Explore The Universe

MONTREAL CENTRE
Royal Astronomical Society of Canada

Name: _____

Date Started: _____

Date Completed: _____

Ver. 2/2019

The RASC *Explore the Universe* Observing Program

Welcome to the RASC *Explore the Universe* observing program, designed to provide any observer with a well-rounded introduction to the night sky visible from the Northern Hemisphere. Following EtU is an excellent way to gain knowledge and experience in amateur astronomy. You will find that a planned observing session based on EtU results in a more satisfying and interesting experience. You will learn and improve your observing skills, an excellent preparation for more challenging observing programs such as the Messier Catalogue, The Finest NGC Objects, and the two lunar programs. Those who complete the observing program and have their observations validated will earn a certificate and pin (**RASC membership not required**).

The program covers the full range of astronomical objects. Here is a summary:

Observing Objective	**Constellations and Bright Stars**	**The Moon**	**Solar System**	**Deep-Sky Objects**	**Double Stars**	**Total**
Requirement	12	16	5	12	10	55
Available	24	32	10	24	20	110

In each category, a range of objects is provided so that you can begin the program at any time of the year. **In order to earn your certificate, you need to observe a minimum of 55 of the 110 objects available.** Here is a summary of some of the terms and abbreviations used in this program:

Instrument (V/B/T)	V—Visual (unaided eye), B—Binocular, T—Telescope
Description	A brief description of the object, its common name, and other details.
Con.	Constellation in which an object can be found. See www.iau.org/public/themes/constellations/.
Mag.	Magnitude—an object's brightness, with smaller numbers indicating the brighter objects.
Seen?✓	Mark each item with a check mark when you have observed it.
Log Page	Cross-reference to the logbook page where you have recorded your observations.

Binoculars

Binoculars are an ideal first observing instrument, and this program has been designed so that it can be completed using binoculars alone. For more information see the *Explore the Universe Guide, 2nd Edition* (RASC, 2017, p. 5) or the *Observer's Handbook* (RASC, 2018, p. 60). By mounting your binoculars on a tripod, you will find that you can see more detail and observe more comfortably.

The Bayer Star Designation

In 1603, Johann Bayer published the star atlas *Uranometria*, based on bright stars that can be seen with the unaided eye in each constellation. Using the Greek alphabet, starting with Alpha, stars are labelled according to how bright they are (with several exceptions). Thus, the brightest star in Ursa Minor is called "Alpha Ursae Minoris," which is written α UMi. Here is a list of all the 24 Greek letters used in astronomy:

α - Alpha	β - Beta	γ - Gamma	δ - Delta	ε - Epsilon	ζ - Zeta	η - Eta	θ - Theta
ι - Iota	κ - Kappa	λ - Lambda	μ - Mu	ν - Nu	ξ - Xi	ο - Omicron	π - Pi
ρ - Rho	σ - Sigma	τ - Tau	υ - Upsilon	φ - Phi	χ - Chi	ψ - Psi	ω - Omega

The Flamsteed Star Designation

John Flamsteed compiled a star catalogue in 1712 that listed stars visible to the unaided eye, by constellation, in order of increasing right ascension (west to east), labelled in Arabic numerals—the higher the number, the further east in a constellation is a given star. Typically, in star atlases and star charts, if a star also has a Bayer designation, that takes precedence; otherwise, the Flamsteed number (Flam #) is used.

Reference Sources

The *Explore the Universe* observing program can be used in conjunction with the *Explore the Universe Guide, 2nd Edition* (RASC, 2017). This RASC publication provides a simple introduction to the observation of astronomical phenomena and appropriate observing techniques. Terence Dickinson's *NightWatch* (4th Ed.) is also highly recommended. In addition to guide books, you will need a basic star atlas or software to help you find several objects in this program. The *Explore the Universe Guide* and *NightWatch* are available at the RASC shop at rasc.ca.

Constellations and Bright Stars (12 of 24)

Constellation	Con.	Observing Notes	Bright Star(s)	Mag.	Bayer	Flam. #	Seen? ✓	Log Page
Spring								
Ursa Major The Great Bear	UMa	Contains "The Big Dipper," with pointer stars leading to *Polaris* and *Arcturus*.	*Dubhe* *Merak*	1.81 2.34	α β	50 48	☐ ☐	
Leo The Lion	Leo	Large constellation that actually looks like its name. Note the "Sickle" asterism.	*Regulus* *Denebola*	1.36 2.14	α β	32 94	☐ ☐	
Virgo The Maiden	Vir	Home to the Virgo Cluster of galaxies, many visible in small telescopes.	*Spica*	0.98	α	67	☐	
Libra The Scales	Lib	In ancient times, the two brightest stars were the two claws of Scorpius.	*Zubenelgenubi* *Zubeneschamali*	2.75 2.61	α β	9 27	☐ ☐	
Boötes The Herdsman	Boo	Arc from Big Dipper's handle to *Arcturus*, the 3rd brightest star.	*Arcturus*	–0.05	α	16	☐	
Ursa Minor The Lesser Bear	UMi	Contains *Polaris* (the Pole Star) and "The Little Dipper."	*Polaris* *Kochab*	1.97 2.07	α β	1 7	☐ ☐	
Summer								
Scorpius The Scorpion	Sco	Runs roughly north to south with bright red *Antares* ("Rival of Mars") at its heart.	*Antares*	1.06	α	21	☐	
Hercules Son of Zeus	Her	*Rasalgethi* is south of the distinctive "Keystone" asterism. Look for M13.	*Rasalgethi*	2.78	α	64	☐	
Sagittarius The Archer	Sgr	Look for "The Teapot." Rich Milky Way region with many clusters and nebulae.	*Nunki*	2.05	σ	34	☐	
Lyra The Lyre or Harp	Lyr	Beautiful star fields in binoculars. *Vega* is the 5th brightest star in the sky.	*Vega*	0.03	α	3	☐	
Aquila The Eagle	Aql	Look for a diamond-shaped pattern. *Altair* is the 12th brightest star in the sky.	*Altair*	0.76	α	53	☐	
Capricornus The Sea Goat	Cap	A wide, V-shaped star field. *Algedi* is a wide visual double star.	*Algedi* *Dabih*	3.60 3.05	α β	6 9	☐ ☐	
Cygnus The Swan	Cyg	Rich in Milky Way stars. Look for the "Northern Cross" asterism.	*Deneb* *Albireo*	1.25 3.36	α β	50 6	☐ ☐	
Autumn								
Pegasus The Winged Horse	Peg	Look for the "Great Square of Pegasus" with *Markab* opposite *Alpheratz*.	*Markab*	2.49	α	54	☐	
Andromeda Cassiopeia's daughter	And	Look for two lines of stars extending from *Alpheratz*. Home to galaxy M31.	*Alpheratz*	2.07	α	21	☐	
Cassiopeia Queen of Ethiopia	Cas	Cassiopeia contains a distinctive "W" or "M" shape in the northern Milky Way.	*Schedar*	2.24	α	18	☐	
Aries The Ram	Ari	Look for a hockey stick between Pegasus and Taurus.	*Hamal* *Sheratan*	2.01 2.64	α β	13 6	☐ ☐	
Perseus Greek Hero	Per	The rich star field near *Mirfak* is best in binoculars. Look for variable star *Algol*.	*Mirfak* *Algol*	1.79 2.1v	α β	33 26	☐ ☐	
Winter								
Taurus The Bull	Tau	The wide, open cluster "The Hyades" forms the head of Taurus the Bull.	*Aldebaran*	0.87	α	87	☐	
Auriga The Charioteer	Aur	Look for a pentagon shape. *Capella* is the 6th brightest star in the sky.	*Capella*	0.08	α	13	☐	
Orion The Hunter	Ori	Prominent constellation with a rich star field around the 3 belt stars.	*Betelgeuse* *Rigel*	0.45 0.18	α β	58 19	☐ ☐	
Canis Major The Big Dog	CMa	Located southeast of Orion. *Sirius* is the brightest star in the sky.	*Sirius*	–1.44	α	9	☐	
Canis Minor The Little Dog	CMi	A small constellation. *Procyon* is the 8th brightest star in the night sky.	*Procyon* *Gomeisa*	0.41 2.89	α β	10 3	☐ ☐	
Gemini The Twins	Gem	*Castor* and *Pollux* are the names of the twins. Beta is the brightest of the pair.	*Castor* *Pollux*	1.58 1.16	α β	66 78	☐ ☐	

Observing the Moon (16 of 32)

As the closest major celestial object to Earth, the Moon reveals more detail to observers than any other object, so much so that a large number of lunar features can be clearly identified in binoculars. To observe the Moon successfully requires a good Moon map, an understanding of lunar phases, and sturdy tripod-mounted or image-stabilized binoculars. *Explore the Universe Guide* contains a Moon map for the specific features listed below. East and west on the Moon follow the convention for planets; that is, opposite from the sky directions east and west, while north and south remain the same. The Moon's terminator, dividing night from day on the Moon, thus continually moves from east to west on the lunar surface. Binoculars with 10× magnification will work best although observers can easily complete this section with 7× magnification. Here are the approximate phases ordered by day after New Moon:

Lunar Phases (4 of 8 observations are required)

The *Observer's Calendar* and *Observer's Handbook* provide day-to-day images of the phases of the Moon and exact times of First Quarter, Full Moon, Last Quarter, and New Moon.

Approx. Day	Phase	V/B/T	Observing Notes	Seen? ✓	Log Page
3	Waxing Crescent	V	Visible within 3 hours of sunset.	☐	
7	First Quarter	V	Within 18 hours before or after exact time of phase.	☐	
11	Waxing Gibbous	V	Visible 3 to 4 days after First Quarter.	☐	
15	Full Moon	V	Within 18 hours before or after exact time of phase.	☐	
18	Waning Gibbous	V	Visible 3 to 4 days after Full Moon.	☐	
22	Last Quarter	V	Within 18 hours before or after exact time of phase.	☐	
26	Waning Crescent	V	Visible within 3 hours of sunrise.	☐	
Any	(Orbital Motion)	V	Over 1 to 2 days, track Moon's orbital motion against background stars.	☐	

Lunar Basins and Maria (6 of 12 observations are required)

The dark lava plains known as lunar basins or maria are the most easily visible feature on the Moon. The following maria are listed from east to west in the order that they appear during the lunar cycle, as the sunrise terminator crosses the Moon's disk. All the maria can be seen at Full Moon. Note the relative sizes ranging from 55,000 km^2 to over 2 million km^2.

Best Day	Feature	V/B/T	Size 1000 km^2	Lat °	Long °	Observing Notes	Seen? ✓	Log Page
3	*Mare Crisium* Sea of Crises	B	180	17 N	59 E	570 km across (size of Great Britain). Large impact basin.	☐	
3	*Mare Fecunditatis* Sea of Fertility	B	330	4 S	50 E	850 km across.	☐	
7	*Mare Nectaris* Sea of Nectar	B	100	15 S	35 E	340 km across.	☐	
7	*Mare Tranquillitatis* Sea of Tranquillity	B	420	8 N	32 E	880 km across (size of Black Sea). Apollo 11 landing site.	☐	
7	*Mare Serenitatis* Sea of Serenity	B	370	28 N	22 E	870 km across. Lake of Dreams and Lake of Death on border.	☐	
7	*Mare Vaporum* Sea of Vapours	B	60	13 N	3 E	230 km across. Circular basin located southeast of the Apennine Mountains.	☐	
11	*Mare Frigoris* Sea of Cold *continued…*	B	440	58 N	45 W–45 E	1450 km long, variable width. Northernmost basin, near Plato. *continued…*	☐	

	...continued					*...continued*		
11	*Mare Imbrium* Sea of Rains	B	830	14 N– 51 N	40 W– 6 E	1250 km across. Large impact basin.	☐	
11	*Mare Nubium* Sea of Clouds	B	250	20 S	15 W	720 km across.	☐	
11	*Sinus Iridum* Bay of Rainbows	B	55	45 N	32 W	260 km across, flooded partial crater extending into Mare Imbrium.	☐	
11	*Mare Humorum* Sea of Moisture	B	110	24 S	39 W	380 km across, nicely paired with Mare Nubium.	☐	
15	*Oceanus Procellarum* Ocean of Storms	B	2100	42 N– 14 S	68 W– 27 W	2600 km across. Largest continuous northwestern feature.	☐	

Impact Craters (6 of 12 observations are required)

For many years, the craters on the Moon were thought to be volcanic in nature. We now know that most of them are a result of major impacts by asteroids and comets. This has contributed greatly to our understanding of the formation and evolution of the Solar System.

"Best Day" is approximately the age of the Moon (in days after New) when the objects will be near the lunar day/night terminator and therefore easiest to see with detail, as the low angle of the sunlight casts long shadows of the rough lunar features. There is a complementary phase during the waning period when the same object will also be on the terminator, but lit at lunar sunset instead of at lunar sunrise; however, these phases will need to be observed after midnight or just before dawn.

Best Day	**Object**	**V/B/T**	**Dia. km**	**Lat °**	**Long °**	**Observing Notes**	**Seen? ✓**	**Log Page**
3–4	*Petavius*	B/T	177	25 S	60 E	Prominent crater with central peak. One of the Gang of Four (with non-EtU craters *Langrenus*, *Vendelinus*, and *Furnerius*).	☐	
3–4	*Cleomedes*	B/T	126	28 N	56 E	Located near Mare Crisium. Easily found in binoculars.	☐	
4–5	*Posidonius*	B/T	95	32 N	30 E	Located on the shore of Mare Serenitatis. Crater walls 2300 m high.	☐	
5–6	*Theophilus*	B/T	100	11 S	26 E	Prominent crater with 1400 m central peak. *Cyrillus* and *Catharina* nearby.	☐	
5–6	*Aristoteles*	B/T	87	50 N	17 E	In Mare Frigoris. Deep terraced walls. Look for *Eudoxus* nearby on the shore of the mare.	☐	
8–9	*Ptolemaeus*	B/T	153	9 S	2 W	Prominent walled plain. *Alphonsus* and *Arzachel* to the south.	☐	
8–9	*Plato*	B/T	101	52 N	9 W	Outstanding crater that is easy to spot due to its dark floor.	☐	
8–9	*Tycho*	B/T	85	43 S	11 W	Famous crater featuring spectacular rays that are best observed at or near full Moon.	☐	
9–10	*Clavius*	B/T	225	58 S	14 W	Very large crater encompassing several smaller craters.	☐	
8–9	*Copernicus*	B/T	93	10 N	20 W	Spectacular crater with 3760 m-deep terraced walls; also features prominent rays at or near full Moon.	☐	
11-12	*Gassendi*	B/T	110	18 S	40 W	Prominent crater on the northern shore of Mare Humorum.	☐	
13-14	*Grimaldi*	B/T	222	5 S	67 W	Very large, dark-floored crater located near the western limb of the Moon.	☐	

The Solar System (5 of 10)

Primary Observations

The Solar System contains the Sun, planets, dwarf and minor planets, comets, and other wonders. Consult the *Observer's Handbook* or planetarium software for details on current positions and visibility.

Object	**V/B/T**	**Observing Notes**	**Seen? ✓**	**Log Page**
Mercury	V/B/T	Mercury is the closest planet to the Sun. Unlike other planets, Mercury is visible only for a few weeks at a time; so check an annual guide such as the *Observer's Handbook* for the best times to spot this fast-moving, elusive object.	☐	
Venus	V/B/T	The brightest planet. Telescope users can see Venus go through phases similar to those of the Moon.	☐	
Mars	V/B/T	Known as the "Red Planet," it is best observed at opposition about every 26 months although it can be seen often at other points of its orbit.	☐	
Jupiter	V/B/T	The largest planet in the Solar System, with four bright moons nearby that can be seen in binoculars. Each moon can be identified by name using the *Observer's Handbook*, but this is not mandatory. Look for motion of the moons over an evening or from night to night.	☐	
Saturn	V/B/T	Any telescope will show Saturn's rings. Saturn has one bright moon, named Titan, and several fainter ones visible in telescopes.	☐	
Uranus	B/T	This planet can be seen clearly in binoculars, particularly when they are mounted on a tripod. A detailed finder chart is published annually in the *Observer's Handbook*. Telescopes will reveal the small round disk of this far away world.	☐	
Neptune	B/T	Neptune is similar to Uranus, but even further away and fainter. It also can be seen in binoculars using the same method as for Uranus. Seeing the disk of Neptune is more difficult, but well within the reach of good amateur telescopes.	☐	
Orbital Motion	V/B	Plot the orbital motion of a planet: This can be done easily by drawing the star field around a planet on two or more separate nights and recording the movement of the planet against the background stars, which do not move. Orbital motion can be plotted visually or through binoculars or a telescope, with the outer planets being the easiest.	☐	
Artificial Satellites and Meteors	V	Observe at least 3 Earth-orbiting artificial satellites (including spacecraft and the International Space Station) and 3 meteors (either of sporadic type or from a meteor shower).	☐	
Sunspots	Filtered B/T	WARNING! USE PROPERLY FILTERED TELESCOPES OR BINOCULARS. A high-quality, full-aperture solar filter is required. This observation may best be done through the telescope of an experienced solar observer who has one set up for public viewing or club events.	☐	

The Solar System

Optional Observations

The following table lists optional Solar System observations.

Object	**V/B/T**	**Observing Notes**	**Seen? ✓**	**Log Page**
Eclipses	V/B	Eclipses occur when one Solar System object passes in front of and hides another Solar System object. A solar eclipse occurs when, on passing between the Sun and the Earth, the Moon is closely enough aligned to hide at least part of the Sun, as viewed from the Earth. A lunar eclipse occurs when, on passing between the Sun and the Moon, the Earth is closely enough aligned for its shadow to fall upon at least some of the Moon. For both solar and lunar eclipses, use the predictions listed in the *Observer's Handbook* to plan your observations.	☐	
Conjunctions	V/B	When two or more celestial objects appear close together in the sky, it is called a conjunction. These are regular occurrences that are listed in the *Observer's Handbook* and in popular astronomy magazines.	☐	
Meteor Showers	V	Sporadic meteors can be seen on most dark, clear nights. Meteor showers, for their part, are regular events occurring at different times throughout the year, when high rates of meteors appear to come from a specific zone or radiant in the sky. Look for a dark, moonless night, and be prepared to stay up late, as the best observing is usually after midnight.	☐	
Aurorae	V	Aurorae Borealis (Northern Lights) are caused by streams of solar particles striking the Earth's upper atmosphere and causing it to glow. Best in dark skies.	☐	
Comets	V/B/T	Small bodies left over from the birth of the Solar System, comets are usually quite faint and require a medium- to large-sized telescope to observe. Occasionally, a comet will appear that is bright enough to be seen through binoculars or even visually.	☐	
Zodiacal Light	V	For mid-northern observers, the best time to view this pyramid of light is after dusk in the western sky during February and March and in the pre-dawn eastern sky during September and October. A dark sky is essential.	☐	
Dwarf Planets or Minor Planets	B/T	Dwarf planet Ceres and several minor planets are bright enough to be seen in binoculars and small telescopes. You can locate these objects by using a finder chart in the *Observer's Handbook* or desktop planetarium software.	☐	

Deep-Sky Objects (12 of 24)

"Deep-Sky Objects" is the catch-all description applied to some of astronomy's most interesting sights including:

★ Open Clusters (OC)—Loose groups of stars with a common origin in a giant molecular cloud.
★ Globular Clusters (GC)—Ancient spherical clusters of stars, often containing hundreds of thousands of stars.
★ Emission (EN) / Reflection Nebulae (RN)—Glowing clouds of interstellar gas or dust, often marking the birth or death of stars.
★ Planetary Nebulae (PN) / Supernova Remnants (SN)—Glowing clouds of gas and dust marking the death of stars.
★ Galaxies (GX)—Huge "island universes," like the Milky Way, containing hundreds of billions of stars, but so distant that they are merely hazy patches of light.

All of the deep-sky objects on this list can be observed with binoculars, and many can be detected visually. Larger telescopes will reveal more detail. "Season" indicates best viewing during the evening hours, but many objects can also be found before and after the suggested time.

Right Ascension (RA): sky equivalent of longitude on Earth. Along the celestial equator, 1 hour of RA = 15°, increasing west to east.
Declination (Dec): sky equivalent of latitude on Earth, measured in degrees, minutes, and seconds north and south (+/–) of the celestial equator.
Size: Angular size measured in arcminutes. 1 degree = 60 arcminutes; that is, 1° = 60′ (width of the pinky finger held at arm's length).

