This paper consists of 25 questions in two parts (A & B).

Use the attached blank sheets for your calculations and also to answer the questions in Part B.

Answer all the questions in this paper and submit all sheets to the supervisor at the end of the examination.

Electronic calculators are allowed.

Useful information:
- Speed of light \( c = 3 \times 10^8 \) m s\(^{-1}\),
- Universal gravitational constant \( G = 6.67 \times 10^{-11} \) m\(^3\) kg\(^{-1}\) s\(^{-2}\),
- Solar Mass \( M_\odot = 1.99 \times 10^{30} \) kg,
- Hubble constant \( H = 75 \) km s\(^{-1}\) Mpc\(^{-1}\),
- Mass of electron \( m_e = 9.11 \times 10^{-31} \) kg
1. Choose the answer contains the types of reflecting telescopes shown in the following in the order.

(1) 1- Prime focus, 2- Newton focus, 3- Cassegrain focus, 4- Coude’ focus
(b) 1- Newton focus, 2- Prime focus, 3- Cassegrain focus, 4- Coude’ focus
(c) 1- Newton focus, 2- Prime focus, 3- Coude’ focus, 4- Cassegrain focus
(d) 1- Prime focus, 2- Newton focus, 3- Coude’ focus, 4- Cassegrain focus
(e) 1- Prime focus, 2- Coude’ focus, 3- Newton focus, 4- Cassegrain focus

2. A star (S) which rotates along its axis is shown in the figure. When observing from Earth (E), a gas is observed to be emitted from the star. A spectral line of that gas’s observed intensity distribution (I) represented as a function of the wavelength (λ) is best shown in which option. If the star is not rotating the intensity distribution of the spectral line is shown in dash lines.

(E) පිළිබඳ මිීම බොහෝවෙකු දෙනින් කිරීමට ගොඩ වේ. (I) ම අතර මිීම බොහෝවෙකු දෙනින් දෙනින් කිරීමට ගොඩ වේ. (l) ම අතර මිීම (λ) අතර මිීම බොහෝවෙකු දෙනින් කිරීමට ගොඩ වේ? මිීම අතර මිීම බොහෝවෙකු දෙනින් කිරීමට ගොඩ වේ?
3. Consider the following three statements given on “Kepler’s Laws” of elliptical motion

1.) All planets move in elliptical orbits, with the sun at one focus.
2.) A line that connects a planet to the sun sweeps out equal areas in equal times.
3.) The square of the period of any planet is proportional to the cube of the major axis of its orbit.

Incorrect Statement/s is/are (වැටන්න ප්‍රකාෂණ/ප්‍රකාෂණ වන්න)?

(a) (1) only  (b) (2) only  (c) (3) only
(d) (2) and (3) only  (e) (1) and (2) only

4. Consider the following image of the moon. Observe that the line separating the illuminated side and the shadowed side is an ellipse arc. Let the length of the semi major axis of this ellipse be ‘a’, the semi minor axis be ‘b’ and the angle between the sun and the moon (as seen from earth) is $\beta$. 
What is the correct expression for the sun-moon-earth angle (β) in terms of 'α' and 'b'.

(a) \[ \beta = \cos^{-1}\left(\frac{b}{a}\right) \]
(b) \[ \beta = \cos^{-1}\left(\frac{a}{b}\right) \]
(c) \[ \beta = \sin^{-1}\left(\frac{b}{a}\right) \]
(d) \[ \beta = \sin^{-1}\left(\frac{a+b}{a-b}\right) \]
(e) \[ \beta = \cos^{-1}\left(\frac{a+b}{a-b}\right) \]

5. Three students commented on the topic “Time measurements in a Black hole” (Assume you can survive in a Black hole to test the variation of time)

<table>
<thead>
<tr>
<th>Student</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>If you were to enter a black hole, you would find your watch ticking along at the same rate as it always had.</td>
</tr>
<tr>
<td>(2)</td>
<td>Although your watch as seen by you would not change its ticking rate, just as in special relativity, someone else would see a different ticking rate on your watch than the usual. You would see the watch of a friend at great distance from the hole to be ticking at a much faster rate than yours.</td>
</tr>
<tr>
<td>(3)</td>
<td>If you stayed just outside the black hole for a while, then went back to join your friend (staying outside of the black hole), you would find that the friend had aged less than you had during your separation.</td>
</tr>
</tbody>
</table>

Considering the assumption above which of the student/s is/are can be considered as correct according to his/their comment. \( \text{වේදීමේදී නොකොට විශේෂ} \)?

