**Supplementary information: A low-cost, IoT enabled platform for automated chemical synthesis**

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# UJ\_FB Design information

## Bill of materials

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bill of materials** |  |  |  |  |  |  |
| **Part number** | **QTY** | **Description** | **Price (ea)** | **Total Price** | **Supplier** | **Product link** |
| **Robot** |  |  |  |  |  |  |
| RB-01 | 1 | Arduino MEGA 2560 microcontroller board | R299.95 | R299.95 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1909> |
| RB-02 | 1 | RAMPS 1.4 3D printing expansion board | R199.95 | R199.95 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/967> |
| RB-03 | 4 | DRV8825 stepper driver with heat sink | R99.95 | R399.80 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1113> |
| RB-04 | 1 | Teflon tubing 1/8 in' OD, 1/16 in' ID, 50 ft length | R2 652.65 | R2 652.65 | Analytical Sales & Services | <https://www.analytical-sales.com/product/teflon-tubing-1-8-od-x-1-16-id-x-50/> |
| RB-05 | 1 | Raspberry Pi 4 Model B 2GB Kit | R1 169.50 | R1 169.50 | PiShop | <https://www.pishop.co.za/store/raspberry-pi_0/raspberry-pi4-model-b-2gb-blackgrey-official-case-essentials-kit-boxed-white-power-supply> |
| RB-06 | 1 | Raspberry Pi Camera Board V2 | R499.00 | R499.00 | PiShop | <https://www.pishop.co.za/store/raspberry-pi-camera-board-v2-8mp1080p?keyword=camera&category_id=0> |
| RB-07 | 1 | Syringe pump assembly |  |  |  |  |
| RB-08 | 1 | Selector valve assembly |  |  |  |  |
| RB-09 | 2 | M3x8 mm bolt |  |  |  |  |
|  |  |  | **Total** | R5 220.85 |  |  |
| **Valves** |  |  |  |  |  |  |
| SV-01 | 2 | C25-618010 10 position manual selector valve for 1/4-28 fittings | R11 330.00 | R22 660.00 | Analytical Sales & Services | <https://www.vici.com/cval/c25-8.php> |
| SV-02 | 2 | NEMA 17 42x42x40 mm stepper motor, 1.8°/step, 1.7 A current/phase, 0.4 Nm holding torque | R269.95 | R539.90 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/stepper-motor-nema-17-x-40mm-1-8-deg-step.html> |
| SV-02 | 2 | KY0024 Linear Hall-Effect sensor development board | R24.72 | R49.44 | Mantech | <https://www.mantech.co.za/ProductInfo.aspx?Item=15M4835> |
| SV-03 | 1 | 200 mm jumper leads | R0.54 | R0.54 | Mantech | <https://www.mantech.co.za/ProductInfo.aspx?Item=15M5046-A> |
| SV-04 | 10 | N35 Neodymium magnet disk | R5.04 | R50.40 | Mantech | <https://www.mantech.co.za/ProductInfo.aspx?Item=15M0681-A> |
| SV-05 | 8 | M3x10 pan head | R0.99 | R7.92 | RS Components | <https://za.rs-online.com/web/p/machine-screws/0526956> |
| SV-06 | 8 | M4 stainless steel hex nut | R1.08 | R8.64 | RS Components | <https://za.rs-online.com/web/p/hex-nuts/0189579> |
| SV-07 | 2 | M4x30 Cheese head steel slot | R1.34 | R2.68 | RS Components | <https://za.rs-online.com/web/p/machine-screws/5466275> |
| SV-08 | 6 | M4x35 Cheese head steel slot | R1.42 | R8.52 | RS Components | <https://za.rs-online.com/web/p/machine-screws/9087769> |
| SV-09 | 2 | Valve mount |  |  |  |  |
| SV-10 | 4 | ¼-28 Bolt |  |  |  |  |
| SV-11 | 2 | Driver gear |  |  |  |  |
| SV-12 | 2 | Driven gear |  |  |  |  |
| SV-13 | 4 | 6x21 mm round bar |  |  |  |  |
| SV-14 | 8 | M3x8 mm grub screw | R4.508 | R36.06 | RS Components | https://za.rs-online.com/web/p/grub-screws-set-screws/1247389 |
| SV-15 | 4 | 6 x19x6 mm Deep groove ball bearing | R55.1 | R220.04 | RS Components | <https://za.rs-online.com/web/p/ball-bearings/6189913/?sra=pstk> |
| SV-16 | 2 | Gearbox bottom |  |  |  |  |
| SV-17 | 2 | Gearbox top |  |  |  |  |
| SV-18 | 8 | M3 hex nut | R0.34 | R4.76 | 3D Printing Store | <https://za.rs-online.com/web/p/hex-nuts/0560293> |
|  |  |  |  |  |  |  |
|  |  |  | **Total** | R23 589.04 |  |  |
| **Syringe Pumps** |  |  |  |  |  |  |
| SP-01 | 2 | NEMA 17 42x42x40 mm stepper motor, 1.8°/step, 1.7 A current/phase, 0.4 Nm holding torque | R269.95 | R539.90 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/stepper-motor-nema-17-x-40mm-1-8-deg-step.html> |
| SP-02 | 2 | Mechanical endstop 90° version | R24.95 | R49.90 | 3D Printing Store | <http://www.3dprintingstore.co.za/electronics/mechanical-endstop-90-version/> |
| SP-03 | 2 | TCST2103 Gap Sensor with phototransistor output | R17.44 | R34.88 | Mantech | <https://www.mantech.co.za/ProductInfo.aspx?Item=35M4257> |
| SP-04 | 2 | LM393 dual voltage comparator | R11.72 | R23.44 | Mantech | <https://www.mantech.co.za/ProductInfo.aspx?Item=15M6164> |
| SP-05 | 4 | Stainless steel rod 6 mm diameter 140 mm | R9.11 | R36.44 | RS Components | <https://za.rs-online.com/web/p/metal-bars-metal-rods/0682826/?cm_mmc=ZA-PLA-DS3A-_-google-_-PLA_ZA_EN_Engineering_Materials_%26_Industrial_Hardware_Whoop+(2)-_-(ZA:Whoop!)+Metal+Bars+%26+Metal+Rods-_-682826&matchtype=&pla-296661033820&gclid=Cj0KCQiA-qGNBhD3ARIsAO_o7ynDE5sim5CrrTd43XbZ6oenPiN6yLHYN5F4Ze4aiBvkW-zTL1EJS3caAvk7EALw_wcB&gclsrc=aw.ds> |
| SP-06 | 2 | TR8x8 lead screw 115 mm | R50.00 | R100.00 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1213> |
| SP-07 | 4 | LM6UU linear bearing pair | R39.00 | R156.00 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1009> |
| SP-08 | 2 | Tr8x8 brass nut | R39.95 | R79.90 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1166> |
| SP-09 | 2 | Rigid coupling 5-8 mm | R69.95 | R139.90 | 3D Printing Store | <https://www.3dprintingstore.co.za/centurionstore/catalog/product/view/id/1659> |
| SP-10 | 20 | M3x20mm bolt | R0.85 | R17.00 | 3D Printing Store | <https://za.rs-online.com/web/p/machine-screws/0560625> |
| SP-11 | 14 | M3x6 mm bolt | R0.32 | R4.48 | 3D Printing Store | <https://za.rs-online.com/web/p/machine-screws/0560580> |
| SP-12 | 14 | M3 hex nut | R0.34 | R4.76 | RS Components | <https://za.rs-online.com/web/p/hex-nuts/0560293> |
| SP-13 | 2 | Hamilton 1010TLL Gastight syringe PTFE luer lock | R1 791.00 | R3 582.00 | Sigma Aldrich | <https://www.sigmaaldrich.com/ZA/en/product/sial/21000u?context=product> |
| SP-14 | 2 | Pump body | - | - | - | - |
| SP-15 | 2 | Pusher Block | - | - | - | - |
| SP-16 | 2 | Syringe holder | - | - | - | - |
| SP-17 | 2 | Slotted disk | - | - | - | - |
| SP-18 | 2 | M3x8 mm bolt | R0.6052 | R1.21 | RS Components | <https://za.rs-online.com/web/p/machine-screws/9087661> |
|  |  |  | **Total** | R4 768.60 |  |  |
|  |  |  |  |  |  |  |
| **Reactor** |  |  |  |  |  |  |
| RCT-01 | 1 | Rostock Delta MK3 Round heated bed | **R329.95** | R329.95 | DIY Electronics | <https://www.diyelectronics.co.za/store/beds-heaters/1532-rostock-delta-mk3-round-heated-bed.html?search_query=rostock&results=1> |
| RCT-02 | 2 | 12 V 4010 Axial Fan | **R69.95** | R139.9 | DIY Electronics | <https://www.diyelectronics.co.za/store/thermistors/630-thermistor-100k-1-ntc-pre-wired.html?search_query=thermistor&results=166> |
| RCT-03 | 1 | 100K Thermistor | **R24.95** | R24.95 | DIY Electronics | <https://www.diyelectronics.co.za/store/thermistors/630-thermistor-100k-1-ntc-pre-wired.html?search_query=thermistor&results=166> |
| RCT-04 | 4 | Neodymium N42 Rectangular Magnet | **R14.95** | R59.80 | DIY Electronics | <https://www.diyelectronics.co.za/store/magnets/1308-neodymium-n42-magnets-rectangular-10x7x2mm.html?search_query=magnet&results=130> |
| RCT-05 | 2 | Fan mount | **-** | - | - | - |
| RCT-06 | 12 | M3x12 mm bolt | **R0.99** | 11.88 | RS Components | <https://za.rs-online.com/web/p/machine-screws/0560697> |
|  |  |  | **Total** | R566.48 |  |  |
|  |  |  |  |  |  |  |

