Harper College

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Request for Proposal Q01214
Digital Accessibility Services
Addendum #1
November 10, 2025

All changes to the Request for Proposal (RFP) are valid only if they are issued by written addendum. Each respondent must acknowledge receipt of any addenda in their proposal submission. Each respondent, by acknowledging receipt of any addenda, is responsible for the contents of the addenda and any changes to the proposal therein. Failure to acknowledge receipt of any addenda may cause the proposal to be rejected. If any language or figures contained in this addendum are in conflict with the original document this addendum shall prevail.

This addendum consists of the following clarifications and additional information:

While the College will attempt to respond specifically to questions outlined below, the following clarifications supersede.

1. The College intends to award a contract to one vendor provided they can complete all the work outlined in the scope of work by the proposed deadline. However, the College reserves the right to award to two vendors if it is required to complete the work on time. In your response, provide information that will allow the College to assess whether you have the capacity and resources to complete the work on time.

2. The College will rely on respondents to provide their approach and recommended solutions to complete the project on time. Clearly identify what resources are needed from the College and what services you will provide.

3. Respondents will be evaluated based on the selection outlined in the Section B. Evaluation Criteria of the RFP

4. Vendors are encouraged to submit their best offer, so the College can shortlist the initial vendors for further discussion. Only shortlisted vendors may have the opportunity to clarify their proposals, and this is not guaranteed as outlined on page 2 of the RFP.

This addendum consists of the following questions received:

1. I understand the compliance goals and that the College wants all course materials to be accessible, but this doesn't address public-facing digital content which falls under Title II and Section 508 compliance requirements. What assets are included in scope? Specifically:
   a. Are all public facing websites in scope? If not, can you provide a list.
      Response: No, only teaching and learning content within our LMS.

   b. Are all public facing or internally facing pdfs in scope? And would the College simply prefer a pricing table for PDFs?

Response: Yes, PDFs in our LMS are in scope. Pricing should be provided in the Pricing Proposal as requested. Other pricing tables you would like to provide can be added as additional information.

c. Are the LMS and course curriculum in scope?
Response: Documents in the LMS

d. Are all mobile applications in scope?
Response: No

2. Can bidders assume internal facing digital assets are outside of scope? For reference, new Title II compliance regulations require both public-facing and internally facing assets accessed by students, staff, and faculty to be compliant with WCAG 2.1 AA by April 24, 2026.
Response: Documents in the LMS are in scope. Public facing documents are outside of scope for this RFP.

3. Does the College want to implement the fixes for compliance violations directly or have the vendor implement the fixes?
Response: The College expects the vendor to complete the scope of work outlined in the RFP.

4. The biggest problem for collegiate education systems are the number of instructors and creators publishing content-causing new violations. Are trainings included in scope? If so, should we recommend a training program based on our experience working with customers like the College?
Response: Yes, training is included in the scope. If you offer a training program please outline what is included.

5. On page 29 of the RFQ (State of Illinois Business Enterprise Program), it states (a) "This solicitation includes a specific BEP participation goal of 0% of the total dollar amount awarded to MBEs and FBEs" and (b) "with at least 50% of the total dollar amount awarded to FBEs". Can you clarify the expectation of total dollar amount awarded to MBEs or FBEs?
Response: The BEP goal being 0%, the total dollar expected is $0.

6. What portion of the 120,000-file inventory do you expect to remediate before the April 24, 2026 deadline, and how will you release work (by term, department, file type)?
Response: All files that we determine need remediation. We will prioritize the files that need remediation and work with the vendor on the process of sending files to the vendor.

7. What volume of work is expected per month?
Response: To be determined after the College reviews the file inventory and prioritization.

8. Can you provide a summary of page/slide/sheet/etc. counts per file type, including what percentage are scanned vs digital? Averages per file will work as well.
Response: We cannot determine page counts per file at this time.
This is an overall summary of file types provided in the scope of work per the most recent Blackboard Ally Report:
   - PDFs – 32%

  - 17% of PDFs are scanned but have not been OCRd
  - 30% of PDFs are not tagged
- Images – 28%
  - 85% of images need alt text
- Presentations – 10%
- Documents – 17%
- Uploaded HTML – 1%
- Other file types such as spreadsheet, audio, software specific files – 12%

9. What percentage of PDF pages have complex tables/forms approximately?
   Response: We cannot determine the number at this time

10. Related to STEM comment, what is the estimated volume and formats (e.g., LaTeX source, MathML, embedded equation objects, images of equations)?
    Response: We cannot determine the estimated volume and format of STEM-related content.

11. Related to media, what are the total minutes for prerecorded video/audio and the percentage already captioned?
    Response: We cannot determine the total minutes. Videos stored on our Panopto platform have auto captions. Most videos have not been human captioned unless there has been an accommodation request.

12. Related to HTML, are the 699 HTML files stand-alone pages, LMS content items, or external sites?
    Response: Upon review, these files are .html files uploaded by the instructor. We will work with the instructor to determine if these files require remediation.

13. For digital documents, will you provide access to source materials to preserve intent and reduce cost versus remediating flattened PDFs?
    Response: If the source file is available, we would have you remediate that file rather than the PDF file.

14. Are any digital documents multilingual? If so, what languages are covered and what are the expectations for translation/accessibility process? We typically review/remediate source files, pass them to College partners for translation, and then review/remediate translated documents.
    Response: Yes, some of the digital documents might be in other languages, however we cannot determine the volume.

15. Is alt-text expected to be vendor-authored or provided by Harper SMEs for discipline-specific accuracy?
    Response: The alt-text should be vendor-authored.

16. Can you provide representative samples for each file type to assist with the scoping process? Links to publicly available documents would suffice.
    Response: Sample documents are attached as examples 1-4.

17. A few of the services are combined on the Pricing Proposal sheet. Can we provide separate pricing tables, breaking out by service and complexity, along with a pricing narrative to provide an explanation of the pricing?

Response: Pricing should be done on the Pricing Proposal table. If there are break-out services, provide that information as noted below the Pricing Proposal table.

18. On the Pricing Proposal sheet: What is "User Testing and Feedback"?
    Response: This is to verify that the remediated document complies with WCAG standards and includes vendor and user checks.

19. Part 1, Section 6. Deliverables indicate Harper College's interest in self-remediation platforms. Can we include pricing for these with our Pricing Proposal?
    Response: Yes, if that is something the vendor offers, please include it in the pricing proposal.

20. Form of Proposal – Pricing: What is the Total Not to Exceed Cost?
    Response: Based on your understanding of the total scope of work as quantified in the RFP, please provide the not to exceed amount you can use to complete the total scope of work. Provide a narrative of your assumptions of what is included and excluded from that amount.

21. Do we need to submit the BEP forms if the BEP goal for this project is 0%?
    Response: No. However, if you are utilizing MBE/WBE firms, please identify on the forms provided including whether or not your firm is and Certified MBE/WBE through the Commission on Equity and Inclusion (CEI).

22. B.11 Insurance Requirements states, "Please state your professional liability coverage if applicable." Does Harper College deem it applicable and, if so, at what level?
    Response: It is applicable, and minimum insurance requirements are outlined in section B.11 of the RFP.

23. Will 100% tag-by-tag conformance reports be sufficient in validating the work we do, or will Harper be testing our work with their own validation process? If so, what does that process entail, and does it include non-sighted screen reader users as part of that process?
    Response: The vendor should conduct a conformance report that aligns with the WCAG 2.1 AA standards. Harper College will also conduct selective compliance checks, which may or may not include users.

24. Please kindly provide the estimated number of documents Harper College anticipates to remediate each month.
    Response: Please see Question #7.

25. Since the final addendum will be issued on November 10, and considering transit time needed for hard copies of proposal packets, will the deadline for submissions be extended beyond November 18?
    Response: No, the submission deadline for proposals will remain at Tuesday, November 18, 2025 at 11:00 a.m., Central Time.

26. Should vendor proposals be in accessible PDF format?
    a. If yes, how would you verify accessibility of the proposals?
    Response: No. This is not required of the RFP response.
    b. What impact does this have on the proposal evaluation/scoring process?
    Response: None

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27. Will you accept proposals from a vendor that is able to provide some, but not all, of the requested services?
    a. If yes, how/where should services offered and not offered be indicated?
    Response: Yes – in the Pricing Proposal section

28. It is understood that Harper College has an inventory of approximately 120,000 files, and that the college is paring down that list and prioritizing documents for remediation.
    a. How many documents do you expect will actually need to be made accessible by April 24, 2026?
    Response: Please see Question #6.

    b. How many total pages are in these documents?
    Response: We cannot determine.

29. Can you please share examples of each of the document/content types listed at the bottom of page 15 (PDF documents, Word and Excel files, PowerPoint lecture slides, HTML files, Image files, other documents, Pre-recorded video and audio materials, Closed captioning and audio descriptions, and STEM content)?
    Response: Please see Question #16.

30. Is the Adobe Acrobat Accessibility Report acceptable accessibility documentation (#5 on page 16)?
    Response: An Adobe Accessibility Report alone is not sufficient for documentation for full legal compliance and remediation. It is an automated report with limitations and there needs to be manual testing of accessibility issues, such as appropriate alt-text, color contrast, correct tagging of artifacts, lists, tables, keyboard navigation, and reading order, etc. Documentation or evidence that what issues were resolved and how they were automated or manually tested for WCAG 2.1 compliance.

31. Would you accept an hourly rate for services, rather than a price per page/minute/session?
    Response: Bidder's pricing must reflect the unit of measure in the pricing proposal.

32. What is the budget amount for this project?
    Response: TBD

33. As a certified woman-owned business in Illinois, would additional points or preference be awarded to our response during the evaluation process?
    Response: No, however, if your firm is certified through the Commission on Equity and Inclusion (CEI) you should identify it on the form provided in the proposal document.

34. How long after the January 21, 2026 Board meeting/approval should the awarded vendor(s) expect to receive a purchase order and therefore actually begin the project?
    Response: The College expects to send over a purchase order before end of January. The work can begin as soon as the PO is received.

35. Can Harper College provide an estimate of how many files (out of the total 120,000) are actually expected to require remediation?
    Response: Please see Question #6.

36. Will Harper provide priority order or categorization of courses/files for remediation?
    Response: Yes

37. Are vendors expected to include captioning and audio description services for all video/audio content, or only when identified by the College?
    Response: Yes, only when identified by the College.

38. Does the College expect remediation of third-party content (e.g., publisher or YouTube materials), or just institution-created files?
    Response: No, only institution-created files.

39. Can Harper clarify what is included under "Other Documents" in the content types list?
    Response: Any other file types that instructors might upload to a Blackboard course, such as audio files, spreadsheets, or specialized application files. We will determine which of these files will need remediation.

40. What platform or method does Harper prefer for secure file exchange (e.g., SFTP, portal, OneDrive, etc.)?
    Response: In your proposal submission identify the options that are available to the College so that we can consider it as part of our evaluation.

41. Is integration with Blackboard Ultra LMS expected at any point in the project lifecycle?
    Response: Integration with Blackboard LMS is not required for this project. However, in your response please describe your workflow solution if you do not support integration.

42. Are there preferred tools or accessibility checkers Harper currently uses (e.g., Ally, Siteimprove, Equidox, etc.)?
    Response: The College uses Blackboard Ally in house. However, vendors should disclose which tools they are proposing.

43. What assistive technologies will be used for post-remediation testing (e.g., JAWS, NVDA, VoiceOver)?
    Response: Depending on the artifact to be tested however to provide a general answer, a computer with a standard keyboard and a mouse running NVDA.

44. Does the College anticipate phased file delivery, or will all materials be shared upfront?
    Response: Phased- the College will determine the files that need remediation by the vendor on a course-by-course basis and those files will be sent to the eWe are looking for vendors to provide us with recommendations on how to delivery files between our entities so that we can be effective in completing the project timely.

45. For the "Standard" and "Expedited" turnaround times, will Harper specify which materials fall under each category?
    Response: Yes

46. Are there specific academic terms or courses prioritized due to the April 24, 2026 federal compliance deadline?

Response: Yes – Spring 2026 semester courses.

47. What is the weighting of evaluation criteria (e.g., technical capability vs. cost vs. experience)?
    Response: Respondents will be evaluated based on the selection criteria outlined in Section B. Evaluation Criteria of the RFP.

48. Will oral interviews (Week of December 8, 2025) be conducted virtually or on-site?
    Response: Virtually

49. Is subcontracting allowed for specialized areas such as STEM content or captioning?
    Response: Yes, this is acceptable.

50. Can Harper clarify whether vendors are required to provide VPATs and ACRs for each remediated file or for the overall project deliverable?
    Response: VPATs and ACRs are not applicable for remediated files.

51. How does Harper define and measure "faculty satisfaction" for performance metrics?
    Response: Via internally developed surveys, continuous feedback, and improvements to Ally Report.

52. What is the process for addressing "irremediable" content identified by the vendor?
    Response:
    Please provide your recommendations based on how this is typically handled.

53. Is the College open to negotiating pricing tiers (volume-based or per-page range)?
    Response: Please see section A. under negotiations.

54. Does Harper require a performance bond or only insurance certificates?
    Response: A performance bond is not required and the contract term minimum insurance rquirements are outlined in section B.11 of the RFP.

55. Are non-U.S.-based subcontractors permitted if data security standards (FERPA compliance) are maintained?
    Response: The College will evaluate any proposals we received. However, if offshore contractors are used the College requires that we will be able to communicate with them during normal Harper Business hours. Any offshore work should be identified in your proposals.

56. Will the College consider a multi-year contract extension beyond the two optional renewals if performance targets are exceeded?
    Response: There is an opportunity for two renewal contract terms as outlined in the RFP. The contract term is only for the duration of the timeline that is in the RFP document.

57. What is the process for initial onboarding and file transfer setup?
    Response: In your response provide your recommendations for how to handle. Tell us what you need and what you will require from the College and timing in order to meet the deadline.

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58. Who will serve as the primary Harper contact for operational coordination?
    Response: To be determined. The primary contact for Harper will be given to the vendor before the start of the project.

59. How will priority files be tracked and communicated during remediation cycles?
    Response: Please see Question #45.

60. What format and frequency are expected for bi-weekly progress reports?
    Response: In an accessible format, bi-weekly.

61. How will QA audits be conducted, random sampling, percentage-based, or all files?
    Response: The College reserves the right to use any or all means available to us. We expect that vendors will audit themselves and ensure their work is compliant based on the statute.

62. What is the escalation procedure if remediation errors are identified post-delivery?
    Response: Please provide your recommendations based on how this is typically handled.

63. What specific training outcomes or materials does Harper expect for faculty (e.g., live workshops, recorded modules)?
    Response: Please review the deliverables section of the RFP the vendor(s) provide; they can be any of these options.