Spring

Con.	Object	Mag.	RA Dec	Observing Notes	Seen? ✓	Log Page
Cnc	M44 The Beehive	3.1	08:40.1 +19° 59′	OC, 95′. With a magnitude of 3.1, it is bright enough to be easily seen with the unaided eye from a dark sky. To locate it, try scanning along an imaginary line from Regulus in Leo to Pollux in Gemini.	☐	
Com	Coma Cluster Melotte 111	1.8	12:25.0 +26° 00′	OC, 275′. This large group of stars lies between Leo and Boötes. It is made up of several chains of mag. 5–6 stars that are said to be the amber tresses of Queen Berenice's hair offered to the goddess Aphrodite for the safe return of her beloved king (Ptolemy III Euergetes) from battle.	☐	
Ser	M5 NGC 5904	5.7	15:18.6 +02° 05′	GC, 17′. As big and bright as the more famous M13. It is located about 2½ binocular fields north of Beta Librae, the northernmost bright star in Libra.	☐	

Summer

Con.	Object	Mag.	RA Dec	Observing Notes	Seen? ✓	Log Page
Her	M13 Hercules Cluster	5.7	16:41.7 +36° 28′	GC, 17′. This well-known globular cluster contains hundreds of thousands of stars. Look for a "fuzzy star" south of Eta, the northwest Keystone star. Note the mag. 7 stars on either side.	☐	
Sco	M4 NGC 6121	5.8	16:23.6 –26° 32′	GC, 26′. Located 1° west of Antares, this cluster is easily found under a dark sky. However, because most of its individual stars are quite dim, it can prove difficult from light-polluted skies.	☐	
Ser	M16 Eagle Nebula	6.0	18:18.6 –13° 58′	EN and OC, 35′ × 28′. Located 4° north of M24 (see below), this nebulous open cluster contains between 20 and 30 stars of magnitude 8–10.	☐	
Sgr	M8 Lagoon Nebula	3.0	18:03.8 –24° 23′	EN, 45′ × 30′. This huge cloud of gas is bisected at one end by a dark lane. To find this deep-sky object, first locate the spout of the "Teapot" and simply scan your binoculars upward 6°, about one binocular field.	☐	
Sgr	M17 Swan Nebula	6.0	18:20.8 –16° 11′	EN, 20′ × 15′. Also known as the Omega Nebula. It is located about halfway between M24 and M16. Look for OC M18 to the south.	☐	
Sgr	M22 NGC 6656	5.1	18:36.4 –23° 54′	GC, 24′. This cluster is almost a magnitude brighter than the well-known M13. Look for a nebulous disk 2° northeast from the top of the Teapot lid.	☐	
Sgr	M23 NGC 6494 *continued…*	5.5	17:56.8 –19° 00′	OC, 27′. Nearly 5° west of M24 (see below), this rich open cluster contains over 120 faint stars. Under dark skies, you may be able to resolve some of them with 10× 50 mm binoculars. *continued…*	☐	

	...continued			*...continued*		
Sgr	M24 Sagittarius Star Cloud	4.6	18:16.5 –18° 50′	Star cloud, 95′ × 35′. Lies a little over 7° north of the Teapot lid. On some charts, it is mislabelled as the small open cluster NGC 6603; it's actually the large cloud surrounding NGC 6603.	☐	
Sgr	M25 IC 4725	4.6	18:31.6 –19° 15′	OC, 32′. Scan your binoculars about 3° east of M24, and you'll be rewarded with a view of this attractive little cluster containing several bright stars.	☐	
Sct	M11 Wild Duck Cluster	5.8	18:51.1 –06° 16′	OC, 13′. Nearly 4° west of Lambda Aquilae, lying in the Scutum Star Cloud, one of the densest parts of the summer Milky Way.	☐	
Vul	Collinder 399 The Coathanger	3.6	19:25.4 +20° 11′	OC, 60′. Also known as Brocchi's Cluster. This unmistakable collection of 10 stars lies a little over 7° south of Beta Cygni, the head of the Swan.	☐	

Autumn

Con.	**Object**	**Mag.**	**RA Dec**	**Observing Notes**	**Seen? ✓**	**Log Page**
And	M31 Andromeda Galaxy	3.4	00:42.7 +41° 16′	Nearest major GX, 185′ × 75′. The visibility of any galaxy depends on the background sky darkness. Follow the outline of the constellation to the second pair of stars and scan the area just to the north for an elongated fuzzy patch of light.	☐	
Per	Melotte 20 Alpha Persei Group	1.2	03:22.0 +49° 00′	OC, 185′. This wide, beautiful group of stars is centred on Alpha Persei (Mirfak) and fills a 5° binocular field of view.	☐	
Per	Double Cluster NGC 869 and NGC 884	5.3	02:19.0 +57° 09′	Two OCs, each 30′. If you scan the Milky Way between Cassiopeia and Perseus under a dark sky, these two beauties will be hard to miss. Without binoculars, you'll probably see a misty patch that betrays the presence of one of the northern sky's grandest sights.	☐	

Winter

Con.	**Object**	**Mag.**	**RA Dec**	**Observing Notes**	**Seen? ✓**	**Log Page**
Tau	M45 Pleiades	1.2	03:47.0 +24° 07′	Visual OC, 110′. Known since ancient times, this spectacular cluster is best viewed through binoculars or a wide-field telescope.	☐	
Tau	Hyades Melotte 25	0.5	04:27.0 +16° 00′	OC, 330′. This group of stars forms the V-shaped head of the Bull. While it is easily visible with the unaided eye, a closer look with binoculars will show you the beautiful and colourful double stars Theta and Delta.	☐	
Cam	Kemble's Cascade	4.0	03:57.0 +63° 00′	Star chain, 180′. From Alpha Persei, scan two binocular fields towards Polaris and you will see a long chain of stars resembling a waterfall. The asterism is named after the late Fr. Lucian Kemble, of the RASC Regina Centre. Look for the small open cluster NGC 1502 at the end of the string.	☐	
Aur	M37 NGC 2099	5.6	05:52.4 +32° 33′	OC, 20′. If you follow an imaginary line north along the feet of Gemini for a couple of binocular fields, you should see this cluster. Although you won't be able to resolve many of this cluster's faint stars with binoculars, if you look closely, you should notice how much more concentrated it becomes toward the centre. Look for M36 and M38 nearby.	☐	
Ori	M42 Orion Nebula	4.6	05:35.4 –05° 27′	EN, 65′ × 60′. The Great Nebula, the brightest one visible in the northern hemisphere. Appears as a bright green cloud surrounding Theta^1 and Theta^2 Orionis, the middle stars in Orion's sword. Once you find M42, look north for NGC 1981, an attractive little group of 7 stars shaped like an aardvark.	☐	
Gem	M35 NGC 2168	5.1	06:08.9 24° 20′	OC, 28′. This cluster lies at the feet of Gemini, appearing best under dark skies, but it can be seen fairly well with 10× 50 mm binoculars from a suburban location.	☐	
Pup	M47 NGC 2422	4.4	07:36.6 –14° 30′	OC, 29′. Starting from Sirius, look about two binocular fields eastward for a little splash of stars. In dark skies, you may also see the faint wisp of M46 (NGC 2437) in the same field.	☐	

Double and Multiple Stars (10 of 20)

Double stars appear to the unaided eye as a single star, but when viewed through binoculars or a telescope they can be split into two components. Optical doubles are a chance alignment in space in which the stars appear adjacent to one another when viewed from Earth. Physical doubles are near one another (as part of an open cluster), while binary stars are known to orbit around a common centre of mass. For some binary stars, one can detect this orbital motion over a period of a few years; otherwise, one notes common proper motion of the pair.

Some double stars offer interesting colour contrasts, magnitude differences, and separations, and many can be viewed easily from locations with moderate to heavy light pollution. To complete this section, it is suggested that you work with binoculars mounted on a tripod. To find the stars listed, you will need a good star atlas where you can plot their location using the coordinates listed. A good way to confirm that you are observing the double star you are looking for is to check the magnitude, separation, and position angle.

Separation (Sep.) is measured in arcseconds (″). 1 arcminute = 60 arcseconds, that is, 1′ = 60″ (recall that 1° = 60′). The larger the separation, the more easily you can see the split between the stars. The Position Angle (PA) is the apparent direction from the brighter star to the dimmer star, measured in degrees counterclockwise from celestial north. The lines of right ascension (RA) on a star chart always point north. Be sure to carefully orient the map when comparing position angles with the binocular or telescope view. Note: Some telescopes have mirror-reversed views, in which case position angle is measured clockwise.

Spring

Con.	Object(s)	Mags.	Sep. ″	PA °	RA Dec	Observing Notes	Seen? ✓	Log Page
Leo	Zeta / 35	3.4 / 5.9	330	340	10:16.7 +23° 25′	Secondary is 35 Leonis. Optical double. *Adhafera*.	☐	
Com	17	5.2 / 6.6	146	251	12:28.9 +25° 55′	In Coma Star Cluster, south of Gamma. Visual binary.	☐	
Com	32 / 33	6.5 / 7.0	196	51	12:52.2 +17° 04′	South of Coma Star Cluster, west of Alpha Comae Berenices.	☐	
CVn	15 / 17	6.0 / 6.3	278	277	13:09.6 +38° 32′	Nice even-magnitude pair located east of Alpha Canum Venaticorum.	☐	
UMa	Zeta / 80	2.4 / 4.0	708	70	13:23.9 +54° 56′	*Mizar* and *Alcor*, in the handle of the Big Dipper. *Mizar* is itself a telescopic binary.	☐	
Lib	Alpha^2 / Alpha^1	2.7 / 5.2	231	315	14:50.9 –16° 02′	*Zubenelgenubi*, between *Spica* and *Antares*. Visual binary. Look for colour.	☐	
Boo	Mu^1 / Mu^2	4.3 / 7.0	107	171	15:24.5 +37° 23′	Located east of Beta and Delta Boötis. A nice contrast of magnitudes. *Alkalurops*.	☐	
CrB	Nu^1 / Nu^2	5.4 / 5.6	361	165	16:22.4 +33° 48′	Look between the half circle of Corona Borealis and the Keystone of Hercules.	☐	
Dra	17 / 16	5.4 / 5.5	90	194	16:36.2 +52° 55′	Find the 4-star "Head of the Dragon" pattern, then use Gamma and Beta as pointers.	☐	
Dra	Nu^1 / Nu^2	4.9 / 4.9	63	312	17:32.2 +55° 11′	Located in the 4-star "Head of the Dragon" pattern. An outstanding even-magnitude double!	☐	

Summer

Con.	Object	Mags.	Sep. ″	PA °	RA Dec	Observing Notes	Seen? ✓	Log Page
Lyr	Epsilon^1 / Epsilon^2	5.0 / 5.3	210	174	18:44.3 +39° 40′	Wide easy binocular pair. Telescope users can try splitting each star again to see the Double Double.	☐	
Lyr	Zeta^1 / Zeta^2	4.3 / 5.6	44	150	18:44.8 +37° 36′	Zeta, Epsilon, and *Vega* form a wide triangle. Use tripod-mounted binoculars or a telescope.	☐	
Lyr	Delta^1 / Delta^2	4.5 / 5.6	630	295	18:53.7 +36° 58′	Very wide, binocular optical double with colour. From *Vega*, go to Zeta, then on to Delta.	☐	
Cap	Alpha^1 / Alpha^2	3.7 / 4.3	378	292	20:18.1 –12° 33′	Wide binocular double in nice star field. *Algedi*.	☐	
Cap	Beta^1 / Beta^2	3.2 / 6.1	207	267	20:21.0 –14° 47′	Look for Beta just south of Alpha. Nice magnitude contrast. *Dabih*.	☐	

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Cyg	Omicron[1] (triple star)	3.8 / 7.7 / 4.8	107 / 338	173 / 292	20:13.6 +46° 44′	Beautiful triple star for binoculars. Second-brightest component is 30 Cygni. The three make a "hockey stick" figure. Look for colour.	☐	
Cyg	Beta (*Albireo*)	3.4 / 4.7	33	54	19:30.7 +27° 58′	*Albireo* is one of the most beautiful coloured double stars in the sky. Use tripod-mounted binoculars or a telescope.	☐	

Autumn and Winter

Con.	Object	Mag.	Sep. "	PA °	RA Dec	Observing Notes	Seen? ✓	Log Page
Cyg	16	6.0 / 6.2	39	133	19:41.8 +50° 32′	Impressive pair located in the area of Iota (mag. 3.8) and just next to Theta (mag. 4.5). Use tripod-mounted binoculars or a telescope.	☐	
Tau	Theta[1] / Theta[2]	3.4 / 3.9	337	348	04:28.7 +15° 52′	Located in the beautiful Hyades star cluster between Alpha and Gamma.	☐	
Cep	Delta	3.5 / 4.4 / 7.5	41	191	22:29.2 +58° 25′	This famous Cepheid variable is also a very pretty double star. Use tripod-mounted binoculars or a telescope.	☐	

Variable Stars—optional observations

A variable star is a star whose brightness changes, over time scales of a few hours to several hundred days, either periodically or irregularly. These stars are among the most interesting and beautiful stars in the sky, and it is well worth the effort to find them. Several categories of variable stars exist, but there are two main classes: (1) intrinsic variables, in which the variation is due to physical or chemical changes within a single star; and (2) extrinsic variables, in which the variation is due to the interaction of a star with one or more other bodies, either stars or planets.

Observing variable stars is not a requirement to earn the *Explore the Universe* certificate, but we offer two typical and well-known—but quite different—examples below to whet your appetite, if you would like a bit of a challenge.

(1) Mira (Omicron Ceti) is an intrinsic variable star, a Long-Period Variable in the Pulsating Variable category, whose brightness varies more than eight magnitudes over 11 months, alternately being visible and invisible to the unaided eye.

(2) Algol (Beta Persei) is an extrinsic variable star in the Eclipsing Binary category, whose brightness varies by more than one magnitude in less than 3 days, owing to a dim secondary star periodically passing in front of the bright primary star as they orbit their common centre of gravity. The times of minimum brightness of Algol are published in "The Sky Month by Month" section of the *Observer's Handbook*.

Observing a variable star requires multiple sessions involving regular estimation of its magnitude, by comparing the brightness of the star to that of nearby stars of known magnitudes. Record the date and time of each magnitude estimate, as well as the comparison stars used. Short-period variable stars such as Algol should be observed more often—hourly or even more frequently—as the brightness changes quickly. Long-period variables such as Mira can be observed weekly, as it takes months to complete a cycle.

Two Typical Variable Stars: Mira and Algol

Con.	Star	Variable Type	Magnitude Range	Period (days)	RA Dec	Notes
Cet	Omicron Ceti (*Mira*)	Long-Period Variable	2.0–10.1	332	02:19.3 –02° 59′	*Mira* has the brightest maxima of all LPVs and is the prototype of its class.
Per	Beta Persei (*Algol*)	Eclipsing Binary	2.1–3.4	2.86	03:08.2 +40° 57′	Compare the brightness of *Algol* with that of Epsilon Persei (mag. 2.9), Delta Persei (mag. 3.1), Kappa Persei (mag. 3.8), and Gamma Andromedae (mag. 2.2).

Observing variable stars is one of the ways that backyard astronomers can contribute helpful information to professional astronomers. Because of the great number of observations required for variable stars, large observatories cannot provide enough observing time for experts to monitor them all. More information about the various categories of variable stars can be found in the *Observer's Handbook* and other observing guides. A highly recommended source of information is the American Association of Variable Star Observers (AAVSO) at aavso.org, who publish variable-star charts with the magnitudes of comparison stars indicated.

Variable Stars (Supplementary)

[Note: this supplement was included as a non-mandatory component of Explore the Universe, Editions 1–4 (2002-2017)]

Observing variable stars is one of the ways that backyard astronomers can contribute information that is helpful to professional astronomers. Because of the great number of observations required for variable stars, large observatories cannot provide enough observing time for experts to monitor them all. Many of these stars are among the most interesting and beautiful stars in the night sky, and it is well worth the effort to find them. There are four main categories of variable stars including **Pulsating**, **Eruptive**, **Eclipsing** and **Rotating**. Each major category has several specific groups within it.

The **Pulsating** category includes Cepheid variables, RR Lyrae-type stars, RV Tauri-type stars, Omicron Ceti (Mira)-type stars that are also known as Long-Period Variables (LPV). Also included in the Pulsating group are Semi-Regular and Irregular variable stars. The **Eruptive** category includes Supernovae, Novae, Recurrent Novae, U Geminorum type stars, Z Camelopardalis type stars, SU Ursae Majoris type stars, R Coronae Borealis type stars, and Symbiotic stars. The **Eclipsing** category (two or more stars passing in front of one another from our point of view) includes Beta Persei (Algol) type stars, Zeta Aurigae type stars, Beta Lyrae type stars, W Ursae Majoris type stars and Ellipsoidal variables. The **Rotating** category includes RS Canum Venaticorum type stars that undergo small amplitude changes. More information about these specific groups of stars can be found in the *Observer's Handbook* or in other fine observing guides. Another excellent source of information is the American Association of Variable Star Observers (AAVSO). Variable star charts are available from the AAVSO on their Web site.

All of the stars listed here are from the Pulsating and Eclipsing categories. It is important when recording variable star magnitudes to observe the star regularly and to make a note of the date and time of each observation. If your time is limited, it is recommended that you make better observations of a moderate number of variable stars regularly than trying to observe a large number sporadically.

For more information on Variable Stars and Variable Star observing, consult the *Observer's Handbook* and the American Association of Variable Star Observers (AAVSO) at www.aavso.org.

Visual / Binocular Objects

Sea-son	Cons	Star	Variable Type	Magnitude Range	Period (days)	Spectral Range	RA	Dec	Notes
Sum	Lyr	Beta 10 Lyrae	E (Eclipsing Binary)	3.3-4.3	12.94	B8-A8	18:50.1	+33:22	Bright EB; Proper name Sheliak; use Gamma Lyrae (Mag.3.3) for comparison.
Sum	Aql	Eta 55 Aquilae	DCEP (Delta Cepheid)	3.5-4.4	7.17	F6-G4	19:52.5	+01:00	Bright Cepheid; use Beta Aquilae (Mag.3.7) for comparison.
Aut	Cep	Mu Cephei	SR (Semi-Regular)	3.4-5.1	835	M2	21:43.5	+58:47	Known as Herschel's "Garnet Star." Compare colour to the white star Alpha Cephei.
Aut	Cep	Delta 27Cephei	DCEP (Delta Cepheid)	3.5-4.4	5.36	F5-G2	22:29.2	+58:25	First Cepheid discovered; use Epsilon Cephei (Mag. 4.2) and Zeta Cephei (Mag.3.4) for comparison.
Aut	Per	Beta 26 Persei (Algol)	E (Eclipsing Binary)	2.1-3.4	2.86	B8+G5	03:08.2	+40:57	Proper name Algol; use Epsilon Per (Mag. 2.9), Delta Per (Mag.3.1), Kappa Per (Mag.3.8), and Gamma And (Mag.2.2) for comparison.
Win	Tau	Lambda-35 Tauri	E (Eclipsing Binary)	3.4-3.9	3.95	B3+A4	04:00.7	+12:29	Bright eclipsing binary; use Gamma Tauri (Mag. 3.6) and Xi Tauri (Mag. 3.7) for comparison.
Win	Gem	Zeta 43 Geminorum	DCEP (Delta Cepheid)	3.6-4.2	10.15	F7-G3	07:04.1	+20:34	Bright Cepheid; use Kappa Gem (Mag. 3.6) and Upsilon Gem (Mag. 4.2) for comparison.

Binocular / Small Telescope Objects

Season	Cons	Star	Variable Type	Magnitude Range	Period (days)	Spectral Range	R.A.	Dec.	Notes
Spr	CVn	Y Canum Venaticorum	SR (Semi-regular)	4.9-5.9	298	C5-4J (N3)	12:45.1	+45:26	Known as "La Superba," it is a deep-red carbon star with a semi-regular period.
Sum	Oph	X Ophiuchi	M (Mira, Long Period Variable)	5.9-8.6	338	M6-K1	18:38.3	+08:50	Good example of a long-period variable for small instruments; variable-star chart recommended.
Sum	Scu	R Scuti	RV (RV Tauri)	4.2-8.6	147	G0-K0	18:47.5	–05:42	RV Tauri type variable with cycles of shallow and deep minima.
Sum	Lyr	RR Lyrae	RR (RR Lyrae)	7.1-8.1	0.56	A8-F7	19:25.5	+42:47	Interesting short-period variable that goes through a complete cycle in less than one day.
Aut	Cet	Omicron 68Ceti (Mira)	M (Mira, Long Period Variable)	2.0-10.1	332	M5-M9	02:19.3	–02:59	Proper name Mira; has the brightest maxima of all LPV's and is the prototype of its class.
Win	Mon	T Monocerotis	DCEP (Delta Cepheid)	5.6-6.6	27.02	F7-K1	06:25.2	+07:05	Located near the Rosette Nebula, just north of the star Epsilon Monocerotis.

Small/Medium Telescope

Season	Cons	Star	Variable Type	Magnitude Range	Period (days)	Spectral Range	RA	Dec	Notes
Spr	Leo	R Leonis	M (Mira, LPV)	4.4-11.3	313	M8	09:47.6	+11:26	Bright LPV that is well placed for observing in the spring season.
Spr	Vir	R Virginis	M (Mira, LPV)	6.1-12.1	146	M4.5	12:38.5	+06:59	LPV with a shorter-than-average period of just 145 days.
Sum	Aql	R Aquilae	M (Mira, LPV)	5.5-12.1	270	M5-M9	19:06.4	+08:14	The brightest LPV in Aquila. Its red colour intensifies around minima.
Aut	Cep	S Cephei	M (Mira, LPV)	7.4-12.9	486	C7(N8)	21:35.2	+78:37	A carbon star that is one of the reddest known. Look for it between Kappa and Gamma Cephei. It will be reddest around minima.
Win	Tau	RW Tauri	E (Eclipsing Binary)	7.9-11.4	2.76	B8+K0	04:03.9	+28:08	An interesting EB that drops 3.5 magnitudes during eclipse. It is located near the star 41 Tauri.
Win	Lep	R Leporis	M (Mira, LPV)	5.5-11.7	445	C6	04:59.6	–14:48	Known as Hind's "Crimson Star," it is a red carbon star that displays a deep red crimson hue around minima.
Win	Ori	U Orionis	M (Mira, LPV)	4.8-13.0	372	M6.5	05:55.8	+20:10	An excellent LPV that features a large range in brightness. Find it near 54 and 57 Orionis.

Using the RASC Visual Observing Log

Session Notes

The Session Notes section describes the observing conditions so that you are able to compare and contrast observations from one night to another as well as from one location to another.

Date	Date of observation in the form of December 25th/ 26th
Time	Time of observation specifying time zone or using Universal Coordinated Time (UTC)
Activity	Type of observing activity on this page (i.e. planetary, deep-sky, solar, lunar, etc.)
Location	Observing location (i.e. Morningside Park)
Seeing	**Transparency**: Subjective rating of sky clarity on a scale from 1 (hazy or murky) to 6 (perfect) **Steadiness**: Subjective rating of steadiness of the atmosphere / optics from 1 (rampant scintillation) to 7 (very steady, no twinkling even at highest power) **Limiting Visual Magnitude**: Faintest naked eye star visible (refer to BOG)

Object Record

This section provides an area for detailed notes on 2 observations per page.