## RAMPS Wiring and voltage comparator circuit

The setup software assumes these groups of pins have been used.

A picture containing table

Description automatically generated

Figure 64: Wiring guide for RAMPS board

Figure 69 shows the circuit diagram for the syringe pump encoder voltage comparator. When the comparator output is off, the input voltage, Vin, must increase to above 4 V turn on the comparator output. When the comparator output is on, the output will only turn off once Vin drops below 2.7 V. This hysteresis effectively prevents oscillations from incrementing the counter. Details regarding the design are presented in Appendix A.

Diagram, schematic

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Figure 69: Schematic for the syringe pump encoder circuit

## Assembly drawings

Diagram, engineering drawing

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Diagram, engineering drawing

Description automatically generated

Diagram, engineering drawing

Description automatically generated

Diagram, engineering drawing

Description automatically generated

# Aspirin synthesis

## Materials and methods

PPE, including a lab coat, gloves, and goggles, were worn when working on the robot. Concentrated sulphuric acid is highly corrosive and should be handled with care. The reaction required the following equipment:

* Computer with UJ\_FB software
* Arduino and RAMPS
* Syringe pump
* Selector valve
* Reactor
* Condenser
* Stirrer hotplate
* Two magnetic stirrer bars
* Round-bottom flask
* Four Schott bottles
* Reagents:
  + Deionised water
  + Acetic anhydride
  + Sulphuric acid
* Conical flask for waste
* Gravity chromatography column
* A beaker containing ice water
* 1/8 in’ Teflon tubing
* PPE
  + Goggles
  + Gloves
  + Lab coat

Before the experiment, the following preliminary steps were followed:

1. Flash the firmware to the Arduino Mega.
2. Connect the syringe pump, selector valve, and reactor to the RAMPS board. Instructions are included in Appendix A.
3. Write and check the XDL for the synthesis.
4. Clean the valve and check that all fasteners on the actuator are secure.
5. Suspend the syringe pump vertically using a retort stand.
6. Prepare an oil bath for the round-bottom flask and place it on the reactor module
7. Suspend the round-bottom flask in the oil bath using a retort stand. Take care when clamping the round-bottom flask to avoid damaging the glass.
8. Attach the condenser to the round-bottom flask and turn on the condenser pump.
9. Prepare tubing for the reactor and filter top, measure and record the length of these tubes.
10. Attach tubing to the reactor, waste, filter top, and filter bottom.
11. Drill 3.2 mm holes in the lids of the Schott bottles for the reagents
12. Attach the tubing to the reagents, concentrated sulphuric acid, and deionised water. Prime each of these lines and flush volume within the syringe to waste.
13. Connect stirrer hotplate to power, place beaker with ice water on top of the plate, then hold gravity chromatography column within the water using a retort stand.
14. Place one stirrer bar into the round-bottom flask and another into the gravity chromatography column.
15. Connect the Arduino to the computer and use Python to run the setup\_GUI.py script to set up the robot.

The method for the experiment is as follows:

1. Weigh 5 g of salicylic acid using a weighing scale.
2. Place the salicylic acid into the round bottom flask using wax paper as a funnel.
3. Start stirring the stirrer hotplate at 500 RPM.
4. Use Python to run main.py within the UJ\_Fluidic\_backbone folder.
5. Load the XDL into the server or the UJ\_FB software.
6. Wait until the XDL execution has paused.
7. Transfer the products into the gravity chromatography column using a spatula.
8. Resume the XDL execution.
9. Wait until the XDL execution is complete.

The XDL document contains the following steps for the robot:

1. Preheat the reactor to 70 °C.
2. Start stirring at 4000 RPM.
3. Transfer 6 ml of acetic anhydride to the reactor (round-bottom flask).
4. Transfer 0.5 ml of sulphuric acid to the reactor.
5. Heat at 70 °C for 15 minutes.
6. Pause until the user moves products to the filter.
7. Add 10 ml of deionised water to the top of the filter.
8. Wait 5 minutes for crystallisation to occur.
9. Remove 10 ml of fluid from the bottom of the filter to waste.
10. Add 5 ml of water to the top of the filter.
11. Remove 8 ml of water from the bottom of the filter to waste.
12. Repeat steps 10-11 twice.

