

# PC Build and Manual

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## Table of Contents

<b>1) Safety</b>	<b>3</b>
<b>2) Introduction</b>	<b>4</b>
<b>3) Tools and Components</b>	<b>5-6</b>
<b>4) Workplace Preparation</b>	<b>6</b>
<b>5) Installing CPU</b>	<b>6</b>
<b>6) Installing Memory</b>	<b>9</b>
<b>7) Installing Motherboard</b>	<b>12</b>
<b>8) Installing Power Supply</b>	<b>15</b>
<b>9) Installing the Hard Drive</b>	<b>17</b>
<b>10) Installing the Optical Drive</b>	<b>20</b>
<b>11) Installing the Video Card</b>	<b>23</b>
<b>12) Installing Mouse, Keyboard and Monitor</b>	<b>24</b>
<b>13) Enter BIOS and Set Date/Time</b>	<b>26</b>
<b>14) Install Windows 10</b>	<b>29</b>
<b>15) Set Up Critical Features</b>	<b>41</b>

## Safety

There are some safety concerns to take note of when working with sensitive components. It is essential to follow proper safety procedures to prevent injury to yourself or damage to the system.

- Electrical shocks and burns can happen. Make sure to turn off and unplug the system from any power sources before working on internal components. **DO NOT** open the power supply.
- Electrostatic Discharge (ESD) is another danger, although mostly to the internal components, it can cause an accidental electrical shock. Use an ESD wrist band to reduce this risk; it also recommended to use an anti-static mat underneath the system components and under your feet while working on the system. Keep the components in their anti-static bag until you are ready to install them.
- Make sure the components cool down before handling them. Like the heat sink and CPU, some parts can generate lots of heats and burn you.
- Be careful of sharp edges; the system case and other components can be sharp enough to cut skin if you are not careful.

## Introduction

This manual will walk you through the process of setting up and putting together a computer system from scratch, either for a customer or for yourself. This guide aims to create a simple, functioning, reliable computer system, following a general step-by-step set of instructions. As such, it will not go into the more complicated system setups.

## Tools and Components

### Tools

- 1 Philips Head Screwdriver



Figure 1: Screwdriver

Adapted from [1]

- 2 Anti-static Mats

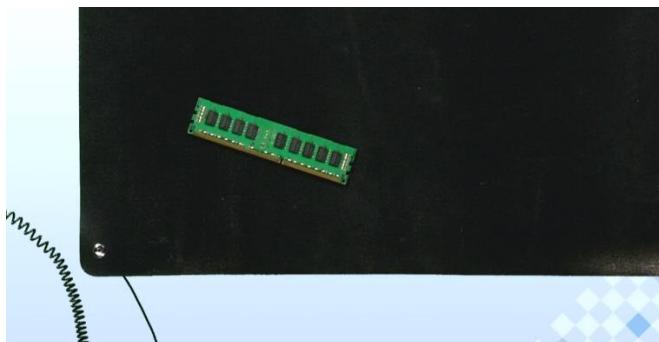


Figure 2: Anti-static mat, with RAM on top

Adapted from [2]

- 1 ESD Wrist Strap

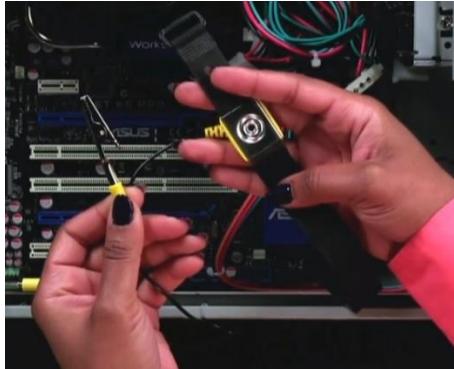


Figure 3: ESD Wrist Strap

Adapted from [2]

- Thermal Paste



Figure 4: Thermal Paste

Adapted from [1]

## Components

- 1 System Case (ATX)
- Motherboard (Asus Prime z370 series)
- Power Supply (PSU) 20+4 Pin, PCIe
- Central Processing Unit (CPU), Processor (i5 8600K, 3.60 GHz, 9 MB cache, LGA1151, 95W)
- Heat Sink and Fan (Socket 1151)
- Two Random Access Memory (RAM) Modules (DDR4 8 GB, DDR4 2400)
- Hard Drive with Mounting Bracket
- CD/DVD/Blu-Ray Drive
- 2 SATA Cables
- PCIe Video Card and HDMI Cable
- Monitor, Mouse, and Keyboard

**Note:** These components are for the specific system build in this manual. The customer's system, or your own, may not have these components but will follow the same general steps. Remember to check the motherboard's specifications if you are unsure of something, and make sure that the power supply can supply enough power to the components you choose.

## Workplace Preparation

1. **Set up your work area.** Ideally, you want to work on a desk, table, or another flat surface in a cold, non-carpeted room. Make sure it is clean and not cluttered to help prevent losing tools or components. You also want to place an anti-static mat where you will be standing, and an anti-static mat to put the components you are using. Anti-static mats will help reduce any static electricity from building up and damaging your computer. After placing the anti-static mat, place the tools in easy reach, and set the system case on the anti-static mat. Conduct all work on the anti-static mat. [2]

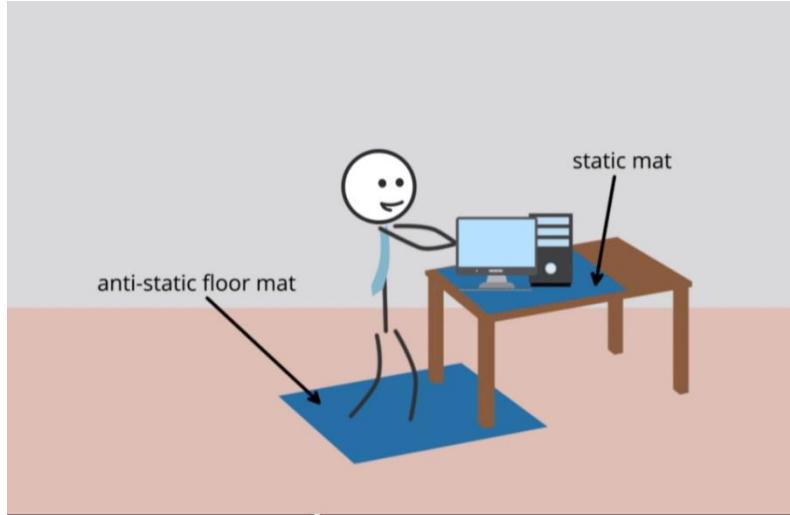


Figure 5: Anti-static Mat Setup

Adapted from [2]

## Installing the CPU

**2. Install the CPU on the motherboard.** To make installation more manageable and less likely to break something, we will install the CPU, the Heat Sink and Fan, and the RAM before placing the motherboard in the system case. Connect your ESD wristband to the anti-static mat before touching the motherboard and CPU. [3]

- Locate the CPU socket, highlighted in red on the image below.

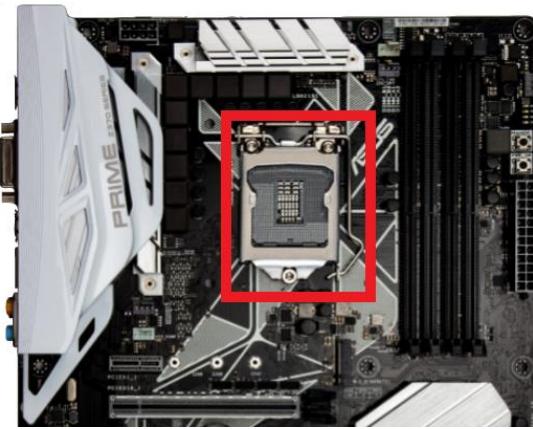


Figure 6: CPU Socket

Adapted from [4]

- Unlatch the spring arm by pulling it out gently and raise the CPU cover. The spring arm is located below. [1]

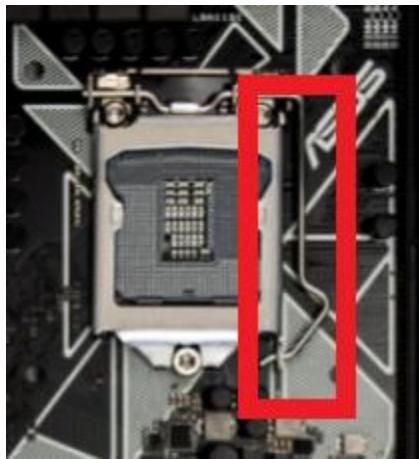


Figure 7: CPU spring arm/lever

Adapted from [4]

- Gently place the CPU into the socket. The CPU will have two notches that align with the socket, shown below. Make sure to align it before placing it in. **DO NOT** apply a downward force that can damage the CPU connections. [1]

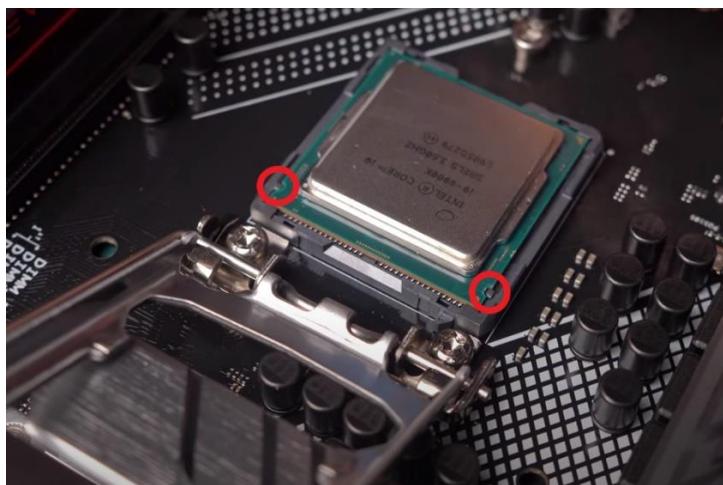


Figure 8: CPU properly aligned and inserted

Adapted from [1]

- Close the CPU cover and secure the spring arm. Once finished, it should look like the image below. [1]



Figure 9: Installed CPU

Adapted from [1]

**3. Install the heat sink and fan.** The heat sink and fan are necessary for cooling down the CPU. Without them, the CPU will quickly overheat and cause the system to shut down. [5]

- Place a small amount of thermal paste on the center of the CPU. No bigger than a couple of grains of rice. Use the image below for reference. [1]



Figure 10: Thermal paste on top of CPU

Adapted from [1]

- Place the heat sink and fan assembly on top of the CPU and secure using the included clips. To do this, line up the fan with the four holes around the CPU. [6]



Figure 11: Fan resting on top of the CPU

Adapted from [6]

- Push down on each pin in the order shown below.



Figure 12: Fan push-pin order

Adapted from [6]

- To ensure it is secured, turn over the motherboard, and the pins should look like the image below. [6]



Figure 13: Properly inserted pins

Adapted from [6]

- Connect the fan power cable to the motherboard. [6]

- The connection for the fan power cable is shown in Figure 17, located on page 14.

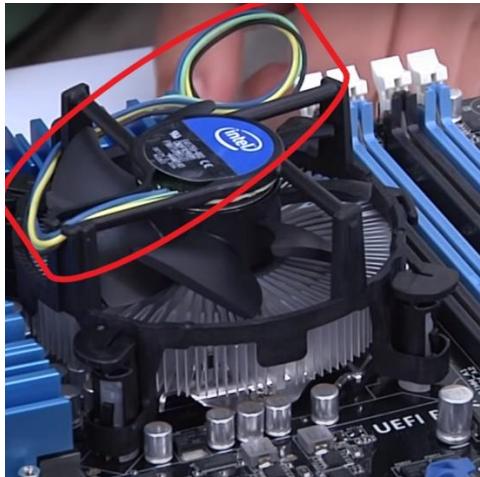


Figure 14: Fan Power Cable

Adapted from [6]

## Installing RAM

**4. Install the RAM.** If you want to increase speed, you can insert more than one RAM module. If you install more than one RAM module, you must use a dual, triple, or quad-channel. If you use dual-channel, the RAM modules must be identical. If you want to use a triple or quad-channel, the third can module can be different from the first two. If you are going to use a quad-channel, the fourth module must be identical to the third. **Always check** the motherboard documentation for proper setup. [7]

To increase speed, we will be installing two RAM modules in Dual-Channel Mode. Multiple-channel modes will increase the speed by about 5% - 15%. The motherboard documentation will tell you which slots are which and which slots to use for Dual-Channel Mode. For this motherboard, install the RAM modules in slots B2 and A2 for Dual-Channel Mode highlighted below. [7]

- Before you install the RAM modules, make sure that the notches line up correctly. If the notches do not line up, the RAM will not fit. [7]
- Pull back the RAM slot tab shown below. These tabs will lock the RAM module in place.

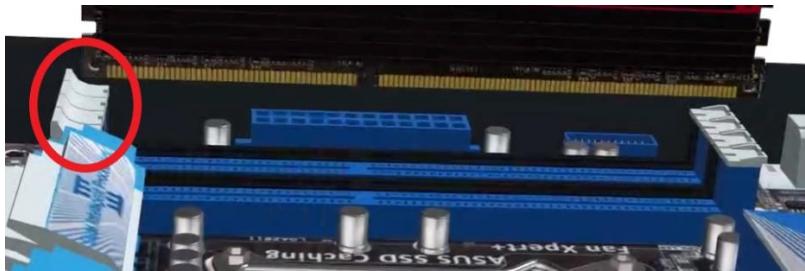


Figure 15: RAM locking tabs

Adapted from [7]

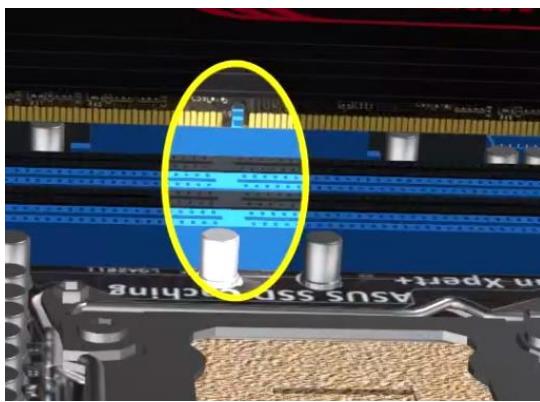


Figure 16: RAM notches need to line up with the slot

Adapted from [7]

- Install the RAM modules in the slot. Do not try to put them in at an angle or one side at a time. They need to be put in a straight line, parallel to the slot. Make sure to push down firmly until you hear a click from each side of the RAM module. The click will let you know it is secure. [7]

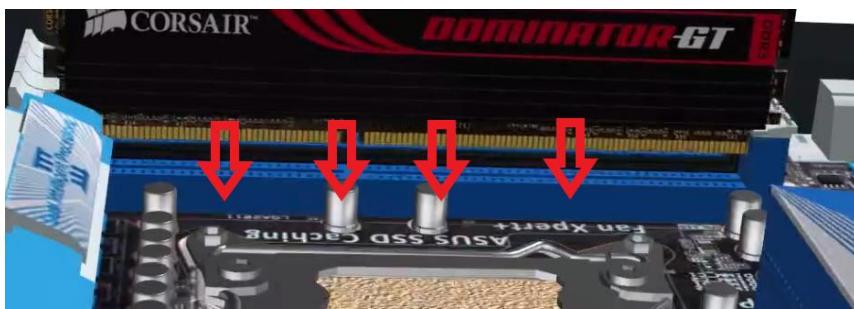


Figure 17: Insert RAM parallel to the slot

Adapted from [7]

## Installing the Motherboard

**5. Install the motherboard.** Before you place the motherboard in the case, you first need to install the I/O Shield. [3]

- Locate the opening for the I/O Shield in the back of the case. To install it, simply press the shield to the case, and it will pop into place. [3]



Figure 18: I/O Shield

Adapted from [3]

- Move the clip for your wristband from the anti-static mat to a metal portion of the case.
- Screw in the standoffs using your hands, do not over tighten them. The standoffs will separate the motherboard from the case, ensuring that the motherboard's bottom does not get damaged, and it assists in cooling. Circled in yellow, the areas for the standoffs are pictured in Figure 19. Not all holes will be used. [3]

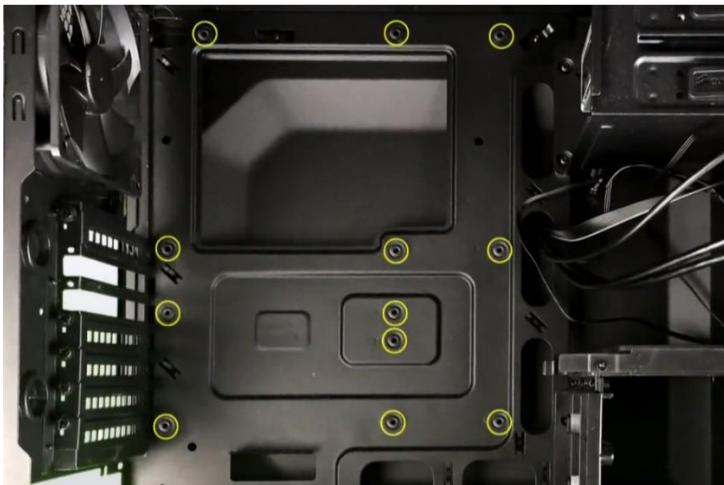


Figure 19: Locations of standoff holes in an ATX Case

Adapted from [3]



Figure 20: An installed standoff

Adapted from [3]

- Slide the I/O ports of the motherboard into the I/O shield, push the ports through the I/O Shield, and line up the motherboard's holes with the standoffs. [3]



Figure 21: I/O Ports and I/O Shield

Adapted from [3]

- Secure the motherboard to the case by using motherboard screws and tightening them into the standoffs. These are smaller screws that should come with the motherboard.