    Who is the target audience for training, faculty, instructional designers, or IT support staff?
    Response: Faculty

64. Will Harper require ongoing accessibility consulting after project completion (e.g., policy development or continuous monitoring)?
    Response: Please refer to the clause in the RFP about possible contract extensions.

65. How often will performance review meetings occur (quarterly or more frequently at project start)?
    Response: To be determined, but at least monthly.

66. Will vendors be required to coordinate directly with faculty for content clarification, or only via Harper's designated team?
    Response: Only via Harper's designated team.

67. Is subcontracting allowed for this opportunity? If yes, are there any specific conditions or limitations regarding the use of subcontractors?
    Response: Please see Question #49.

68. Can we utilize the experience and references of our subcontractors to meet the qualification requirements?
    Response: Please identify team members and subcontractors critical to the completion of the work so we can perform a proper evaluation.

69. Is it mandatory to demonstrate prior experience specifically in the higher education sector, or can we include relevant experience and references from other public sector agencies, departments, and commercial clients?
Response: Relevant experience and references are acceptable. It will not be limited to higher education, but should be familiar with remediation of STEM-related content.

70. Is there any preference or scoring advantage for vendors based in Illinois or locally registered firms?
Response: No

71. Can we propose a consortium or partnership model (prime–sub or joint venture) for this RFP?
Response: We don't have enough information to properly answer this question. The College will evaluate proposals received. If you are providing pricing based on a consortium, please identify the consortium.

72. Can we utilize offshore resources or teams (for example, based in India) for remediation work, provided that data security, confidentiality, and FERPA compliance are fully maintained?
Response: Please see Question #55.

73. Do we need to submit detailed resumes of our proposed project personnel, or would brief professional bios highlighting qualifications and relevant experience be acceptable?
Response: Bios and relevant professional experience are acceptable. However, please ensure that you provide enough information for us to be able to evaluate their experience.

74. Can we include the experience and references of our proposed key personnel (such as Project Manager, Accessibility Specialists, and QA Leads) to strengthen our proposal?
Response: Yes.

75. Is there any minimum or maximum staffing requirement expected from vendors for this project?
Response: Vendors should be clear in demonstrating that they provided enough staff to complete the scope of work as identified in the RFP. Sufficient to meet the deadline outlined in the RFP.

76. Will Harper College require background verification or security clearance for any team members handling student or institutional data?
Response: As applicable, the contractor agrees to conduct criminal background checks on each of its employees, as well as employees of its subcontractors, prior to sending them to the College. The College may request new background checks of any employee at any time. Such criminal background checks will be performed at Contractor's or Subcontractor's expense and at no additional cost to the College. If in the College's sole discretion objectionable information regarding any employee is discovered in the background check, such person shall not be allowed to continue working at the College. The minimum background check process shall include, but not be limited to, the following checks:

    1. Social Security Number trace
    2. Federal, State and County Criminal Background Checks
    3. National Sex Offender Registry

Additionally, the contractor/supplier acknowledges that firearms are prohibited on the College's campus except as provided in Section 65 of the Firearm Concealed Carry Act, 430 ILCS 66/65. The Contractor shall inform its employees and subcontractors of this prohibition and shall strictly enforce it when on the College's campus. The supplier/contractor further agrees to consult and comply with Harper College's Board Policies regarding the possession of firearms on campus.

77. Can we submit a mix of public and private sector references, or does the College prefer only educational and public institution clients?
Response: Please see Question #70.

78. Will Harper College accept global (non-U.S.) client references, provided that project scope and compliance standards align with WCAG and Section 508?
Response: Yes.

79. How many client references are required at minimum — three as stated, or can we provide additional ones?
Response: Yes.

80. Will Harper College contact all provided references during evaluation, or only selected ones?
Response: The College reserves the right to contact any or all references provided.

81. Can the College clarify how the evaluation weighting will be distributed among technical proposal, experience, and pricing?
Response: Please see the evaluation Considerations outlined in the Section B. Evaluation Criteria of the RFP.

82. Can the vendor use its own secure, FERPA-compliant platform for file exchange and project tracking?
Response: Yes.

83. Will Harper College share a sample file set for vendors to assess remediation complexity and accurate pricing assumptions?
Response: Please see Question #16.

84. Are vendors required to provide Accessibility Conformance Reports (ACRs) for every remediated file, or only for representative samples?
Response: Please see Question #50.

85. Is VPAT submission mandatory for all tools and platforms, or only if the vendor provides proprietary technology?
Response: No, unless it is a platform that the Harper College team will need to access.

86. Can vendors propose alternative remediation methodologies or automated tools, provided that the final deliverables meet WCAG 2.1 AA standards?

Response: Yes. Please identify any methodologies, tools or subcontractor you will be utilizing to complete this work

87. Does Harper College intend to award this contract to a single vendor, or is a multiple-award structure (e.g., split workload) possible?
Response: Review Section 11 of the Scope of Services of the RFP.

88. Are non-U.S. legal entities eligible to contract directly with Harper College if all tax and insurance requirements are met?
Response: The College will evaluate any proposals we received. However, if offshore contractors are used the College requires that we will be able to communicate with them during normal Harper Business hours. Any offshore work should be identified in your proposals.

89. Can Harper College clarify the process for contract renewal and performance review at the end of each term?
Response: The contract renewal process will involve verbal and written communication, followed by a formal purchase order which will be sent to the vendor for each renewal year as confirmation. As for any performance review, please see section 10 under Performance Monitoring and Quality Assurance.

90. Is there any required performance bond, bid bond, or financial capacity documentation to be submitted with the proposal?
Response: No

91. What are the invoicing and payment frequency expectations (monthly, milestone-based, or upon delivery)?
Response: Please see section C.05.2, under Invoicing Requirements

92. Can we utilize the experience and references of our proposed key personnel or project team members as part of our firm's overall experience and references, particularly if those individuals have successfully completed similar digital accessibility or higher education projects while working with previous employers?
Response: Yes.

93. Can you please provide the list of interested bidders or companies that have obtained the RFP documents and/or attended the non-mandatory pre-submission meeting?
Response: No.

94. Are there any alternative submission methods besides mailing physical copies, such email?
Response: No

95. Regarding the statement that respondents may be required to meet with various College and outside officials, is this a mandatory requirement? How often are these meetings expected to occur, and can they be conducted via Zoom or Microsoft Teams instead of in person?
Response: See question #66, meetings will be virtual.

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96. The pricing form requests a price per training session. Can you define the expected topics and duration per session?
Response: To be determined based on the needs of the college.

97. For user testing and feedback, how many hours should be assumed per session for pricing purposes?
Response: Please include a narrative of assumption of hours based on the scope and provide pricing per session.

98. We do not see a line item for STEM content. Can related costs be placed under "Identify any additional costs associated with each itemized service"?
Response: Yes, STEM content can be separated out for further clarity.

99. Are sample documents available to review to better understand file types and complexity?
Response: Please see Question #16.

100. We charge differently for files containing interactive form fields and for Alt Text generation. Can we add separate line items for these on the pricing proposal sheet?
Response: Yes.

101. Can you provide an estimated percentage of the total documents that contain form fields or other interactive elements?
Response: We cannot determine this.

102. The BEP section notes a 0% goal for MBEs and FBEs with at least 50% awarded to FBEs. Can you confirm if California-based small businesses are eligible to participate and whether there are any additional Illinois-specific certification requirements?
Response: Vendors do not need to be certified to participate. However, if you are certified by the Commission on Equity and Inclusion or, you are subcontracting to a certified BEP, please identify them in your response. Vendors can find BEP certification information at https://cei.illinois.gov/vendor-resources/get-bep-certified.html.

103. We assume Harper College team will collaborate and help prepare a consolidated list of representative audit scope (platform/tool/page/screen/document) that may represent an overall feature/component to be audited for accessibility conformance.
Response: We don't understand the questions being asked and therefore cannot respond. You can address any assumptions being made in your proposal submission.

104. We assume Accessibility audit of the External video players (eg. Youtube player) is not required?
Response: No, not required.

105. Are there preferences for receiving Accessibility Conformance Reports (ACRs) to be provided - per file, per course, or per content type?
Response: Please see Question #50.

106. Are there expectations around converting the PDFs into fillable PDFs? Or these will be standard tagged PDFs?
Response: Standard tagged PDFs, we will not be converting any files into fillable PDFs.

107. Does the College have any accessibility testing preferences over (OS, browser, AT combinations)?
Response: Yes, Harper College prefers accessibility testing to focus on the most commonly used OS, browser, and assistive technology (AT) combinations, based on real-world user data from the WebAIM Screen Reader User Survey (latest available). Vendors should prioritize manual testing with these top combinations (covering ~80% of respondents):

    JAWS with Chrome (24.7%) – Windows 11 recommended.
    NVDA with Chrome (21.3%) – Windows 11; free and widely used.
    JAWS with Edge (11.4%) – Windows 11.
    NVDA with Firefox (10.0%) – Windows 11.
    VoiceOver with Safari (7.0%) – macOS Sonoma/Ventura and iOS 18.

108. For mobile platforms, are there preferences on testing of apps on iOS vs. Android devices vs. both?
Response: Not applicable.

109. Should the VPATs align with VPAT® Version 2.5 (Revised International Edition), or does the College require a specific version or standard format (e.g., Section 508, WCAG 2.1/2.2, or EN 301 549)?
Response: Please see Question #50.

110. Optional: VPATs for proprietary tools or platforms.
Which tools and platforms are being referred here? Please share more information on which platforms and tools are part of the scope.
Response: Please see Question #86.

111. Please suggest the anticipated volume/size per batch for remediation?
Response: To be determined.

112. Do we have scope on Multimedia, particularly if these are only Audio and Videos, or span to other interaction types. Kindly share more details.
Response: If there are any multimedia files, they will be limited to audio and video files.

113. Are there specific authoring tools that should be used for the media (e.g., Articulate 360, Lectora, Camtasia)?
Response: No.

114. Will scanned PDF pages be part of the educational materials? If so, can the College estimate the expected volume, given that OCR conversion adds to the remediation cost per page?
Response: Yes. Of the overall PDF count 7300 are scanned

115. Should images be remediated by adding alt-text, or replaced with text equivalents?
Response: Add alt-text.

116. For video and audio materials, will Harper provide transcripts, or should vendors produce captions and audio descriptions?
Response: Vendors should produce captions and audio descriptions.

117. For STEM content (LaTeX/MathML), what level of accessibility compliance is required (e.g., MathML tagging vs. alt-text)?
Response: HTML or EPUB format with MathML tagging is preferred. Alt-text could be considered additional option.

118. Are third-party materials (e.g., publisher content, YouTube videos) within scope?
Response: No.

119. As discussed during yesterday's call, Harper expects all remediation work to be completed within a three-month period to meet the April 2026 compliance deadline. Can the College confirm the actual estimated page count rather than just file counts, to help assess project scope and effort?
Response: Page counts cannot be determined**.**

120. How will the College determine which materials require remediation versus those already compliant?
Response: Data from Ally Report.

121. Does Harper anticipate remediation of all listed content types, or will certain formats (e.g., PDFs, Office docs) be prioritized?
Response: Prioritizing PDFs and STEM-related content.

122. Will remediation occur in phases (by department or course) or concurrently across all materials?
Response: Please see Question #44.

123. If a vendor proposes a purpose-built tool for internal remediation, how many Harper staff members are currently trained or available to perform remediation?
Response: None at this time.

124. Is the College open to a hybrid approach combining vendor automation tools with College staff participation for greater efficiency?
Response: Yes

125. Does Harper currently use any accessibility automation tools (e.g., Blackboard Ally, CommonLook, or other PDF/UA platforms)?
Response: Blackboard Ally

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126. Will pricing be evaluated solely on unit cost, or will other qualitative factors—such as experience, scalability, and use of automation—also be considered?
Response: The price is only one factor for consideration of award. Other qualitative factors are considered separately. Please refer to section B.06 Evaluation Considerations.

127. It was noted in the RFP that this may be awarded to multiple vendors, which leads to my question: If we are only wanting to bid on one specific document type (ex. PDFs only) would the best way to annotate that be in the Pricing Proposal Unit Cost Line?
Response: Please note, the College intends to award a contract to one vendor provided they can complete all the work outlined in the scope of work by the proposed deadline. However, the College reserves the right to award to two vendors if it is required to complete the work on time.

128. Thank you for hosting yesterday's information session on the RFP for the Digital Accessibility Services. I was reviewing my notes today and I recall that someone had asked the question about the BEP and whether the form is required to be included in the submission if our organization does not have any relevant participation. I believe the answer was no, or we simply include it with an "Not Applicable" – which does the review committee prefer?
Response: Form is not required if not application.

129. Also, I must apologize as I came into the meeting a bit later as my network was having issues. I initially received a message from Webex indicating the meeting was canceled or that it had concluded. I was wondering if earlier discussions included how to format the responses – whether they should be included within the RFP document under each relevant section or whether the responses should be added at the end with a reference to which section they are addressing?
Response: Please see section C. PROPOSALS (RFP Response)-FORM AND CONTENT.

Sincerely,

Nathan Chung
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Attachments:

1. Sample Document 1
2. Sample Document 2
3. Sample Document 3
4 Sample Document 4

Answer Key

Harper College Chemistry 121 Fall 2025

Exam 2

100 points. Multiple choice questions are worth 2 points each with no partial credit (50 points total). Free response questions are labeled with point values and partial credit will be awarded if the work is shown (50 points total).

24.31 32.00 40.31 g/mol
$2Mg + O_2 \rightarrow 2MgO$

1. A reaction vessel contains equal masses of solid magnesium metal and oxygen gas. The mixture is ignited and burns with a burst of light and heat, producing magnesium oxide. The mass of magnesium oxide is less than the initial mass of the combined masses of magnesium and oxygen reactants. What is your explanation for this apparent loss of mass? LR
$10g\,Mg\left(\frac{mol\,Mg}{24.31g}\right)\left(\frac{2\,mol\,MgO}{2\,mol\,Mg}\right) = 0.411\ mol\ MgO$
$XS\ O_2\left(\frac{mol}{32g}\right)\left(\frac{2\,mol\,MgO}{1\,mol\,O}\right) = 0.625\ mol\ MgO$ B
   a. Conservation of mass is violated in this reaction.
   b. Some of the mass was converted into energy (heat and light) as $E = mc^2$.
C c. Not all the oxygen reacted.
   d. Not all the magnesium reacted
   e. Measurement must be in error because mass is conserved in chemical reactions.