## Aspirin synthesis XDL

**<?xdl** **version**="1.0"**?>**

**<XDL>**

**<Synthesis>**

**<Metadata>**

**</Metadata>**

**<Hardware>**

**<Component** **id**="Reactor1" **type**="reactor"**/>**

**</Hardware>**

**<Parameters>**

**</Parameters>**

**<Reagents>**

**<Reagent** **id**="salicylic\_acid" **/>**

**<Reagent** **id**="acetic\_anhydride" **/>**

**<Reagent** **id**="sulphuric\_acid" **/>**

**<Reagent** **id**="water" **/>**

**</Reagents>**

**<Procedure>**

<!--Preheat the reactor-->

**<HeatChillToTemp**

**vessel**="reactor"

**temp**="70 °C" **/>**

<!--Maintain reactor temperature-->

**<StartHeatChill**

**vessel**="reactor"

**temp**="70 °C"**/>**

<!--Maintain stirring-->

**<StartStir**

**vessel**="reactor"

**stir\_speed**="4000 rpm"**/>**

<!--Add bulk of acetic anhydride-->

**<Add**

**reagent**="acetic\_anhydride"

**vessel**="Reactor1"

**volume**="6 ml" **/>**

<!--Add sulphuric acid-->

**<Add**

**reagent**="sulphuric\_acid"

**vessel**="reactor"

**volume**="0.5 ml" **/>**

<!--Maintain at temp for specified time-->

**<HeatChill**

**vessel**="Reactor1"

**temp**="70 °C"

**time**="900 s"**/>**

**<Wait**

**time**='0s'

**comments**="wait\_user, wait\_reason(transfer to filter)" **/>**

**<--!** **add** **water** **to** **top** **of** **filter** **for** **crystallisation** --**>**

**<Add**

**reagent**="water"

**vessel**="flask0"

**volume**="10 ml"

**/>**

<!--Wait while cooling-->

**<StopHeatChill**

**vessel**="reactor1" **/>**

**<Wait**

**time**="300 s"

**comments**="wait\_reason(crystallisation)" **/>**

<!-- wash the products -->

**<Transfer**

**from\_vessel**="filter\_bot"

**to\_vessel**="waste"

**volume**="10 ml" **/>**

**<Add**

**reagent**="water"

**vessel**="filter\_top"

**volume**="5 ml" **/>**

**<Transfer**

**from\_vessel**="filter\_bot"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

**<Add**

**reagent**="water"

**vessel**="filter\_top"

**volume**="5 ml" **/>**

**<Transfer**

**from\_vessel**="filter\_bot"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

**<Add**

**reagent**="water"

**vessel**="filter\_top"

**volume**="5 ml" **/>**

**<Transfer**

**from\_vessel**="filter\_bot"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

**</Procedure>**

**</Synthesis>**

**</XDL>**

## Aspirin reaction data

**NMR spectrum**

Diagram

Description automatically generated

Nuclear Magnetic Resonance Spectroscopy (1H and 13C{H}) Analysis of Aspirin

1H-NMR (500 MHz, CDCl3) δ ppm: 2.33 (s, CH3), 7.122 (d, aromatic H), 7.335 (t, aromatic H), 7.604 (m, aromatic H), 8.103 (dd, OH). 13C{H}-NMR (125 MHz, CDCl3) δ ppm: 21.20 (s, CH3), 122.50 (s, aromatic C), 124.25 (s, aromatic C), 126.36 (s, aromatic C), 132.73 (s, aromatic C), 135.05 (s, aromatic C), 151.53 (s, aromatic C), 169.88 (d, COOH)

# Collaborative azo dye search

## Materials and methods

Stock solutions were prepared using a solvent comprised of 0.01 M acetone and 1.7 M HCl in a 1:1 ratio. 0.01 M sodium nitrite solution was prepared in water and 0.5 M sodium hydroxide in water. The following equipment was used for the azo dye syntheses:

Table 3: Equipment for azo dye reactions

|  |  |
| --- | --- |
| QTY | Item |
| 3 | Raspberry Pi 4 |
| 3 | Raspberry Pi camera module |
| 3 | Arduino and RAMPS |
| 6 | DRV8825 stepper drivers |
| 3 | Syringe pump module |
| 3 | Selector valve module |
| 3 | Stirrer module |
| 3 | Sample vial holder |
| 3 | 100 ml Schott bottle |
| 2 | 250 ml Schott bottle |
| 2 | 1 l Schott bottle |
| 3 | Magnetic stirrer bar |
| 1 | 15 m of 1/8 in’ diameter tubing |
| 1 | 10 cm of 1/16 in’ diameter tubing |
| 4 | 3D printed tiles for Schott bottles |
| 1 | 100 ml aniline solution |
| 1 | 100 ml 4-nitroaniline solution |
| 1 | 100 ml 1-naphthylamine solution |
| 1 | 250 ml sodium hydroxide solution |
| 1 | 250 ml sodium nitrate solution |
| 2 | Retort stands |

The following steps were followed to set up for the reaction:

1. Flash the firmware to the Arduino Mega.
2. Install UJ\_FB, Commanduino, and OpenCV on the Raspberry Pi.
3. Connect the syringe pump, selector valve, and reactor to the RAMPS board. Instructions are included in Appendix A.
4. Write and check the XDL for the synthesis.
5. Clean the valve and check that all fasteners on the actuator are secure.
6. Suspend the syringe pump vertically using a retort stand.
7. Drill four 3.2 mm holes in the lids of each Schott bottle
8. Drill one 3.2 mm hole in each of the sample vials
9. Prepare the tubing for the sample vials, measuring the length of the tubing.
10. Prepare and attach tubing for the reagents, deionised water, and waste.
11. Place each sample vial into a 3D printed holder with a sheet of white paper backing the sample vial.
12. Place a short length of 1/16 in tubing in the end of the tubes to the reactor.
13. Prime the tubing to the reagents and deionised water.
14. Secure the camera module mount to the table.
15. Run the setup\_GUI.py script to set up the UJ\_FB software.
16. Focus the cameras using included tool and video captured from OpenCV.

A 3D printed holder was designed to secure the sample vial without obscuring the solution within the vial. The experimental setup for the syntheses is shown in Figure 63. The reagents, water, and waste were set up between two rows of robots. The reactions were distributed across three discrete robots by installing the UJ\_FB software on three Raspberry Pis connected to an instance of the MC\_Labserver software running on a fourth Raspberry Pi.

A picture containing text

Description automatically generated

Figure 1: Experimental setup for azo dye synthesis

Common reagent bottles were set up that each robot could access independently. The selector valve for each robot was plumbed to each of the reagents and to a common waste bottle. Reactions were performed in sample vials held in place over a fan-based magnetic stirrer using a 3D printed holder. While the reactions were running, the reagents were refilled as required. The waste bottle was replaced whenever it became full.

The following process was followed to carry out the reactions:

1. Upload a batch of reactions as a CSV file to the server
2. Set up an SSH instance connecting to the Raspberry Pi
3. Start a Python shell and create an instance of the Manager
4. Start stirring at 2500 RPM.
5. Add X ml of reagent one to the sample vial.
6. Add Y ml of sodium nitrite.
7. Stir for 120 s.
8. Pause stirring, take image one and upload to the server, then resume stirring.
9. Add Z ml of reagent two to the sample vial.
10. Wait 30 min for reaction completion.
11. Pause stirring, take image two and upload to the server, then resume stirring.
12. Transfer 5 ml of products from sample vial to waste.
13. Add 5ml of deionised water to the sample vial
14. Pause stirring, take image three and upload to the server, then resume stirring.
15. Add 2 ml of sodium hydroxide to the sample vial.
16. Pause stirring, take image four and upload to the server, then resume stirring.
17. Flush the reactor and rinse it three times.

