HandBook

January 2016

Introduction

The National Astronomy Olympiad Program is an educational program designed by Nepal Astronomical Society (NASO) and ESPRO Foundation to encourage Nepalese students who pursue further studies in Physics, Math, Astronomy and Space Science.

Vision: *School students will be empowered to recognize and comprehend the celestial objects inhabiting our universe and their association with the evolution and preservation of our lives on earth thereby dispelling superstitious beliefs of their influences prevailing in our society.*

Mission: *School students will be trained to be abundantly versed with astronomy for logically convincing and communicating with any member of local or international society on the importance and indispensability of cosmic entities dwelling in our universe.*

Goal: *Our goal is to impart school students with sufficient knowledge on basic astronomy to recognize and understand the heavenly entities for enabling them to participate in annual international astronomy Olympiad successfully.*

Objective: *School Students will be selected, prepared, facilitated and qualified for their successful participation in annual regional and international astronomy Olympiads.*

The Third National Astronomy Olympiad 2016 (NAO2016) will be held in Nepal during January-June, 2016.

You can visit our office in Kathmandu during Monday-Wednesday-Friday from during 2:00 PM – 5:00 PM or meet our representatives nearest to you to collect the application form.

Stages of the NAO2016

Stage I (Entrance Exam)

Entrance exam will be objective type carrying ***90 marks***; remaining 10 marks will be calculated on the basic of the marks of ***School Leaving Certificate (SLC)*** or equivalent *(5 marks)* and **motivation** *(5 marks)* section of your application form.

Total duration of the exam will be ***2 hours***. Programmable/scientific calculator is not allowed inside the examination hall.

Please note that the scheduled date for this exam is ***Saturday, March 26, 2016*****.**

Stage II (Closed Camp)

Selected students from the Stage I will go through this stage during May/June 2016 .Details of the closed camp will be emailed to the selected students and will be available in our website: www.nepalastronomicalsociety.org

The camp includes several theoretical and experimental classes and tests being based on the IOAA/IAO/APAO syllabus. Orientation is provided to students especially in experiments. Resource persons include the well trained Olympiad Teachers, professional experts from

Tribhuvan University, Nepal Physical Society, Research Group of Astronomy and Astrophysics Nepal and Nepal Astronomical Society and concerned institution in Nepal. The camp will conclude with a valedictory function where distinguished scientists are invited to speak to the students.

The top 5 students from closed camp will be announced as a winner of Third National Astronomy Olympiad 2016 (NAO-2016).

Stage III (Pre-departure Training camp PDT, for IOAA, IOA and APAO)

National Delegations[1, 2] for the regional and international competitions will be formed based on merit list. The selected students for the delegations will undergo a rigorous training program in Kathmandu in theory, data analysis and observational astronomy during July.

[1] *International participations will be subjected to the availability of funds for our participation. Details will be available prior to the international event.*

[2] *Each country can have two types of teams: regular and guest teams. Guest teams and observers are facilitated for their participations provided that they will take care of their expenses themselves.*

Stage IV (International Participation)

National Delegation of maximum of five students and two team leaders will be facilitated to participate for upcoming 12th Asian Pacific Astronomy Olympiad (12th APAO) during September-December *(host country not decided yet)*, 21st International Astronomy Olympia (21st IAO) during September-October *(Bulgaria)* and 10th International Olympiad in Astronomy and Astrophysics (10th IOAA) during December 2016 *(India).*

Guest team and observers can participate to the Olympiad. For more details, please contact us during our office hours.

How can you be a part of NAO-2016?

- Collect your **NAO-2016 Application Form** from our office or collection centers. The application fee for NAO2016 is NR. 1,000 /-
- Submit the application form along with your academic certificate and character certificate with the application fee.
- In case, you apply as the **endorsed team** from your college/school, your team can submit 6 applications in total NRs 5,000 /- For this registration category, all your team members must be from same college.
- Give the entrance exam from the nearby examination centers. The list of centers will be updates in our website.