Figure 22: Motherboard screws

Adapted from [3]

- Plug in the system panel, front and rear fans, and the USB and Audio connections from the case to the motherboard. Their locations are shown in the figures below. [3]

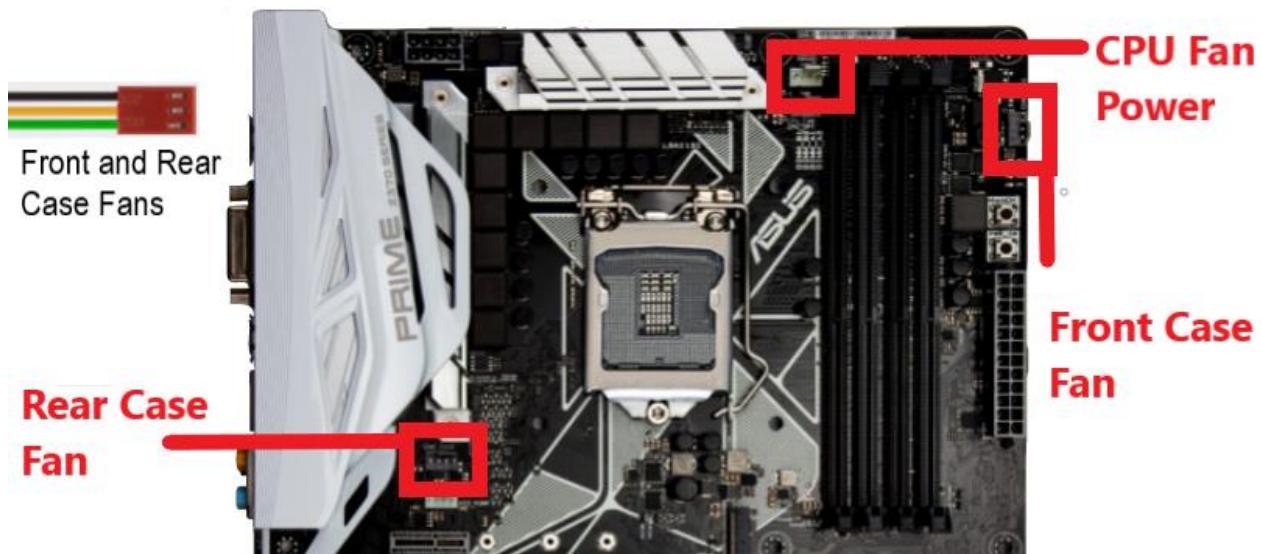


Figure 23: Front and Rear Case fans and CPU Fan power connectors.

Adapted from [4]



Figure 24: Audio, USB, and System Panel connections

Adapted from [4]

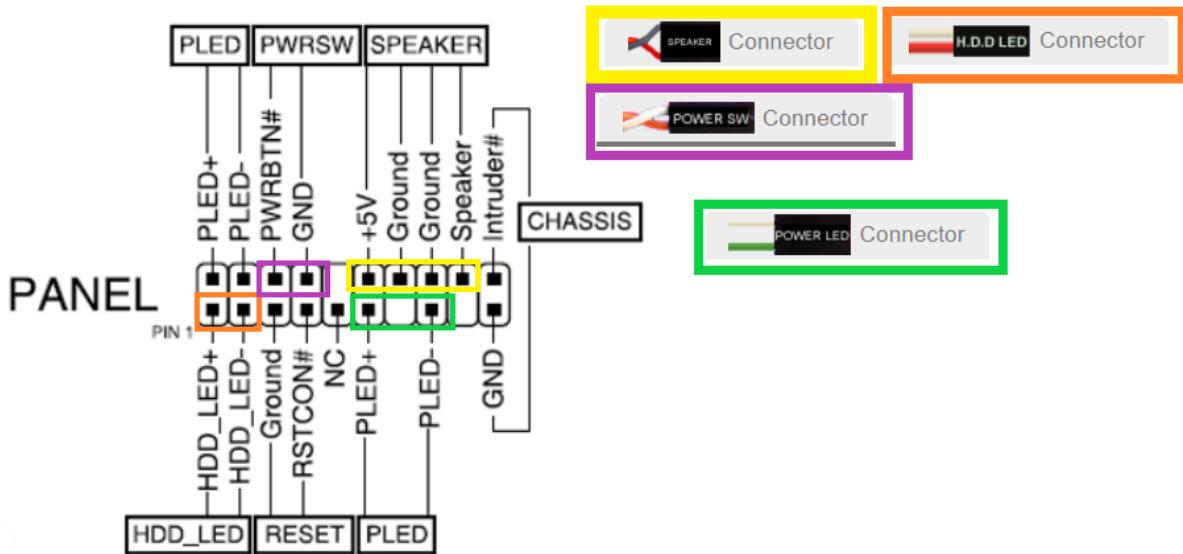


Figure 25: Color-coded System Panel connections

Adapted from [4]

## Installing the Power Supply

**6. Install the power supply.** When choosing your power supply unit, make sure to choose one that will provide enough power and has the right connections for the rest of the hardware. In this example, we need a power supply that supports a PCIe connection for the video card will be using in Part 2. [8]

- Slide the power supply into the bottom left portion of the case.  
*Note: The power supply may go into a different area with another case.*



Figure 26: Power Supply inside case

Adapted from [9]

- Secure the power supply to the case using the four mounting screws. [8]

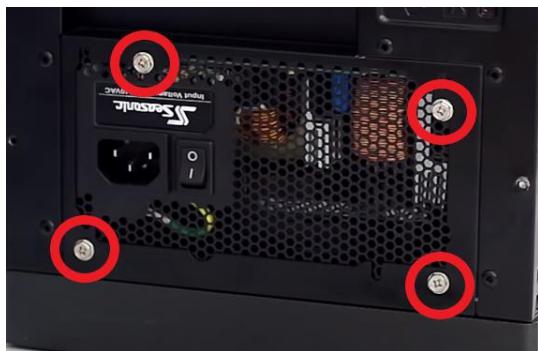


Figure 27: PSU secured by screws

Adapted from [9]

## 7. Connect the power supply to the components.

- Connect the 20+4-pin connection to the motherboard power slot. [3]
- Connect the 8-pin connection to the CPU power slot. [3]

*Note: These connections are keyed, which means they will only go in one way.*

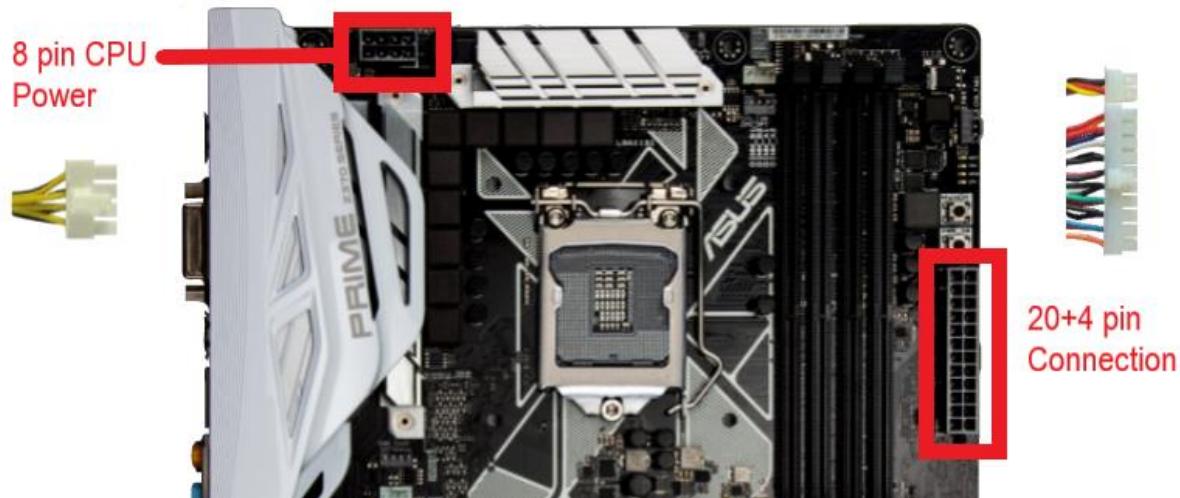


Figure 28: Motherboard and CPU Power connections

Adapted from [4]

## Installing the Hard Drive

### 8. Install the Hard Drive

- Place the hard drive in the mounting bracket.
- Insert the knobs on the bracket into the holes on the hard drive, as shown in the images below.



Figure 29: Hard drive and Mounting Bracket

Adapted from [10]

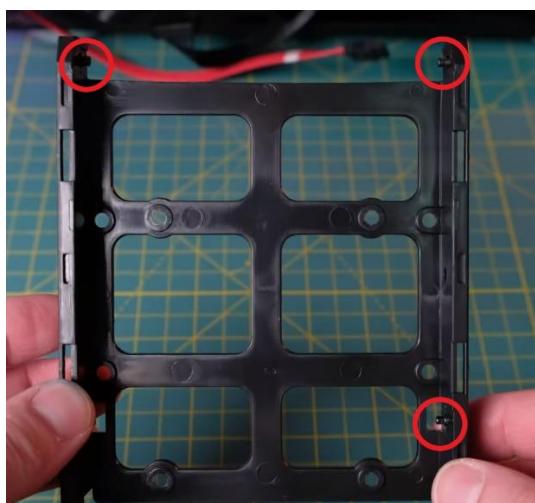


Figure 30: Bracket Knobs

Adapted from [10]



Figure 31: Hard Drive holes

Adapted from [11]



Figure 32: Hard Drive Inside Mounting Bracket

Adapted from [10]

- Find an empty hard drive slot, as shown in Figure 33.



Figure 33: Empty Hard Drive Slot

Adapted from [11]

- Insert the hard drive while in the mounting bracket until you hear a click. The result should look like Figure 34.



Figure 34: Inserted Hard Drive

Adapted from [11]

- Connect the SATA connection and SATA power cable to the back of the hard drive. The connectors are shown in Figures 35.  
*Note:* The SATA power cable connects to the power supply. It has a flat black connection, and there should be about 5 of them. You can see the connector in Figure 35.

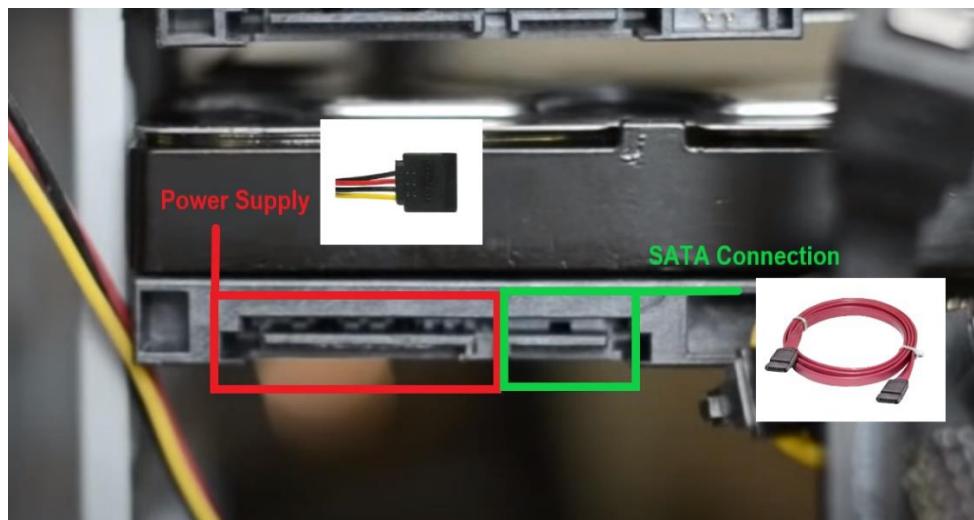


Figure 35: Power Supply and SATA Connections

Adapted from [11]

- Connect the SATA connection to the motherboard, starting from the top left slot.

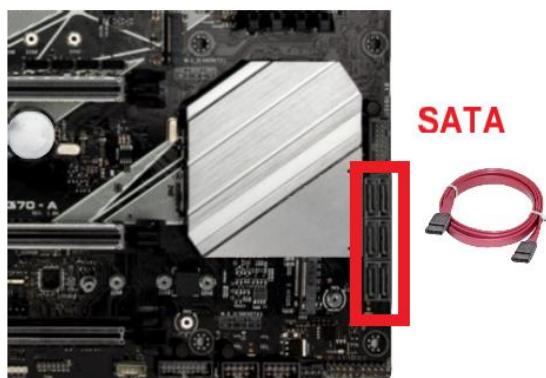


Figure 36: Motherboard SATA Connections

Adapted from [4]

## Installing the Optical Drive

### 9. Remove the front and side panels

- Remove the screws on the computer's back and remove the side panel, shown in Figure 37.



Figure 37: Screws for Side Panel

Adapted from [12]

- Remove the front panel by gently lifting from the bottom of the case. It should look like Figure 38.



Figure 38: Removed Front Panel

Adapted from [12]

## 10. Insert the Optical Drive

- Slide the optical drive into the uppermost slot. Make sure it is right-side up. When done, it should look like figure 39.



Figure 39: Inserted Optical Drive

Adapted from [12]

- Check if the drive aligns with the front case cover. Replace the front cover and make sure the drive is not sticking too far out or too far inside of the case.
- Line up the holes on the side and insert screws into holes. The holes are shown in figure 40. Insert screws on both sides of the optical drives.



Figure 40: Holes for Screws

Adapted from [12]

- Replace the front and side panels by going in the opposite order you removed them.

## 11. Connect the power supply and SATA cable.

- Connect the power cable and the SATA cable to both the optical drive and the motherboard.  
*Note:* These connections are the same as the hard drive shown above in Figures 35 and 36.

## Installing the Video Card

### 12. Insert the video card

- Locate the PCIe expansion slot, shown below in Figure 41.

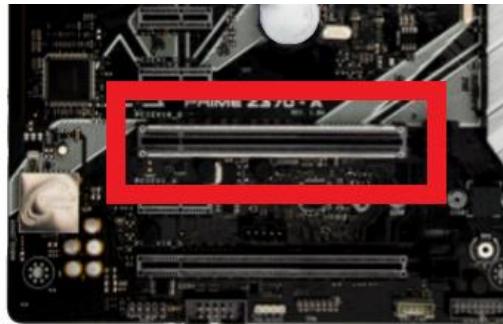


Figure 41: PCIe Expansion Slot

Adapted from [4]

- Remove the slot cover from the case. Do this by locating the screw attached to the cover. Unscrew it and then slide out the cover. The screw, circled in red, is in Figure 42.

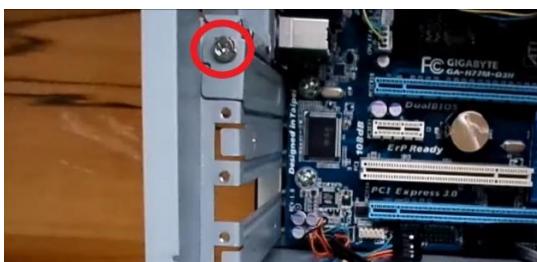


Figure 42: Expansion slot cover

Adapted from [13]

- Insert the video card into the expansion slot the same way you inserted the RAM Modules. It should look like Figure 42.