NaF = 41.99 g/mol

2. Sodium fluoride is added to drinking water in some municipalities to protect teeth against cavities. What is the molarity of a 10.0 mg/L sodium fluoride solution?
   a. 1.99×10^{-5} *M*
   b. 1.19×10^{-4} *M*
C c. 2.38×10^{-4} *M*
   d. 2.63×10^{-4} *M*
   e. 0.263 *M*

$\frac{10\,mg}{L}\left(\frac{10^{-3}\,g}{mg}\right)\left(\frac{mol\,NaF}{41.99\,g\,NaF}\right) = 2.38 \times 10^{-4}\ \frac{mol}{L}\ NaF$

3. If 100.0 mL of 3.0 M solution were diluted to 250.0 mL, what would the concentration be?
   a. 0.012 *M*
   b. 0.12 *M*
C c. 1.2 *M*
   d. 12 *M*
   e. 120 *M*

$M_1 = 3.0\ M$
$V_1 = 100.0\ mL$ $M_1V_1 = M_2V_2$
$M_2 = ?$
$V_2 = 250.0\ mL$
$M_2 = \frac{M_1V_1}{V_2} = \frac{(3.0\,M)(100.0\,mL)}{250.0\,mL}$
$M_2 = 1.2\ M$

4. Which of the following aqueous solutions contains more solute particles: 0.10 *M* CH_3OH or 0.10 *M* NaCl? ← no ions
$Na^+_{(aq)} + Cl^-_{(aq)} = 0.20\ M\ ions$
   a. They contain the same number of solute particles.
   b. The salt solution contains twice as many particles as the methanol solution.
   c. The methanol solution contains three times as many particles as the salt solution.
   d. Neither solution contains solute particles.
   e. The methanol solution contains six times as many particles as the salt solution.

5. Which one of the following is the net ionic equation for the reaction of aqueous hydrochloric acid with aqueous lithium hydroxide? spectator ions
$HCl_{(aq)} + LiOH_{(aq)} \rightarrow LiCl_{(aq)} + H_2O_{(l)}$
   a. $HCl_{(aq)} + LiOH_{(aq)} \rightarrow LiCl_{(aq)} + H_2O_{(l)}$
   b. $H^+_{(aq)} + Cl^-_{(aq)} + Li^+_{(aq)} + OH^-_{(aq)} \rightarrow Cl^-_{(aq)} + Li^+_{(aq)} + H_2O_{(l)}$
E c. $H^+_{(aq)} + Cl^-_{(aq)} + Li^+_{(aq)} + OH^-_{(aq)} \rightarrow LiCl_{(s)} + 2\,H^+_{(l)} + O^{2-}_{(l)}$
   d. $Cl^-_{(aq)} + Li^+_{(aq)} \rightarrow LiCl_{(s)}$
   e. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

6. Water soluble toxic chromium compounds are waste products of electroplating operations, but the chromium can be precipitated as $Cr(OH)_3$ to remediate the water. How much 1.0 *M* NaOH solution is needed to remove the chromium from 100 L of a solution that is 0.001 *M* in Cr^{3+}?
$Cr^{3+}_{(aq)} + 3NaOH_{(aq)} \rightarrow Cr(OH)_{3(s)} + 3Na^+_{(aq)}$
   a. 100 mL
B b. 300 mL
   c. 10 L
   d. 30 L
   e. 33 L

$100\,L\left(\frac{0.001\,mol\,Cr^{3+}}{L}\right) = 0.1\ mol\ Cr^{3+}$
$0.1\ mol\ Cr^{3+}\left(\frac{3\,mol\,NaOH}{1\,mol\,Cr^{3+}}\right)\left(\frac{L}{1.0\,M}\right)\left(\frac{mL}{10^{-3}L}\right)$
$= 300\ mL$
$0.300\ L$

7. To carry out a calculation to determine the unknown concentration of a sample from titration data, which of the following is NOT needed?

   a. the volume of the titrant used to reach the end point
   b. the volume of the analyte
   c. the stoichiometry of the reaction between the titrant and the analyte
   d. the concentration of the analyte ← that's the unknown
   e. the concentration of the titrant

8. Which of the following phosphate compounds is soluble in water?

   a. Ag_3PO_4
   b. $Ca_3(PO_4)_2$
   c. $(NH_4)_3PO_4$ *ammonium (NH_4^+) salts are soluble
   d. $AlPO_4$
   e. $Mg_3(PO_4)_2$

9. Which of the following statements is NOT correct regarding the following reaction?

$$\overset{+4\ -2}{MnO_{2(s)}} + 4\ \overset{+1\ -1}{HCl_{(aq)}} \rightarrow \overset{+2\ -1}{MnCl_{2(aq)}} + \overset{0}{Cl_{2(g)}} + 2\ \overset{+1\ -2}{H_2O_{(l)}}$$

   Mn: +4 → +2, reduced, oxidizing agent

   a. Manganese(IV) oxide is the oxidizing agent. T
   b. Chloride is oxidized. T
   c. The oxidation number of Mn changes from +4 to +2. T
   d. The oxidation number of Cl changes from -1 to 0. T
   e. One electron is transferred from manganese to each chloride. F

   Cl: -1 → 0, oxidized, reducing agent

10. In which compound does chlorine have an oxidation number of +5?

    a. $HClO_4$ (+1 +7 -2)
    b. $HClO_3$ (+1 +5 -2)
    c. $HClO_2$ (+1 +3 -2)
    d. HClO (+1 +1 -2)
    e. HCl (+1 -1)

11. Why does a soft drink rise in a straw when you suck on the straw?

    a. The vacuum pulls the liquid up the straw.
    b. Capillary forces attract the liquid to the walls of the straw.
    c. The air pressure inside the straw is less than the air pressure outside the straw.
    d. The air pressure inside the straw is greater than the air pressure outside the straw.
    e. The liquid level inside the straw is pushed up by the liquid level outside the straw.

12. A sample of gas at 4.0 atm and 25.0 mL is heated from 25 °C to 40 °C. If the pressure remains constant, what is the final volume of the gas?

    $V_1 = 25\ mL$
    $T_1 = 25°C + 273 = 298\ K$
    $V_2 = ?$
    $T_2 = 40°C + 273 = 313\ K$

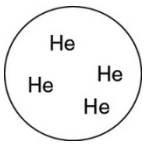
    a. 23.8 mL
    b. 25.0 mL
    c. 26.2 mL
    d. 40.0 mL
    e. 105 mL

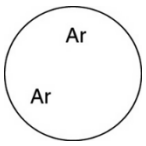
    $\frac{V_1}{T_1} = \frac{V_2}{T_2} \rightarrow V_2 = \frac{V_1 T_2}{T_1} = \frac{(25\ mL)(313\ K)}{298\ K}$ V = 26.3 mL

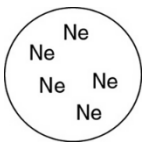
13. Which of the gases shown here will exert the lowest pressure, assuming that each container has the same volume and temperature?

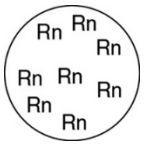
    $PV = nRT$

    $P \propto n$

    a. 

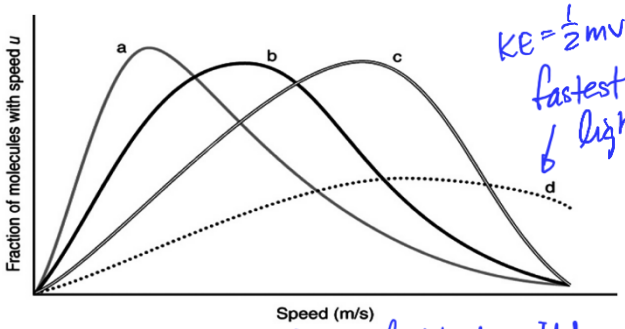
    b. 

    c. 

    d. 

    e. not enough information to determine

14. Using the graph below, which gas has the lowest density at STP?



$KE = \frac{1}{2}mv^2$ fastest & lightest

$d = \frac{P(MM)}{RT}$ ← lightest will have lowest density

D

a. a
b. b
c. c
(d.) d
e. All the gases have the same density at STP.

15. What is the pressure of a 0.17 mol sample of carbon monoxide gas contained in a 750 mL flask at 50 °C? 323K

$P = \frac{nRT}{V}$ 0.750L

a. 6.01×10^{-3} atm
b. 0.166 atm
c. 0.930 atm
d. 1.08 atm
(e.) 6.01 atm

E

$P = \frac{(0.17\,mol)(0.0821\,\frac{atm\,L}{mol\,K})(323K)}{0.750L}$

$P = 6.01\,atm$

16. Which of the following gases has nearly the same density as CO_2 at room temperature and atmospheric pressure?

$d = \frac{P(MM)}{RT}$

C

a. N_2 28.02 g/mol
b. O_2 32.00
(c.) N_2O 44.02
d. Ar 39.95
e. CO 28.01

Find the one will a similar molar mass to CO_2 = 44.01 g/mol

17. During the decomposition of solid calcium carbonate into solid calcium oxide and carbon dioxide gas, 100.0 mL of gas is collected by the displacement of water in a flask at 25 °C with an atmospheric pressure of 755 mmHg. What is the mass of carbon dioxide collected?

44.01 g/mol

E

a. 0.173 mg
b. 0.807 mg
c. 12.9 mg
d. 21.7 mg
(e.) 173 mg

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

$P_{total} = P_{H_2O} + P_{CO_2}$

P_{H_2O} at 25°C = 24 mmHg

$P_{CO_2} = 755 - 24 = 731$ mmHg

$731\,mmHg\left(\frac{1\,atm}{760\,mmHg}\right) = 0.962\,atm$

$n = \frac{PV}{RT} = \frac{(0.962)(0.100L)}{(0.0821)(298K)}$

$n = 3.93 \times 10^{-3}\,mol\left(\frac{44.01g}{mol}\right) = 0.173g = 173\,mg$

18. Which one of the following statements is FALSE?

a. An increase in temperature causes an increase in pressure of a gas because the frequency of molecules colliding with the walls of the container increases. T
b. An increase in temperature causes an increase in pressure of a gas because the average force exerted by molecules colliding with the walls of the container increases. T
c. All gases behave like an ideal gas at sufficiently low pressure and high temperature. T

E

d. The ratio PV/nRT for a real gas can be less than 1 due to attractive forces between molecules. T ↓T causes P to be lower than expected.
(e.) The pressure exerted by oxygen molecules is greater than the pressure exerted by nitrogen molecules in a balloon filled with air because oxygen molecules are heavier. F

19. A gas was found to effuse twice as slow as helium. Which of the following was the gas?

$\frac{rate\,He}{rate\,gas} = \sqrt{\frac{MM_{gas}}{MM_{He}}}$

D

a. CO
b. H_2
c. F_2
(d.) CH_4
e. Ne

$\left(\frac{2x}{x}\right)^2 = \left(\sqrt{\frac{MM_{gas}}{4}}\right)^2 \Rightarrow y = \frac{x}{4}$

$x = 16\,g/mol$

20. What is the wavelength of a radio station operating at a frequency of 99.6 MHz?

$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8\,\frac{m}{s}}{99.6 \times 10^6\,\frac{1}{s}}$

a. 3.01×10^6 m
(b.) 3.01 m

B

c. 3.32×10^{-7} m
d. 0.332 m
e. 3.32 m

$\lambda = 3.01\,m$

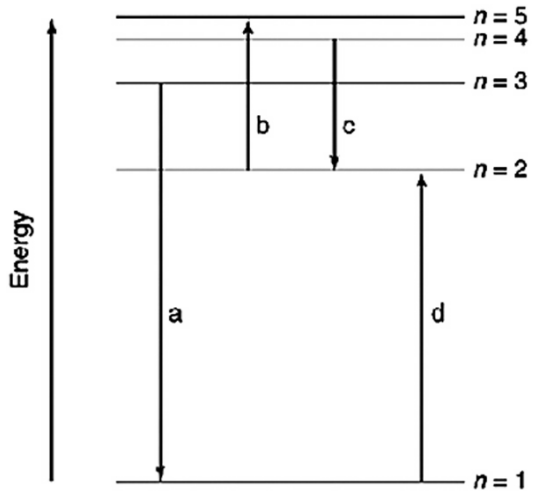
21. Which of the following is a possible set of quantum numbers for a 3d orbital?

D

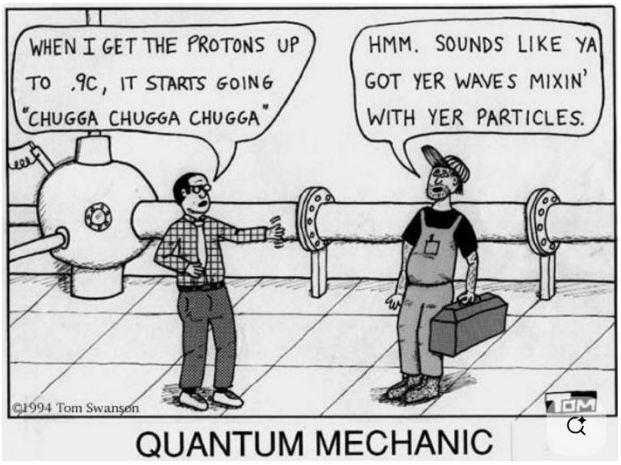
a. n = 3, l = 1, m_l = -1
b. n = 3, l = 0, m_l = 0
c. n = 3, l = 2, m_l = 3
(d.) n = 3, l = 2, m_l = 0
e. n = 3, l = 1, m_l = 2

$n = 3$
$l = 2$
$m_l = -2, -1, 0, 1, 2$

22. Which of the transitions in the following hydrogen atom energy level diagram involves the shortest wavelength photon?



A (a.) a $E = h\nu = \frac{hc}{\lambda}$ ∴ ↓λ, ↑E
b. b
c. c
d. d
e. cannot tell from the above diagram



23. How many orbitals are possible for the n = 3 shell?

E a. 1
b. 3
c. 4
d. 5
(e.) 9

$\ell = 0 \quad \ell = 1 \quad \ell = 2$
$m_\ell = 0 \quad m_\ell = -1, 0, 1 \quad m_\ell = -2, -1, 0, 1, 2$
9 orbitals

24. Which of the following is FALSE?

a. The photoelectric effect demonstrates that light can behave like a particle. T
b. Diffraction proves that electrons can behave like waves through their interference patterns. T
c. We cannot simultaneously know an electron's position and where it is going. T
(d.) When considering bonding models, the positions and energies of electrons are not important. F
e. Quantum mechanics explains the behavior of very small particles that do not obey the laws of classical physics. T

25. How many photons are contained in a burst of yellow light (589 nm) from a sodium lamp that contains 630 kJ of energy?

C a. 2.12×10^{13} photons
b. 3.08×10^{30} photons
(c.) 1.87×10^{24} photons
d. 1.87×10^{28} photons
e. 2.52×10^{25} photons

$\frac{E_{burst}}{E_{photon}} = \#\,photons$

$E_{photon} = \frac{(6.626\times10^{-34}\,J\cdot s)(3\times10^{8}\,\frac{m}{s})}{589\times10^{-9}\,m}$

$E_{photon} = 3.37\times10^{-19}\,J$

$E_{burst} = 630\times10^{3}\,J$

$\frac{630\times10^{3}\,J}{3.37\times10^{-19}\,J} = 1.87\times10^{24}\,photons$

Keep going! You've got this!

