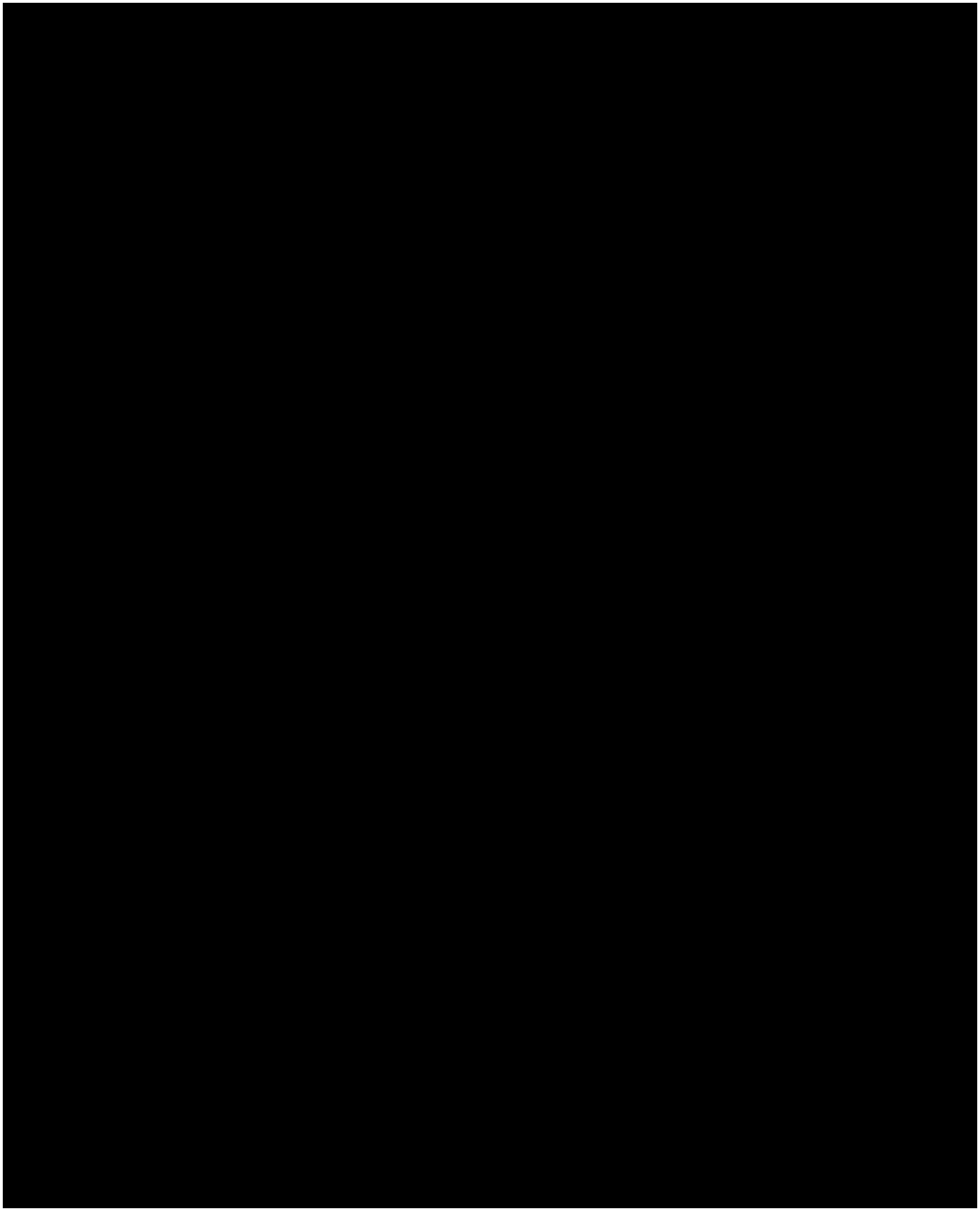


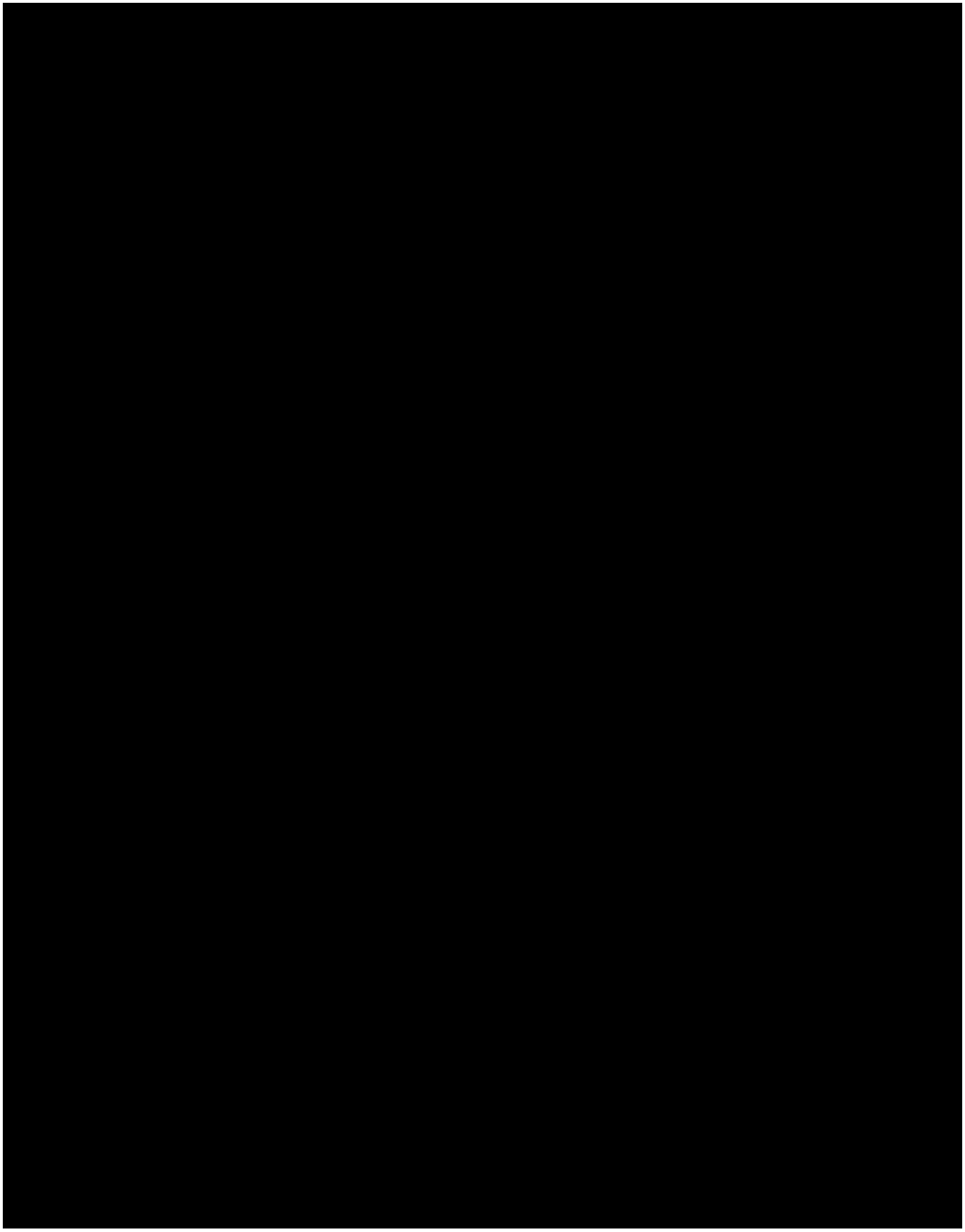


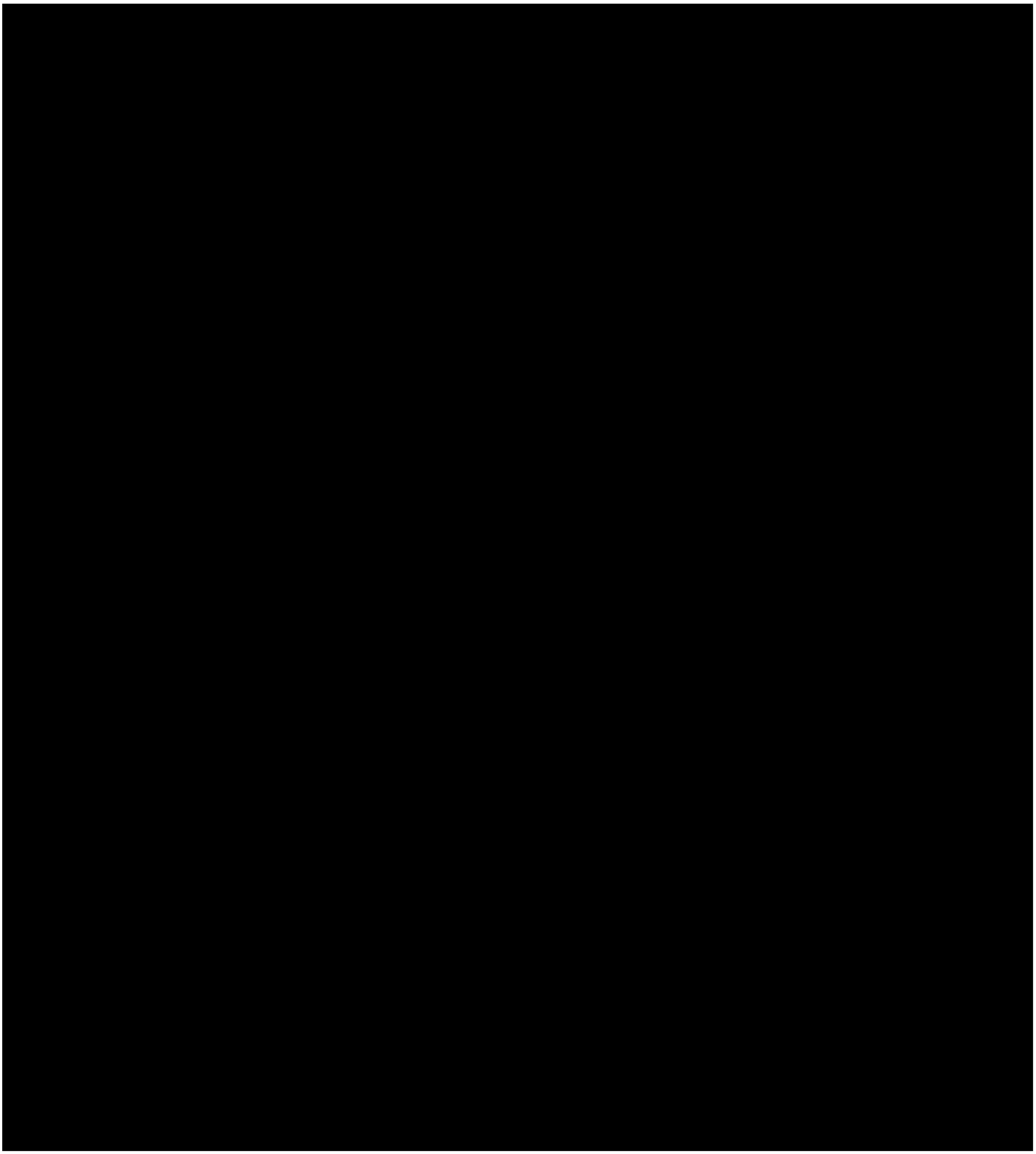


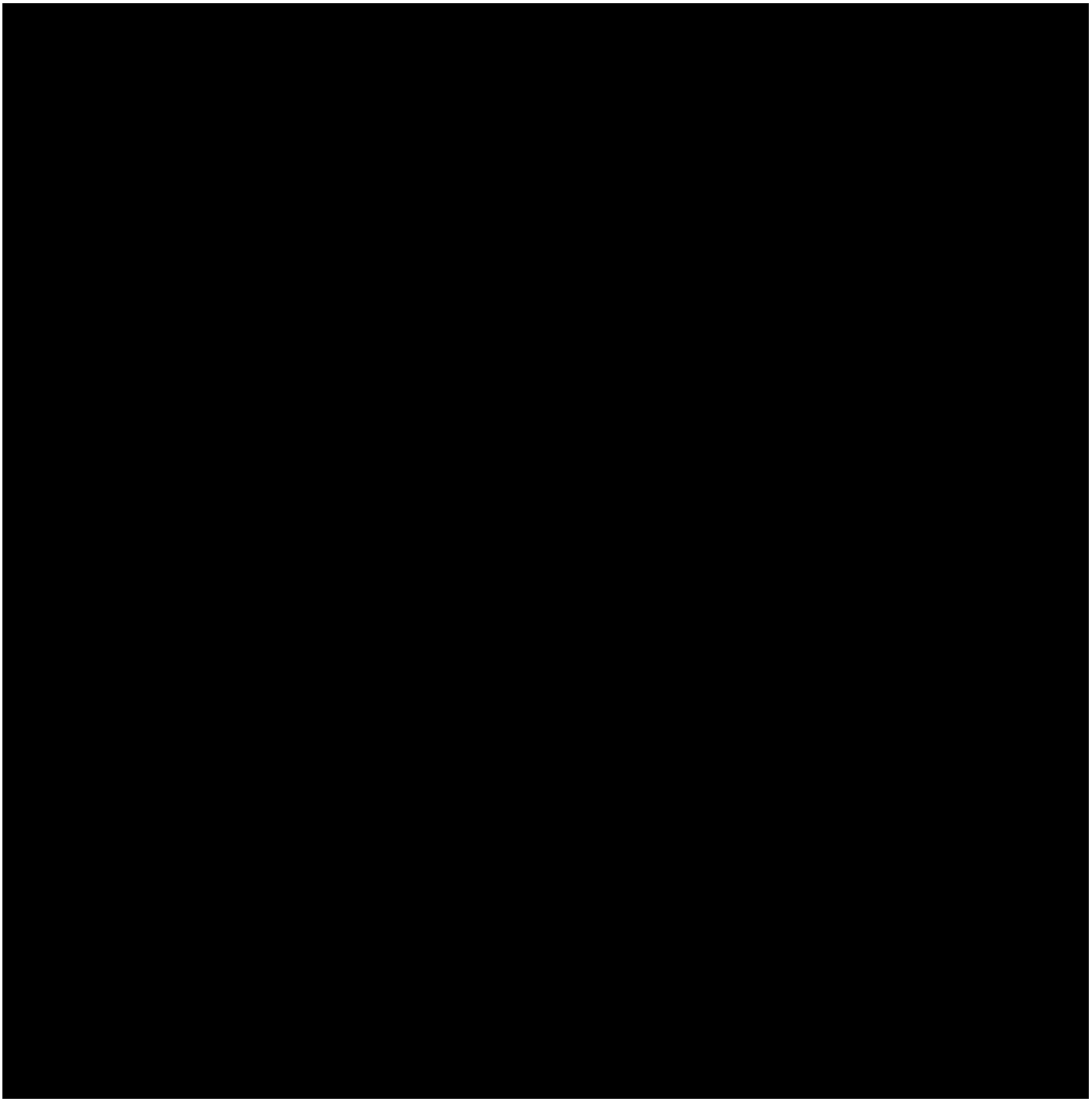












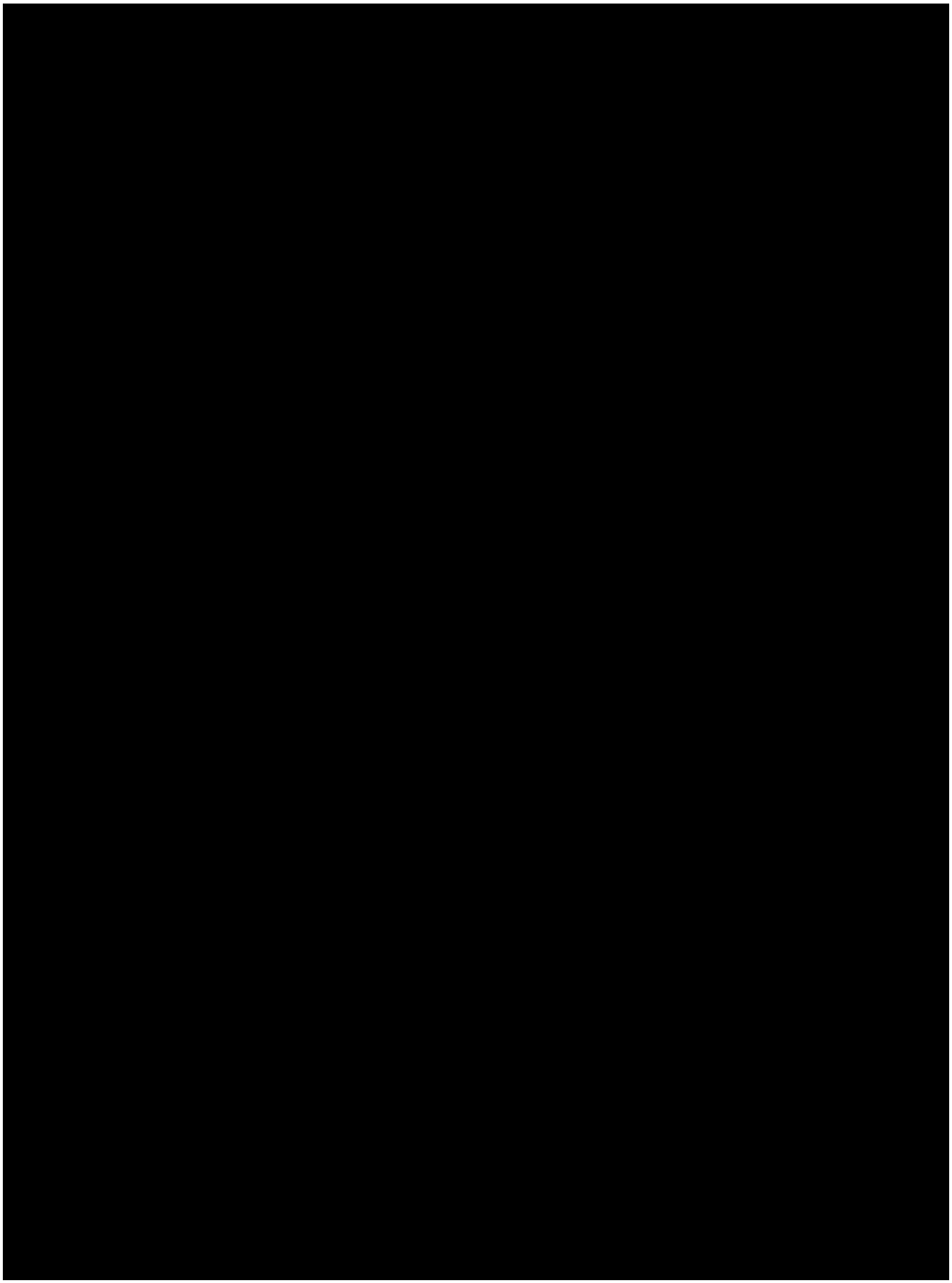
4 BIO overview

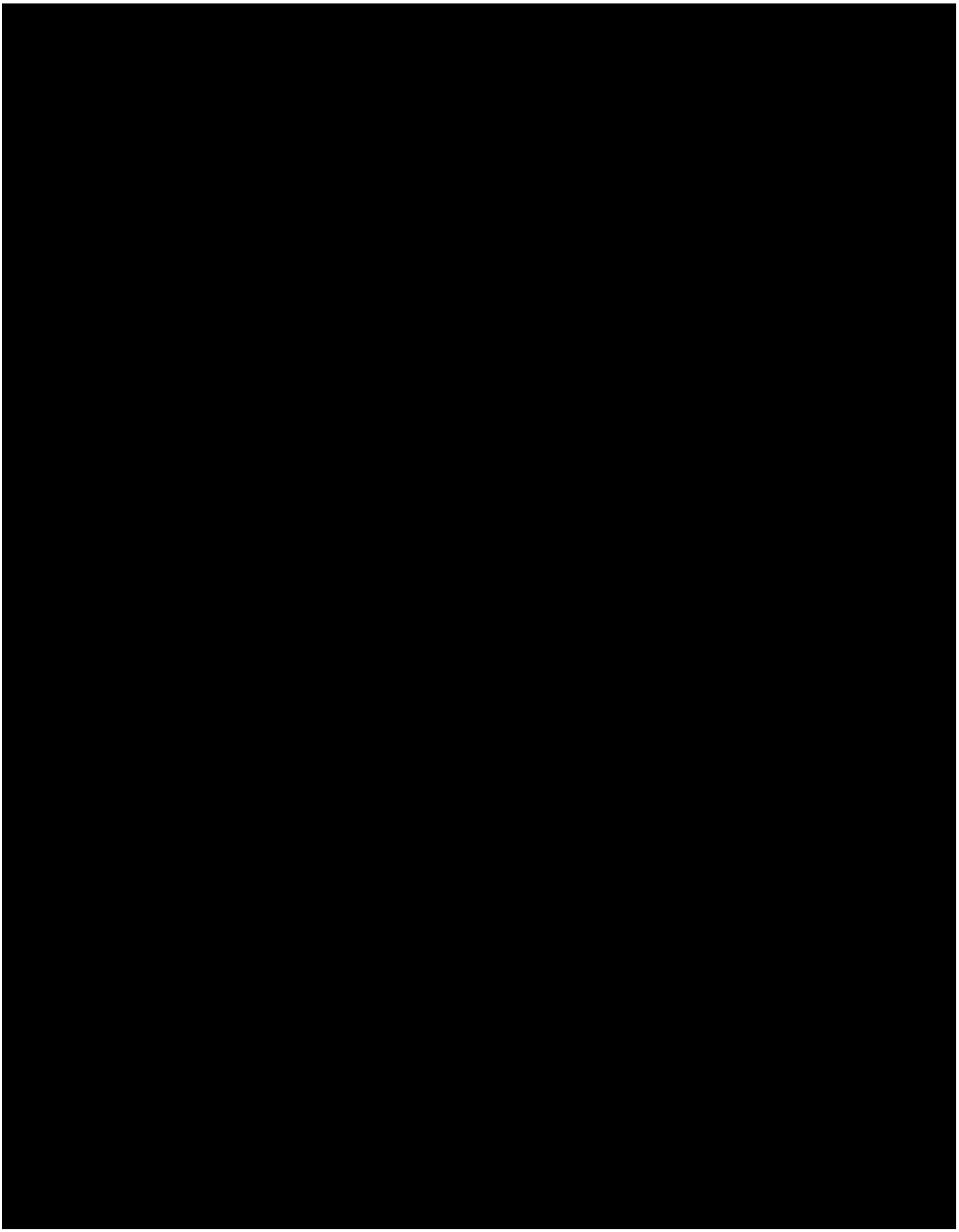
This section will provide an overview of the functionalities that are included in the BIO module. This module is divided in two different biometric systems, one in charge of fingerprint verification and the other in charge of Palm Vein verification. There have been no major changes in neither of the subsystems in regards of the work described in D3.2, since both are in a mature level.