(a) (1) only (b) (2) only (c) (3) only (d) (2) and (3) only (e) (1) and (2) only

6. Consider the following statements about F-number of a telescope. Which one of the following is not correct?

(a) Decreasing the aperture is meant to be as the incensement of the F-number.
(b) F-number is calculated from the equation $\frac{f}{D}$. Where $f$ is the focal length of the eye-piece and $D$ is the diameter of the eye-piece.

\[ F = \frac{f}{d} \]  
Where $f$ is the focal length of the eye-piece and $D$ is the diameter of the eye-piece.

(c) A 100 mm focal length lens with an aperture setting of f/8 will have a pupil diameter of 25 mm.

\[ f = 100 \text{ mm}, \quad f/8 = 12.5 \text{ mm} \]

(d) The greater the focal ratio, the fainter the images created (measuring brightness per unit area of the image).

\[ \text{f/8 will have a pupil diameter of 25 mm} \]

(e) None of the above.

7. **Astronomical Telescope** is a valuable instrument used in observing the sky. Following are some of the statements given on its characteristics. Which one of the following is **not correct**?

(a) It creates a real image in the vicinity of the eye of the observer.

(b) The distance between the objective lens and the eyepiece is equal to $f_o + f_e$. Where $f_o$ is the focal length of the objective and $f_e$ is the focal length of the eyepiece.

(c) The magnifying power of an astronomical telescope may be defined as the ratio of the angle subtended at the eye by the image to the angle subtended at the eye by the object.

(d) Magnifying power can also be given as $\frac{f_o}{f_e}$. Where $f_o$ and $f_e$ are focal lengths of objective and eyepiece respectively.

(e) Objective lens has larger focal length than the eyepiece.

8. A 5th magnitude star is how many times brighter than an 8th magnitude star?

<table>
<thead>
<tr>
<th>Option</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>3</td>
</tr>
<tr>
<td>(b)</td>
<td>15.85</td>
</tr>
<tr>
<td>(c)</td>
<td>16.00</td>
</tr>
<tr>
<td>(d)</td>
<td>15.05</td>
</tr>
<tr>
<td>(e)</td>
<td>12.85</td>
</tr>
</tbody>
</table>
9. Which of the following is true for retrograde motion? 
   Retrograde motion is:  
   (a) Caused by epicycles.  
   (b) Undergone only by superior planets.  
   (c) Undergone only by inferior planets.  
   (d) An effect due to the projection of planet orbits onto the sky.  
   (e) An effect due to the mass of the planet.

10. If you were watching a star collapsing to form a black hole, the light would disappear because it: 
   (a) Is strongly redshifted  
   (b) Is strongly blue shifted  
   (c) Its color suddenly becomes black  
   (d) Its explosion due to lack of Hydrogen & Helium  
   (e) None of the above

11. A supernova shines with luminosity $10^{10}$ times that of the Sun. If such a supernova appears in our sky bright as the Sun, how far away from us might be located?  
   (a) 0.485 Ly  
   (b) 1.58 Ly  
   (c) 105 Ly  
   (d) 0.158 Ly  
   (e) 4.85 Ly

12. A nova was observed with a maximum apparent magnitude of -1.1 in year 2000 by a earth based optical interferometer. The wave length shift of its Hydrogen Hα line was 37Å. When it was again observed in year 2008 with the same telescope system, there was a gas shell around that star with a diameter of 16 arc seconds. What is the absolute magnitude of this star?  
   (a) -7.35  
   (b) -5.60  
   (c) 1.45  
   (d) 3.50  
   (e) 2.90
13. A Primordial Hydrogen gas cloud on a cosmic microwave background radiation (CMBR), having an actual diameter of 1 x 105 light years was observed with an observable angular diameter of 6.00 X 10^-6 rad. With respect to the above data, what is the correct statement about the space curvature of the universe and the deceleration parameter? (Consider that the density parameter of dark energy is a constant.)

- The critical density of the universe (1.0 x 10^-26 Kgm^-3) and the density parameter of dark energy (0.74) are constants which are independent from time. Then what is the value of the deceleration parameter to stop the expansion of the universe in some certain time (Consider the values of Hubble = 71 Kms^-1 Mpc^-1, constant and the gravitational constant = 6.67 x 10^-11 kg^2 Nm^-2 as given here).