26. (10 points) When 125 mL of 0.150 *M* barium chloride is mixed with 125 mL of 0.150 *M* iron(III) sulfate, a precipitate forms.

2pts (a) Write a balanced net ionic equation for this reaction.

2pts (b) Is this a redox reaction, yes or no? If yes, identify the reducing agent. If not, you get 2 points for saying no.

3pts (c) What mass of precipitate should form?

3pts (d) If the experiment results in a 67.8% yield, how much precipitate was prepared for reals?

(a) $3BaCl_{2(aq)} + Fe_2(SO_4)_{3(aq)} \longrightarrow 3BaSO_{4(s)} + 2FeCl_{3(aq)}$ double displacement rxn

g/mol: 208.2 399.91 233.37

Net Ionic: $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

(b) No, this is not a redox rxn. The oxidation states do not change.
↳ double displacement is never redox

(c) $0.125L\left(\frac{0.150\,mol\,BaCl_2}{L}\right)\left(\frac{3\,mol\,BaSO_4}{3\,mol\,BaCl_2}\right)\left(\frac{233.37g\,BaSO_4}{mol\,BaSO_4}\right) = 4.38g\,BaSO_4$

$0.125L\left(\frac{0.150\,mol\,Fe_2(SO_4)_3}{L}\right)\left(\frac{3\,mol\,BaSO_4}{1\,mol\,Fe_2(SO_4)_3}\right)\left(\frac{233.37g\,BaSO_4}{mol\,BaSO_4}\right) = 13.1g\,BaSO_4$

(d) $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100\% = \%\text{ yield}$

$\text{actual yield} = \frac{\%\text{ yield}(\text{theoretical yield})}{100\%} = \frac{67.8\%(4.38g\,BaSO_4)}{100\%}$

actual yield = 2.97g $BaSO_4$

27. (10 points) Solutions of calcium hydroxide, $Ca(OH)_2$, are used in the paper industry during the Kraft process which converts wood into wood pulp. Titration with hydrochloric acid is required to verify the concentration of this calcium hydroxide solution.

4pts (a) Write a step-by-step procedure for the preparation of 1.00 L of 0.650 *M* HCl from the 12.1 *M* HCl stock solution. Include proper measurements and appropriate equipment in your prep.

2pts (b) What is the difference between the equivalence point and the end point of a titration?

4pts (c) If 45.40 mL of 0.650 *M* HCl is used to titrate 20.00 mL of the calcium hydroxide solution, what is the concentration (in *M*) of the calcium hydroxide solution?

(a) $M_1 = 12.1\ M\ HCl$ $M_2 = 0.650\ M\ HCl$ $M_1V_1 = M_2V_2$ $V_1 = \frac{M_2V_2}{M_1} = \frac{(0.650\,M)(1.00\,L)}{12.1\,M}$

$V_1 = ?$ $V_2 = 1.00\,L$ $V_1 = 0.0537\,L = 53.7\,mL$

- Using a graduated cylinder or volumetric pipet or buret, add 53.7 mL of 12.1 M HCl to a 1.00 L volumetric flask.
- Add deionized water to the 1.00 L tick mark. Mix thoroughly.

(b) Of a titration:

equivalence point → when moles OH^- = moles H^+ and the unknown analyte is completely neutralized.

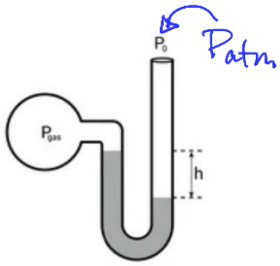
end point → one drip past the equivalence point so the indicator changes color to show the "end" of the titration.

(c) $2HCl_{(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaCl_{2(aq)} + 2H_2O_{(l)}$

$0.04540\,L \left(\frac{0.650\,mol\,HCl}{L}\right)\left(\frac{1\,mol\,Ca(OH)_2}{2\,mol\,HCl}\right) = 0.0148\,mol\,Ca(OH)_2$

$\frac{0.0148\,mol\,Ca(OH)_2}{0.0200\,L} = 0.740\,M\,Ca(OH)_2$

28. (15 points) Flask A is 275 mL and filled with pure $He_{(g)}$. Flask B contains pure $Ar_{(g)}$ and has a volume of 475 mL. Both flasks are at 25 °C.



P_{atm}

Figure 1.

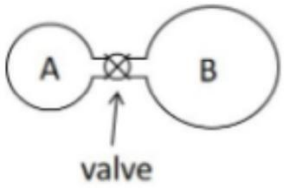


Figure 2.

18 mmHg = 18 torr

3 pts (a) When Flask A is connected to an open manometer, the difference in mercury levels is h = 1.8 cm. (See Figure 1.) If barometric pressure is 770 torr, what is the pressure (in torr) of the helium gas?

5 pts (b) If the amount of argon in Flask B is known to have a pressure of 490 torr when the volume is 700 mL at constant temperature, what is the pressure (in torr) of the argon at 475 mL?

7 pts (c) Once the pressures are determined in each flask, Flask A and Flask B are connected with a valve and that valve is then opened (Figure 2). Given enough time to ensure complete mixing, what is the partial pressure (in torr) of each gas and the total pressure of the mixture?

(a) Flask A: $P_{gas} < P_{atm}$, $P_{gas} = P_{atm} - h = 770\ torr - 18\ torr = 752\ torr$

$752\ torr \left(\frac{1\ atm}{760\ torr}\right) = 0.989\ atm$

(b) Flask B:

$P_1 = 490\ torr$
$V_1 = 700\ mL$
$P_2 = ?$
$V_2 = 475\ mL$

$P_1V_1 = P_2V_2$ (Boyle's Law)

$P_2 = \frac{P_1V_1}{V_2} = \frac{(490\ torr)(700\ mL)}{475\ mL} = 722\ torr$

$722\ torr \left(\frac{1\ atm}{760\ torr}\right) = 0.950\ atm$

(C) Flask A: $n_A = \frac{PV}{RT} = \frac{(0.989\ atm)(0.275\ L)}{(0.0821\ \frac{atm \cdot L}{mol \cdot K})(298\ K)} = 0.0111\ mol\ He$

+

Flask B: $n_B = \frac{PV}{RT} = \frac{(0.950\ atm)(0.475\ L)}{(0.0821\ \frac{atm \cdot L}{mol \cdot K})(298\ K)} = 0.0184\ mol\ Ar$

$0.0295\ mol = n_{total}$

Once valve opens: $V_{total} = 0.275\ L + 0.475\ L = 0.750\ L\ total$

$P_{total} = \frac{n_{total}RT}{V_{total}} = \frac{(0.0295\ mol)(0.0821\ \frac{atm \cdot L}{mol \cdot K})(298\ K)}{0.750\ L} = 0.962\ atm = 731\ torr$

$P_{He} = \chi_{He} \cdot P_{total} = \frac{0.0111\ mol\ He}{0.0295\ mol\ total}(0.962\ atm)$

$P_{He} = 0.362\ atm = 275\ torr$

$P_{Ar} = \chi_{Ar} \cdot P_{total} = \frac{0.0184\ mol\ Ar}{0.0295\ mol\ total}(0.962\ atm)$

$P_{Ar} = 0.600\ atm = 456\ torr$

29. (5 points) In some aquatic ecosystems, nitrate is converted to nitrite, which then decomposes to nitrogen and water. As an example of this second reaction, consider the decomposition of ammonium nitrite:

$$NH_4NO_{2(aq)} \rightarrow N_{2(g)} + 2\ H_2O_{(l)}$$

What is the change in pressure in a sealed 10.0 L vessel resulting from the formation of N_2 gas when the ammonium nitrite in 1.00 L of 1.0 *M* NH_4NO_2 decomposes at 25 °C? 298 K

$1.00\,L\left(\frac{1.0\ mol\ NH_4NO_2}{2}\right) = 1.0\ mol\ NH_4NO_2\left(\frac{1\ mol\ N_2}{1\ mol\ NH_4NO_2}\right) = 1.0\ mol\ N_2$ produced.

$T = 298\,K$

$V = 10.0\,L - 1.00\,L$ soln $= 9.00\,L$ available for gas

Must assume the volume of soln does not change upon reaction.

$$P = \frac{nRT}{V} = \frac{(1.0\ mol)\left(0.0821\ \frac{atm \cdot L}{mol \cdot K}\right)(298\,K)}{9.00\,L} = 2.72\ atm\ N_2$$

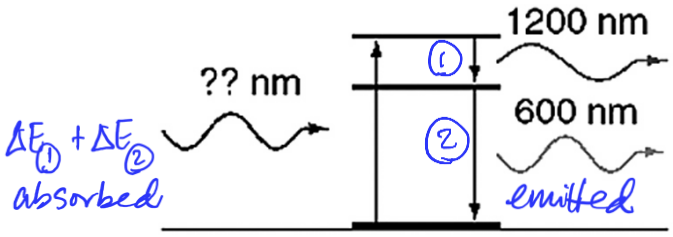
The pressure in the vessel increases by this much

30. (5 points) The Bohr model was first to describe how an atomic spectrum might be related to the electronic structure of the hydrogen atom. Then came along the quantum mechanical model which further refined our understanding of the atom.
    (a) How are these models similar? Explain.
    (b) How are the models different? Explain.

(a) Similar: e^- have levels of specific distances from the nucleus that correspond to specific energy levels.

(b) Different: orbits (Bohr) where the e^- can be found versus orbitals (quantum mechanics) that use statistics to describe where an e^- is likely to be found.

31. (5 points) An atom in its ground state absorbs a single photon of light and then relaxes back to the ground state by emitting an infrared photon (1,200 nm) followed by an orange photon (600 nm). What is the wavelength (in nm) of the photon that was absorbed initially?



$$\Delta E_{①} = \frac{hc}{\lambda} = \frac{(6.626\times10^{-34}\ J\cdot s)(3.00\times10^{8}\ \frac{m}{s})}{1200\times10^{-9}\ m}$$

$$\Delta E_{①} = 1.66\times10^{-19}\ J$$

$$\Delta E_{②} = \frac{(6.626\times10^{-34}\ J\cdot s)(3.00\times10^{8}\ \frac{m}{s})}{600\times10^{-9}\ m}$$

$$\Delta E_{②} = 3.31\times10^{-19}\ J$$

$$\Delta E_{①} + \Delta E_{②} = (1.66\times10^{-19}\ J + 3.31\times10^{-19}\ J) = 4.97\times10^{-19}\ J$$

$$\lambda_{absorbed} = \frac{(6.626\times10^{-3}\ J\cdot s)(3.00\times10^{8}\ \frac{m}{s})}{4.97\times10^{-19}\ J}$$

$$\lambda_{absorbed} = 4.00\times10^{-7}\ m\left(\frac{nm}{10^{-9}m}\right) = 400\ nm$$

Extra Credit (5 points)

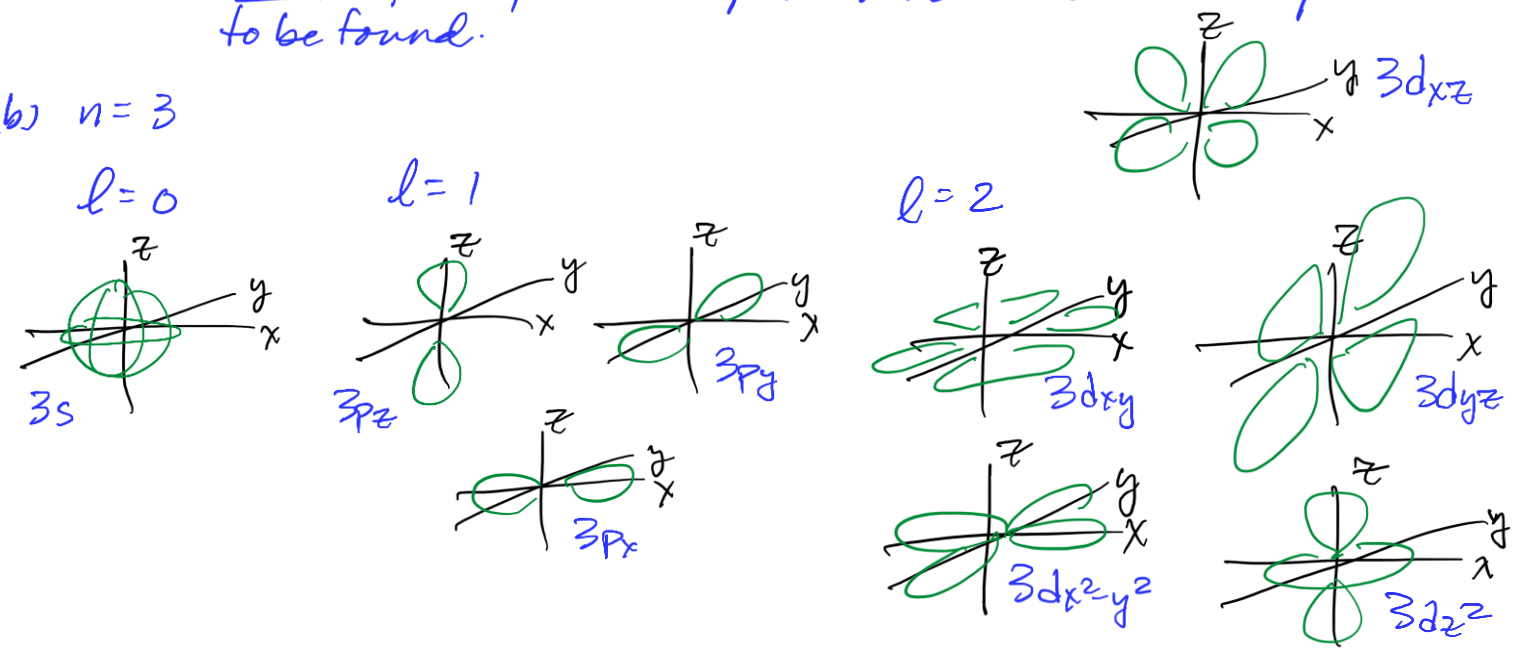
Schrodinger's Equation: HΨ = EΨ, was solved in an attempt to better understand where electrons can be found in the hydrogen atom.

2pts (a) What does Ψ^2, the square of the wave function, represent in the quantum mechanical model of the hydrogen atom?

