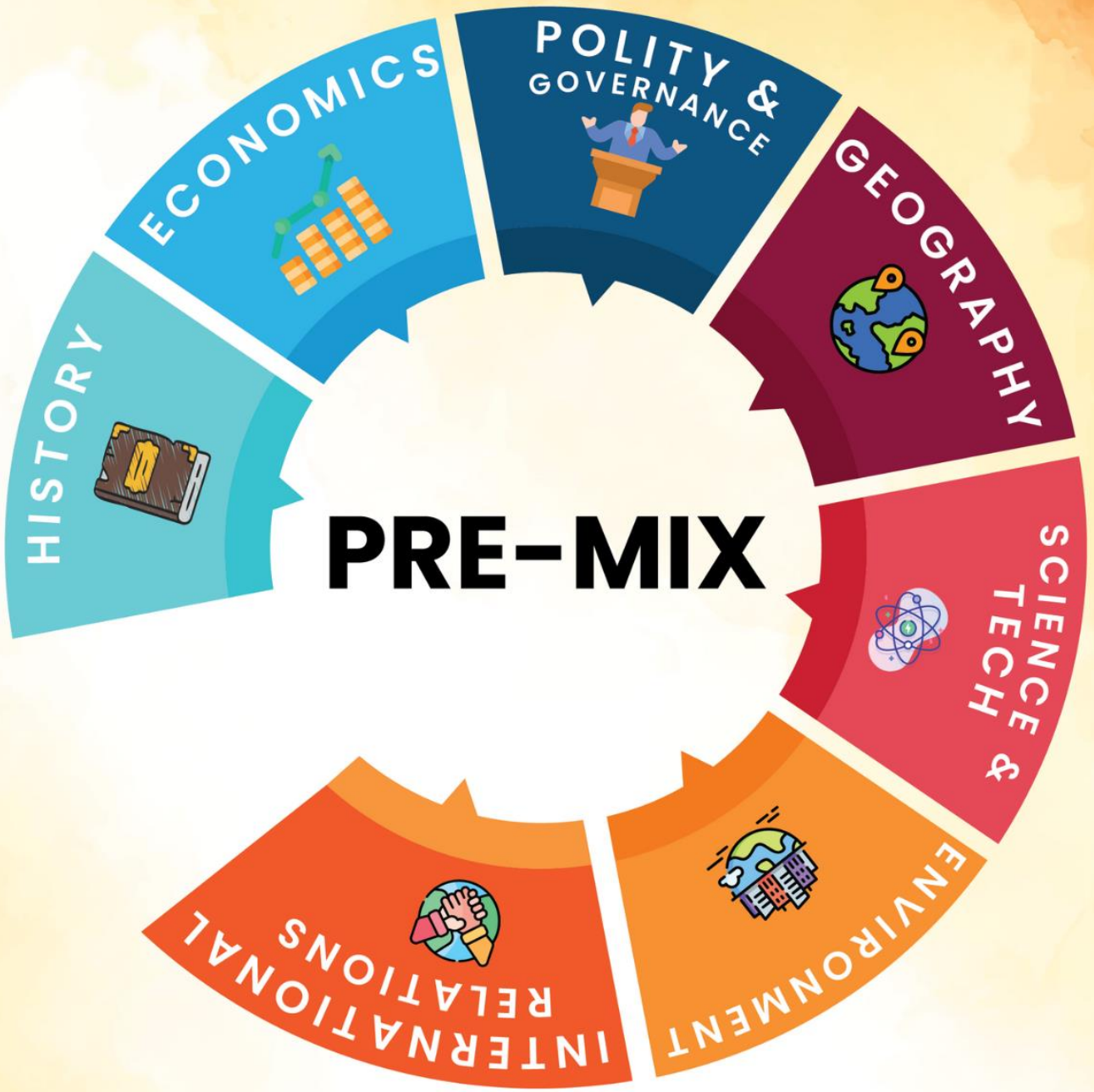
Sleepy Classes IAS
Awakening Toppers



TOPPERS CHOICE

5 subject-specific questions daily to comprehensively prepare for UPSC PRELIMS 2024.

SCIENCE & TECH.

May 2023 to July 2023

Date – 2nd May 2023

1. Which among the following is/are correct regarding Space Bricks seen in news recently:

1. They are developed by NASA from Martian soil with the help of bacteria and urea.
2. Their can be used to construct building-like structures on Mars that could facilitate human settlement on the red planet.

