THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

SASKATOON CENTRE

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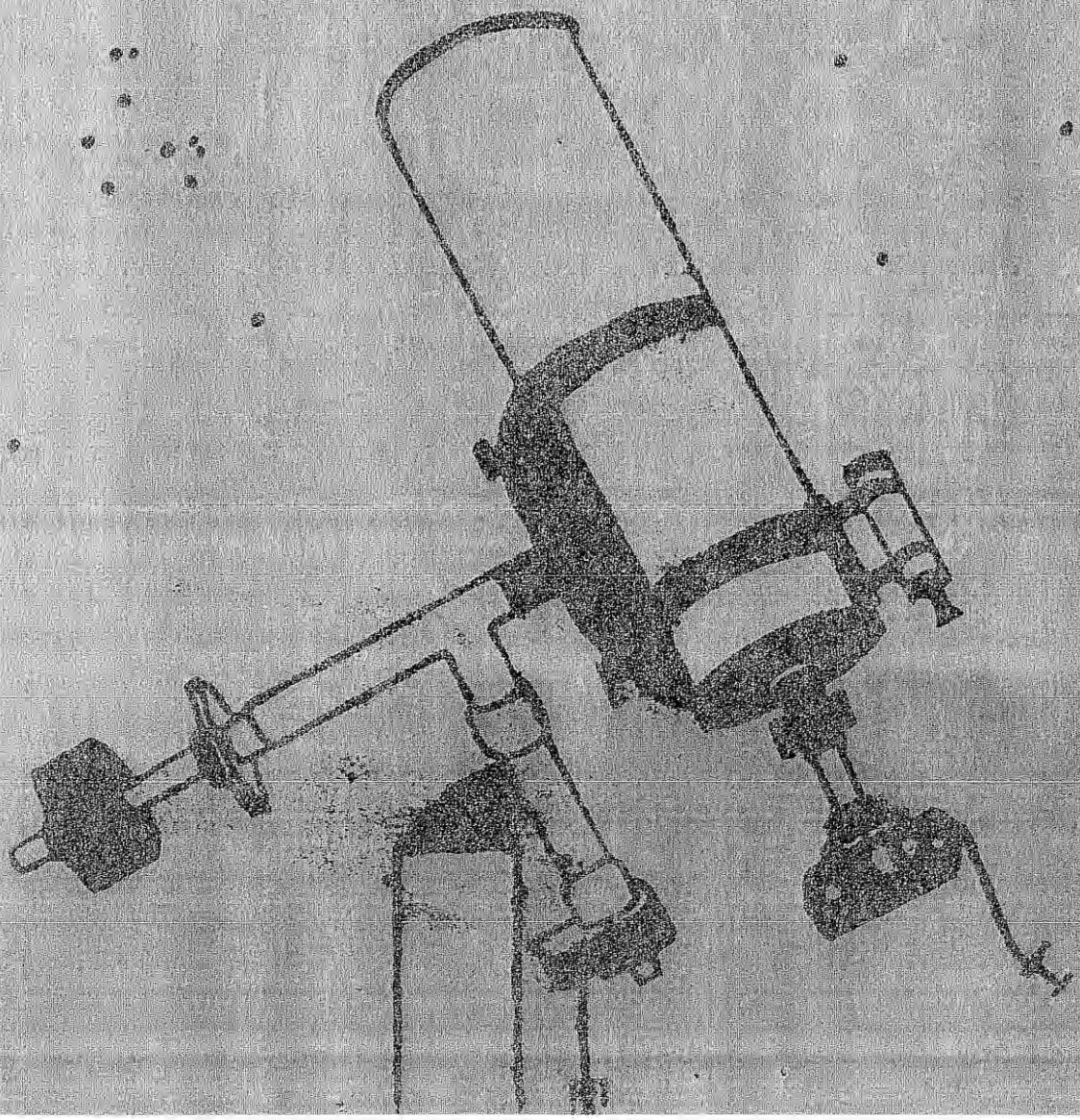
NEWSLETTER



ANSWERS TO PRACTICAL ASTROPHOTOGRAPHY EXAMINATION PAPER — G.N.Patterson

1(a) Telescope Aperture = 10" = 254 mm; E.F.L. = 2500 mm : $f/\# = \frac{2500}{254} = f/9.84$

Projection Distance, Q, = 190 mm; Ocular f = 18 mm

Magnification, $M = \frac{Q - f}{f} = \frac{190 - 18}{18} = 9.56X$

f/# of system = f/# of telescope x M = 9.84 x 9.56 = f/94.03

E.F.L. of system = E.F.L. of telescope x M = 2500 x 9.56 = 23,900 mm

ASA Panatomic-X = 32; with Diafine = 32 x 6 = 192

a)i - Venus on May 15/75 = $-3^m.7$ = brightness, B, of 29.5 (from chart)

Calculated Exposure, $T = \frac{f^2}{ASA \times B} = \frac{94.03^2}{192 \times 29.5} = 1.56$ seconds

Using #15 filter, factor is x3; Calculated exposure = 1.56 x 3 = 4.68 sec.

