The science behind the report:

Boosting productivity and security with modern devices: A comparative study

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report Boosting productivity and security with modern devices: A comparative study.

We concluded our hands-on testing on February 22, 2023. 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 November 21, 2022 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Dell Technologies provided the systems that we tested.

Our results

To learn more about how we have calculated the wins in this report, go to http://facts.pt/calculating-and-highlighting-wins. Unless we state otherwise, we have followed the rules and principles we outline in that document.

Phase 1 results

While some benchmark subscores are reported in milliseconds, where less time is better, higher benchmark overall ratings are better. We also measured surface temperatures while the PCs were under load. Lower temperatures are better.

Table 1: Results of Phase 1 testing. We ran each test three times on each system and report the median scores and temperature results.

	Laptops		All-in-ones	
	Dell™ Latitude™ 7430 12th Gen Intel® Core™ i7-1265U	**Dell Latitude 7410** 10th Gen Intel Core i7-10810U	**Dell OptiPlex™ 7400** 12th Gen Intel Core i7-12700	**Dell OptiPlex 7480** 10th Gen Intel Core i5-10500
Cinebench R23 benchmark scores				
Single-core overall rating	7,636	3,782	10,596	7,730
Multi-core overall rating	1,761	1,074	1,901	1,200
3DMark benchmark scores				
Fire Strike overall rating	3,712	1,260	3,398	1,110
Time Spy overall rating	1,499	482	1,392	468

	Laptops		All-in-ones	
	Dell™ Latitude™ 7430 12th Gen Intel® Core™ i7-1265U	**Dell Latitude 7410** 10th Gen Intel Core i7-10810U	**Dell OptiPlex™ 7400** 12th Gen Intel Core i7-12700	**Dell OptiPlex 7480** 10th Gen Intel Core i5-10500
UL Procyon® benchmark scores				
Photo Editing Benchmark overall rating	6,079	3,814	5,227	3,966
Video Editing Benchmark overall rating	1,642	1,000	2,432	976
Office Productivity Benchmark overall rating	6,378	4,586	6,622	5,108
WebXPRT 4 benchmark scores on Edge (Chromium)				
Overall score	254	188	257	200
Subscores (milliseconds, lower is better)				
Photo enhancement	318	400	377	381
Organize album using AI	1,359	1,961	1,329	1,940
Stock option pricing	87	121	86	112
Encrypt notes and OCR scan	749	1157	732	1,049
Sales graph	270	321	257	297
Online homework	1,880	2,518	1,670	2,355
Thermal testing results				
Cinebench R23 multi-core overall score	7,327	3,150	10,307	7,729
Delta from ambient room temperature	80.9°F (27.1°C)	85.1°F (29.5°C)	63.0°F (17.2°C)	62.7°F (17.1°C)
Ambient room temperature	68.0°F (20.0°C)	67.1°F (19.5°C)	68.0°F (20.0°C)	66.5°F (19.2°C)
Hottest top surface point temperature	117°F (47°C)	120°F (49°C)	99°F (37°C)	97°F (36°C)
Hottest bottom surface point temperature	124°F (51°C)	125°F (52°C)	103°F (39°C)	108°F (42°C)

Phase 2 results

For phase 2 testing, we ran a subset of benchmarks we used in Phase 1. Higher benchmark overall ratings are better. We also tested battery life on both Dell Latitude laptops. Longer battery life is better.

Table 2: Results of Phase 2 testing. We ran each test three times on each system and report the median scores and battery life results.