## Collaborative azo dye search XDL

**<?xdl** **version**="1.0"**?>**

**<XDL>**

**<Synthesis>**

**<Metadata**

**description**="XDL for the azo-dye collaborative reactions"

**img\_processing**="azo"**>**

**</Metadata>**

**<Hardware>**

**<Component** **id**="Reactor1" **type**="reactor"**/>**

**</Hardware>**

**<Parameters>**

**</Parameters>**

**<Reagents>**

**<Reagent** **id**="1 naphthylamine" **/>**

**<Reagent** **id**="nitroaniline" **/>**

**<Reagent** **id**="aniline" **/>**

**<Reagent** **id**="sodium nitrate" **/>**

**<Reagent** **id**="water" **/>**

**<Reagent** **id**="sodium hydroxide" **/>**

**</Reagents>**

**<Procedure>**

<!--Maintain stirrring-->

**<StartStir**

**vessel**="reactor"

**stir\_speed**="2500 rpm"**/>**

<!-- reagent1 -->

**<Add**

**reagent** = "1 naphthylamine"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_0" **/>**

**<Add**

**reagent** = "nitroaniline"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_1" **/>**

**<Add**

**reagent** = "aniline"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_2" **/>**

**<Add**

**reagent**="water"

**vessel**="waste"

**volume**="1 ml" **/>**

<!-- sodium nitrate -->

**<Add**

**reagent** = "sodium nitrate"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_3" **/>**

**<Add**

**reagent**="water"

**vessel**="waste"

**volume**="1 ml" **/>**

**<Wait**

**time** = "120 s"

**comments** = "wait\_reason(mixing)" **/>**

**<StopStir**

**vessel**="reactor1" **/>**

**<Wait**

**time**= "0 s"

**comments**="Picture1" **/>**

**<StartStir**

**vessel**="reactor1"

**stir\_speed**="2500 rpm" **/>**

<!-- reagent2 -->

**<Add**

**reagent** = "1 naphthylamine"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_4" **/>**

**<Add**

**reagent** = "nitroaniline"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_5" **/>**

**<Add**

**reagent** = "aniline"

**vessel** = "reactor"

**volume** = ""

**step\_param0** = "param\_6" **/>**

**<Add**

**reagent**="water"

**vessel**="waste"

**volume**="1 ml" **/>**

<!-- wait 30 min for reaction completion -->

**<Wait**

**time**= "30 min"

**comments** = "wait\_reason(waiting for reaction completion)" **/>**

**<StopStir**

**vessel**="reactor1" **/>**

**<Wait**

**time**="20 s"

**comments**="Picture2" **/>**

**<StartStir**

**vessel**="reactor1"

**stir\_speed**="2500 rpm" **/>**

<!-- Transfer 4.4 ml of products to waste for dilution (assume we've lost ~ 0.6 ml to residue in syringe-->