Object	Description of the Object should include its: **Catalogue Number** (i.e. M13) **Type** OC – Open Cluster, SNR – Supernova Remnant, EN -Emission Nebula, RN - Reflection Nebula, Globular Cluster, DS - Double Star, G - Galaxy, PN – Planetary Nebula) **Magnitude** – Magnitude of the object **Size** – Angular size of the object.
Constellation	Constellation of the object (i.e. Gemini)
Chart Ref:	Cross reference to star atlas for this object.
Eyepiece	Size of eyepiece in mm & type / magnification
Filter	Type of filter used (if applicable).
RA/Dec	Right Ascension (Hr, Min, Sec) & Declination (Deg, Min, Sec) of the object.
Instrument	Instrument used (i.e. binoculars, 80 mm refractor)
Notes	Notes on your observation.
Drawing area	Area for a sketch of your eyepiece impressions.

Using the RASC Visual Observing Log

Session Notes

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Object Record

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Object	Description of the Object should include its: **Catalogue Number** (i.e. M13) **Type** OC – Open Cluster, SNR – Supernova Remnant, EN -Emission Nebula, RN - Reflection Nebula, Globular Cluster, DS - Double Star, G - Galaxy, PN – Planetary Nebula) **Magnitude** – Magnitude of the object **Size** – Angular size of the object.
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RASC Visual Observing Log

Date:	Time:	Activity:
Location:		
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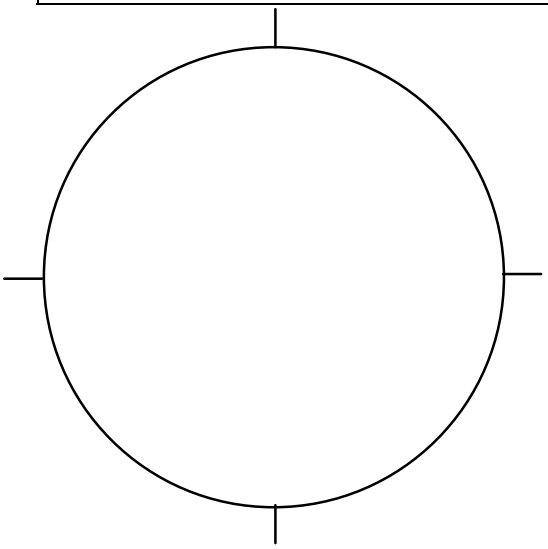

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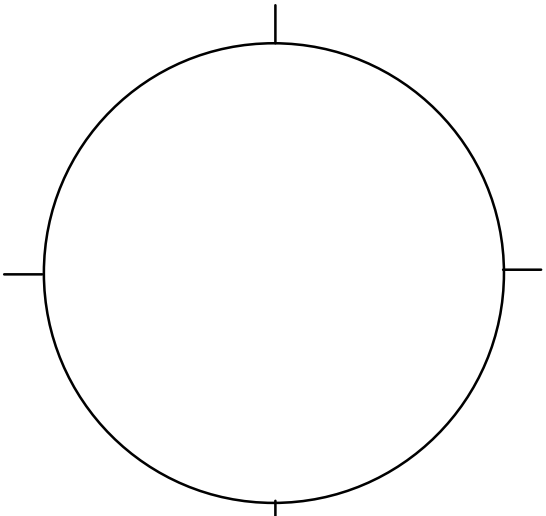

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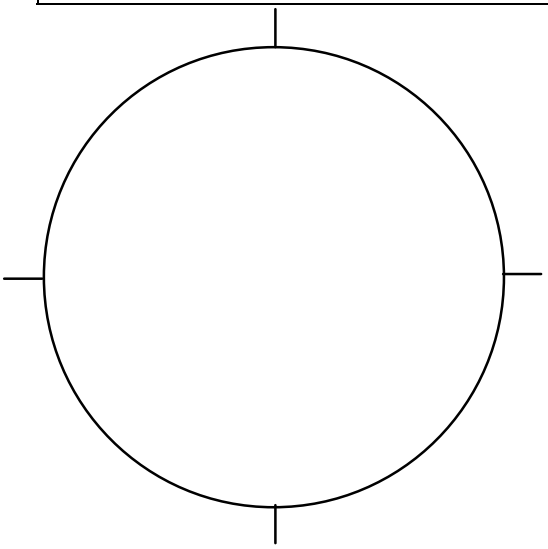

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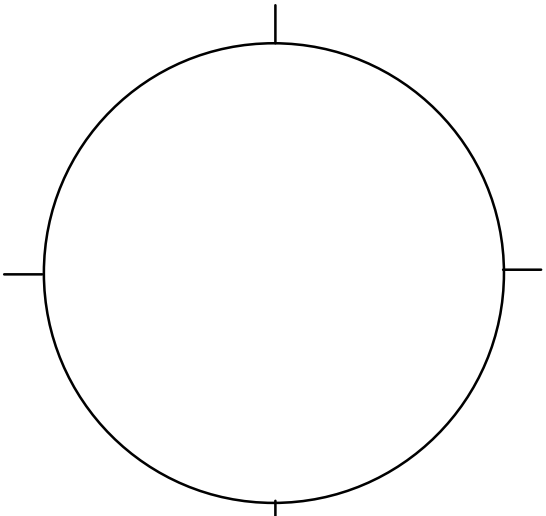

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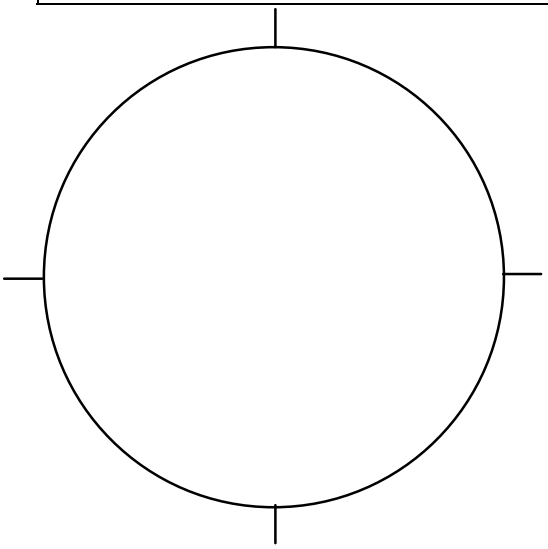

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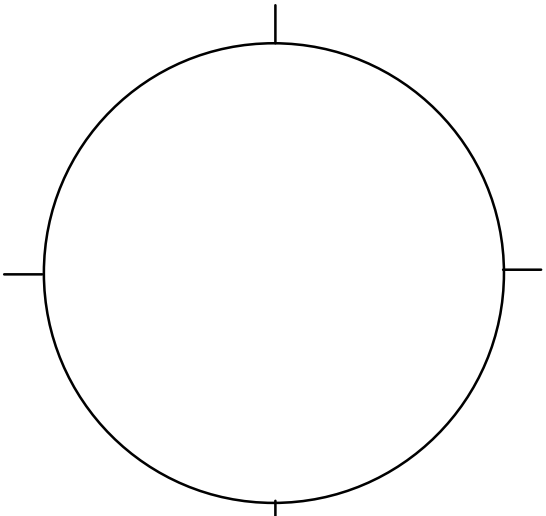

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RASC Visual Observing Log

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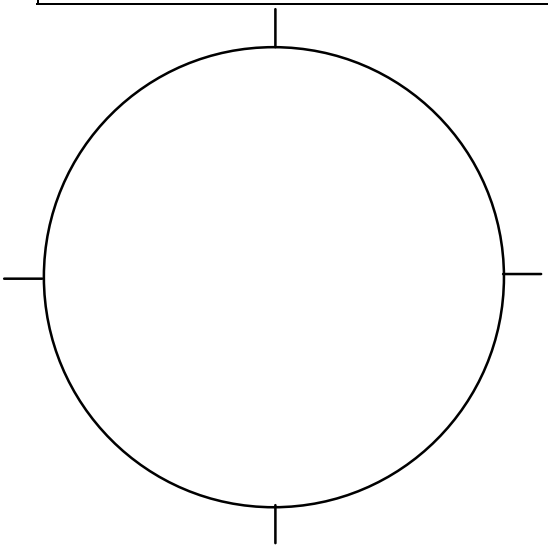

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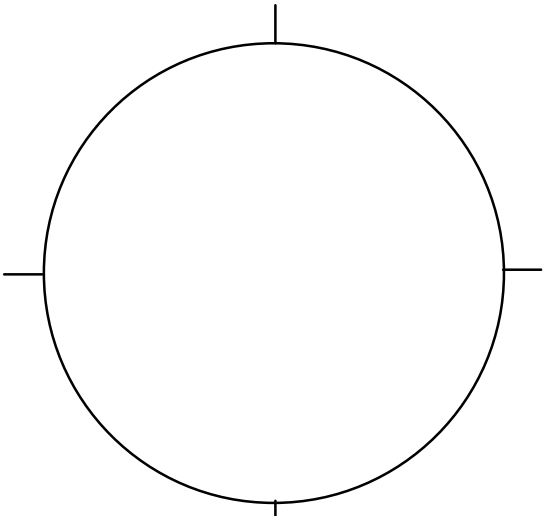

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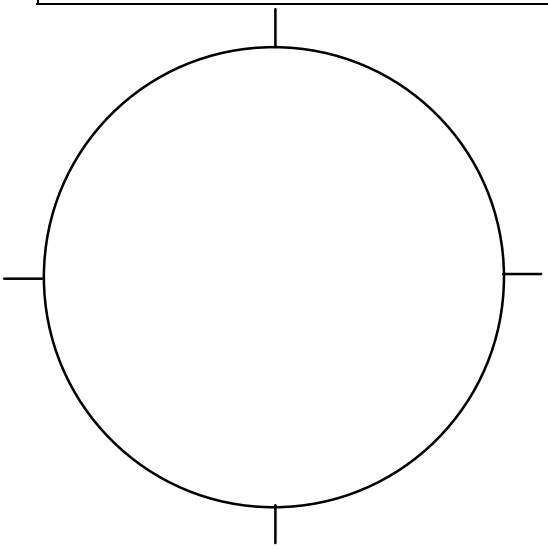

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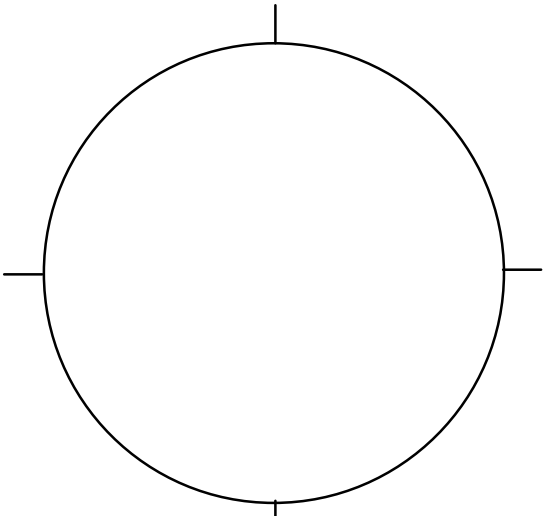

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Conditions:	**Transparency** ① ② ③ ④ ⑤	**Seeing** ① ② ③ ④ ⑤ ⑥ ⑦ / **Limiting Visual Magnitude:**

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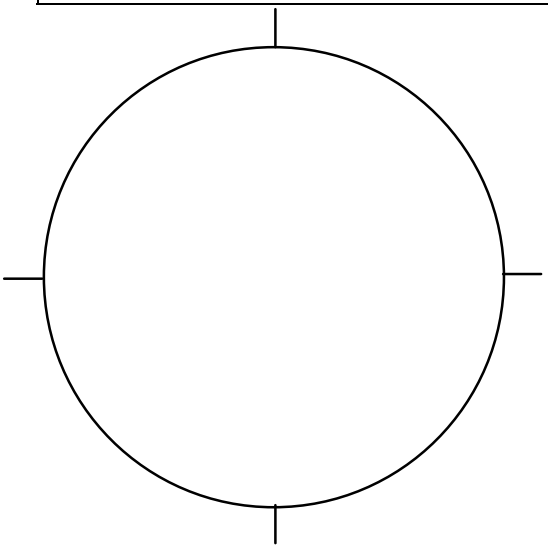

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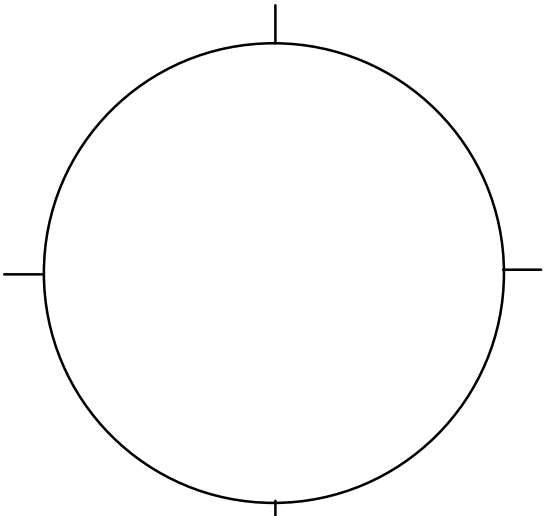

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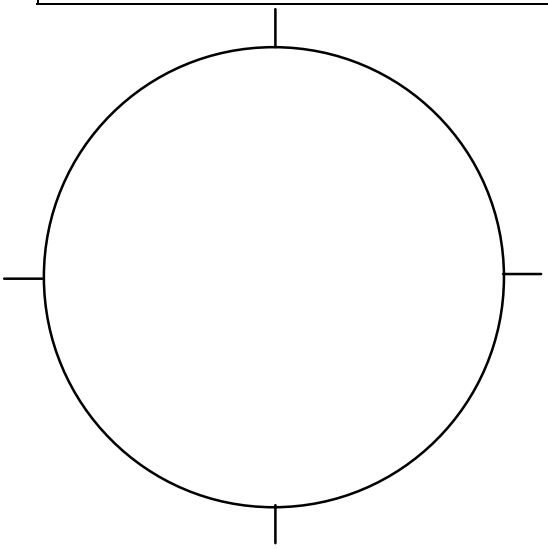

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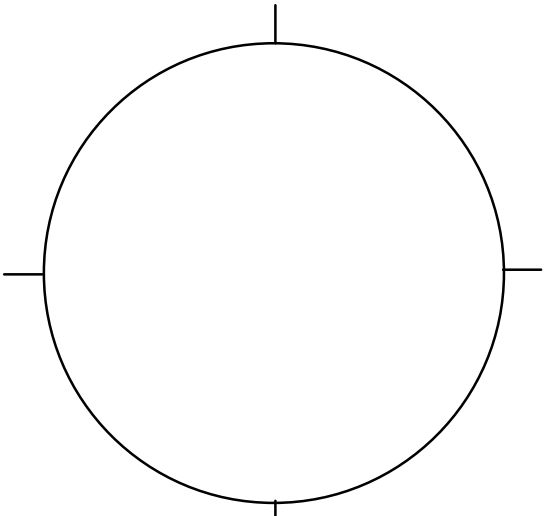

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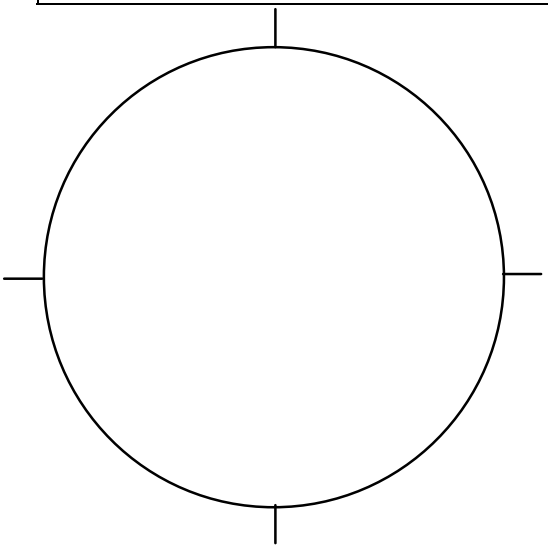

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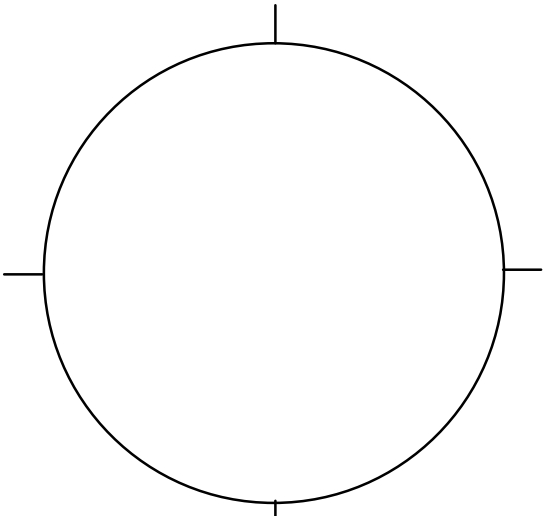

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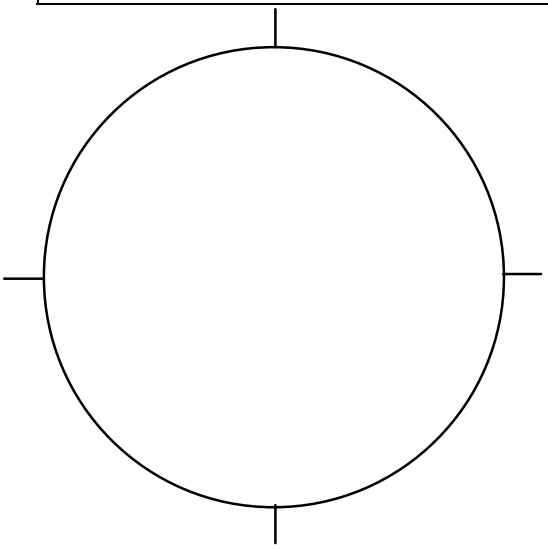

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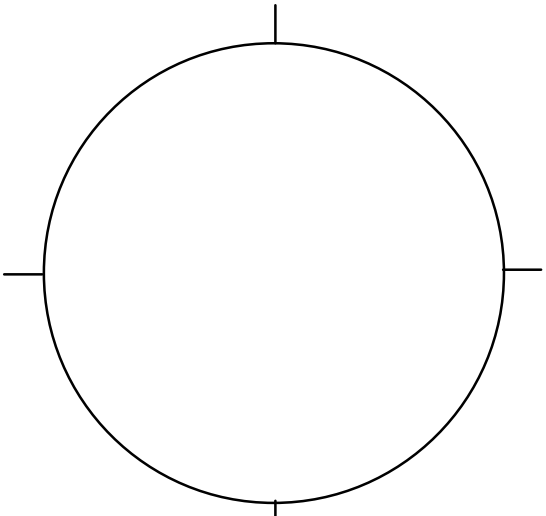

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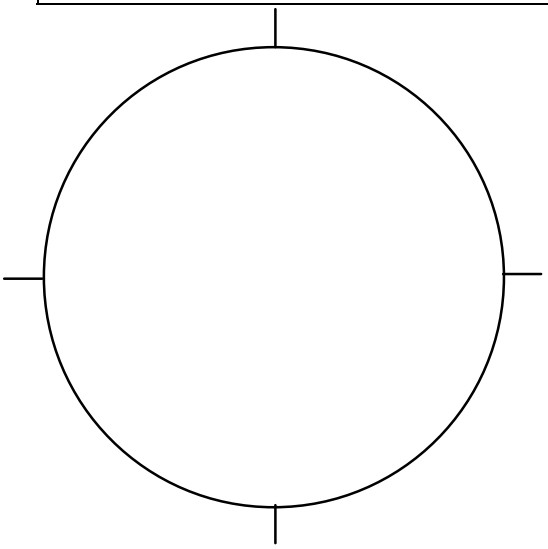

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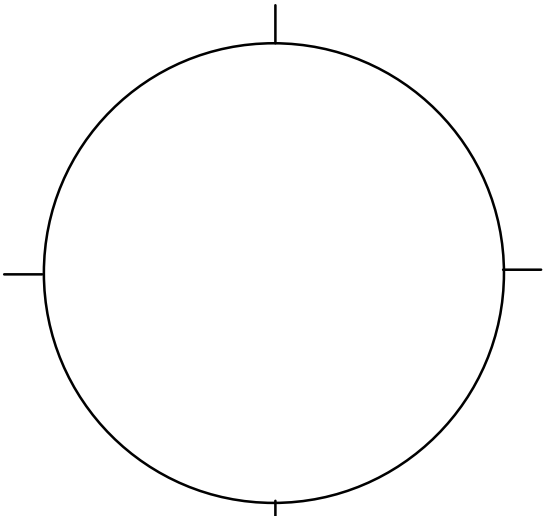

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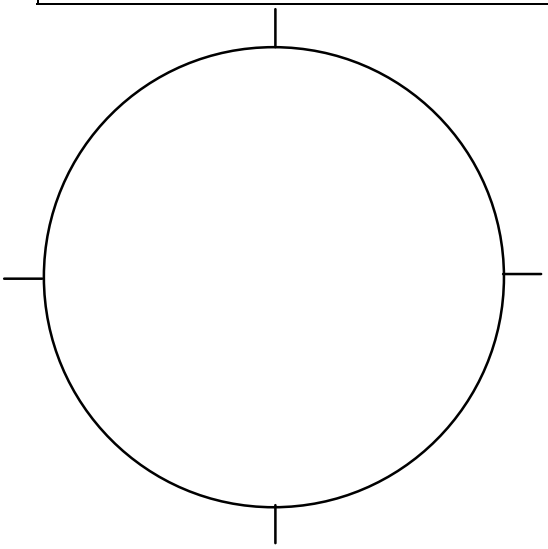