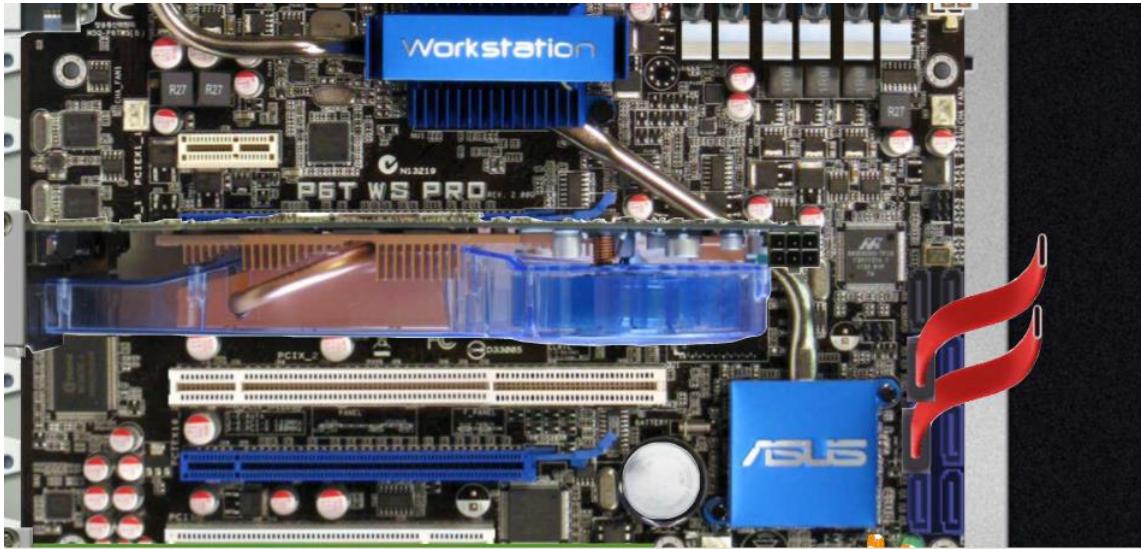


Figure 43: Inserted Video Card

Adapted from [14]

- Plug in the power supply connection shown in Figure 43.



Figure 44: Video Card Power Supply Connection

Adapted from [14]

- Close the system case.

## Installing the Mouse, Keyboard, and Monitor

### 13. Plug in the Mouse and Keyboard

- Find the USB Ports on the back of the PC. Shown in figure 44.

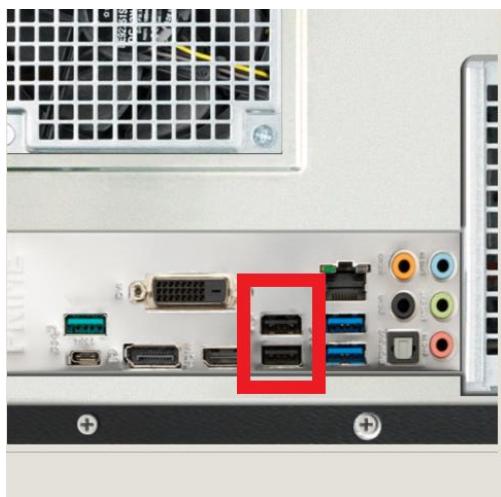


Figure 45: USB Ports

Adapted from [4]

- The mouse and keyboard each have only one wire connected to them. These wires are USB and will be connected to the ports above.

### Connect the Monitor

- Find the HDMI Port on the back of the monitor that connects to the video card you installed earlier. The HDMI port will look like the one shown in Figure 45.



Figure 46: HDMI Port

Adapted from [4]

- Find the monitor's HDMI port and connect it to the HDMI port on the PC's back.
- Connect the power cable to the monitor, and the other end into a wall outlet.

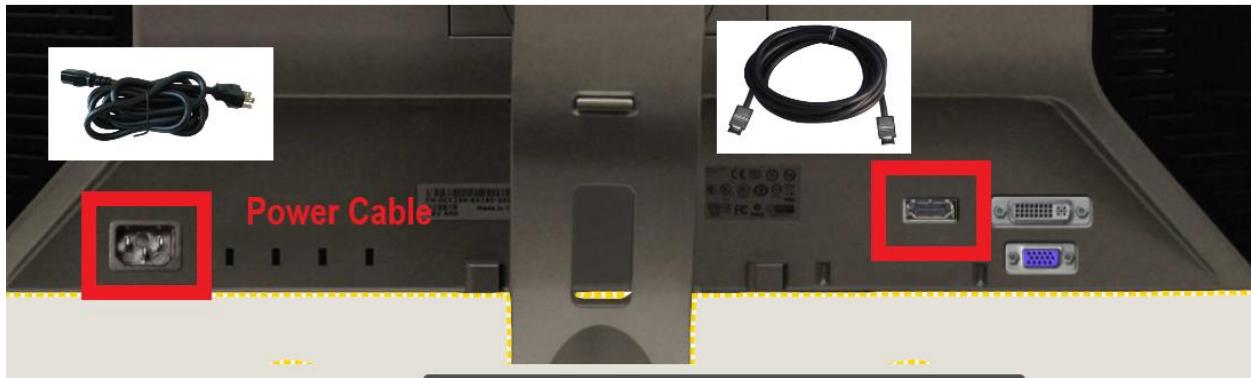


Figure 47: Monitor Connections

Adapted from [4]

#### 14. Connect the power cord to the PC

- Find the power connection on the back of the PC.
- Plug the power cable into the PC and then into the wall outlet.
- Turn on the power switch.



Figure 48: Power Connection and Switch

Adapted from [4]

### Verify Installation and Set Date/Time

#### 15. Turn on the PC

- Press the power button on the front of the PC and the monitor.
- As the computer is turning on, press the "F2" button to enter the BIOS.
  - The BIOS will help verify that everything is installed correctly.

## 16. Verify everything is installed

- If everything is installed correctly, the first screen should show the following information.
- Memory Install = 16384
- DIMM A and C Size = 8192 MB each
- Processor Type = Intel i5-8600k @ 3.6 GHz
- SATA 1 = 808.28 GB HDD

*Note:* It is highly recommended that you go to the motherboard website and download and install the latest BIOS/UEFI Update.

## 17. Set the time

- Go to the Date/Time Settings shown in green in figure 49.
- Set the correct time. For now, this is the last thing you need to do. **DO NOT CHANGE ANY OTHER SETTINGS.** Changing any other setting could cause damage to the system.

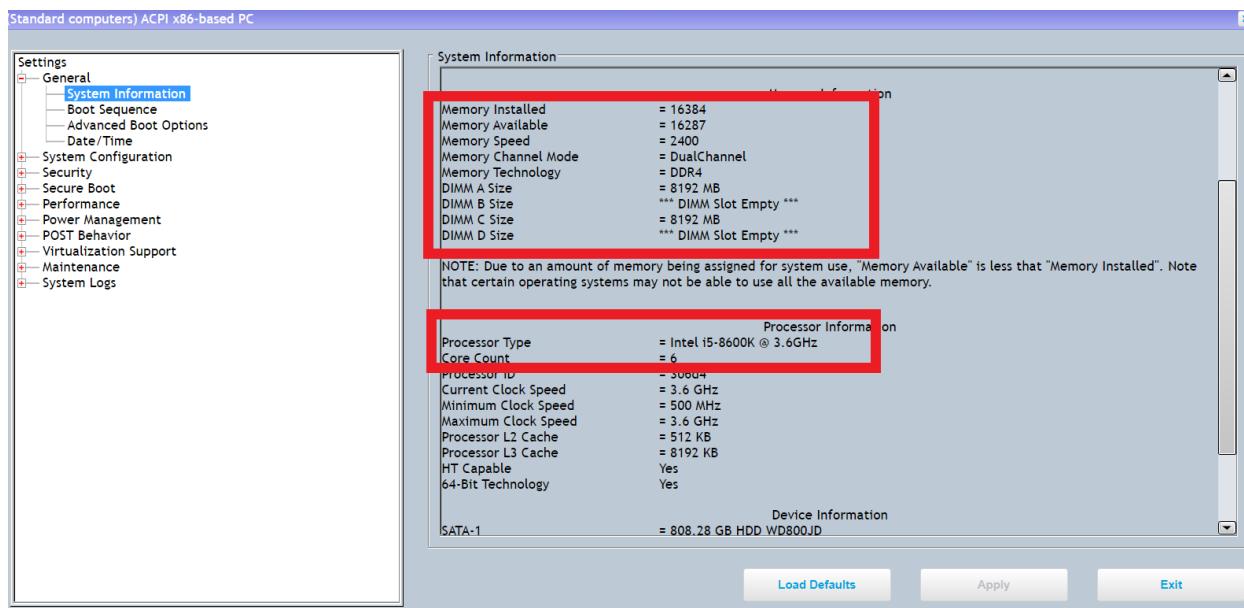


Figure 49: BIOS 1

Adapted from [4]

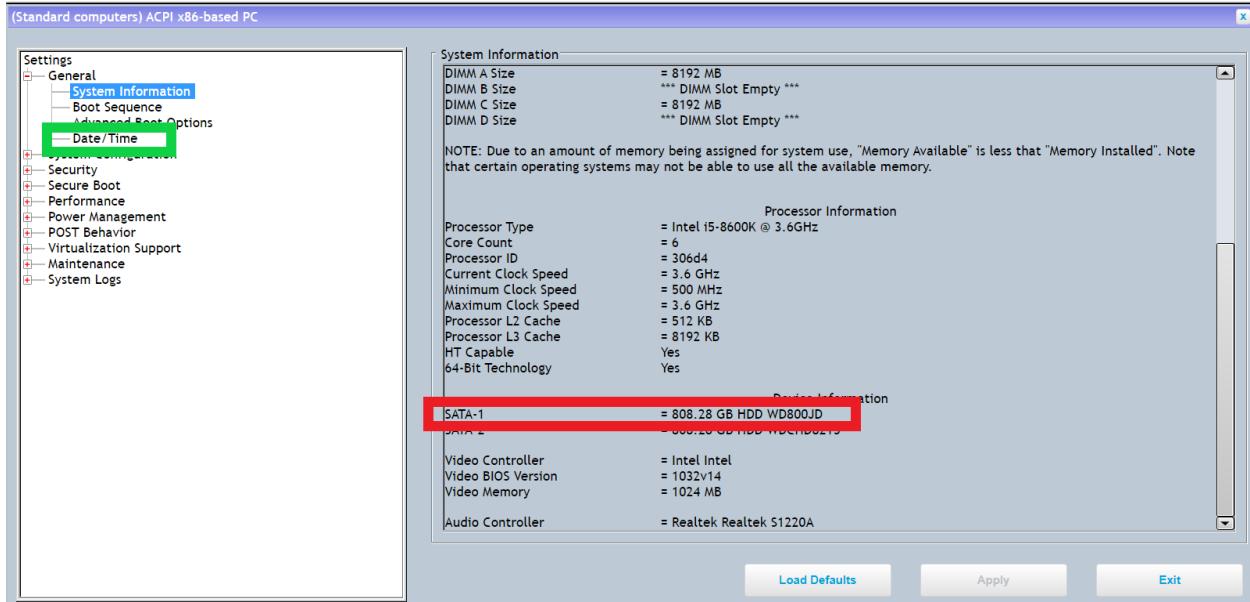


Figure 50: BIOS 2

Adapted from [4]

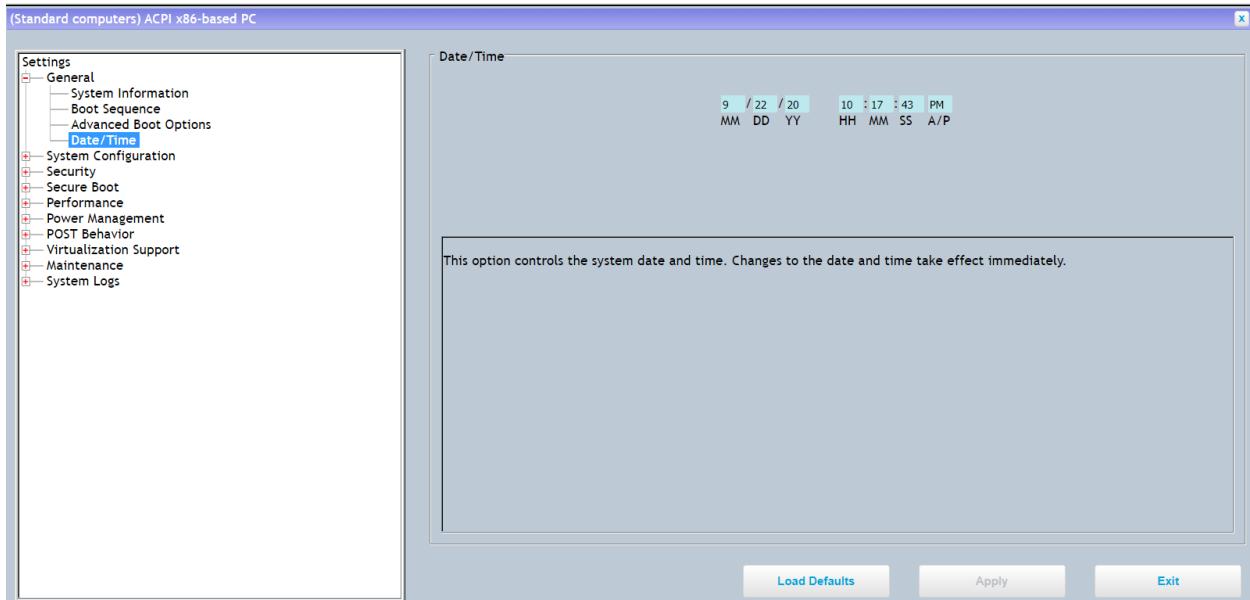


Figure 51: BIOS Date/Time Settings

Adapted from [4]

## Install Windows 10

### 18. Decide which version to install.

Different versions of Windows 10 provide different capabilities. Look over the different versions of Windows 10 Home and Pro, and decide what kind of system you are making. You can find a comparison at the link below.

<https://www.microsoft.com/en-us/windows/compare-windows-10-home-vs-pro>

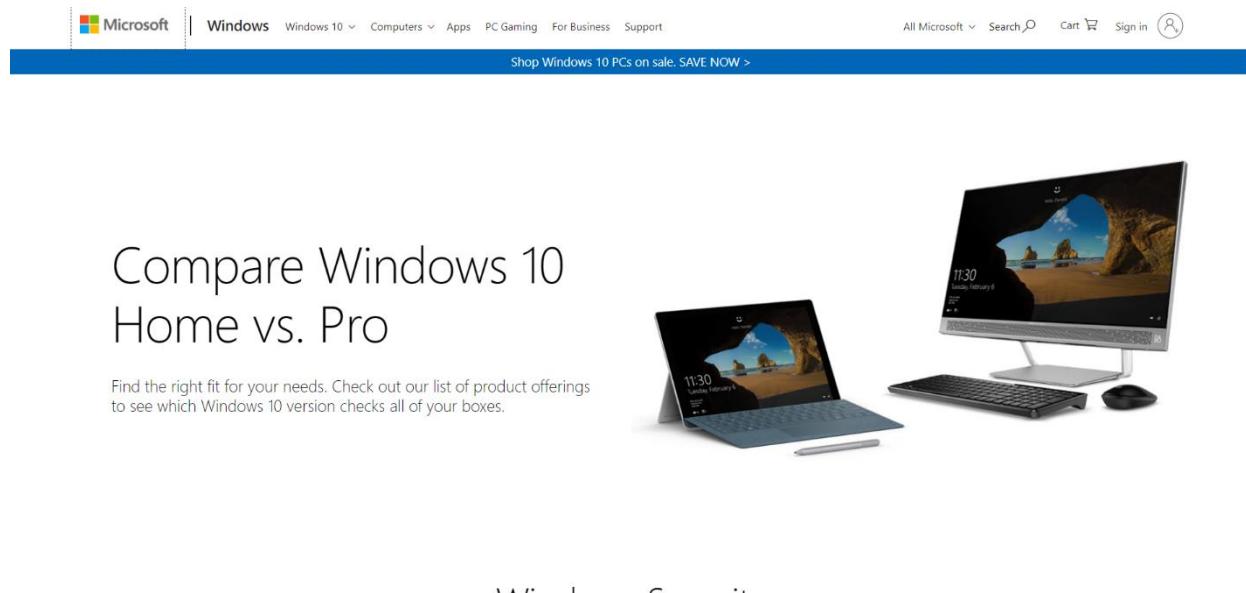


Figure 52: Window Home vs. Pro webpage [15]

Choose a version that best enables the system to run the way you want.

### 19. Choose a 32-bit or 64-bit version of windows [16].

In addition to different versions of Windows 10, you must decide whether you want a 32-bit or 64-bit version.

Advantages of 64-bit include: support for 4GB or more of memory, 64-bit drivers, and can run 32-bit applications.

If the processor you installed is a 64-bit processor or want to use 4GB or more of RAM, you will need to use a 64-bit version of Windows 10.

### 19. Make sure the hardware is compatible with Windows 10

Use the link below to check for compatibility with Windows 10. Many products may not show on the list but should have basic functionality with Windows 10. You can also go to the hardware vendor's website to check.