	Laptops			All-in-ones		
	Dell Latitude 7430 12th Gen Intel® Core™ i7-1265U	**Dell Latitude 7410** 10th Gen Intel Core i7-10810U		**Dell OptiPlex 7400** 12th Gen Intel Core i7-12700	**Dell OptiPlex 7480** 10th Gen Intel Core i5-10500	
	VBS enabled (default)	VBS enabled (default)	VBS disabled	VBS enabled (default)	VBS enabled (default)	VBS disabled
Cinebench R23 benchmark scores						
Single-core overall rating	1,673	1,019	1,033	1,911	1,199	1,195
Multi-core overall rating	7,537	3,357	3,497	10,315	7,758	7,692
3DMark benchmark scores						
Time Spy overall rating	1,454	448	452	1,388	465	461
Procyon benchmark scores						
Photo Editing Benchmark overall rating	5,978	3,506	3,758	5,020	3,876	3,972
Video Editing Benchmark overall rating	1,733	1,002	1,009	2,056	974	987
Office Productivity Benchmark overall rating	6,843	4,670	4,676	6,866	5,366	5,428
MobileMark 2018 benchmark results						
Battery life (minutes)	563	356	360	N/A	N/A	N/A
Overall score	892	934	972	N/A	N/A	N/A
Productivity	915	852	873	N/A	N/A	N/A
Creativity	1,158	1,074	1,124	N/A	N/A	N/A
Web Browsing	674	891	926	N/A	N/A	N/A

System configuration information

Laptops

Table 3: Detailed information on the laptops we tested.

System configuration information	Dell Latitude 7410	Dell Latitude 7430
Processor		
Vendor	Intel	Intel
Model number	Core i7-10810U	Core i7-1265U
Core frequency (GHz)	1.10 – 4.90	3.60 – 4.80
Number of cores	6	10
Cache (MB)	12	12
Memory		
Amount (GB)	16 (built-in onboard)	16 (built-in onboard)
Type	DDR4	DDR4
Speed (MHz)	2,667	3,200
Graphics		
Vendor	Intel	Intel
Model number	UHD Graphics	Iris Xe® Graphics
Storage		
Vendor	Kioxia	Samsung
Model number	KXG60ZN512G	PM9A1
Amount (GB)	512	1,024
Type	PCIe NVMe	PCIe NVMe
Connectivity/expansion		
Wireless internet	Intel Wi-Fi 6 AX201	Intel Wi-Fi 6E AX211
Bluetooth	5.2	5.2
USB	2 x 3.2, 2 x Type-C	1 x 3.2 Gen 1
Thunderbolt	0	2 x Thunderbolt 4
Video	1 x HDMI	1 x HDMI
Battery		
Type	Lithium-polymer	Lithium-polymer
Rated capacity (Whr)	38	58

System configuration information	Dell Latitude 7410	Dell Latitude 7430
Display		
Size (in.)	14	14
Type	FHD AR/AS, Touch	FHD AG, Touch
Resolution	1,920 x 1,080	1,920 x 1,080
Touchscreen	Yes	Yes
Operating system (Phase 1)		
Vendor	Windows	Windows
Name	10 Pro	10 Pro
Build number or version	19045	19045
Operating system (Phase 2)		
Vendor	Windows	Windows
Name	10 Pro	11 Pro
Build number or version	22621	22621
BIOS		
BIOS name and version	Dell Inc. 1.19.0	Dell Inc. 1.11.0
Dimensions		
Height (in)	0.66	0.65
Width (in)	12.65	12.65
Depth (in)	8.33	8.22
Weight (lbs.)	3.07	3.18

All-in-one desktops

Table 4: Detailed information on the all-in-one (AIO) desktops we tested.

System configuration information	Dell OptiPlex 7480	Dell OptiPlex 7400
Processor		
Vendor	Intel	Intel
Model number	Core i5-10500	Core i7-12700
Core frequency (GHz)	3.10 – 4.50	3.50 – 4.70
Number of cores	6	14
Cache (MB)	12	25
Memory		
Amount (GB)	8	8
Type	DDR4	DDR4
Speed (MHz)	2,666	3,200
Integrated graphics		
Vendor	Intel	Intel
Model number	UHD Graphics 630	UHD Graphics
Discrete graphics		
Number of cards	N/A	1
Vendor	N/A	AMD
Model number	N/A	Radeon™ RX 6500M
VRAM	N/A	4GB GDDR6
Storage 1		
Vendor	KIOXIA	KIOXIA
Model number	KBG40ZNS256G	KBG40ZNS256G
Amount (GB)	256	256
Type	PCIe NVMe	PCIe NVMe
Storage 1		
Vendor	N/A	KIOXIA
Model number	N/A	KBG40ZNS256G
Amount (GB)	N/A	256
Type	N/A	PCIe NVMe