Syllabus (Entrance exam)

The syllabus for Entrance exam of **National Astronomy Olympiad (NAO)** is broadly equivalent to the senior secondary level (up to Class XII) of Higher Secondary Education Board (HSEB) Nepal.

- **Mechanics**: Newton's Laws of Motion; Gravitation; Circular Motion; Rotational Motion; Simple Harmonic Motion
- **Heat and Thermodynamics**: Thermodynamic Equilibrium; Ideal Gas; Energy Transfer; Black Body Radiation
- **Nuclear Physics**: Atom; Hydrogen Spectrum; Nucleus and Radioactivity; X-Rays
- **Wave and Optics**: Light; Interference, Diffraction, Polarization; Microwave, Infrared, Ultraviolet, Gamma Rays, Visible Wavelength Bands; Optical Instruments; Doppler's Effect
- **Electricity and Magnetism:** Electromagnetic Theory; Magnetic Properties and Behavior
- **The Sun**: Solar Structure; Sun-Earth Relation; Solar Wind and Radiation; Eclipse
- **The Earth**: Atmosphere; Longitude and Latitude; Tides; Seasons; Meteor Shower; Aurorae
- **The Solar System**: Earth-Moon System; Planets introduction
- **The Stars**: Life Cycle; Neutron Star; Black Hole; Supernova; Constellation
- **Universe**: Galaxy; Dark Matter; Hubble's law
- **Space Exploration**: Satellites; Human exploration and missions
- **Mathematics**: 3-D figures (Sphere, Cone, Prism, Cylinder, Cuboid, Cube); 2-D figures (Triangle, Quadrilateral, Circle)

Note: Above mentioned sections are as per the syllabus of HSEB, students are encouraged to explore reference materials. If you have any queries, feel free to contact us during office hours.

Sample Objective Questions

(*Students are requested to encircle one correct answer among the given options*)

FM: 90 PM: 35 Time: 2 Hours

Each question carries 2 marks

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1) The moment of linear momentum is called

a).torque b) force
c) linear momentum d) centripetal momentum.

2) A transverse wave of amplitude 0.5 m, wavelength 1m and frequency 2c/s is propagating in a string along negative X-direction. The equation for the wave is

a) $y = 0.5\cos 2\pi(x+t)$ b) $y = 0.5\cos 2\pi(x+2t)$
c) $y = 0.5\sin 2\pi(x-t)$ d) $y = 0.5\cos 2\pi(x-2t)$

3) A machine Gun is mounted on a 2000kg car on a horizontal frictionless surface. At some instant the gun fires bullet of mass 10g with a velocity of 500m/s with respect to the car. The number of bullets fired per second is 10. The average thrust due to ejected bullet on the system is

a) $2.5\text{x}10^{-3}$ N b) 50 N
c) 250 N d) 550 N

4) At what height from the earth's surface the value of g will become one-fourth of its value at earth's surface?(R_e=Radius of earth)?

a) R_e b) $R_e/2$
c) $R_e/4$ d) $2R_e$

5) A car sometimes overturns while taking a turn. When it overturns

a) its inner wheel leaves the ground first b) its outer wheel leaves the ground first
c) Both wheels leave the ground simultaneously
d) Either wheel leaves the ground first

6) In an isothermal process

a) Pressure remains constant b) Thermal energy remains constant
c) Volume remains constant d) Temperature remains constant

7) 110 J of heat is added to a gaseous system whose energy increases by 40 J, then the amount of external work done is

a) 40J b) 70J

c) 110J d) 150J

8) The rate of radiation of a black body at 0^0c is E Joules/sec. The rate of radiation of the blackbody at 273^0C will be

a) E b) 4E

c) 8E d) 16E

9) What is the ratio of the orbital electron in 4^{th} and 5^{th} orbit of the hydrogen atom?

a) 4:5 b) 5:4
c) 16:25 d) 25:16

10) The ionization power is the maximum for

a) X-rays b) Beta Rays
c) An alpha rays d) Gamma rays

11) What is the diameter of Sun in terms of radius of Earth (R_e)?

a) 50 R_e c) 118 R_e
b) 218 R_e d) 318 R_e

12) The LAST manned moon flight was made in what year?