<table>
<thead>
<tr>
<th>space curvature (u)</th>
<th>deceleration parameter (q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>q = ½</td>
</tr>
<tr>
<td>+</td>
<td>q &gt; ½</td>
</tr>
<tr>
<td>+</td>
<td>q &lt; ½</td>
</tr>
<tr>
<td>-</td>
<td>q &lt; ½</td>
</tr>
<tr>
<td>-</td>
<td>q = ½</td>
</tr>
</tbody>
</table>

14. If the values of critical density of the universe (1.0 X 10^-26 Kgm^-3) and the density parameter of dark energy (0.74) are constants which are independent from time, Then what is the value of the deceleration parameter to stop the expansion of the universe in some certain time (Consider the values of Hubble = 71 Kms^-1 Mpc^-1, constant and the gravitational constant = 6.67 x 10^-11 kg^2 Nm^-2 as given here).

Theoretical and observational evidences proved that the universe was ρ_{rad} > ρ_{mat} between the 2500 years and the big bang happened. The values of matter density and the radiation density were transited each other (ρ_{rad} < ρ_{mat}). Which statement is not acceptable with the above process of the universe, which was happened 2500 after the big bang.

<table>
<thead>
<tr>
<th>ρ_{rad} &gt; ρ_{mat}</th>
<th>ρ_{rad} &lt; ρ_{mat}</th>
<th>ρ_{rad} = ρ_{mat}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 0.10</td>
<td>(b) 0.15</td>
<td>(c) 0.25</td>
</tr>
</tbody>
</table>

15. Theoretical and observational evidences proved that the universe was ρ_{rad} > ρ_{mat} between the 2500 years and the big bang happened. The values of matter density and the radiation density were transited each other (ρ_{rad} < ρ_{mat}). Which statement is not acceptable with the above process of the universe, which was happened 2500 after the big bang.
8.

(a) Universe got transparency for the photons in Recombination Era
Recombination Era ගැටීමට පසු ගොඩ ගලා ගොඩ ගොඩ ගොඩ ගොඩ ගොඩ ගොඩ.

(b) While the movement via the universe, Wavelengths of photons were more influenced with cosmic expansion than the matter.

(c) Maximum photons amount which generated by Quantum physical processes of primordial universe was obtained at Spectral decoupling era.

(d) Ratio of Neutrons and Protons were obtained in Weak Decoupling Era

(e) None of the above (ඉහත කිසිවක් බැවිය)

16. When a spectrum of a B2 star was analyzed, the Hα line of its spectrum was absent. A spectrum of a B5 star with a same Luminosity shows a H alpha line of its spectrum. What is the most relevant statement to explain this phenomenon?

(a) Energy of electrons in energy levels of Hydrogen atoms in B2 star is lower than those values of B5 star

(b) There are no electrons in 2nd energy level of B2 star because of those electrons are shifted to stable states that have higher energy.

(c) The electron density of B5 star is lower than the electron density of B2 star

(d) Temperature of B2 star is higher than temperature of B5 star.

(e) None of the above (ඉහත කිසිවක් බැවිය)
17. A $5 \ M_{\odot}$ star causes a gravitational red-shift (Einstein shift) such that a 500 nm photon is detected with a wavelength of 600 nm. What is the radius of the Star in solar units?

- (a) $8.8 \ R_{\odot}$
- (b) $5.8 \ R_{\odot}$
- (c) $6.8 \ R_{\odot}$
- (d) $21.6 \ R_{\odot}$
- (e) $15 \ R_{\odot}$

18. Comet Hale Bopp had a perihelion distance of 0.9141 AU and eccentricity 0.9951. What is the aphelion distance of the comet?

- (a) 407 AU
- (b) 156 AU
- (c) 372 AU
- (d) 78 AU
- (e) 24 AU

19. Cepheids vary in luminosity by up to a factor of 150. If this variation is only due to change in radii, the ratio of radii during maxima and minima is.

- (a) 15
- (b) 20
- (c) 150
- (d) 225
- (e) 12

20. In observations taken on the Summer Solstice and Winter Solstice the position of Polaris is seen to be shifted by 0.007 arc sec. What is the distance to the Pole Star?