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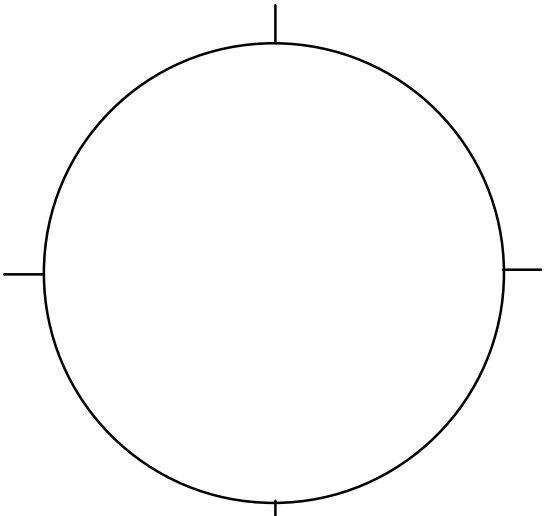

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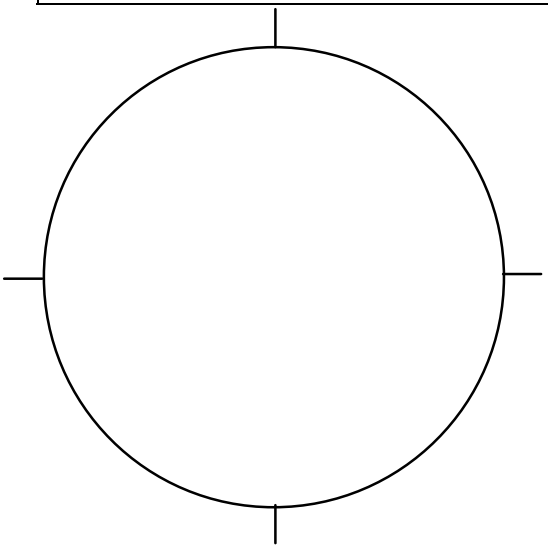

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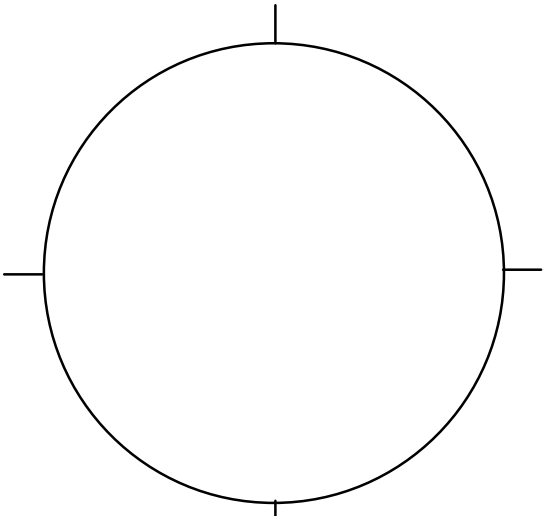

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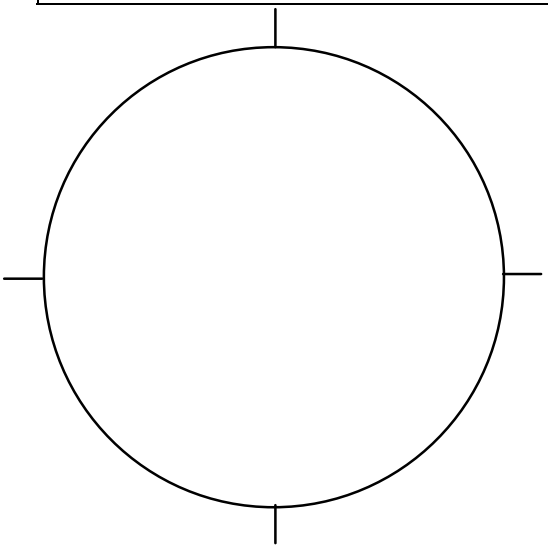

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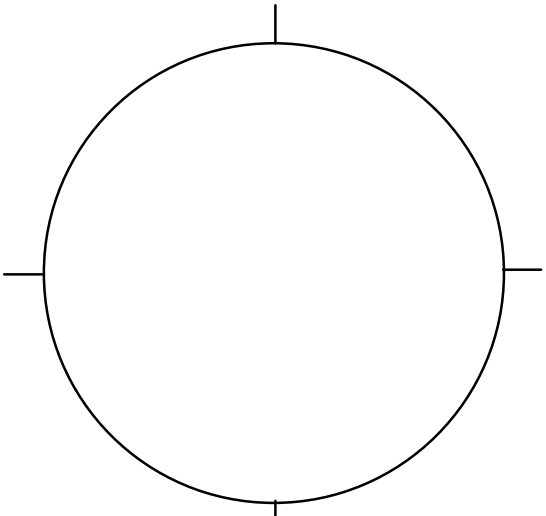

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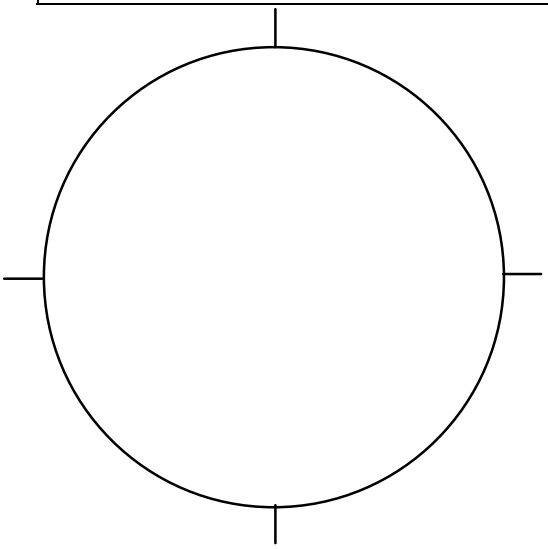

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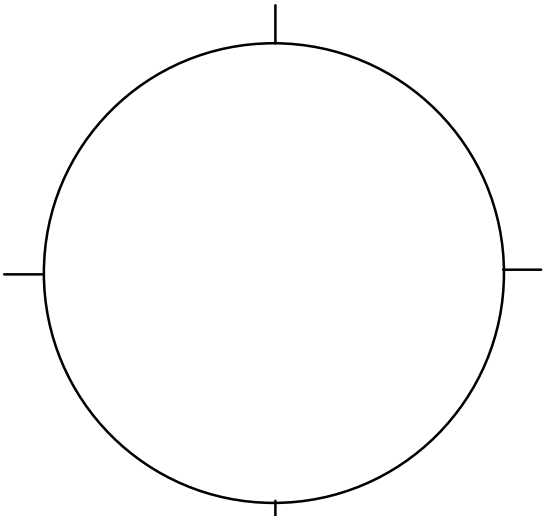

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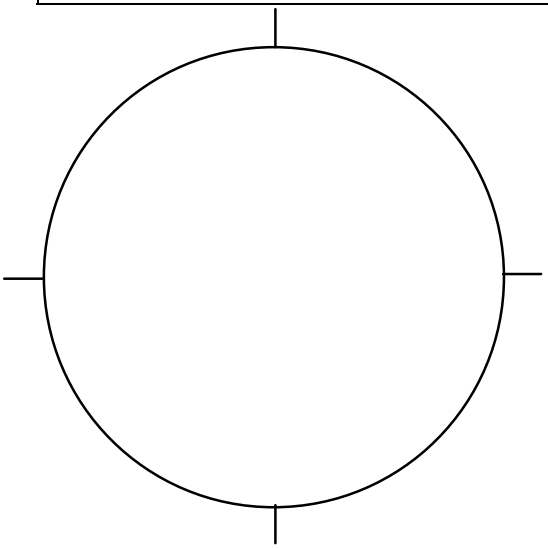

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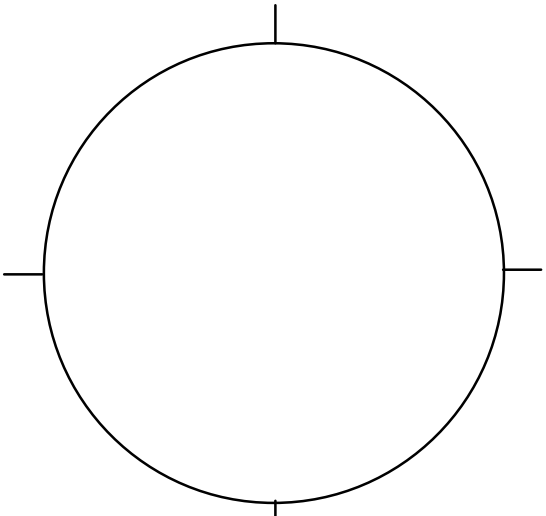

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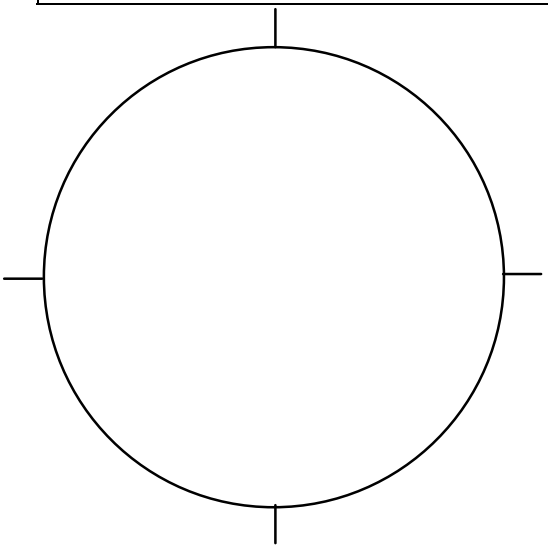

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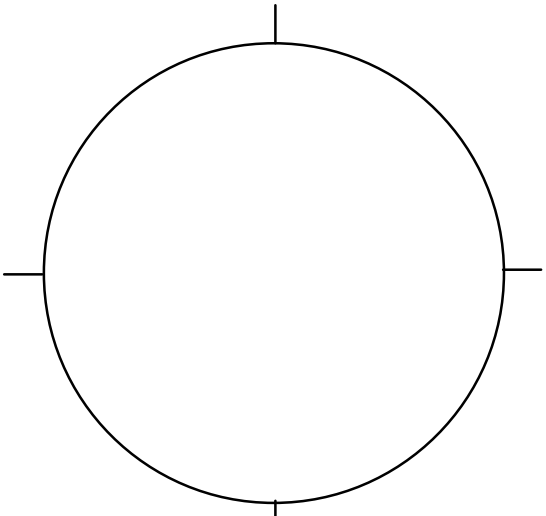

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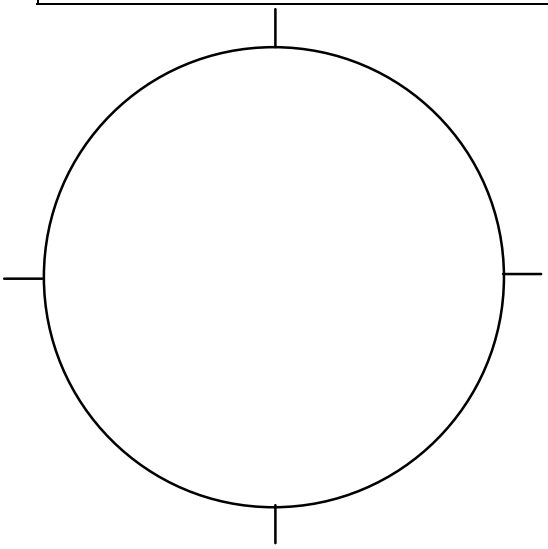

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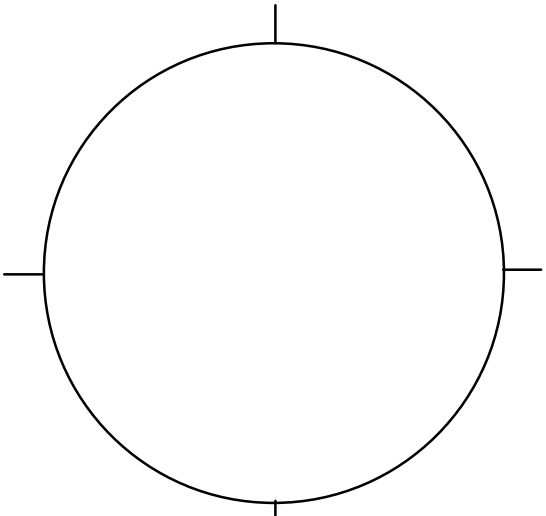

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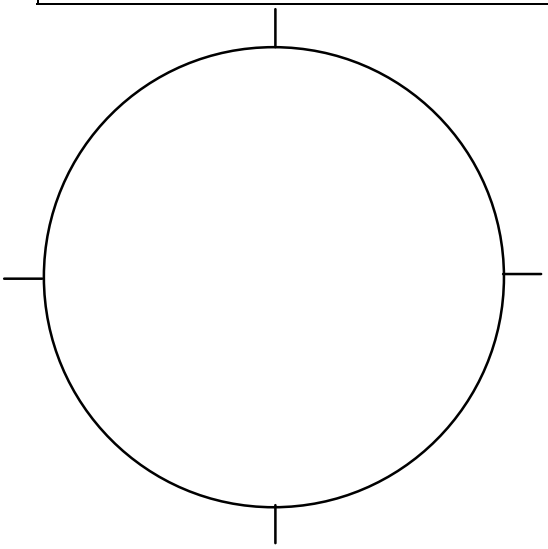

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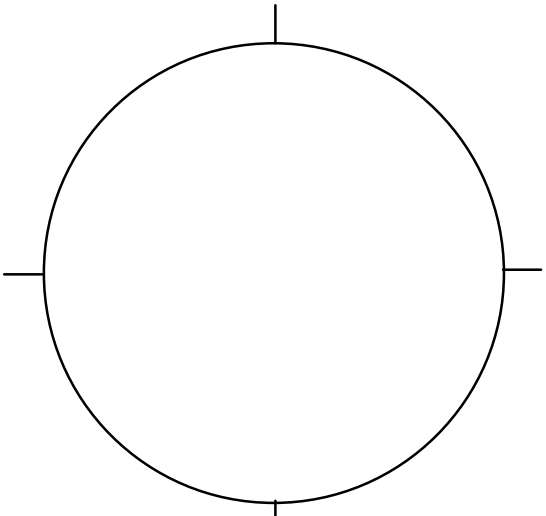

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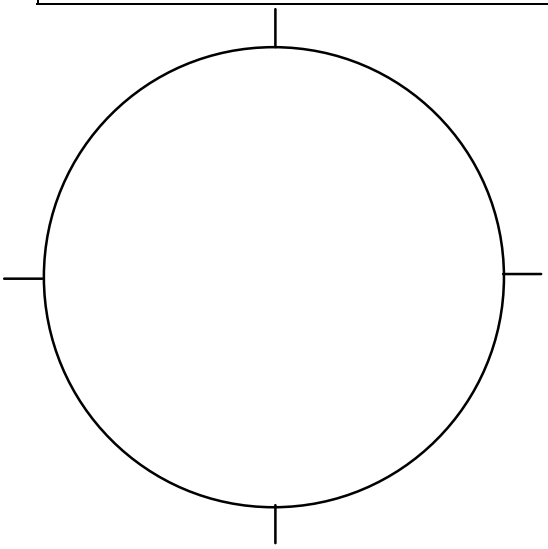

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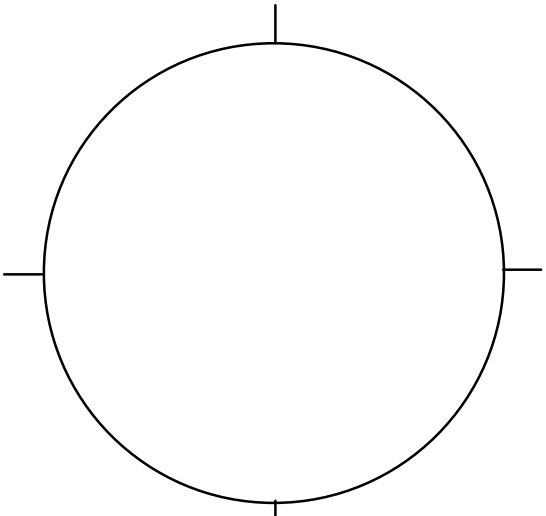

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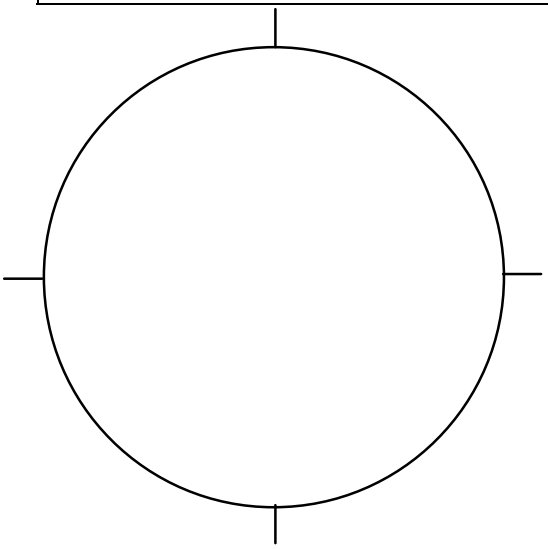

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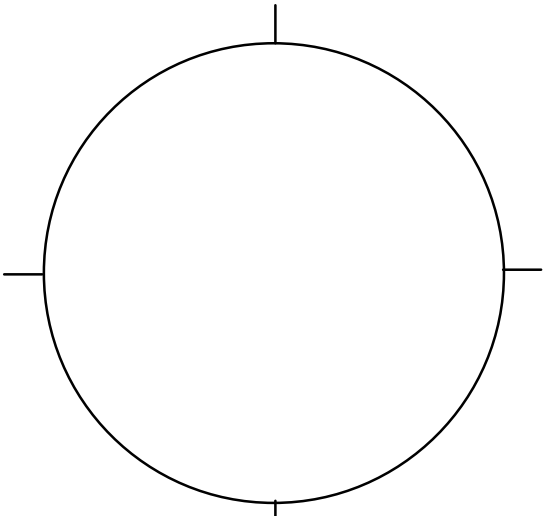

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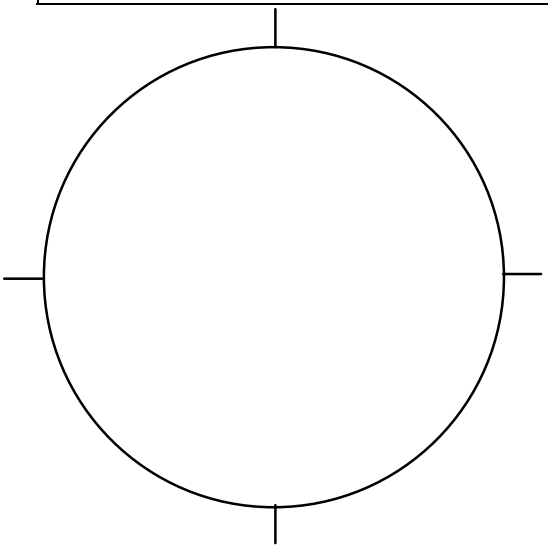

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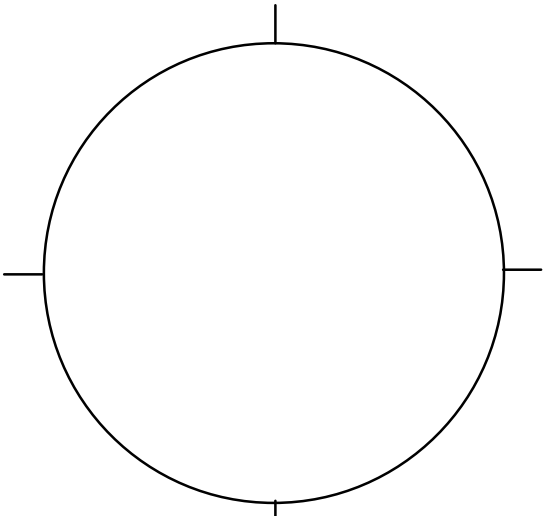

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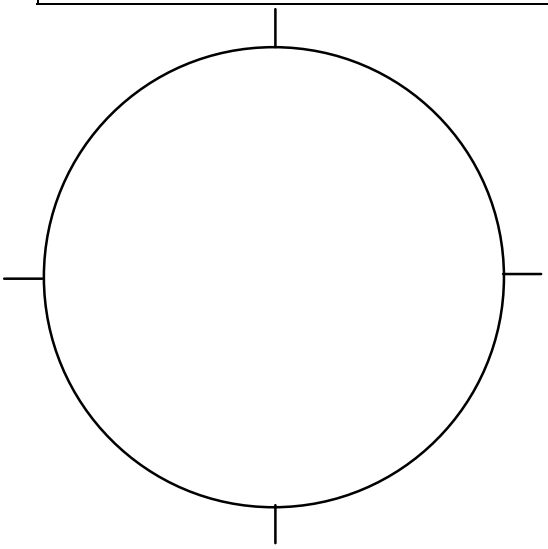

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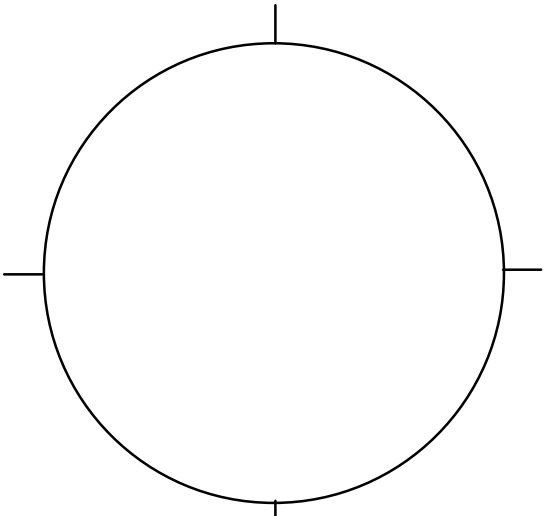