a) 1971 b) 1972

c) 1973 d) 1974

13) According to Kepler's Laws, all orbits of the planets are:

a) Ellipses c) parabolas
b) Hyperbolas d) square

14) A conic section is the locus of the point in a plane which moves in such a way that the ratio of its distance from a fixed point (called a focus) to its perpendicular distance from a fixed straight line (called a directrix) is a constant e(called eccentricity). The conic section is an ellipse if

a)e=1 b) e>1

c) e<1 d) e>0

15) The largest moon in our solar system has an atmosphere that isdenser than the atmosphere of Mars. The name of this moon is:

a) Titan b) Ganymede

c) Triton d) Io

16) Where are most asteroids located? Is it between

a) Jupiter and Saturn
b) Mars and Venus
c) Earth and Mars
d) Mars and Jupiter

17) Data from Voyager II indicate that previous estimates of Triton'ssize were in error. It is now known that Neptune's largest moon is

a) nearly the size of Mars
b) half the size of Mercury
c) twice the size of the Earth's moon
d) even larger than previously thought

18) A monoatomic gas at atmospheric pressure has a volume V. Now the gas is expended adiabatically to the volume 8V; if gamma =5/3, the new pressure is

a) 1 atm
b) 1/32 atm
c) 32 atm
d) 1/8 atm

19) 0.93 Watt hour energy is supplied to a block of ice weighting 10g. It is found that

a) Half of the block melts
b) The entire block melts
c) The entire blocks melt and the wer attains a temperature of 4^{o}c
d) The block remains unmelted

20) The relative emissive power of a black body is

a) 0
b) 0.5
c) 1.0
d) Infinity

21) The ionization energy of the hydrogen atom from ground state is equal to

a) 13.6eV
b) 13.6 joule
c) 13.6erg
d) 13.6×10^{-19}joule

22) What percentage of mass accounts by Sun alone in solar system?

a) 50 %
b) 70%
c) 90%
d) 99%

23) The VISUAL aurora consists of luminous arcs, rays or bands in the night sky, usually confined to high latitudes and located in the:

a) troposphere
b) stratosphere
b) ozonosphere
b) ionosphere

24) 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 blueshifted
c) its color suddenly becomes black
d) none of the above

25) The equation for parabola is

a) $x^2+y^2=r^2$
b) $y=ax^2$
c) $y=mx+c$
d) $y=ax^3+bx^2+cx+d$

26) Which of the following men wrote the book "On the Revolutions of the Heavenly Spheres"?

a) Kepler
b) Euclid
c) Copernicus
d) Newton

27) On one of the moon landings astronauts left an object on the moon.Scientists periodically bounce a laser beam off of this object to measure the distance between theearth and the moon. What is this object?

a) Lens
c) Mirror
b) Compass
d) Watch

28) What is the most distant object in the sky that the human eye can seewithout optical instruments?

a) The Horsehead Nebula
c) The Andromeda Galaxy
b) The Sagittarius Constellation
d) The Aurora Borealis

29) A star like object with a very large redshift is a

a) neutron star
b) nova.
c) quasar
d) supernova.

30) When two sounds waves of same frequency and constant initial phase travelling in the same direction in the same line at the same instant, superpose to give maxima and minima. The phenomena is called

a) Refraction
c) diffraction
b) Interference
d) beats

31) With increase in stretching force of the wire its frequency

a) increases
b) decreases
c) remains unchanged
d) may increase or decrease

32) An observer is approaching a stationary source. The observer will hear sound of frequency

a) lower than actual frequency
b) higher than actual frequency
c) same as actual frequency
d) lower or higher frequency depending on the speed of observer

33) The image of an object formed by device is always virtual and small. The device may be

a) concave lens
b) concave mirror
c) a glass plate
d) convex lens

34) The focal length of concave mirror is

a) maximum for red color
b) maximum for yellow color
c) maximum for violet color
d) same for all colors mirror

