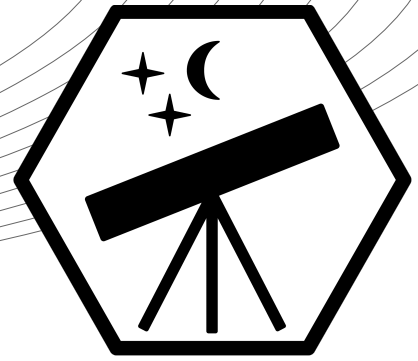


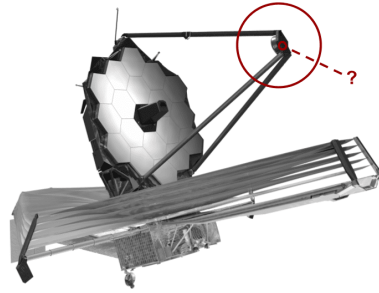
# International Astronomy and Astrophysics Competition Final Round



## **Final Round Exam 2022**

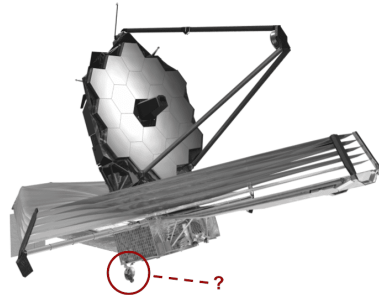
The final round exam was given in the form of an online exam.  
Each participant was given a subset of 20 questions in random order.  
This paper version is only available for training purposes.

**Question 1 :** What is the name of the JWST component highlighted below?



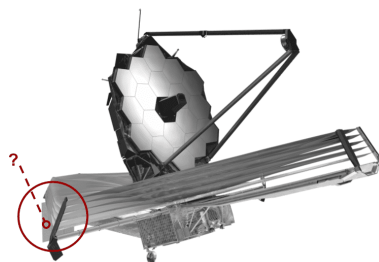
- (A) Primary mirror
- (B) Secondary mirror
- (C) Optics subsystem
- (D) Antenna

**Question 2 :** What is the name of the JWST component highlighted below?



- (A) Stabilization flap
- (B) Spacecraft bus
- (C) Antenna
- (D) Star tracker

**Question 3 :** What is the name of the JWST component highlighted below?



- (A) Antenna
- (B) Sunshield
- (C) Optics subsystem
- (D) Stabilization flap

**Question 4 :** When a **neutron star** rotates, it becomes a ...

- (A) Neutron dwarf    (B) Rotar    (C) Quasar    (D) Pulsar
- 

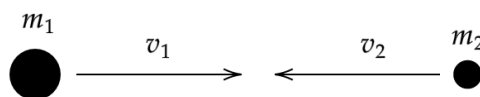
**Question 5 :** If the Earth had the density of a neutron star, what would be the diameter of the Earth?

- (A) between 1 - 100 m    (B) between 100 - 500 m  
(C) between 500 - 1000 m    (D) between 1000 - 5000 m
- 

**Question 6 :** Where in space is the JWST located?

- (A) Geostationary orbit    (B) In the Moon's shadow  
(C) Lagrange point    (D) Between Earth and Moon
- 

**Question 7 :** Two asteroids with masses  $m_1$ ,  $m_2$  and velocities  $v_1$ ,  $v_2$  collide horizontally and merge into a single object. What is the velocity of the new asteroid?



- (A)  $\frac{m_1 v_1 + m_2 v_2}{2}$     (B)  $\frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$   
(C)  $\frac{m_1 v_1 - m_2 v_2}{2}$     (D)  $\frac{m_1 v_1 - m_2 v_2}{m_1 + m_2}$
- 

**Question 8 :** Which one of these wavelengths is considered **ultraviolet radiation**?

- (A) 150 meters    (B) 150 millimeters  
(C) 150 micrometers    (D) 150 nanometers
- 

**Question 9 :** Which one of these wavelengths is considered **infrared radiation**?

- (A) 150 meters    (B) 150 millimeters  
(C) 150 micrometers    (D) 150 nanometers
-

**Question 10 :** The planet's **albedo** is the fraction of incident light ...

- (A) reflected by the planet's surface.      (B) absorbed by the planet's surface.  
(C) blocked by the planet's surface.      (D) emitted by the planet's surface.
- 

**Question 11 :** Earth's current average surface temperature is around ...

- (A) 5 °C      (B) 10 °C      (C) 15 °C      (D) 20 °C
- 

**Question 12 :** Which of the following acronyms refers to an instrument of the JWST?

- (A) NIRSpec      (B) HELIOS      (C) Exo-FMS      (D) HAZMAT
- 

**Question 13 :** A star has the luminosity  $L_0$ . The temperature  $T$  of the star doubles. How does the luminosity change?