- (a) 293 pc
- (b) 562 pc
- (c) 1000 pc
- (d) 4.2 pc
- (e) 25 pc
21. This question consists of 3 tables and full sky charts in Alt-Azimuth coordinates, showing the sky of June 2013. On the chart different objects are marked in different numbering systems: constellations are noted in capital letters; stars are noted in Arabic numeral and deep sky objects are noted in small caps. The star chart contain 5 deep sky objects, 10 constellations and 10 stars, to be marked on tables I, II and III. Your task is to correctly address the objects in the tables.

Table I - List of deep sky objects (deep sky objects in small caps)

<table>
<thead>
<tr>
<th>( ) Andromeda Galaxy</th>
<th>( ) Eta Carinae Nebula</th>
<th>( ) Perseus Double Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Butterfly Cluster</td>
<td>( ) Great Rift</td>
<td>( ) Pleiades</td>
</tr>
<tr>
<td>( ) Centaurus A</td>
<td>( ) Helix Nebula</td>
<td>( ) Praesepe Cluster</td>
</tr>
<tr>
<td>( ) Cone Nebula</td>
<td>( ) Hercules Globular Cluster</td>
<td>( ) Ring Nebula</td>
</tr>
<tr>
<td>( ) Crab Nebula</td>
<td>( ) Lagoon Nebula – M8</td>
<td>( ) Horse Head Nebula</td>
</tr>
<tr>
<td>( ) Dumbell Nebula</td>
<td>( ) Omega Centauri Cluster</td>
<td>( ) Small Magellanic Cloud</td>
</tr>
<tr>
<td>( ) Eagle Nebula – M16</td>
<td>( ) Orion Nebula</td>
<td>( ) Ptolemy Cluster – M7</td>
</tr>
</tbody>
</table>
Table II - List of constellations (තරකා රාශි)

(A, B, C, D, E, F, G, H, J, K)

<table>
<thead>
<tr>
<th>( ) Andromeda</th>
<th>( ) Antlia</th>
<th>( ) Apus</th>
<th>( ) Aquarius</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Aquila</td>
<td>( ) Ara</td>
<td>( ) Aries</td>
<td>( ) Auriga</td>
</tr>
<tr>
<td>( ) Bootes</td>
<td>( ) Caelum</td>
<td>( ) Camelopardus</td>
<td>( ) Cancer</td>
</tr>
<tr>
<td>( ) CanesVenatici</td>
<td>( ) Canis Major</td>
<td>( ) Canis Minor</td>
<td>( ) Capricornus</td>
</tr>
<tr>
<td>( ) Carina</td>
<td>( ) Cassiopeia</td>
<td>( ) Centaurus</td>
<td>( ) Cepheus</td>
</tr>
<tr>
<td>( ) Cetus</td>
<td>( ) Chamaeleon</td>
<td>( ) Circinus</td>
<td>( ) Columba</td>
</tr>
<tr>
<td>( ) Coma Berenices</td>
<td>( ) Corona Australis</td>
<td>( ) Corona Borealis</td>
<td>( ) Corvus</td>
</tr>
<tr>
<td>( ) Crater</td>
<td>( ) Crux</td>
<td>( ) Cygnus</td>
<td>( ) Delphinus</td>
</tr>
<tr>
<td>( ) Dorado</td>
<td>( ) Draco</td>
<td>( ) Equuleus</td>
<td>( ) Eridano</td>
</tr>
<tr>
<td>( ) Fornax</td>
<td>( ) Gemini</td>
<td>( ) Grus</td>
<td>( ) Hercules</td>
</tr>
<tr>
<td>( ) Horologium</td>
<td>( ) Hydra</td>
<td>( ) Hydrus</td>
<td>( ) Indus</td>
</tr>
<tr>
<td>( ) Lacerta</td>
<td>( ) Leo</td>
<td>( ) Leo Minor</td>
<td>( ) Lepus</td>
</tr>
<tr>
<td>( ) Libra</td>
<td>( ) Lupus</td>
<td>( ) Lynx</td>
<td>( ) Lyra</td>
</tr>
<tr>
<td>( ) Mensa</td>
<td>( ) Microscopium</td>
<td>( ) Monoceros</td>
<td>( ) Musca</td>
</tr>
<tr>
<td>( ) Norma</td>
<td>( ) Octans</td>
<td>( ) Ophiuchus</td>
<td>( ) Orion</td>
</tr>
<tr>
<td>( ) Pavo</td>
<td>( ) Pegasus</td>
<td>( ) Perseus</td>
<td>( ) Phoenix</td>
</tr>
<tr>
<td>( ) Pictor</td>
<td>( ) Pisces</td>
<td>( ) Piscis Australis</td>
<td>( ) Puppis</td>
</tr>
<tr>
<td>( ) Pyxis</td>
<td>( ) Reticulum</td>
<td>( ) Sagitta</td>
<td>( ) Sagitarius</td>
</tr>
<tr>
<td>( ) Scorpius</td>
<td>( ) Sculptor</td>
<td>( ) Scutum</td>
<td>( ) Serpens</td>
</tr>
<tr>
<td>( ) Sextans</td>
<td>( ) Taurus</td>
<td>( ) Telescopium</td>
<td>( ) Triangulum</td>
</tr>
<tr>
<td>( ) Triangulum Australis</td>
<td>( ) Tucana</td>
<td>( ) Ursa Major</td>
<td>( ) Ursa Minor</td>
</tr>
<tr>
<td>( ) Vela</td>
<td>( ) Virgo</td>
<td>( ) Volans</td>
<td>( ) Vulpecula</td>
</tr>
</tbody>
</table>
Table III - List of stars (තරකා රප)