<https://www.microsoft.com/accessories/en-us/support/compatibility>

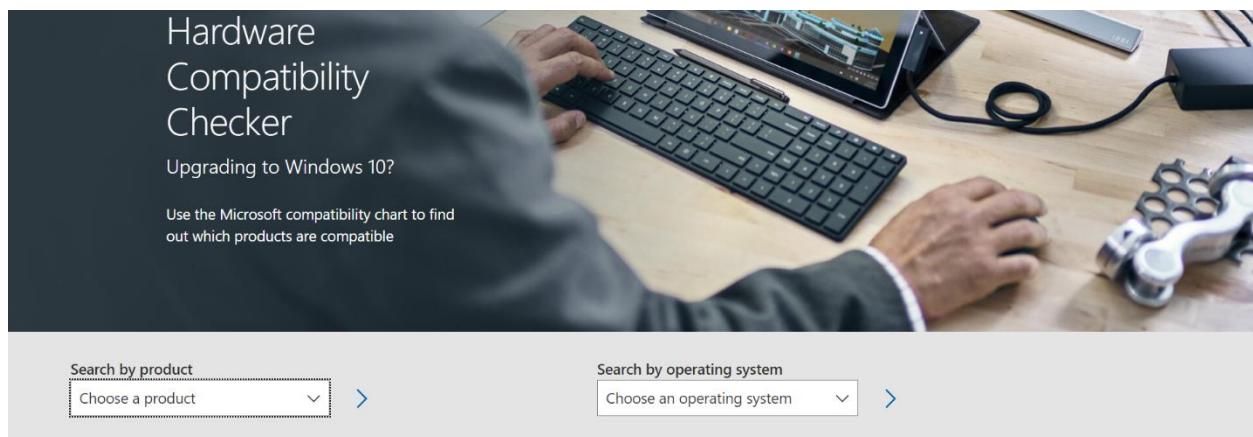


Figure 53: Windows Compatibility Checker [17]

## 20. Check the minimum requirements

The minimum requirements for Windows 10 are [16]:

- 1GHz Processor
- 1GB RAM (2GB for 64-bit system)
- 16GB free disk space (20 for 64-bit system)
- DirectX 9 Graphics device
- DVD-ROM Drive (if installing from a DVD)

Double-check to make sure your system meets the requirements.

**21. Insert the Windows 10 DVD and press any key to boot from CD/DVD.****22. Follow the installation wizard.**

- Select language, time/currency format, and keyboard and input method. Click “Next.”

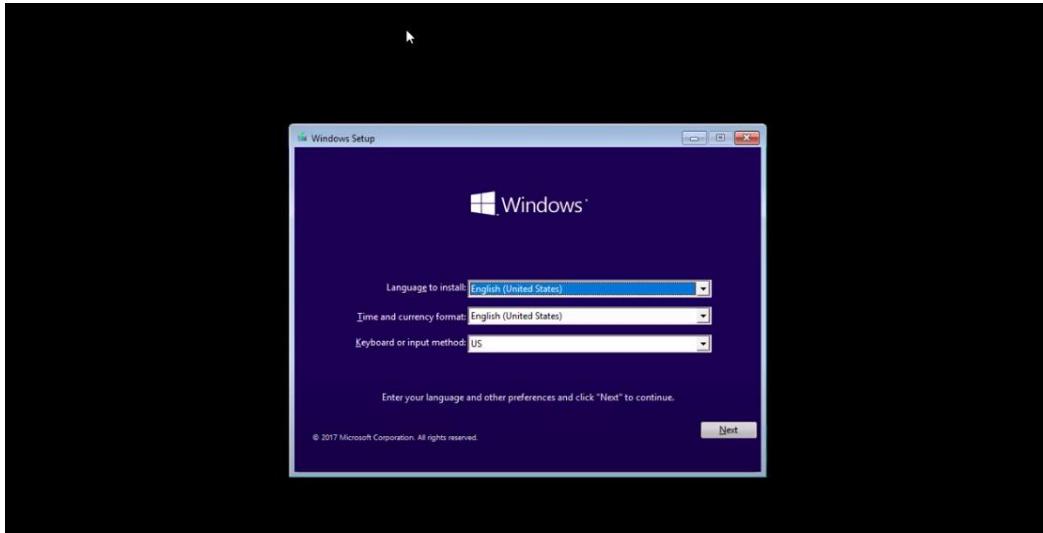


Figure 54: Windows Installation 1

Adapted from [18]

- Click “Install Now”

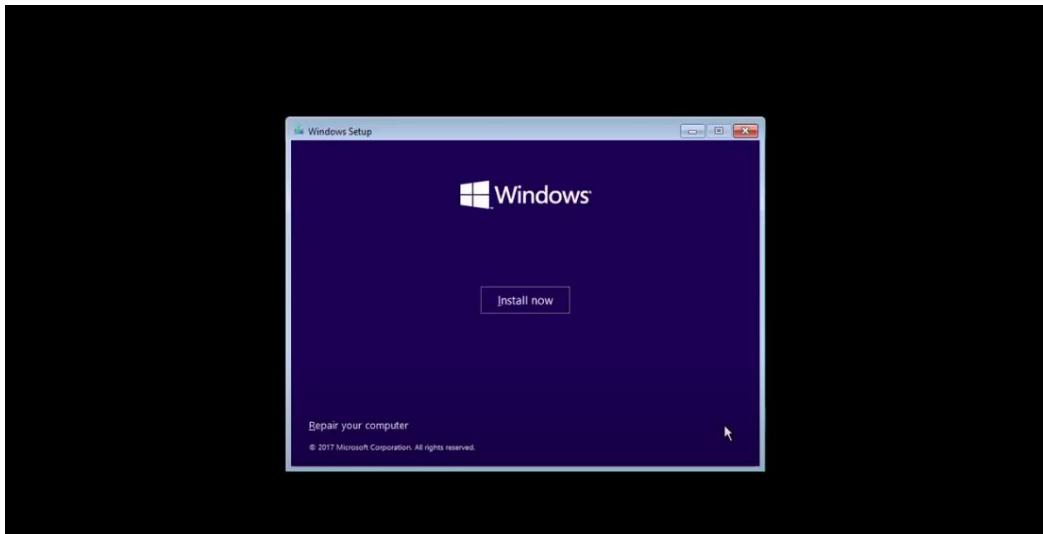


Figure 55: Windows Installation 2

Adapted from [18]

- Enter Product Key. This should be in an email or on the inner label of the product box. Then click “Next.”
  - If you don’t have a product key, click, “I don’t have a product key.”
  - If you don’t have a product key, select the product you want to install on the next page. Click “Next.”

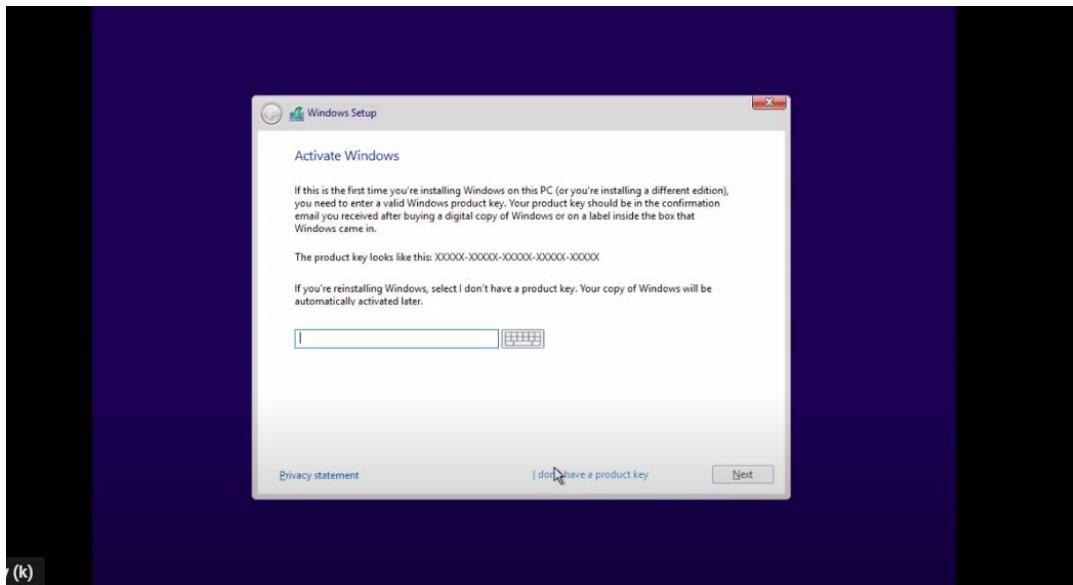


Figure 56: Windows Installation 3

Adapted from [18]

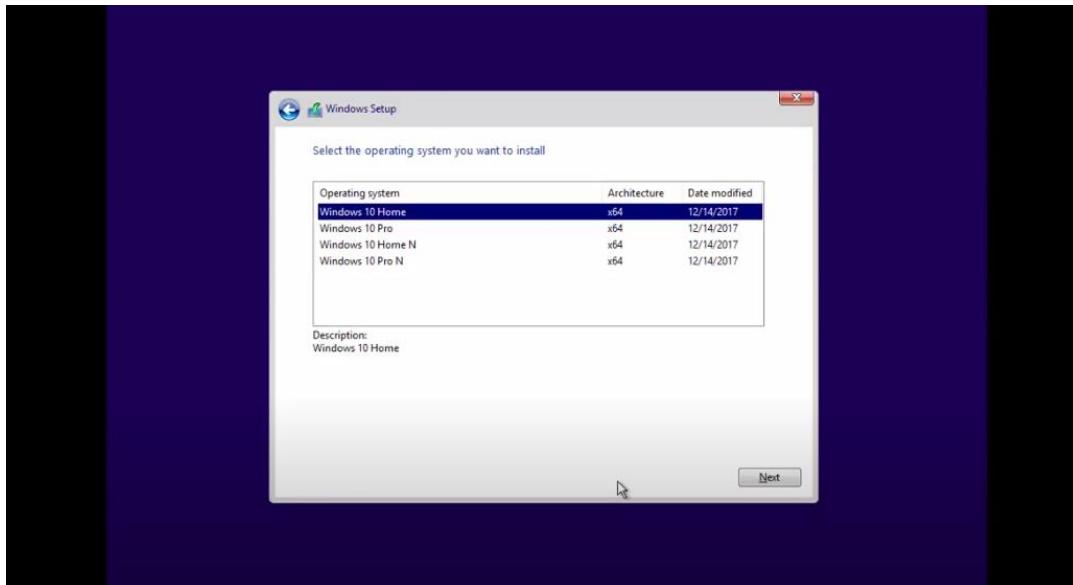


Figure 57: Windows Installation 4

Adapted from [18]

- Check the box to accept the license terms. Click “Next.”

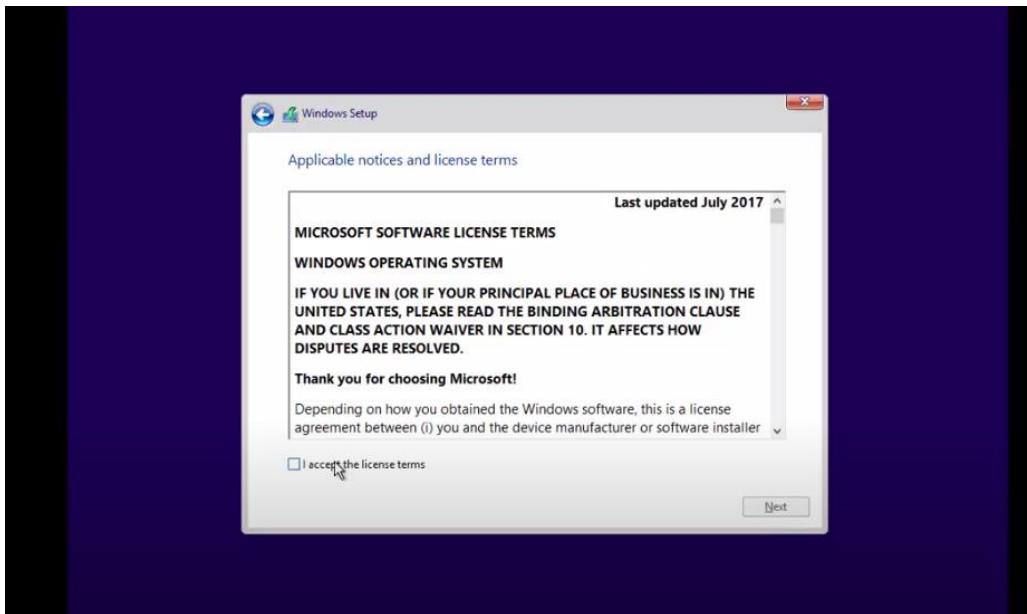


Figure 58: Windows Installation 5

Adapted from [18]

- Click Custom Install.

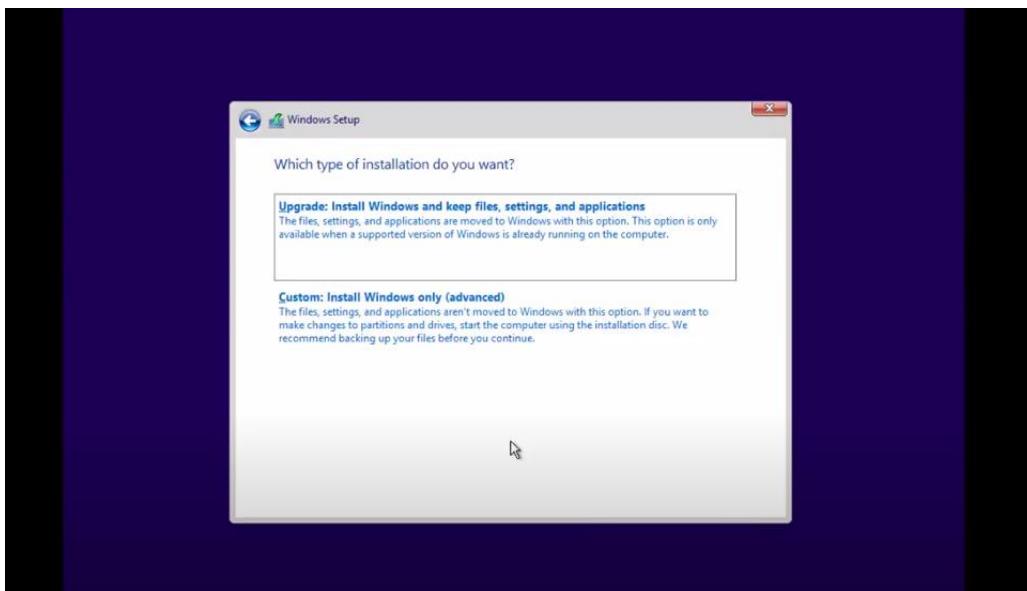


Figure 59: Windows Installation 6

Adapted from [18]

- Click “Next.”

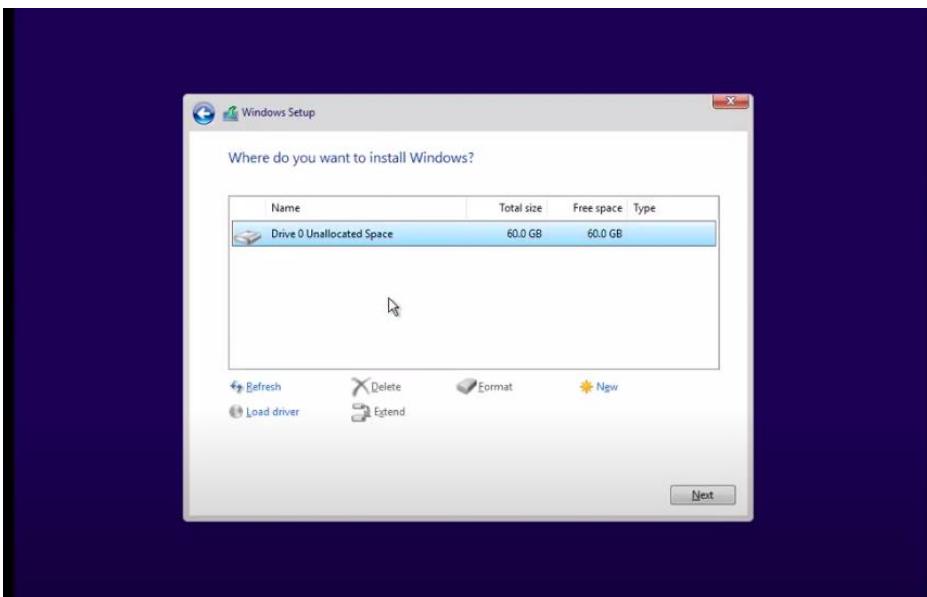


Figure 60: Windows Installation 7

Adapted from [18]

- Click, “Ok.”