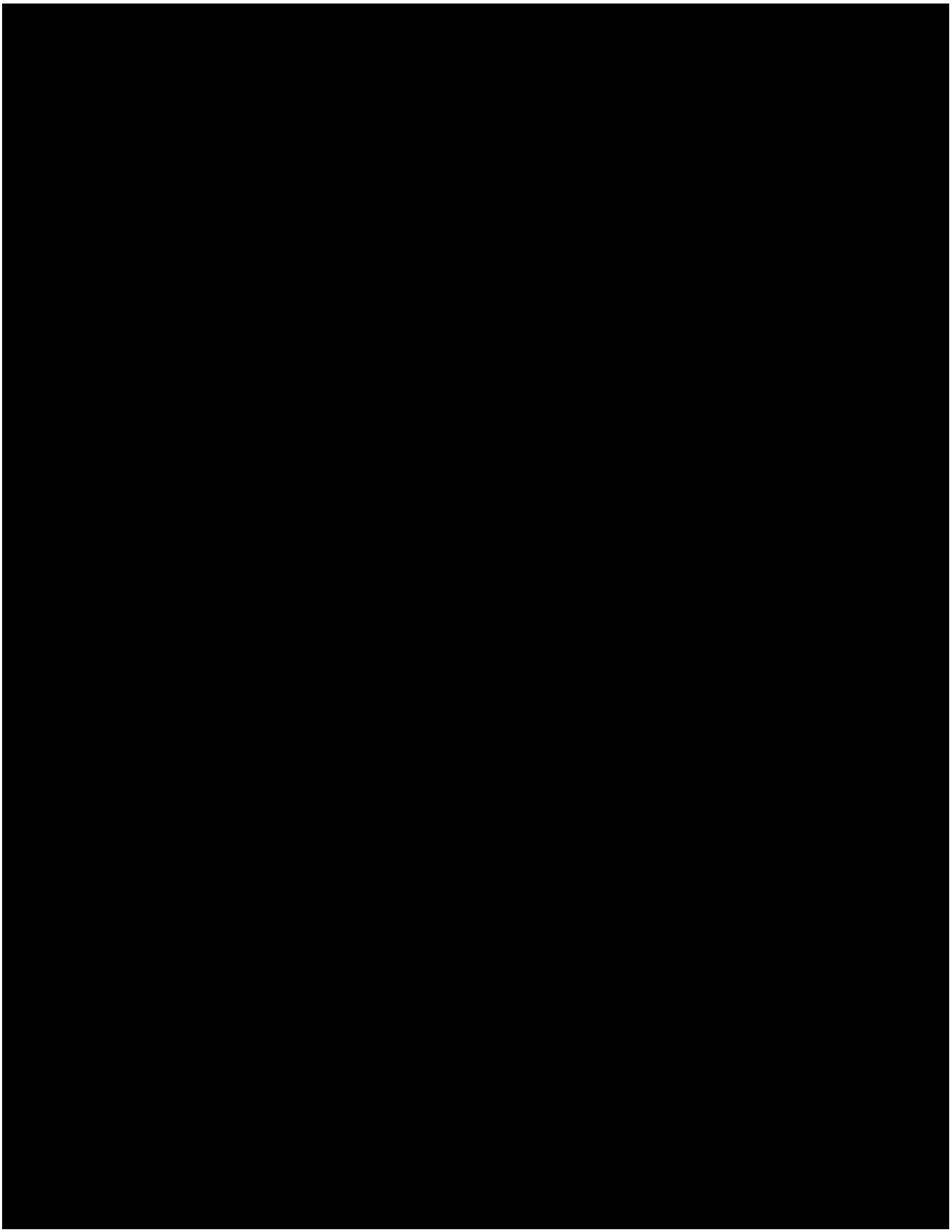
4.1 Fingerprints module

This module, integrated in the iBorderCtrl Portable Unit, is used during the crossing border phase to validate the identity of a traveller using the fingerprints stored in their travel document (biometric passport – RFID chip) and comparing them with the sample that the fingerprint reader in the portable unit will capture. If needed, this module can also use fingerprints retrieved from different national or European databases like SIS II or VIS. [redacted].

The module compares both images (live capture and passport stored) and provides a match / not match result. Besides this result, a risk score based on the fingerprint verification score will be send to the iBorderCtrl database and the RBAT module.





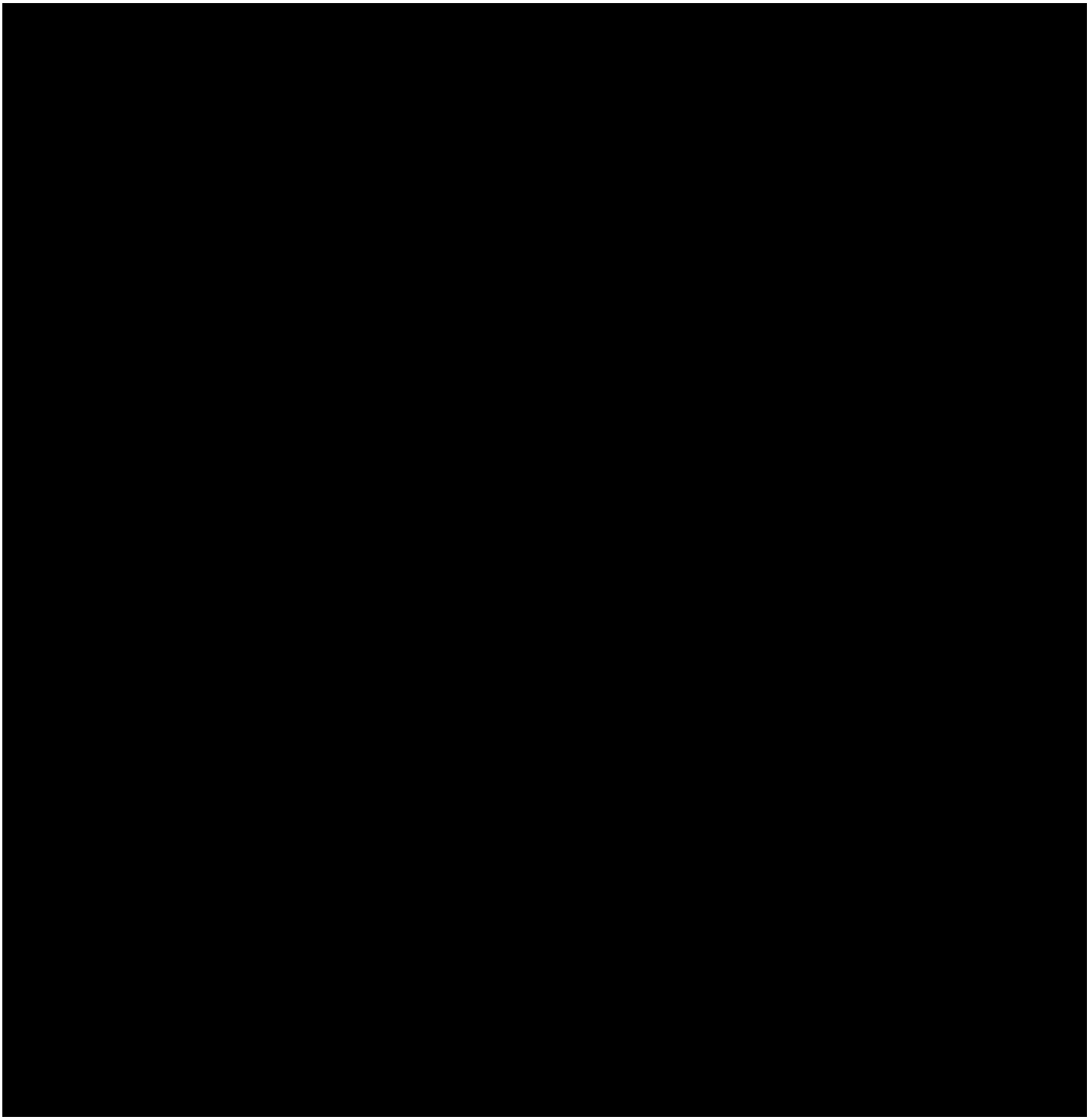


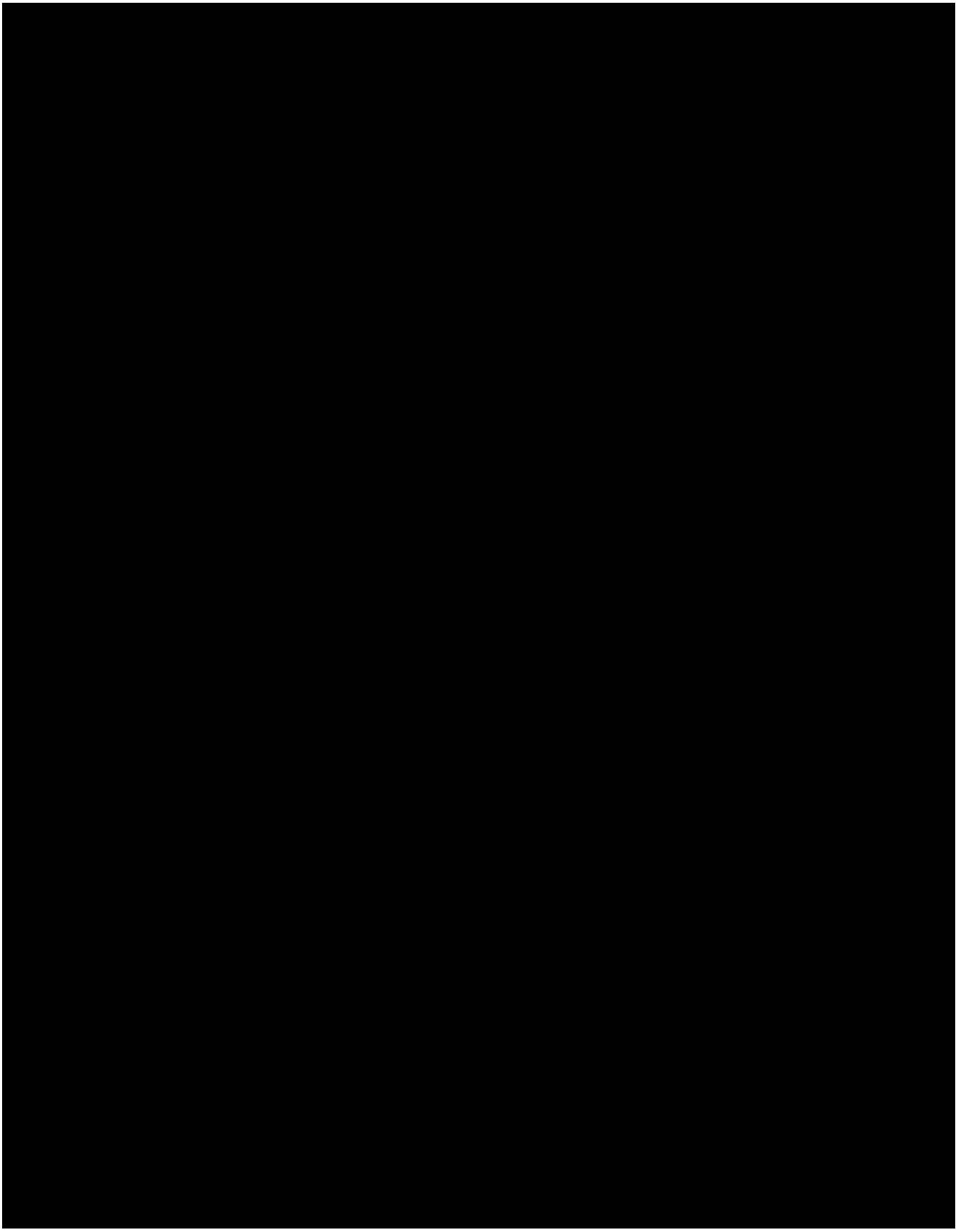
[redacted]

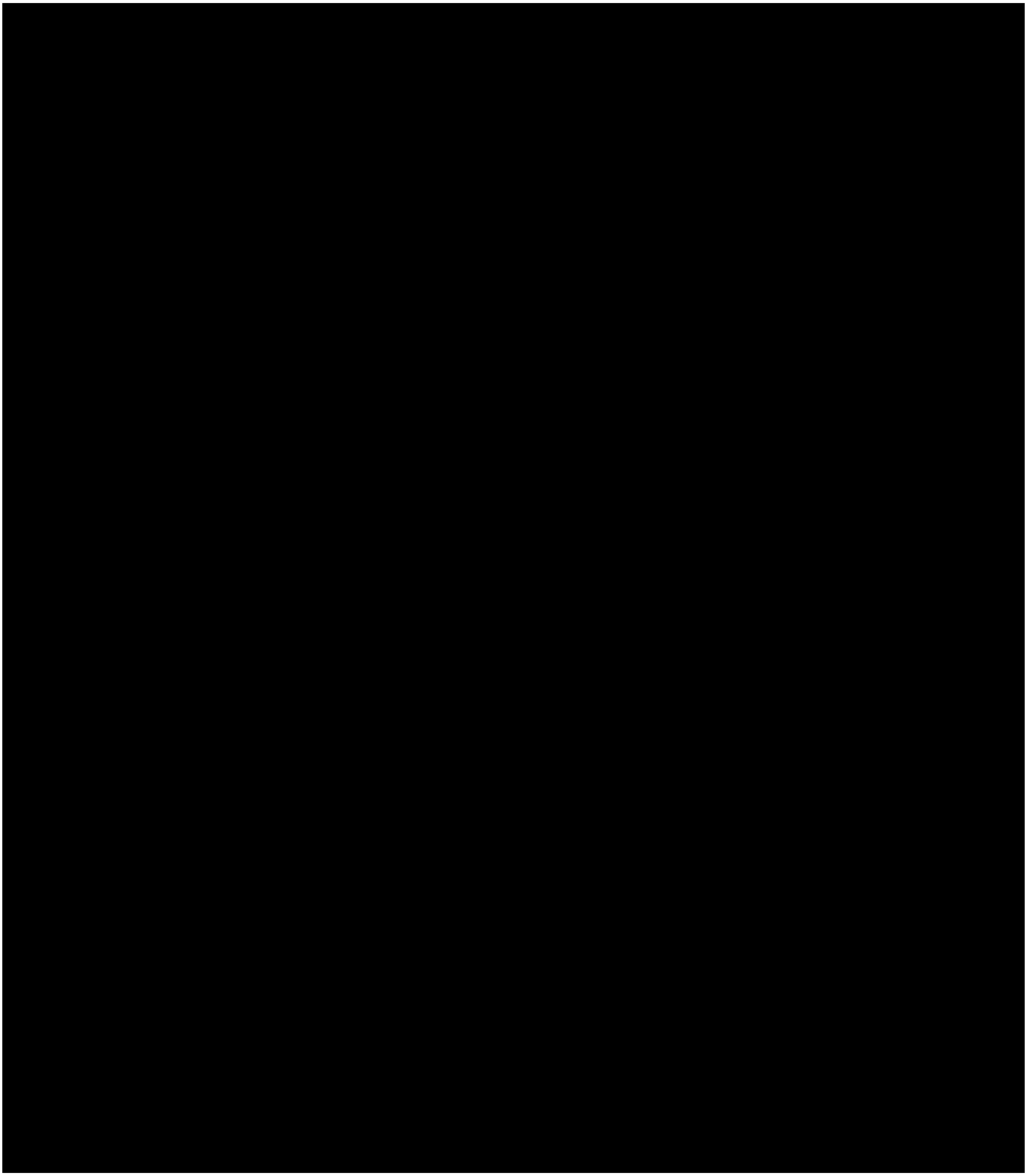
4.2 Palm Vein module

This module, [redacted], is the most mature one from all the iBorderCtrl tools and will be as well integrated in the iBorderCtrl Portable Unit. The methodology of palm veins checks is similar to that of the fingerprints module presented in the previous section. The palm vein module will be used during the crossing border phase as well, to validate the identity of a traveller using the palm vein sample image that the respective palm vein scanner in the portable unit.

[redacted]