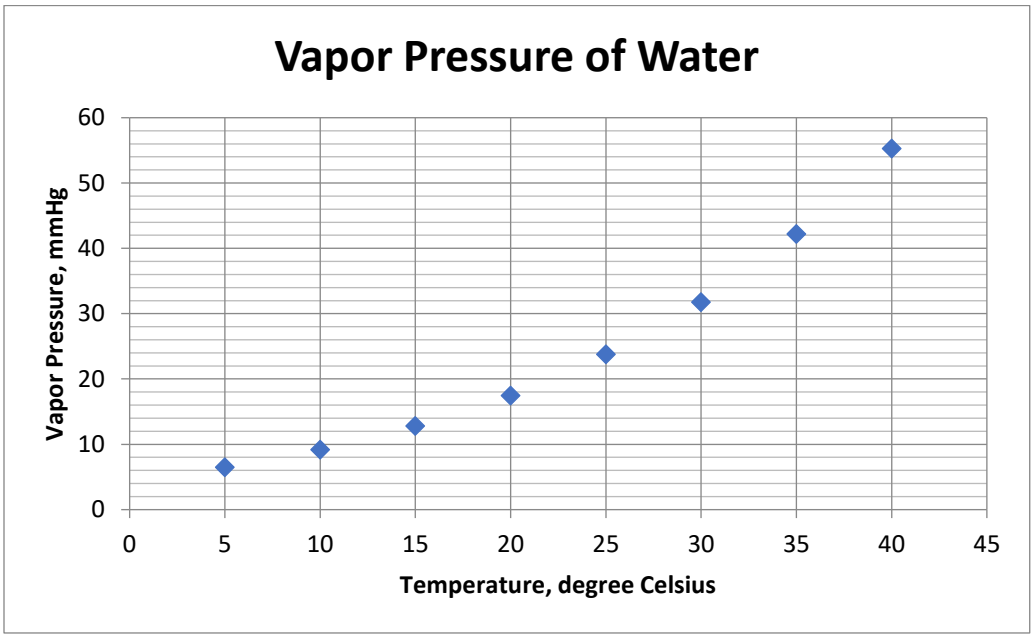
3pts (b) For the n = 3 level in the hydrogen atom, draw and name all the possible Ψ^2 representations.

(a) Ψ^2 → orbital, the probability of where the e^- is likely to be found.

(b) $n = 3$



Equations and Constants:



°F = 9/5(°C) + 32

K = °C + 273.15

1 atm = 760 torr = 760 mmHg = 29.92 inHg = 101,325 Pa = 14.7 psi

Avogadro's number = 6.022×10^{23} particles/mole

percent = (part/whole) x 100%

% yield = (actual/theoretical) x 100

ppm = (part/whole) x 10^6 ppm

$V_1M_1 = V_2M_2$

$$\frac{1}{\lambda} = R\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$$

d = m/V

molarity = mol/L

R = 1.097×10^7 m^{-1}

n = m/(MM), where MM is molar mass

PV = nRT

STP: T = 0 °C, P = 1 atm

$$\lambda = \frac{h}{mv}$$

$d = \frac{P(MM)}{RT}$, where MM is molar mass

$(P + a(n/V)^2)(V - nb) = nRT$

$1\ J = \frac{kg\ m^2}{s^2}$

$P_A = (X_A)(P_{total})$

R = 0.0821 atm·L/(mol·K)

$X_A = n_A/n_{total}$

R = 8.314 J/(mol·K)

h = 6.626×10^{-34} J·s

$P_{total} = P_A + P_B + P_C + \ldots$

E = hν

c = 3.00×10^8 m/s

$KE = \frac{1}{2}mv^2$

νλ = c

$KE = \frac{1}{2}mv^2$

$rate_{effusion} = \sqrt{\frac{1}{MM}}$, where MM is molar mass

$E_n = -2.18 \times 10^{-18}\ J \left(\frac{1}{n^2}\right)$

$\Delta E = -2.18 \times 10^{-18}\ J \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

Answer Key

Harper College Chemistry 121-004 Fall 2025

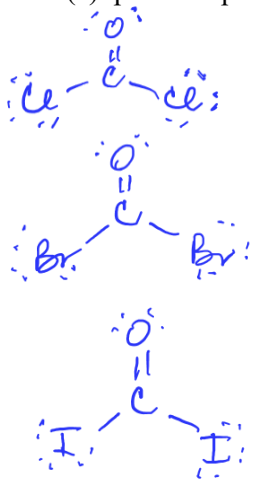
Quiz 11

20 point quiz. You may work together or get help from the tutoring center, but you may NOT work through these problems during SI sessions. *Please be sure your answers are in your own words/numbers!* **Due Thursday, November 20 at the beginning of class.**

1. (2 points) Can a nonpolar molecule ever contain polar bonds, yes or no? Explain. Yes!

A nonpolar molecule can have polar bonds if they are arranged symmetrically around a central atom so the δ^- density they are pulling is equally distributed throughout the molecule.

2. (3 points) Compounds with the formula: COX_2, where X = Cl, Br, or I, can cause blistering of the skin if exposed. The severity of the blistering is related to the polarity of the species.
   (a) Draw Lewis structures for these three compounds.
   (b) Rank the compounds (not the bonds) from least to most polar. Explain your answer.
   (c) polar. Explain your answer.



least polar most polar

$COCl_2 < COBr_2 < COI_2$

The iodine is the least EN of the halogens so it has the weakest pull on the e^- in their C–I bonds. The oxygen is the 2nd most EN atom on the PTotE so it pulls the e^- density toward it more strongly than the iodine atoms creating the lgest dipole.

3. (2 points) Draw a Lewis structure for the cyanide ion, CN^-. In aqueous solution, this ion interacts with H^+ to form hydrocyanic acid. Should the acid formula be written as HNC or HCN? Explain your choice using Lewis structures and formal charges.

CN^- $:C\equiv N:$

C: $4e^-$
N: $5e^-$
-1 chg: $+1e^-$
$10e^-$
$-2e^-$
$8e^-$

$[:C\equiv N:]^-$

$H-C\equiv N:$ or $H-N\equiv C:$

Formal Chgs
H: $1e^- - (0+1) = 0$
C: $4e^- - (0+4) = 0$
N: $5e^- - (0+5) = 0$

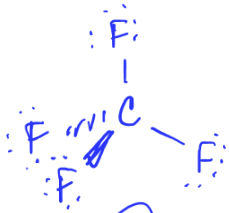
Formal Chgs
H: $1e^- - (0+1) = 0$
N: $5e^- - (0+4) = +1$
C: $4e^- - (0+5) = -1$

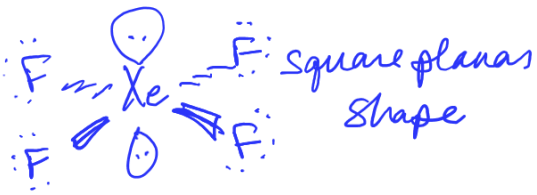
The rule is that generally the LEAST EN atom is found in the central position. This is supported when using formal charges. HCN has f.c. of zero for all atoms. HNC has +1 on the most EN atom & -1 on the least EN atoms... not preferred.

4. (3 points) Draw Lewis structures for the following compounds.
   (a) Label the carbon-oxygen bonds in these compounds from shortest to intermediate to longest.
   (b) How many σ–bonds and π-bonds does each compound contain?

carbon monoxide, CO		**methanol, CH_3OH (C-O-H)**		**carbonyl difluoride, CF_2O**	
C: 4e⁻ O: 6e⁻ 10e⁻ −2e⁻ 8e⁻ −6e⁻ 2e⁻	:C≡O:	C: 4e⁻ 4H: 4(1e⁻) O: 6e⁻ 14e⁻ −10e⁻ 4e⁻ −4e⁻ 0	H–C(H)(H)–O–H	C: 4e⁻ 2F: 2(7e⁻) O: 6e⁻ 24e⁻ −6e⁻ 18e⁻	:F–C(=O)–F:
(a) Shortest		longest		intermediate	
(b) **σ–bonds**: 1	**π-bonds**: 2	**σ–bonds**: 5	**π-bonds**: 0	**σ–bonds**: 3	**π-bonds**: 1

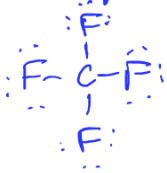
5. (2 points) Why do CF_4, SF_4 and XeF_4 have different molecular (geometries) shapes even though they all consist of a central atom bonded to four fluorine atoms? Use Lewis structures of each in your explanation.

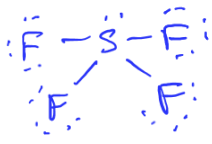




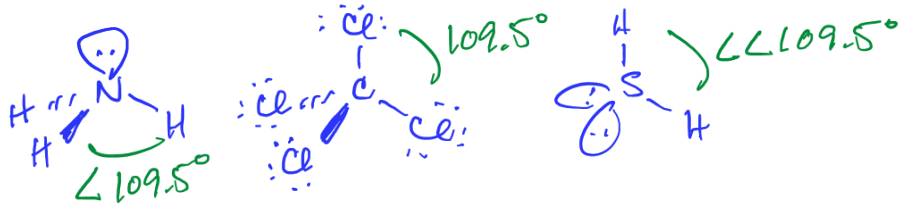
Even though all three molecules have 4 F atoms, they have variable #s of lone pairs. Lone pairs take up space around the central atoms and as such, they can modify the molecular geometry depending on how many are present.

$CF_4 = AX_4$; $SF_4 = AX_4E$; $XeF_4 = AX_4E_2$





6. (2 points) Rank the following molecules in order of increasing bond angles: NH_3, CCl_4, and H_2S. In the absence of actual experimental data, please give an explanation as to your chosen ranking using VSEPR Theory.



Bond angles: H-S-H < H-N-H < Cl-C-Cl

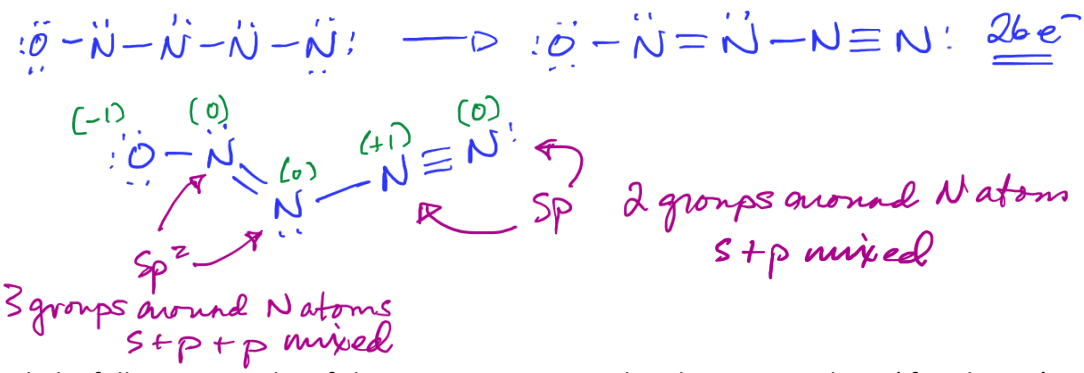
The lone pairs require more space around the central atom than the terminal atoms. The lone pairs repel bonds more ∴ bond angles are squished.

7. (2 points) Where does the idea of orbital hybridization come from? What does it mean to "hybridize" orbitals?

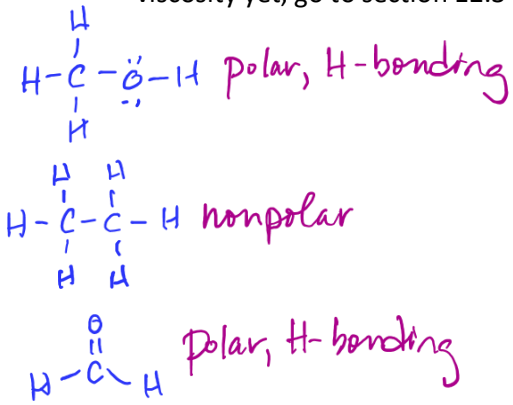
Atomic orbitals: s, p, d, f mathematically predict e^- density areas around the nucleus. Valence bond theory states that covalent bonds form upon overlap of AO's of 2 separate atoms. The issue lies in where the orbital are found versus the molecular shapes of the molecules. AO placement cannot account for 109.5°, 120°, or 180° bond angles. Hybridization comes into play when AOs are mathematically mixed so the new orbitals actually point in 109.5°, 120°, and 180° directions.

8. (2 points) The Lewis structure for N_4O, with a skeletal structure O-N-N-N-N, contains one N-N, one N=N, and one N≡N. Is the hybridization of all the nitrogen atoms the same, yes or no? Prove it.

O: 6e⁻
4N: 4(5e⁻)
26e⁻
−8e⁻
18e⁻
−6e⁻
12e⁻
−6e⁻
6e⁻



9. (2 points) Rank the following in order of *decreasing* viscosity and explain your ranking. (If we haven't gotten to viscosity yet, go to section 12.3-12.4 in the textbook/eText for help.)



CH_3OH CH_3CH_3 $H_2C{=}O$

$CH_3OH > CH_2{=}O > CH_3CH_3$

The most viscous will have strongest IMF. Strongest IMF cause molecules to stick which increases resistance to flow. H-bonding is strongest type of dipole-dipole followed by regular dipole-dipole. Lastly dispersion forces (nonpolar) are the weakest IMF.

Assignment 9 – Lighting Effects with Envelope

Materials

Graphite pencils
Pencil sharpener
Kneaded eraser
Newsprint
Drawing paper (half sheet)
White business envelope

Description

Develop a drawing based on the kind of realism referred to as trompe-l'oeil. Trompe-l'oeil is a French term that means to fool the eye. In painting, it specifically means to momentarily trick the viewer into believing that a flat representation of an object is an actual object.

Emphasize dimensional elements of the envelope such as its flap, crumpled folds, and the pin(s) or tape that secure it in position, to create a strong illusion of its three-dimensional surface. The use of value, based on lighting, and feathering/layering technique should be your primary concerns.

1. Pin or tape your envelope to a wall or vertical surface at least as big as a half sheet of drawing paper (12 x 18). This can be any neutral-colored material such as a bulletin board, piece of cardboard, piece of paper, etc.

2. Make sure that you have a lighting situation that provides for good contrast. This can be daylight or artificial light but should be coming mostly from either the left or the right side of the still life. If daylight is involved, it will be important that you work during the same 2-3-hour block of time each time you work on the drawing. This will help to ensure that the lighting and contrast stays consistent.

3. Take a photograph of your envelope setup, including all the space around it that will be in your drawing, from the exact view that you will be drawing it, which should be head-on at eye level. You may use your photograph as a reference while drawing, but you should rely mostly on direct observation of the setup. You will need to post a photograph of your setup along with your drawing when it is due.

Assignment 9 – Lighting Effects with Envelope

Cont'd

4. Before starting the final version on drawing paper, consider making a study on a half sheet of newsprint that takes into account your overall composition. You may use your paper horizontally or vertically, depending on which format your setup fits into best. Your drawing of the envelope should be the actual size of the envelope. You need not do a lot of, or any, shading in the sketch. The primary purpose of the sketch is to plan how your envelope will be positioned within the edges of your paper and to get its actual size and proportions correct.

5. When you feel confident that your sketched composition is balanced and interesting, *lightly* re-draw or trace its outlines on a half sheet of drawing paper. No outlines should be visible in the finished drawing. Use the blending technique that was applied in the Value Scale and Gradation Chart to render your drawing.