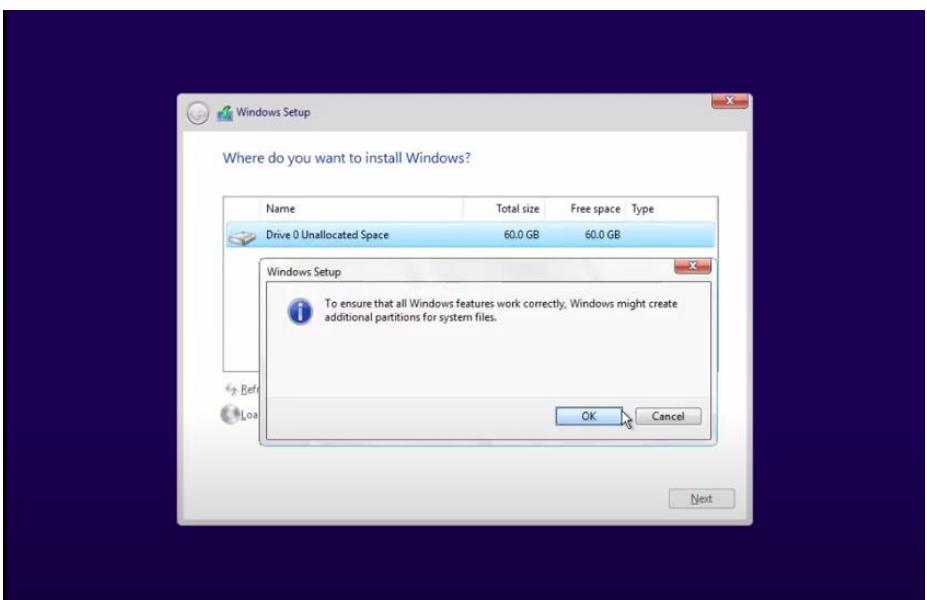


Figure 61: Windows Installation 8

Adapted from [18]

- Click “Next.”

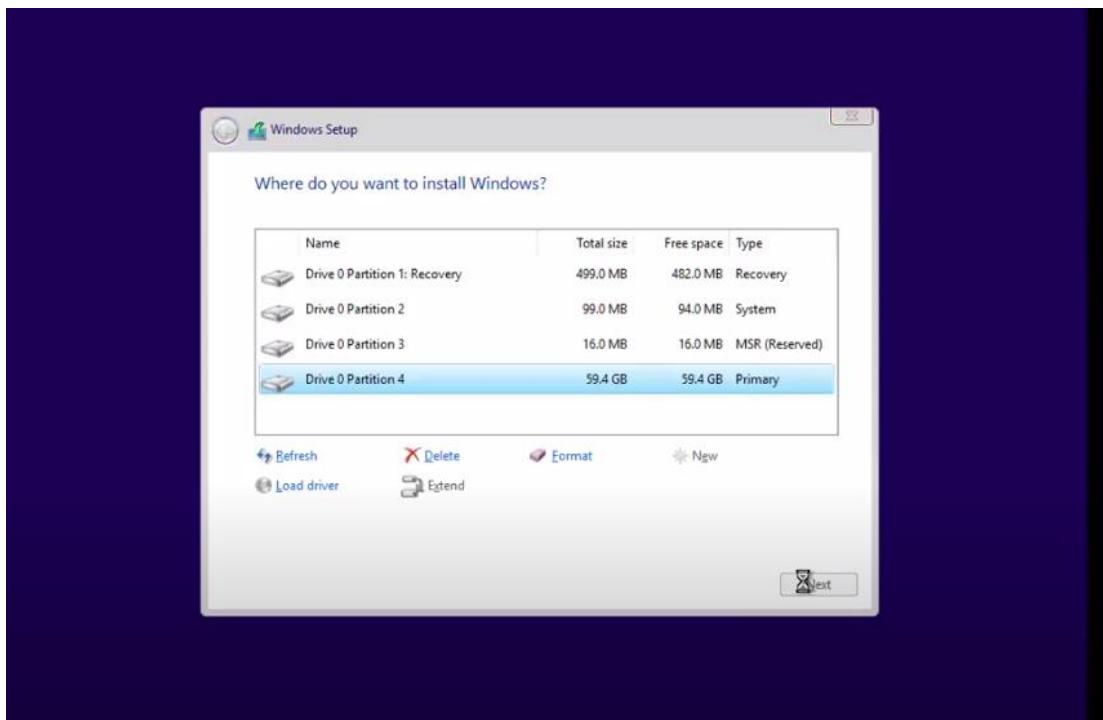


Figure 62: Windows Installation 9

Adapted from [18]

- Let Windows Install, and your computer will automatically restart.
- Once it finishes loading, select your keyboard layout, and then click “Yes.”
  - Press “Skip” unless you would like to add a second keyboard layout.

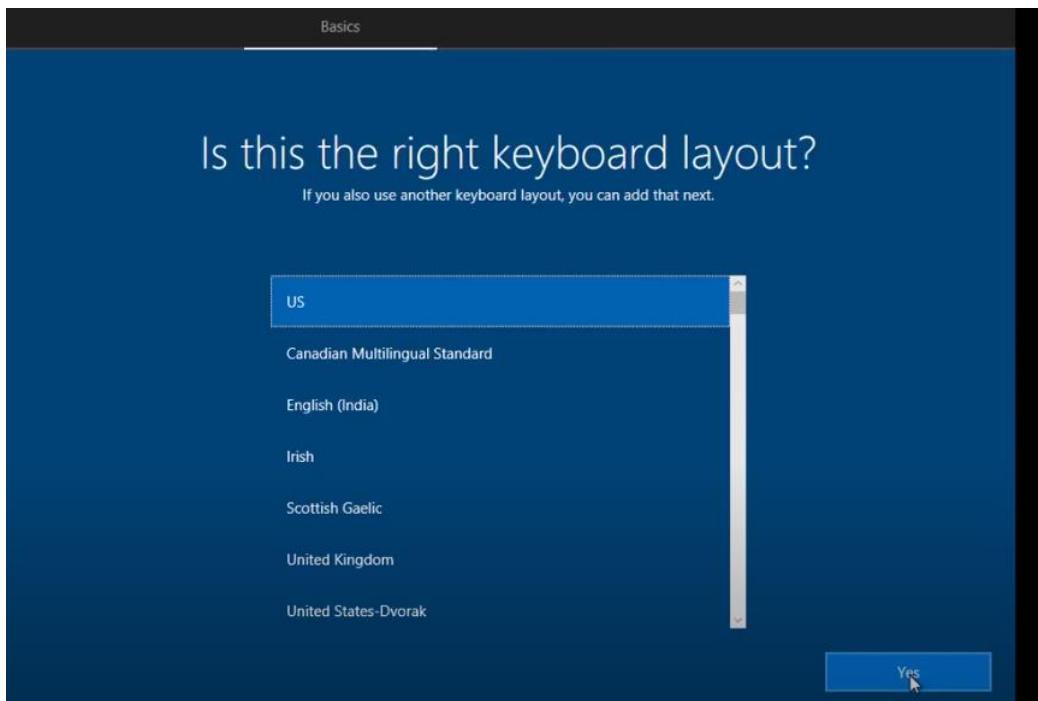


Figure 63: Windows Installation 10

Adapted from [18]

- Choose if you want to set up for home or office use. This manual will go over home use. Click “next.”

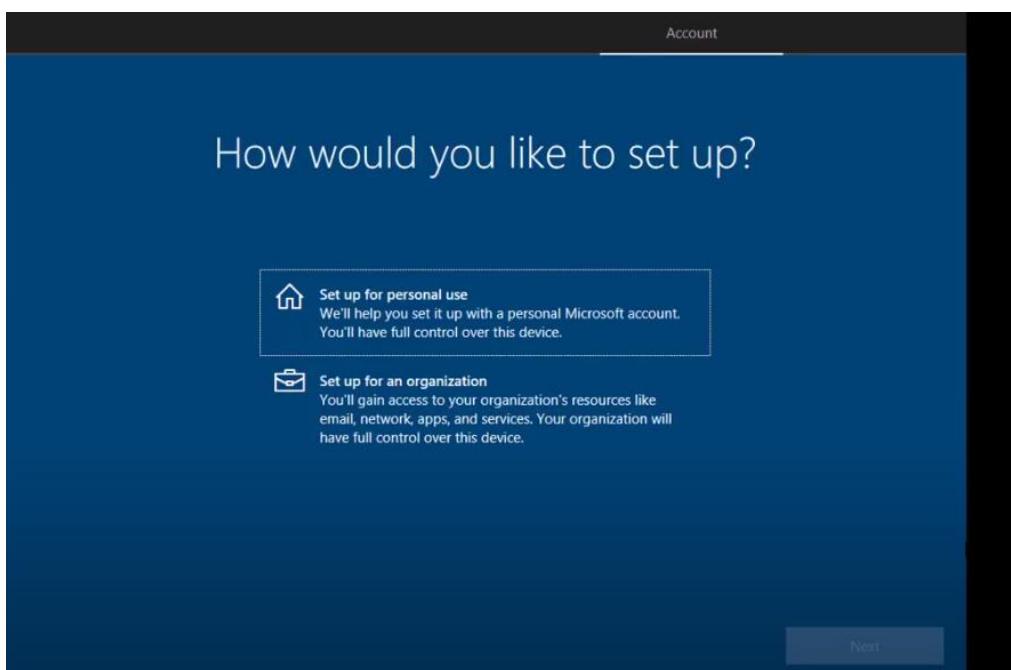


Figure 64: Windows Installation 11

Adapted from [18]

- For now, click “Offline Account.” Or you can create a new account/enter your old account information

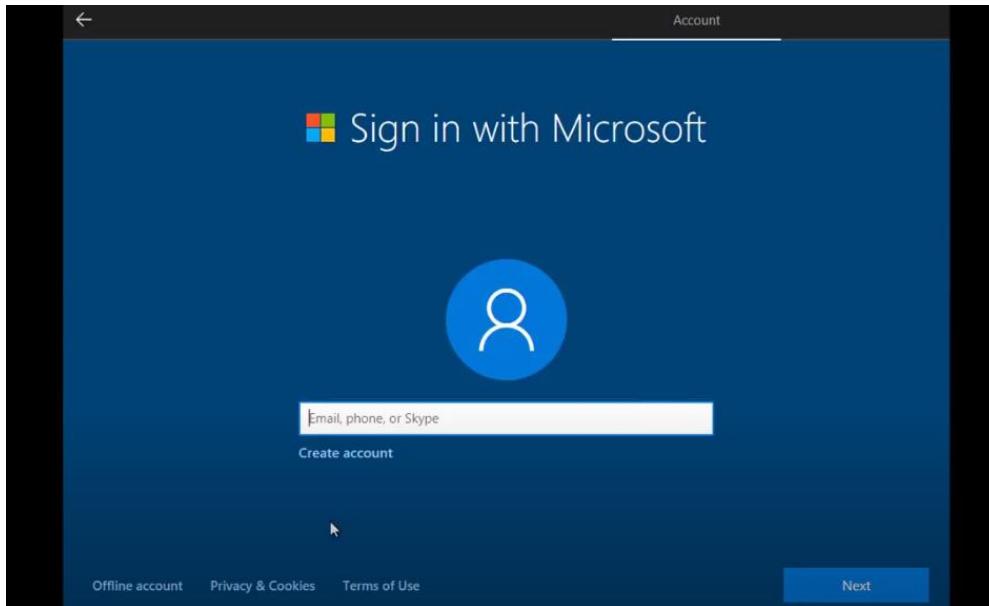


Figure 65: Windows Installation 12

Adapted from [18]

- Click “No.” Or, sign in with your Microsoft Account.

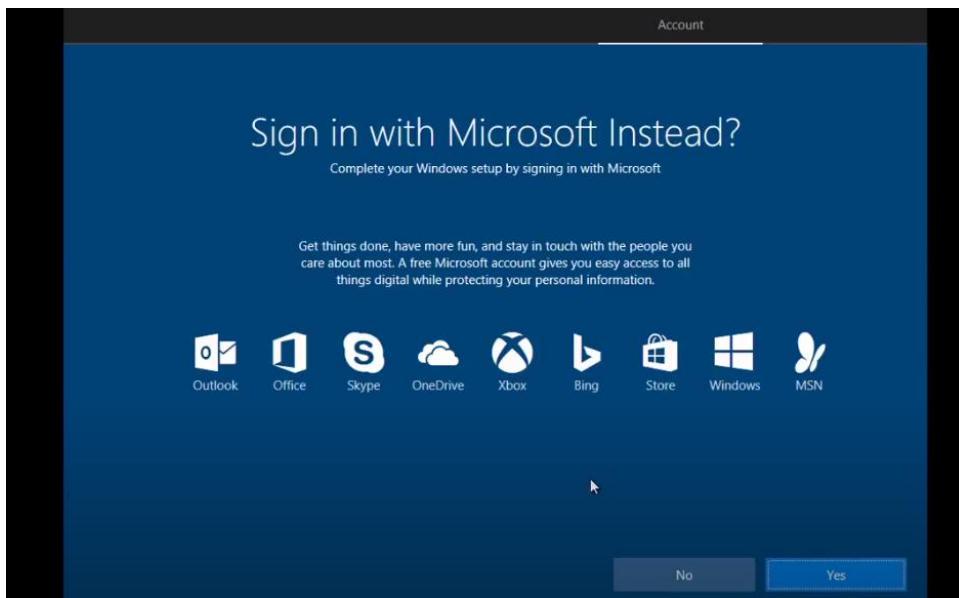


Figure 66: Windows Installation 13

Adapted from [18]

- Enter your username and then click “Next.”

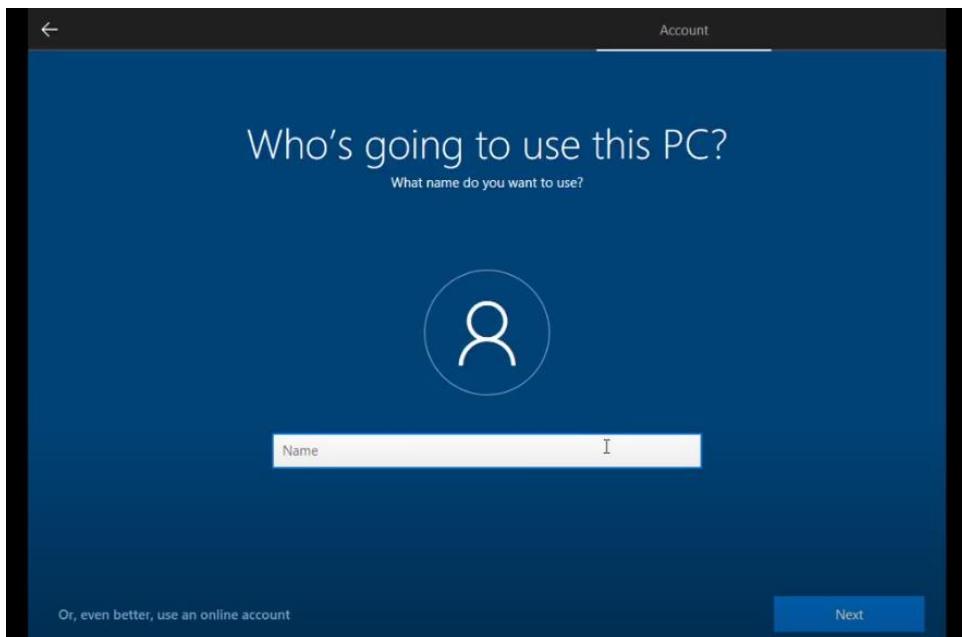


Figure 67: Windows Installation 14

Adapted from [18]

- Create your password. Click “Next.”

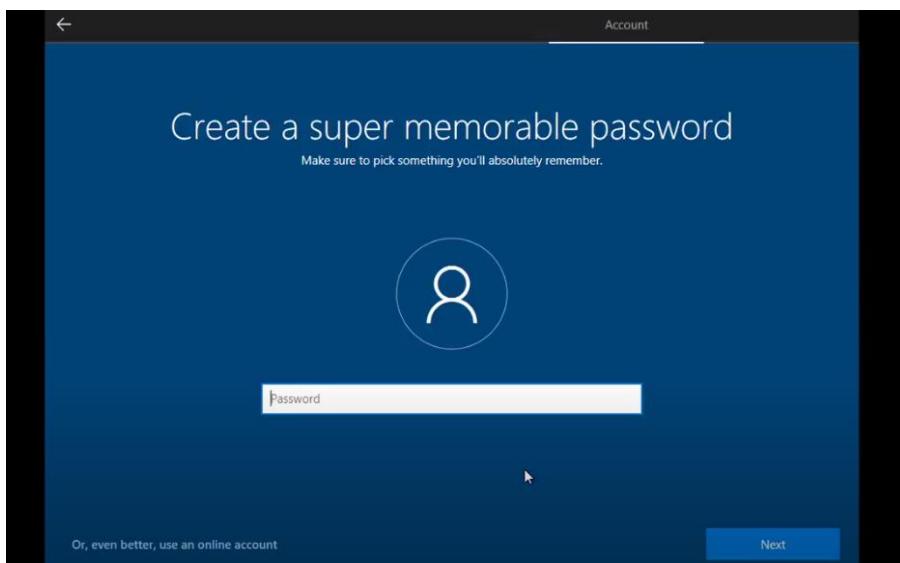


Figure 68: Windows Installation 15

Adapted from [18]

- Confirm your password. Click “Next.”