EXPOSURE TABLE

	Calculated	With Rec. Failure
4T	18.72	140 sec
2T	9.36	59 sec
T	4.68	25.5 sec
$\frac{1}{2}$T	2.34	9.5 sec
$\frac{1}{4}$T	1.17	3.8 sec

Image Size = $\frac{\text{Obj.Size(sec)} \times \text{E.F.L.}}{200{,}000}$

Venus Max. = 65.56"; Image Max = 7.83 mm

Venus Min = 9.57"; Image Min = 1.14 mm

a)ii - Moon on May 17/75 - 6 days old = $-4^m.0$; Brightness, B, = 32

Calculated Exposure, $T = \frac{94.03^2}{192 \times 32} = 1.44$ seconds

Using #12 filter, factor is x2; Calculated exposure = 1.44 x 2 = 2.88 sec.

EXPOSURE TABLE

	Calculated	With Rec. Failure
4T	11.52	77 sec
2T	5.76	32 Sec
T	2.88	13.5 sec
$\frac{1}{2}$T	1.44	5.1 sec
$\frac{1}{4}$T	0.72	1.0 sec

Moon = 30' = 1800"

Image Size = $\frac{1800 \times 23{,}900}{200{,}000}$

= 215.0 mm

a)iii - Saturn on Mar 15/75 = $0^m.2$; B = 12.5 ; #58 filter factor = x8

Cal. Exposure = $\frac{94.03^2}{192 \times 12.5} = 3.68$ seconds x 8 = 29.47 seconds.

EXPOSURE TABLE

	Calculated	With Rec. Failure
4T	117.88	1200 sec
2T	58.94	530 sec
T	29.47	240 sec
$\frac{1}{2}$T	14.74	105 sec
$\frac{1}{4}$T	7.37	44 sec

Image Size

Ball Max = 20.77"; Image = 2.48 mm

Min = 15.07"; Image = 1.80 mm

Ring Size

Max = 48.35"; Image = 5.78 mm

Min = 35.10"; Image = 4.19 mm

1.(b) These astrophotos should be taken after Sunset, but not after the object is less than 15° above the horizon. Times apply to Saskatoon area.

i) Venus - between 2053 hrs and 2253 hrs; Sunset is 2053 hrs.

ii) Moon - between 2100 hrs and 2300 hrs; Sunset is 1909 hrs.

iii) Saturn - between 2200 hrs and 2400 hrs; Sunset is 2057 hrs.

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2. Binoculars 8x50; Camera 50 mm efl lens; Plus-X ASA = 125.

$$f/\# = \frac{\text{Power}}{\text{Aperture}} \times \text{efl}_{\text{camera}} = \frac{8}{50} \times 50 = f/8$$

$$\text{efl} = \text{Power} \times \text{efl}_{\text{camera}} = 8 \times 50 = 400 \text{ mm}$$

Moon 19April 75 = 8 days = $-6^m.2$; B = 52

$$T = \frac{8 \times 8}{125 \times 52} = 0.010 \text{ sec}$$

	Cal.	Shutter
4T	0.04	30
2T	0.02	60
T	0.01	125
½T	0.005	250
¼T	0.0025	500

$$\text{Image Size} = \frac{30' \times 60 \times 400}{200{,}000} = 3.6 \text{ mm}$$

Venus 19 April 75 = $-3^m.5$; B = 28

$$T = \frac{8 \times 8}{125 \times 28} = 0.02 \text{ sec}$$

	Cal.	Shutter
4T	0.08	15
2T	0.04	30
T	0.02	60
½T	0.01	125
¼T	0.005	250

$$\text{Max Image Size} = \frac{65.56 \times 400}{200{,}000} = 0.13 \text{ mm}$$

$$\text{Min Image Size} = \frac{9.57 \times 400}{200{,}000} = 0.02 \text{ mm}$$

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3. Color Slide of Moon: Celestron 8 = f/10; Kodachrome II = ASA 25