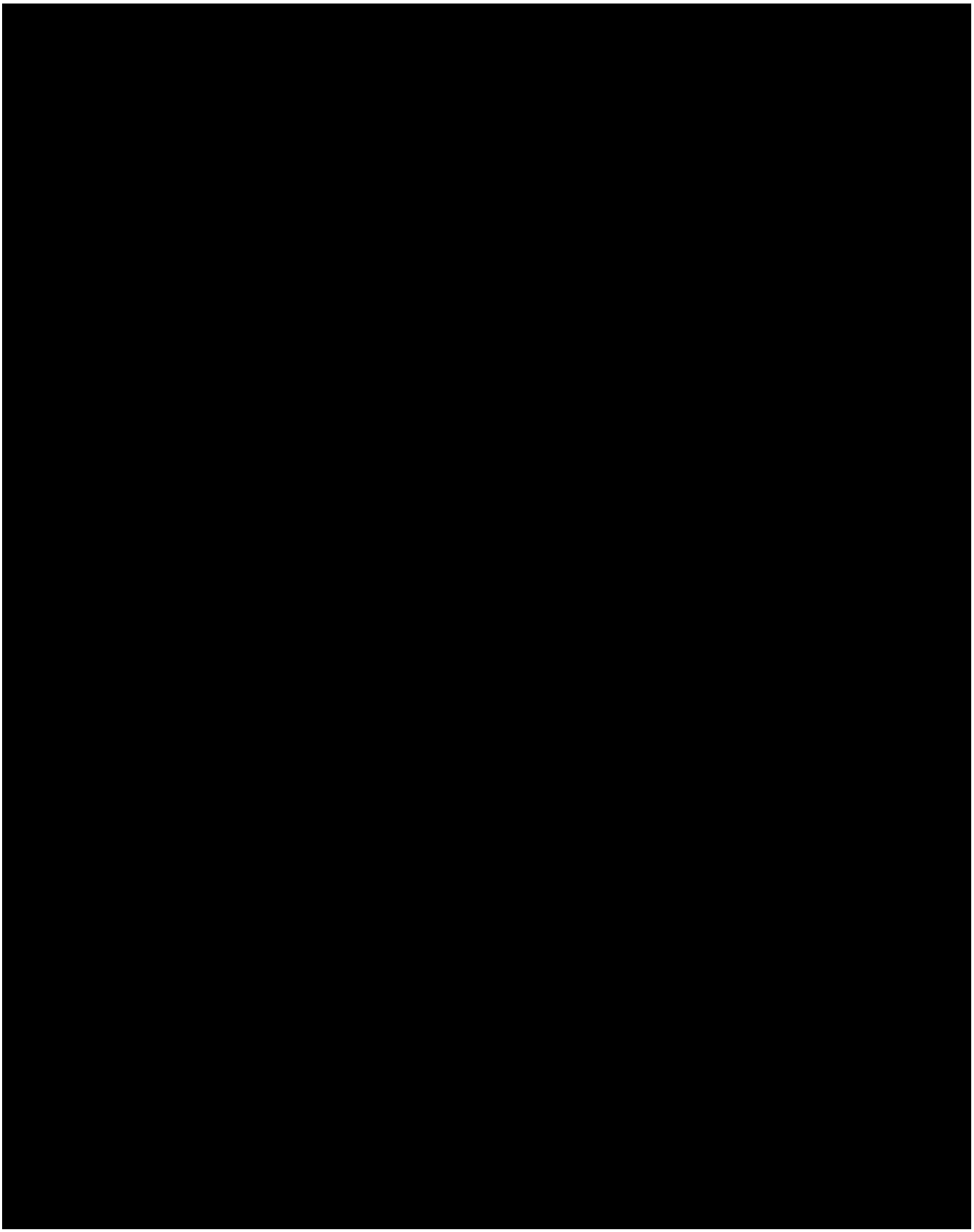


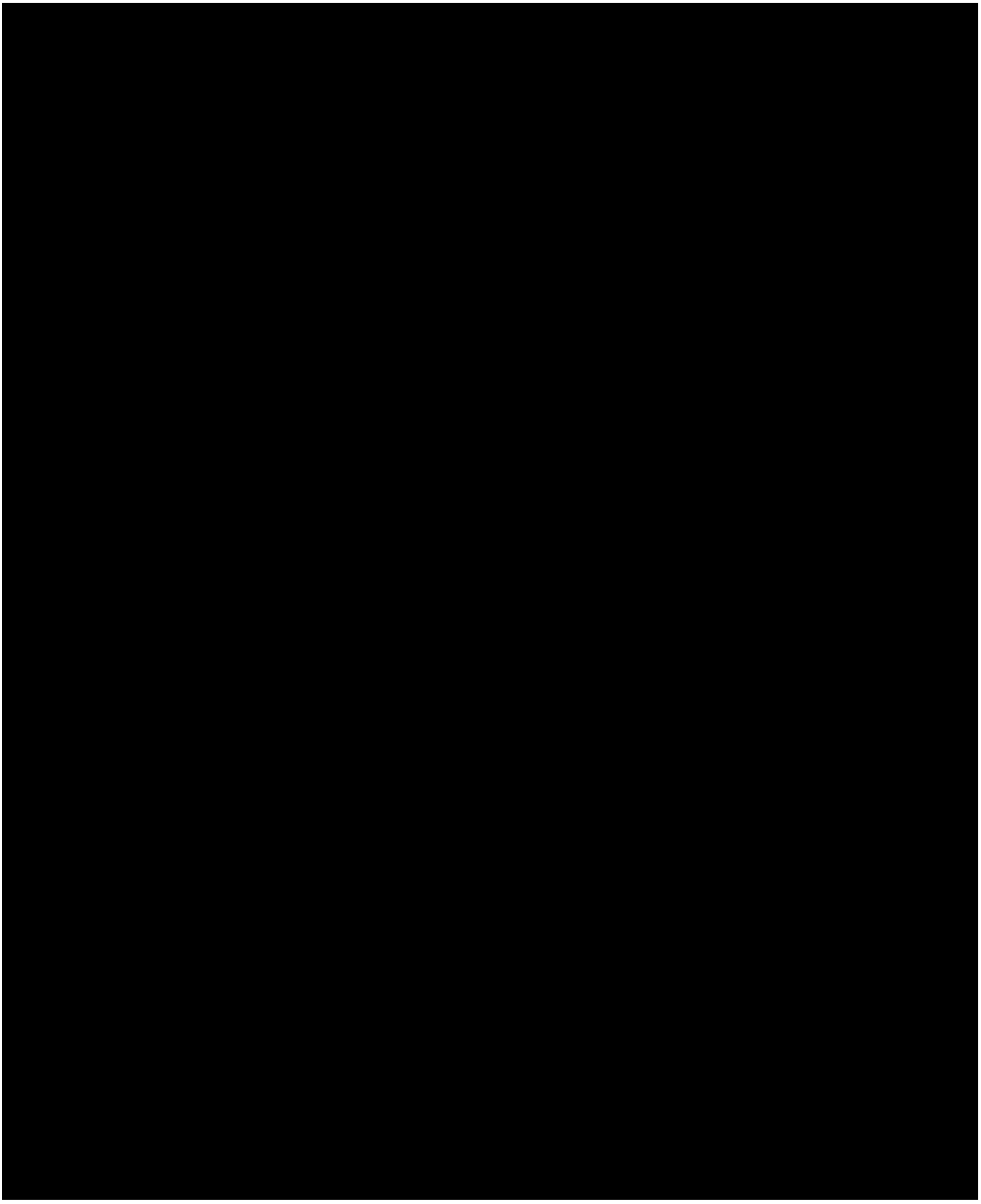
5 FMT overview

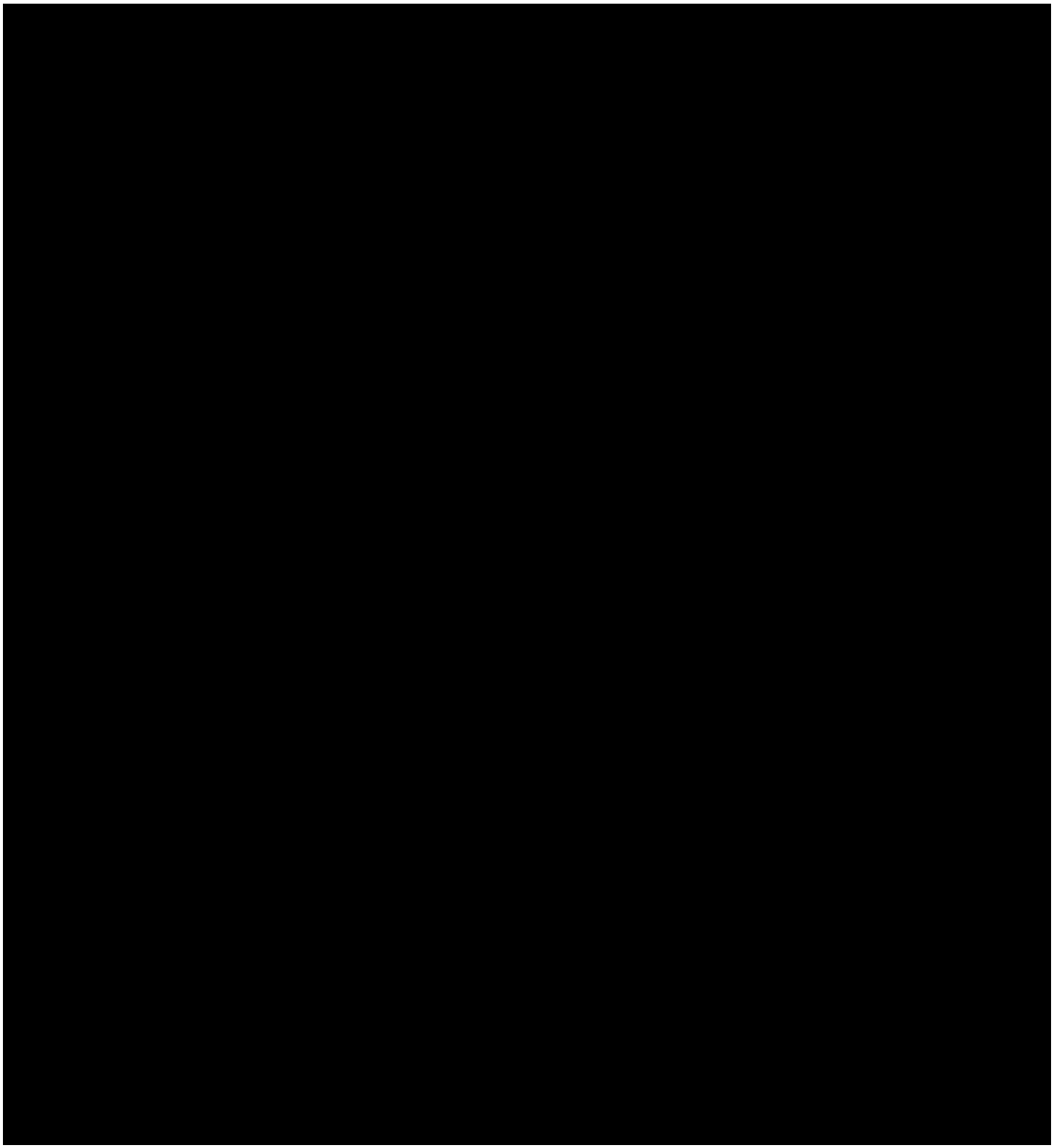
The FMT (Face Matching Tool) module's main purpose is to identify the risk of impersonation both during the pre-registration and border crossing phases. This module provides to the iBorderCtrl solution facial recognition capabilities to:

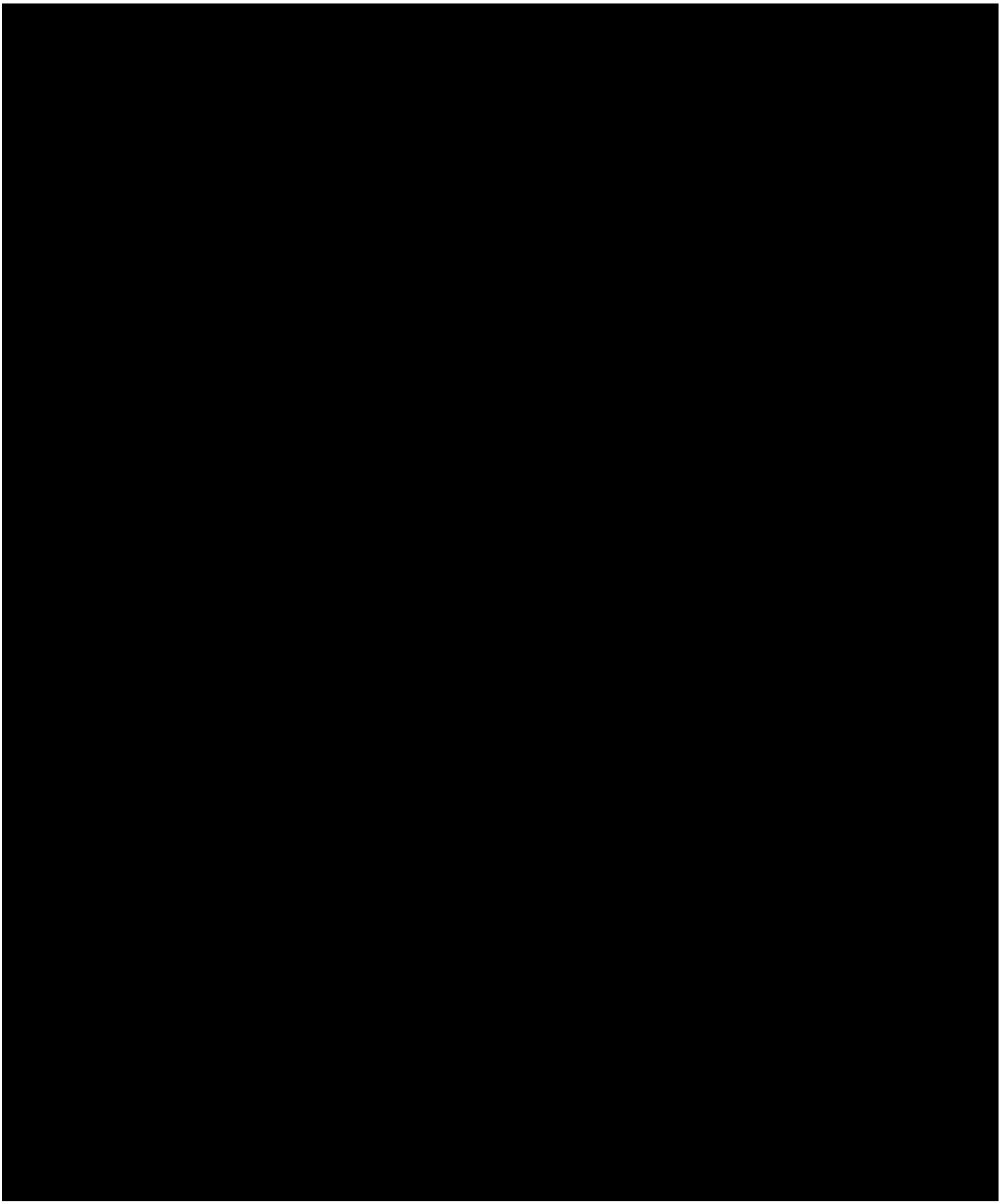
1. Asses the risk of a different person than the registered user undertaking the Avatar interview during the pre-registration phase
2. Verify the identity of the traveller during the border check and provide a risk score.

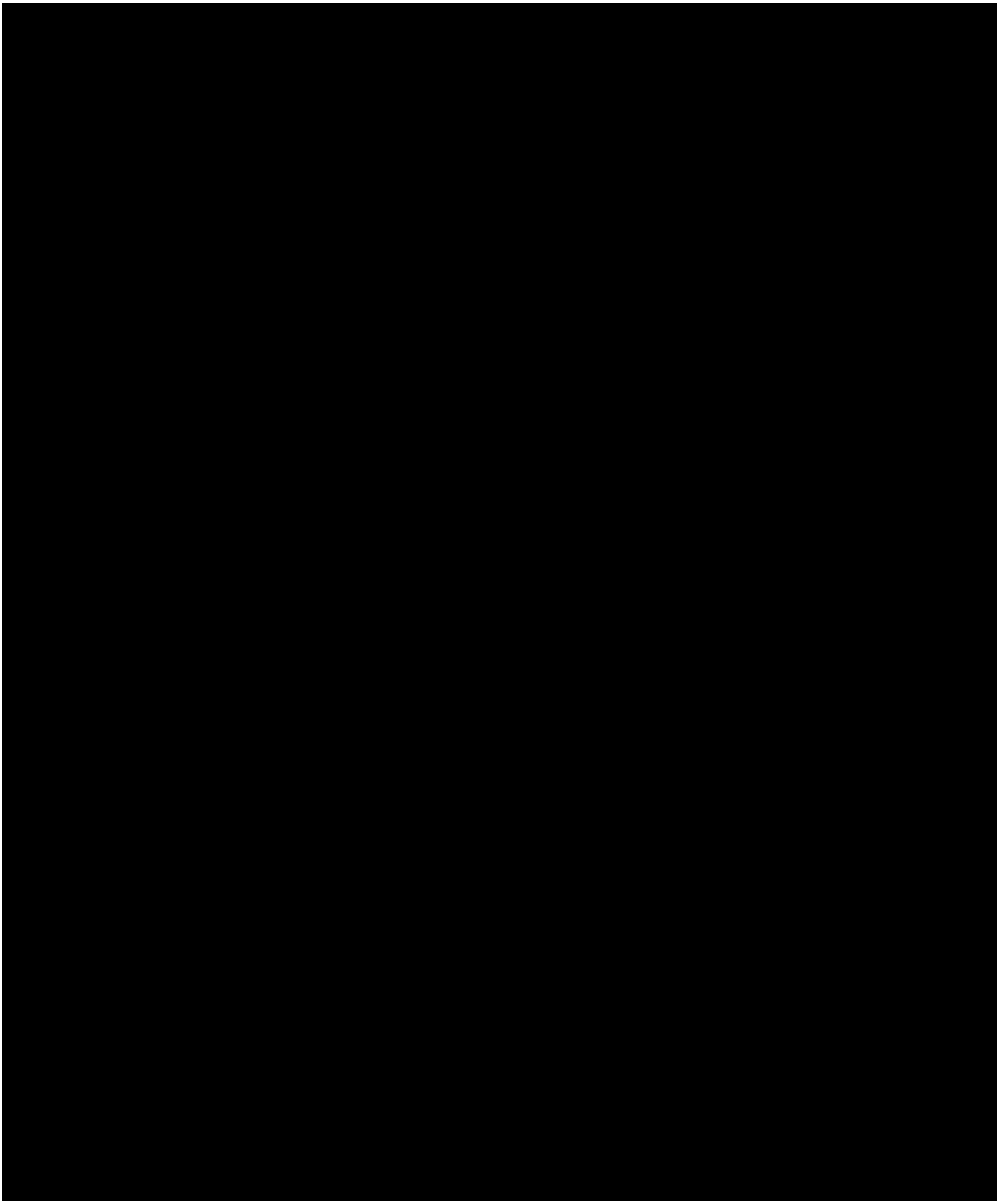
This assessment will be done using images from the Avatar interview, images taken during the border check and also from the passport or other travel documents.

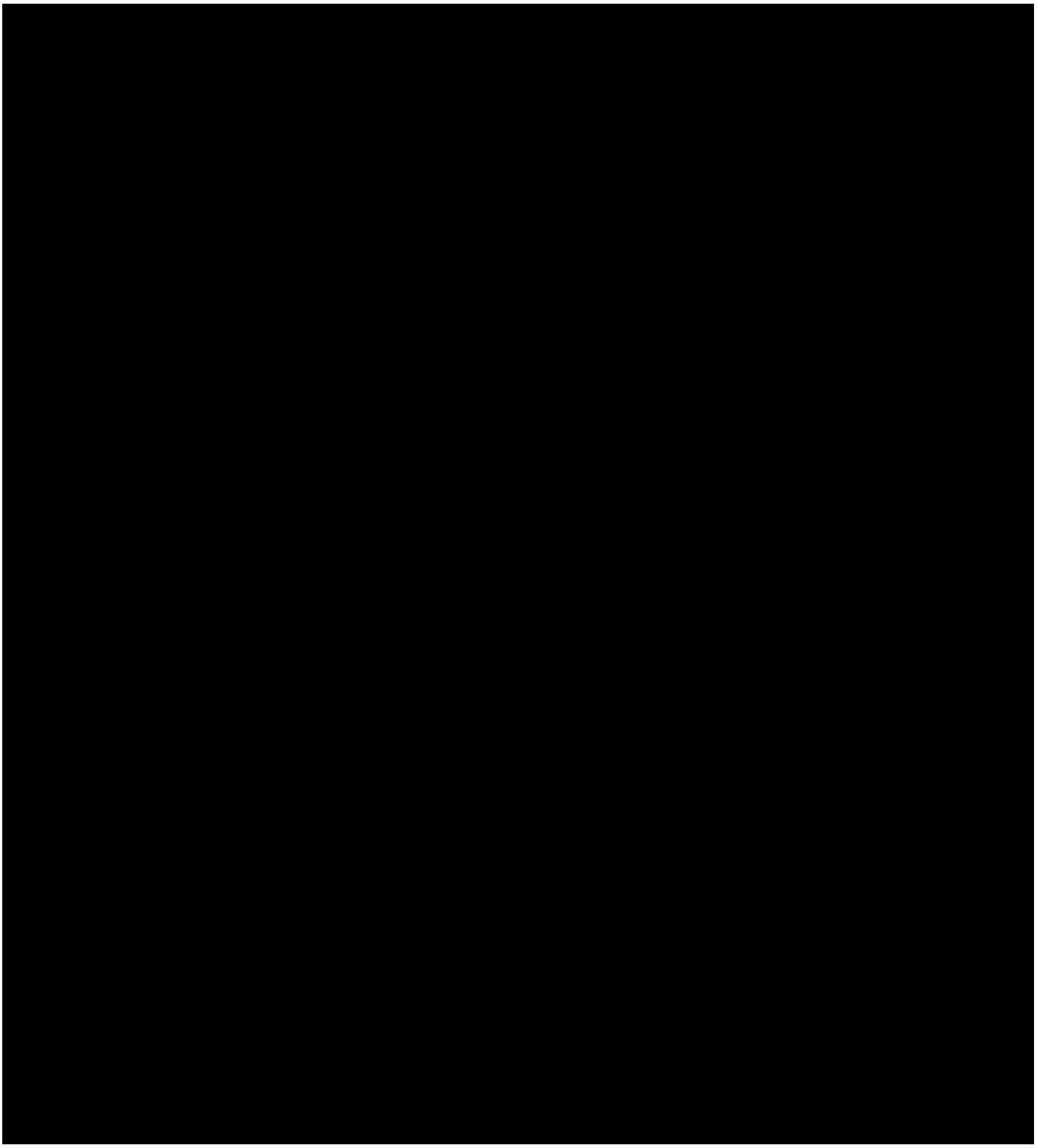


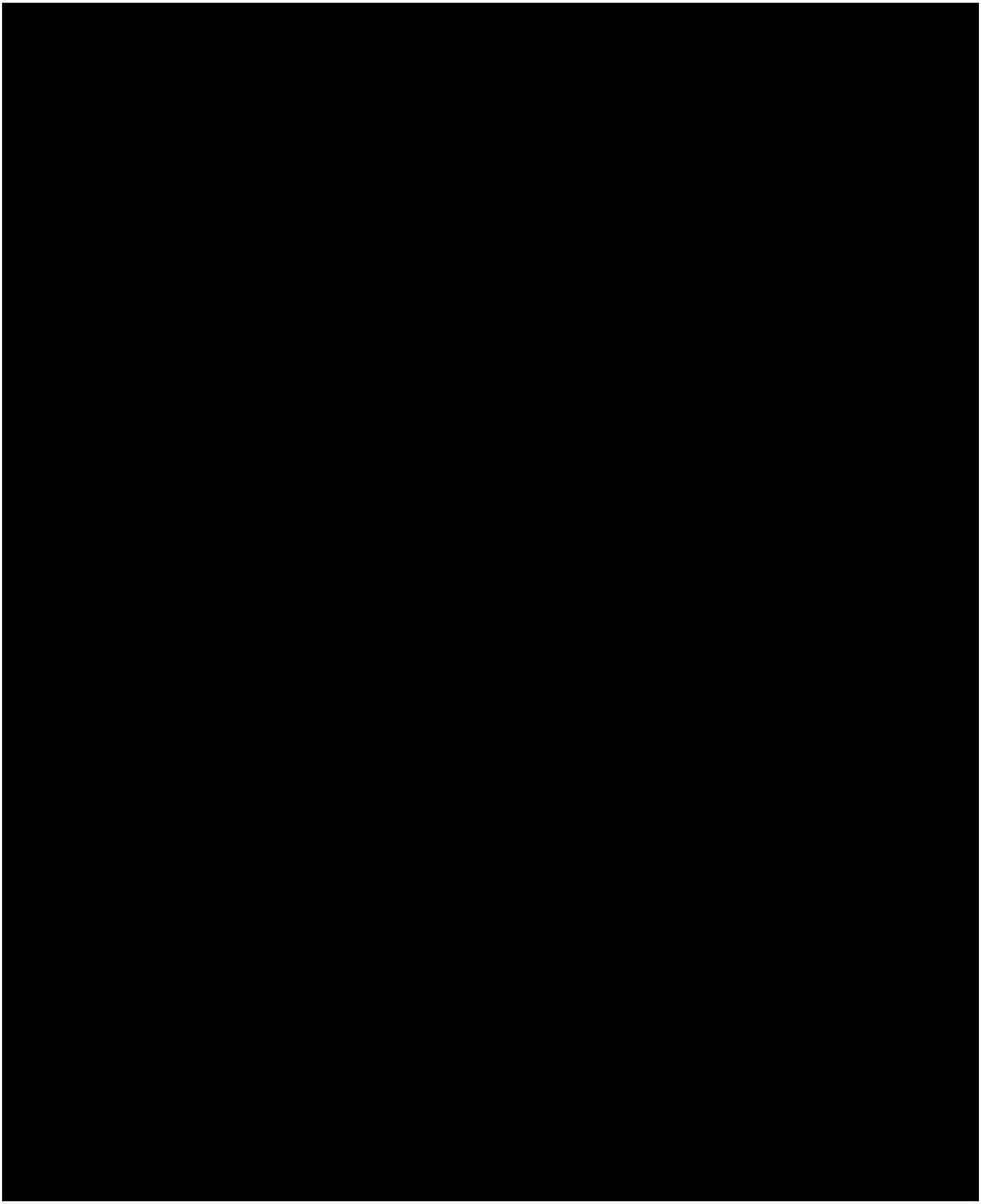












6 HHD overview

The Hidden Humans Detection tool (HHD), [redacted] addresses the issue of illegal migration and trafficking, often confronted at the border control points; passengers trying to illegally cross the borders, often hide themselves inside ordinary vehicles or closed compartments (i.e. in cargo containers).