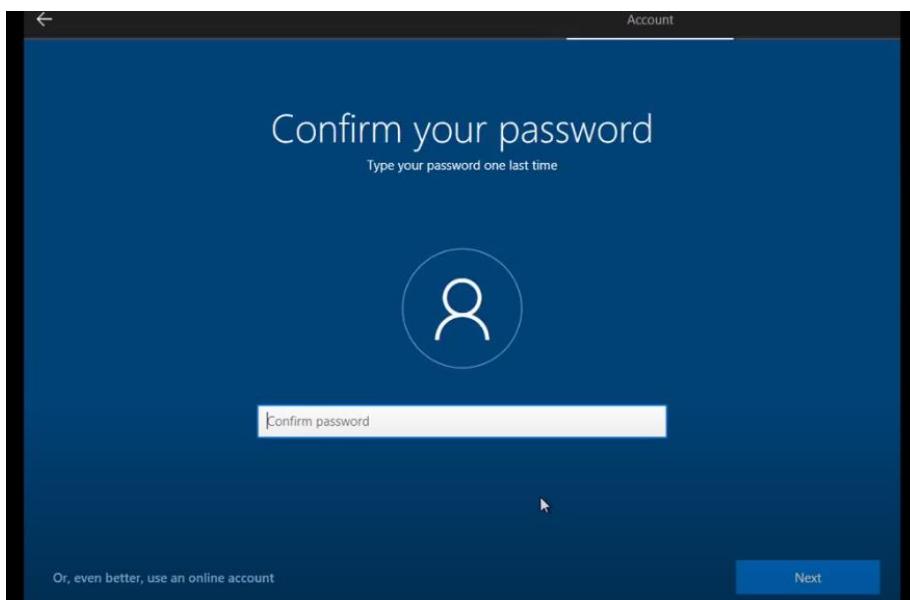


Figure 69: Windows Installation 16

Adapted from [18]

- Pick and answer 3 security questions. Press “Enter” on your keyboard to confirm each question and answer.

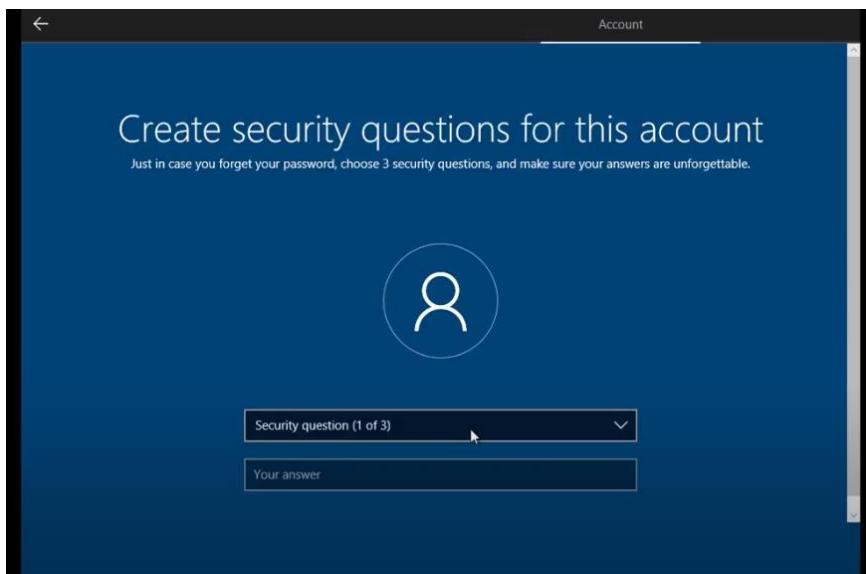


Figure 70: Windows Installation 17

Adapted from [18]

- Either allow or deny the Cortana program specific permissions.

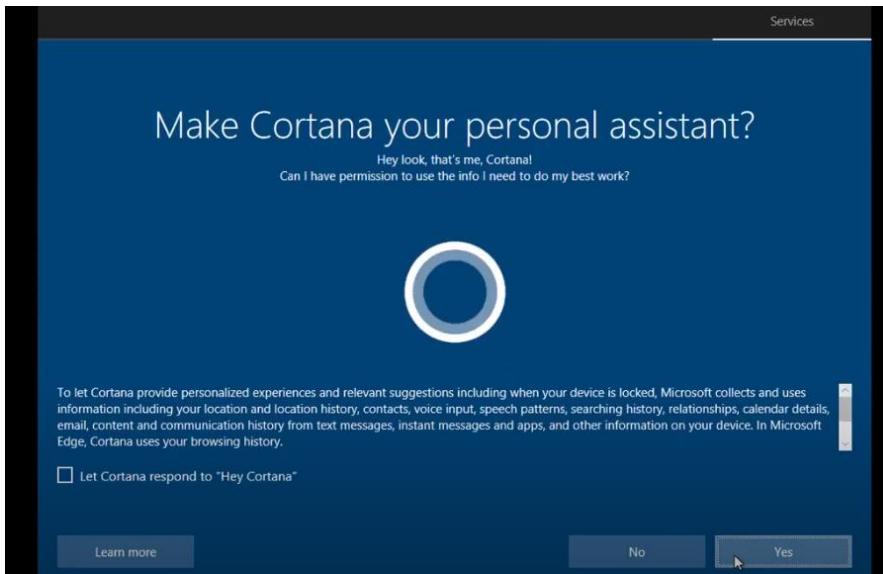


Figure 71: Windows Installation 18

Adapted from [18]

- Choose your Privacy Settings and then click “Accept.”

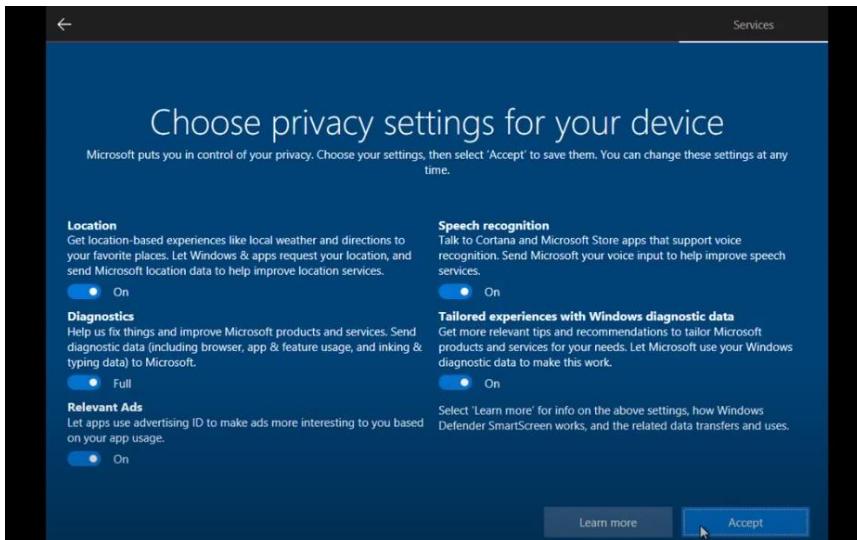


Figure 72: Windows Installation 18

Adapted from [18]

Windows will load to the home screen.

## Set Up Critical Features

The following features can be considered critical. These updates, backups, restoration points, and anti-virus software will allow you to keep your computer running as smoothly and problem-free as possible. If an accident occurs and you lose files or the computer becomes faulty, the backups and restoration will be able to bring your computer back to a state that is fully functional and with data that may have been lost.

### 23. Set up Windows Updates

- Search for “Update” in the bottom left corner.
- Click on “Check for Updates.”

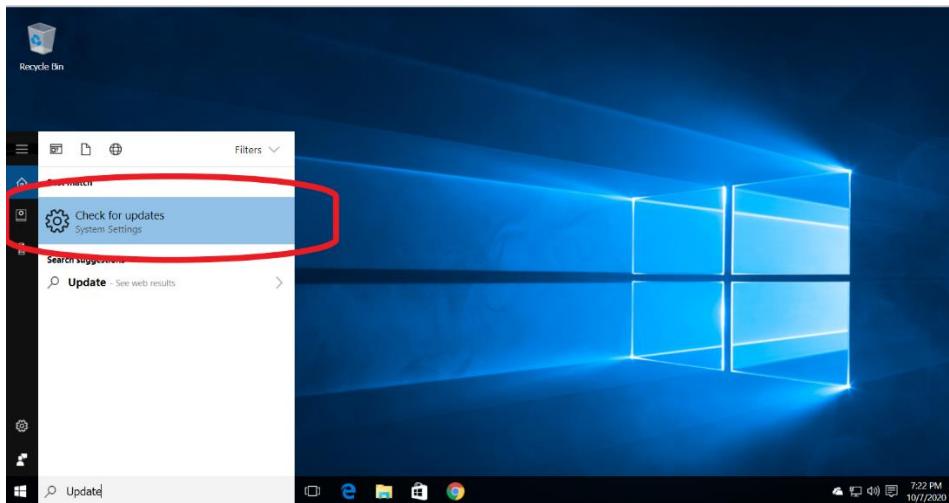


Figure 73: Update Settings

Adapted from [19]

- Click on “Check for Updates” and install any updates found.

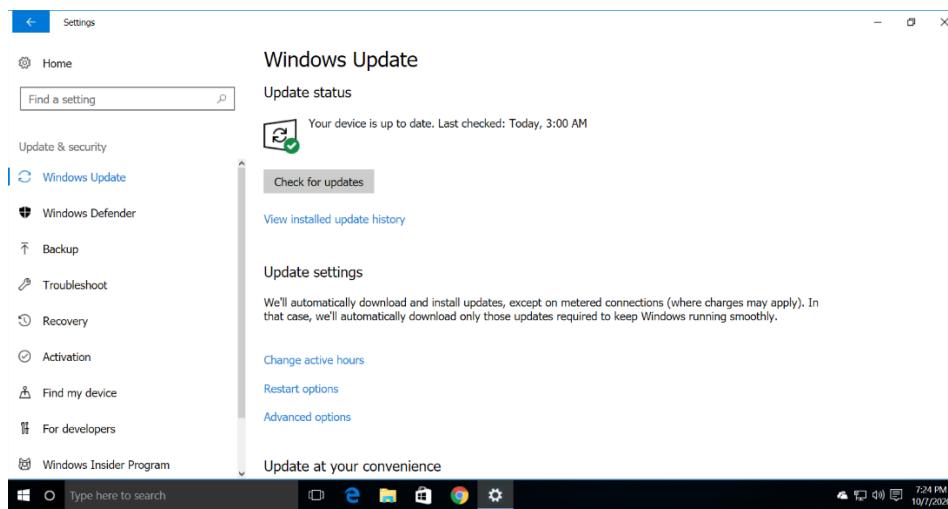


Figure 74: Update Settings

Adapted from [19]

- Click on “Change Active Hours” and set the hours to the usual time this computer will be in use. This will allow the computer to search for and install automatic updates. Restarting the computer will finalize updates; the active hours prevents the computer from automatically restarting without your permission.
- Click “Save.”

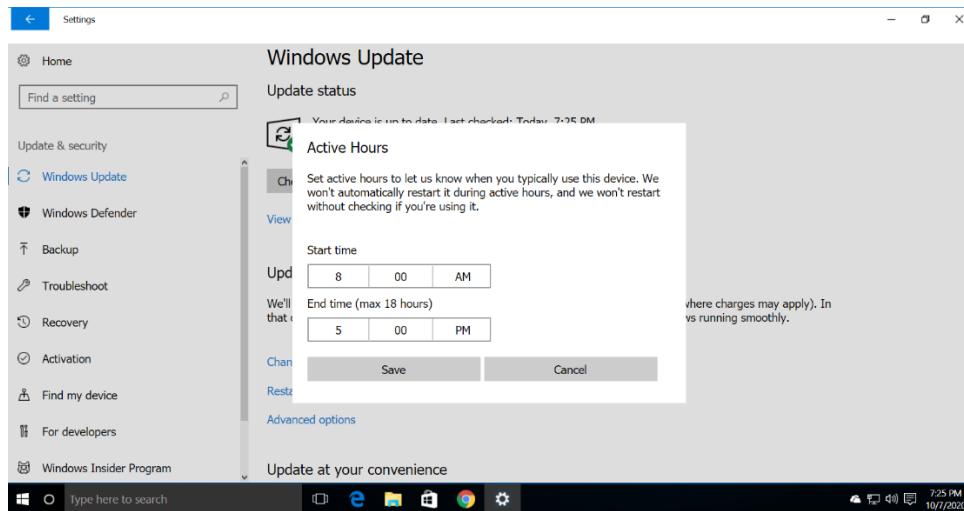


Figure 75: Active Hours Settings

Adapted from [19]

- Click on Advanced Options.
- Check the first box to search and install updates for Windows Products installed on your computer when Windows is updated.

- You can also choose to download updates over metered connections, which may cause extra charges.
- You can choose to restart a computer as soon as possible when an update is ready. Usually, you will be prompted to restart the computer.
- You can turn the restart notification on or off.
- You can pause updates for a certain amount of time, but any updates must be installed before you can pause again.

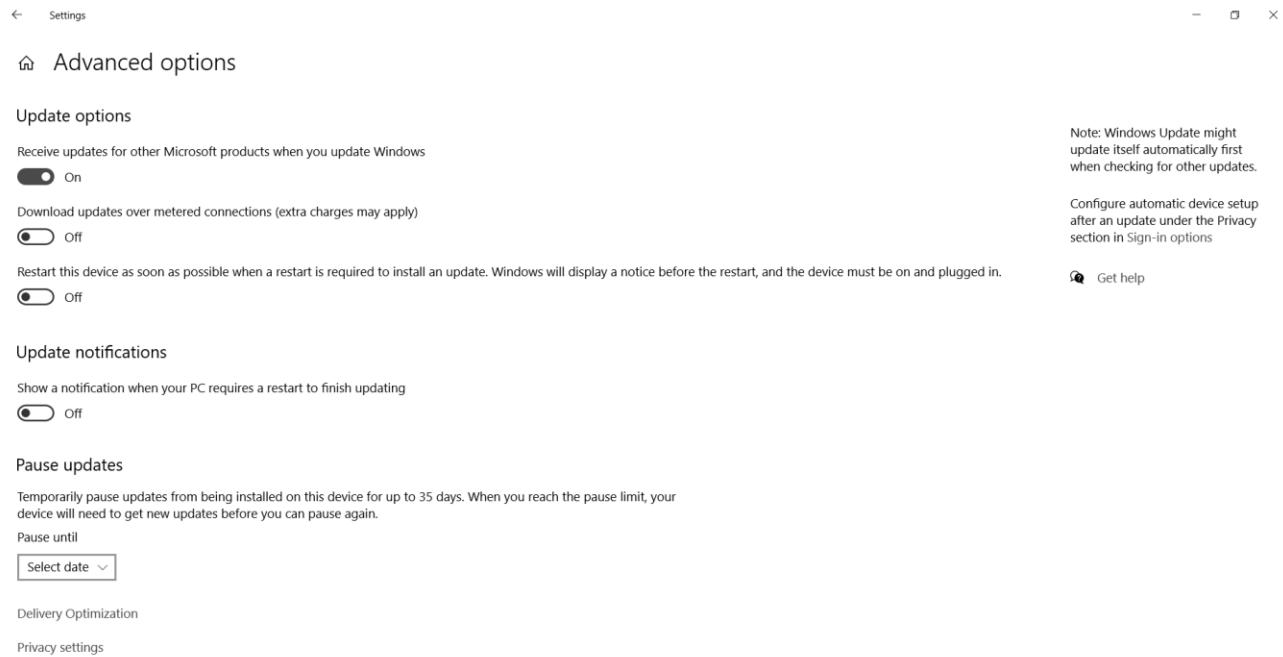


Figure 76: Advanced Update Options

## 24. Set up Data Backup and Restore

- Click on “Backup.”