System configuration information	Dell OptiPlex 7480	Dell OptiPlex 7400
Connectivity/expansion		
Wired internet	1 x Gigabit Ethernet	1 x Gigabit Ethernet
Wireless internet	802.11ac (802.11a/b/g/n compatible)	Intel Wi-Fi 6E AX211
Bluetooth	5.0	5.2
USB	5 x 3.2 Gen 1, 1 x 3.2 Type-C	5 x 3.2 Gen 1, 1 x 3.2 Type-C
Video	1 x HDMI-In 1.4a 1 x HDMI 2.0 1 x Display Port 1.4	1 x HDMI-In 1.4a 1 x HDMI 2.0 1 x Display Port 1.4
Display		
Size (in.)	23.8	23.8
Type	FHD, Touch	FHD WVA, Touch
Resolution	1,920 x 1,080	1,920 x 1,080
Touchscreen	Yes	Yes
Operating system (Phase 1)		
Vendor	Windows	Windows
Name	10 Pro	10 Pro
Build number or version	19045	19045
Operating system (Phase 2)		
Vendor	Windows	Windows
Name	10 Pro	11 Pro
Build number or version	22621	22621
BIOS		
BIOS name and version	Dell Inc. 98.0.23	Dell Inc. 0.6.15
Dimensions		
Height (in)	13.54	13.54
Width (in)	21.26	21.26
Depth (in)	2.07	2.07
Weight (lbs.)	13.11	13.89

How we tested

For phase 1 testing, we compared Dell Latitude 7430 and OptiPlex 7400 PCs running Windows 10 Pro with Microsoft security features enabled vs. Dell Latitude 7410 and OptiPlex 7480 PCs running Windows 10 Pro with Microsoft security features enabled. We ran all eight benchmarks and tested surface temperatures while the PCs were under load.

For phase 2 testing, we compared Dell Latitude 7430 and OptiPlex 7400 PCs running Windows 11 Pro with Microsoft security features enabled vs. Dell Latitude 7410 and OptiPlex 7480 PCs running Windows 10 Pro with VBS enabled and disabled. We ran a subset of Phase 1 benchmarks and tested battery life on both Dell Latitude laptops.

Setting up the systems

We captured two system images for each PC under test; one image for Windows 10 and one image for Windows 11. Before capturing the images, we installed all available drivers, firmware, BIOS updates, and Windows Updates. We used the captured images to restore between versions of Windows for our comparisons.

Creating and updating the OEM Windows image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. In the bottom right-hand corner, click the battery icon, and adjust the Windows Power mode (plugged in) to Best Performance.
4. Unplug the system, click the battery icon, and adjust the Windows Power mode (on battery) to Balanced. Plug the system back in.
5. Set DPI scaling to 100%, and set Screen and Sleep options to Never:
    a. Right-click the desktop, and select Display settings.
    b. Under the Scale and layout section, for the Change the size of text, apps, and other items, select 100%.
    c. From the left column, select Power & Sleep.
    d. For all power options listed under Screen and Sleep, select Never.
6. Disable User Account Control notifications:
    a. Select Windows Start, type `UAC`, and press Enter.
    b. Move the slider control to Never notify, and click OK.
7. Disable Virtualization Based Security:
    a. Select Windows Start, type `Group Policy`, and press Enter.
    b. Select Computer Configuration→Administrative Templates→System→Device Guard
    c. Double-click Turn on Virtualization Based Security.
    d. Select Disabled, click Apply, and click OK.
8. Run Windows Update, and install all updates available.
9. Launch the Windows Store app, and install all Store app updates.
10. Launch the Dell SupportAssist application, and install all available updates.
11. Verify the date and time are correct, and synchronize the system clock with the time server.
12. Disable Automatic Windows Update:
    a. Right-click the Windows Start button.
    b. Select Computer Management.
    c. Select Services and Applications.
    d. Select Services.
    e. Scroll down, and double-click Windows Update.
    f. Click Stop.
    g. From the Startup drop-down menu, select Disabled.