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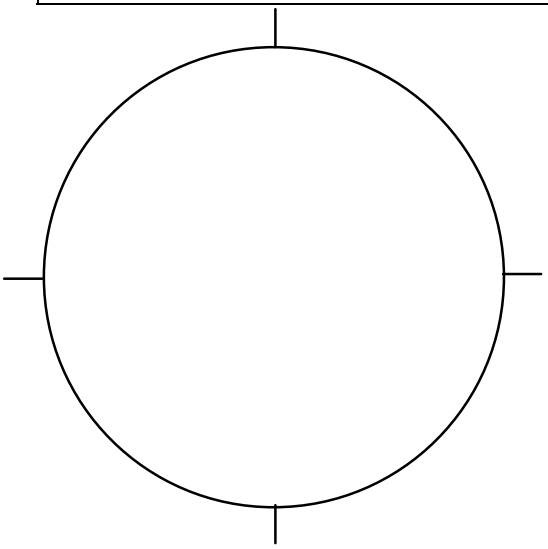

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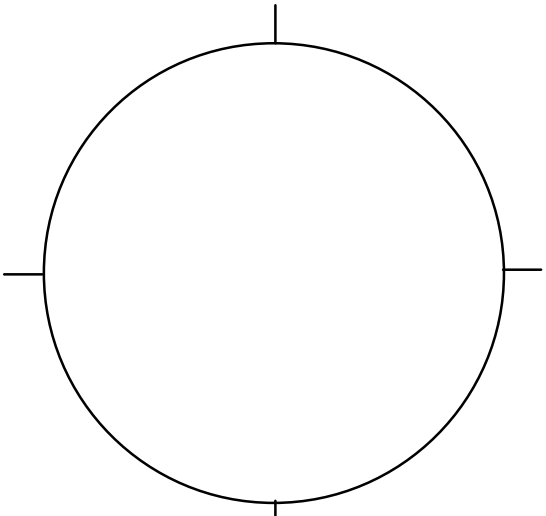

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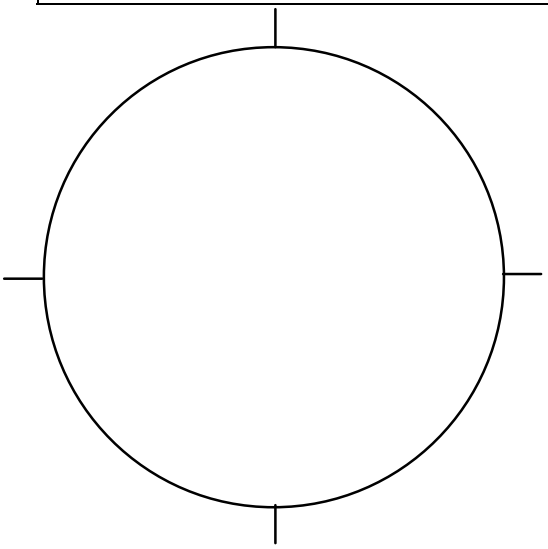

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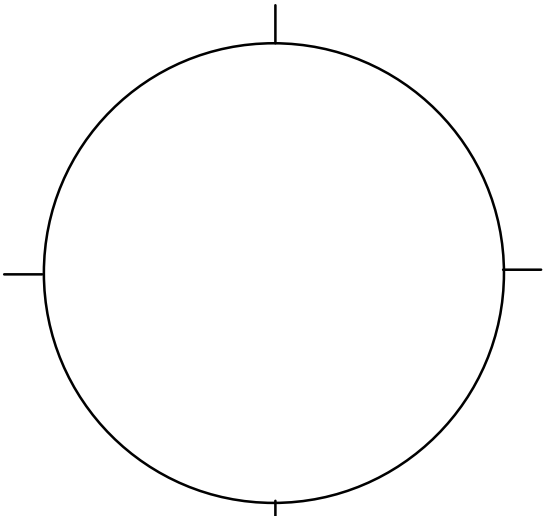

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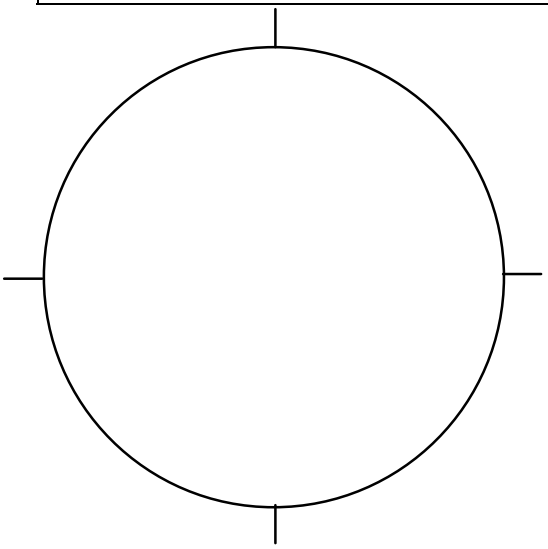

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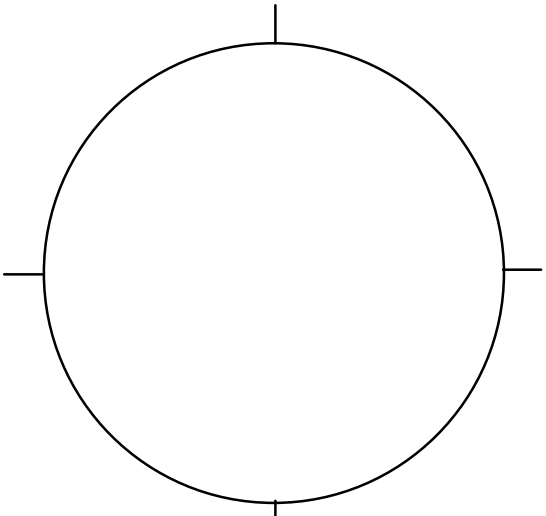

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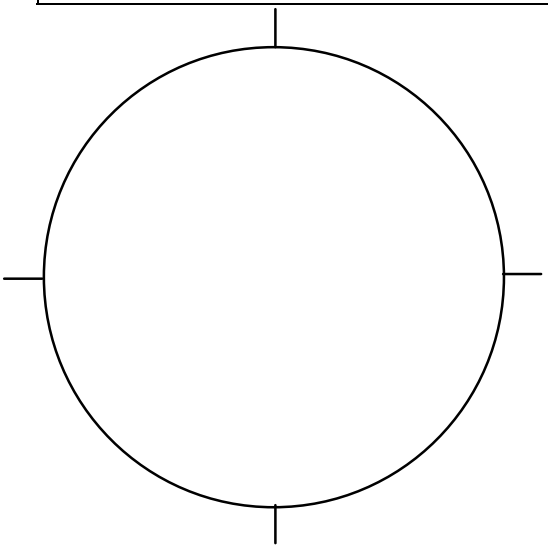

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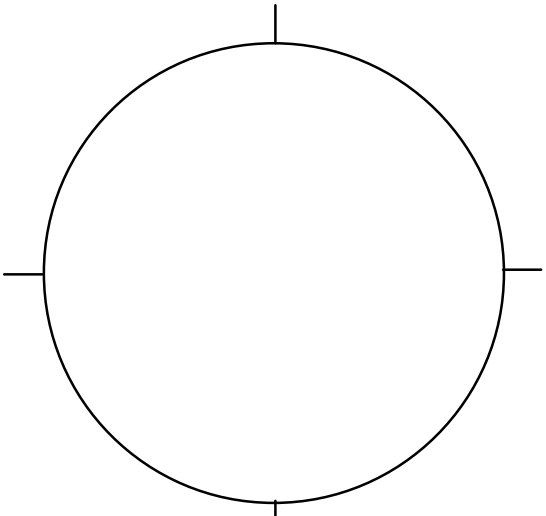

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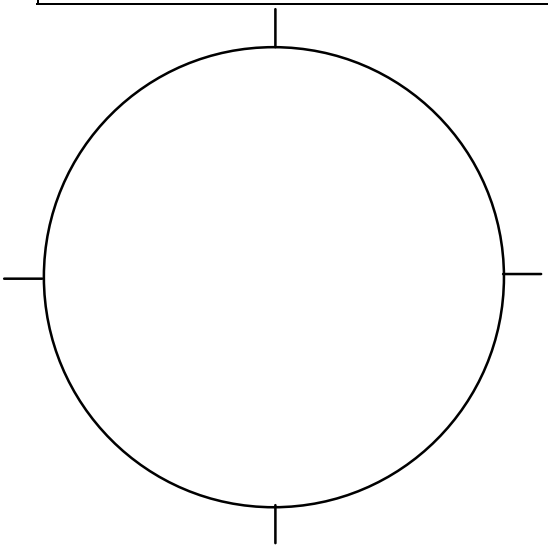

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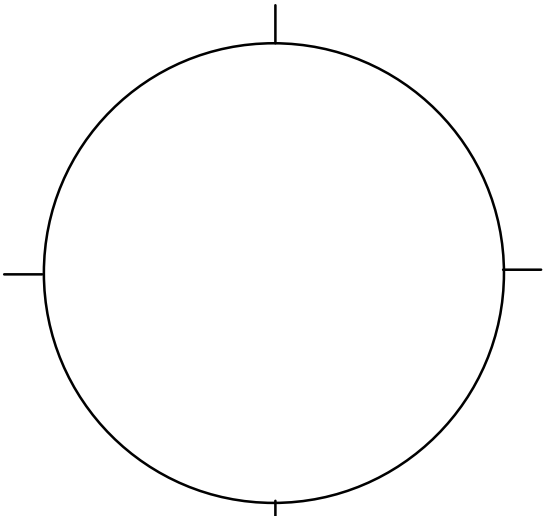

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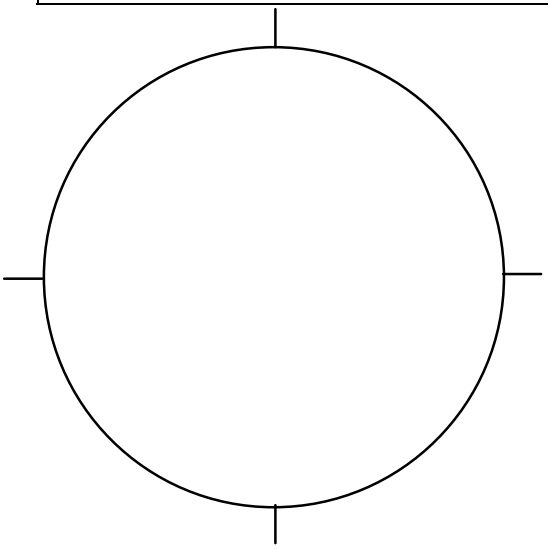

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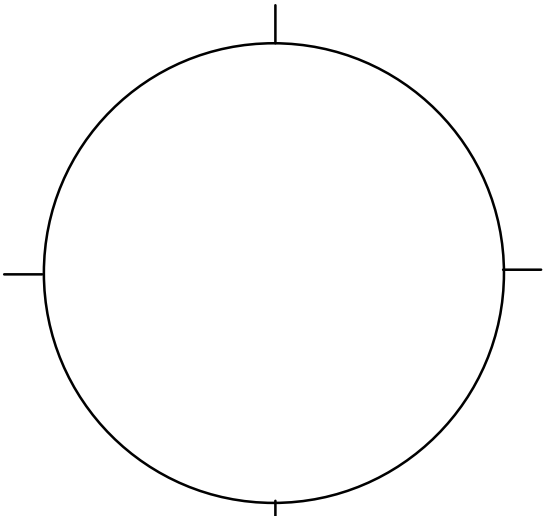

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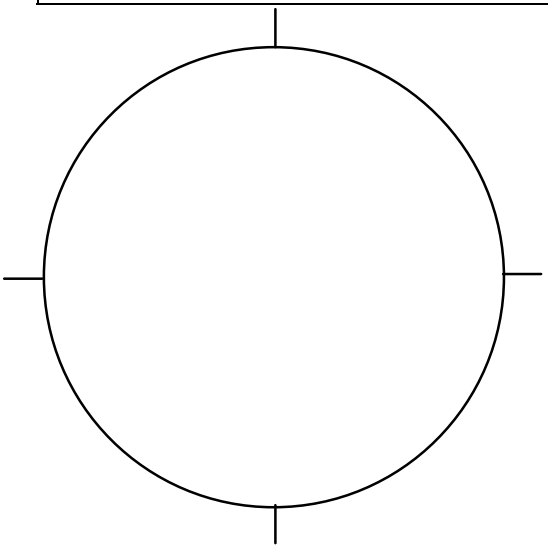

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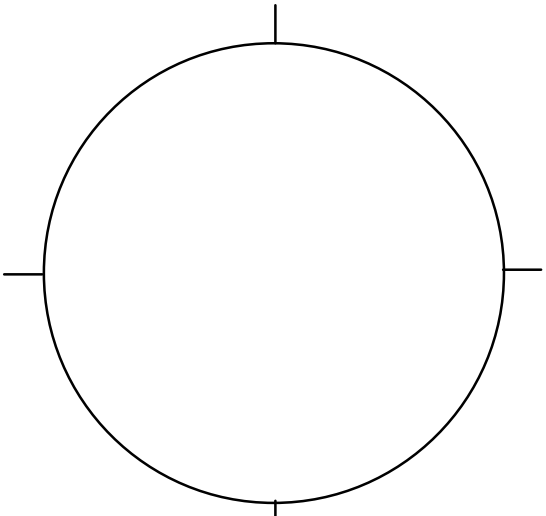

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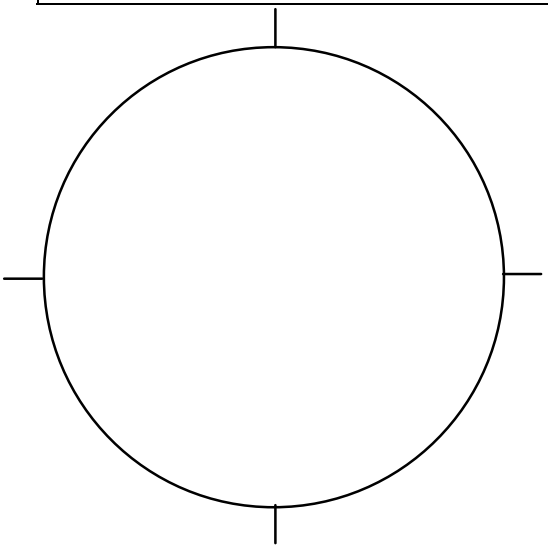

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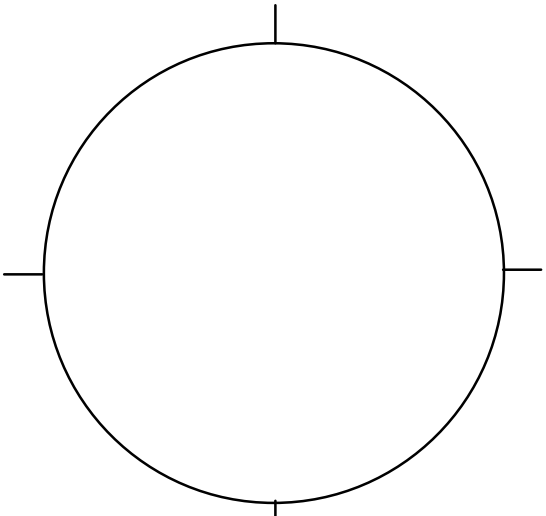

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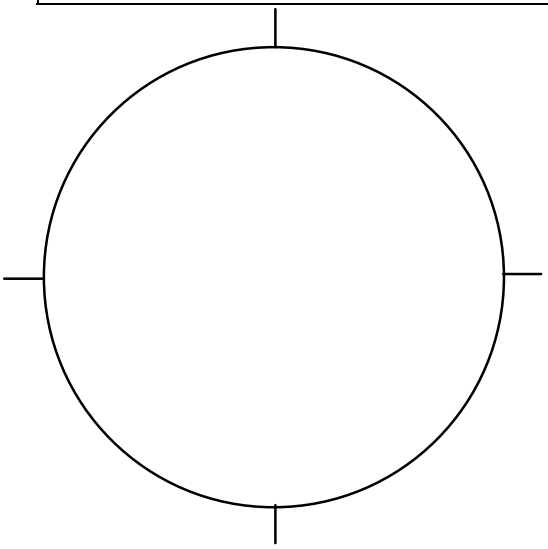

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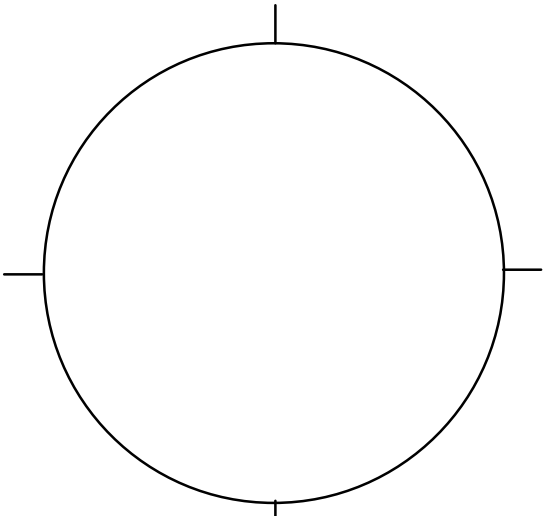

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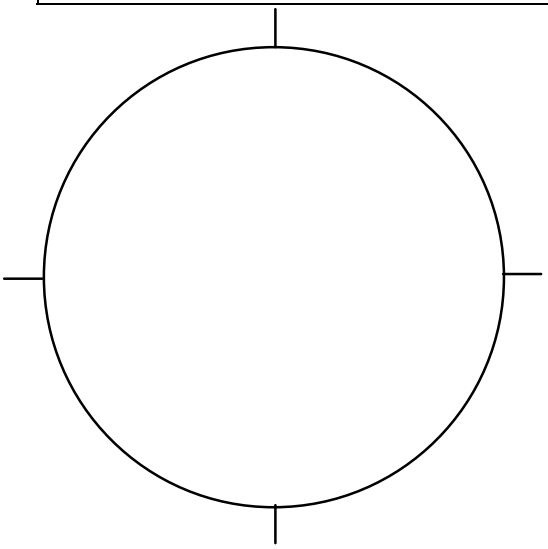

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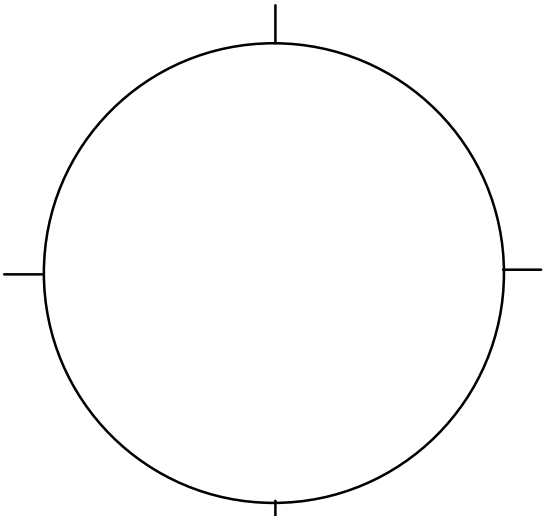

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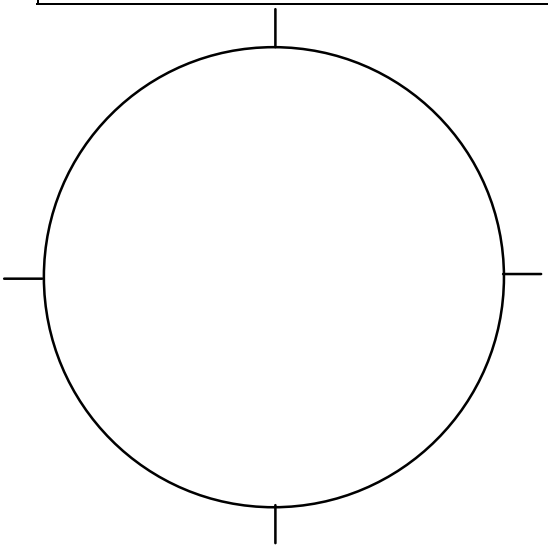

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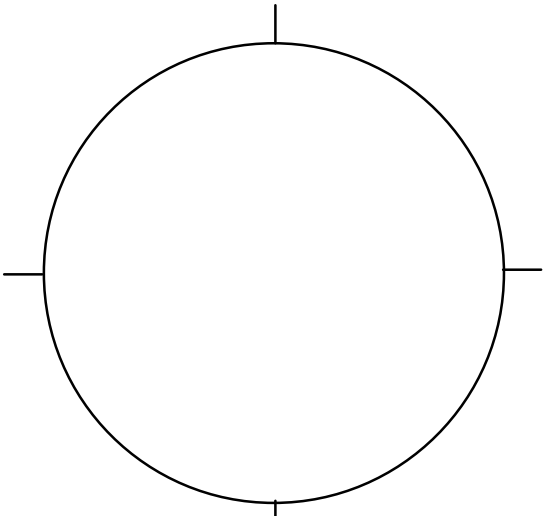

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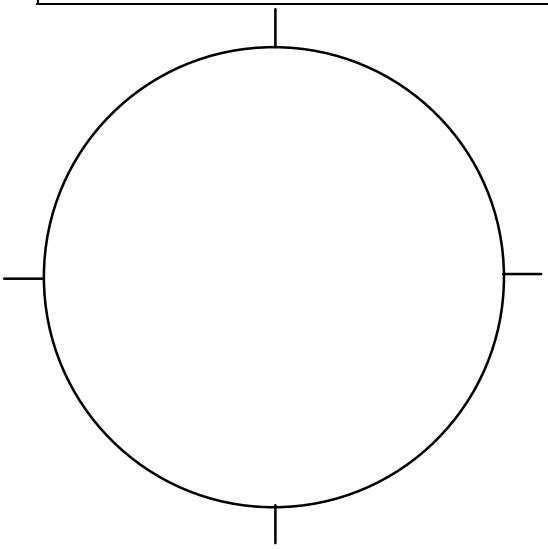