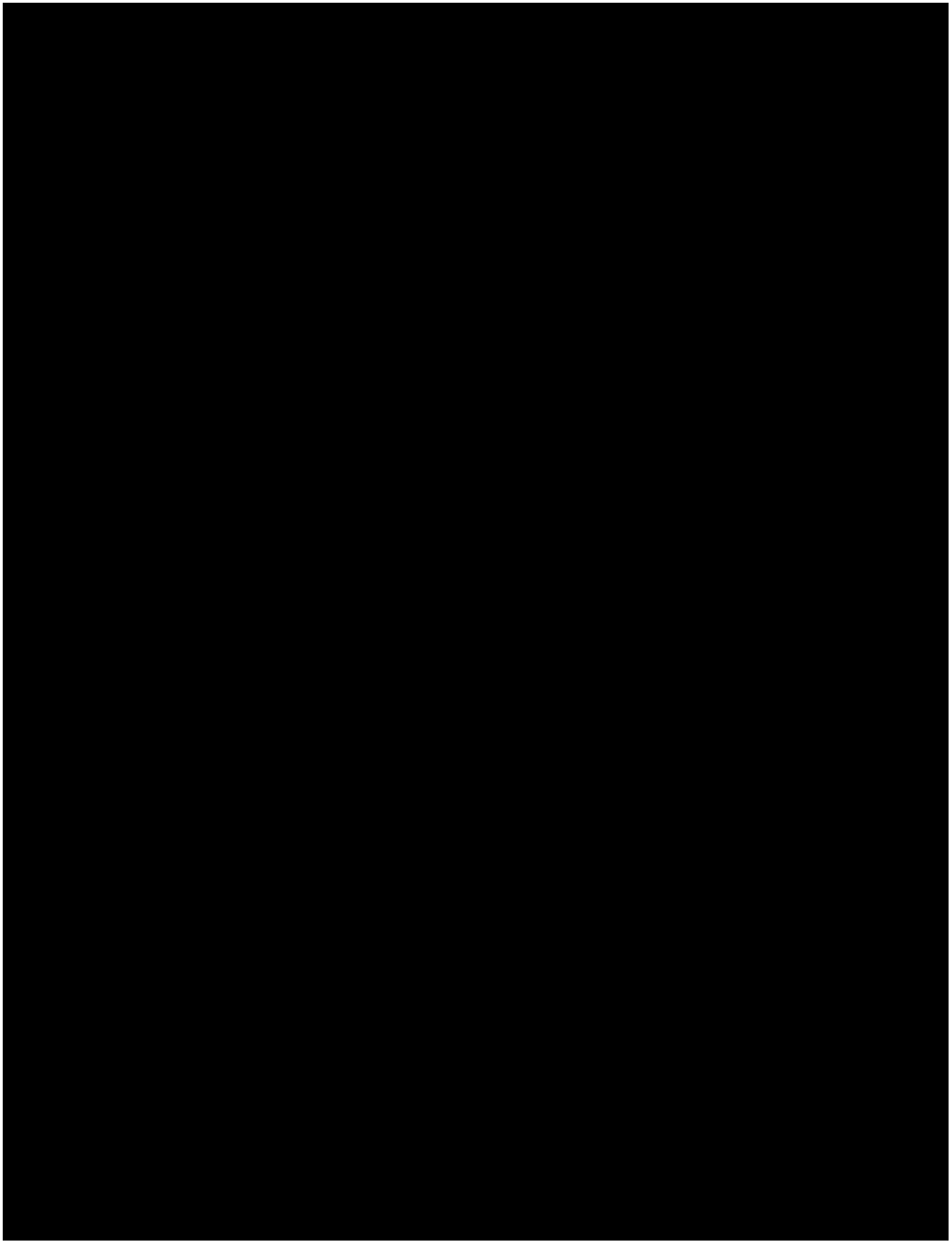
The main purpose of the HHD module is to detect the presence of an alive being inside vehicles or closed compartments and provide a risk related with this possibility.

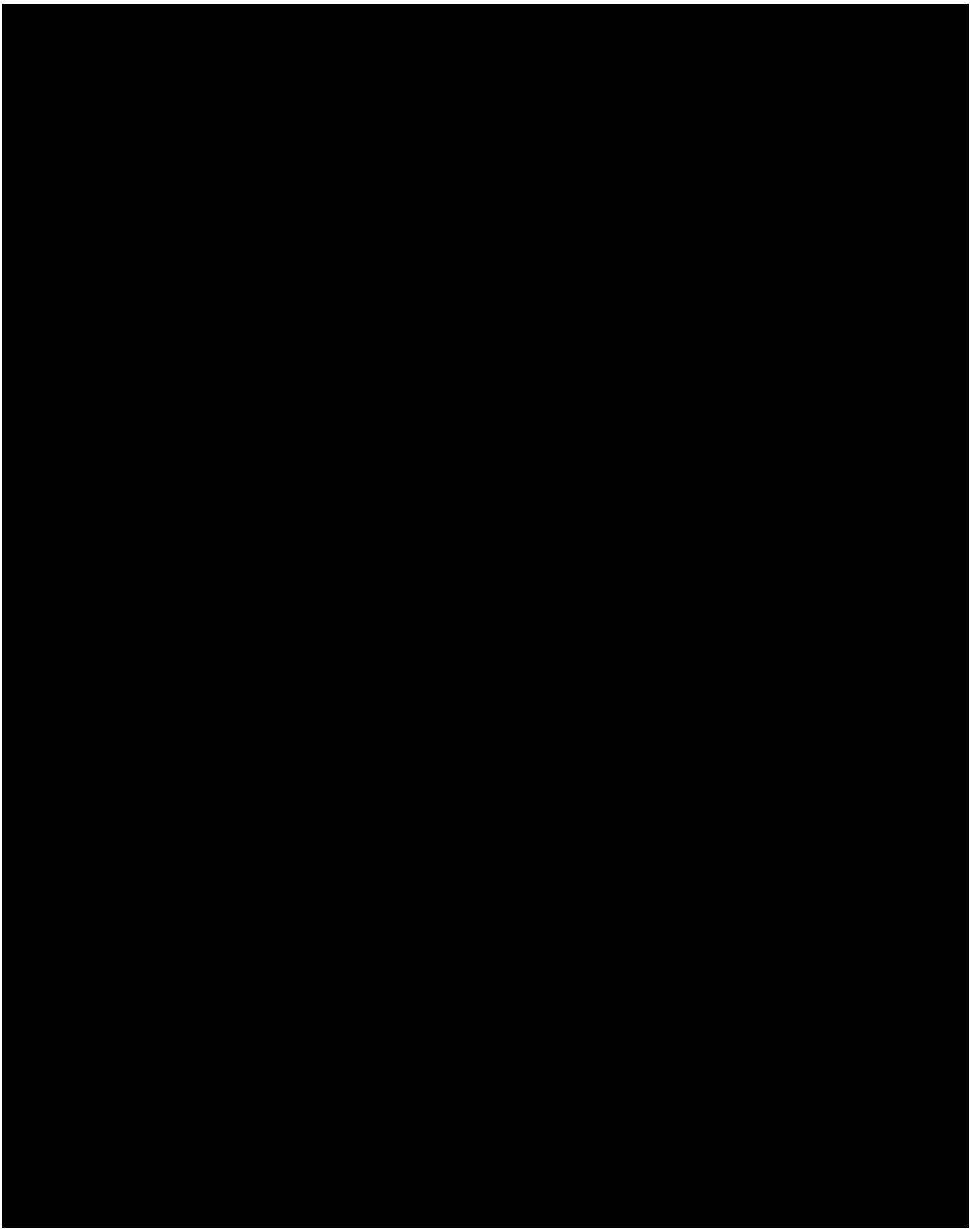
In the previous Deliverables D2.1, D2.2, D3.1 and D3.2, both the scientific state of the art and the commercially available solutions in a wider perspective have been expensively described; the detailed aspects of the scientific problem and the up-to-date confronting mechanisms especially in comparison with current practices like x-rays or border guard's visual inspection have been widely dealt identifying specific needs to dictate the relevant context of the iBorderCtrl project.

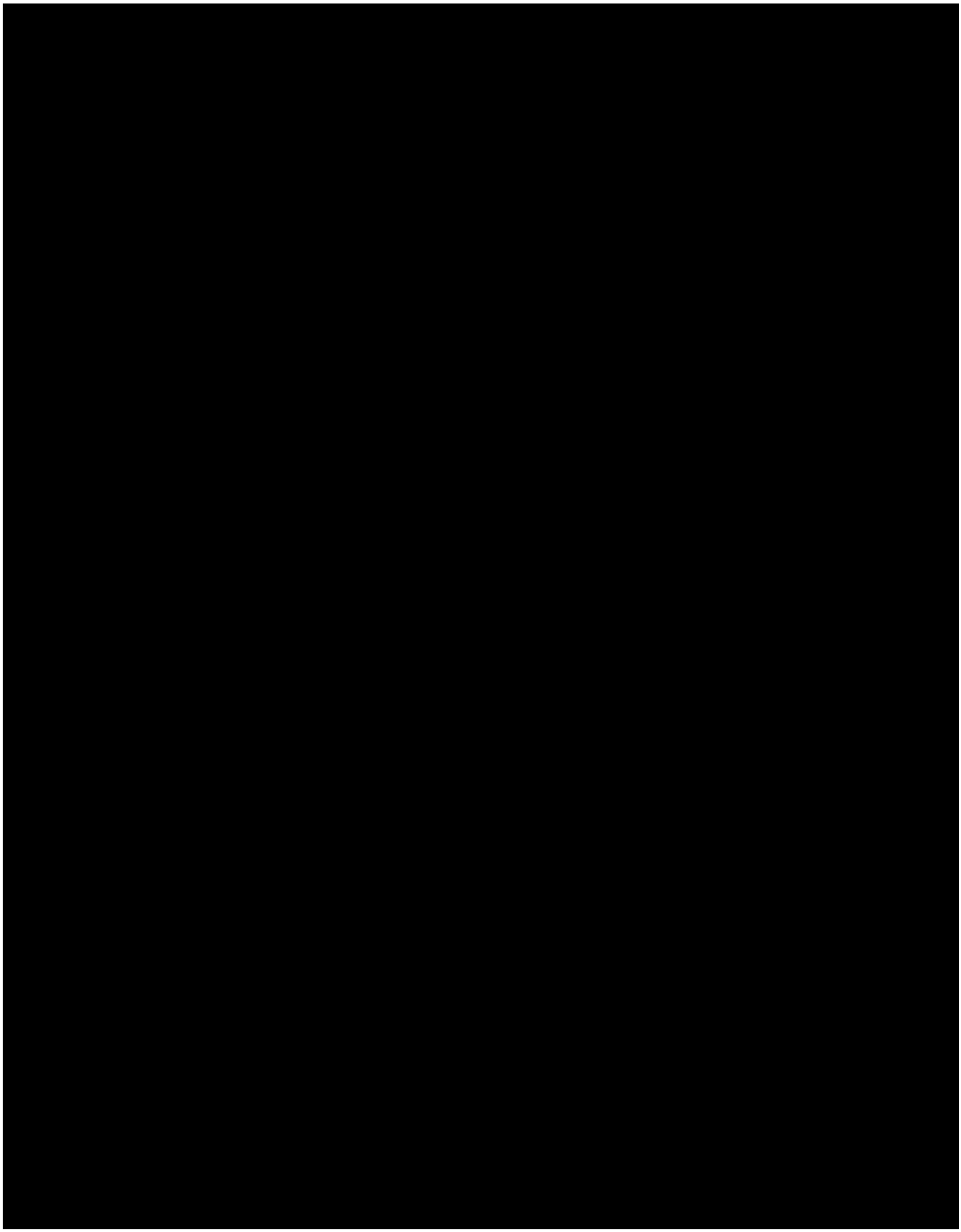
Thus, the attempt of implementing hidden human detection (HHD) tool within the iBorderCtrl:

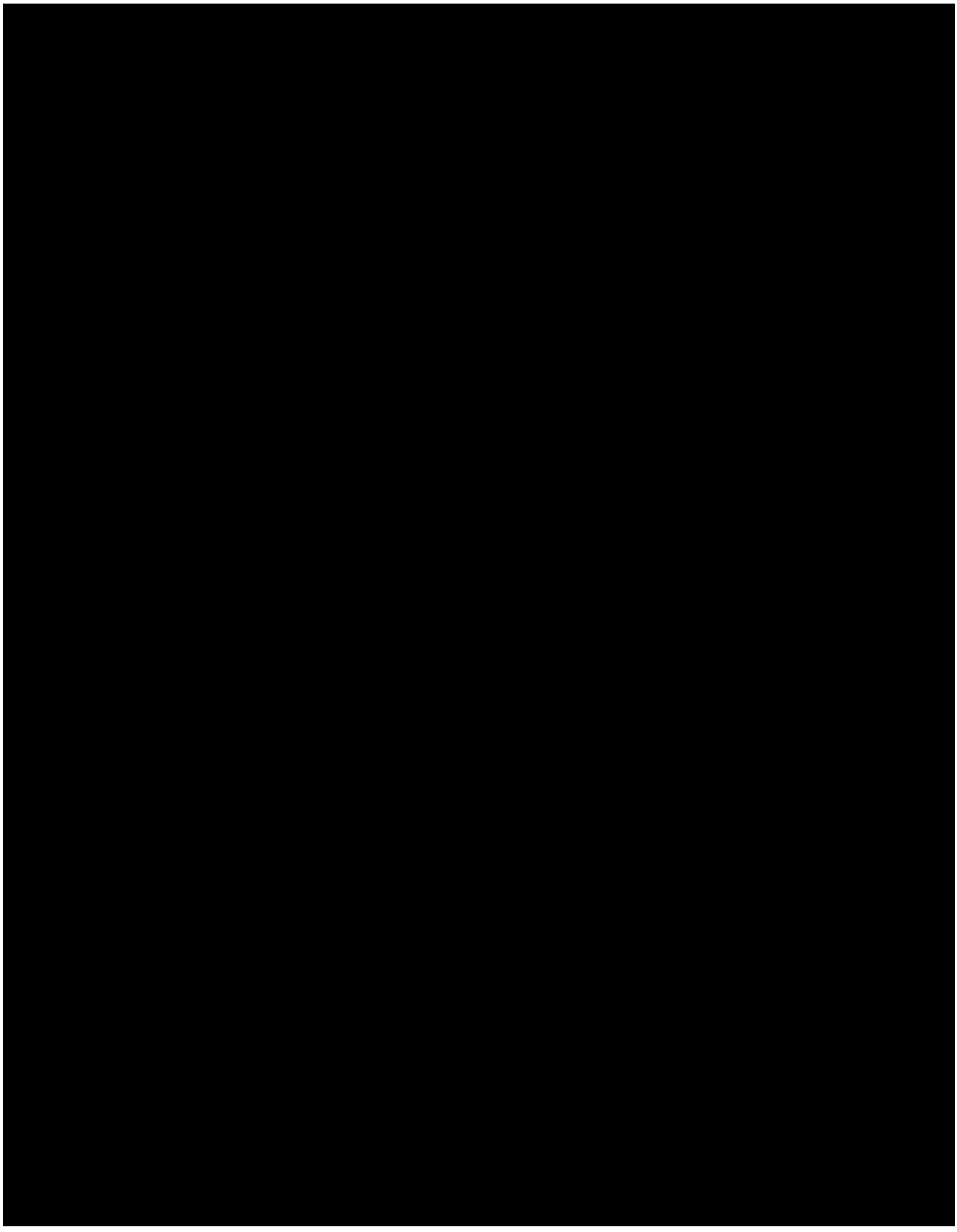
- addresses the issue of transferring the relevant control checks from the second line to the first one;
- targets to provide the border guard with the ability to perform at least preliminary checks of this kind on a routine basis and check if this approach leads to reducing the inherent delays
- presupposes light weight and small in size equipment and enables integration aspects to an overall holistic software platform

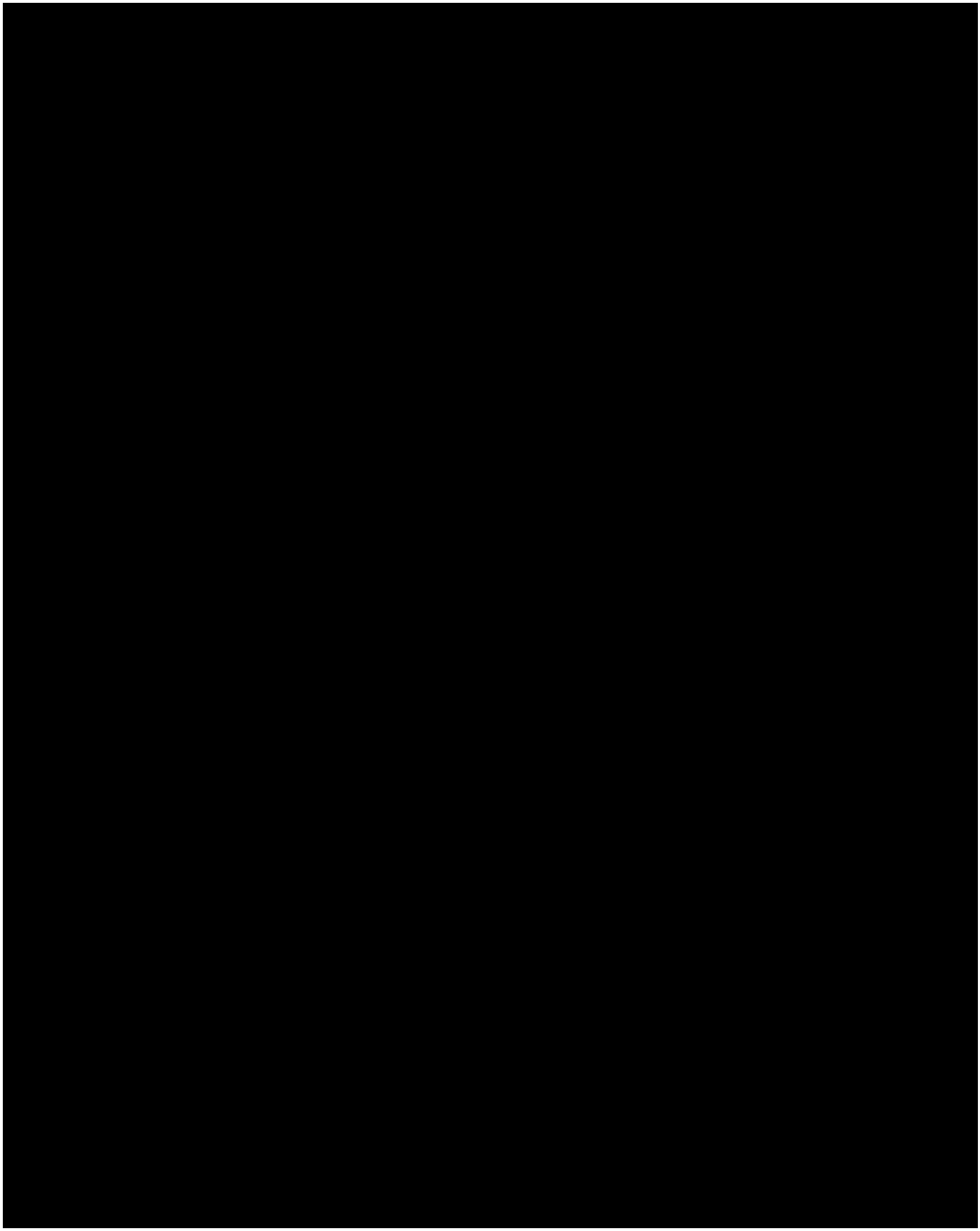
Within the iBorderCtrl project, the detection of presence is based on the detection (capture, tracking) of the micro-movements or vital signs of the alive being, potentially hidden inside, such as: breathing, slight movements or slight vibrations derived when leaning upon the surface in between.