35) The speed of light in vacuum depends on

a) wavelength
b) frequency
c) intensity
d) none

36) At what angle does a diver see the setting sun

a) at 49 degree to the horizon
b) at 90 degree to the horizon
c) at 41 degree to the horizon
d) at 60 degree to the horizon

37) If monochromatic red light is used instead of blue light then focal length of a lens

a) Increases
b) decreases
c) remains same
d) may decrease or increase depending on material lens

38) Chromatic and spherical aberration are absent in

a) Reflecting telescope
b) refracting telescope
c) Galilean telescope
d) any astronomical telescope

39) The light is falling normally on the surface. If the surface is tilted, then the illuminance on the surface would

a) increased
b) decreased
c) remains unchanged
d) none of above

40) The electric field intensity at the surface of a charged conductor is

a) Zero
b) directed normally to the surface
c) directed tangent to the surface
d) directed along 45degree to the surface

41) Electric potential of the Earth is taken to be zero because Earth is good

a) insulator
b) conductor
c) dielectric
d) semiconductor

42) When a difference of temperature is maintained across the same conductor and the current is absorbed. The effect is said

a) Joule's effect
b) Seebeck effect
c) Peltier effect
d) Thomson effect

43) Two parallel wires carrying current in a opposite direction

a) attract each other
b) repeal each other
c) cancel each other
d) none of above

44) What is the mean distance between the Sun and Earth?

a) 93 million km
b) 150 million miles
c) 150 million km
d) 150 AU

45) About how many light years across is the Milky Way? Is it:

a) 1,000
b) 10,000
c) 100,000
d) 1,000,000

National Astronomy Olympiad Organizing Committee-Nepal

Prof. Dr. Binil Aryal, *Advisor*

Prof. Dr. Binil Aryal is a Head of Department at the Central Department of Physics, Tribhuvan University, Kathmandu, Nepal. He is pioneer introducing Astrophysics in Nepal and working in the field of Galaxy orientation and Evolution. He field of research includes Evolution of Galaxy in Cluster, Clusters of Galaxy, Interaction in the ISM, Dust Structures around PNe, White Dwarfs and Pulsars, Chirality of the Large Scale Structure, Dark Energy.

Er. Rishi Shah, *Chair*

Rishi Shah, academician at Nepal Academy of Science and Technology (NAST), has been advocating for astronomy, astrophysics and space science outreach and education in Nepal since 1980s. He has been actively promoting astronomy outreach working with youths during the decades.

Mr. Prabodh Rijal, *Co-chair*

Prabodh Rijal has been promoting science education in Nepal since 1990s with First Astronomical Exhibition in Nepal, 1995 and Inter School Young Scientist's Fairs, Inter-school competitive exhibition, where students get an opportunity to showcase their talents. He is the president of ESPRO Foundation Nepal.

Mr. Suresh Bhattarai

Suresh Bhattarai is chairman of Nepal Astronomical Society (NASO). He has extensive experience on outreach and educational activities on science. He is also a Regional Coordinator for Asia Pacific at Space Generation Advisory Council in Support of United Nations Program on Space Applications (SGAC). He is a board member of International Olympiad on Astronomy and Astrophysics (IOAA).

Ms. Manisha Dwa

Manisha Dwa is working as Project Coordinator at Nepal Astronomical Society (NASO). She is coordinating Women in Astronomy-Nepal (WIAN) and UNAWE-Nepal. Her expertise lies on outreach activities with children and high school students. She enjoys photography and promoting landscape astrophotography in Nepal. She is a board member of International Olympiad on Astronomy an Astrophysics (IOAA).

Mr. Kishor Acharya

Kishor Acharya is currently studying M.Sc. Physics at St. Xavier's College, Maitighar, Kathmandu, Nepal. He is working as Program Coordinator at Nepal Astronomical Society (NASO). He is also National Point of Contact (NPoC) of Space Generation Advisory Council (SGAC) to Nepal.

For more details:

Nepal Astronomical Society

Bijay Chowk, Prayag Marg

Kathmandu, Nepal

Tel: +977-1-4110344

Email: contact@nepalastronomicalsociety.org

Website: www.nepalastronomicalsociety.org