

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

Student's Name:

School's Name:

**** Exam instructions:**

- The duration of the exam is one hour only.
- The exam consists of 30 multiple-choice questions, each is worth 3.33 marks (30 Q's x 3.33 marks/Q = 100 marks).
- The total number is 9 pages, including the "Useful Relationships and Constants" page.
- Smartphones and other electronic devices are not permitted except for regular calculators.
- Please transcribe the answer code into the following table and submit it with the exam paper.
- Wishing our students the best of luck.

Question Number	Answer	Question Number	Answer
1		16	
2		17	
3		18	
4		19	
5		20	
6		21	
7		22	
8		23	
9		24	
10		25	
11		26	
12		27	
13		28	
14		29	
15		30	

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

Circle the correct answer symbol in the following questions:

1. Copernicus heliocentric model assumed the following:

A- The sun is the center of the universe. B- The planets move around the Sun in circular orbits C- The planet's orbital speed is constant. D- All of the above

2. The Italian astronomer Galileo was the first to observe the sky using an astronomical telescope. This took place in:

A- 1509 B- 1609 C- 1709 D- 1809

3. The star Proxima Centauri is about 4.2 light-years away from Earth. If this star exploded now, we would see the light of its explosion after:

A- 2.1 years B- 4.2 years C- 8.4 years

D- We will never see the light of the explosion

4. The electromagnetic wavelengths visible to the human eye (i.e. visible light) range between:

A - 4000 - 7000 Angstroms B - 4000 - 7000 nanometers

C - 4000 - 7000 microns D- 4000 – 7000 mm

5. The sky is blue during the day; this is mainly caused by:

A- Refraction of light in the atmosphere B- Reflection of light in the oceans

C- Scattering of light in the atmosphere. D- All of the above

6. What mainly distinguishes a rocky planet from a gas planet is:

A- A rocky planet has a thin atmosphere B- A gas planet has a large number of moons

C- A rocky planet has a solid surface D- A gas planet has a strong magnetic field

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

7. A celestial object that enters the Earth's atmosphere and reaches the Earth's surface (at least partially) is called:

- A- Asteroid B- Meteor C- Fireball D- Meteorite

8. Io, Europa, Ganymede and Callisto are the moons of:

- A- Neptune B- Uranus C- Saturn D- Jupiter

9. Morphologically, our Milky Way galaxy is classified as:

- A- Irregular B- Elliptical C- Barred-spiral D- spiral

10. The final stages of stars' life is in the form of:

- A- Black hole B- Neutron star C- White dwarf D- All of the above

11. The main factor that determines the total age of a star is:

- A- Its chemical composition B- Its initial mass C- Its volume D- Its colour

12. The age of the Sun, our parent star, is approximately:

- A- 4.6 million years B- 46 million years C- 460 million years
D- 4600 million years

13. The average duration of the solar activity cycle is about:

- A- 5.5 years B- 11 years C- 17.5 years D- 22 years

14. The celestial coordinate system that is equivalent to the geographic coordinate system (on Earth) is:

- A – The galactic coordinate system B – The ecliptic coordinate system
C – The equatorial coordinate system D- The horizontal coordinate system

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

15. The succession of the four seasons on Earth is mainly caused by:

- A - The Earth's elliptical orbit around the Sun B - The axial tilt of the Earth by 23.4°
C- Inclination of the Moon's orbit by about 5° D- None of the above

16. If the orbital period of asteroid X around the Sun is 1.5 years, its mean distance to the Sun in AU is:

- A- 0.500 B- 0.630 C- 1.00 D- 1.31

17. Hubble's law states that: The speed of recession of a galaxy's = Hubble's constant x distance of galaxy, where the Hubble constant = 70 km/s/mega-parsec. The recession speed of the galaxy NGC007, which is 100 million parsecs away from us, is:

- A- 7 km/s B- 70 km/s C- 700 km/s D- 7000 km/s

18. If the wavelength of a photon of red light is 7000 angstroms ($7000 \text{ \AA}$), then its frequency is:

- A- 4.28 Hz B- 4.28×10^4 Hz C- 4.28×10^{14} Hz D- 4.28×10^{24} Hz

19. If the wavelength of a photon of green light is 5500 angstroms ($5500 \text{ \AA}$), then the energy of this photon in joules is:

- A- 3.61×10^{49} B- 3.61×10^{14} C- 3.61 D- 3.61×10^{-19}

20. If the focal length of the objective lens of a refracting telescope is 5000 mm, and the focal length of the ocular is 50 mm, then the magnification of this telescope is:

- A- 1 B- 10 C- 100 D- 1000

21. If the focal ratio of the University telescope is 5, the diameter of the telescope's objective is 30 centimeters, and the focal length of the eyepiece is 15 millimeters, then the magnification of this telescope is:

- A- 1 B- 10 C- 100 D- 1000

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

22. An asteroid is moving in an elliptical orbit around the sun. If the eccentricity of its orbit is 0.60, then the ratio of the asteroid's velocity at perihelion to its velocity at aphelion is:

- A- 4 B- 1.67 C- 0.60 D- 0.25

23. If the speed of an asteroid is 20 km/s when it is at 1.4 AU from the sun, then, its speed when it reaches 0.7 AU from the sun is:

- A- 10 km/s B- 20 km/s C- 30 km/s D- 40 km/s

24. If the greatest elongation of asteroid Z is 45 degrees, which occurs today, 7/3/2024. After how many days will this asteroid return to its position of greatest elongation? (Assume that the asteroid's orbit around the Sun is circular and moves in the same direction as the Earth's orbit and in the same orbital plane)

