



Three Chromebooks™ powered by an Intel® Core™ i3-10110U processor, an Intel Core i5-10210U processor, and an Intel Core i7-10510U processor†Δ



Intel Celeron® N4020 processor-powered Chromebook†Δ

Empower your business collaborators with a fast Intel Core processor-powered Chromebook

Three Chromebooks powered by Intel Core processors completed common tasks in less time than a Chromebook powered by an Intel Celeron processor

At Principled Technologies, we tested the responsiveness of four Chromebooks while completing tasks in a variety of professional and creative apps. The following processors powered each device:

- Intel Celeron N4020 processor
- Intel Core i3-10110U processor
- Intel Core i5-10210U processor
- Intel Core i7-10510U processor

In our tests, the devices powered by Intel Core processors completed the tasks in less time than the device powered by the Intel Celeron N4020 processor. Work is a bit different during the pandemic, but responsive devices can help ameliorate some of the challenges of working from home by providing a fast user experience.



Up to **36% less time** opening & editing a shared document while multi-tasking†Δ



Up to **66% less time** editing photo & video†Δ



Up to **49% less time** collaborating on a presentation†Δ

†Three Acer Chromebook Spin 713 devices (powered by an Intel Core i3-10110U processor, an Intel Core i5-10210U processor, and an Intel Core i7-10510U processor) compared to an Acer Chromebook 315 powered by an Intel Celeron N4020 processor.

ΔSee [the science behind this report](#) for detailed system configurations and benchmark results.

In this report, text in the **light blue sections** represents fictional scenarios based on the results of PT testing. Though the people aren't real, the scenarios represent a lifelike picture of the benefits users may see in the real world.



How we tested

We used common tasks in a variety of creative and productivity apps to test the responsiveness of four Intel processor-powered Chromebooks. We grouped related tasks together to compare performance over multiple tasks. For brevity's sake, the majority of this report focuses on the overall timing of these task groups rather than the specific timings for each task. If you'd like a more detailed look at the results for each Chromebook, see [the Science behind this report](#).

Note that during all of our tests on a Chromebook, that system was connected to a Google Meet video chat with five total participants to reflect that people routinely perform tasks during video chat sessions. We included launching Google Meet and starting this meeting in the first group of tasks. In subsequent task groups, we excluded the meeting timings, assuming that the hypothetical user would already be part of a meeting.



^ASee [the science behind this report](#) for detailed system configurations and benchmark results.



From her sunny window side perch, Brooke Hockaday signs into her Intel Core i7 processor-powered Chromebook and joins her morning's big meeting. The Galemeadow Real Estate team is meeting to review a contract for a new and exciting project: The owner of a downtown estate is finally selling their home, which the firm sees as a huge business opportunity. These days, much of the firm's work takes place over video conferencing. Their Intel Core processor-powered Chromebooks enable them to easily host meetings that facilitate creative and administrative processes while keeping their community safe.

Save time handling documents during meetings

In this scenario, we tested a variety of general tasks an office worker might need to do as part of their daily workload. In our hands-on tests, the Intel Core processor-powered Chromebooks performed better than the Intel Celeron N4020 processor-powered Chromebook. For example, when viewing a print preview of a PDF:

- The Intel Celeron N4020 processor-powered Chromebook **required 35.9 seconds**
- The Intel Core i3 processor-powered Chromebook **saved 10.5 seconds**
- The Intel Core i5 processor-powered Chromebook **saved 8.7 seconds**
- The Intel Core i7 processor-powered Chromebook **saved 10.7 seconds**

Remember that for each of these scenarios, the Chromebook we tested was also running a five-participant video call, representing a more real-world use case than simply timing each task in isolation.

Save up to 29 seconds opening and editing a shared document while multi-tasking with Google Meet, Google Drive, and Google Docs