Full Moon, B = 220 - Only half up, B = 110

Loss due to low altitude, less than 1° = 3 Magnitudes or x 0.063

Therefore B = 110 x 0.063 = 6.93

$$T = \frac{10^2}{25 \times 6.93} = 0.58 \text{ Sec}$$

	Cal	Actual
4T	2.32	9.5 sec with RF
2T	1.16	3.5 sec with RF
T	0.58	2 (Shutter)
½T	0.29	4 (Shutter)
¼T	0.145	8 (Shutter)

4. Color slide of total lunar eclipse with ASA 64 film, f/8 telephoto lens.

Brilliance, B for Umbra = 0.005; for Earth Shine = 0.01

$$T_{umbra} = \frac{8 \times 8}{64 \times 0.005} = 200 \text{ seconds, plus Reciprocity Correction}$$

$$T_{shine} = \frac{8 \times 8}{64 \times 0.01} = 100 \text{ seconds, plus Reciprocity Correction}$$

Photos should be bracketted at 4T, 2T, T, $\frac{1}{2}$T and $\frac{1}{4}$T

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5. Photo of the Pleiades. Size $2^{\circ} = 120' = 7200''$ of arc.

Usable width of 35 mm film is 24 mm.

$$\text{EFL of Telecamera System} = \frac{\text{Size} \times 200{,}000}{\text{Object Size}} = \frac{24 \times 200{,}000}{7{,}200} = 666.67 \text{ mm}$$

Use a 600 mm telephoto lens system.

Exposure time will depend upon usable aperture, film speed and developing, so use Tri-X, ASA 400, expose for a minimum of 10 to 20 minutes with accurate tracking, and develop film in Diafine to increase effective ASA to 2400. This should show all stars down to about 13.0 magnitude.

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6. Approximate limiting photographic magnitude for f/10 telescope with an efl of 3500 mm.

$$\text{Usable aperture} = \frac{\text{efl}}{\text{f/\#}} = \frac{3500}{10} = 350 \text{ mm} = 13.78 \text{ inches}$$

Visual Magnitude = 9 + 5.log Aperture in inches = 9 + 5.log 13.78

$= 14^{m}.70$

Photographic magnitude is about 2 to 3 magnitudes more, so the approximate photographic magnitude is $16^{m}.7$ to $17^{m}.7$.

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NOTE: Re Question 1: Sky & Telescope gives the size of Venus as 17", and of Saturn - Rings 39" x 16.5", Planet $17\frac{1}{4}$" x $15\frac{1}{2}$".

Image Size of Venus = (17 x 23,900)/200,000 = 2.03 mm

Image size of Saturn - Planet = 2.06 mm x 1.85 mm

Rings = 4.66 mm x 1.97 mm

In Question 2, Size of Venus Image = (17 x 400)/200,000 = 0.034 mm.

ANSWERS TO FUNDAMENTALS OF ASTRONOMY EXAMINATION PAPER — C.N.Patterson

1. To calculate sidereal time at Winnipeg for 7:30 pm CDST May 27/75

Change to 24 hour clock CDT = 6:30 pm CST = 18:30:00 CST

Subtract Long. Correction for WPG (29C) −00:29:00 p14 Handbook

= 18:01:00 Wpg Local Time

Add Vernal Equinox Correction +12:00:00

= 30:01:00

Add Apparent R.A. of Sun +04:16:01 p7, Handbook

= 34:17:01

Subtract Sun Dial Correction −02:58 p7, Handbook (Two Negatives Add)

= 34:19:59

Subtract whole day interval −24:00:00

Therefore, sidereal time at Winnipeg = 10:19:59 or $10^h19^m59^s$

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2. Star at Zenith at Winnipeg at 7:30 CST or 7:30 − 0:29 = 7:01 local Wpg time

Time at Calgary = 6:30 MST = 6:30 − 0:36 = 5:54 local Calgary time

Star will be at Zenith at Calgary at 7:01 − 5:54 = $1^{hr}07^{min}$ later.

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3. Sunrise & Sunset at Regina May 27/75. Regina at 50°N, Correction $+58^m$ C

Sunrise at 4:01am local = 4:01 + 58 = 4:58 CST

Sunset at 19:54 local = 19:54 + 58 = 20:56 CST = 8:56 pm CST

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4. Orbital eccentricity = 0.750; perihelion distance = 0.5 a.u. = a(1−e)

Mean distance, a, $= \frac{0.5}{1-e} = \frac{0.5}{1-0.75} = \frac{0.5}{0.250} = 2$ a.u.