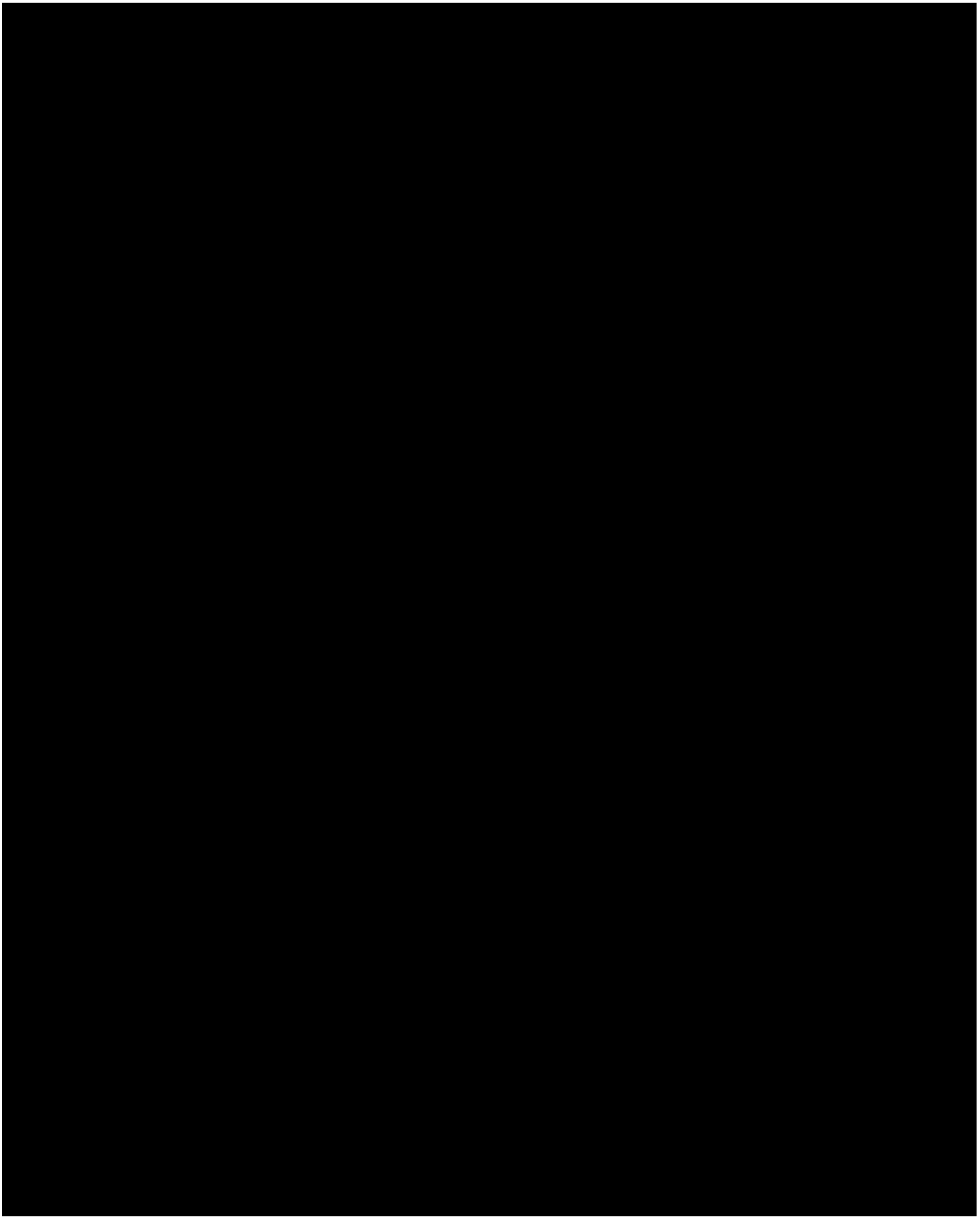


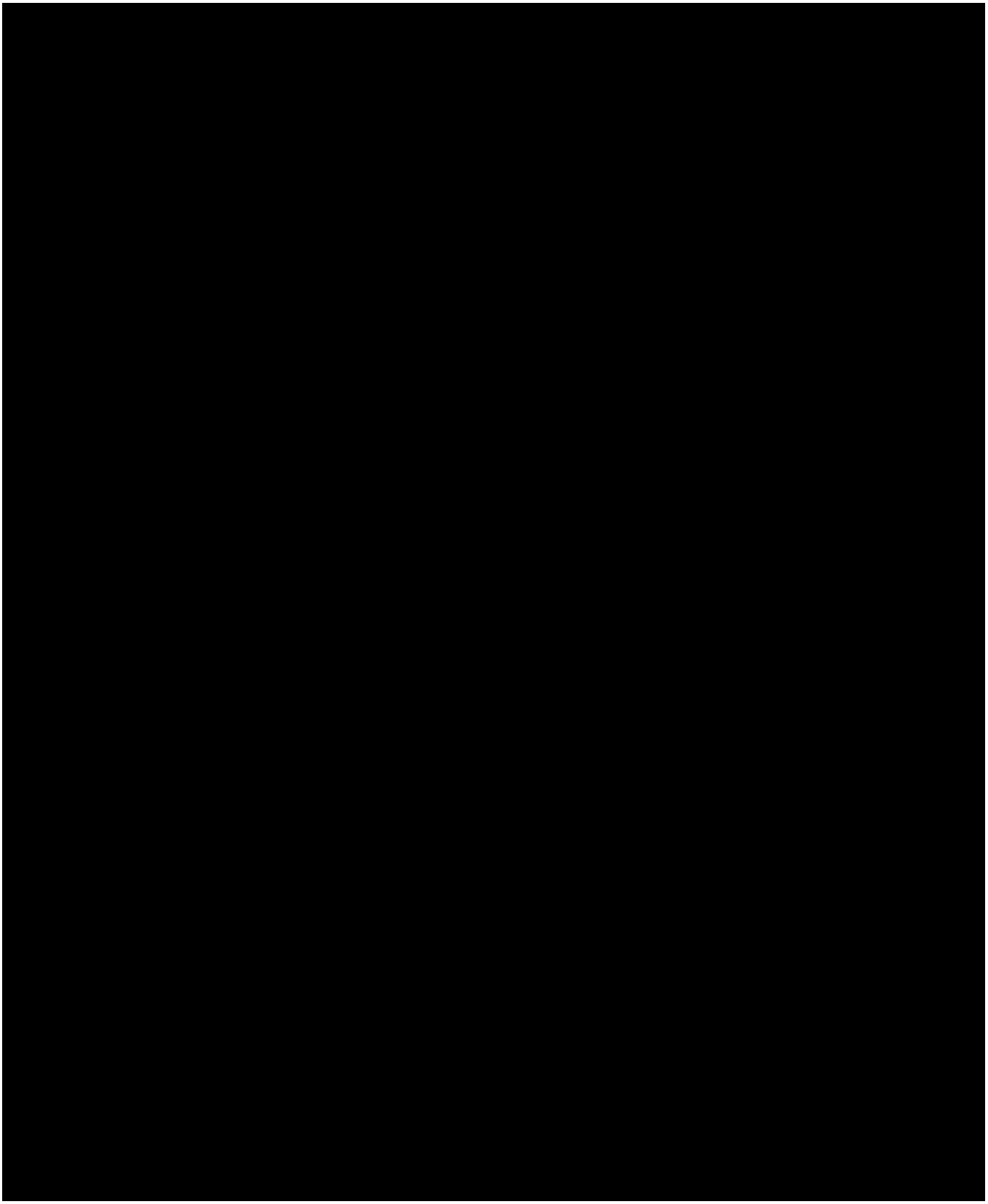


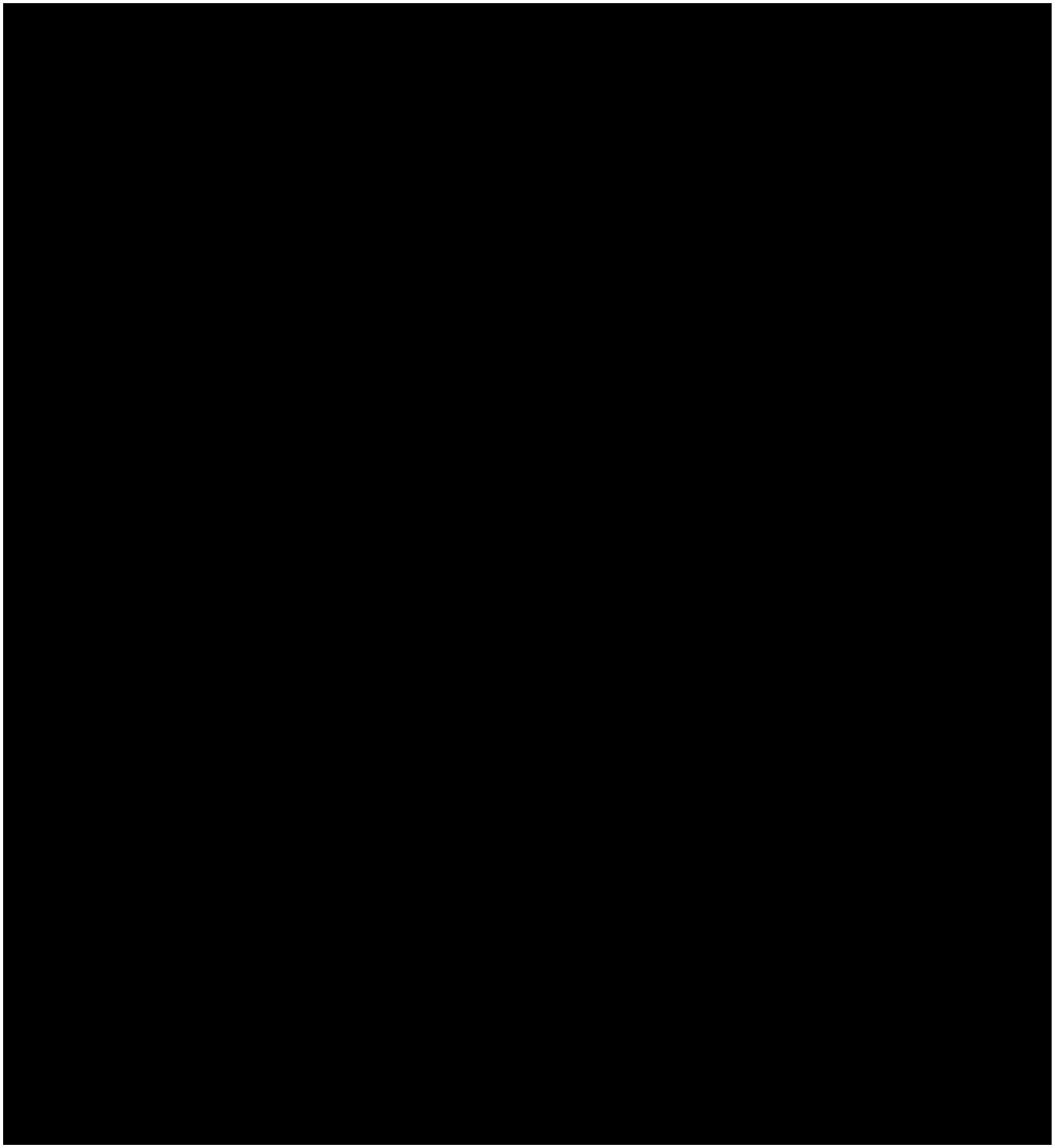


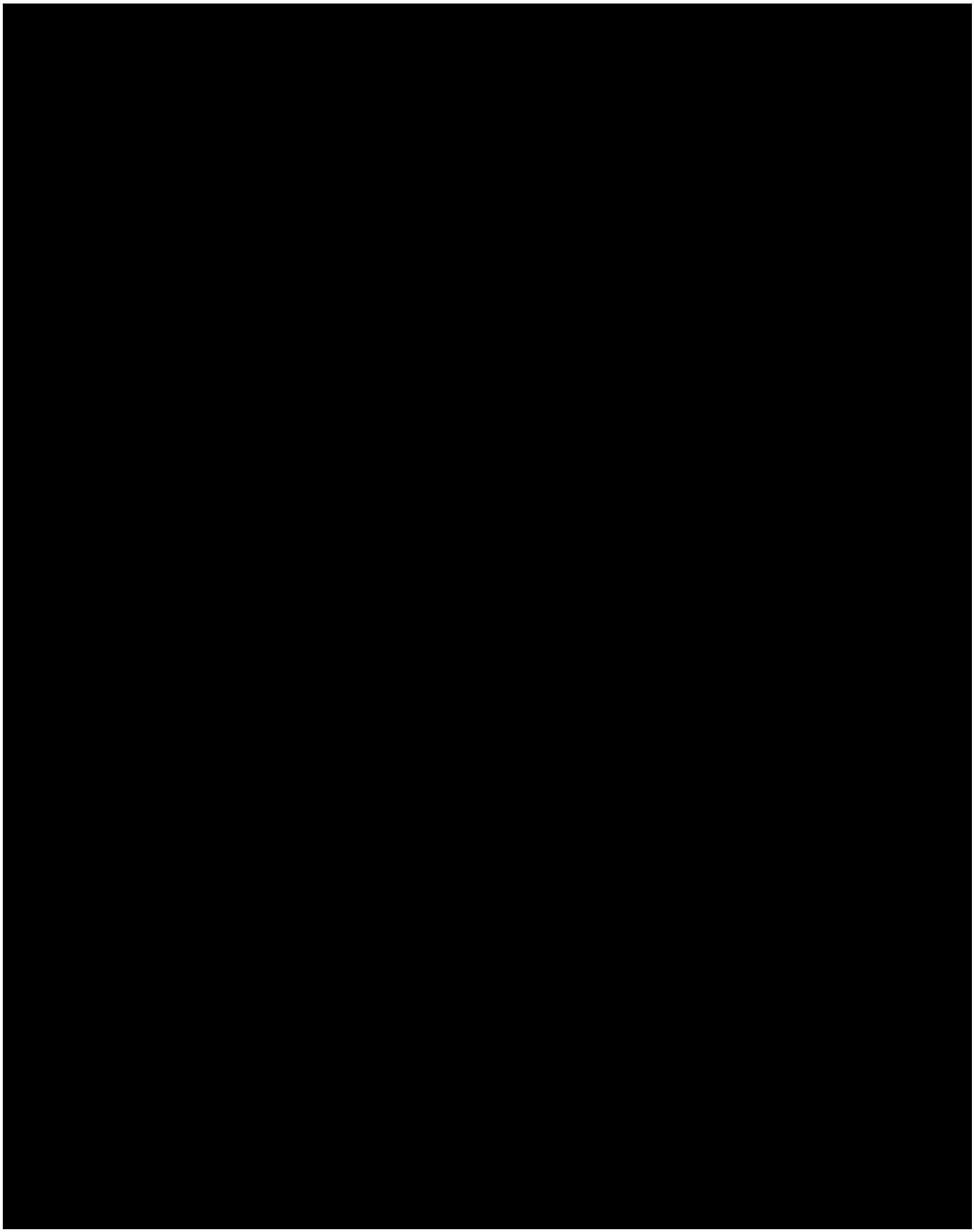


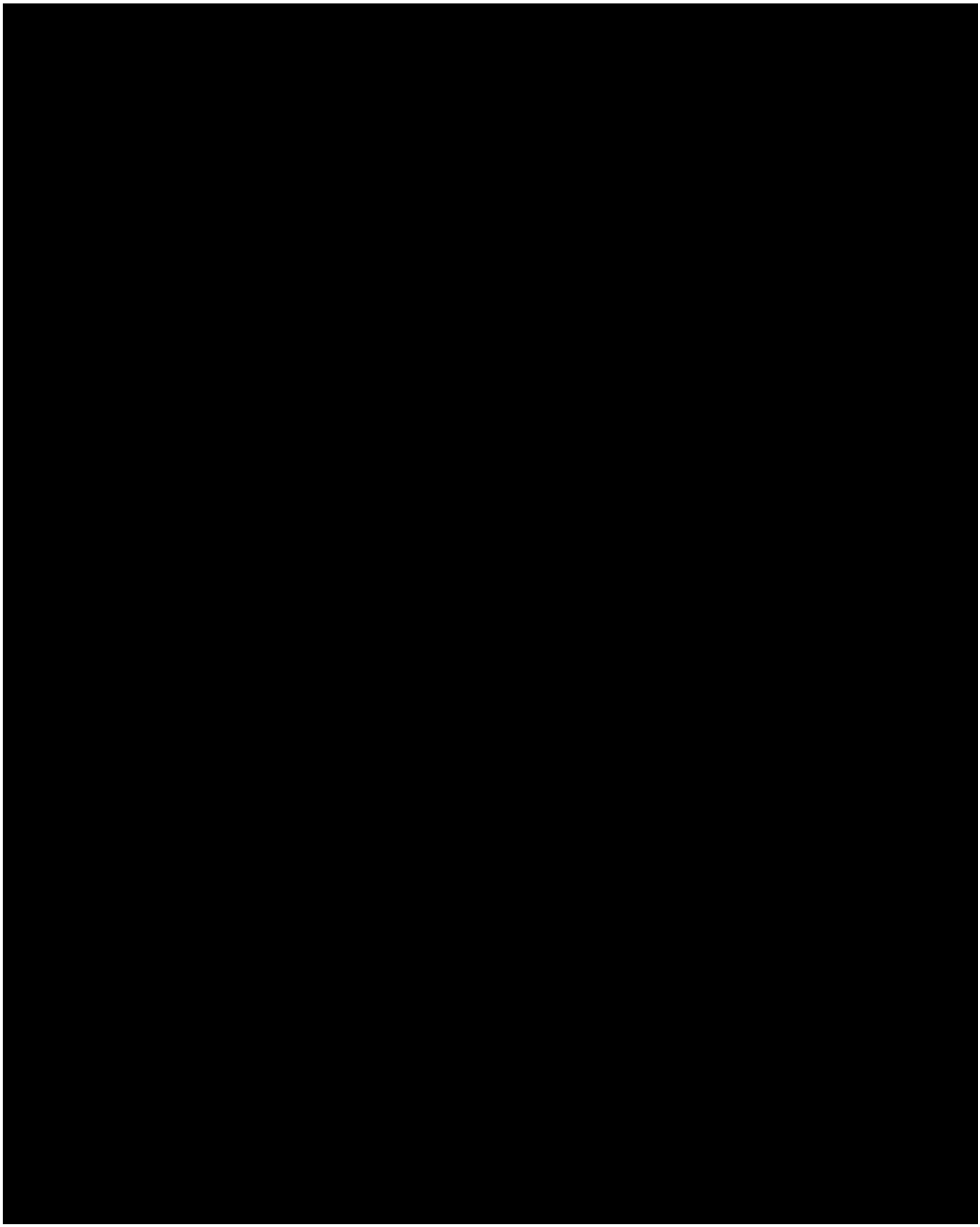


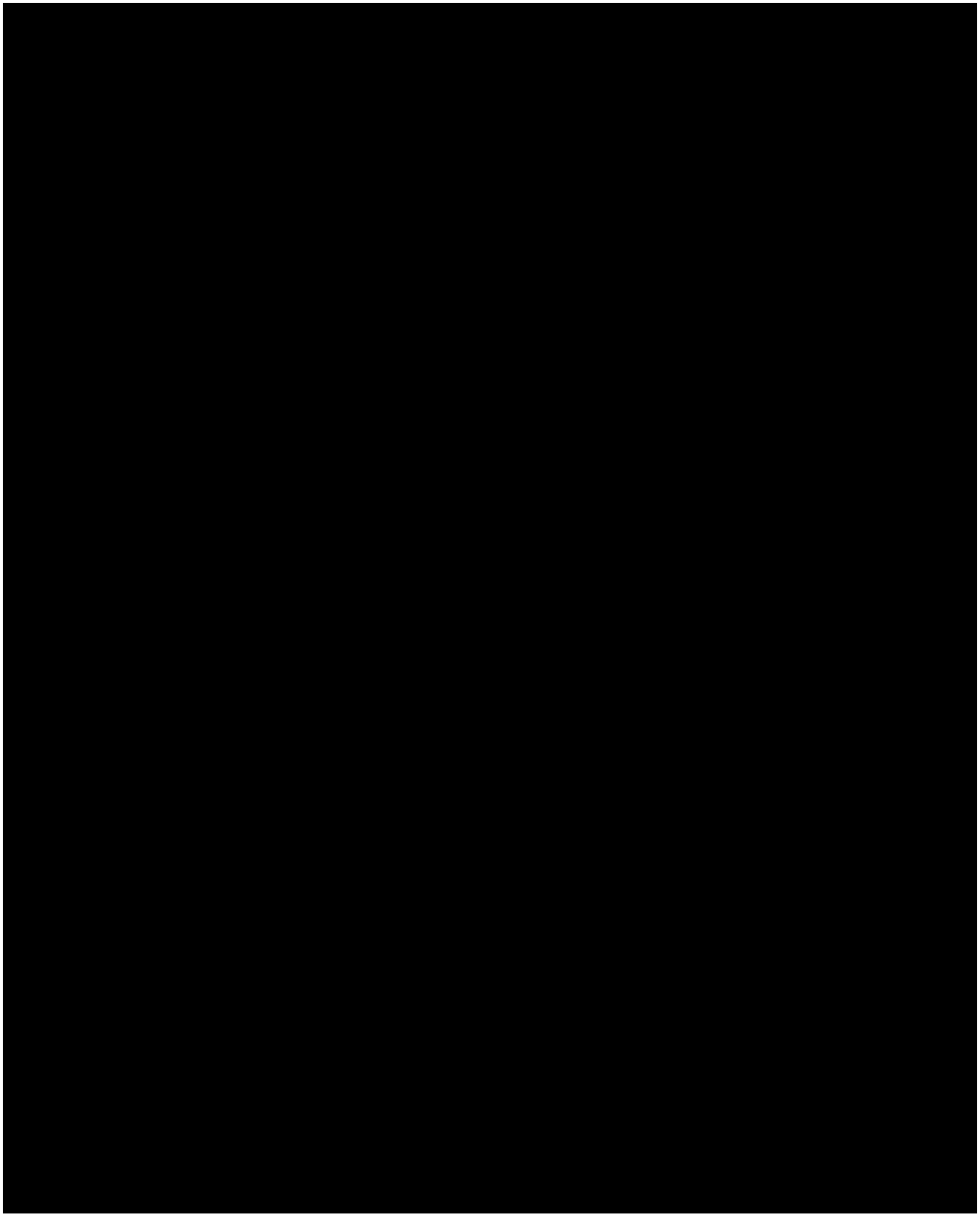


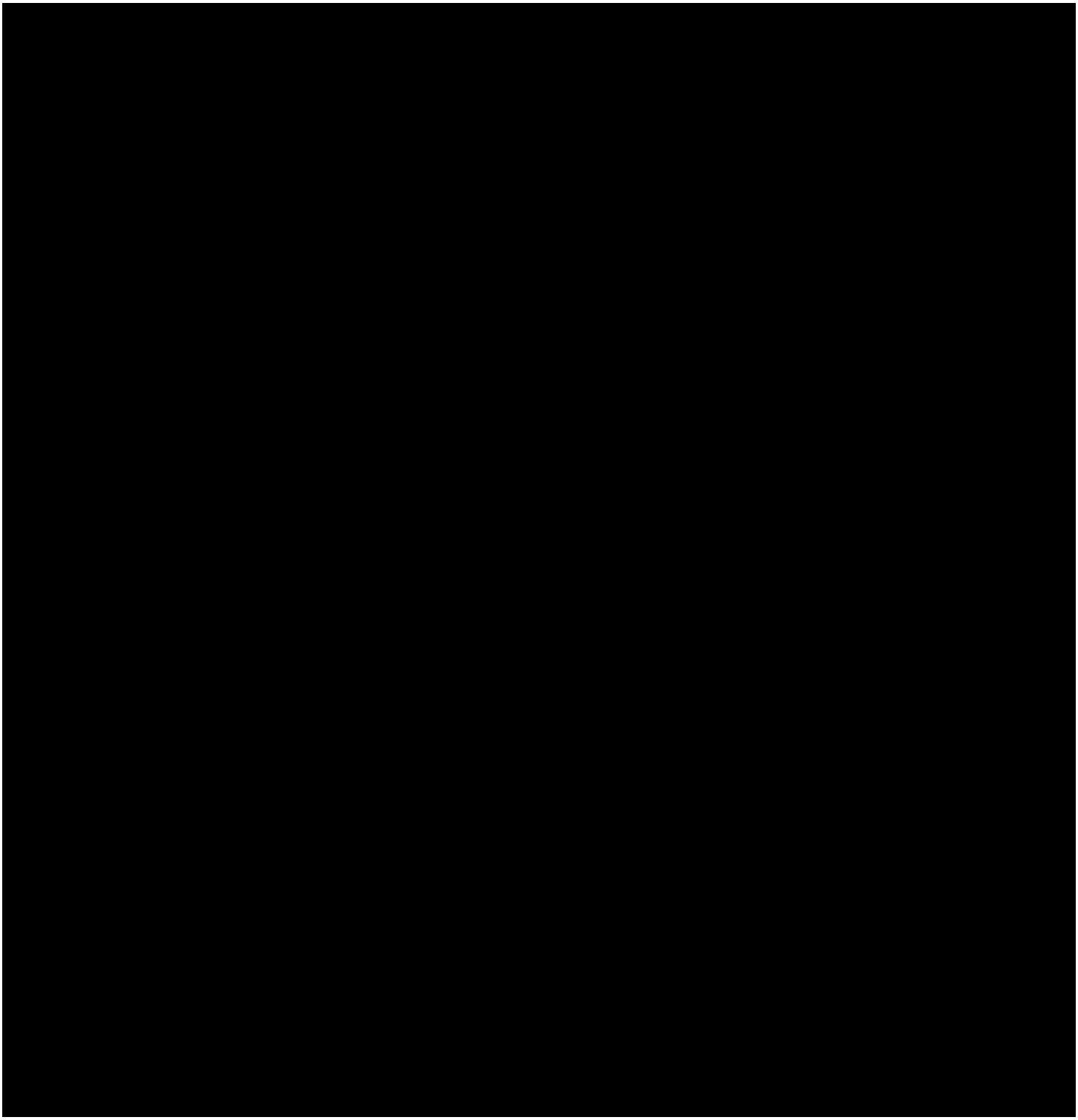


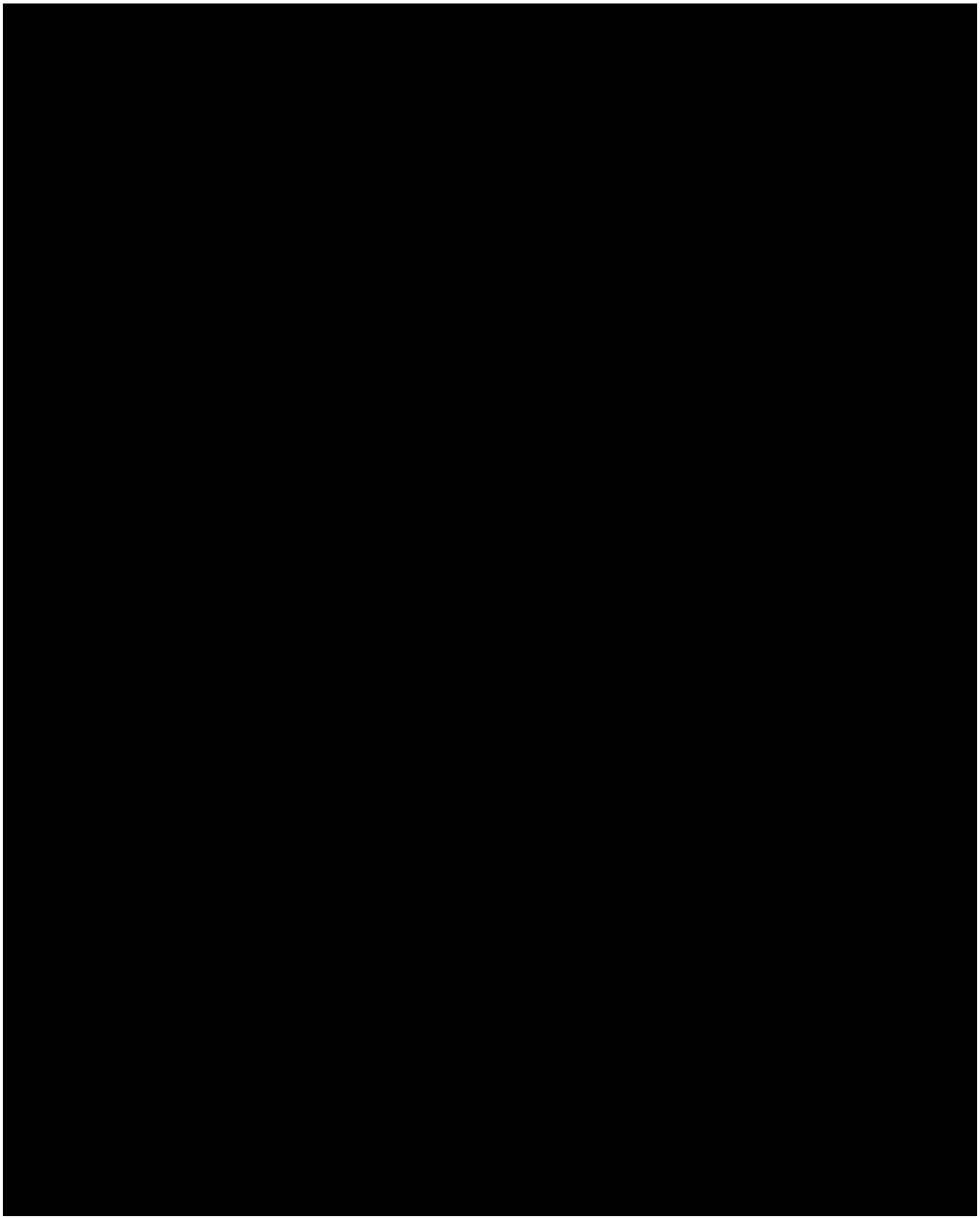


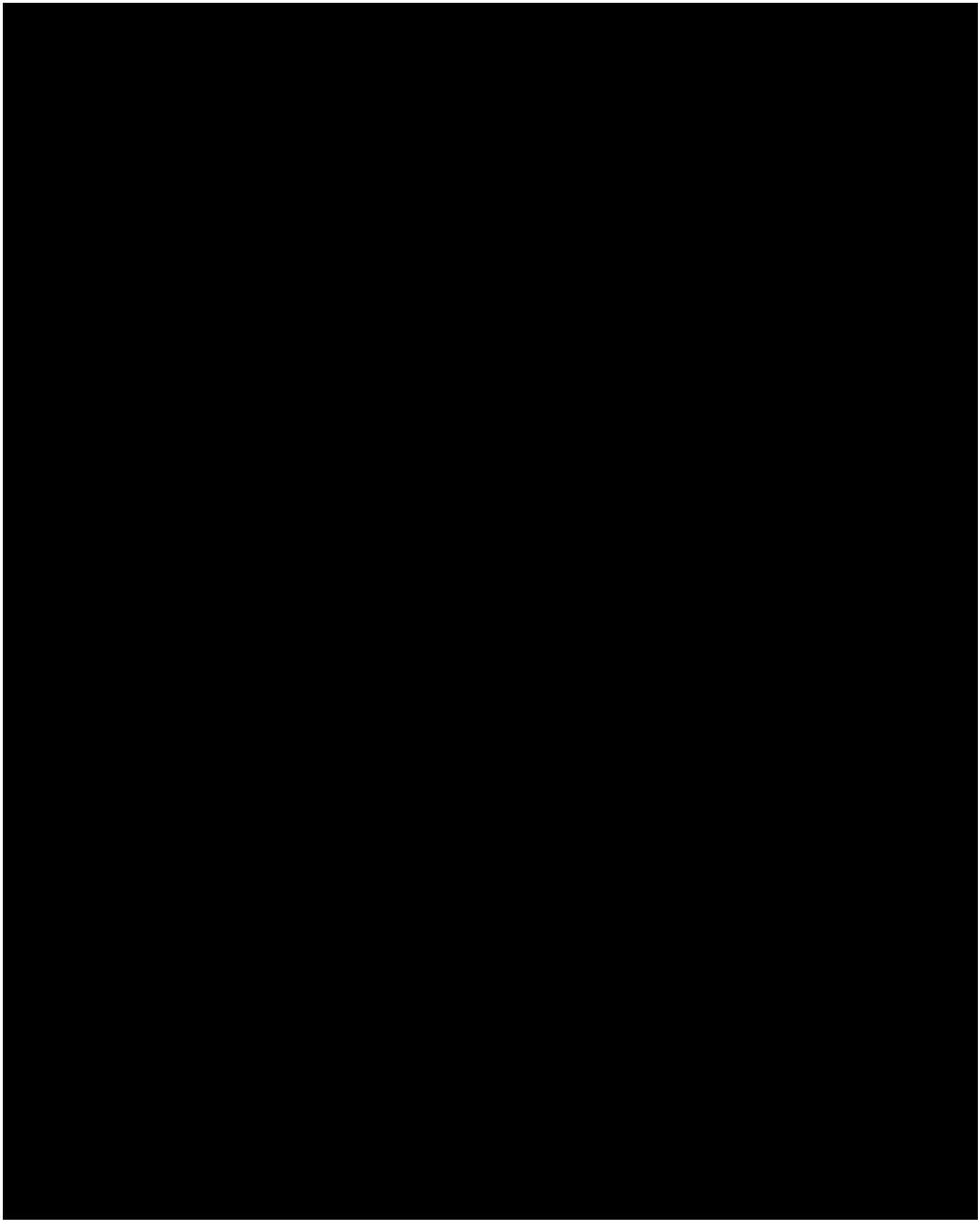


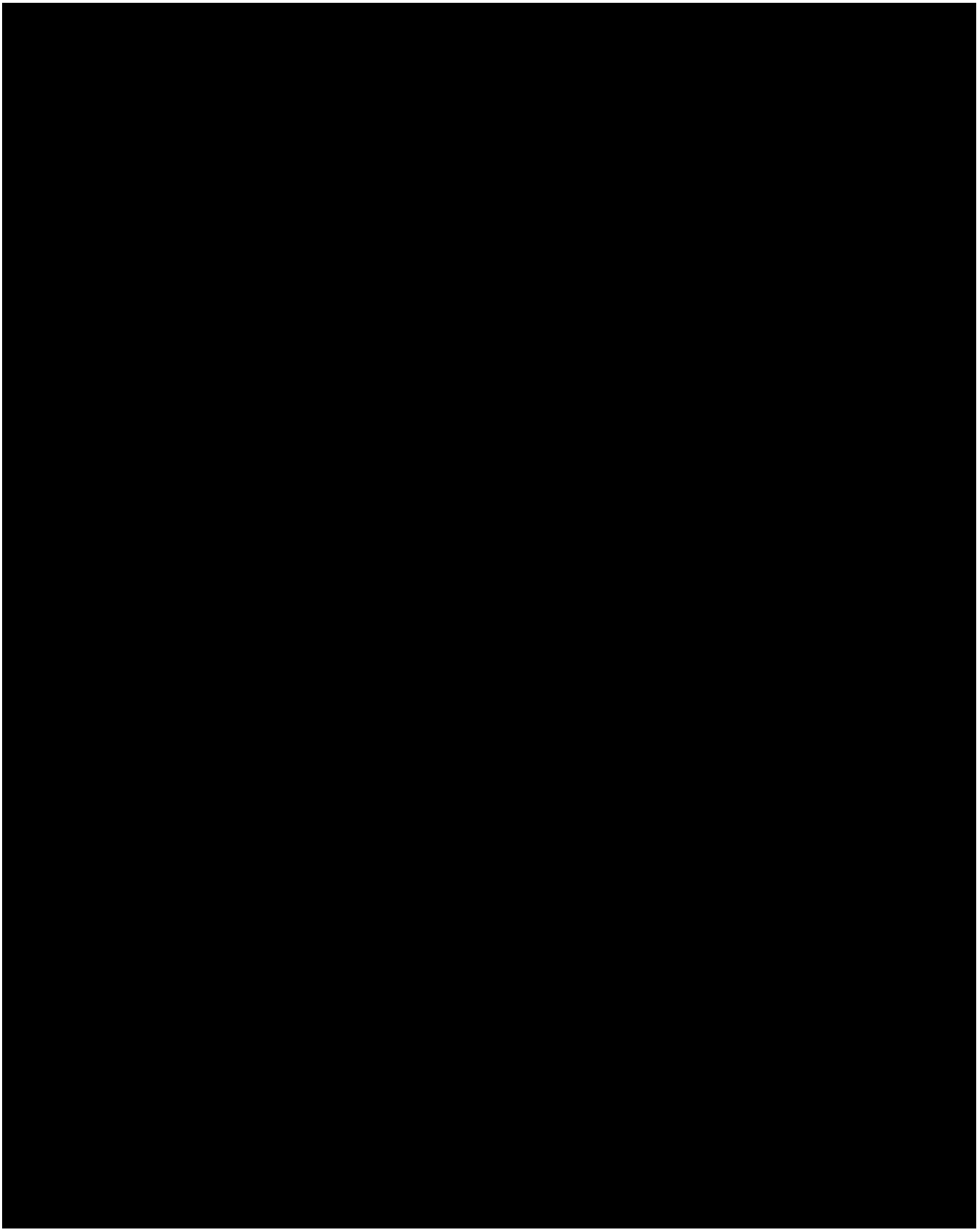


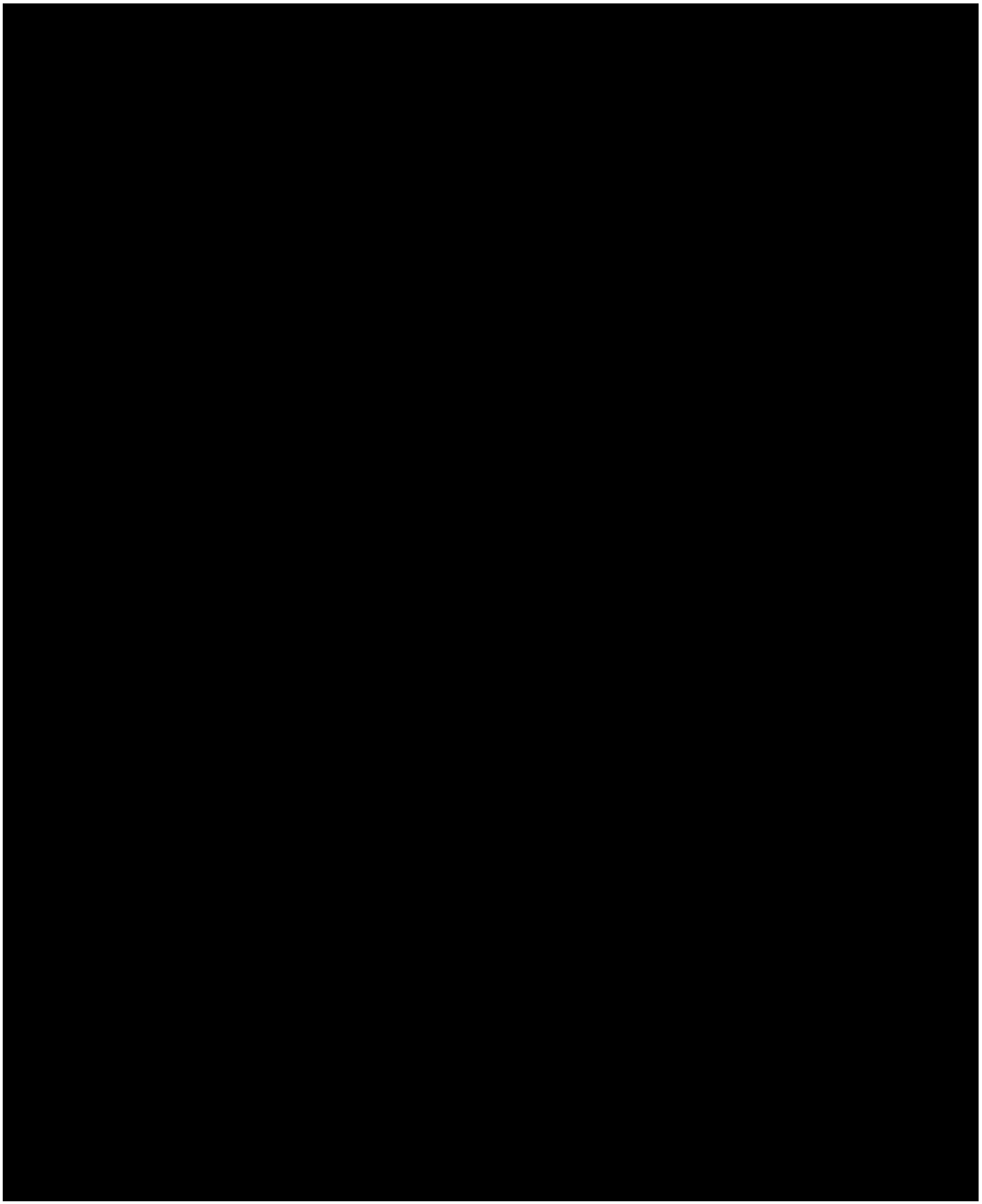


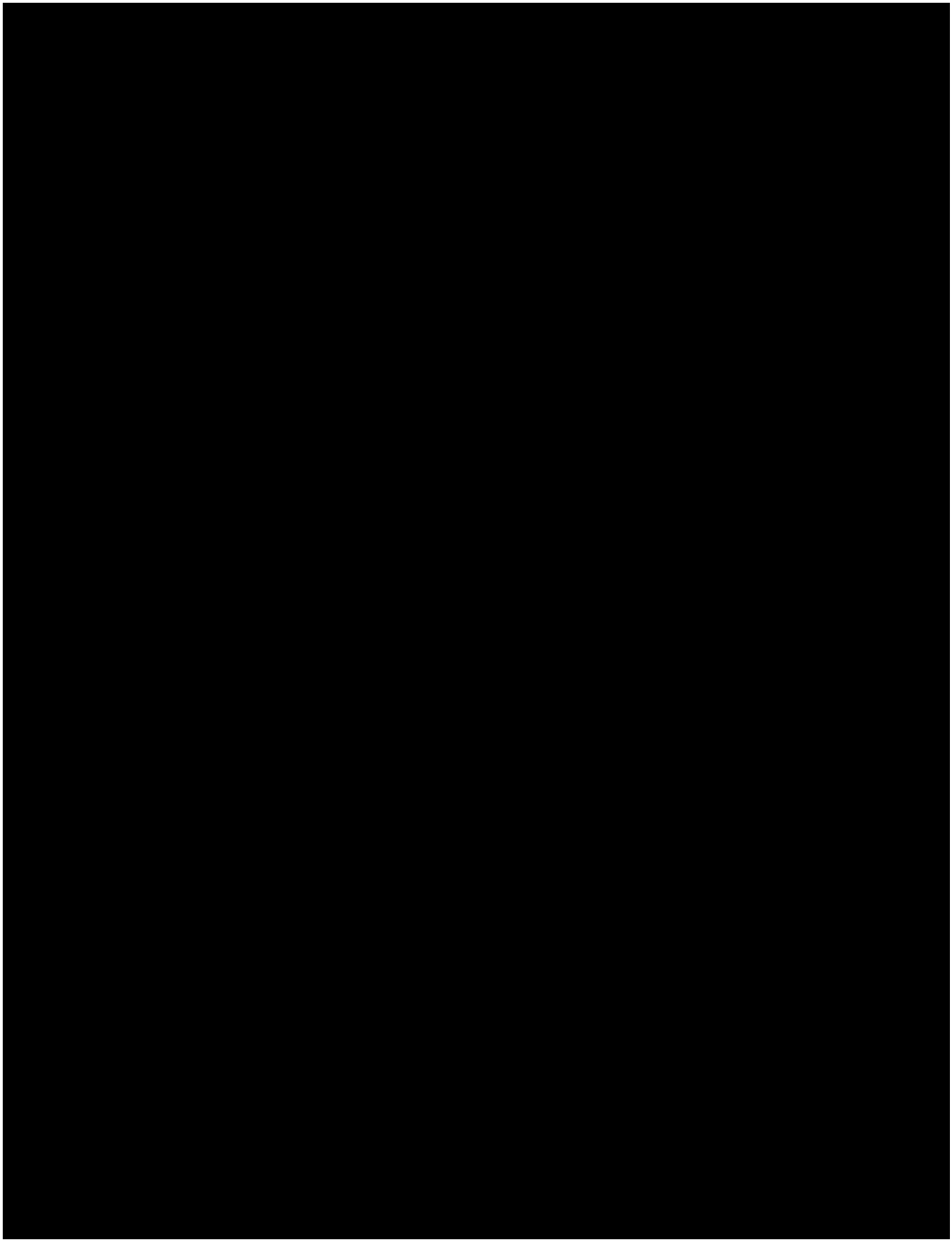