Select the correct answer code:

A. 1 only

B. 2 only

C. Both 1 and 2

D. None of the above

Answer: B

Context

- Researchers from ISRO and Indian Institute of Science (IISc) have developed a way to make bricks of complex shapes from Martian soil with the help of bacteria and urea.
- First slurry was made by mixing Martian soil with guar gum, a bacterium called **Sporosarcina pasteurii,** urea and nickel chloride (NiCl2).
- Bacteria convert the urea into crystals of calcium carbonate.
- These crystals, along with **biopolymers secreted by microbes**, act as cement holding soil particles together.
- In the past, the team had made bricks out of lunar soil using a similar method.

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2. Arrange the following states of matter from lowest to highest energy levels:

1. Solid
2. Liquid
3. Gas
4. Plasma
5. Bose Einstein condensate

Which of the above statements is/are correct?

A. 1,2,3,4,5

B. 4,1,2,3,5

C. 5,1,2,3,4

D. 5,4,1,2,3

Answer: C

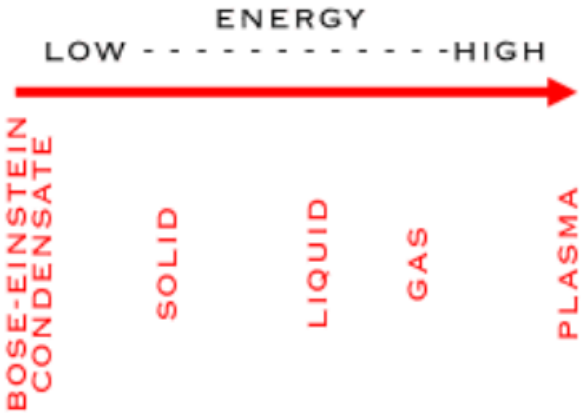
- NASA scientists on Earth have collaborated with astronauts on the International Space Station (ISS) **to corral the first ever Bose-Einstein condensate (BEC)- the fifth state of matter- outside of Earth's gravity**.
- The matter has been **created in one of the coldest places in the universe- the Cold Atom Laboratory– a device on board the International Space Station (ISS).**

Five states of matter

- There are four natural states of matter: Solids, liquids, gases and plasma.
- The **fifth state is the man-made Bose-Einstein condensates.**

About Bose-Einstein condensate

- BEC are formed when the atoms of certain elements are **cooled to near absolute zero (0 K or – 273.15°C).**
- At this point, atoms become a **single entity** with quantum property, **whereas each particle also functions as a wave of matter.**



- Scientists have believed that BECs contain **vital clues to mysterious phenomena such as dark energy which is unknown energy thought to be behind the Universe's accelerating expansion.**
- These are **extremely fragile and the slightest interaction with the external world is** enough to warm them past their condensation threshold.
- Because of this condition, **it becomes nearly impossible for scientists to study BECs on Earth as gravity interferes with the magnetic field required to hold them in place for observation**.
- BECs in terrestrial lab generally last a handful of milliseconds before dissipating while aboard ISS, those lasted more than a second.
- Studying BECs in microgravity has opened up a host of opportunities.
- The existence of **Bose-Einstein condensates (BEC) was predicted by an Indian mathematician Satyendra Nath Bose and Albert Einstein** almost a century ago.

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3. Which of the following diseases is/are transmitted by Aedes species of mosquitoes?

1. Dengue fever
2. Chikungunya
3. Zika fever
4. Yellow Fever

Select the correct answer using the codes given below.

A. 1,2 and 3 only

B. 2,3 and 4 only

C. 1,3 and 4 only

D. All of the above

Answer: D

---

4. Consider the following statements regarding Gelbots seen in news recently:

1. They are soft robots made out of gelatin
2. They are capable of moving without requiring an extra power source
3. They can be used to deliver targeted medicines in human body

Select the correct answer code:

A. 1 and 2 only

B. 2 and 3 only

C. 1 and 3 only

D. All of the above

Answer: D

Gelbots

Recently John Hopkins University scientists have built a soft robot named Gelbots.

- They are created by **3D printing made out of gelatin** and capable of moving **without requiring an extra power source** because of the way their shape, dimensions and patterning of gel are designed.