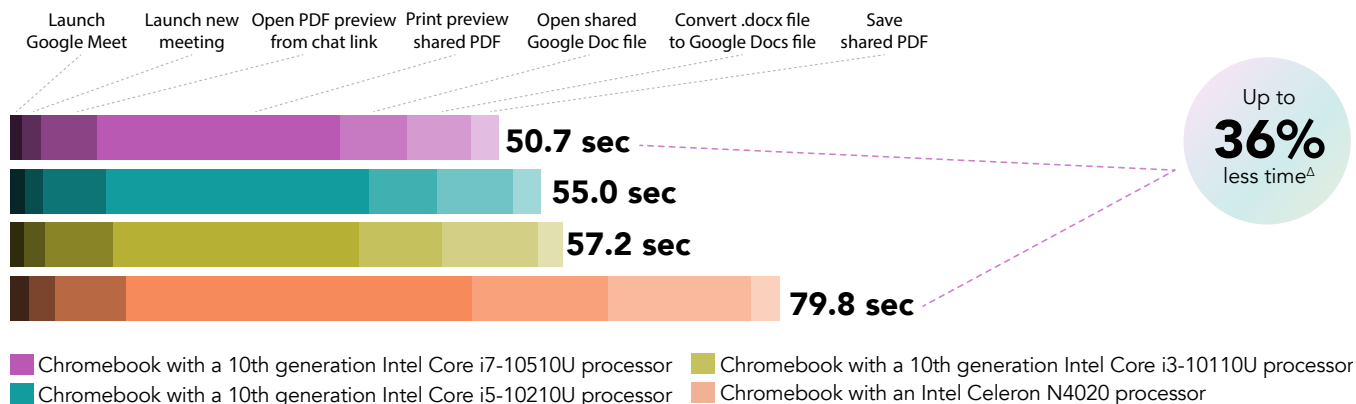


Figure 1: Time (in seconds) to complete a series of tasks while also engaging in a five-way video chat session in Google Meet. Less time is better. Source: Principled Technologies.

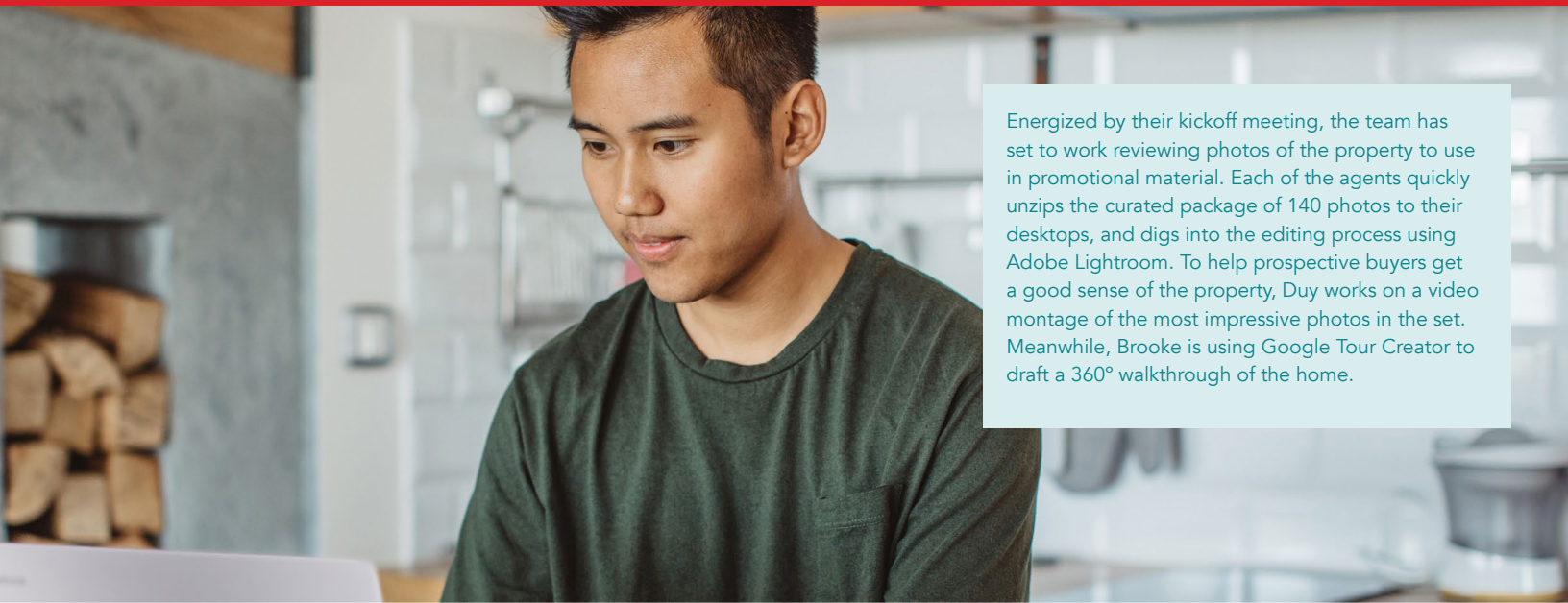
Google Meet

Google has made their premium video conferencing product free and available to the general public. According to Google, the app is used in schools, governments, and companies worldwide.¹

Google Workspace

In October 2020, Google rebranded its G Suite app offerings as Google Workspace—but you'll still get the same productivity and collaboration tools you've come to rely on over the years, including Google Docs, Google Slides, Google Meet, Google Drive, and more.²

^ASee [the science behind this report](#) for detailed system configurations and benchmark results.