6. Follow the steps outlined below to evolve your drawing into a complete rendering.

* Don't forget to take a photograph of your still life from the exact view that you drew it. You will need to include this photograph in your posting.

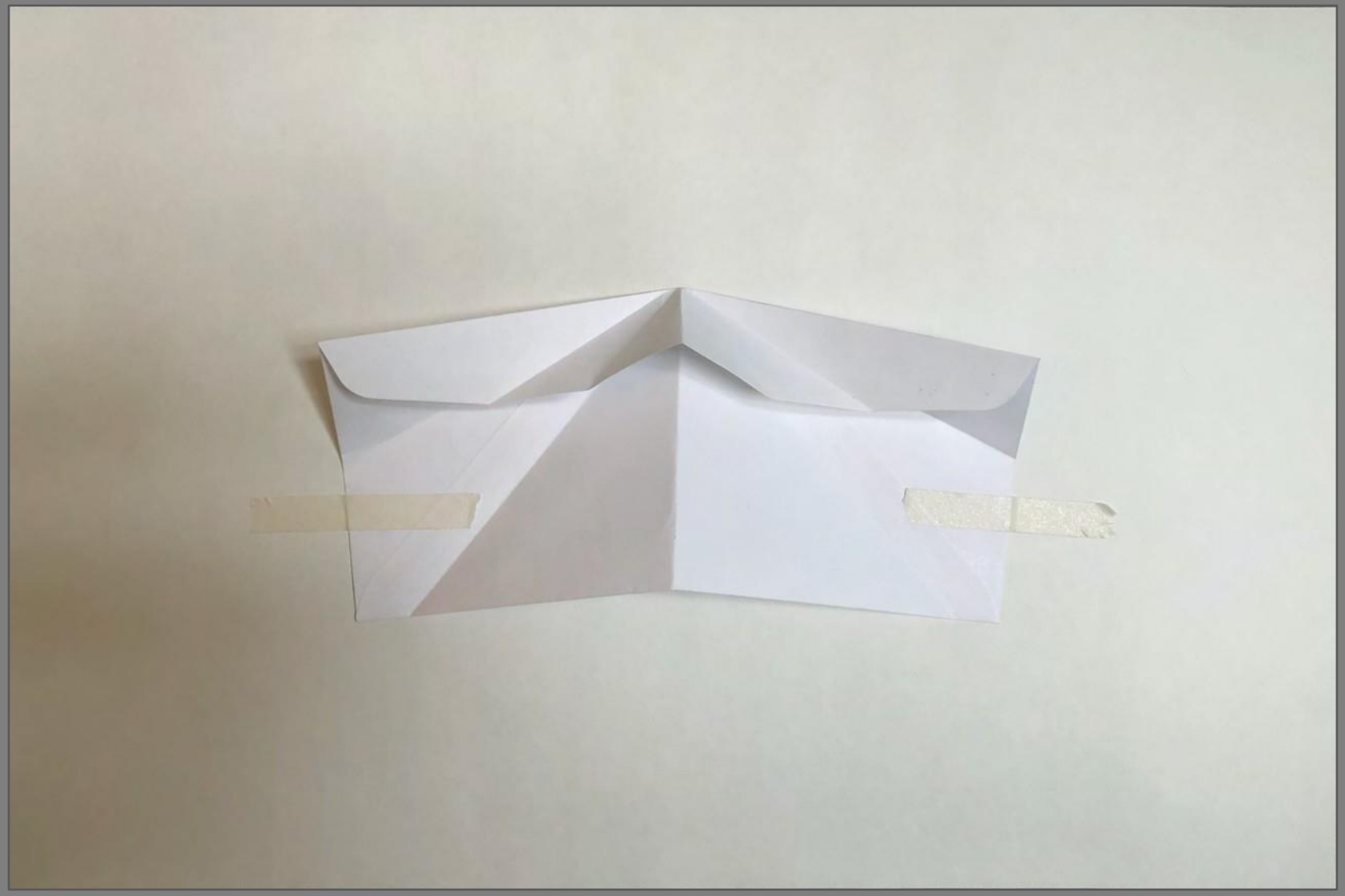
Evaluation Criteria

Proportion and scale of drawing to match the actual envelope.

Consistency of shading technique

Degree to which the trompe-l'oeil effect was achieved

Overall presentation (neatness, balance, quality)



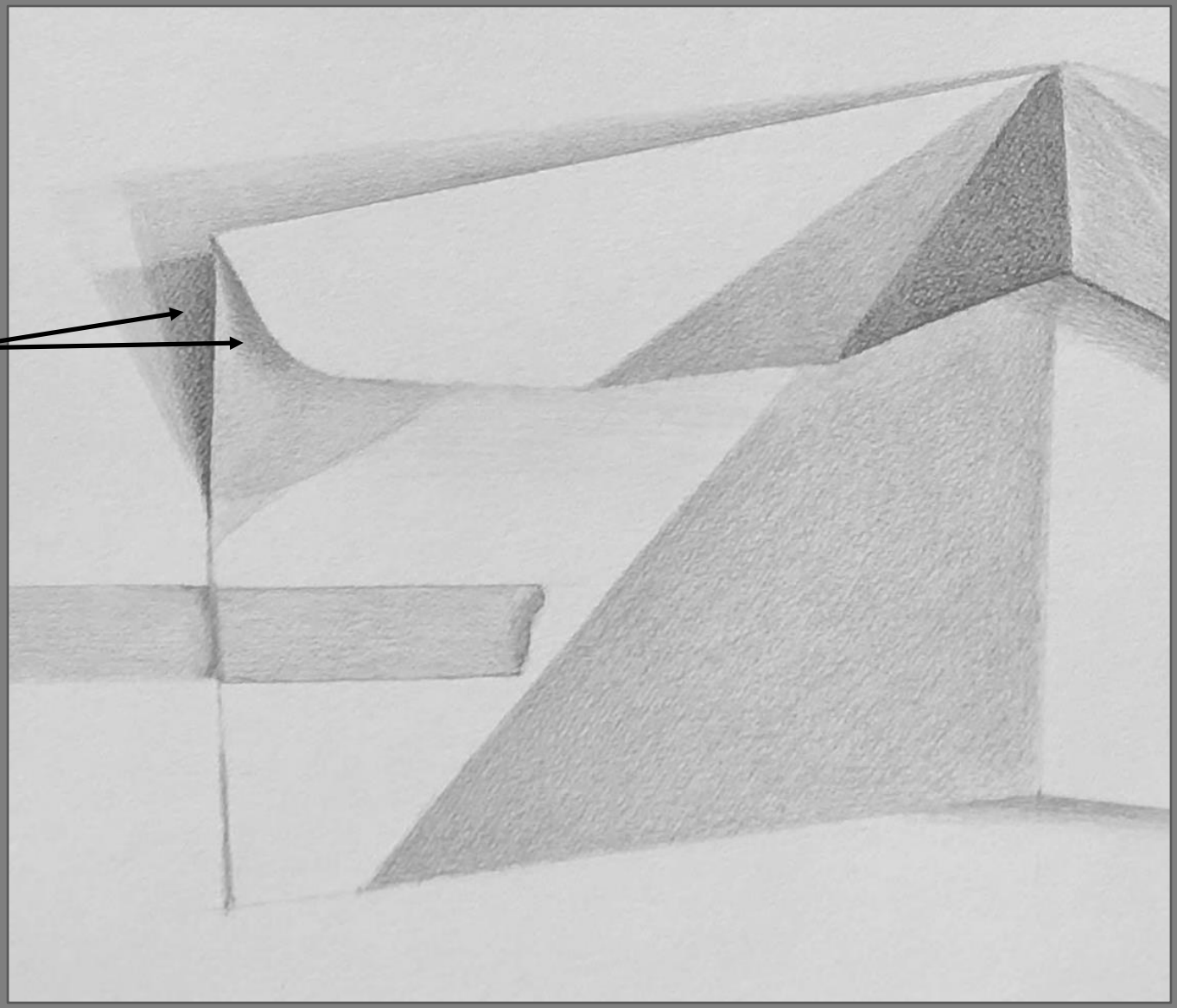
This is a photograph of my setup. For some reason, I had the idea to fold my envelope kind of like a paper airplane. I used tape to attach it to a half sheet of drawing paper and in a way that keeps the composition symmetrical. Your composition need not be symmetrical. My lighting conditions create sufficient contrast, making the dimensional aspects of the envelope easy to see. Create your own setup that you think is interesting and conducive to this assignment. Make sure to view the variety of examples by other students that follow for inspiration.

This is the layout for my final version. Notice how light my lines are. No outlines should be visible when the drawing is finished.

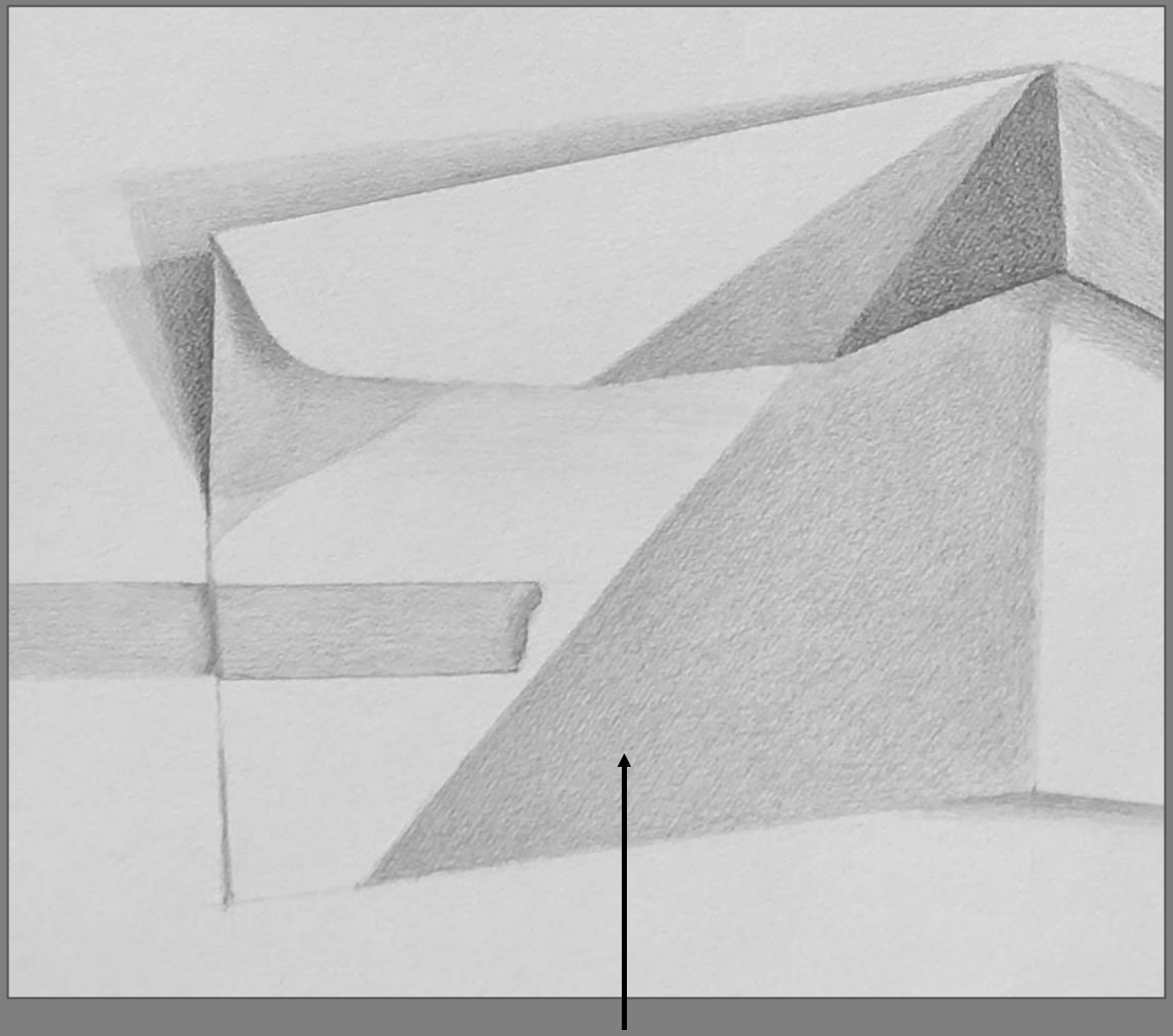
This is how my first stage of shading looks. I've focused on the areas of the envelope that are the most easily observed. In other words, the darkest values. Before you start to shade, try to identify where the lightest, darkest, and middle values are located. At this stage, do not get caught up in details like tiny wrinkles or other small surface variations that cause changes in value. Instead, record an average value of each basic shape.

Next, I put the cast shadows in. Remember that shadows typically fade from dark to light as they extend away from the object causing them. They also typically have sharp edges where they meet or go ‘behind’ the object that is causing them, and soft edges on their ‘away’ sides.

Notice how the cast shadows fade lighter and softer as they move away from the the envelope.