Significace

- For moving on surfaces through the human body to deliver targeted medicines,
- To deploy as marine robots, patrolling and monitoring the ocean's surface and
- Trained to crawl in response to variations in human biomarkers and biochemical.

---

5. Why astronauts and objects float in space?

A. There is no gravity in space

B. In a vacuum all objects to fall at the same rate.

C. Microgravity can't be found on Earth

D. Gravity of stellar bodies does not change

Answer: B

What Is Microgravity?

- Microgravity is the condition in which people or objects appear to be weightless. The effects of microgravity can be seen when astronauts and objects float in space. Microgravity can be experienced in other ways, as well. "Micro-" means "very small," so microgravity refers to the condition where gravity seems to be very small.
- Microgravity is sometimes called "**zero gravity," but this is misleading.**

Why Do Objects Float in Orbit?

- If 90 percent of Earth's gravity reaches the space station, then why do astronauts float there? The answer is because they are in **free fall**. In a **vacuum**, gravity causes all objects to fall at the same rate. The **mass** of the object does not matter.

If a person drops a hammer and a feather, air will make the feather fall more slowly. But if there were no air, they would fall at the same acceleration.

Date – 9th May 2023

1. Solar technology has greatly improved in terms of efficiency and cost, it is still more expensive than traditional energy sources. Its energy conversion efficiency can be further increased by :

1. Increasing electron recombination
2. Decreasing secondary absorption
3. Reflecting specific wavelengths that normally generate heat out of the solar cells
4. Inserting dielectric passivation layer

Select the correct answer code:

A. 1,2 and 3 only

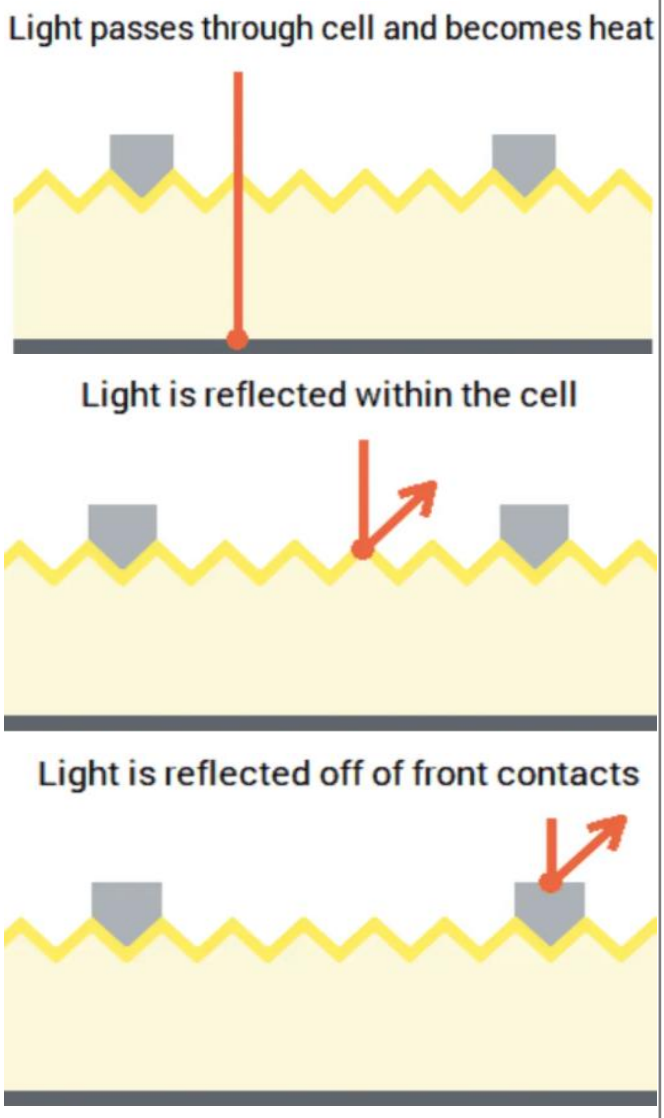
B. 2,3 and 4 only

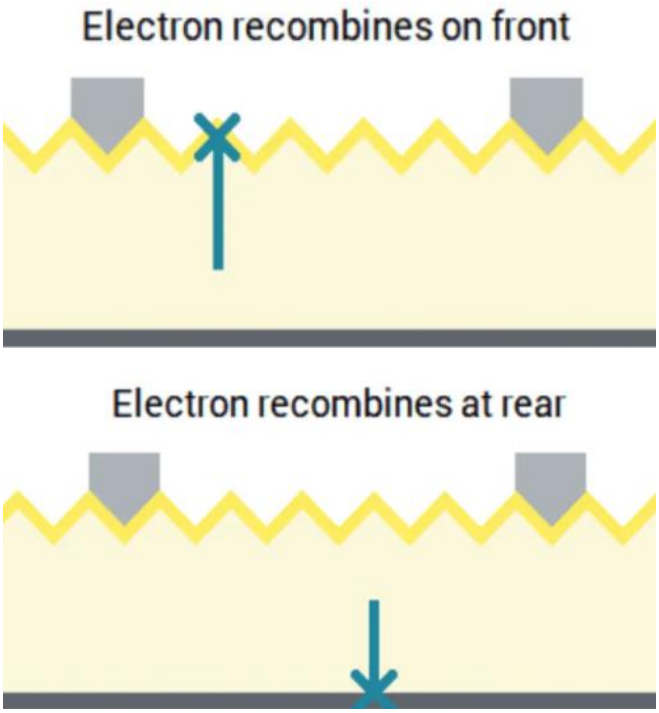
C. 3 and 4 only

D. All of the above

Answer: C

Standard Solar panel-Issues





The dielectric passivation layer contributes to the increase of efficiency by:

Reducing electron recombination	• Electron recombination blocks the free flow of electrons through the cell, reducing efficiency. • The extra passivation layer makes the flow of electrons more steadyand consistent thereby producing additional electric current.
Increasing the solar cell's ability to capture light	• Unabsorbed light is reflected by the passivation layer back to the solar cell for a second absorption attempt to produce additional energy making the cells more efficient.
Reflecting specific wavelengths that normally generate heat out of the solar cells	• Certain wavelengths are absorbed by the rear layer of the solar cell accumulating heat and reducing efficiency. • The additional passivation layer reflects these wavelengths out of the solar cell maintaining the temperature of the solar cell.

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2. Consider the following statements regarding Uranium enrichment, often in news in recent times:

1. It is an isotopic separation process that increases the proportion of the uranium-238 isotope in relation to uranium-235 in natural uranium.
2. Uranium enriched 3-4 % percent is used in nuclear power plants

3. States with nuclear weapons typically use so-called weapon grade High-enriched uranium, which is typically defined as 90% HEU or above

Select the correct answer code:

A. 1 and 2 only

B. 1 and 3 only

C. 2 and 3 only

D. All of the above

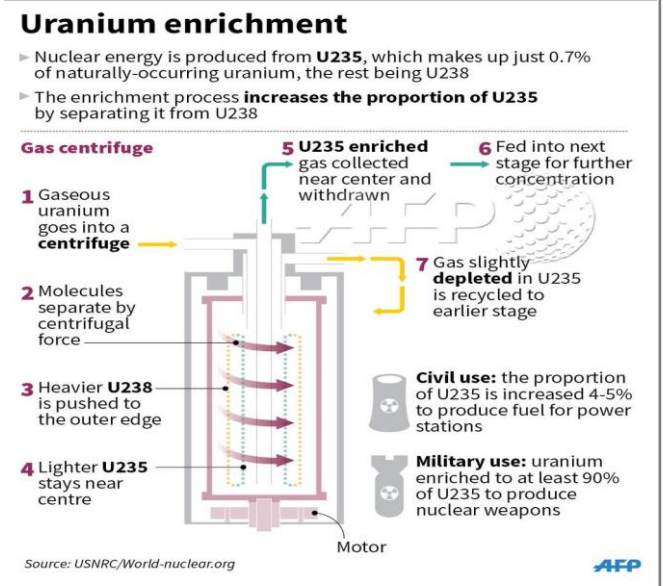
Answer: C

Fissile Material –

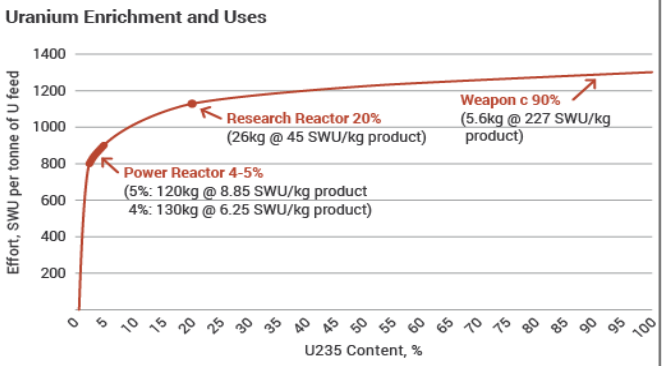
- Uranium-233, Uranium-235, Plutonium-239, Plutonium-241, etc.