(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)

<table>
<thead>
<tr>
<th>( ) Achernar</th>
<th>( ) Atria</th>
<th>( ) Fomalhaut</th>
<th>( ) Pollux</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Acrux</td>
<td>( ) Avior</td>
<td>( ) GacruX</td>
<td>( ) Procion</td>
</tr>
<tr>
<td>( ) Adhara</td>
<td>( ) Polaris</td>
<td>( ) GammaVelorum</td>
<td>( ) Regulus</td>
</tr>
<tr>
<td>( ) Al Na'ir</td>
<td>( ) Bellatrix</td>
<td>( ) Hadar</td>
<td>( ) Rigel</td>
</tr>
<tr>
<td>( ) Aldebaran</td>
<td>( ) Betelgeuse</td>
<td>( ) Hamal</td>
<td>( ) RigilKentaurus</td>
</tr>
<tr>
<td>( ) Alhena</td>
<td>( ) Canopus</td>
<td>( ) KausAustralis</td>
<td>( ) Sargas</td>
</tr>
<tr>
<td>( ) Alioth</td>
<td>( ) Capella</td>
<td>( ) Menkaliman</td>
<td>( ) Shaula</td>
</tr>
<tr>
<td>( ) Alkaid</td>
<td>( ) Castor</td>
<td>( ) Miaplacidus</td>
<td>( ) Sirius</td>
</tr>
<tr>
<td>( ) Alnilam</td>
<td>( ) Delta Velorum</td>
<td>( ) Mirfak</td>
<td>( ) Spica</td>
</tr>
<tr>
<td>( ) Alphard</td>
<td>( ) Deneb</td>
<td>( ) Mirzam</td>
<td>( ) Vega</td>
</tr>
<tr>
<td>( ) Altair</td>
<td>( ) DenebKaitos</td>
<td>( ) Nunki</td>
<td>( ) Wezen</td>
</tr>
<tr>
<td>( ) Antares</td>
<td>( ) Dubhe</td>
<td>( ) Peacock</td>
<td>( ) Saiph</td>
</tr>
<tr>
<td>( ) Arcturus</td>
<td>( ) El Nath</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chart I – This month’s Night Sky (තමම ලංමප ලංමපරභත්රීාලං මකිතව ප ලංප හාපයැක්තව ප ලංප ප්‍රොඩිඩේණිය ඇවත්)

A

B

C

D

E

F

G

H

I

J

K

(a)

(b)

(c)

(d)

(e)
22. This problem models the launching of a detector from the surface of the earth to Mars. We assume that the earth and Mars are moving around the sun in circles resting on the same plane. The radius of the orbit of Mars is $R_m$, which is 1.5 times larger than that of the earth. An economical and simple way to lounge the detector consists of 2 steps. First, a rocket is used to accelerate the detector on the earth’s surface such that it acquires enough kinetic energy to overcome the gravitational force of the earth and becomes a satellite moving around the earth. Second, at a suitable time, an engine that connects to the detector ignites for a short instant and accelerates the detector along its direction of motion. After a short (negligible) time, the speed of the detector increases to a suitable value such that the detector moves along an elliptical orbit that connects the earth and Mars, with the two planets located at the end points of the ellipse (see Diagram A)

a) In Step I, what is the minimum speed needed for the detector to become an artificial satellite that moves along the earth’s orbit?