Energized by their kickoff meeting, the team has set to work reviewing photos of the property to use in promotional material. Each of the agents quickly unzips the curated package of 140 photos to their desktops, and digs into the editing process using Adobe Lightroom. To help prospective buyers get a good sense of the property, Duy works on a video montage of the most impressive photos in the set. Meanwhile, Brooke is using Google Tour Creator to draft a 360° walkthrough of the home.

Save time on photo editing and video creation

This scenario focused on the work a creative professional might have to do on a day to day basis. A notable result from this scenario is importing a set of 140 photos into Adobe Lightroom:

- The Intel Celeron N4020 processor-powered Chromebook **required 6.0 minutes**
- The Intel Core i3 processor-powered Chromebook **saved 3.1 minutes**
- The Intel Core i5 processor-powered Chromebook **saved 3.6 minutes**
- The Intel Core i7 processor-powered Chromebook **saved 3.7 minutes**

Save up to 15 minutes editing photo and video

with Google System, Adobe Lightroom, Kinemaster, and Google Tour Creator

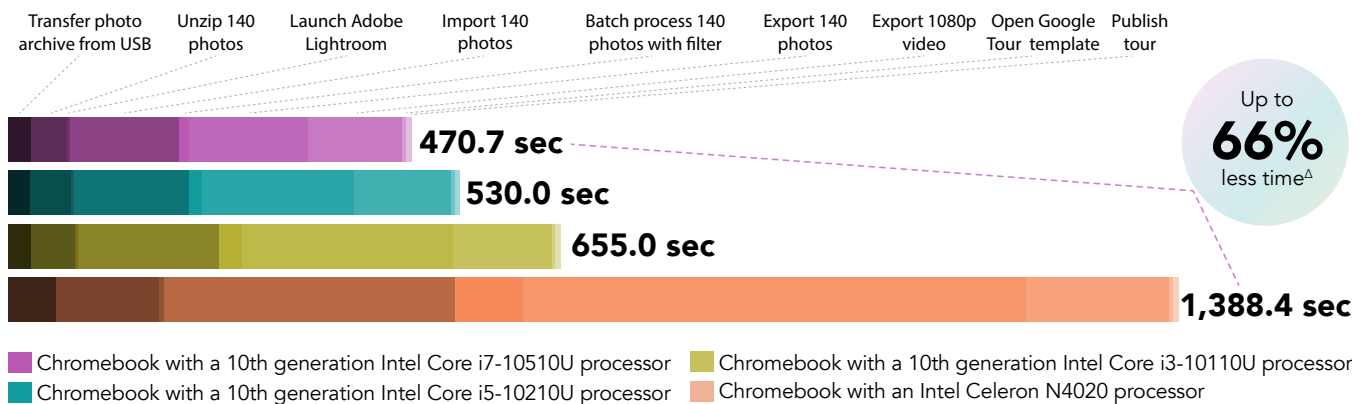


Figure 2: Time (in seconds) to complete a series of tasks while also engaging in a five-way video chat session in Google Meet. Less time is better. Source: Principled Technologies.

Adobe Lightroom

Adobe Lightroom is a free photo editing and camera app that enables you to use customizable filters and other options to create your photo masterpiece.³