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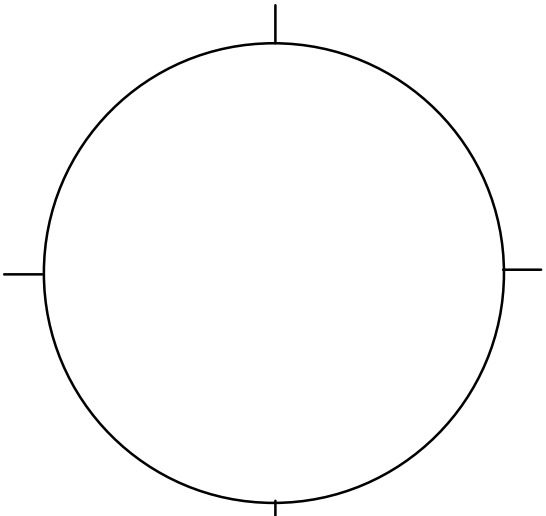

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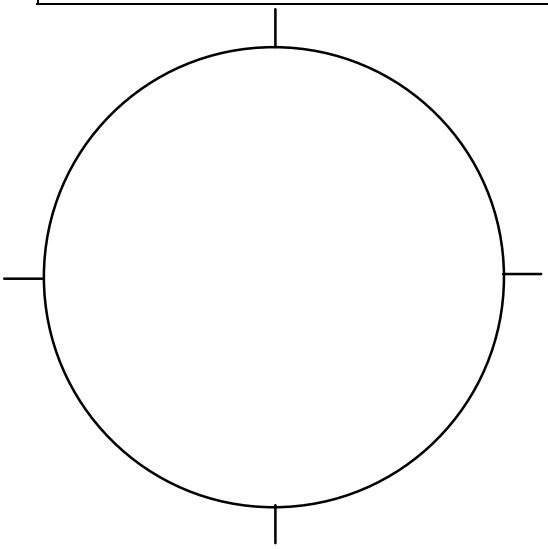

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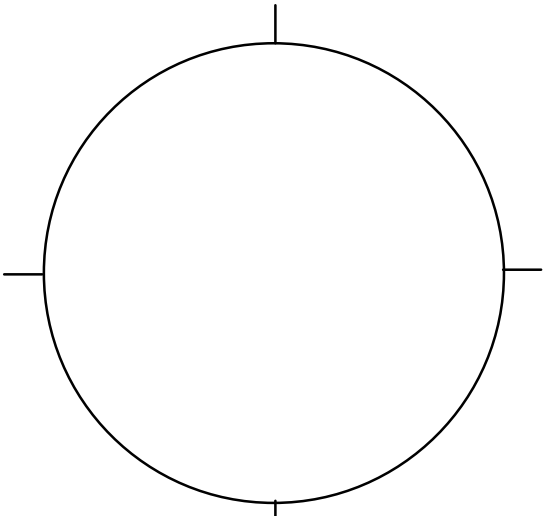

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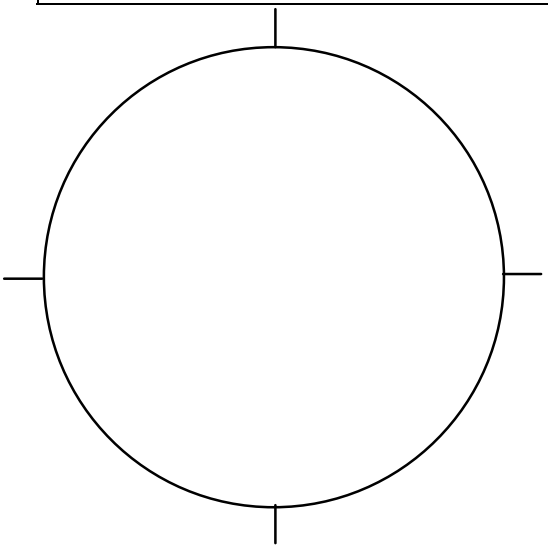

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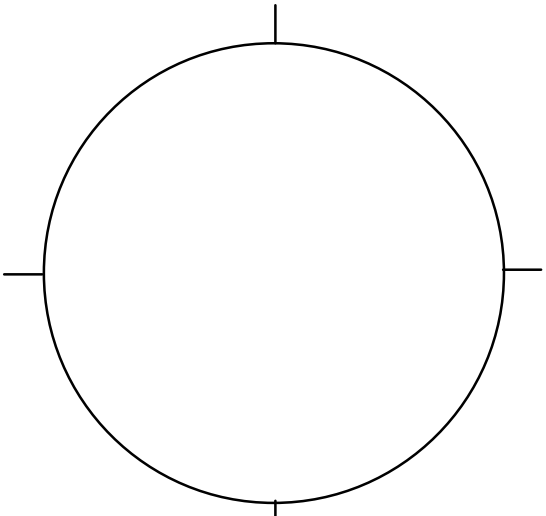

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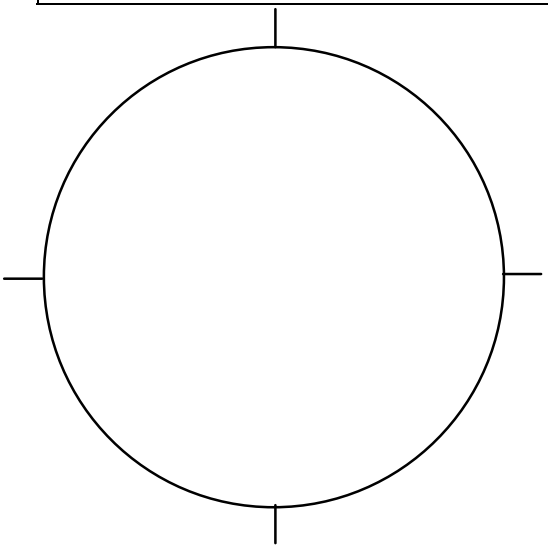

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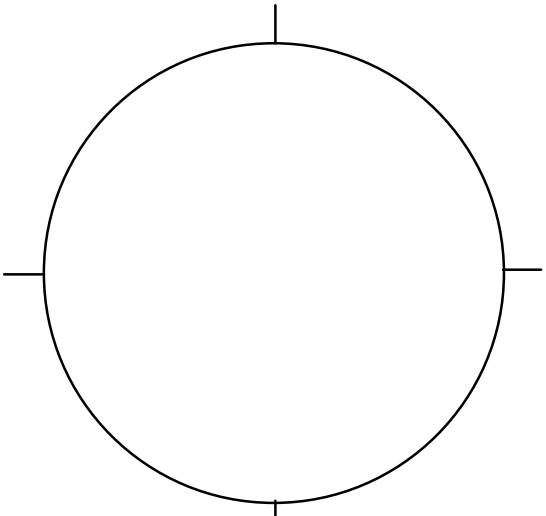

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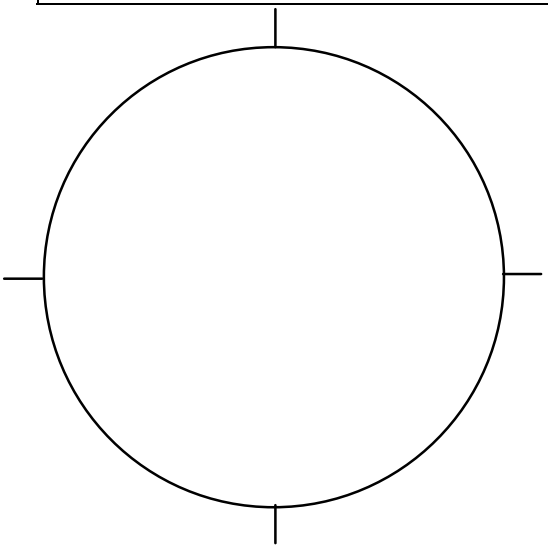

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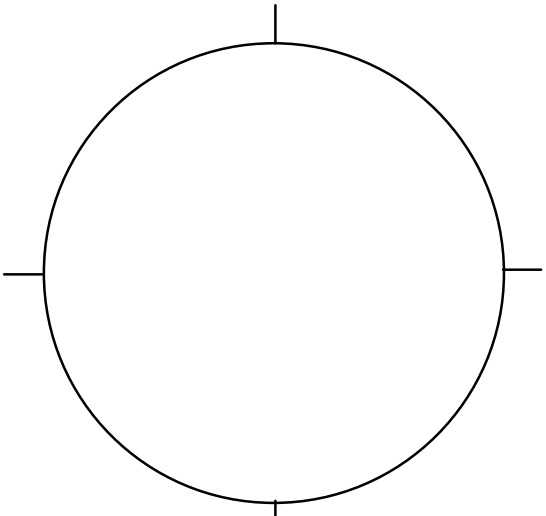

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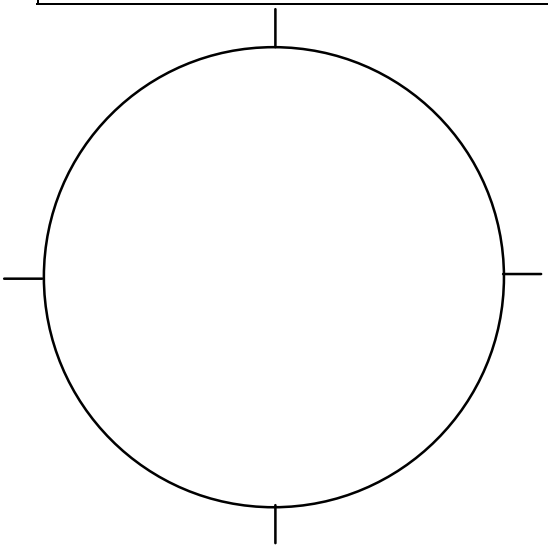

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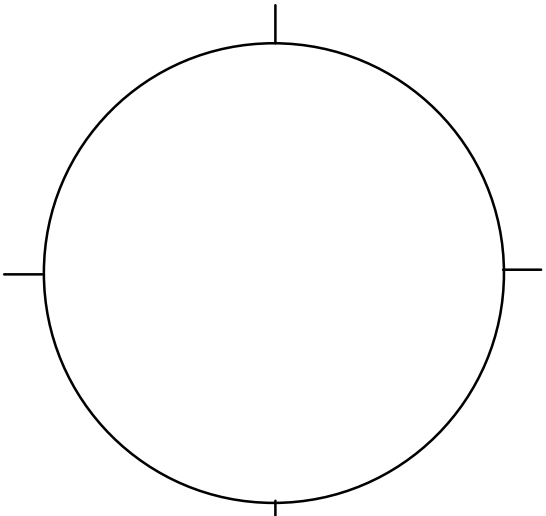

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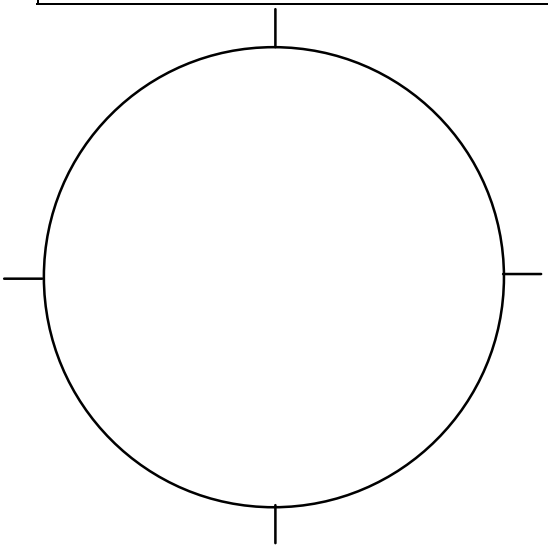

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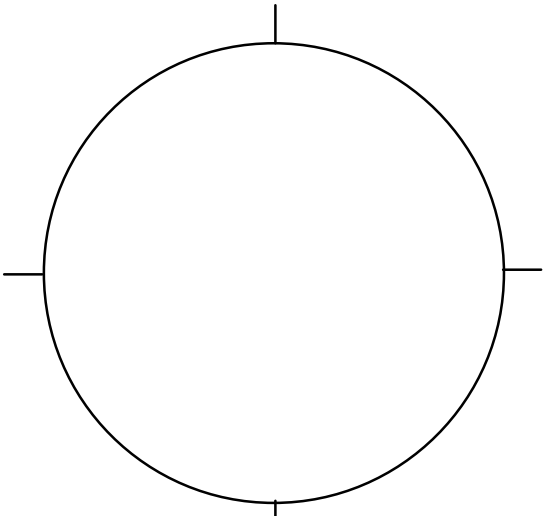

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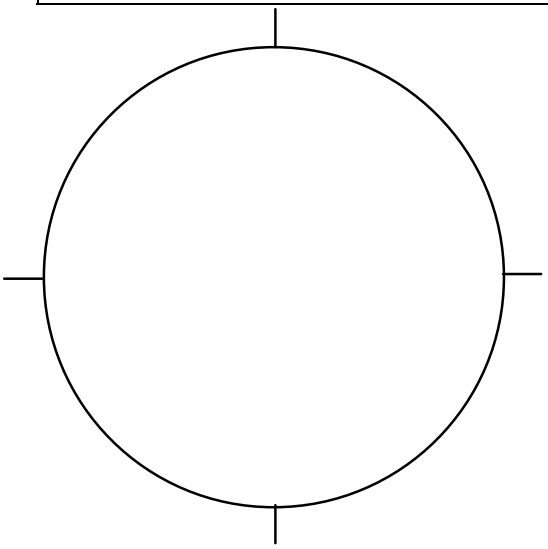

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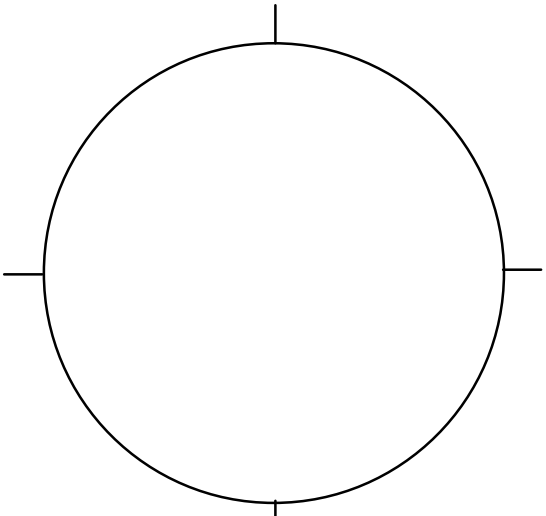

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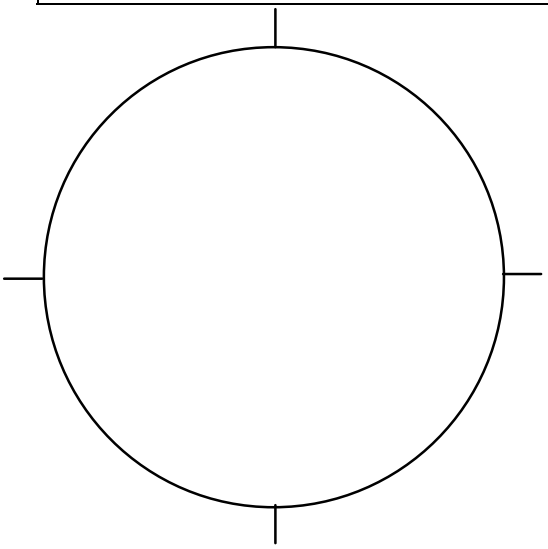

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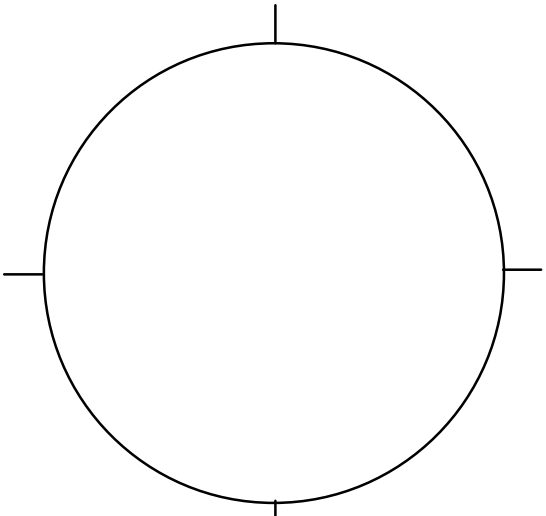

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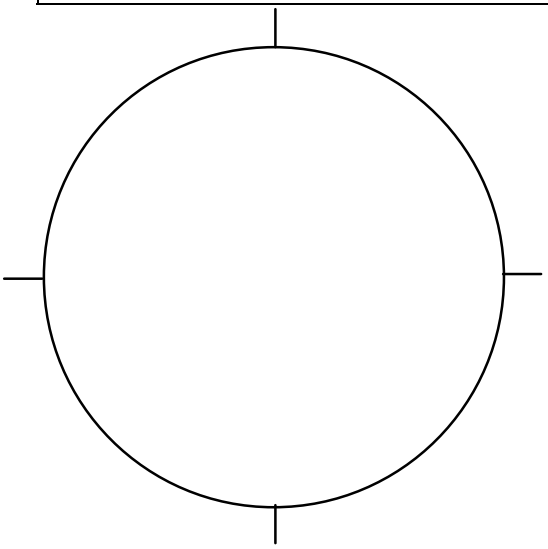

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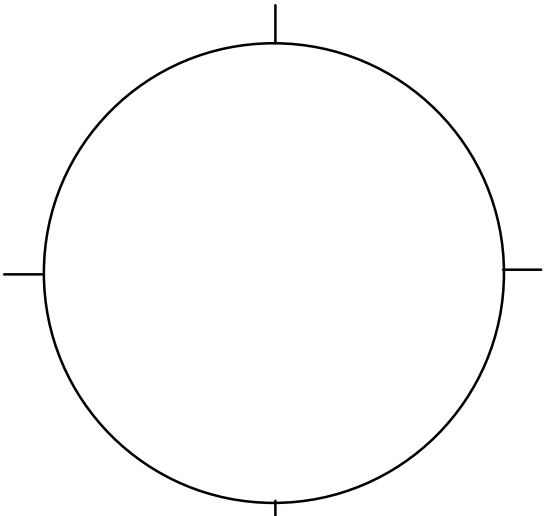

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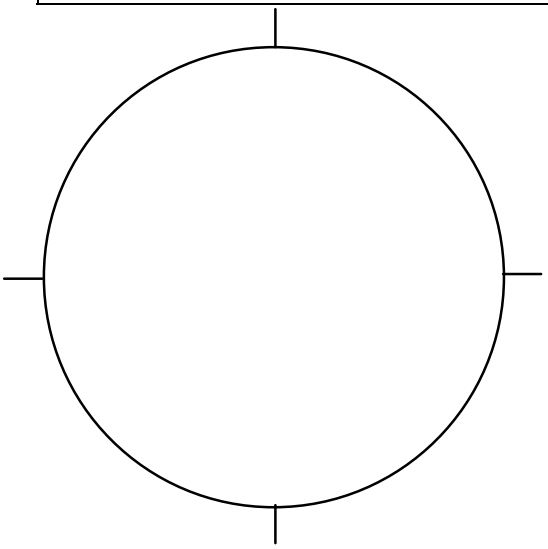

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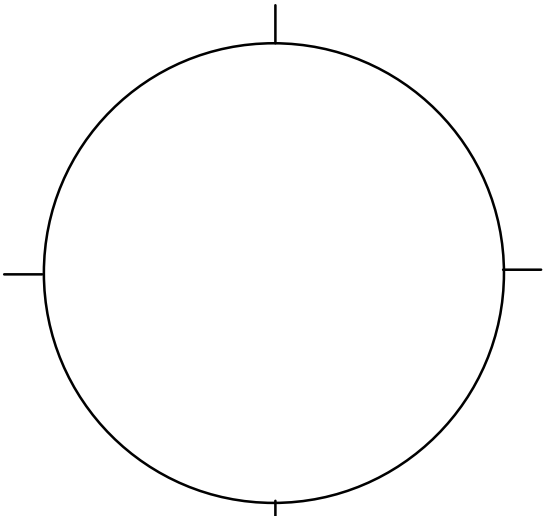

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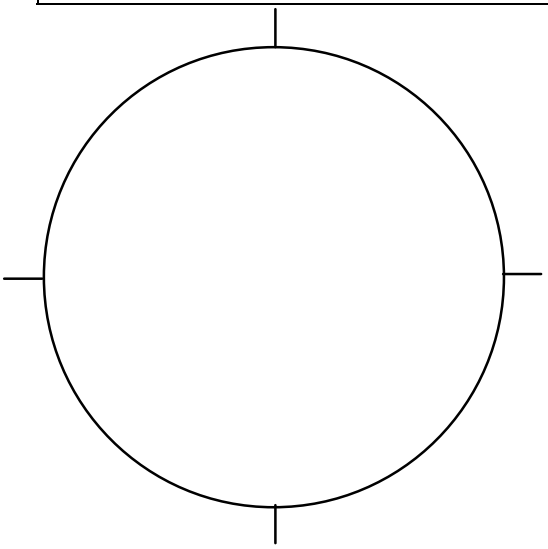

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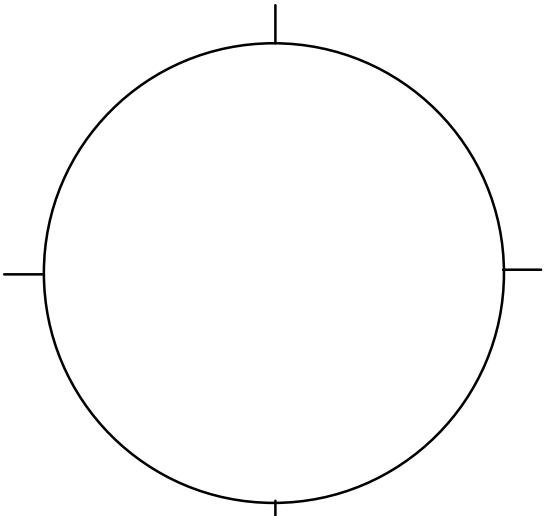