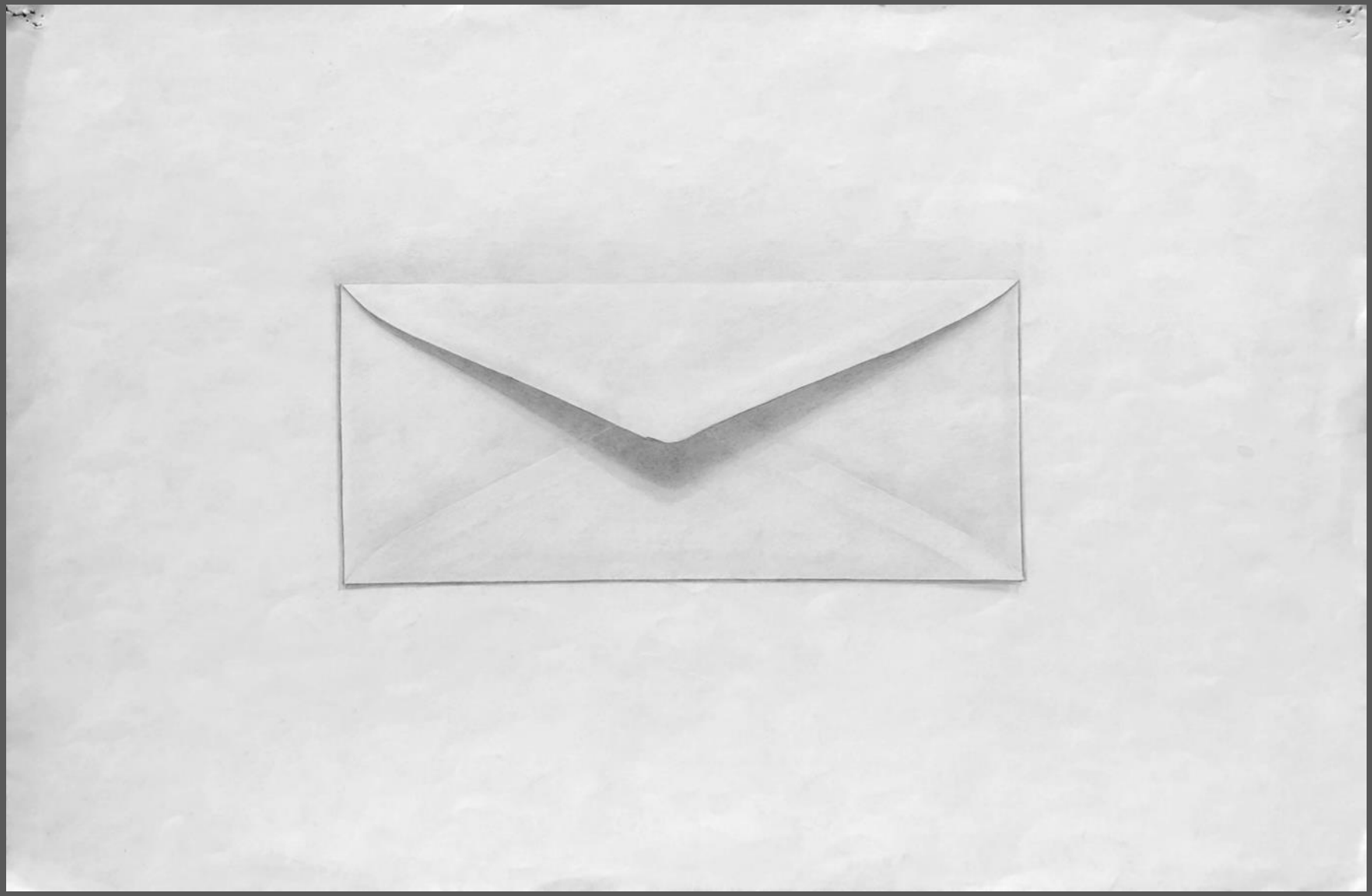


The last stage involved putting in the more subtle grays as well as finalizing details and gradations. You will not be able to (or want to) include every detail that you can see. All materials have limitations and cannot be made to record the level of nuance for which your eyes are capable. Besides, more does not necessarily equal better, even for highly realistic work. I left the seams out because I thought they caused unnecessary complexity that detracted from the overall form of the envelope. I also decided to make the tape darker than it appeared because the contrast looked too wimpy. Take liberties like these if they contribute to a better drawing.



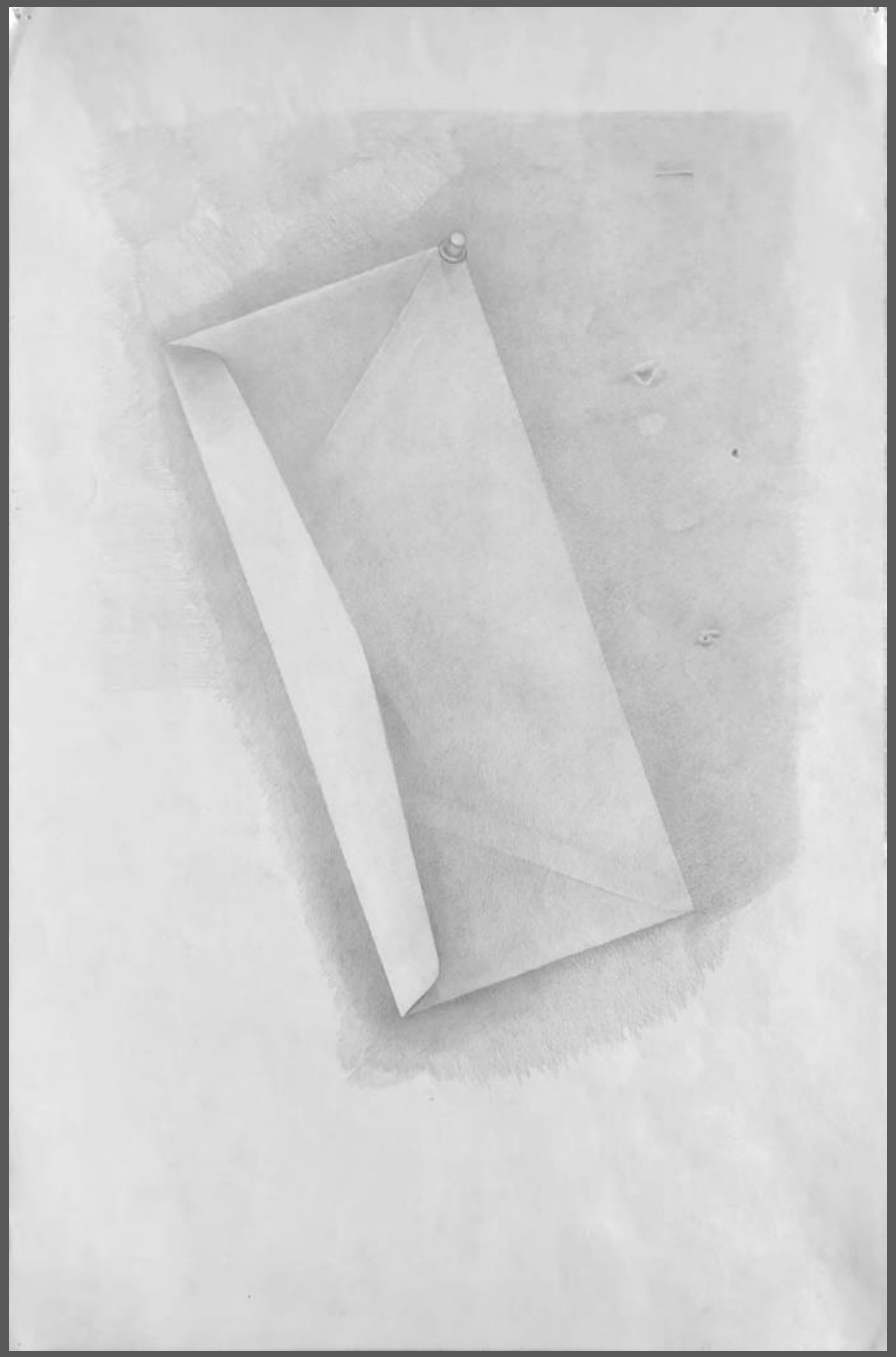
Notice the subtle gradation within this shape.

Examples of Assignment 9



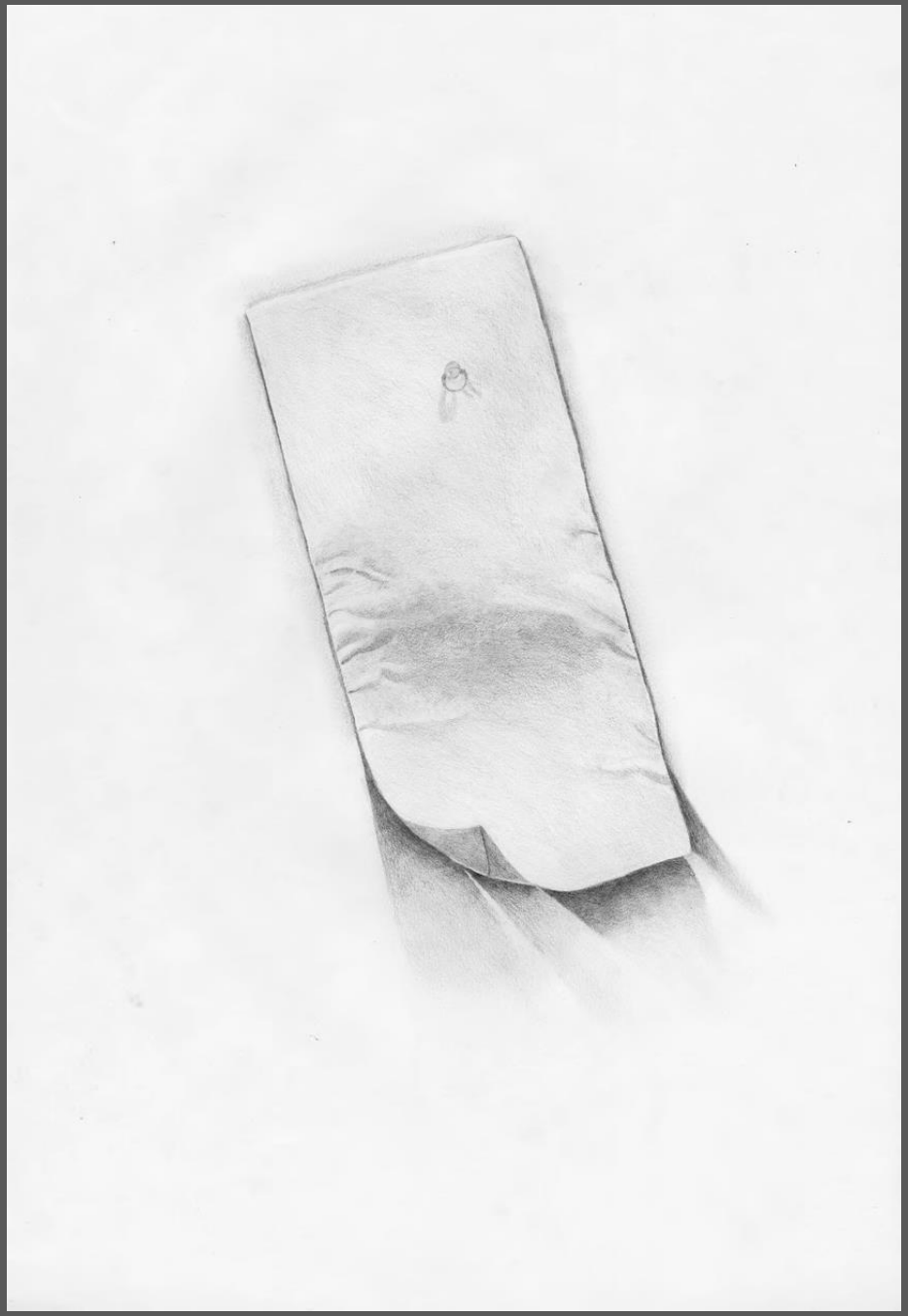
Instructor

Instructor

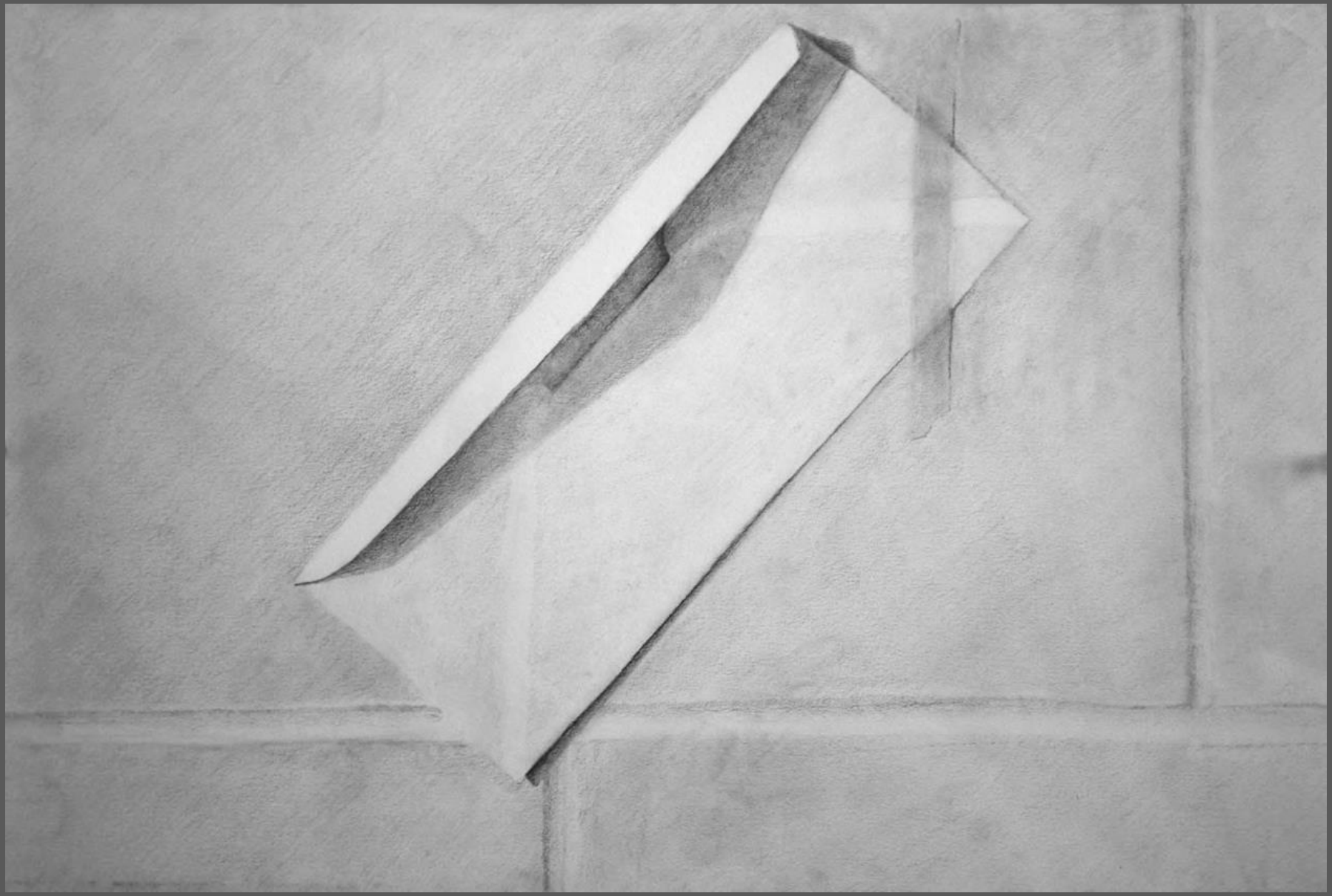


This is a demo piece purposely left unfinished so that the layering process can be seen. Zoom in if you can.