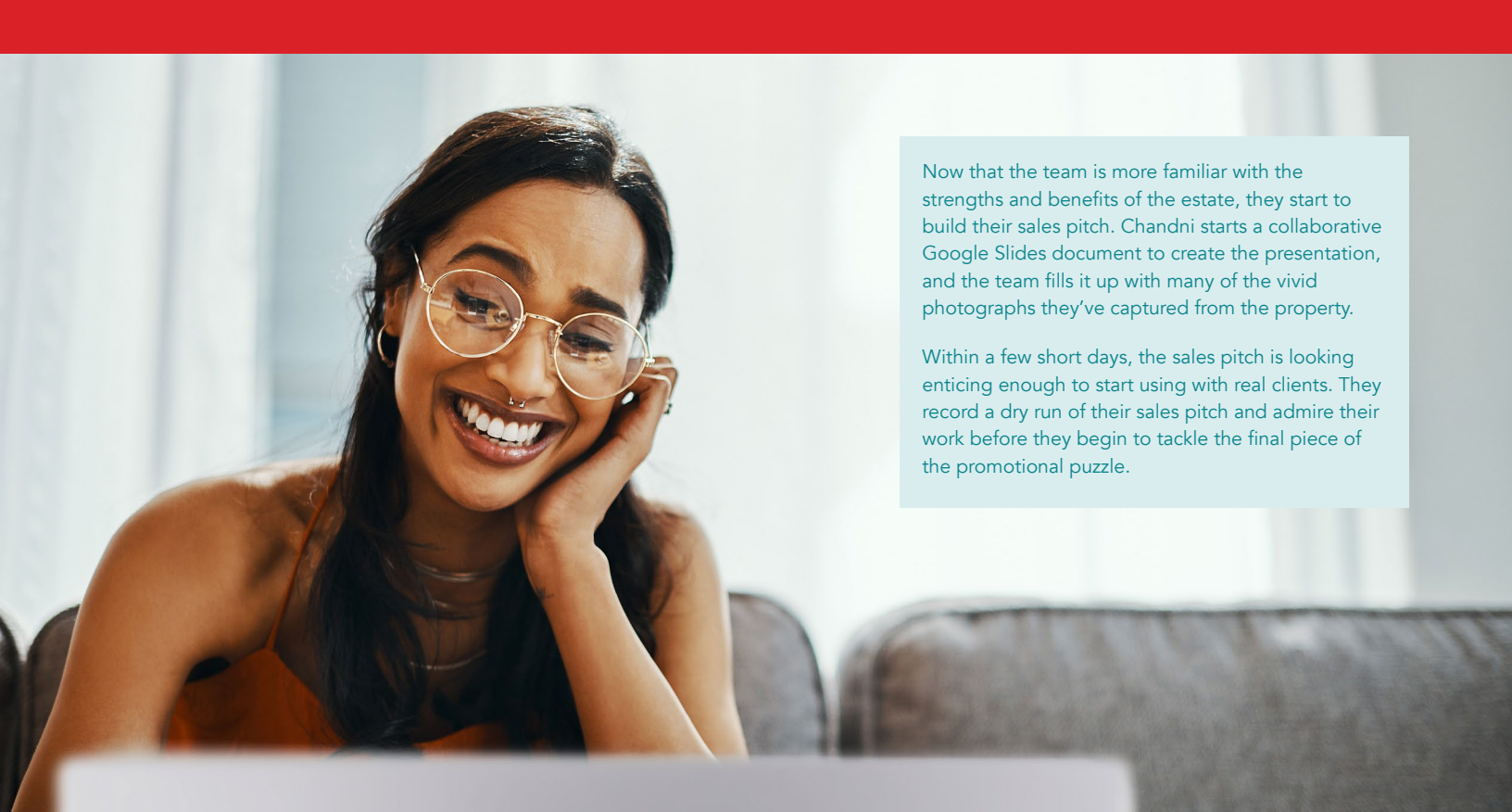
Kinemaster

Kinemaster is a free-to-use video editing app available on Google Play Store that allows users to add and customize audio, apply keyframe animation techniques, export 4K 2160p video, and more.⁴

Google Tour Creator

Part of Google's set of AR and VR offerings, Tour Creator enables you to implement 360° photos, highlight points of interest, overlay images, and more.⁵

^ASee [the science behind this report](#) for detailed system configurations and benchmark results.



Now that the team is more familiar with the strengths and benefits of the estate, they start to build their sales pitch. Chandni starts a collaborative Google Slides document to create the presentation, and the team fills it up with many of the vivid photographs they've captured from the property.

Within a few short days, the sales pitch is looking enticing enough to start using with real clients. They record a dry run of their sales pitch and admire their work before they begin to tackle the final piece of the promotional puzzle.

Save time while collaborating on presentations

We designed this scenario to showcase collaborative performance. While we saw strong performance from all four Chromebooks during these tests, the Chromebooks powered by Intel Core i3, Core i5, and Core i7 processors completed tasks in less time than the Intel Celeron processor-powered Chromebook.