Capturing an image

1. Connect an external HDD to the system.
2. Open Control Panel, and click the arrow next to it to select All Control Panel Items.
3. Click Backup and Restore.
4. Click Create a system image.
5. Verify that the external HDD is selected as the save drive, and click Next.
6. Verify that all drives are selected to back up, and click Next.
7. Click Start backup.
8. At Do you want to create a system repair disc, select No, and close the dialogs.

Restoring an image

1. Connect an external HDD to the system.
2. Press and hold the Shift key while restarting the system.
3. Select Troubleshoot.
4. Select Advanced options.
5. Select See more recovery options.
6. Select System image recovery.
7. At the Restore system files and settings screen, select Next.
8. Verify that the external HDD is selected, and click Next.
9. Once the recovery has completed, click Finish.

Measuring performance using benchmarks

Cinebench R23 benchmark testing

Setting up and running Cinebench R23

1. Download and install Cinebench R23 from the Microsoft Store.
2. Launch Cinebench R23.
3. Select either CPU (multi-core) or CPU (single-core), and click Start.
4. Record the result.
5. Wait 15 minutes before re-running.
6. Repeat steps 2 through 4 two more times.

3DMark benchmark testing

Setting up 3DMark

1. Download the 3DMark benchmark from https://www.futuremark.com/benchmarks/3dmark/all.
2. Install 3DMark with the default options by double-clicking the 3DMark installer.exe file.
3. Launch 3DMark by double-clicking on the 3DMark desktop icon. Enter the registration code, and click Register.
4. Exit 3DMark.

Running 3DMark Fire Strike or Time Spy

1. Boot the system, and wait 5 minutes before running the test.
2. Double-click the 3DMark desktop icon.
3. At the 3DMark Home screen, click More Tests.
4. Select the desired benchmark to run (i.e., Fire Strike or Time Spy).
5. Move the slider button to turn off the Include Demo feature.
6. Click Run.
7. When the benchmark run completes, record the results.
8. Perform steps 1 through 7 two more times for each benchmark, and report the median of the three runs.

UL Procyon benchmark testing

Setting up Procyon

1. Purchase and download the Procyon benchmark from https://benchmarks.ul.com/procyon.
2. Install Procyon.
3. Launch Procyon.
4. Select Settings, and input the Office Productivity and Video & Photo Editing license keys.
5. Close Procyon.
6. Install Adobe Photoshop, LightRoom Classic, and Premiere.
7. Open each Adobe app, and close any welcome or tutorial messages that appear.
8. Close the apps.
9. Install Microsoft Outlook, PowerPoint, Excel, and Word.
10. Open each Microsoft app, and close any welcome or tutorial messages that appear.
11. Close the apps.

Running Procyon Photo Editing Benchmark

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Launch Procyon.
7. Select Test Suite.
8. Select the Photo Editing test.
9. Click Run.
10. When the test completes, record the results, and shut down the system.
11. Repeat steps 1 through 10 twice more, and record the median results.

Running Procyon Video Editing Benchmark

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Launch Procyon.
7. Select Test Suite.
8. Select the Video Editing test.
9. Click Run.
10. When the test completes, record the results, and shut down the system.
11. Repeat steps 1 through 10 twice more, and record the median results.

Running Procyon Office Productivity Benchmark

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Launch Procyon.
7. Select Test Suite.
8. Select the Office Productivity test.
9. Click Run.
10. When the test completes, record the results, and shut down the system.
11. Repeat steps 1 through 10 twice more, and record the median results.