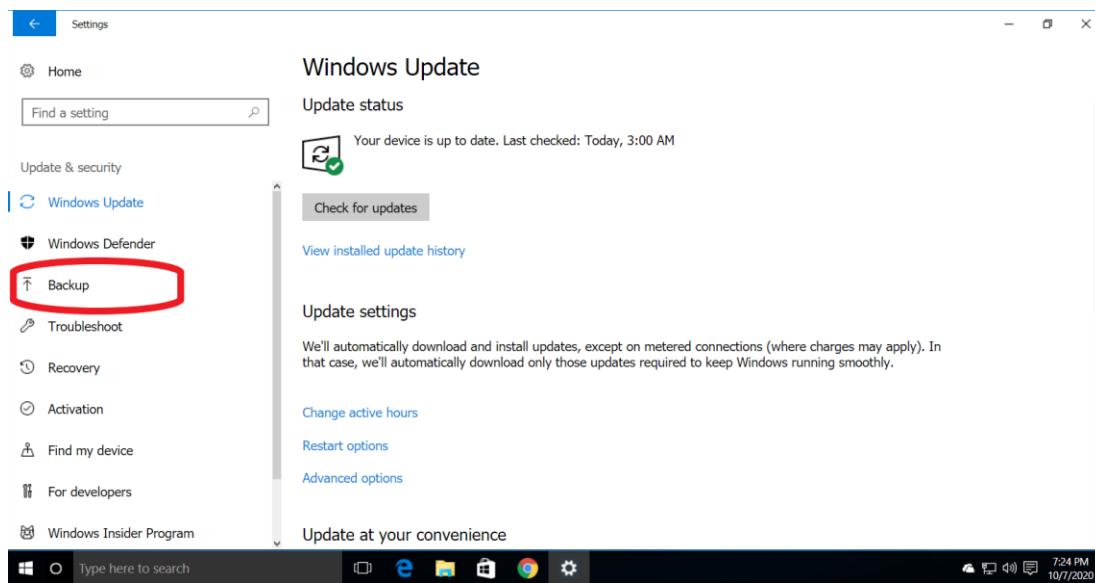


Figure 77: How to get to Backup Options

Adapted from [19]

- Click on “Add a Drive.”

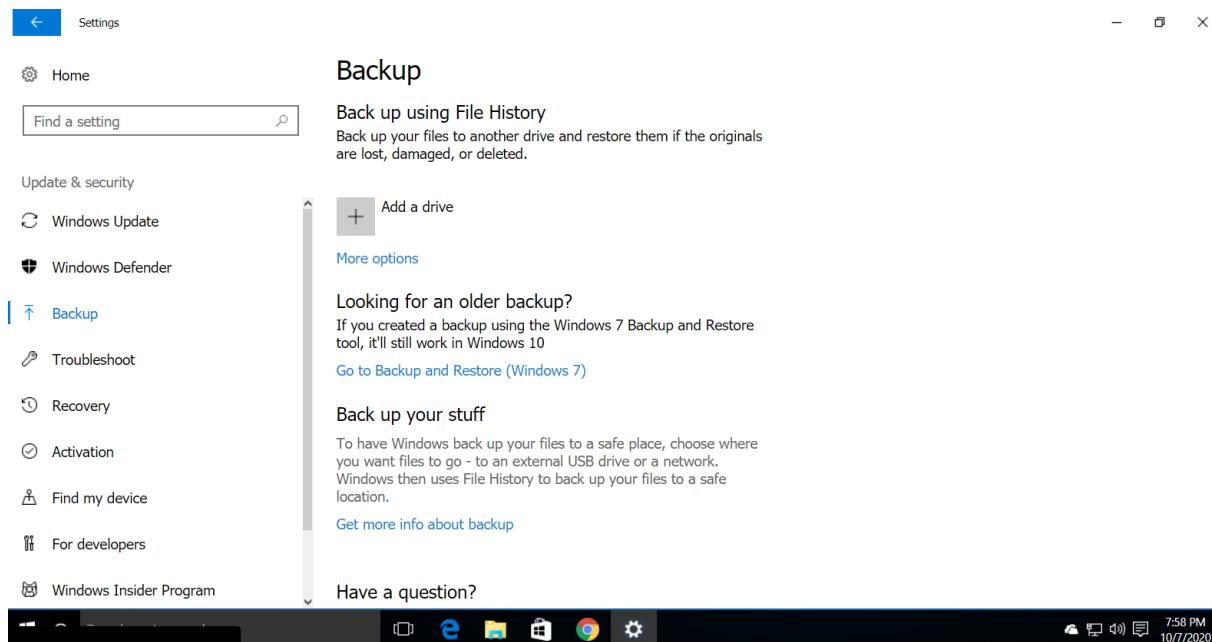


Figure 78: Backup options before a drive is selected

Adapted from [19]

- Select which drive you want to use for the backup.

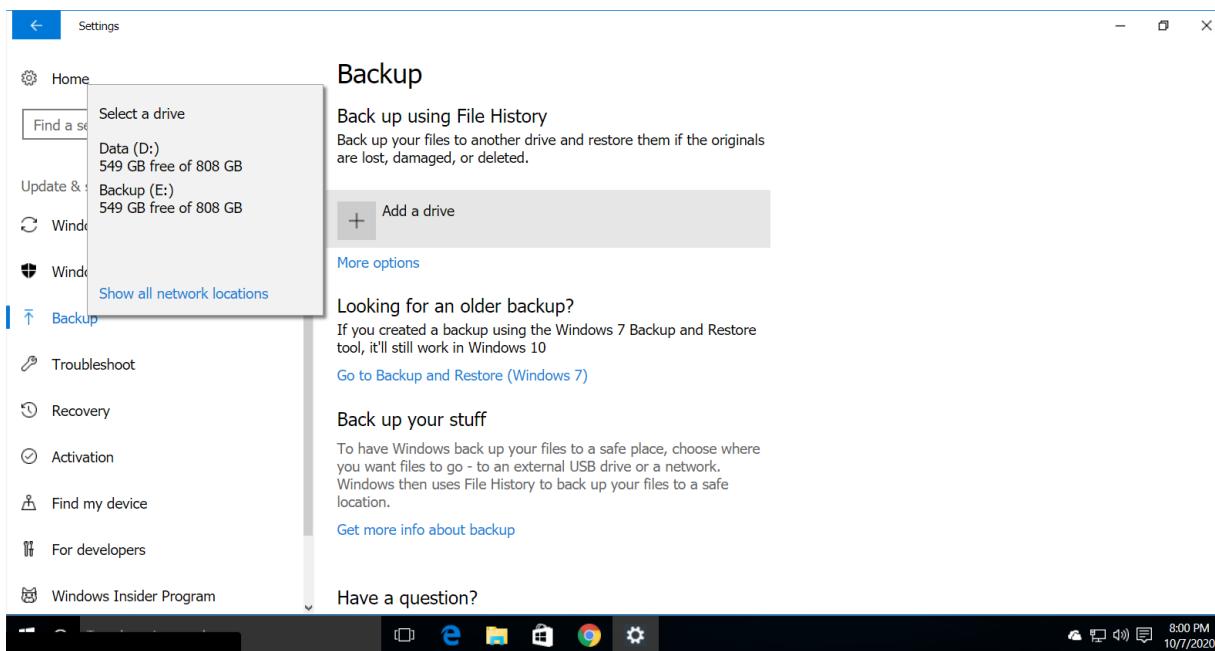


Figure 79: Select a backup drive

Adapted from [19]

- Click on “More options.”

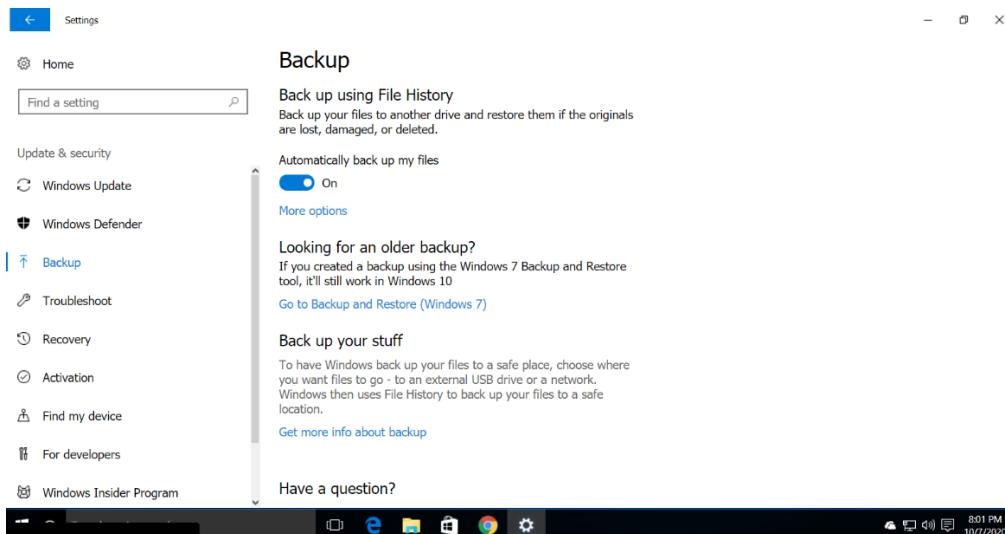


Figure 80: Backup Options after a drive is selected

Adapted from [19]

- Choose how often you want to back up the files and how long to keep the backup.
- Choose what files you want to backup.
- Click “Backup Now.”

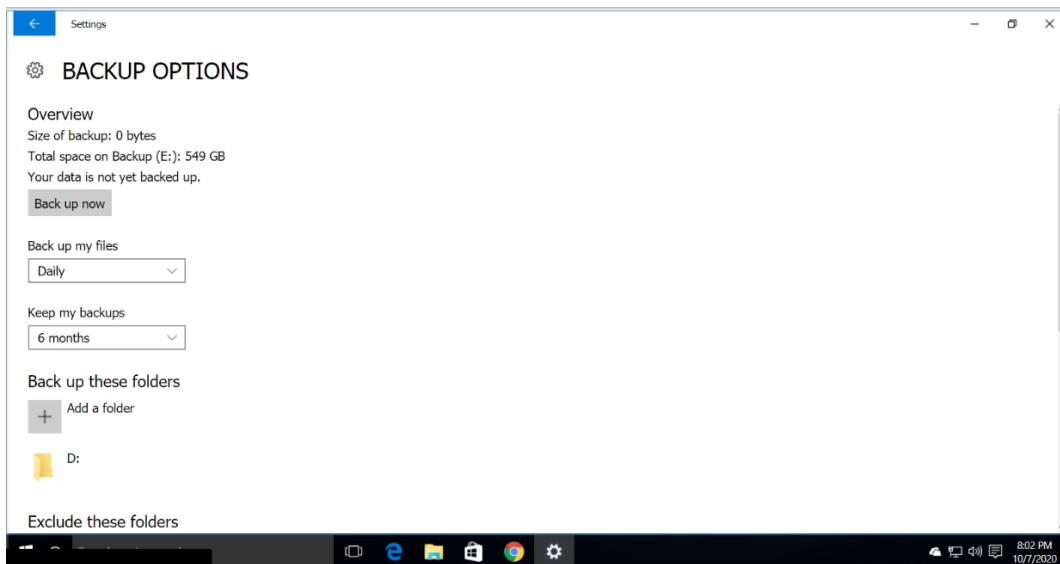


Figure 81: Advanced Backup Options

Adapted from [19]

## 25. Set up a Restore Point

- Search for Control Panel in the bottom left search bar.
- Click on Control Panel.

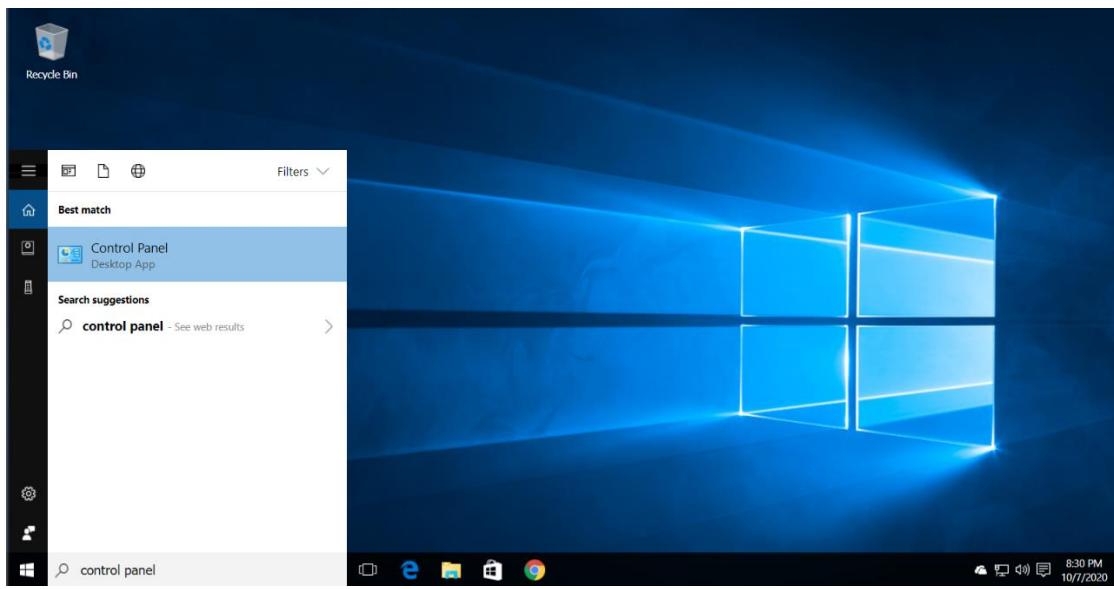


Figure 82: Accessing the Control Panel

Adapted from [19]

- Click on System and Security

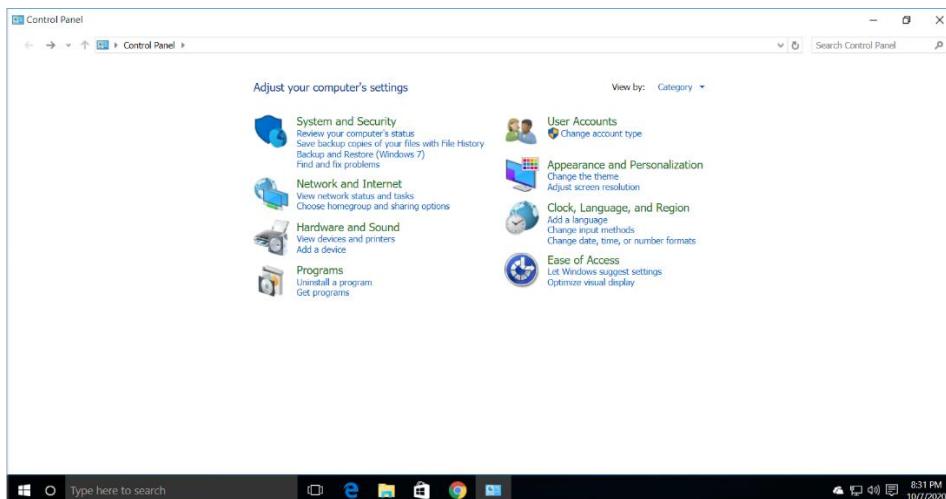


Figure 83: Computer Settings

Adapted from [19]

- Click on System

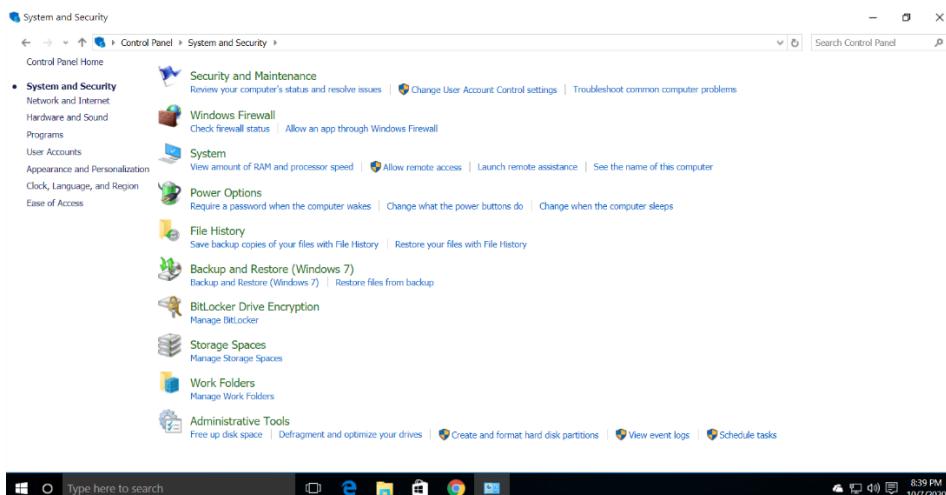


Figure 84: System Settings

Adapted from [19]

- Click on System Protection in the top left.