b) After the detector becomes a satellite moving around the earth, on 1 March 00.00am of a certain year, the angular distance between the detector and Mars is measured to be 60° (diagram B). What is the date that the engine of the detector should be fired so that the detector can fall on the surface of Mars (Correct today)? Given: radius of the earth: $6.4 \times 10^6$ m, acceleration due to gravity = 9.8 m/s$^2$
23. Answer to both parts (රකොටසථ රදකටණ ලිරවිුව සපයන්ව)

(i) Stars produce their energy by fusing hydrogen into helium. If the mass deficit of helium after the nuclear reaction is 0.7% of the mass of the constituent hydrogen atoms, and if 10% of the hydrogen in the Sun undergoes fusion reactions, calculate the total available nuclear energy of the Sun in Joules.

(ii) How long the Sun could emit energy produced by nuclear fusion if the Sun has had constant luminosity ($L_{\text{sun}}$) of $4 \times 10^{26}$ W

24. Hiran can observe the great spiral galaxy Andromeda with an apparent magnitude of 3.4 and there are 1010 stars in it. The distance to the galaxy is 2.4 million light years.

(i) What is the average absolute magnitude of each star ($M_0$)?

(ii) If Andromeda is spread over an area of $3\circ \times 1\circ$ in the sky, calculate its radius if it?

Find out the angle of tilt of the galaxy to our line of sight.

(iii) The Andromeda galaxy is moving towards the Milky-Way at 250 km/s. Calculate the blue shift. (Is this in violation of Hubble's law? Explain.)

25. A photograph of Jupiter was taken by the largest telescope in Sri Lanka, which situated at the Arther C. Clarke institute, Katubadda. (A cassegrain reflector with aperture diameter 45 cm, f/12) using SBIG ST. monochrome CCD camera on 19th January 2013 at 0007 (LCT). The overall size of the CCD photograph was (765 x 510 pixels) and great red spot of Jupiter was detected by 30x12 pixels region on the photograph. Great red spot of Jupiter was located at $30^\circ$ west from Jupiter’s central meridian and $20^\circ$ south from equator of Jupiter’s disk at that time. Pixel scale of the CCD camera is (1pixel = 9µm) average diameter is $1.43 \times 10^3$ and Jupiter (on that day) was $6.60 \times 10^8$ km
(i) Find the area of Jupiter’s great red spot using above data of CCD photograph in unit of millionth of Jovian hemisphere (mJh)

(ii) What is the importance of the quantum efficiency of a CCD chip for a photograph of a deep sky object taken by this camera (briefly explain)

(iii) A.) Why does the temperature off CCD chip must be kept in low value when we obtaining a photograph.

B.) The cooling mechanism of the CCD camera was malfunctioning by its own technical failure, how it effects for the quality of the image (briefly explain)

- 2013 නවම්බර් දෙසින් 19 මැයි ඉහත පෙටියන්යන් අධීයතන (LCT) බිමේවම් සැමාරගතව කාලි සිටවියට පහළ 45cm, f/12 හෝ අනුවෙන්මා අදහස් සැමාරගතව අදහස් හෝ SBIG ST-7 පිටති ලැබීයේ CCD අදහස් සැමාරගතව අදහස් හෝ අදහස් අදහස් (765 x 510 pixels) අවකාශයේ බිමේවම් ඔහු වලින් 30 x 12 pixels පුළුලේවිට අදහස් අදහස්.

- කාලියක් අධීයතන සිටින්ම අධීයතන තැන් අදහස් අධීයතන මැයි ඉහත පෙටියන්යන් අදහස් හෝ 300 ක් දෙසේ මැයි ඉහත පෙටියන්යන් අදහස් 200 ක් දෙසේ අදහස් අදහස් අදහස්.

- CCD අදහස් ආදායම් අධීයතන (1pixel = 9µm) පෙටියන්යන් අධීයතන අදහස්කාර කාර මැයි ඉහත පෙටියන්යන්යන් අදහස් හෝ (mJh) අදහස් අදහස්කාර කාර?

i. අධීයතන ව්‍රණගින් බිමේවම් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අධීයතන ව්‍රණගින් අදහස් අදහස් අදහස් අදහස් කාරන්කර සිදුවීමින් පෑණ රකිරයන් පහදන්ව.

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