**<Transfer**

**from\_vessel**="reactor"

**to\_vessel**="waste"

**volume**="4.4 ml" **/>**

<!-- dilute to 1/6 parts -->

**<Add**

**reagent**="water"

**vessel**="reactor"

**volume**="5 ml" **/>**

**<StopStir**

**vessel**="reactor" **/>**

**<Wait**

**time**= "20 s"

**comments**="Picture3" **/>**

**<StartStir**

**vessel**="reactor"

**stir\_speed**="2500 rpm" **/>**

<!-- Add base -->

**<Add**

**reagent**="sodium hydroxide"

**vessel**="reactor"

**volume**="2 ml" **/>**

**<StopStir**

**vessel**="reactor" **/>**

**<Wait**

**time**= "20 s"

**comments**= "Picture4" **/>**

**<StartStir**

**vessel**="reactor"

**stir\_speed**="2500 rpm" **/>**

<!-- empty reactor -->

**<Transfer**

**from\_vessel**="reactor"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

<!-- wash 1 -->

**<Add**

**reagent**="water"

**vessel**="reactor"

**volume**="8 ml" **/>**

**<Transfer**

**from\_vessel**="reactor"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

<!-- wash 2 -->

**<Add**

**reagent**="water"

**vessel**="reactor"

**volume**="8 ml" **/>**

**<Transfer**

**from\_vessel**="reactor"

**to\_vessel**="waste"

**volume**="8 ml" **/>**

<!-- wash 3 -->

**<Add**

**reagent**="water"

**vessel**="reactor"

**volume**="8 ml" **/>**

**<Transfer**

**from\_vessel**="reactor"

**to\_vessel**="waste"

**volume**="15 ml" **/>**

**<StopStir**

**vessel**="reactor" **/>**

**</Procedure>**

**</Synthesis>**

**</XDL>**

## Collaborative azo search results

**Raw results**

This set of results is from the raw images. Lighting in the laboratory was poor, leading many of the colours to be too dark.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Reaction ID | 1-Naphthylamine r1 [ml] | 4-Nitroaniline r1 [ml] | Aniline r1 [ml] | Sodium nitrite r2 [ml] | 1-Naphthylamine r3 [ml] | 4-Nitroaniline r3 [ml] | Aniline r3 [ml] | Colour 1 [hex] | Colour 1 | Colour 2 [hex] | Colour 2 | Colour 3 [hex] | Colour 3 | Colour 4 [hex] | Colour 4 |
| 72 | 0.3 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0x302c2e |  | 0xd050c |  | 0x452c3c |  | 0x2b1210 |  |
| 73 | 1.1 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 0x1d1416 |  | 0x1f1518 |  | 0x231517 |  | 0x23181a |  |
| 74 | 2.9 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 0x291829 |  | 0xe0a13 |  | 0x2a1033 |  | 0x110506 |  |
| 78 | 3.7 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 0x37262f |  | 0x2e1d28 |  | 0x615862 |  | 0x5c5259 |  |
| 79 | 2.0 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0x433c2f |  | 0x463b28 |  | 0x3f3a39 |  | 0x472118 |  |
| 80 | 2.0 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0x393122 |  | 0x210e11 |  | 0x372f31 |  | 0x100506 |  |
| 81 | 2.0 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x2f242f |  | 0x141117 |  | 0x1f0a29 |  | 0x12070c |  |
| 82 | 2.0 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0x675c69 |  | 0xa060e |  | 0x220f33 |  | 0x321138 |  |
| 83 | 3.7 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 0x392c38 |  | 0x110b16 |  | 0x200b2b |  | 0x310f2b |  |
| 84 | 2.9 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 0x140914 |  | 0xa080d |  | 0x17071e |  | 0x1c0908 |  |
| 85 | 1.1 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 0x413a2f |  | 0x1d0d11 |  | 0x38282f |  | 0x80303 |  |
| 86 | 0.3 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0x453f39 |  | 0x3b301d |  | 0x50453c |  | 0xc0305 |  |
| 87 | 2.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0x241912 |  | 0xd080e |  | 0x352434 |  | 0x14080a |  |
| 156 | 0.3 | 0.0 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0x3c3a42 |  | 0x54200f |  | 0x4f3119 |  | 0x422412 |  |
| 157 | 1.1 | 0.0 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0x161214 |  | 0x32090d |  | 0x4d1610 |  | 0x3e0e0a |  |
| 158 | 2.9 | 0.0 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0x27050c |  | 0x80304 |  | 0x230409 |  | 0x29070a |  |
| 159 | 3.7 | 0.0 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0x200516 |  | 0xa060b |  | 0x150618 |  | 0x1b0508 |  |
| 160 | 2.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0x221b17 |  | 0x49351d |  | 0x4e4336 |  | 0x2c110d |  |
| 161 | 2.0 | 0.0 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0x492d21 |  | 0x491910 |  | 0x5a362a |  | 0x57241b |  |
| 162 | 2.0 | 0.0 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x290f1f |  | 0xf0508 |  | 0x2d0d11 |  | 0x1b0405 |  |
| 163 | 2.0 | 0.0 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0x4f4155 |  | 0xf0708 |  | 0x2b1210 |  | 0x481d14 |  |
| 164 | 3.7 | 0.0 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0x35202a |  | 0x10070a |  | 0x2c0f17 |  | 0x320f14 |  |
| 165 | 2.9 | 0.0 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0x270f13 |  | 0x10090b |  | 0x2c0a11 |  | 0x140507 |  |
| 166 | 1.1 | 0.0 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0x3f312c |  | 0x55240d |  | 0x5f4021 |  | 0x40101 |  |
| 167 | 0.3 | 0.0 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0x332926 |  | 0x40362a |  | 0x433d39 |  | 0x1b1611 |  |
| 168 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0x341d21 |  | 0x3a0910 |  | 0x310e0d |  | 0xc0403 |  |
| 101 | 0.3 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 3.7 | 0x423b34 |  | 0x58493b |  | 0x58514e |  | 0x4f130b |  |
| 102 | 1.1 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.9 | 0x342f26 |  | 0x40372a |  | 0x242022 |  | 0x4b3d38 |  |
| 103 | 2.9 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 1.1 | 0x2a1820 |  | 0x110a13 |  | 0x2d152f |  | 0x90405 |  |
| 104 | 3.7 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.3 | 0x1c0c11 |  | 0xd090d |  | 0x1b0721 |  | 0xa0201 |  |
| 105 | 2.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0x403b2a |  | 0x443a26 |  | 0x4d463e |  | 0x130608 |  |
| 106 | 2.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0x3b3527 |  | 0x40331e |  | 0x433b35 |  | 0xe0202 |  |
| 107 | 2.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0x3b2f37 |  | 0x130a14 |  | 0x311934 |  | 0x130607 |  |
| 108 | 2.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x3a2c36 |  | 0x140715 |  | 0x391c3b |  | 0x422333 |  |
| 109 | 3.7 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 2.0 | 0x2a1820 |  | 0xd080e |  | 0x250c2e |  | 0x421639 |  |
| 110 | 2.9 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.0 | 0x2e232f |  | 0xf0b13 |  | 0x1e0927 |  | 0x3c150f |  |
| 111 | 1.1 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 2.0 | 0x352f25 |  | 0x453c2f |  | 0x494341 |  | 0x160806 |  |
| 112 | 0.3 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 2.0 | 0x433e3b |  | 0x4c443c |  | 0x4c4346 |  | 0x4d1208 |  |
| 113 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0x2d241d |  | 0x3d2f21 |  | 0x4c4441 |  | 0xb0405 |  |
| 169 | 0.0 | 0.3 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0x6b3d4c |  | 0x18080b |  | 0x1d080c |  | 0x1d080c |  |
| 170 | 0.0 | 1.1 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 0x1b1214 |  | 0xb0506 |  | 0x80101 |  | 0x60203 |  |
| 171 | 0.0 | 2.9 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 0x4e3c19 |  | 0x180e10 |  | 0x1f0b0e |  | 0xd0705 |  |
| 172 | 0.0 | 3.7 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 0x4a210f |  | 0x110607 |  | 0x27090b |  | 0x310b09 |  |
| 173 | 0.0 | 2.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0x5a3c2c |  | 0x502011 |  | 0x572d29 |  | 0x281810 |  |
| 174 | 0.0 | 2.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0x613e3a |  | 0x80202 |  | 0xc0405 |  | 0xe0406 |  |
| 175 | 0.0 | 2.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x321316 |  | 0x180c0e |  | 0x18090a |  | 0x150504 |  |
| 176 | 0.0 | 2.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0x270f11 |  | 0x140609 |  | 0x410c11 |  | 0x4b0d11 |  |
| 177 | 0.0 | 3.7 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 0x50140b |  | 0x110303 |  | 0x1e0506 |  | 0x210406 |  |
| 178 | 0.0 | 2.9 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 0x330608 |  | 0x190507 |  | 0x210508 |  | 0x230608 |  |