Save up to 24 seconds collaborating on a presentation with Google Slides and Screencastify

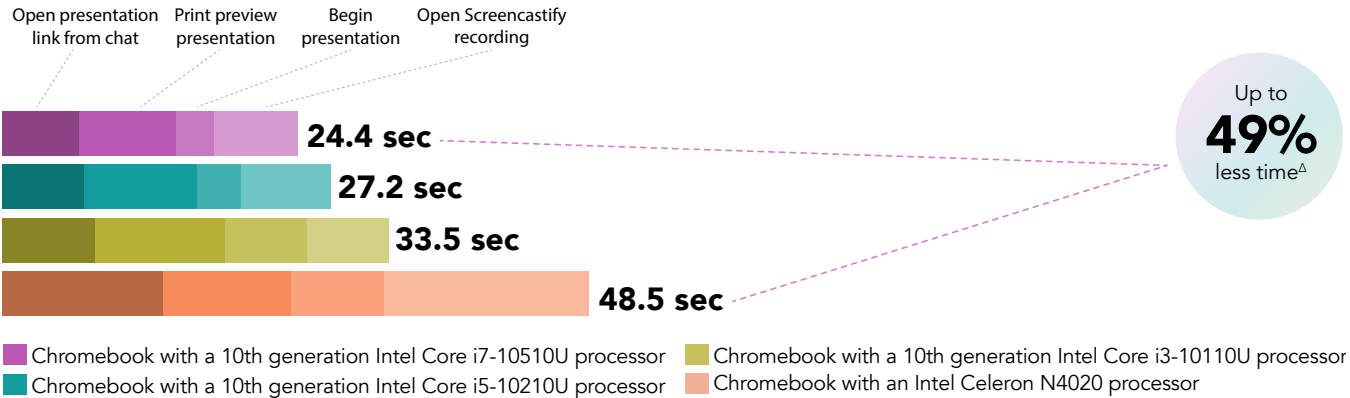


Figure 3: Time (in seconds) to complete a series of tasks while also engaging in a five-way video chat session in Google Meet. Less time is better. Source: Principled Technologies.

Screencastify

Screencastify is a Chrome extension for capturing, editing, and sharing videos from a system desktop, browser tab, or webcam. According to their website, more than 12 million people use Screencastify around the world.⁶

^ΔSee [the science behind this report](#) for detailed system configurations and benchmark results.



Conclusion

In our tests, Chromebooks powered by Intel Core i3, Core i5, and Core i7 processors completed tasks in various professional and creative apps faster than a Chromebook powered by an Intel Celeron N4020 processor. The Chromebooks achieved their respective timings while connected to a five-way Google Meet video call, representing a true to life use case. The Intel Core i7 processor-powered Chromebook generally had the best results of the pack, though the Intel Core i3 and Core i5 processor-powered Chromebooks both consistently outperformed the Intel Celeron N4020 processor-powered Chromebook, which itself may still be suitable for professional needs.

Because many of last year's office workers are now working from home, it's important for businesses to invest in technology that enables their employees to stay connected while carrying out day to day tasks. To that end, an Intel Core processor-powered Chromebook may be a strong candidate for your next set of employee devices.

For more information, visit <https://intel.com/Chromebooks>

-
- 1 Javier Soltero, "Google Meet premium video meetings—free for everyone," accessed November 16, 2020, <https://www.blog.google/products/meet/bringing-google-meet-to-more-people/>.
 - 2 "Introducing Google Workspaces and a new set of offerings to better meet your needs," accessed November 16, 2020, <https://workspaceupdates.googleblog.com/2020/10/introducing-google-workspace.html>.
 - 3 "Adobe Lightroom," accessed November 16, 2020, https://play.google.com/store/apps/details?id=com.adobe.lrmobile&hl=en_US.
 - 4 "KineMaster - Video Editor, Video Maker," accessed November 16, 2020, https://play.google.com/store/apps/details?id=com.nexstreaming.app.kinemasterfree&hl=en_US.
 - 5 "Tour Creator," accessed November 16, 2020, <https://arvr.google.com/tourcreator/>.
 - 6 "Screencastify | The #1 Screen Recorder for Chrome," accessed November 16, 2020, <https://screencastify.com>.

We concluded our hands-on testing on November 4, 2020. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on October 26, 2020 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

Table 1: Time in seconds to complete tasks in various apps.