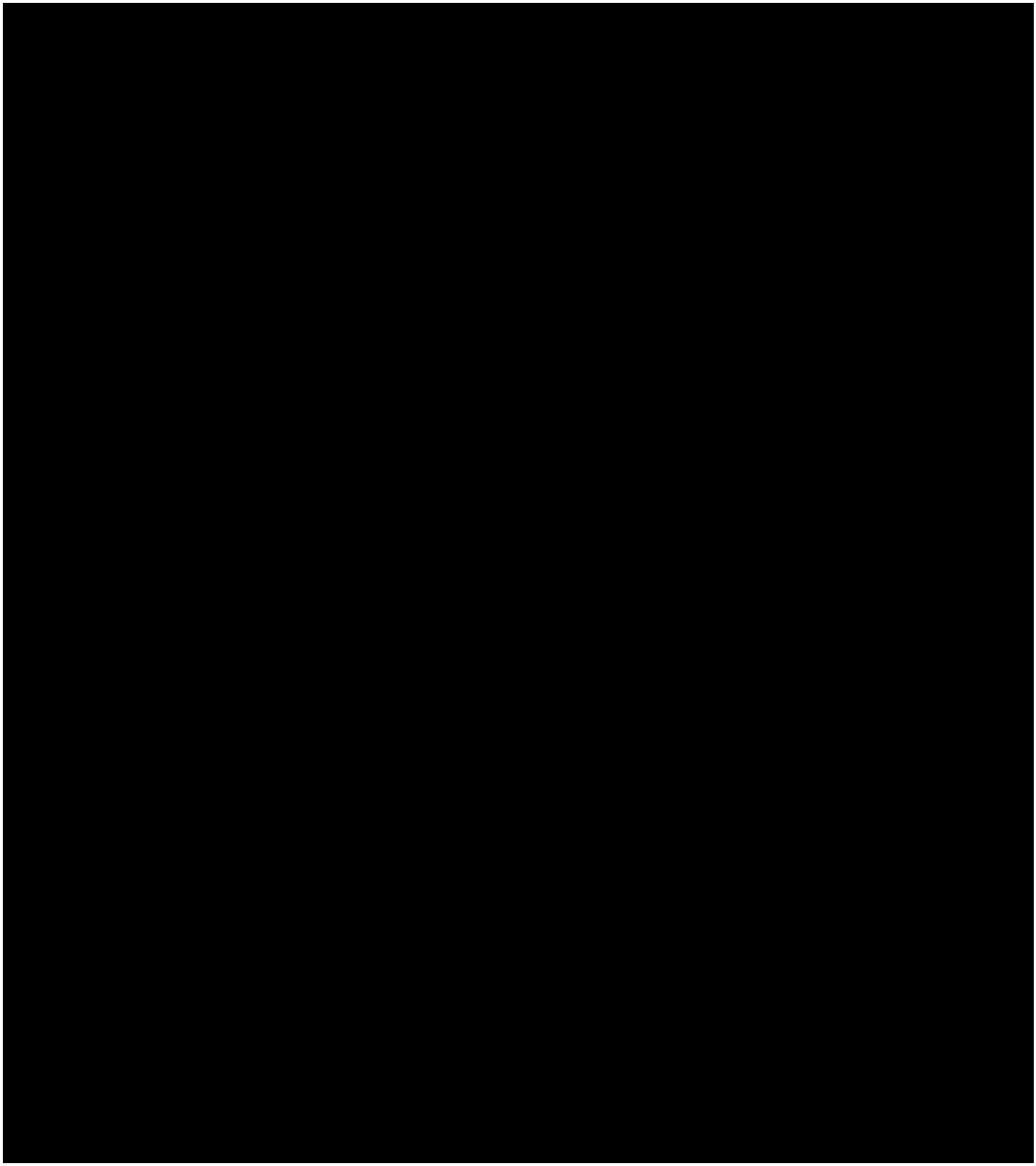


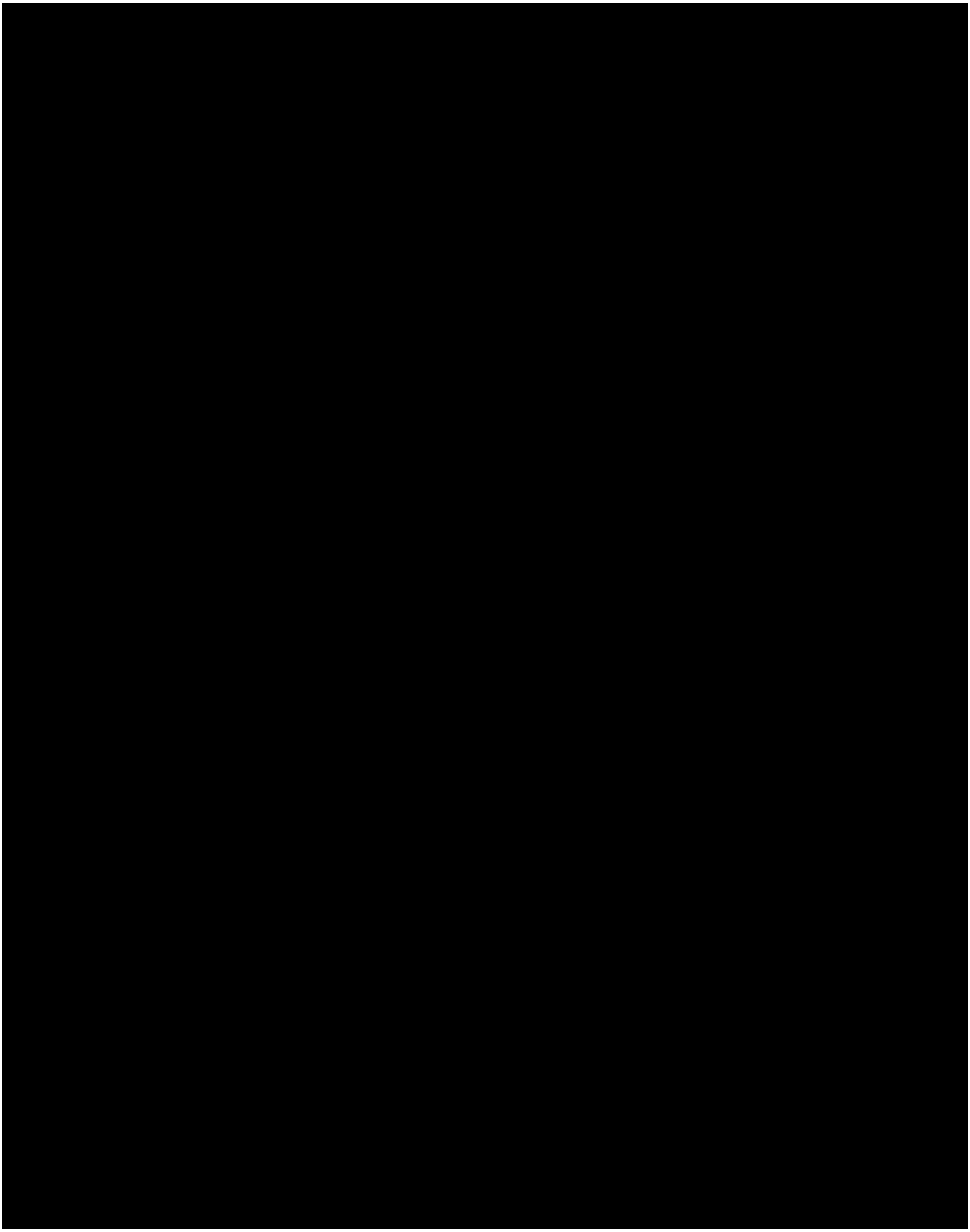


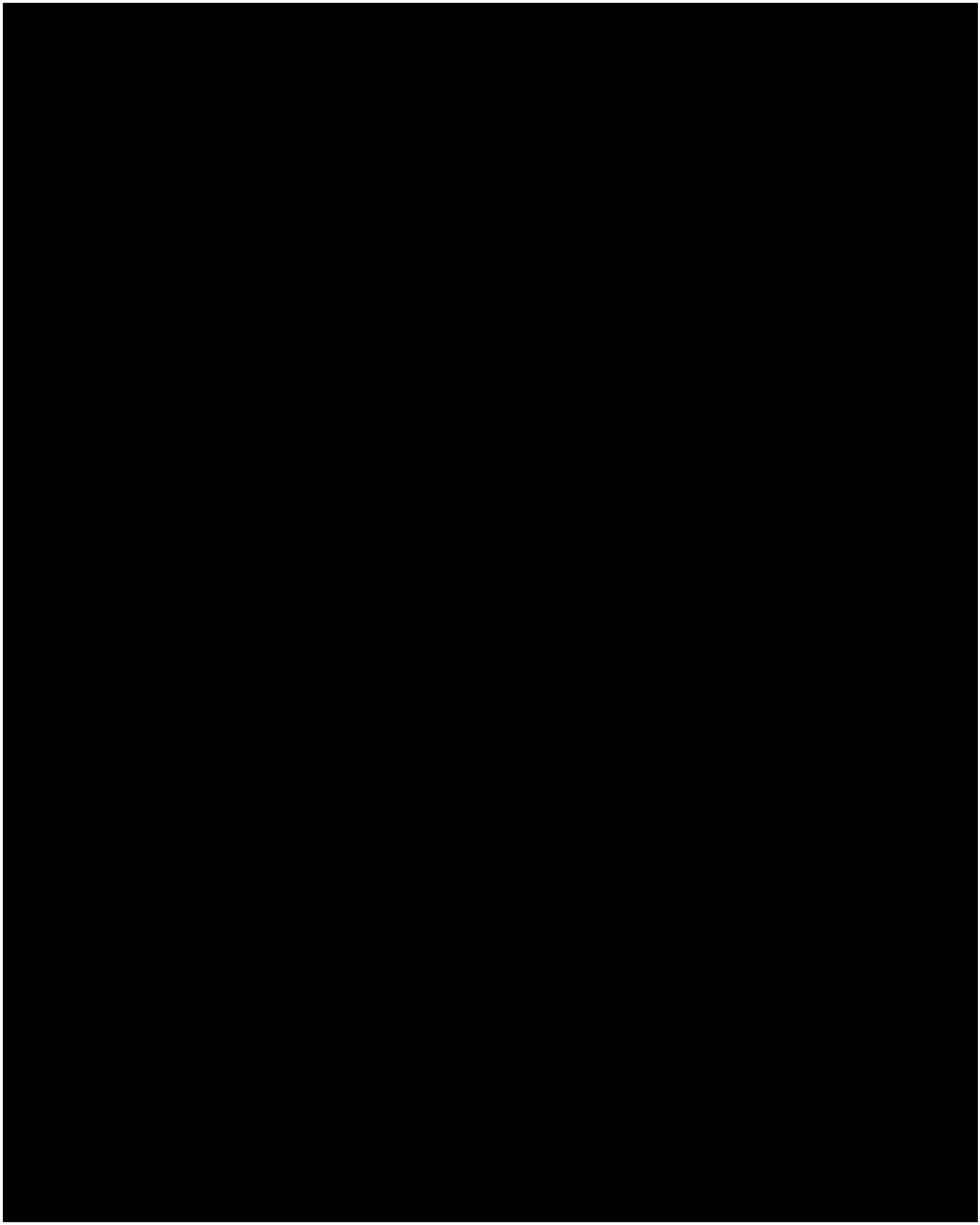


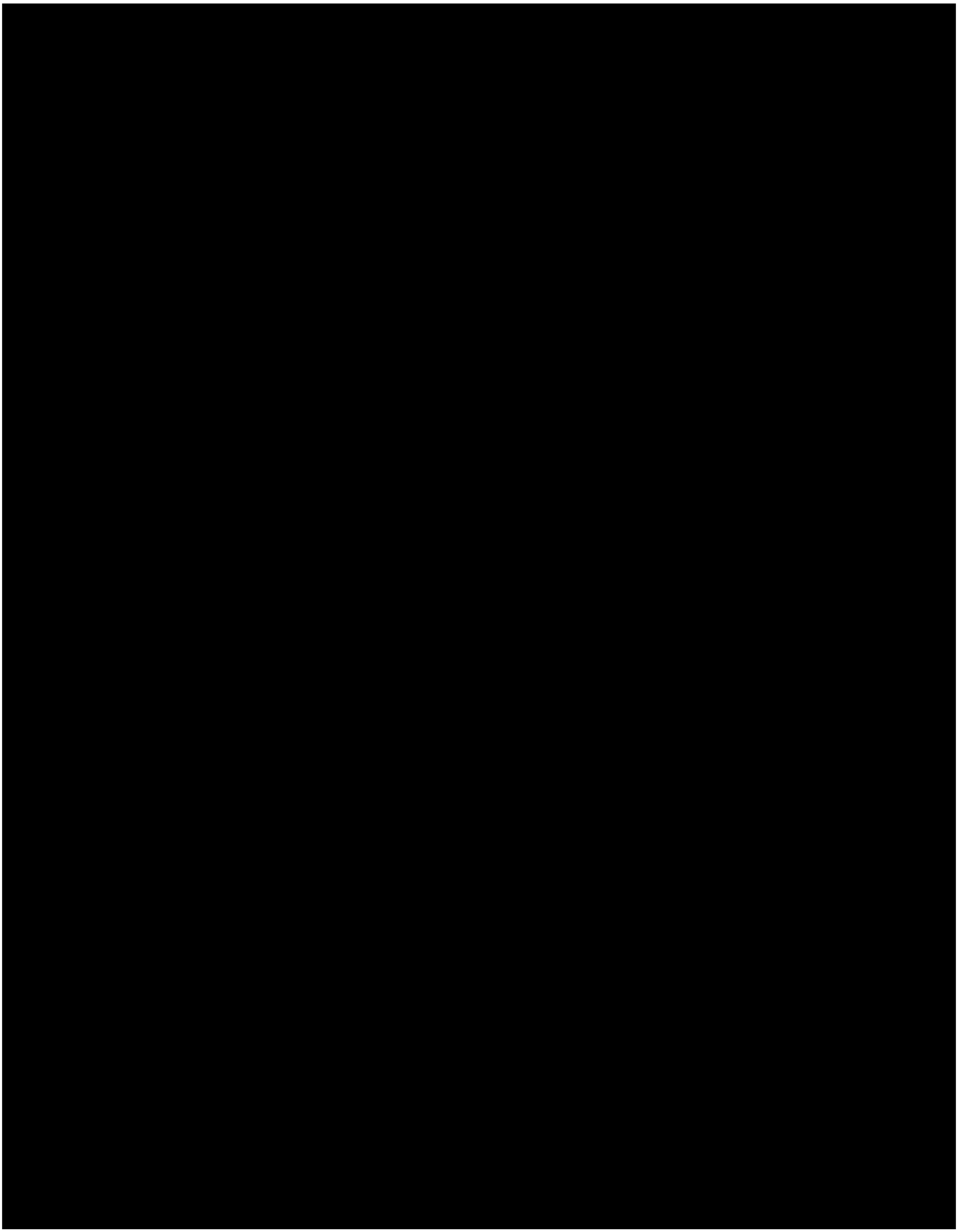


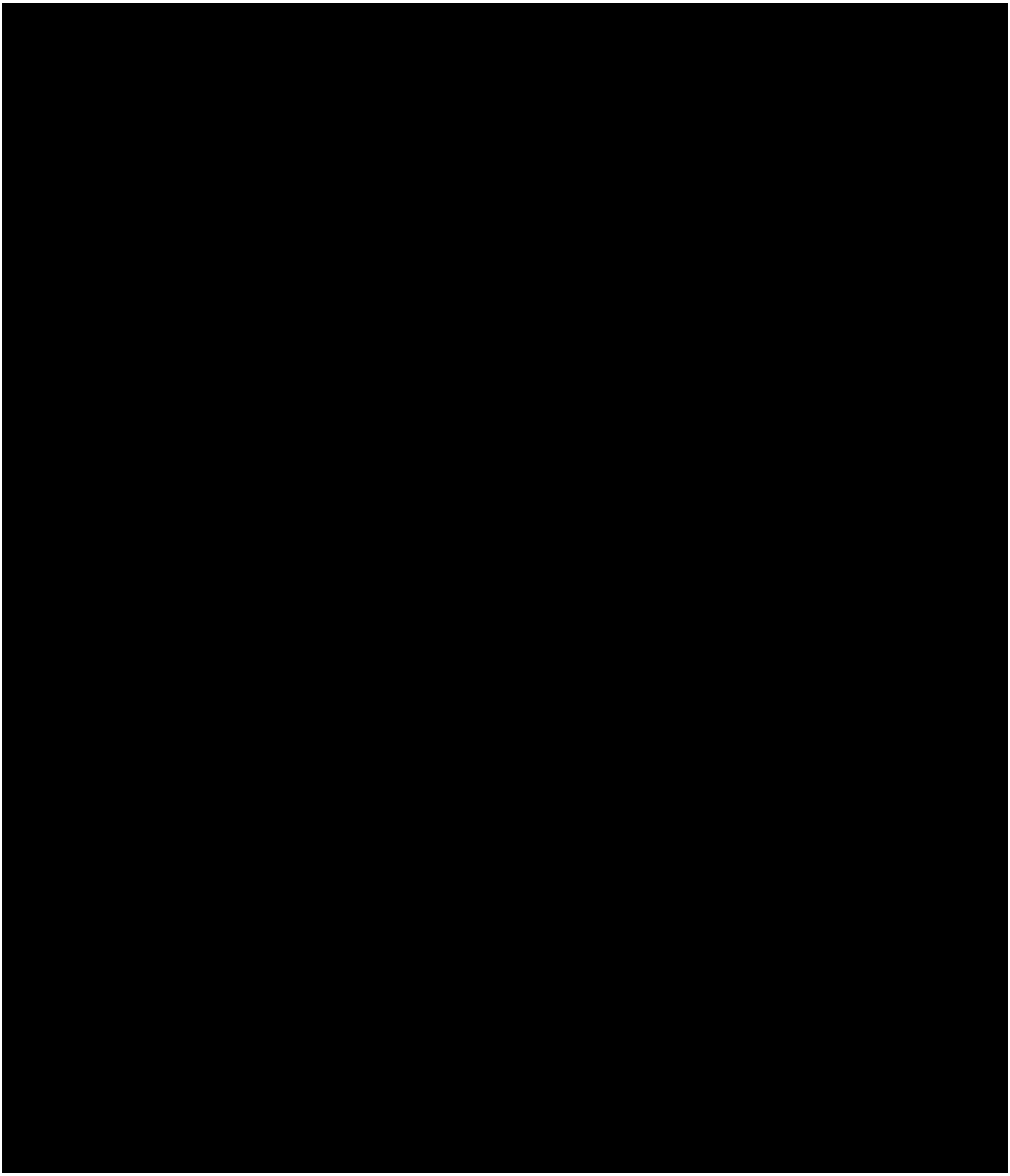


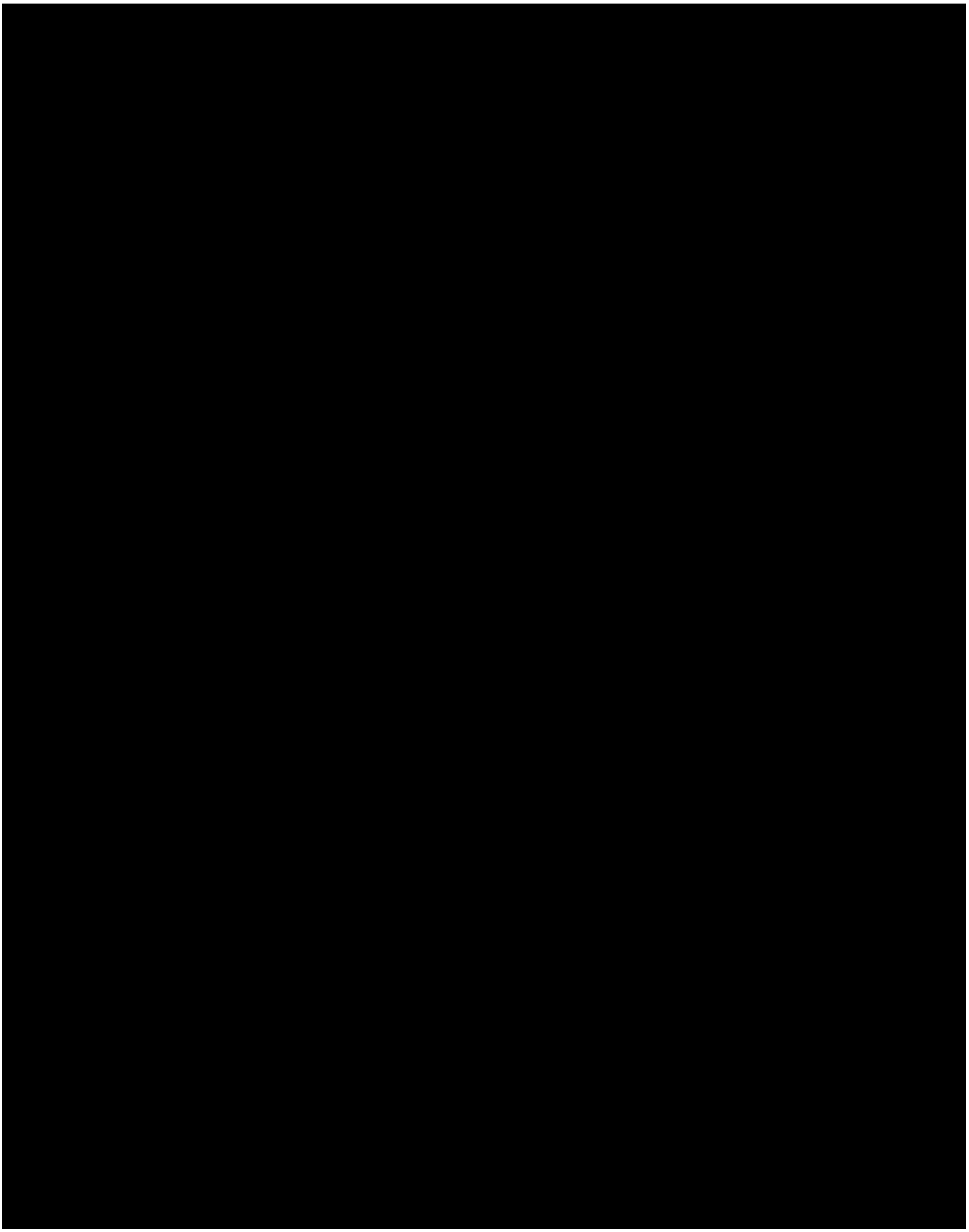


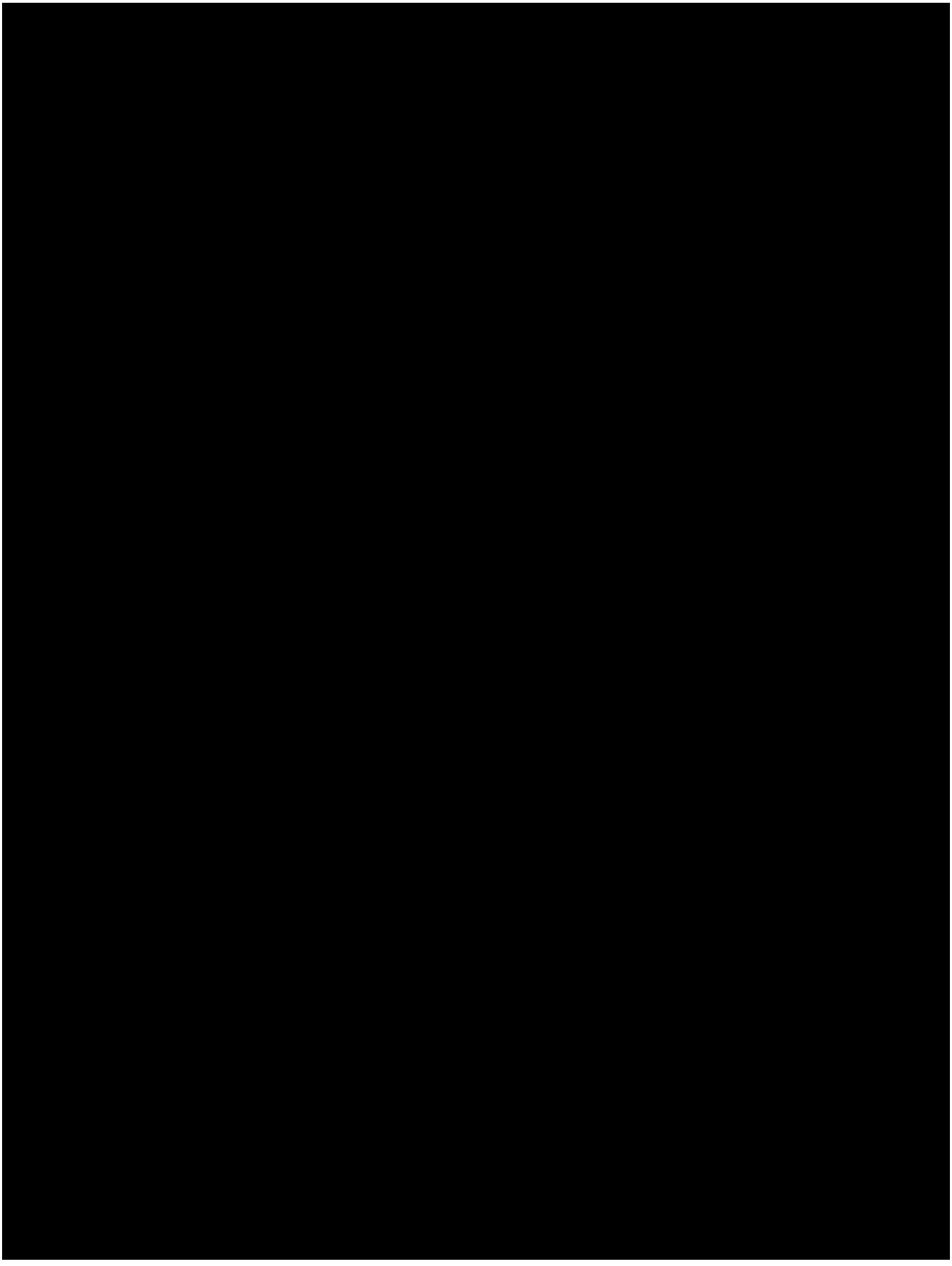


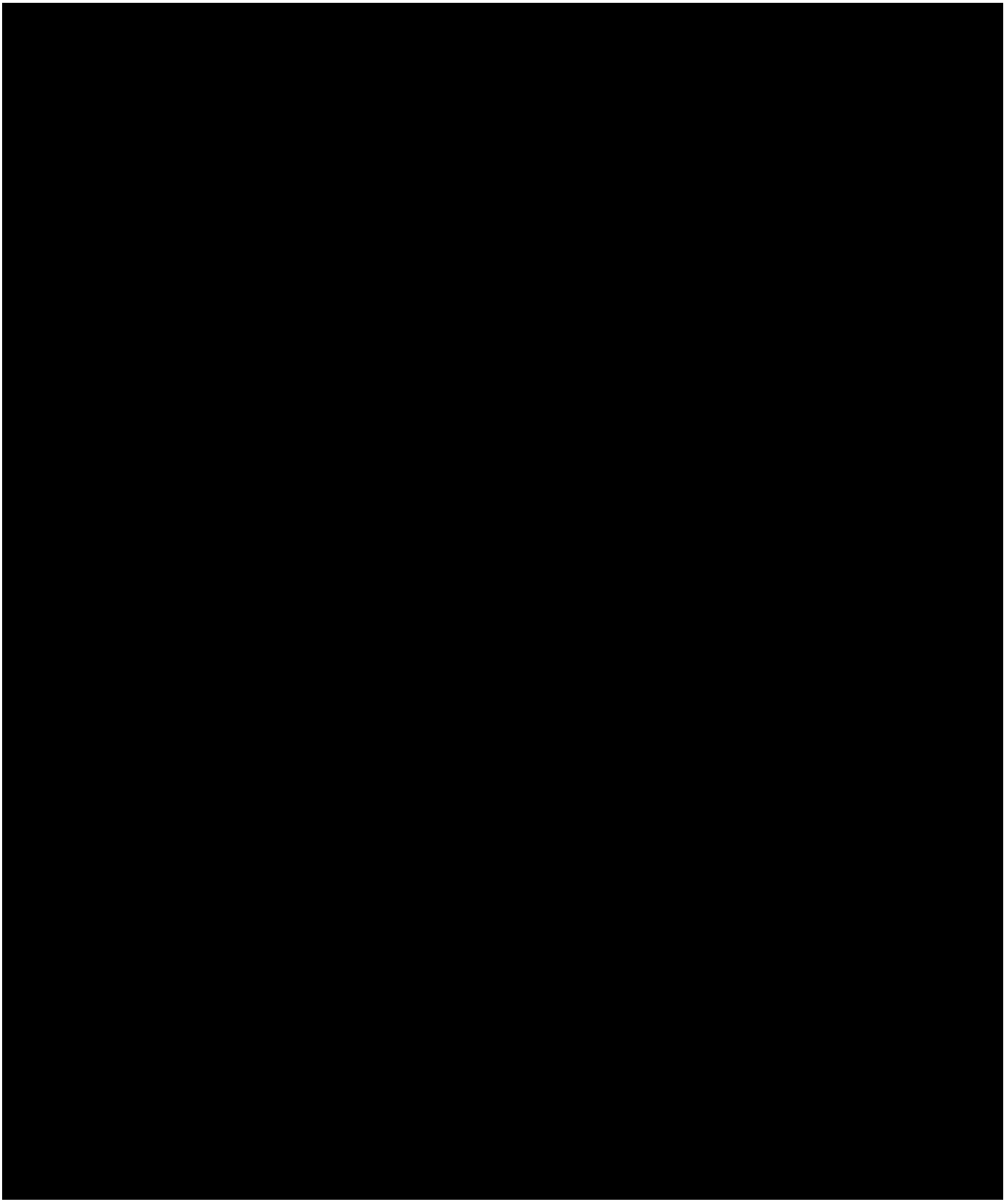


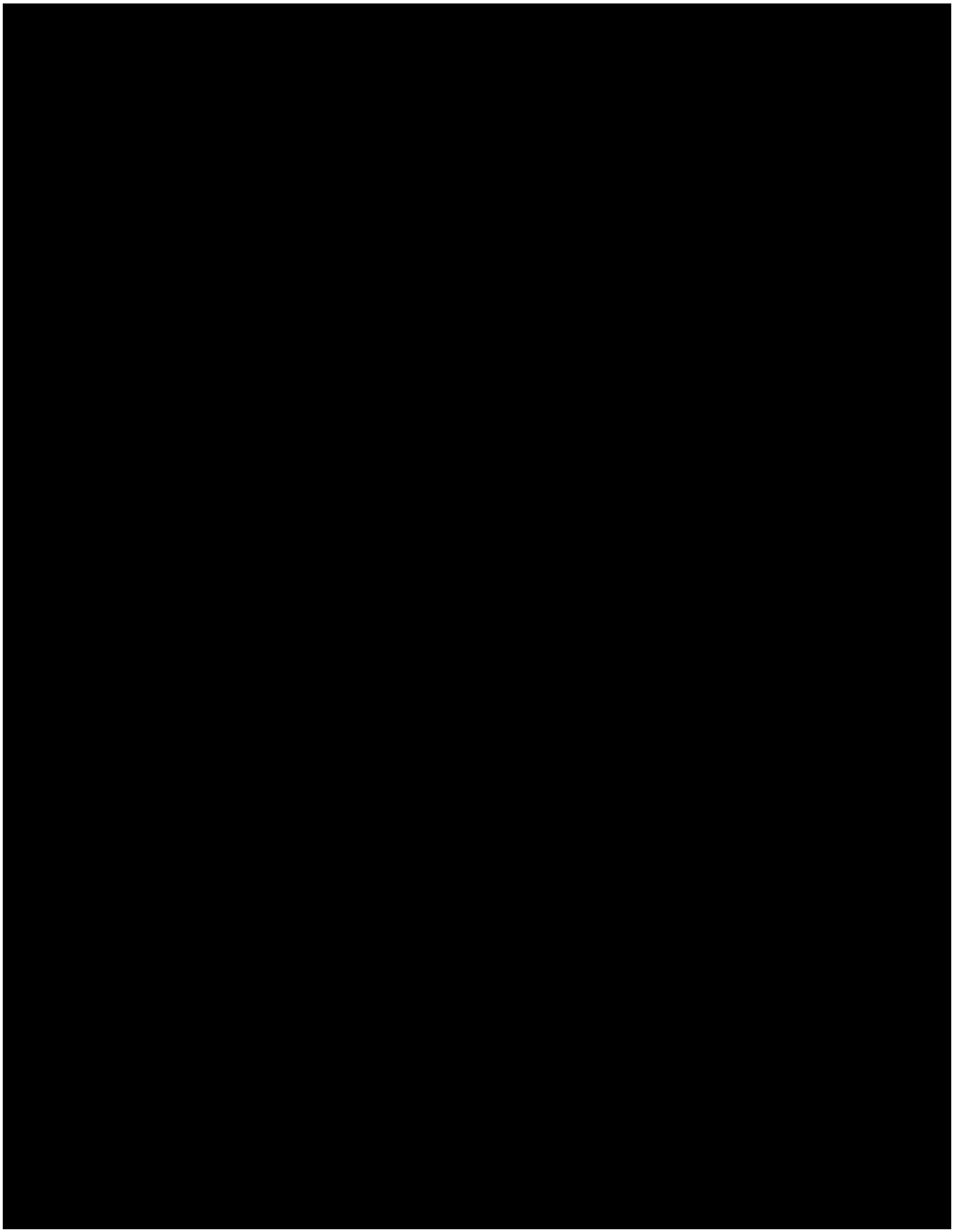


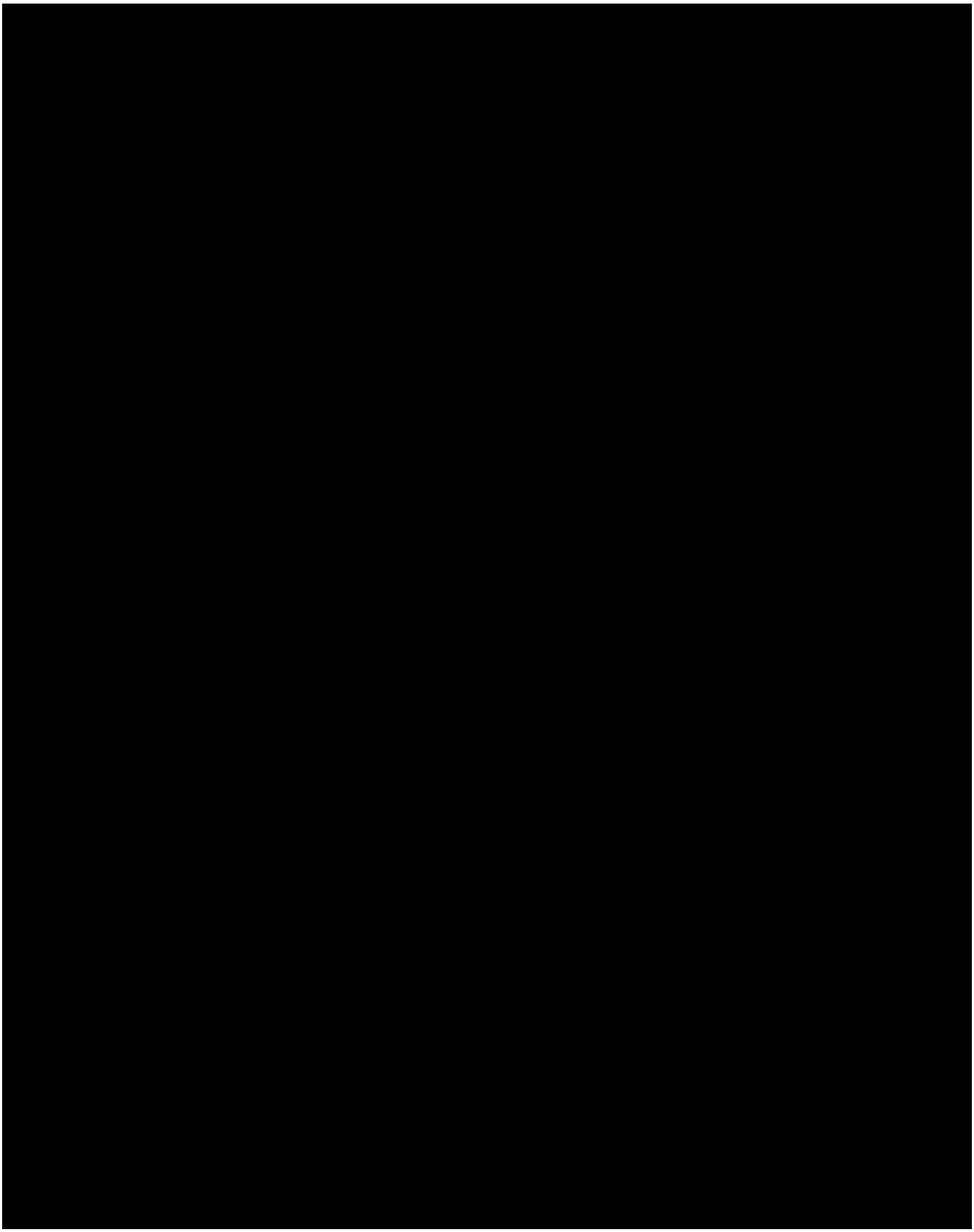


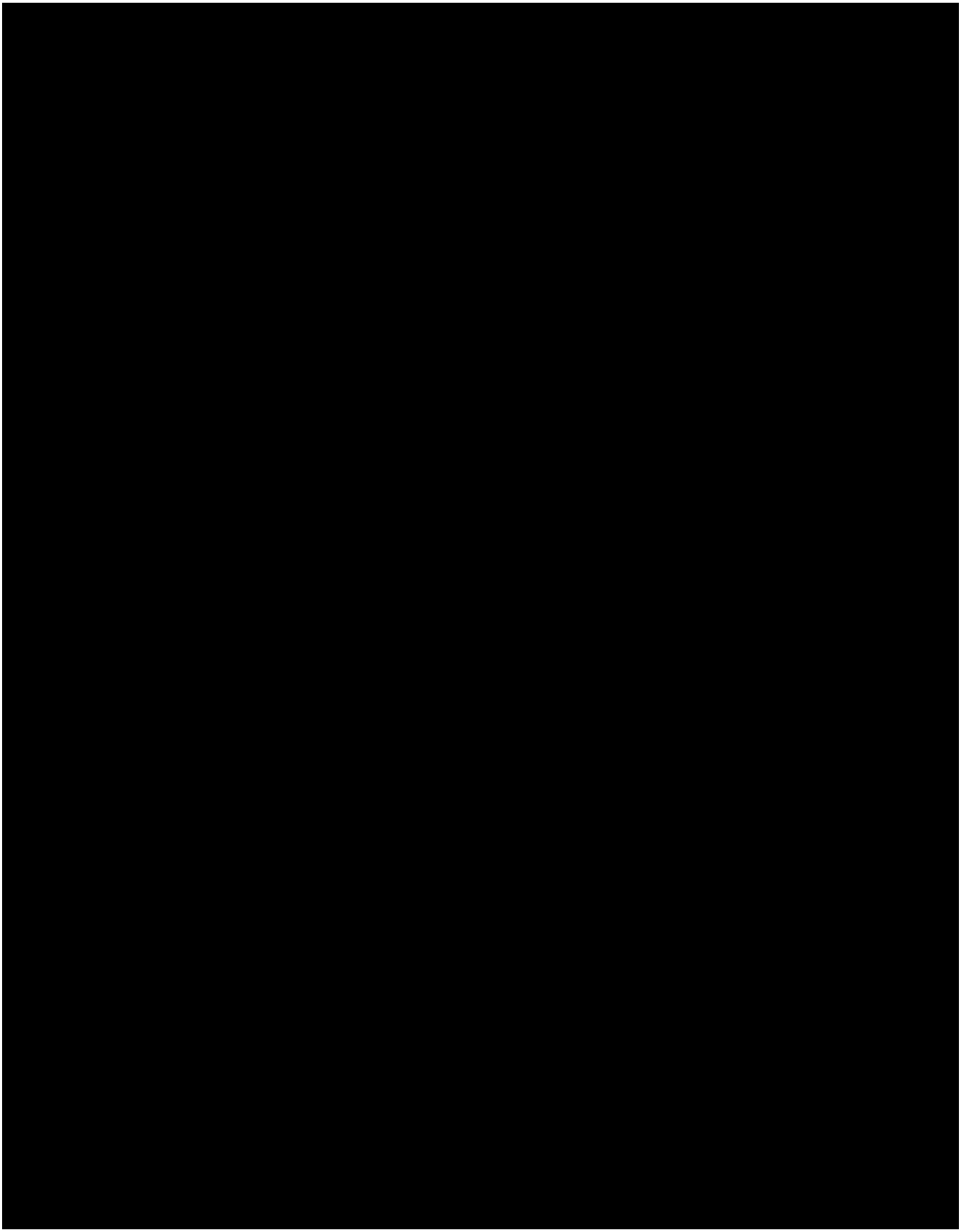












7 Conclusions

Following the thorough technical analysis and performance results of the different implementations, concerning the separate technology modules, it should be noted that at the current stage, where WP3 has been finalised, their respective final prototypes are completed.

The presented deliverable D3.3 indicates the end of WP3 where the separate modules are implemented with their full functionalities, ready to be integrated and form the final iBorderCtrl system and start the integration and full implementation process.

The assessment conducted within this report, related to the fulfilment of the technical requirements (as these have been handed over by D2.1 and D2.2) assures the successful realisation of the project and the acceptance by the end-users. The technical operation and performance results presented, enable the integration process to be continued, both in terms of hardware integration but mainly of software integration that will allow to identify and tackle all related technical interoperability problems and bugs.