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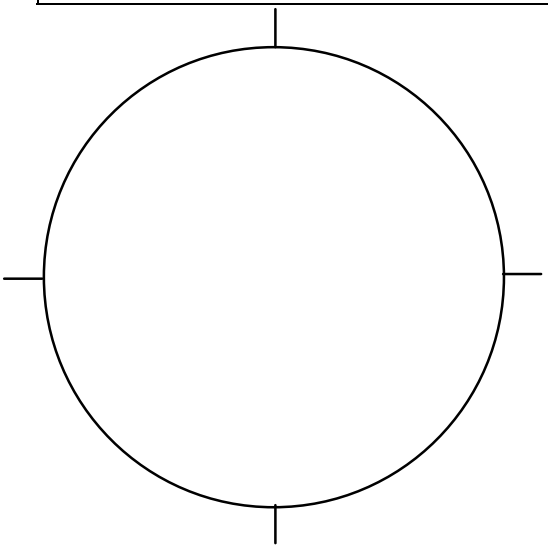

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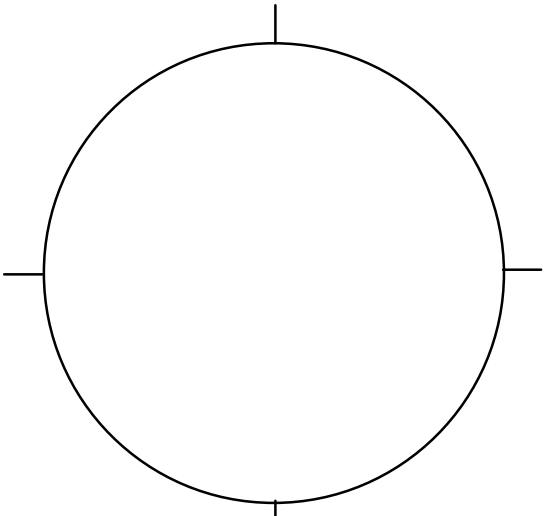

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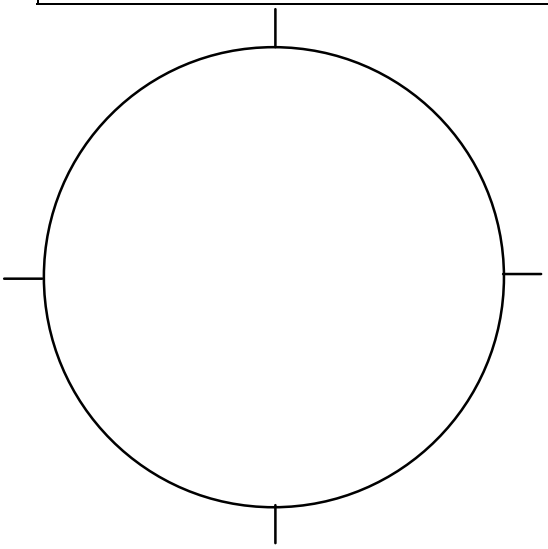

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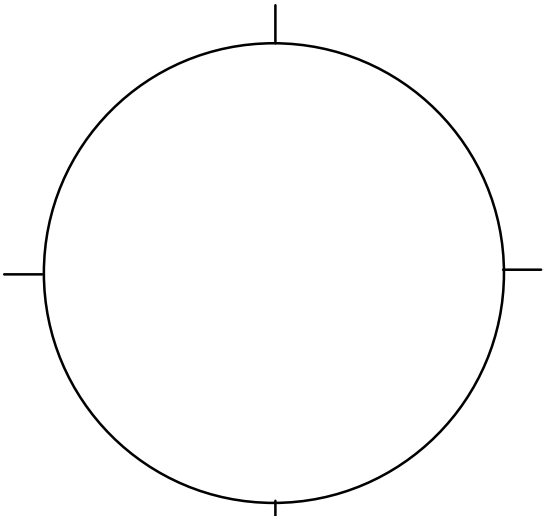

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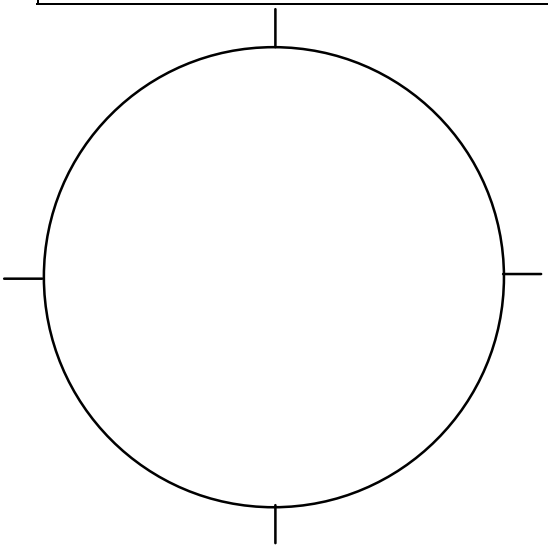

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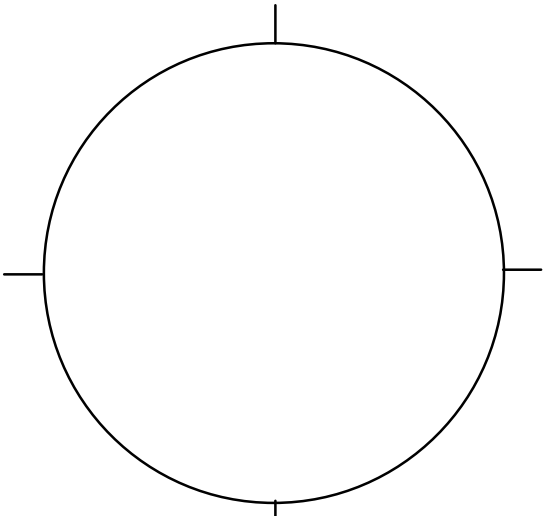

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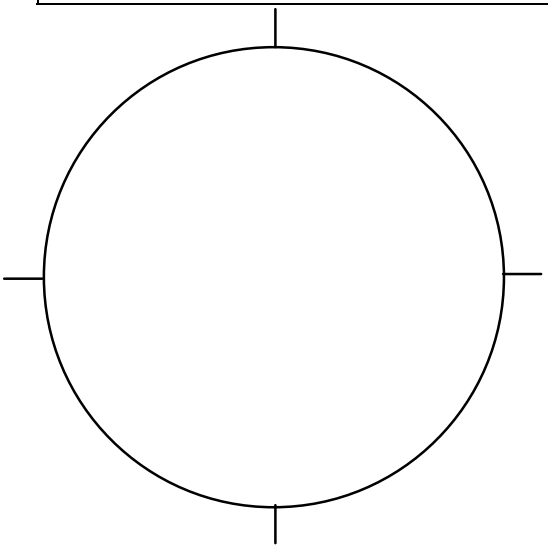

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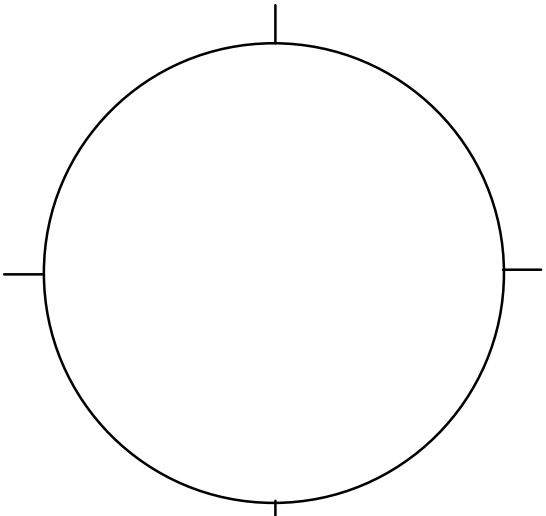

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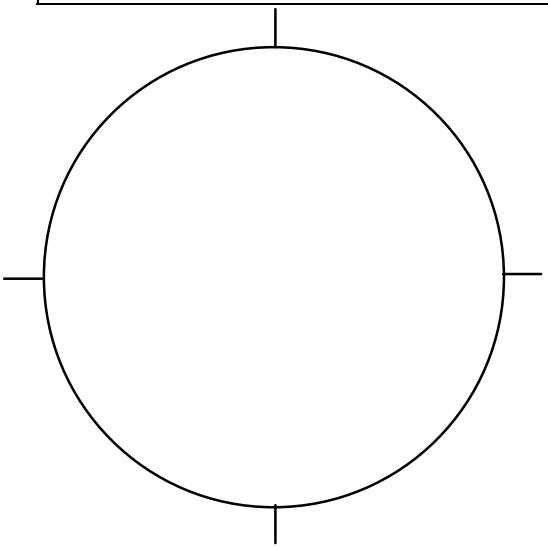

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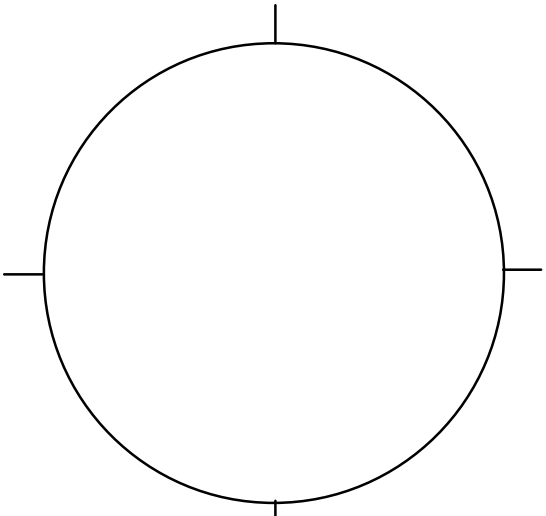

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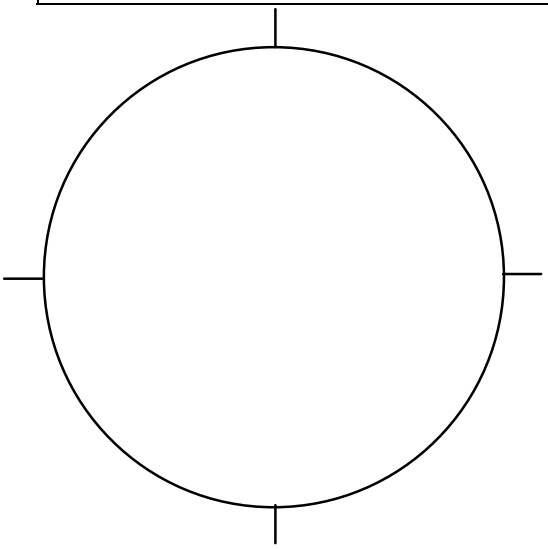

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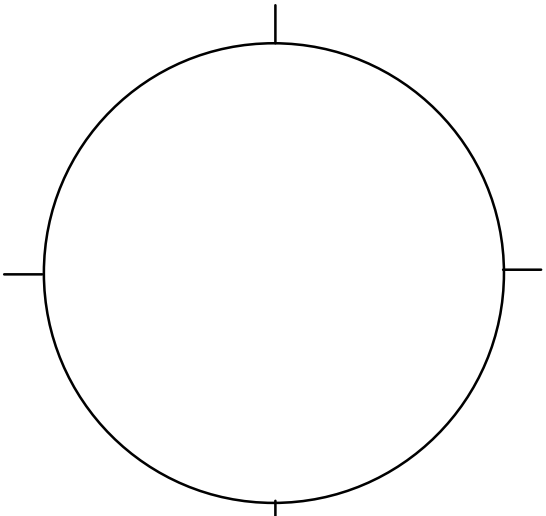

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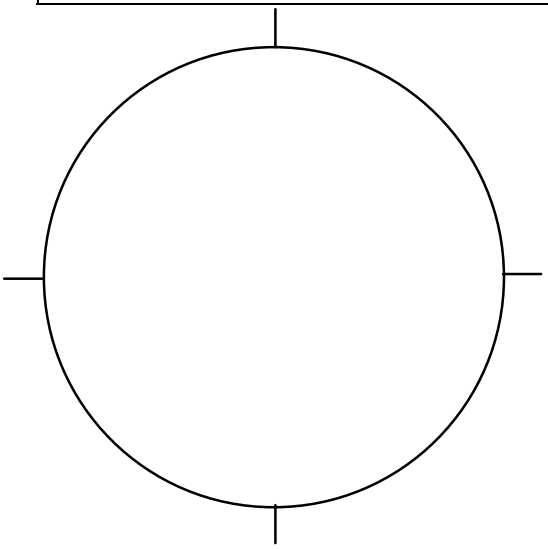

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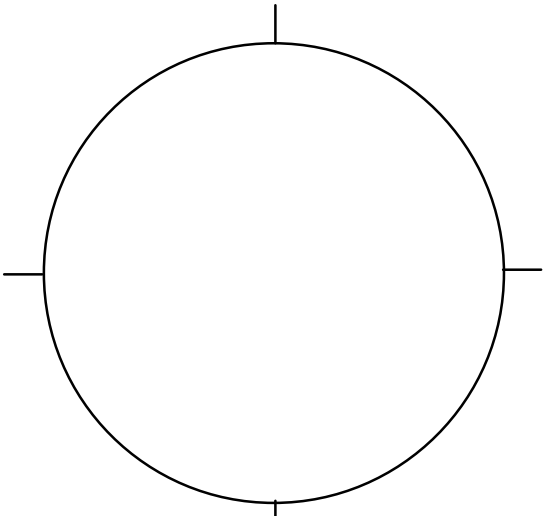

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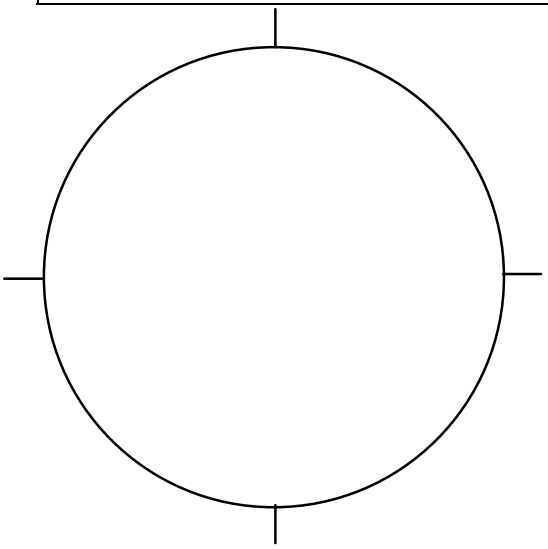

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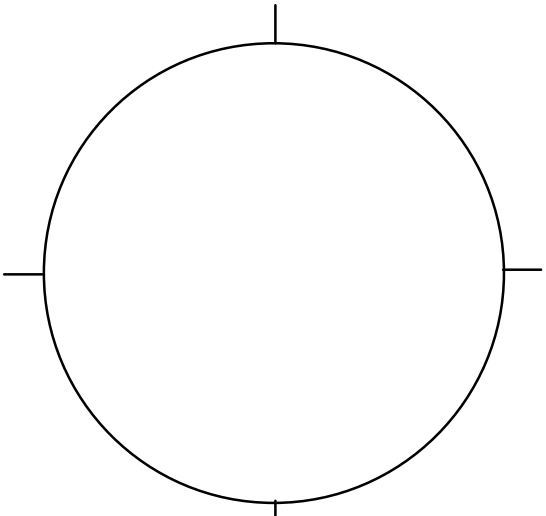

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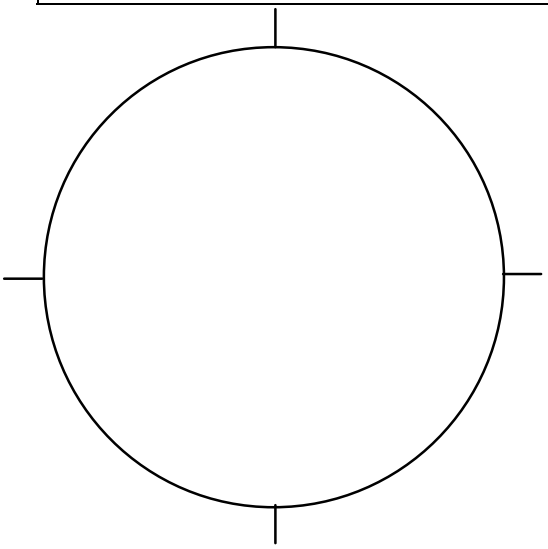

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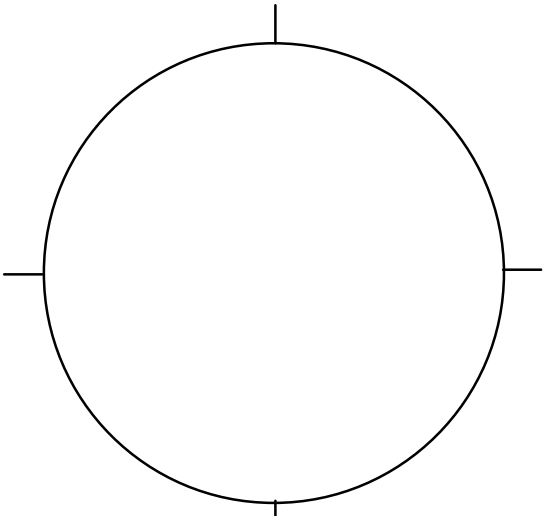

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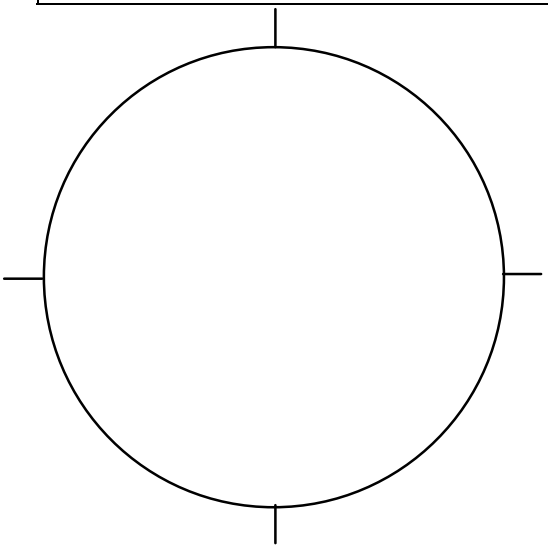

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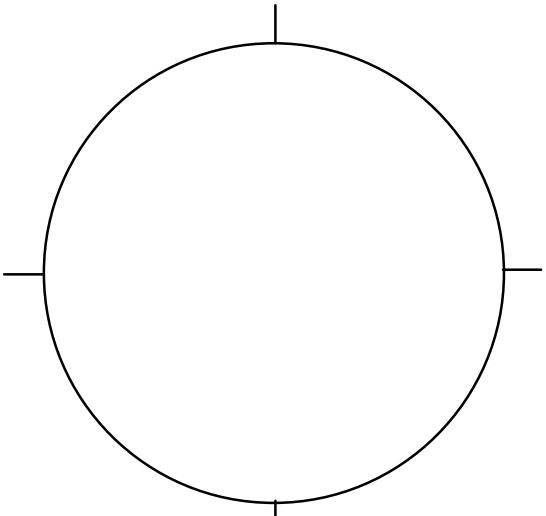

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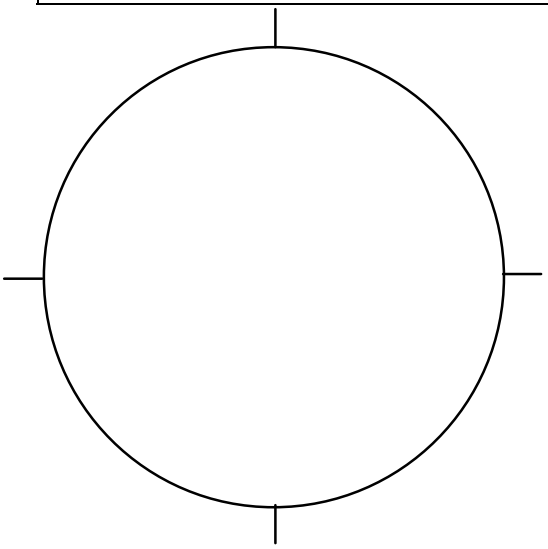

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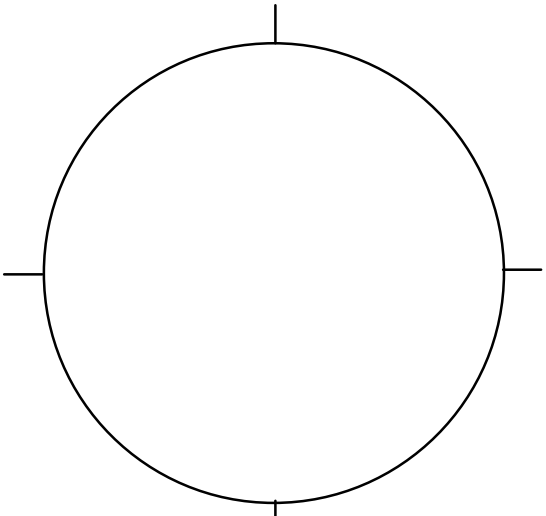

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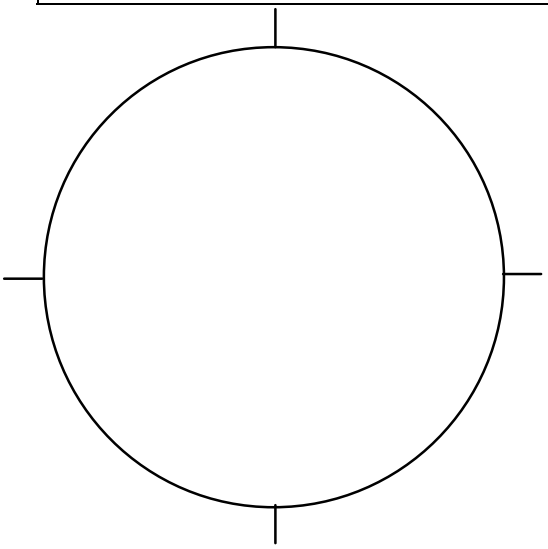