WebXPRT 4 benchmark testing

Running WebXPRT 4

1. Open the Google Chrome web browser, and go to https://www.principledtechnologies.com/benchmarkxprt/webxprt/.
2. Click Run WebXPRT 4.
3. At the Ready to test your browser screen, click Continue.
4. Click Start.
5. When the test completes, record the results.
6. To rerun WebXPRT, click Run Again, and click Start.
7. Record the results.
8. Repeat steps 2 through 7 two more times.

Measuring temperatures using Cinebench R23

Setting up the environmental heatmap test

1. Download and install Cinebench R23 from the Microsoft Store.
2. Launch Cinebench R23.
3. Select File, and check Advanced Benchmark.
4. Select File and Preferences.
5. In the Preferences pop-up, select Custom Minimum Test Duration, and enter 60 minutes.
6. Click OK.
7. Close Cinebench R23.

Running the environmental heatmap test

1. Launch Cinebench R23.
2. From the Minimum Test Duration drop-down menu, select Custom, and enter 30 minutes.
3. Select CPU (multi-core), and click Start.
4. After 30 minutes, photograph the top and bottom of the laptop or screen and back chassis of the AIO with a FLIR E6-XT thermal camera. View the images and report the highest temperature for the top and bottom (back and front) areas.
5. Repeat steps 3 and 4 two more times, and record the results.

Measuring battery life using MobileMark 2018

We used a Gossen Mavolux5032C luxmeter for this test.

Setting up the PCs

Adjusting display brightness and power settings

The brightness of a PC's display affects its battery life. Therefore, BAPCo requires that, before you test with MobileMark 2018, you ensure the brightness of the PC's monitor is greater than or equal to 200 nits in the center of a completely white screen while the PC is unplugged and running on battery power. The measurement follows the standards from the Video Electronics Standards Association (www.vesa.org).

We complied with this standard for all our tests by setting each PC's brightness as close to 200 nits as we could without going below that level. We used the following procedure before we started each test.

1. To create a completely blank, white screen, open Microsoft Paint by clicking Start→All Programs→Accessories→Paint.
2. To open the Resize and Skew dialog, press Ctrl+W.
3. Under Horizontal and Vertical, enter 200, and click OK.
4. Click the View tab.
5. To view a white screen, click Full screen.
6. To allow the screen to warm, wait 45 minutes.
7. Unplug the PC from the power supply, and measure the display's brightness using a luminance meter in the center of the screen.
8. If the reading is below or significantly greater than 200 nits, adjust the screen brightness to as close to 200 nits as you can without going under, and retest:
    a. Click the Windows Start button.
    b. In the Windows Start search box, type `display settings`
    c. Adjust the slider to change the Display brightness to the correct percentage that produces no less than 200 nits.
9. Allow the PC to run on battery power for 10 minutes, re-measure the display, and adjust the brightness up or down as necessary.
10. Verify that the PC saved the brightness setting by plugging in the system, unplugging it, and taking another reading.

Using the MobileMark 2018 built-in configuration tool

We used the official BAPCo "Run Benchmark" default as outlined in the BAPCo MobileMark2018 User Guide (https://bapco.com/wp-content/uploads/2019/03/BAPCo_MobileMark2018_user_guide_v1.3.pdf), which runs the benchmark using the Required and Recommended options.

Setting up MobileMark 2018

1. Verify that the wireless adapter is enabled and connected to a wireless router that is not connected to the internet.
2. Verify that the screen brightness is set to no less than 200 nits.
3. Install MobileMark 2018 with the default options.

Running MobileMark 2018

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Launch MobileMark 2018.
7. Click the Settings Gear icon.
8. Verify that Conditioning Run is enabled.
9. Enter a name for the benchmark run.
10. To return to the main menu, click Back.
11. Click Run Benchmark.
12. When prompted, unplug the AC power adapter. The test will begin immediately.
13. When the PC has fully depleted its battery and is no longer operational when running on battery power, the benchmark is complete.
14. Record the results.
15. Recharge the PC battery.
16. Repeat steps 1 through 15 two more times.

Read the report at https://facts.pt/Wg2xkg6 ▶

This project was commissioned by Dell Technologies.

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