| 179 | 0.0 | 1.1 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 0x4f3f37 |  | 0xb0506 |  | 0x3f090f |  | 0xe0302 |  |
| 180 | 0.0 | 0.3 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0x282122 |  | 0x3c130d |  | 0x59131f |  | 0xf0506 |  |
| 181 | 0.0 | 2.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0x56151e |  | 0xb0302 |  | 0x170504 |  | 0x140705 |  |
| 182 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0x56525c |  | 0x504014 |  | 0x564624 |  | 0x643f15 |  |
| 183 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0x181112 |  | 0x490e08 |  | 0x5c3018 |  | 0x310e08 |  |
| 184 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0x3c0907 |  | 0x180506 |  | 0x562b1c |  | 0x230f09 |  |
| 185 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0x4f080e |  | 0x3a080d |  | 0x521d17 |  | 0x260f0c |  |
| 186 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0x584d3d |  | 0x4e4235 |  | 0x3c3431 |  | 0x4b352b |  |
| 187 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0x573a30 |  | 0x533423 |  | 0x53413a |  | 0x332418 |  |
| 188 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x462617 |  | 0x4b1f0d |  | 0x563d1d |  | 0x6c4b1a |  |
| 189 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0x32171a |  | 0x35080b |  | 0x5e2a1a |  | 0x73361c |  |
| 190 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0x4a2a12 |  | 0x471509 |  | 0x4d311a |  | 0x603b13 |  |
| 191 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0x4e2e15 |  | 0x4c230e |  | 0x523d1d |  | 0x674a1c |  |
| 192 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0x554b41 |  | 0x50412f |  | 0x55483d |  | 0x34251b |  |
| 193 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0x1c1819 |  | 0x534639 |  | 0x524549 |  | 0x4b382c |  |
| 194 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0x463a2c |  | 0x4c3a12 |  | 0x4b4024 |  | 0x2f1309 |  |
| 195 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0.0 | 3.7 | 0x191719 |  | 0x502e21 |  | 0x423032 |  | 0x4d160c |  |
| 196 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0.0 | 2.9 | 0x423b36 |  | 0x583116 |  | 0x5a4237 |  | 0x1f0906 |  |
| 197 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0.0 | 1.1 | 0x5a3f1b |  | 0x562810 |  | 0x5a432b |  | 0x331813 |  |
| 198 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0.0 | 0.3 | 0x523c16 |  | 0x4a3213 |  | 0x514325 |  | 0x2d130d |  |
| 199 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0x574e42 |  | 0x51473b |  | 0x403a38 |  | 0x1e130c |  |
| 200 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0x574d44 |  | 0x4b4033 |  | 0x3c3433 |  | 0x211009 |  |
| 201 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0x4e401c |  | 0x53290a |  | 0x5b4121 |  | 0x6e4c1e |  |
| 202 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x4d3f1c |  | 0x5b3715 |  | 0x5f4c2c |  | 0x6a5430 |  |
| 203 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0.0 | 2.0 | 0x4a3818 |  | 0x482c10 |  | 0x4e3e1f |  | 0x644f24 |  |
| 204 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0.0 | 2.0 | 0x4f3418 |  | 0x491e0d |  | 0x573d1f |  | 0x643e19 |  |
| 205 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0.0 | 2.0 | 0x504841 |  | 0x51473f |  | 0x423b3e |  | 0x240b07 |  |
| 206 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0.0 | 2.0 | 0x563b31 |  | 0x635341 |  | 0x493f3d |  | 0x4f1b0c |  |
| 207 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0x5f4930 |  | 0x612f10 |  | 0x5c4639 |  | 0x3a1d10 |  |
| 208 | 0.0 | 0.0 | 0.3 | 2.0 | 3.7 | 0.0 | 0.0 | 0x4d4953 |  | 0xc060c |  | 0x1f0518 |  | 0x70101 |  |
| 209 | 0.0 | 0.0 | 1.1 | 2.0 | 2.9 | 0.0 | 0.0 | 0x4c4850 |  | 0x11050c |  | 0x300615 |  | 0x180709 |  |
| 210 | 0.0 | 0.0 | 2.9 | 2.0 | 1.1 | 0.0 | 0.0 | 0x5b443e |  | 0x3a0416 |  | 0x561040 |  | 0x52170a |  |
| 211 | 0.0 | 0.0 | 3.7 | 2.0 | 0.3 | 0.0 | 0.0 | 0x5b4843 |  | 0x440923 |  | 0x512841 |  | 0x4f1e12 |  |
| 212 | 0.0 | 0.0 | 2.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0x473935 |  | 0x41362f |  | 0x463d3b |  | 0x200608 |  |
| 213 | 0.0 | 0.0 | 2.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0x412d2b |  | 0x431728 |  | 0x573747 |  | 0x1f0709 |  |
| 214 | 0.0 | 0.0 | 2.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x2d2427 |  | 0x19040a |  | 0x48082d |  | 0x5e2511 |  |
| 215 | 0.0 | 0.0 | 2.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0x42353a |  | 0x280613 |  | 0x480c36 |  | 0x63381b |  |
| 216 | 0.0 | 0.0 | 3.7 | 0.3 | 2.0 | 0.0 | 0.0 | 0x4b332b |  | 0x2f0514 |  | 0x4e0a30 |  | 0x660c38 |  |
| 217 | 0.0 | 0.0 | 2.9 | 1.1 | 2.0 | 0.0 | 0.0 | 0x442925 |  | 0x22040d |  | 0x480627 |  | 0x5e1b0d |  |
| 218 | 0.0 | 0.0 | 1.1 | 2.9 | 2.0 | 0.0 | 0.0 | 0x4f4742 |  | 0x514531 |  | 0x322d2f |  | 0x190506 |  |
| 219 | 0.0 | 0.0 | 0.3 | 3.7 | 2.0 | 0.0 | 0.0 | 0x181616 |  | 0x534a33 |  | 0x4f4440 |  | 0x21080c |  |
| 220 | 0.0 | 0.0 | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0x594b51 |  | 0x1c050d |  | 0x400625 |  | 0x380c06 |  |
| 221 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 3.7 | 0.0 | 0x3b363c |  | 0x53130d |  | 0x603821 |  | 0x6c3710 |  |
| 222 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 2.9 | 0.0 | 0x29272b |  | 0x35080b |  | 0x562e23 |  | 0x2a0f0a |  |
| 223 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 1.1 | 0.0 | 0x473835 |  | 0x4d0d13 |  | 0x5a5561 |  | 0x140f10 |  |
| 224 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.3 | 0.0 | 0x553035 |  | 0x1e0e0f |  | 0x443133 |  | 0x541d0c |  |
| 225 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0x5b4f4a |  | 0x483f3c |  | 0x50474b |  | 0x552212 |  |
| 226 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0x584743 |  | 0x594d40 |  | 0x59504a |  | 0x3f180d |  |
| 227 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x100e0f |  | 0x563515 |  | 0x4b381d |  | 0x5b270c |  |
| 228 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0x251e21 |  | 0x301808 |  | 0x5b4320 |  | 0x7a5e26 |  |
| 229 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 2.0 | 0.0 | 0x61444d |  | 0x4a0a0e |  | 0x531e1a |  | 0x763026 |  |
| 230 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 2.0 | 0.0 | 0x4e3021 |  | 0x5b3216 |  | 0x504f56 |  | 0xb0909 |  |
| 231 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 2.0 | 0.0 | 0x2f2b2d |  | 0x514336 |  | 0x51453f |  | 0x2a130a |  |
| 232 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 2.0 | 0.0 | 0x716b75 |  | 0x554c42 |  | 0x403a3b |  | 0x381c0e |  |
| 233 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0x52474e |  | 0x5a431e |  | 0x5f5033 |  | 0x491a0d |  |
| 234 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 3.7 | 0x514d58 |  | 0x2c2628 |  | 0x56515d |  | 0x3c220d |  |
| 235 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 2.9 | 0x201e21 |  | 0x141112 |  | 0x564a51 |  | 0x45100a |  |
| 236 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 1.1 | 0x624752 |  | 0x502f3a |  | 0x57474f |  | 0x52170a |  |
| 237 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0.3 | 0x534542 |  | 0xf0d0e |  | 0x554b52 |  | 0x3e1107 |  |
| 238 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0x1c1a1b |  | 0x312d2e |  | 0x6d6975 |  | 0x3b2b1e |  |
| 239 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0x342f31 |  | 0x352f31 |  | 0x4b454d |  | 0x42160d |  |
| 240 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0x4c3e34 |  | 0x50342d |  | 0x56454b |  | 0x612c0c |  |
| 241 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x1a181a |  | 0x473229 |  | 0x473a3e |  | 0x4c3c3a |  |
| 242 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 2.0 | 0x141213 |  | 0xf0d0e |  | 0x4f4a55 |  | 0xe0d0e |  |
| 243 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 2.0 | 0x1c1819 |  | 0x34282a |  | 0x48404b |  | 0x452e19 |  |
| 244 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 2.0 | 0x363234 |  | 0x433a38 |  | 0x52494e |  | 0x4d180b |  |
| 245 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 2.0 | 0x3f3b40 |  | 0x352f31 |  | 0x4b4247 |  | 0x4c2312 |  |
| 246 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0x352f2c |  | 0x473c38 |  | 0x575460 |  | 0xe0809 |  |