Instructor



Student



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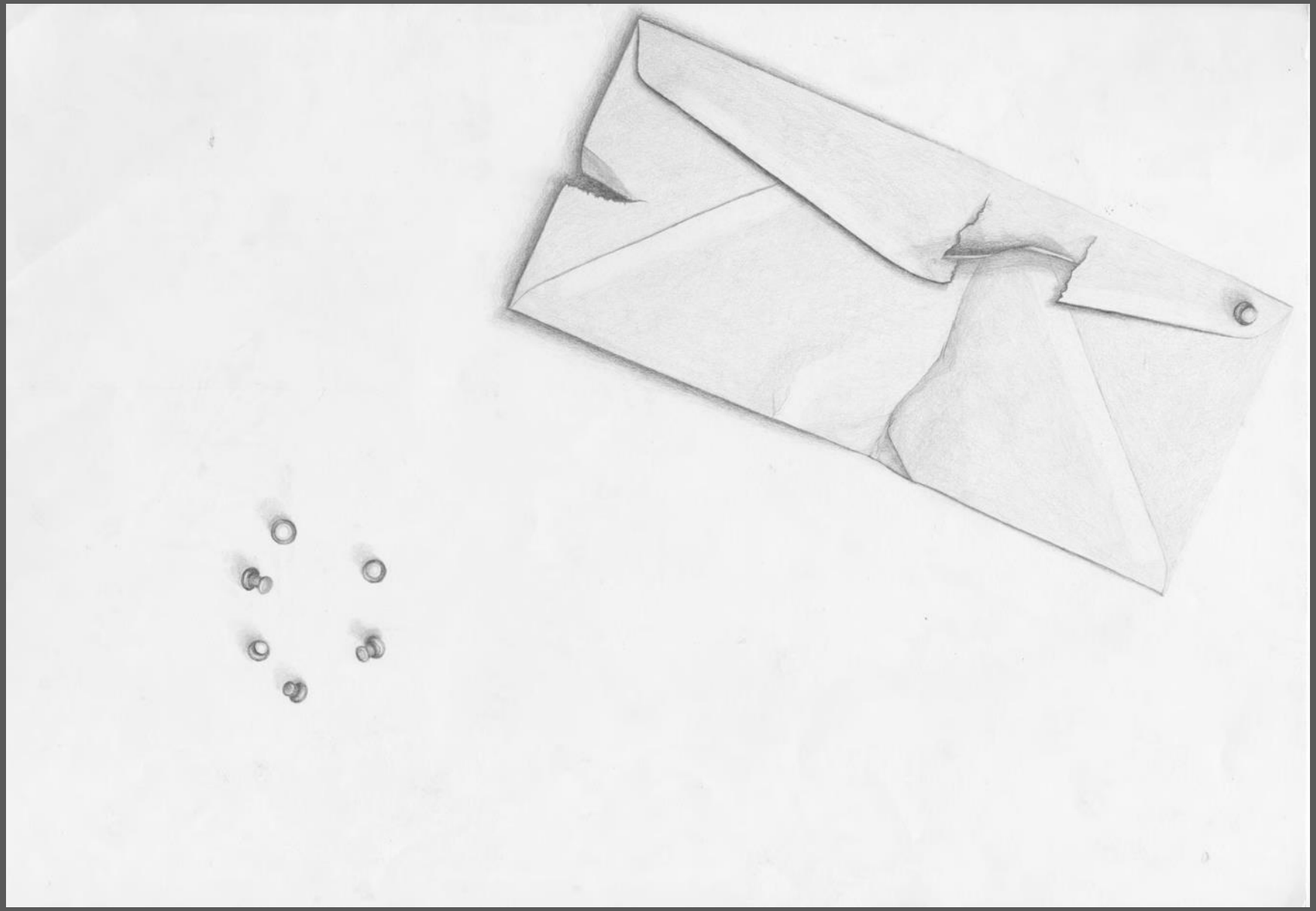

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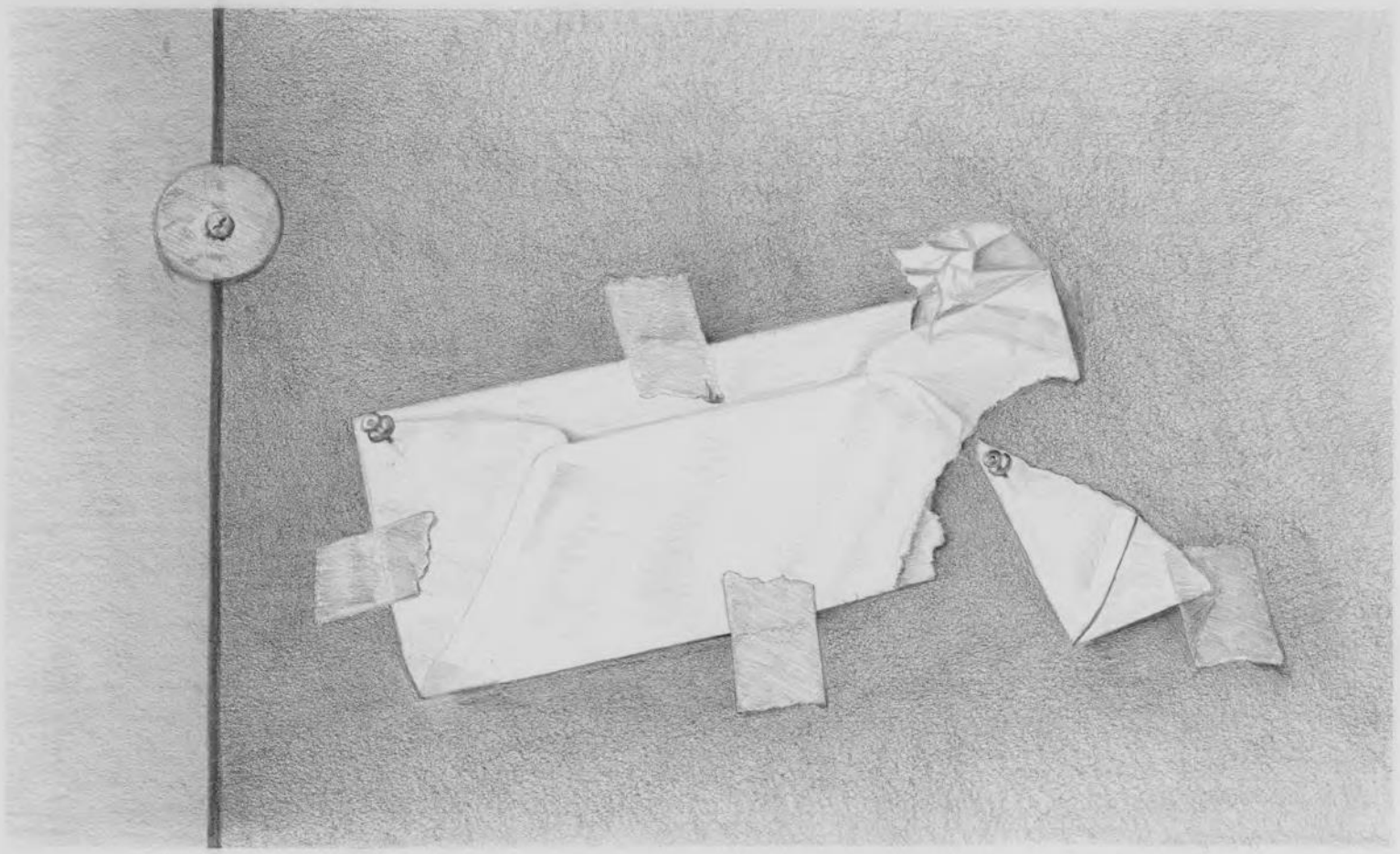

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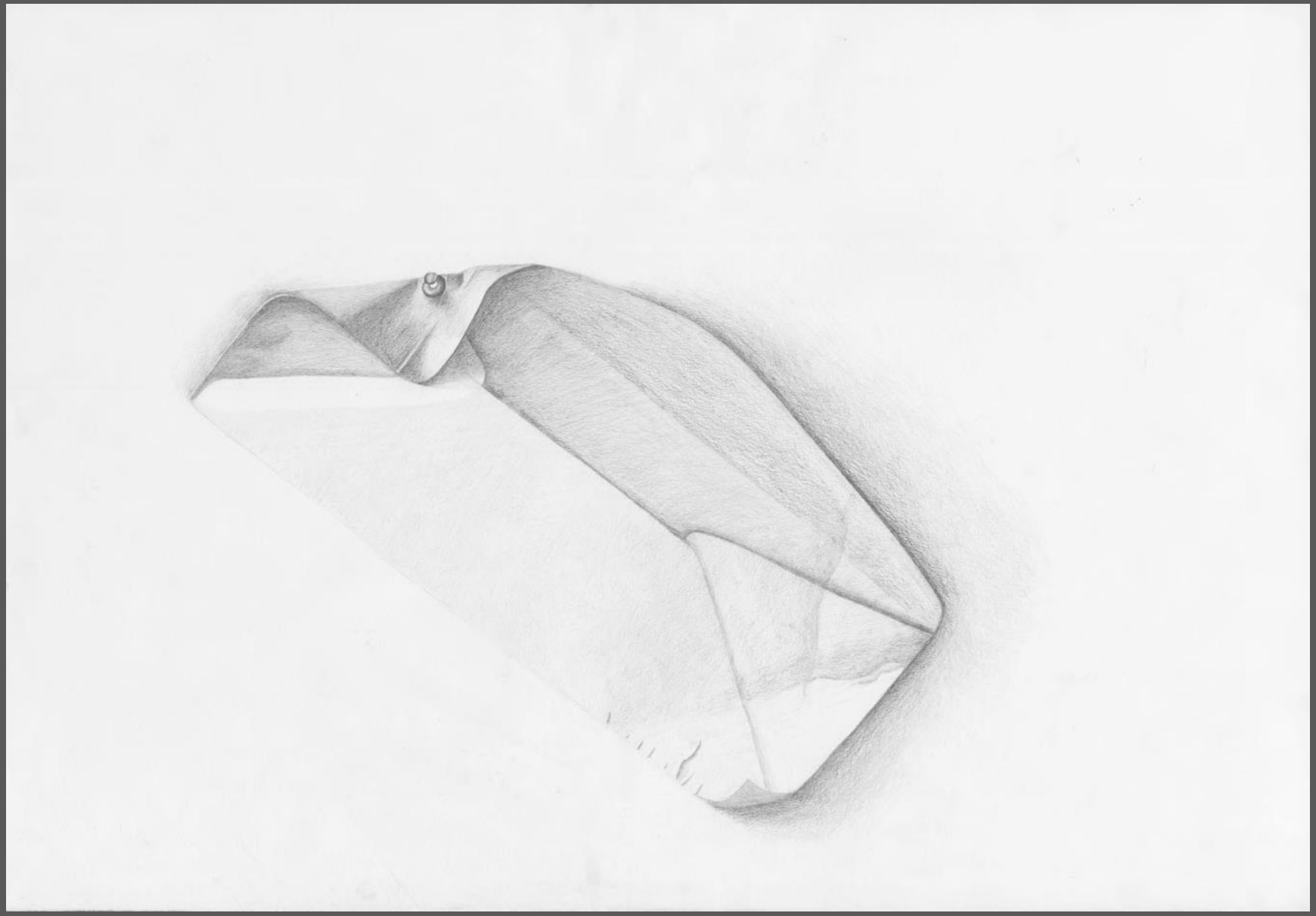


Student

The paintings that follow by William Harnett and Alan Magee are superb examples of the trompe-l’oeil aesthetic.

William Harnett

1848-1892


100
Mélodies
30
PETITS
MORCEAUX
VIDA, Y HECHOS
DON

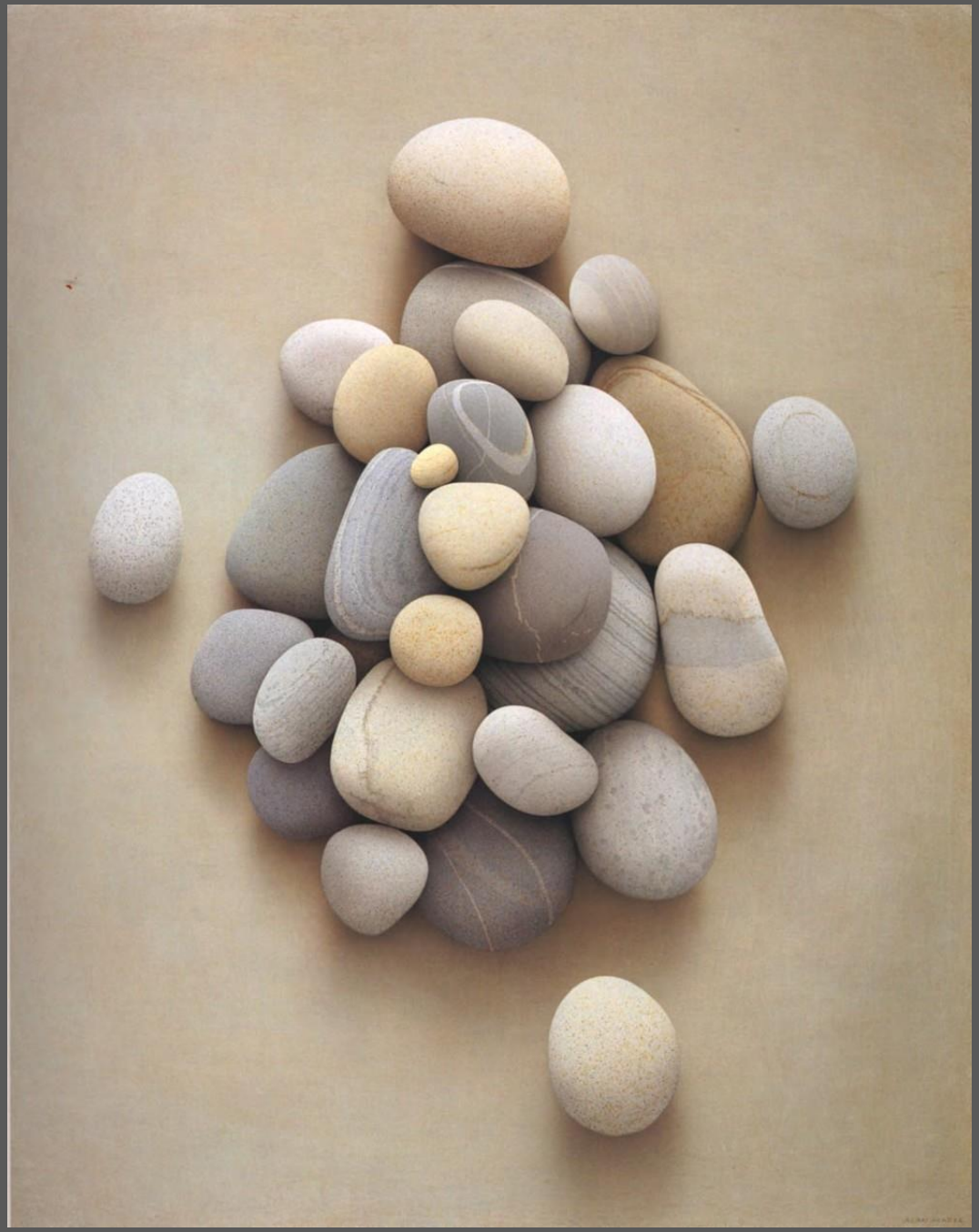

POSTAL
ary Commandery
No. 36,
CHARNETT
1888.


E. JARNETT
1892

Detail

Alan Magee

1947-present




Pelmincke NE 4/12


AIR MAIL
REGISTERED


ALAN MAGEE