Aphelion distance = a(1+e) = 2(1 + 0.75) = 2 x 1.75 = 3.5 a.u.

$\frac{T_a^2}{T_e^2} = \frac{R_a^3}{R_e^3}$; $T_a = \sqrt{\frac{2^3 \times 1^2}{1^3}} = \sqrt{8} = 2.8284$ earth years = 1,033.08 days

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5. Convex lens, f_1 = 200 mm; Desired f_o = 800 mm $f_o = \frac{f_1 \cdot f_2}{f_1 + f_2}$

Therefore, $f_2 = \frac{f_o \cdot f_1}{f_1 - f_o} = \frac{800 \times 200}{200 - 800} = -266.67$ mm

Focal length of concave lens = −266.67 mm

5. Maximum Usable Power = 60X/inch of Aperture

Aperture = $\frac{\text{efl}}{\text{f/\#}} = \frac{2500}{8}$ = 312.5 mm = 12.3 inches; Usable Power = 60x12.3 = 738.19X

Limiting Visual Mag. = 9 + 5.log(Aperture in inches)
= 9 + 5.log 12.3 = 14.45 Magnitude

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7. Radial Velocity of a star where λ_o is shifted from 6640Å to 6615Å

Velocity = $c.\frac{(\nu_o - \nu_a)}{\nu_o}$ $\qquad \nu_o = \frac{c}{\lambda o} = \frac{2.997925 \times 10^{10} \text{ cm/sec}}{6640 \times 10^{-8} \text{ cm}}$

$= 4.5149472 \times 10^{14}$

$\nu_a = \frac{c}{\lambda a} = \frac{2.997925 \times 10^{10} \text{ cm/sec}}{6615 \times 10^{-8} \text{ cm}}$

$= 4.5320106 \times 10^{14}$

$$\text{Velocity} = 2.997925 \times 10^{10} \left(\frac{4.5320106 \times 10^{14} - 4.5149472 \times 10^{14}}{4.5149472 \times 10^{14}}\right)$$

$= +1.1330097 \times 10^{8}$ cm/sec

$= +1.1330097 \times 10^{3}$ kilometers/sec; + sign means star is nearing or approaching our Solar System

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8. Visual magnitude = $3^m.44$; Distance = 1,300 light years.

Parallax = $\frac{10 \text{ l.y.}}{\text{Distance}} \times 0''.1 = \frac{32.58 \text{ ly}}{1{,}300 \text{ ly}} \times 0''.1 = 0''.0025$

Absolute Magnitude, M_v = V + 5 + 5.log parallax
= 3.44 + 5 + 5.log 0.0025 = $-4^m.56497$ or $-4^m.6$

This star is Gamma Phoenix, or γPhe, listed on p.82 in the Handbook

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9. Detail in Handbook on the star Antares. Page 89 in Handbook.
Antares - Alpha Scorpio A, R.A = $16^h27^m.6$; Dec. = $-26^o22'$
Visual Magnitude = $0^m.92$ variable; Color Index = +1.84 indicating star is red.
It is a type M1, less lumious super giant with a unresolved composite spectrum
Parallax is 0".019; Absolute magnitude of $-5^m.1$; distance 520 light years, with a proper motion(sideways) of 0".029 per year, and a radial velocity of -3.2 km/sec away from Earth. Star A magnitude varies from $0^m.86$ to $1^m.32$;, Star B is 3" away from A and has a magnitude of $5^m.07$

10. Determining Stellar Distances

a) Trigonometric Parallax - measuring the parallax using the diameter of the Earth's orbit as a base line. Limited to relatively close stars.

b) Spectroscopic Parallax - Intensity of spectral lines gives a relationship to the absolute magnitude. Visual magnitude can be measured and distance determined.

c) Period Luminosity Law of Cepheid Variables - Absolute magnitude is determined from the period of variability, visual magnitude can be measured, hence distance determined.

d) Relationship of Spectral Shift - determines radial velocity. The greater the velocity, the further away the star.

11. Motions of the Earth

a) Daily Rotation

b) Rotation about the Barycentre

c) Orbital Rotation about the Sun

d) Nutation

e) Precession

f) Rotation about the Galactic Center

12. NGC 6720, otherwise known as M57, the Ring Nebula in Lyra.
Located about midway between Beta Lyrae and Gamma Lyrae.
R.A = $18^h52^m.5$; Dec. = $+33^\circ00'$; Gamma Lyrae R.A = 18^h49^m; Dec. = $33^\circ20'$

Find Vega, then Gamma Lyrae. Use low powered telescope, place Gamma Lyrae in view in ocular, but below center. Stop telescope drive for $3\frac{1}{2}$ minutes and M57 should be in center of telescope.