**Brightness adjusted results**

The following gives the results from the collaborative search of an azo coupling chemical space after adjusting the brightness of the images. The images were adjusted with γ = 0.75, α = 2, and β=10.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Reaction ID | 1-Naphthylamine r1 [ml] | 4-Nitroaniline r1 [ml] | Aniline r1 [ml] | Sodium nitrite r2 [ml] | 1-Naphthylamine r3 [ml] | 4-Nitroaniline r3 [ml] | Aniline r3 [ml] | Colour 1 [hex] | Colour 1 | Colour 2 [hex] | Colour 2 | Colour 3 [hex] | Colour 3 | Colour 4 [hex] | Colour 4 |
| 72 | 0.3 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0x656264 |  | 0x352433 |  | 0x97718c |  | 0x6d3f3c |  |
| 73 | 1.1 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 0x3f3a3a |  | 0x403a3a |  | 0x48393a |  | 0x443c3d |  |
| 74 | 2.9 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 0x6c4c6c |  | 0x372e41 |  | 0x6e3b7d |  | 0x3e2427 |  |
| 78 | 3.7 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 0x856978 |  | 0x75586b |  | 0xc3b9c3 |  | 0xbcb1b8 |  |
| 79 | 2.0 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0x9a8f79 |  | 0x9d8c6c |  | 0x898482 |  | 0xa56350 |  |
| 80 | 2.0 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0x887b60 |  | 0x5c373d |  | 0x7c7375 |  | 0x3c2225 |  |
| 81 | 2.0 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x776276 |  | 0x413b47 |  | 0x5b306f |  | 0x3c2731 |  |
| 82 | 2.0 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0xdacbda |  | 0x2e2536 |  | 0x633982 |  | 0x823f8e |  |
| 83 | 3.7 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 0x897284 |  | 0x3c3046 |  | 0x5c3072 |  | 0x7e3c74 |  |
| 84 | 2.9 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 0x432d43 |  | 0x302936 |  | 0x4c2859 |  | 0x532d2b |  |
| 85 | 1.1 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 0x968b79 |  | 0x573640 |  | 0x886d7a |  | 0x2b1e1e |  |
| 86 | 0.3 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0x9a9287 |  | 0x8a7a57 |  | 0xab9d8f |  | 0x352023 |  |
| 87 | 2.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0x614f40 |  | 0x372b3a |  | 0x816580 |  | 0x452a2f |  |
| 156 | 0.3 | 0.0 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0x8b8791 |  | 0xb35e3c |  | 0xab7d4f |  | 0x9b6843 |  |
| 157 | 1.1 | 0.0 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0x403b3c |  | 0x802c37 |  | 0xa94a3f |  | 0x963a31 |  |
| 158 | 2.9 | 0.0 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0x6c2334 |  | 0x291e21 |  | 0x66222e |  | 0x722830 |  |
| 159 | 3.7 | 0.0 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0x5d244b |  | 0x2d2530 |  | 0x48264d |  | 0x53232a |  |
| 160 | 2.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0x584d47 |  | 0xa38558 |  | 0xa89985 |  | 0x773f35 |  |
| 161 | 2.0 | 0.0 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0xa37660 |  | 0xa2513e |  | 0xba8873 |  | 0xc06958 |  |
| 162 | 2.0 | 0.0 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x6c395a |  | 0x3a242b |  | 0x783741 |  | 0x512225 |  |
| 163 | 2.0 | 0.0 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0xaa95ac |  | 0x39272b |  | 0x6c413d |  | 0xa75b49 |  |
| 164 | 3.7 | 0.0 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0x845e71 |  | 0x3d2930 |  | 0x743b4c |  | 0x813c47 |  |
| 165 | 2.9 | 0.0 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0x693a43 |  | 0x3c2c31 |  | 0x752f40 |  | 0x46252a |  |
| 166 | 1.1 | 0.0 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0x937d73 |  | 0xb36637 |  | 0xc39961 |  | 0x221a1a |  |
| 167 | 0.3 | 0.0 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0x7b6b66 |  | 0x938470 |  | 0x9a8f89 |  | 0x554c41 |  |
| 168 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0x7f575e |  | 0x8d2d3d |  | 0x753735 |  | 0x36201e |  |
| 101 | 0.3 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 3.7 | 0x848179 |  | 0xaba18d |  | 0xa5a2a1 |  | 0xae4432 |  |
| 102 | 1.1 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.9 | 0x797264 |  | 0x92846f |  | 0x575355 |  | 0xa7918a |  |
| 103 | 2.9 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 1.1 | 0x704e5e |  | 0x3e2d42 |  | 0x76497a |  | 0x2e2124 |  |
| 104 | 3.7 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.3 | 0x563440 |  | 0x332b33 |  | 0x54285f |  | 0x311c19 |  |
| 105 | 2.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0x958d71 |  | 0x9a8b69 |  | 0xa99f93 |  | 0x45252c |  |
| 106 | 2.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0x8e836b |  | 0x937f5a |  | 0x958981 |  | 0x3a1d1b |  |
| 107 | 2.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0x8d7886 |  | 0x412e44 |  | 0x7a5081 |  | 0x45252a |  |
| 108 | 2.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x867080 |  | 0x462847 |  | 0x8a568d |  | 0x9a6482 |  |
| 109 | 3.7 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 2.0 | 0x6f4e5c |  | 0x332936 |  | 0x693379 |  | 0xa04c90 |  |
| 110 | 2.9 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.0 | 0x766376 |  | 0x392f40 |  | 0x5a2d6a |  | 0x91483c |  |
| 111 | 1.1 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 2.0 | 0x7e7465 |  | 0x978c76 |  | 0x999391 |  | 0x432a25 |  |
| 112 | 0.3 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 2.0 | 0x928c89 |  | 0xa3998e |  | 0x9e9698 |  | 0xb2432a |  |
| 113 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0x726357 |  | 0x8e785f |  | 0x9c9592 |  | 0x312124 |  |
| 169 | 0.0 | 0.3 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0xde99b1 |  | 0x532c34 |  | 0x5d2c37 |  | 0x5c2c37 |  |
| 170 | 0.0 | 1.1 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 0x4a3b3f |  | 0x302326 |  | 0x2d1a19 |  | 0x251c1e |  |
| 171 | 0.0 | 2.9 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 0xa78e50 |  | 0x4a373b |  | 0x5b3338 |  | 0x362724 |  |
| 172 | 0.0 | 3.7 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 0xa8623c |  | 0x3f2629 |  | 0x692e32 |  | 0x7f342e |  |
| 173 | 0.0 | 2.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0xb08f74 |  | 0xad5d3f |  | 0xb1776e |  | 0x70503e |  |
| 174 | 0.0 | 2.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0xb4938c |  | 0x2a1c1c |  | 0x352024 |  | 0x3b2226 |  |
| 175 | 0.0 | 2.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x784047 |  | 0x4a3337 |  | 0x4a2c2f |  | 0x472322 |  |
| 176 | 0.0 | 2.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0x60383c |  | 0x44262d |  | 0x9b3440 |  | 0xae3740 |  |
| 177 | 0.0 | 3.7 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 0x9c4530 |  | 0x3f1e1d |  | 0x552224 |  | 0x5b2224 |  |
| 178 | 0.0 | 2.9 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 0x82272c |  | 0x532329 |  | 0x64252c |  | 0x67262c |  |
| 179 | 0.0 | 1.1 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 0x9c8f84 |  | 0x302224 |  | 0x952c3b |  | 0x381e1c |  |
| 180 | 0.0 | 0.3 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0x5d5558 |  | 0x8f4336 |  | 0xbf465e |  | 0x3a2326 |  |
| 181 | 0.0 | 2.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0xaa475a |  | 0x331f1d |  | 0x4d2320 |  | 0x472923 |  |
| 182 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0xb6b1ba |  | 0xa89446 |  | 0xb39e66 |  | 0xd59b4a |  |
| 183 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0x41383a |  | 0x9f372a |  | 0xb77c4f |  | 0x80392a |  |