	Configuration A	Configuration B	Configuration C	Configuration D	Percentage win
Task	Acer Chromebook CB-315-3H with Intel Celeron N4020	Acer Chromebook Spin CP713-2W-38P1 with Intel Core i3-10110U	Acer Chromebook Spin CP713-2W-5874 with Intel Core i5-10210U	Acer Chromebook Spin CP713-2W-79H3 with Intel Core i7-10510U	Configuration D vs. Configuration A
Scenario 1					
Median sum of all tasks for Scenario 1	79.8	57.2	55.0	50.7	36%
Google Meet					
Launch Google Meet	2.0	1.5	1.6	1.3	35%
Launch new meeting	2.7	2.1	1.8	2.0	25%
Google Drive					
Open PDF preview from Google Drive	7.3	7.1	6.6	5.7	21%
Print Preview PDF	35.9	25.4	27.2	25.2	29%
Google Docs					
Open shared .docx file in Google Docs	14.07	8.74	7.18	6.97	50%
Convert .docx file to Google Docs document	14.97	9.91	7.90	6.70	55%
Downloaded converted doc to .docx	3.01	2.55	2.84	2.93	3%

	Configuration A	Configuration B	Configuration C	Configuration D	Percentage win
Task	Acer Chromebook CB-315-3H with Intel Celeron N4020	Acer Chromebook Spin CP713-2W-38P1 with Intel Core i3-10110U	Acer Chromebook Spin CP713-2W-5874 with Intel Core i5-10210U	Acer Chromebook Spin CP713-2W-79H3 with Intel Core i7-10510U	Configuration D vs. Configuration A
Scenario 2					
Median sum of all tasks for Scenario 2	1,388.4	655.0	530.0	470.7	66%
Unarchiving photos					
Transfer 140 photo .zip archive from USB	59.2	28.6	28.1	28.4	52%
Unzip 140 photos to desktop	127.9	54.3	49.9	44.7	65%
Adobe Lightroom					
Launch Adobe Lightroom	5.2	3.3	3.1	3.0	42%
Import 140 photos	361.1	174.9	143.3	135.2	62%
Batch process 140 photos with filter preset	84.3	28.2	15.4	13.1	84%
Export 140 photos	620.5	259.6	187.1	146.7	76%
Kinemaster					
Time to export 1080p video	177.2	123.8	121.1	116.4	34%
Google Tour Creator					
Open Google Tour Creator template	5.4	4.5	4.6	4.7	13%
Publish Google Tour Creator tour	6.8	6.4	5.5	6.9	-1%
Scenario 3					
Median sum of all tasks for Scenario 3	48.5	33.5	27.2	24.4	49%
Google Slides					
Open shared Google Slides presentation	13.3	7.7	6.8	6.4	51%
Print Preview Google Slides presentation	10.6	10.8	9.3	8.0	24%
Begin Google Slides Presentation	7.7	6.7	3.7	3.1	59%
Screencastify					
Open Recording in Project Editor	16.91	8.30	7.4	6.9	59%

System configuration information

Table 2: The table below presents detailed information on the systems we tested.

System	Acer Chromebook CB-315-3H	Acer Chromebook Spin CP713-2W-38P1	Acer Chromebook Spin CP713-2W-5874	Acer Chromebook Spin CP713-2W-79H3
Processor	Intel Celeron N4020	Intel Core i3-10110U	Intel Core i5-10210U	Intel Core i7-10510U
Processor frequency (GHz)	1.10	2.10	1.60	1.80
Processor cores	2	2	4	4
Memory (GB)	4	8	8	16
Storage (GB)	64	256	128	128
Bluetooth	5	5	5	5
USB	2x USB 3.1 Type-C 2x USB 3.1 Gen 1	2x USB 3.1 Type-C 1x USB 3.1 Gen 1	2x USB 3.1 Type-C 1x USB 3.1 Gen 1	2x USB 3.1 Type-C 1x USB 3.1 Gen 1
Battery type	Lithium-Ion	Lithium-Ion	Lithium-Ion	Lithium-Ion
Battery capacity (Wh)	48	48	48	48
Display	15.6" 1366x768	13.5" 2256x1504	13.5" 2256x1054	13.5" 2256x1054
OS (version)	86.0.4240.112	86.0.4240.112	86.0.4240.112	86.0.4240.112
System Weight (lbs.)	4.19	3.02	3.02	3.02

How we tested

Creating the background workload

To simulate typical Chromebook use, we ran a combination of news, email, chat, music, document viewing, and social media websites in the background. For websites that required accounts, we created test profiles and logged in the users on each device.