- (A)  $2 \times L_0$       (B)  $4 \times L_0$       (C)  $8 \times L_0$       (D)  $16 \times L_0$
- 

**Question 14 :** An object emits light at a wavelength of 200 nanometers. You receive the light at 1000 nanometers. What is the redshift  $z$ ?

- (A)  $z = 1.2$       (B)  $z = 4$       (C)  $z = 5$       (D)  $z = 6$
- 

**Question 15 :** Why is it hard to observe the universe with **infrared radiation** from the Earth's surface?

- (A) Harmful to humans      (B) Blocked by the atmosphere  
(C) Reflected by the atmosphere      (D) Distorted by the atmosphere
- 

**Question 16 :** The moment of inertia of a solid cylinder with radius  $R$  and mass  $M$  is given by ...

- (A)  $MR^2/2$       (B)  $2MR^2/5$       (C)  $3MR^2/10$       (D)  $MR^2/3$
- 

**Question 17 :** Keplers 2nd law states that ...

- (A) the orbit of a planet is an ellipse.      (B)  $dA/dt$  is constant.  
(C)  $a^3/T^2$  is constant.      (D)  $a^2/T^3$  is constant.
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**Question 18 :** Scientists detect no  $\text{CH}_3\text{OH}$  and no  $\text{NH}_3$  in the atmosphere of a sub-Neptune planet. What type of surface does this planet probably have?

- (A) Shallow surface (B) Water oceans  
(C) Dry surface (D) Methane oceans
- 

**Question 19 : Sub-Neptune** planets are ...

- (A) smaller than Neptune. (B) bigger than Neptune.  
(C) farther away than Neptune. (D) closer than Neptune.
- 

**Question 20 :** The surface temperature (in  $^\circ\text{C}$ ) of the Sun is close to ...

- (A)  $5200^\circ\text{C}$  (B)  $5500^\circ\text{C}$  (C)  $5800^\circ\text{C}$  (D)  $6000^\circ\text{C}$
- 

**Question 21 :** An object's **spectral energy distribution (SED)** is formally given by ...

- (A)  $dE/d\lambda$  (B)  $dE/dt$  (C)  $dz/d\lambda$  (D)  $dz/dt$
- 

**Question 22 :** Galileo discovered with his telescope that **Venus** ...

- (A) has a diameter similar to the Earth (B) has mountains on the surface.  
(C) has phases like the Moon. (D) has clouds in the atmosphere.
- 

**Question 23 :** The **Jovian planets** are ...

- (A) Mercury, Venus, Earth, Mars (B) Mercury, Venus, Earth, Mars, Jupiter, Saturn  
(C) Jupiter, Saturn, Uranus, Neptune (D) Uranus, Neptune
- 

**Question 24 :** Neptune's diameter is similar to ...

- (A) Venus (B) Jupiter (C) Saturn (D) Uranus
-

**Question 25 :** Compared to the Sun's surface temperature, **sunspots** are ...

- (A) cooler (B) hotter  
(C) same temperature (D) sometimes hotter and sometimes cooler
- 

**Question 26 :** The brightest star in the night sky is called ...

- (A) Polaris / North star (B) Betelgeuse  
(C) Alpha Centauri (D) Sirius
- 

**Question 27 :** **Alpha Centauri** is the closest star system to the Earth. It is located on the ...

- (A) northern hemisphere, 1.3 light-years away  
(B) northern hemisphere, 4.3 light-years away  
(C) southern hemisphere, 1.3 light-years away  
(D) southern hemisphere, 4.3 light-years away
- 

**Question 28 :** The atmosphere of Venus contains high amounts of ...

- (A) Methane (B) Sulfur (C) Phosphorus (D) Iron
- 

**Question 29 :** What is the name of Jupiter's moon shown in the figure below?



- (A) Io (B) Europa (C) Callisto (D) Ganymede
- 

**Question 30 :** The moon **Titan** orbits around ...

- (A) Mars (B) Jupiter (C) Saturn (D) Neptune
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