| 184 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0x852d29 |  | 0x462325 |  | 0xb97557 |  | 0x653b2f |  |
| 185 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0xaf2b39 |  | 0x8b2b38 |  | 0xb0594c |  | 0x6a3c34 |  |
| 186 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0xb3a992 |  | 0xa69782 |  | 0x827975 |  | 0xad8876 |  |
| 187 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0xaa8b79 |  | 0xa78062 |  | 0xaa958c |  | 0x83694f |  |
| 188 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x9b674b |  | 0xa85d37 |  | 0xb99359 |  | 0xe2b156 |  |
| 189 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0x70474c |  | 0x7c2931 |  | 0xbb7154 |  | 0xe18a5a |  |
| 190 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0x9d6f40 |  | 0x9d482e |  | 0xa97e53 |  | 0xcf9445 |  |
| 191 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0x9f7548 |  | 0xa56238 |  | 0xaf9159 |  | 0xd6ac5a |  |
| 192 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0xafa597 |  | 0xad997a |  | 0xb5a593 |  | 0x876c57 |  |
| 193 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0x484445 |  | 0xac9e8a |  | 0xa89b9f |  | 0xae8d79 |  |
| 194 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0x978871 |  | 0xa38a41 |  | 0xa79666 |  | 0x7d462f |  |
| 195 | 0.0 | 0.3 | 0.0 | 2.0 | 0.0 | 0.0 | 3.7 | 0x424142 |  | 0xa7775f |  | 0x8d777a |  | 0xaf4b36 |  |
| 196 | 0.0 | 1.1 | 0.0 | 2.0 | 0.0 | 0.0 | 2.9 | 0x908881 |  | 0xb37e48 |  | 0xbb9b88 |  | 0x5d2e27 |  |
| 197 | 0.0 | 2.9 | 0.0 | 2.0 | 0.0 | 0.0 | 1.1 | 0xac9454 |  | 0xad6c3e |  | 0xb69b73 |  | 0x835146 |  |
| 198 | 0.0 | 3.7 | 0.0 | 2.0 | 0.0 | 0.0 | 0.3 | 0xb1914c |  | 0xa47e44 |  | 0xae9b68 |  | 0x7b4737 |  |
| 199 | 0.0 | 2.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0xb3aa99 |  | 0xa69d8c |  | 0x8d8583 |  | 0x5c4635 |  |
| 200 | 0.0 | 2.0 | 0.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0xb3a99c |  | 0xa6947f |  | 0x817977 |  | 0x613e2f |  |
| 201 | 0.0 | 2.0 | 0.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0xa49355 |  | 0xb5712f |  | 0xbc9961 |  | 0xe5b35c |  |
| 202 | 0.0 | 2.0 | 0.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x8f8953 |  | 0xb28648 |  | 0xbca975 |  | 0xd0b77f |  |
| 203 | 0.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0.0 | 2.0 | 0x9f874e |  | 0xa0733e |  | 0xaa935d |  | 0xd2b56a |  |
| 204 | 0.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0.0 | 2.0 | 0xa4814d |  | 0xa35935 |  | 0xae905b |  | 0xd09852 |  |
| 205 | 0.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0.0 | 2.0 | 0xa69e95 |  | 0xa79c91 |  | 0x91888b |  | 0x693329 |  |
| 206 | 0.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0.0 | 2.0 | 0xa48b7a |  | 0xb7ad97 |  | 0x8c8684 |  | 0xb35536 |  |
| 207 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0xa79f7a |  | 0xb0793a |  | 0xad9a89 |  | 0x8f593d |  |
| 208 | 0.0 | 0.0 | 0.3 | 2.0 | 3.7 | 0.0 | 0.0 | 0xa39fa5 |  | 0x342432 |  | 0x5c234f |  | 0x281a1a |  |
| 209 | 0.0 | 0.0 | 1.1 | 2.0 | 2.9 | 0.0 | 0.0 | 0xa19da3 |  | 0x402433 |  | 0x7e274a |  | 0x4f292e |  |
| 210 | 0.0 | 0.0 | 2.9 | 2.0 | 1.1 | 0.0 | 0.0 | 0xa59790 |  | 0x8b214a |  | 0xb53c97 |  | 0xb94d31 |  |
| 211 | 0.0 | 0.0 | 3.7 | 2.0 | 0.3 | 0.0 | 0.0 | 0xaca099 |  | 0x9d2d64 |  | 0xad6c99 |  | 0xb45c43 |  |
| 212 | 0.0 | 0.0 | 2.0 | 3.7 | 0.3 | 0.0 | 0.0 | 0x9a8781 |  | 0x938377 |  | 0x988d8a |  | 0x5e262b |  |
| 213 | 0.0 | 0.0 | 2.0 | 2.9 | 1.1 | 0.0 | 0.0 | 0x91736f |  | 0x9b4c6c |  | 0xbf8aa6 |  | 0x5c282d |  |
| 214 | 0.0 | 0.0 | 2.0 | 1.1 | 2.9 | 0.0 | 0.0 | 0x615b5d |  | 0x4f202e |  | 0xa22a77 |  | 0xca6b40 |  |
| 215 | 0.0 | 0.0 | 2.0 | 0.3 | 3.7 | 0.0 | 0.0 | 0x8c7d82 |  | 0x6c2444 |  | 0xa33486 |  | 0xce8e56 |  |
| 216 | 0.0 | 0.0 | 3.7 | 0.3 | 2.0 | 0.0 | 0.0 | 0x9c7d6f |  | 0x792346 |  | 0xac2e7b |  | 0xd5348f |  |
| 217 | 0.0 | 0.0 | 2.9 | 1.1 | 2.0 | 0.0 | 0.0 | 0x936c65 |  | 0x622235 |  | 0xa6266e |  | 0xd05937 |  |
| 218 | 0.0 | 0.0 | 1.1 | 2.9 | 2.0 | 0.0 | 0.0 | 0x94928f |  | 0xa5987b |  | 0x6e6a6b |  | 0x4f2327 |  |
| 219 | 0.0 | 0.0 | 0.3 | 3.7 | 2.0 | 0.0 | 0.0 | 0x413f40 |  | 0xaca381 |  | 0xa19793 |  | 0x622c35 |  |
| 220 | 0.0 | 0.0 | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0xaba3a7 |  | 0x562236 |  | 0x962568 |  | 0x873426 |  |
| 221 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 3.7 | 0.0 | 0x807c80 |  | 0xb04336 |  | 0xc18b62 |  | 0xe28e40 |  |
| 222 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 2.9 | 0.0 | 0x595859 |  | 0x7f2a32 |  | 0xb17765 |  | 0x723c31 |  |
| 223 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 1.1 | 0.0 | 0x90827e |  | 0xa23543 |  | 0xaeadae |  | 0x3e3537 |  |
| 224 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.3 | 0.0 | 0xa37a81 |  | 0x503638 |  | 0x8d777b |  | 0xb85835 |  |
| 225 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.3 | 0.0 | 0xb5aba4 |  | 0x958b87 |  | 0xa59ca1 |  | 0xbf6443 |  |
| 226 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 1.1 | 0.0 | 0xa19a96 |  | 0xaba394 |  | 0xada6a0 |  | 0x994f36 |  |
| 227 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 2.9 | 0.0 | 0x323131 |  | 0xab8247 |  | 0xa68858 |  | 0xc26d34 |  |
| 228 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 3.7 | 0.0 | 0x575154 |  | 0x7c4e2a |  | 0xb0985e |  | 0xdec96d |  |
| 229 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 2.0 | 0.0 | 0xc19fad |  | 0xa62e39 |  | 0xaf5b53 |  | 0xeb816d |  |
| 230 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 2.0 | 0.0 | 0x9f785f |  | 0xb17f4a |  | 0x9d9d9d |  | 0x2b2828 |  |
| 231 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 2.0 | 0.0 | 0x646364 |  | 0xa29583 |  | 0xa39890 |  | 0x72442f |  |
| 232 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 2.0 | 0.0 | 0xd1d0d1 |  | 0xa8a195 |  | 0x858082 |  | 0x8d5838 |  |
| 233 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 2.0 | 0.0 | 0xa49ca2 |  | 0xb3995a |  | 0xbeaf82 |  | 0xad5436 |  |
| 234 | 0.0 | 0.0 | 0.3 | 2.0 | 0.0 | 0.0 | 3.7 | 0xb3adbc |  | 0x696164 |  | 0xbbb4c2 |  | 0x886034 |  |
| 235 | 0.0 | 0.0 | 1.1 | 2.0 | 0.0 | 0.0 | 2.9 | 0x525052 |  | 0x3a3738 |  | 0xb0a4ab |  | 0xa23f30 |  |
| 236 | 0.0 | 0.0 | 2.9 | 2.0 | 0.0 | 0.0 | 1.1 | 0xbba2b0 |  | 0xa6788a |  | 0xb09fa9 |  | 0xb64d30 |  |
| 237 | 0.0 | 0.0 | 3.7 | 2.0 | 0.0 | 0.0 | 0.3 | 0xa59996 |  | 0x333031 |  | 0xb3a6af |  | 0x9a412a |  |
| 238 | 0.0 | 0.0 | 2.0 | 3.7 | 0.0 | 0.0 | 0.3 | 0x4b4849 |  | 0x6d6b6c |  | 0xd0ced0 |  | 0x836c56 |  |
| 239 | 0.0 | 0.0 | 2.0 | 2.9 | 0.0 | 0.0 | 1.1 | 0x726e70 |  | 0x777173 |  | 0xa29ba3 |  | 0x9e4c39 |  |
| 240 | 0.0 | 0.0 | 2.0 | 1.1 | 0.0 | 0.0 | 2.9 | 0x938c7d |  | 0xa18074 |  | 0xac9ba3 |  | 0xcc7634 |  |
| 241 | 0.0 | 0.0 | 2.0 | 0.3 | 0.0 | 0.0 | 3.7 | 0x494548 |  | 0x997d6c |  | 0x9d8a91 |  | 0xa48f8b |  |
| 242 | 0.0 | 0.0 | 3.7 | 0.3 | 0.0 | 0.0 | 2.0 | 0x3e3b3d |  | 0x333032 |  | 0xafa8b8 |  | 0x333032 |  |
| 243 | 0.0 | 0.0 | 2.9 | 1.1 | 0.0 | 0.0 | 2.0 | 0x4a4546 |  | 0x7b676b |  | 0xa095a2 |  | 0x9a774f |  |
| 244 | 0.0 | 0.0 | 1.1 | 2.9 | 0.0 | 0.0 | 2.0 | 0x717071 |  | 0x8c8482 |  | 0xa89ea3 |  | 0xb04f32 |  |
| 245 | 0.0 | 0.0 | 0.3 | 3.7 | 0.0 | 0.0 | 2.0 | 0x8f8990 |  | 0x7c7376 |  | 0xa799a2 |  | 0xb06745 |  |
| 246 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0x7d736e |  | 0x9a8c86 |  | 0xb3b1b5 |  | 0x33282a |  |