1. From the shelf, open Chromebook settings.
2. Navigate to the On Startup section of the settings.
3. Select Open a specific page or set of pages.
4. Insert the following URLs, and click OK:
 - [Forbes.com](https://forbes.com)
 - [Markets.ft.com/data](https://markets.ft.com/data)
 - [Arstechnica.com](https://arstechnica.com)
 - mail.google.com
 - slack.com (logged into Slack chat, #general channel)
 - drive.google.com
 - docs.google.com (viewing document)
 - youtube.com/feed/music
 - drive.google.com (viewing document)
 - sheets.google.com (viewing spreadsheet)
 - twitter.com
 - facebook.com
5. Restart the Chromebook. Before testing, navigate through each tab to ensure that both devices have fully loaded the same content.

Testing the applications

For each scenario, we downloaded, installed, and pinned the requisite apps to the Chrome shelf. For applications that required accounts or Google Authentication, we created test profiles and logged in the users on each device. We tested each task for a given scenario sequentially. After one run of a given scenario, we reset the Chromebook and performed two additional runs for a total of three.

Scenario one

Google Meet

Launching Google Meet

1. Simultaneously start the timer and launch the Meet app from the shelf.
2. When the app fully loads and the webcam preview appears, stop the timer.

Launching a new Google Meet meeting

1. From the Meet main screen, simultaneously start the timer and click New meeting.
2. When the meeting invite code appears and the webcam preview refreshes, stop the timer.
3. Join a four-way video call, and minimize the app for the remainder of the Scenario One tasks.

Google Drive

Open PDF preview from Google Drive

1. From the Google Meet chat window, simultaneously start the timer, and click the link to the test PDF.
2. Stop the timer when the PDF preview fully loads in the web browser.

Print Preview PDF

1. From the Google Meet chat window, click the link to the test PDF shared via Google Drive.
2. When the PDF loads, simultaneously start the timer, and click the Print icon.
3. Stop the timer when the print preview fully loads.

Google Docs

Open shared .docx file In Google Docs

1. From the Google Meet chat window, click the link to the test .docx file shared via Google Drive.
2. When the .docx file preview loads, simultaneously start the timer, and click the Open with Google Docs button from the top menu.
3. Stop the timer when the Google Docs editor fully loads.

Convert .docx file to Google Docs document

1. From the Google Meet chat window, click the link to the test .docx file shared via Google Drive.
2. When the .docx file preview loads, click the Open with Google Docs button from the top menu.
3. From the Google Docs editor, click the File dropdown menu.
4. Simultaneously start the timer, and click Save as Google Docs.
5. Stop the timer when the newly opened Google Doc fully loads.

Downloaded converted Google Doc to .docx

1. From the Google Meet chat window, click the link to the test .docx file shared via Google Drive.
2. When the .docx file preview loads, click the Open with Google Docs button from the top menu.
3. From the Google Docs editor, click the File dropdown menu, and select Save as Google Docs.
4. When the newly opened Google Doc fully loads, click the File dropdown menu, and hover over Download.
5. Simultaneously start the timer, and click Microsoft Word (.docx) from the Download menu.
6. Stop the timer when the download notification completes.

Scenario Two

Unarchiving Photos

Transfer 140 photo .zip archive from USB

1. Prepare a flash drive with the test .zip archive.
2. Connect the flash drive to the system under test.
3. Open the File application from the ChromeOS application launcher, and select the attached drive.
4. Click and drag the .zip archive to the Download folder. Start the timer before releasing the trackpad mouse button.
5. Stop the timer when the file transfer completes.

Unzip 140 photos from the Desktop

1. From the Files application, navigate to the test archive location.
2. Double-click to open the test archive using the default system viewer.
3. Select the contents of the test archive, and click and drag the contents to an empty folder.
4. Simultaneously start the timer and unclick the dragged content.
5. Stop the timer when the copying files dialog completes.

Adobe Lightroom

Launch Adobe Lightroom

1. Simultaneously start the timer, and launch Adobe Lightroom from the shelf.
2. Stop the timer when the app has fully loaded.

Import 140 photos

1. From the Adobe Lightroom home page, click the blue import photos icon.
2. Sort by Device Folders, and select the unarchived test photos by clicking the checkbox next to the folder name.
3. Simultaneously start the timer, and click Add.
4. Stop the timer when the import dialog completes.

Batch process 140 photos with filter preset

1. From the Adobe Lightroom home page, click the collection containing the test photos.
2. Click the first image.
3. Click the Adjustments icon.
4. Click Auto to apply auto adjustments.
5. Click the menu button in the top right, and select Copy Settings.