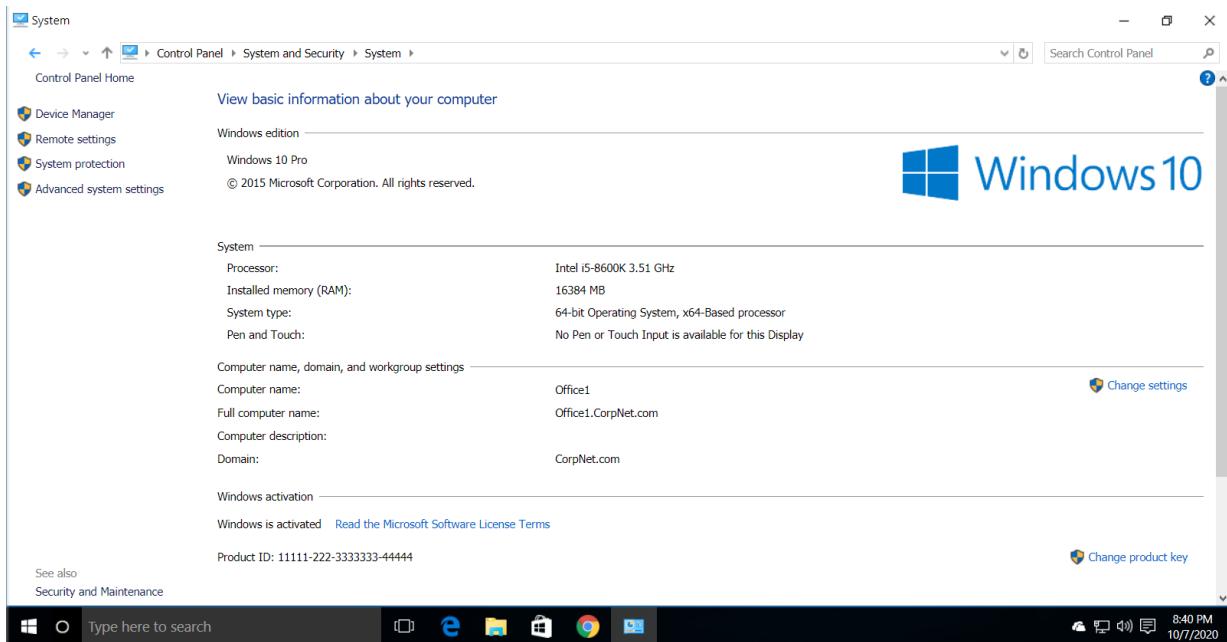


Figure 85: System Information

Adapted from [19]

- Click on Configure

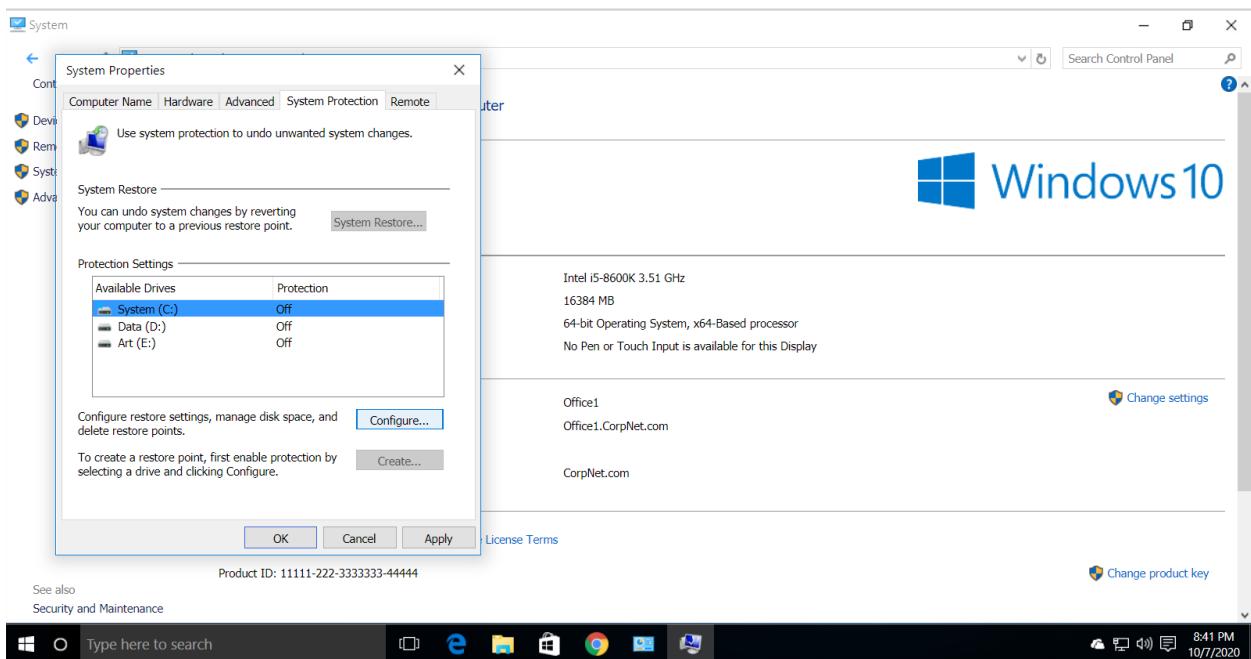


Figure 86: System Protection Options

Adapted from [19]

- Turn on System Protection and set a maximum amount of space to use for a restore point.
- Click on “Apply.”

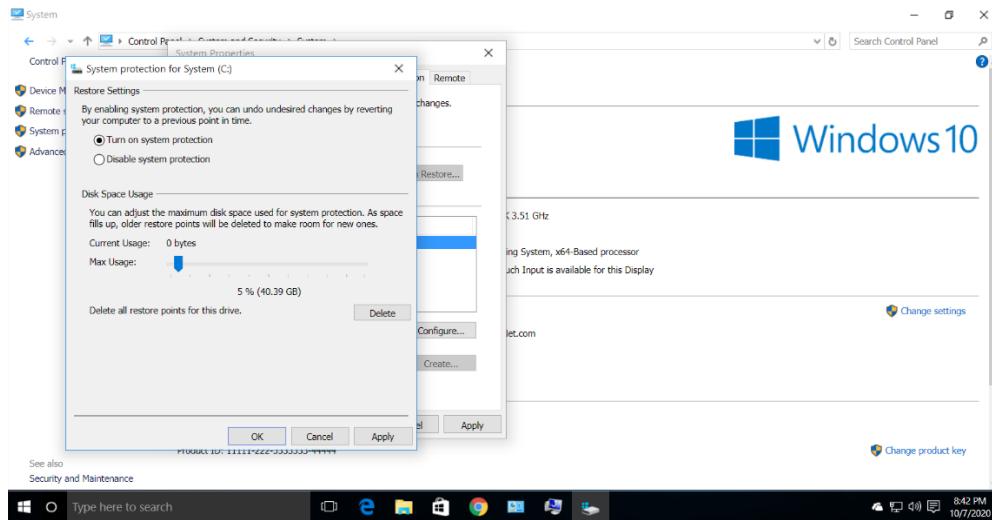


Figure 87: System Restore Point Set Up

Adapted from [19]

- Click on “Create”
- Pick a name for your restore point. And press “Create” This will set up your restore point.
- Click Apply when finished.

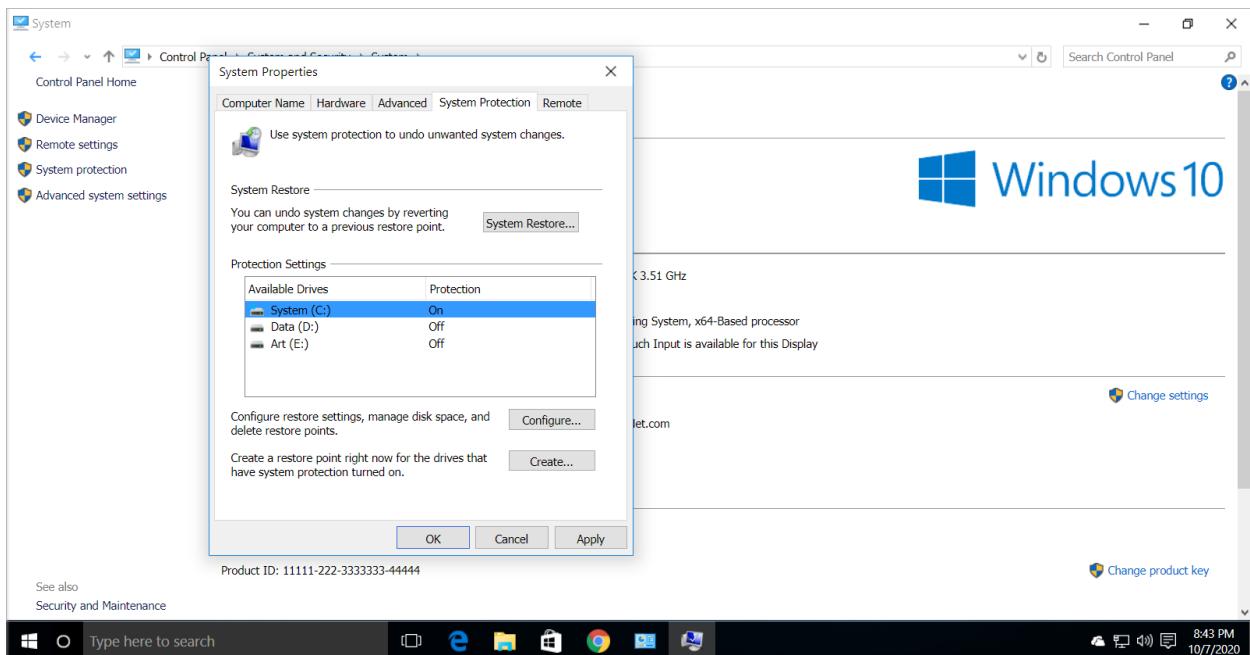


Figure 88: System Restore Point Creation

Adapted from [19]

## 26. Configure Anti-virus

There are many anti-virus programs out there. It is up to you to pick and choose which one you like. This manual will describe the process of installing AVG anti-virus.

- Using Internet Explorer or a web browser of your choice ( go to <https://www.avg.com/en-ww/homepage#pc> )
- Press the Download Button

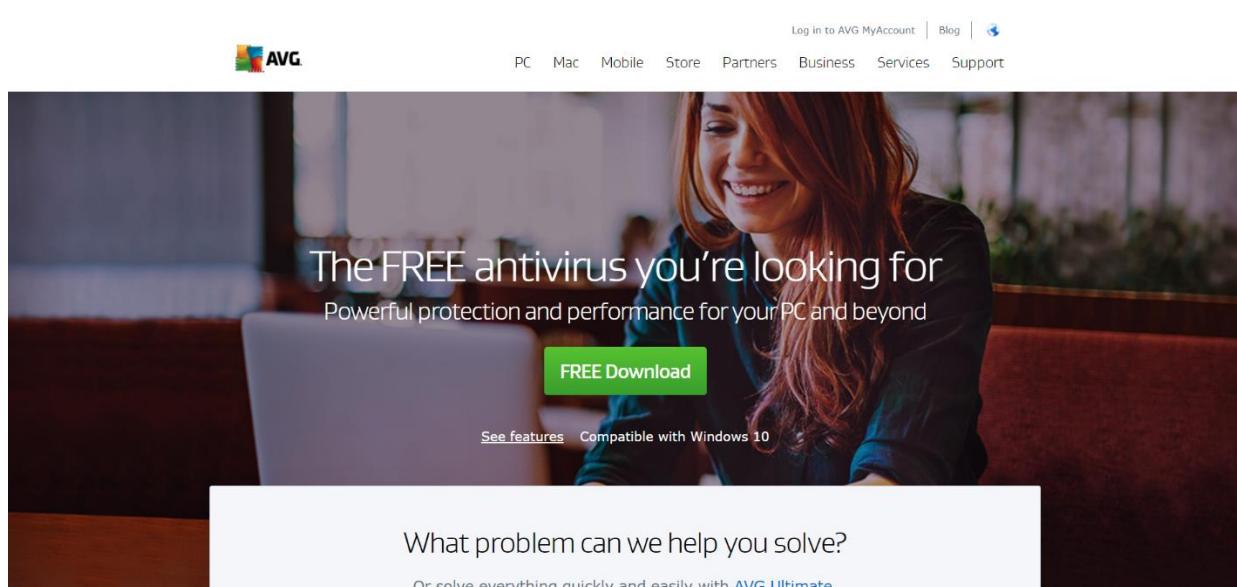


Figure 89: AVG anti-virus home page

Adapted from [20]

- Open the downloaded file.

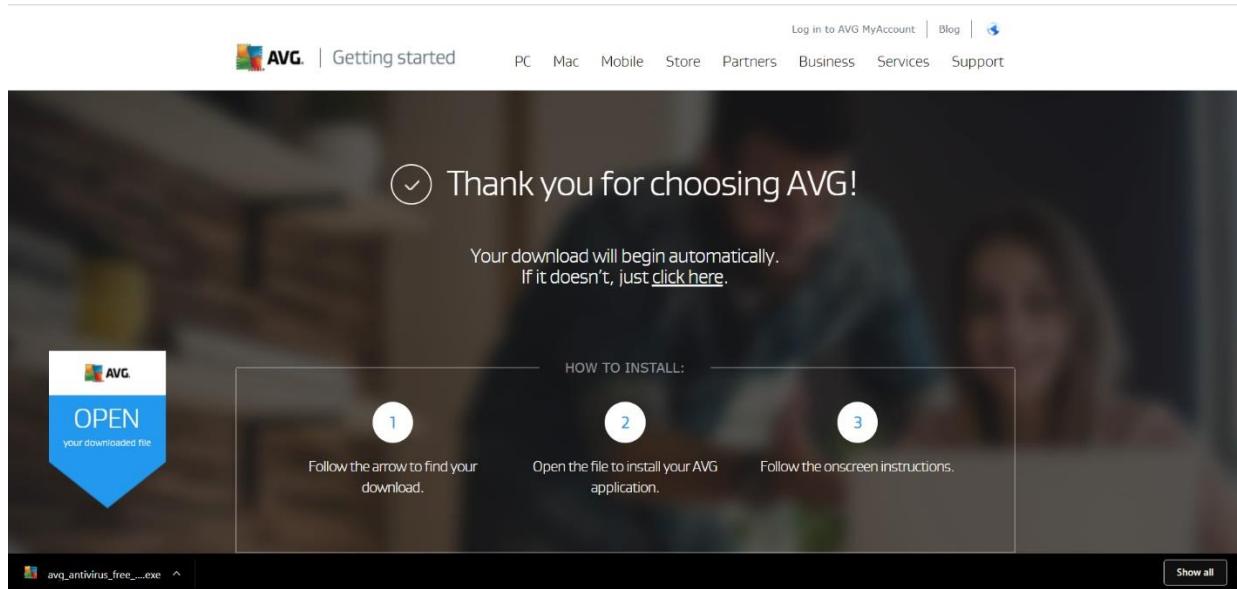


Figure 90: Downloaded anti-virus installer

Adapted from [20]

- Uncheck the ‘Install AVG Web Browser’ in the bottom left corner.
- Click the Install Button

- The installation process is automatic.

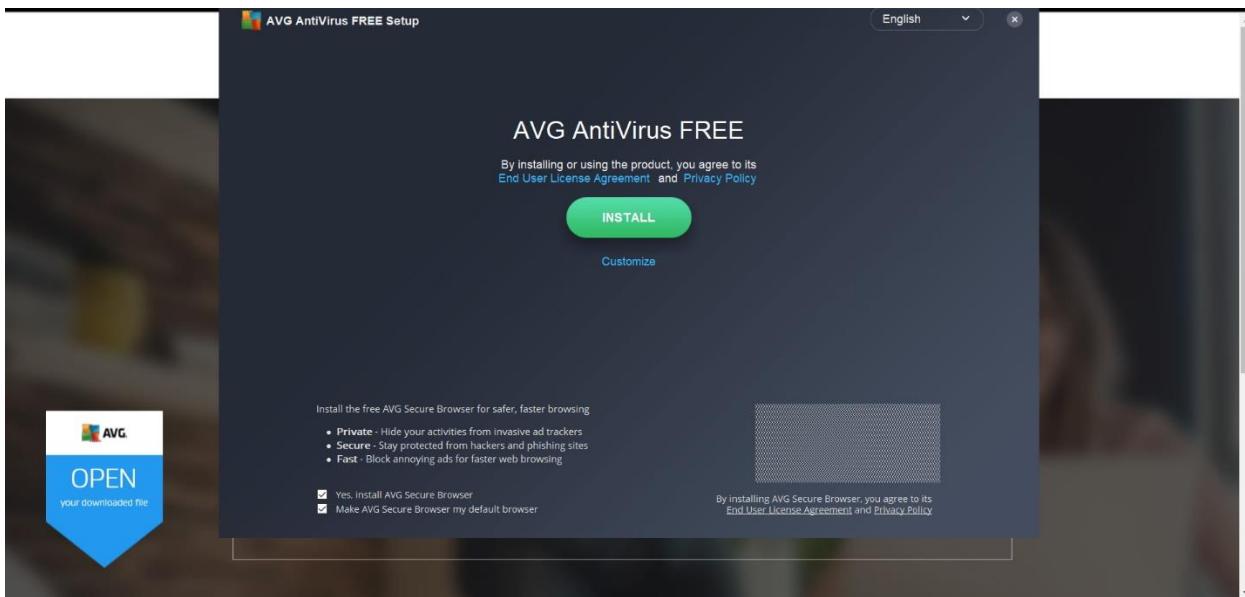


Figure 91: Anti-virus Installation

Adapted from [20]

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