- A- 435 days B- 500 days C- 535 days D- 600 days

25. If the dwarf planet Pluto was in opposition, and its distance from the Sun was around 40 AU. At the same moment, a comet fell on the surface of Pluto, causing a powerful explosion. We (as observers on Earth) will see the light of this explosion after:

- A- 317 minutes B- 325 minutes C- 333 minutes D- 401 minutes

26. If the sidereal orbital period of asteroid X is 200 days, its synodic period is:

- A- 75 days B- 200 days C- 365 days D- 442 days

27. An asteroid orbits the Sun in a circular path at a distance of 4 AU from it. The speed of this asteroid is:

- A- 14.9 km/s B- 19.9 km/s C- 24.9 km/s D- 29.9 km/s

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

28. If the mean distance of a comet from the Sun (the semimajor axis of its orbit) is 10 AU, and the eccentricity of its orbit is 0.70, then the perihelion of this comet (closest distance to the Sun) is:

- A- 0.3 AU B- 1.7 AU C- 3.0 AU D- 17 AU

29. A comet orbits the sun in an elliptical orbit. If its aphelion (farthest point from the Sun) is 35.5 astronomical units, and its perihelion (the closest point to the Sun) is 0.5 astronomical units; the orbital period of the comet is:

- A- 56.4 years B- 66.4 years C- 76.4 years D- 86.4 years

30. For the comet mentioned in the previous question, the eccentricity of the comet's orbit is:

- A- 0.90 B- 0.93 C- 0.95 D- 0.97

بعض العلاقات والثوابت المفيدة Some Useful Formulae & Constants

عندما تكون السرعة ثابتة When speed is constant المسافة = السرعة × الزمن distance = speed x time
علاقة الأنجستروم بالمتر Angstrom – meter relation $1 \text{ } ^\circ\text{A} = 10^{-10} \text{ m}$
سرعة الضوء Speed of light $c = 3 \times 10^8 \text{ m/s} = 300,000,000 \text{ م/ث}$

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

سرعة الضوء، الطول الموجي & التردد سرعة الضوء = الطول الموجي $\times$ التردد $c = \lambda f$ التردد (هيرتز) = f (Hz) ; الطول الموجي (م) = λ (m) ; سرعة الضوء (م/ث) = c (m/s)
علاقة طاقة الفوتون بالتردد طاقة فوتون = ثابت بلانك $\times$ التردد $E = h f$ التردد (هيرتز) = f (Hz) ; ثابت بلانك = $h = 6.626 \times 10^{-34}$ J/Hz ; طاقة الفوتون (جول) = E (J)
محيط الدائرة نصف قطر الدائرة = r ; $C = 2 \pi r$
البعد البؤري لشيئية التلسكوب = النسبة البؤرية $\times$ قطر الشيئية focal length of telescope's objective = focal ratio $\times$ objective's diameter
تكبير التلسكوب telescope's magnification $M = \text{focal length of objective} / \text{focal length of ocular}$ تكبير التلسكوب = البعد البؤري للشيئية / البعد البؤري للعينية
للمدار الإهليلجي For elliptical orbits بعد نقطة الأوج في المدار Aphelion distance $r_A = a(1+e)$

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

بعد نقطة الحضيض في المدار Perihelion distance

$$r_p = a(1-e)$$

a : semimajor axis = mean distance = متوسط البعد = نصف المحور الأعظم

e : eccentricity of orbit = الاختلاف المركزي للمدار

إحدى صيغ قانون كبلر الثاني One form of Kepler's 2nd law

بعد الجرم الفضائي عن الشمس x سرعته المدارية = ثابت

Distance of object from Sun x orbital speed = constant

$$v_1 r_1 = v_2 r_2$$

متوسط بعد الأرض عن الشمس Mean distance of Sun-Earth

(1 وحدة فلكية = 1 AU = 1 Astronomical Unit)

$$1 \text{ AU} = 150 \text{ million km} = 1.5 \times 10^{11} \text{ m}$$

إحدى صيغ قانون كبلر الثالث One form of Kepler's 3rd law

$$P^2 (\text{year}) = a^3 (\text{AU})$$

P = sidereal orbital period of object (year) = الفترة المدارية النجمية للجرم (بالسنوات)

a = semimajor axis = mean distance of object (AU)

a = متوسط بعد الجرم عن الشمس = نصف المحور الأكبر للمدار (بالوحدات الفلكية، AU)

السنة الأرضية النجمية (سنة واحدة) = 365.2564 يوم

Earth's sidereal year (1 year) = 365.2564 days

The Jordanian Olympiads of Science: Astronomy & Space Science – Stage II – 7/3/2024

قانون الفترة الاقترانية Synodic period law

$$\frac{1}{S} = \frac{1}{P_1} - \frac{1}{P_2}$$

S = synodic period = الفترة الاقترانية

P_1 = sidereal period for object 1 = الفترة النجمية للجسم الأول

P_2 = sidereal period for object 2 = الفترة النجمية للجسم الثاني

* يجب استعمال نفس وحدات القياس في الفترات: إما بالأيام أو بالسنوات

* The same units of measurement should be used: either days or years

علاقة الاستطالة العظمى ببعد الجسم عن الشمس

The greatest elongation – distance of object from Sun relation

$$r \text{ (AU)} = \sin \alpha$$

α = greatest elongation angle = زاوية الاستطالة العظمى

r = distance from Sun in AU = البعد عن الشمس بالوحدة الفلكية

قياس الزوايا measurement of angles

1 ساعة = 15 درجة (°)

1 درجة = 60 دقيقة قوسية (')

1 دقيقة قوسية = 60 ثانية قوسية (')

1 hour = 15 degrees (°)

1 degree = 60 arcminutes (')

1 arcminute = 60 arcseconds (')