6. Leave the default Copy Settings, and click OK.
7. Click the back arrow to return to the collection view.
8. Long click the first photo to select it.
9. Click the menu button in the top right, and select Select All.
10. Click the menu button in the top right again, and select Paste Settings.
11. Simultaneously start the timer, and click Apply.
12. Stop the timer when the processing dialog closes, and “Changes applied to 140 photos” appears.

Export 140 photos

1. From the Adobe Lightroom home page, click the collection containing the test photos.
2. Click to select the first image.
3. From the dropdown menu, click to Select All images.
4. With all images selected, click the Share icon.
5. From the Share dialog box, click Export As...
6. Leave the default settings. Simultaneously start the timer, and click the checkmark icon.
7. Stop the timer when the export dialog completes.

Kinemaster

Time to export 1080p video

1. Launch the application from the shelf.
2. Click the + icon to create a new video project.
3. Click 16:9 to set the video aspect ratio.
4. From the Media Browser, click to select the test video footage. Import the test audio, and test photo files.
5. From the video editor, click the export icon.
6. Leave the default Resolution and Frame Rate settings. Simultaneously start the timer, and click Export.
7. Stop the timer when the export completes.

Google Tour Creator

Open Google Tour Creator Template

1. Open the Chrome Browser window, and navigate to the Google Tour Creator web application (avvr.google.com).
2. Click Get Started.
3. Click to select the Templates tab.
4. Simultaneously start the timer, and click the New York City template.

Publish Google Tour Creator tour

1. From the Google Tour Creator editor, click Publish.
2. Simultaneously start the timer, and click Publish again.
3. Stop the timer when the published tour preview fully loads.

Scenario Three

Google Slides

Open shared Google Slides Presentation

1. From the Google Meet chat window, simultaneously start the timer, and click the link to the Google Slides test document shared via Google Drive.
2. Stop the timer when the Slides presentation fully loads.

Print Preview Google Slides Presentation

1. From the Google Meet chat window, click the link to the Google Slides test document shared via Google Drive.
2. When the Slides presentation loads, click the File dropdown menu.
3. Simultaneously start the timer, and click Print.
4. Stop the timer when the Print Preview fully loads.

Begin Google Slides Presentation

1. From the Google Meet chat window, click the link to the Google Slides test document shared via Google Drive.'
2. Simultaneously start the timer, and click the Present button.
3. Stop the timer when the Presentation fully loads.

Screencastify

Open Recording In Project Editor

1. From the Chrome browser, click the Extensions icon.
2. From the Extensions menu, click Screencastify - Screen Video Recorder.
3. When the Screencastify extension menu loads, click the Record button.
4. Click to select Entire Desktop.
5. Record 5 minutes of the Google Slides presentation set to loop and auto advance every 10 seconds. When recording reaches 5 minutes, the Chrome Screencastify extension will open.
6. Simultaneously start the timer, and click Project Editor.
7. Stop the timer when the video editor fully loads.

Export presentation video to .mp4

1. From the Editor window, click to expand the Download options.
2. Click Export as MP4.
3. Check Convert to fixed frame rate, and leave the default value of 30.
4. Simultaneously start the timer, and click Export.
5. Stop the timer when the export dialog completes.

Intel contributes to the development of benchmarks by participating in, sponsoring, and/or contributing technical support to various benchmarking groups, including the BenchmarkXPRT Development Community administered by Principled Technologies.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors.

Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/benchmarks.

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.

This project was commissioned by Intel.



Facts matter.®

Principled Technologies is a registered trademark of Principled Technologies, Inc. All other product names are the trademarks of their respective owners.

DISCLAIMER OF WARRANTIES; LIMITATION OF LIABILITY:

Principled Technologies, Inc. has made reasonable efforts to ensure the accuracy and validity of its testing, however, Principled Technologies, Inc. specifically disclaims any warranty, expressed or implied, relating to the test results and analysis, their accuracy, completeness or quality, including any implied warranty of fitness for any particular purpose. All persons or entities relying on the results of any testing do so at their own risk, and agree that Principled Technologies, Inc., its employees and its subcontractors shall have no liability whatsoever from any claim of loss or damage on account of any alleged error or defect in any testing procedure or result.

In no event shall Principled Technologies, Inc. be liable for indirect, special, incidental, or consequential damages in connection with its testing, even if advised of the possibility of such damages. In no event shall Principled Technologies, Inc.'s liability, including for direct damages, exceed the amounts paid in connection with Principled Technologies, Inc.'s testing. Customer's sole and exclusive remedies are as set forth herein.