Lyra is normally considered a Summer constellation, but may be viewed late into the Fall.

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CORRECTION TO FUNDAMENTALS OF ASTRONOMY EXAMINATION ANSWERS

Question 1: An error was made in the calculation of the Apparent R.A. of Sun. This should read $04^h12^m41^s$, changing the final result to read $10^h16^m39^s$.

Question 12: The reference star should read Beta Lyrae (R.A. 18^h49^m, Dec $33^\circ20'$) instead of Gamma Lyrae.

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RESULTS OF 1975 SASKATOON CENTRE EXAMINATIONS

Certificates of Achievement for 1975 will be awarded to the following:

FUNDAMENTALS OF ASTRONOMY

Milton AUPPERLE
Ross ELLIOTT
Dennis MARQUIS
Arthur MINERS
Debbie PALCHINSKI
Blair PETTERSON
Blair YOCHIM

ASTROPHOTOGRAPHY

Dennis MARQUIS
Debbie PALCHINSKI
Lee WARNER

ADVANCED FUNDAMENTALS OF ASTRONOMY

Gregory TOWSTEGO - Honors
Lillia WILCOX - Honors
Tory WILCOX
James YOUNG - Honors

PRACTICAL ASTROPHOTOGRAPHY

Douglas BECK - Honors
Gregory TOWSTEGO
Lillia WILCOX
Tory WILCOX
James YOUNG - Honors

Over the past three years the following members have participated in classes and successfully passed, being awarded Certificates of Achievement:
FUNDAMENTALS: Milton AUPPERLE 75; Doug BECK 73/74; Dave DUCHALARD 73/74; Ross ELLIOTT 75; Bruce FULTON 73/74; Ted HELSTROM 73; Alan HOILAND 73; Hugh HUNTER 73; Dennis MARQUIS 75; Danny McCLEAN 73; Merlyn MELBY 74; Arthur MINERS 75; Debbie PALCHINSKI 75; Blair PETTERSON 75; Dave PRISTUPA 73/74; Greg TOWSTEGO 73/74/75; Lee WARNER 74; Lillia WILCOX 75; Tory WILCOX 75; Jim YOUNG 74/75; Blair YOCHIM 75.
ASTROPHOTOGRAPHY: Doug BECK 73/74/75; Alan HOILAND 73; Hugh HUNTER 73; Dennis MARQUIS 75; Merlyn MELBY 74; Debbie PALCHINSKI 75; Dave PRISTUPA 73/74; Greg TOWSTEGO 73/74/75; Lee WARNER 75; Lillia WILCOX 75; Tory WILCOX 75; Jim YOUNG 74/75.

All these members are to be congratulated for their personal efforts to improve their knowledge of astronomy and/or astrophotography.

* * * TELESCOPE PARTS FOR SALE * * *

6 inch mirror grinding kit

6 inch mirror mount

1/8 wave diagonal for 6" reflector telescope

60 inch long aluminum tube suitable for 6" telescope

Eyepiece mount

7 X finder scope, some amateur telescope making books.

Smithsonian Astrophysical Observatory Atlas, 1969. 18" X 22"

All of the items listed above are for sale, and the seller will take $ 100.00 for the whole lot. A very good buy! If you are interested, call Edwin Serack at 382 - 8024.

OVERDUE BOOKS

The following books are overdue. Will everyone listed please return them as soon as possible.

Popular Star Atlas by R.M.G. Inglis . . . . Blair Petterson

Astronomy Made Simple by M.H. Degani . . . . Dennis Marquis

Astronomy with Binoculars by J. Muirden . . . . Debbie Palchinski

The Telescope and the World of Astronomy by M.F. Reimer . . . . . . Debbie Palchinski

Amateur Astronomer by Patrick Moore . . . . Blair Petterson

Foundations of Astronomy by W.M. Smart . . . . Adrian Arbus

The Universe Nature Library . . . . Lorne Gaska

2001: A Space Odyssey by Arthur C. Clarke . . . . Richard Shaver

The Stars - Steppingstones into Space by Irving Adler . David Pristupa

Galaxies and Cosmology by P.W. Hodge . . . . Doug Beck

GENERAL MEETING

DATE: Tuesday, 17 June, 1975
TIME: 8:00 pm
PLACE: Room B111, Health Sciences Building, U of S
(across from observatory)
PROGRAM: Regular Business, followed by a film show.

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