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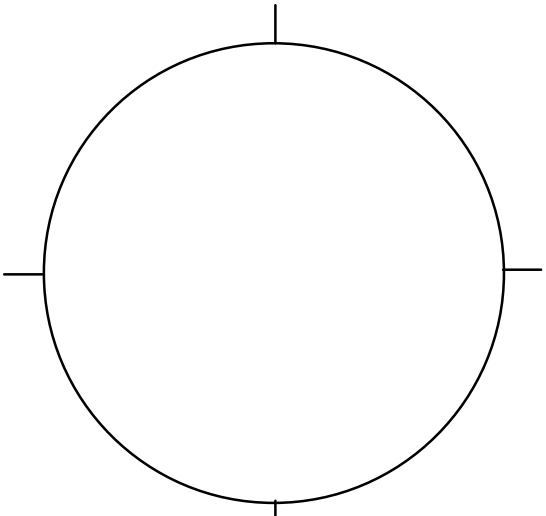

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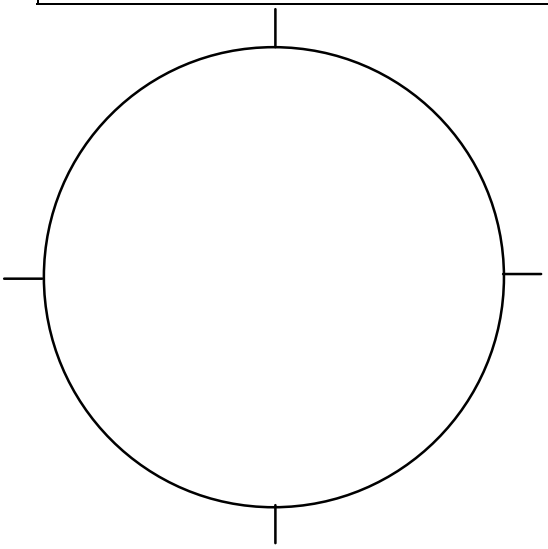

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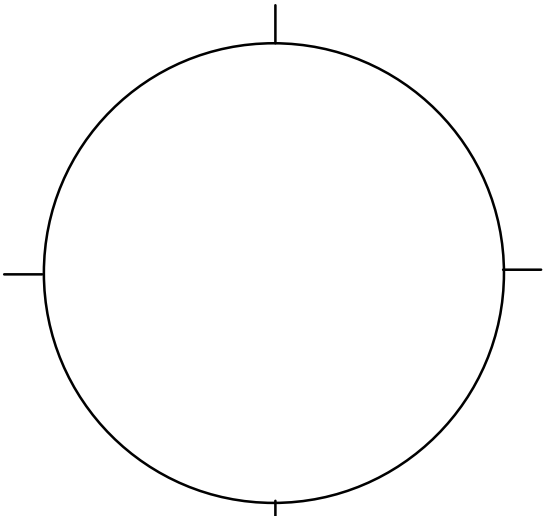

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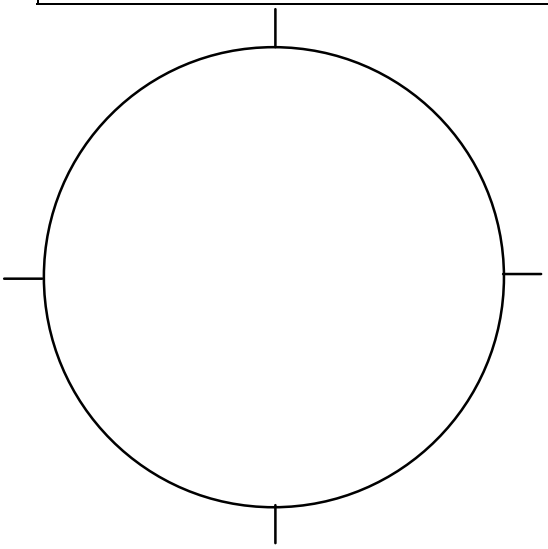

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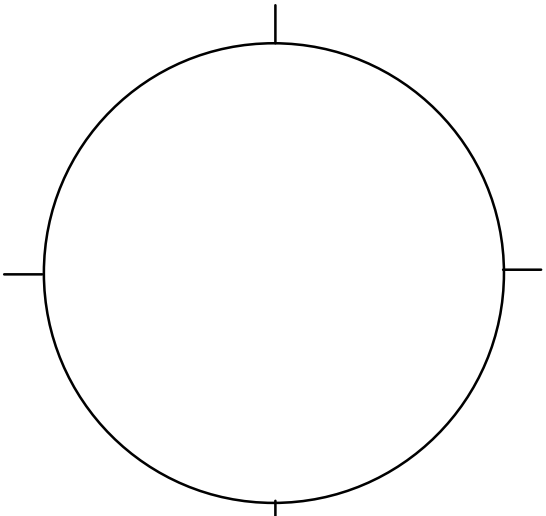

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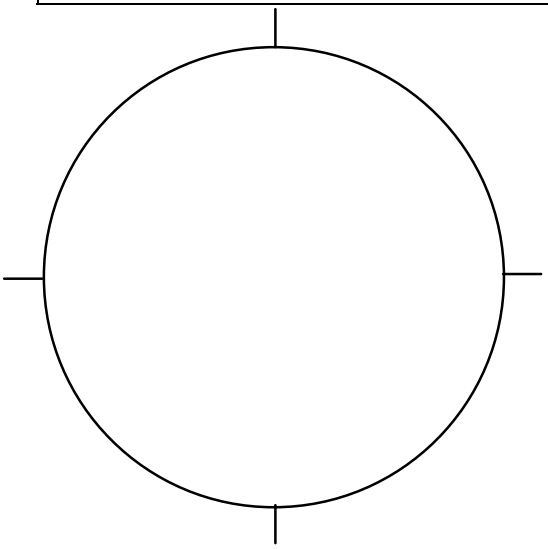

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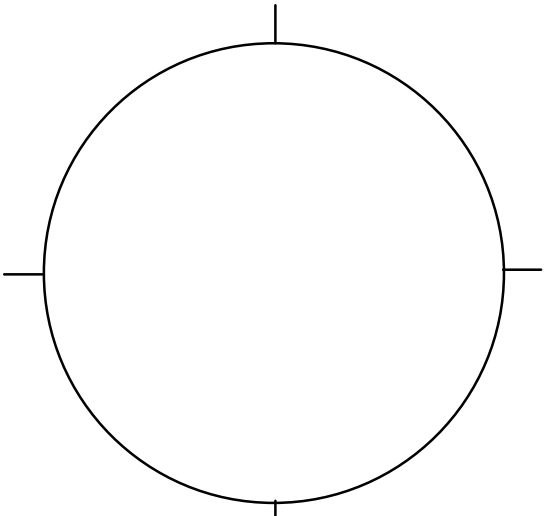

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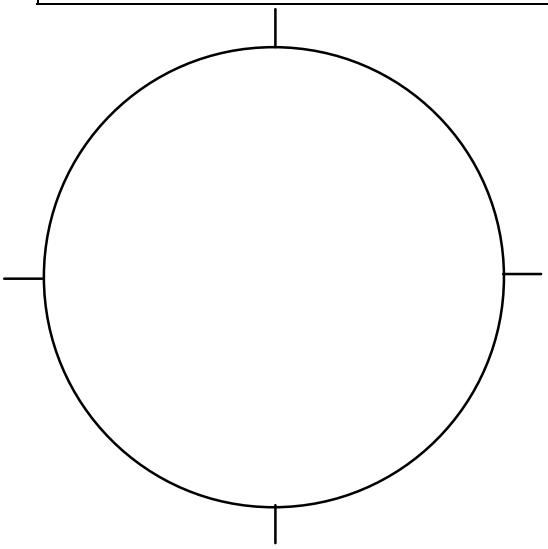
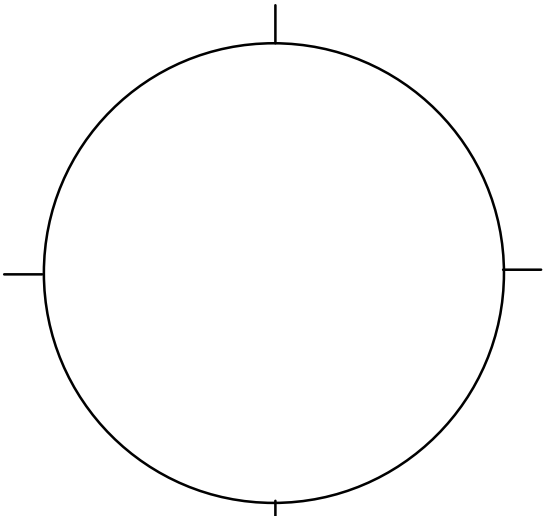


Notes:

Object:		Cons:	RA h m s
Type:	Mag/Size:	Chart Ref:	Dec ° m s
Instrument:	Eyepiece: mm	Filter:	



Notes:

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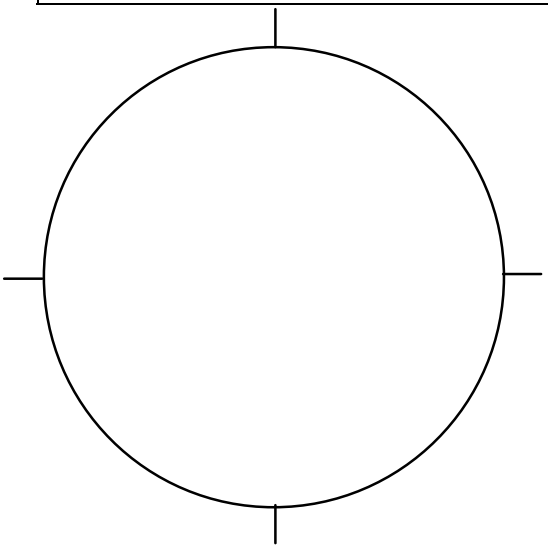
RASC Visual Observing Log

Date:	Time:	Activity:
Location:		
Conditions:	**Transparency** ① ② ③ ④ ⑤	**Seeing** ① ② ③ ④ ⑤ ⑥ ⑦ / **Limiting Visual Magnitude:**

Object:		Cons:	RA h m s
Type:	Mag/Size:	Chart Ref:	Dec ° m s
Instrument:	Eyepiece: mm	Filter:	



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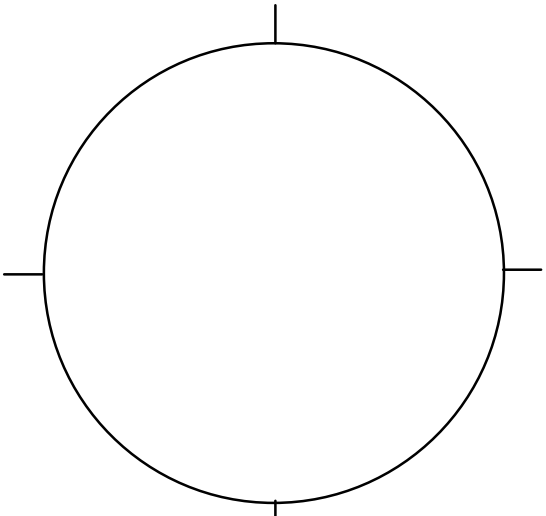
Type:	Mag/Size:	Chart Ref:	Dec ° m s
Instrument:	Eyepiece: mm	Filter:	



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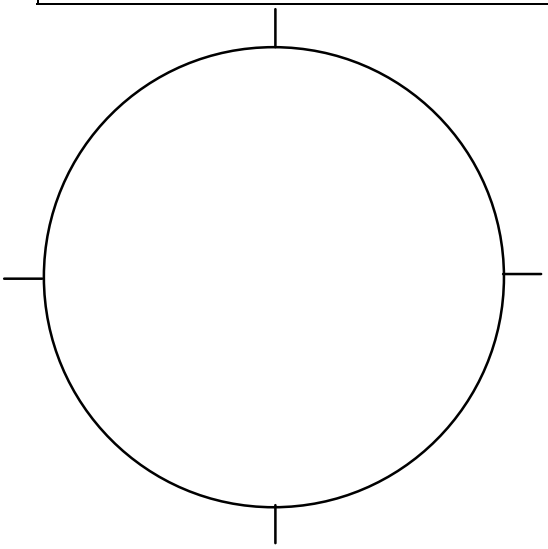

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Type:	Mag/Size:	Chart Ref:	Dec ° m s
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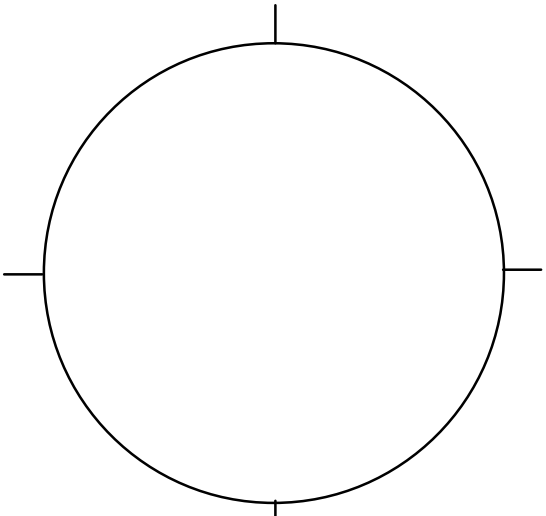

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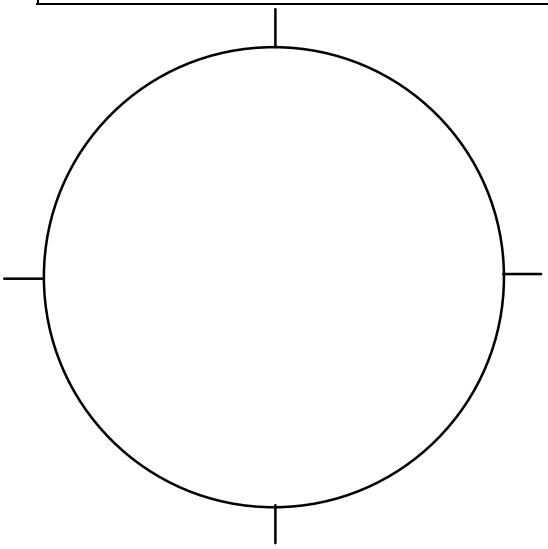

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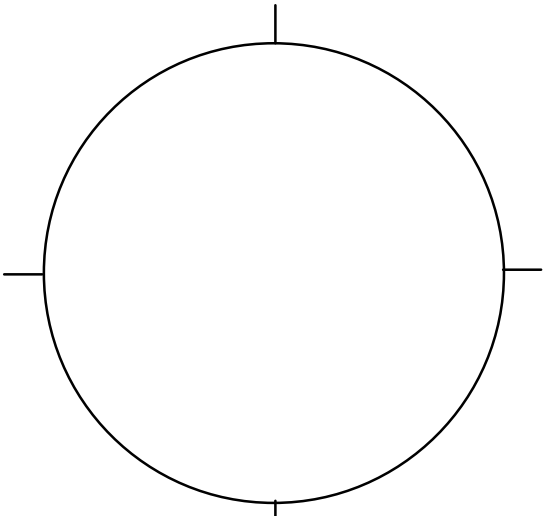

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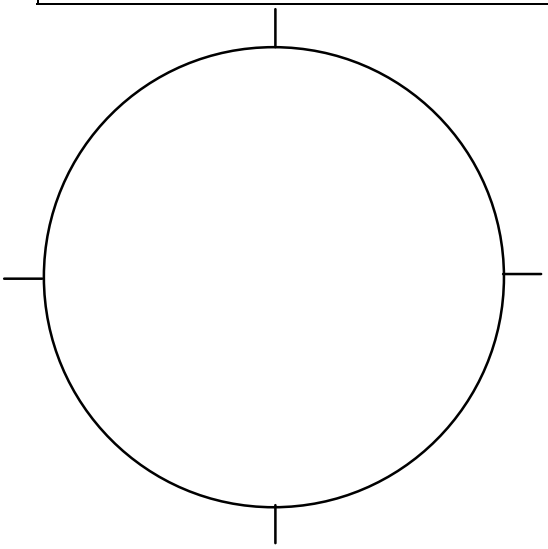

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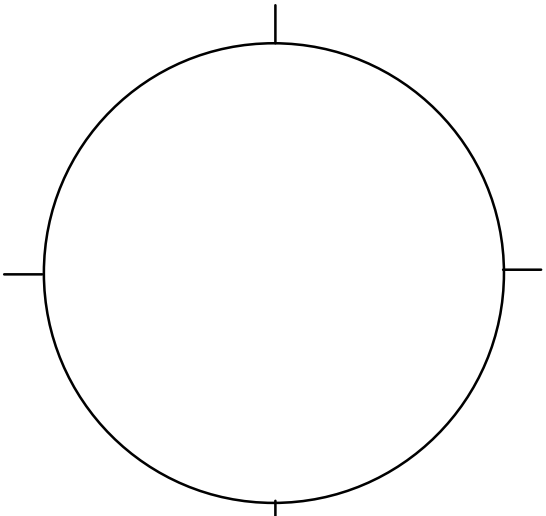

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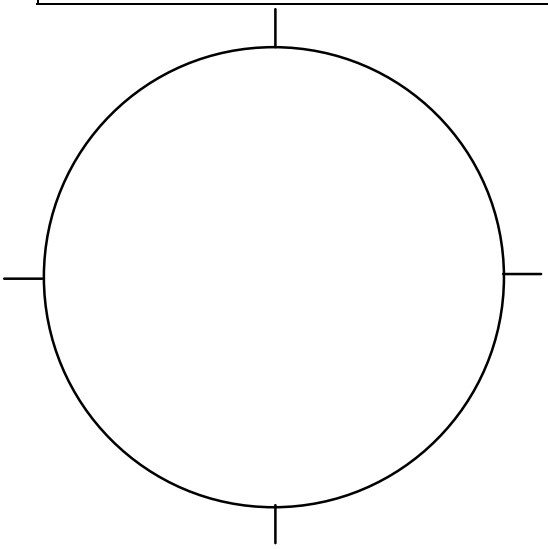

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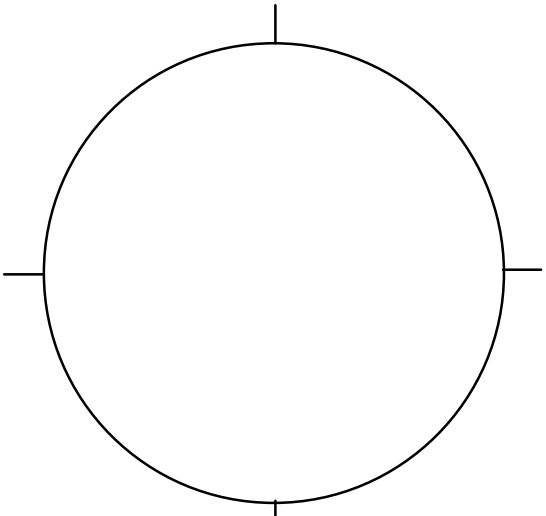

Notes:

Explore the Universe Observing Program – Application

Congratulations on completing the Explore the Universe Observing Program! In order to receive your certificate, please complete this form and submit it as follows:

For RASC Members of Local Certification Centres	For Unattached Members, Members of National Certification Centres, or Non-RASC Observers
If your local RASC Centre is a sponsor of the Explore the Universe Observing Program, you may submit this application form to a representative of your local Observing Group or to a member of your local Executive. Your local Centre will present the certificate to you. Consult your local website or newsletter for more details.	Forward your completed application form to: Chair, Observing Committee Royal Astronomical of Society of Canada 8 LAKEVIEW AVE DARTMOUTH NS B3A 3S7 Email to observing@rasc.ca

Affidavit:

I, _____ do attest to the following:

1. I have found and described all of the objects listed below myself.
2. I have not used a computerized "go-to" telescope to meet the requirements outlined in the program.
3. I have completed the required number of observations for each section of the program.

.

Date_____ (yyyy-mm-dd)

Authentication: (By a qualified member of your Centre, or by the Observing Committee Chair)

I declare that this form has been filled out completely and correctly and that the above-named observer has qualified for the *Explore the Universe Certificate* of The Royal Astronomical Society of Canada.

_____ (yyyy-mm-dd)
Date

_____ _____
Name RASC Centre

Certificate in English ☐ French ☐

The following form is available as a fillable pdf form file at www.rasc.ca/explore-universe as well as full details of the Explore the Universe Program.

Explore the Universe Observing Program – Observation Report Form

Constellations and Bright Stars – 12 of 24

#	Constellation	Bright Star	Bright Star [1]	Date	Time
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

1. Only required if more than one bright star is listed for a constellation.

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Phases of the Moon / Orbital Motion – 4 of 8

#	Phase / Orbital Motion[1]	Date	Time	Description
1				
2				
3				
4				

1. Orbital motion is an optional observation to replace New Moon, which is not visible.

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Lunar Basins / Maria – 6 of 12

#	Lunar Basins / Maria	Date	Time	Instrument
1				
2				
3				
4				
5				
6				

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Lunar Craters – 6 of 12

#	Lunar Craters	Date	Time	Instrument
1				
2				
3				
4				
5				
6				

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Solar System – 5 of 10

#	Planet / Other[1]	Date	Time	Instrument
1				
2				
3				
4				
5				

1. Other Solar System observations listed in the 5 of 10 selections list. This includes satellites & meteors, orbital motion of a planet, or sunspots.

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Deep-Sky Objects – 12 of 24

#	Deep-Sky Object	Date	Time	Instrument
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Double or Multiple Stars – 10 of 20

#	Double or Multiple Stars	Date	Time	Instrument	P.A. Check[1]
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

1. Position angle checks are an optional, but recommended, way to confirm that you are observing the correct double star.

Observing Notes

Explore the Universe Observing Program – Observation Report Form

Additional Observing Notes[1]

Observing Notes

1. Blank page for additional observing notes if needed. This page may be photocopied.

Explore the Universe Observing Program – Observation Report Form

Optional Observations[1]

Observing Notes

1. Blank page for recording optional observations. This page may be photocopied.