Fertile Material-

- Thorium 232, Uranium 238



Uranium enrichment



3. Consider the following statements in context to LDL(Low density lipoprotein) and HDL (High density lipoprotein)

1. Trans fats decreases LDL and increases HDL in body
2. HDL is known as a bad cholesterol whereas LDL is a good cholesterol.

Select the correct answer code:

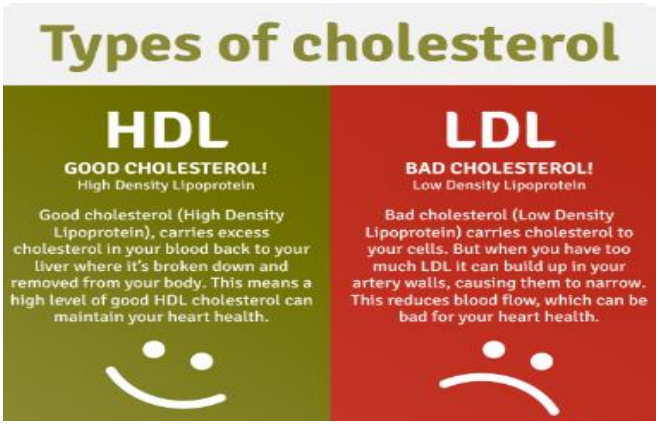
1 only

2 only

Both 1 and 2

None of the above

Answer: D



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4. Consider the following statements:

1. Fortification increases the nutritional value of foods by adding trace amounts of micronutrients to foods during processing
2. Biofortification is the process by which the nutritional value of food crops is enhanced by various methods including plant breeding, agronomic practices and modern biotechnological techniques.
3. Fortification is generally cost effective as it is one time investment to develop fortified crop and recurrent cost is low

Select the correct answer code:

A. 1 and 2 only

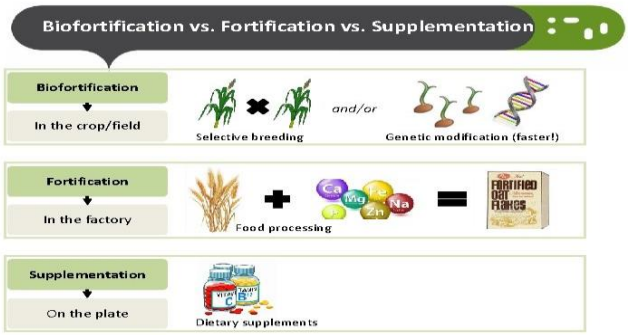
B. 2 and 3 only

C. 1 and 3 only

D. All of the above

Answer: A

- Fortification increases the nutritional value of foods by adding trace amounts of micronutrients to foods during processing
- Biofortification is the process by which the nutritional value of food crops is enhanced by various methods including plant breeding, agronomic practices and modern biotechnological techniques.



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5. Consider the following statements:

1. Unlike a Cryogenic engine, a Semi Cryogenic engine uses Refined kerosene instead of liquid oxygen.
2. Refined Kerosene occupies less space, making it possible to carry more propellant in a Semi Cryogenic engines fuel compartment

Which of the statements given above /are correct?

A. 1 only

B. 2 only

C. Both 1 and 2

D. None of the above.

Answer: B

Semi-Cryogenic Propellant Tank

- A **cryogenic engine provides** more force with each kilogram of cryogenic propellant it uses compared to other propellants, such as solid and liquid propellant rocket engines and is more efficient.
- It uses **Liquid Oxygen (LOX) and Liquid Hydrogen (LH2)** as propellants which liquefy at -183 deg C and -253 deg C respectively.
- In a semi-cryogenic engine, the liquid hydrogen is replaced by civil aviation fuel, which is most mostly kerosene or even CNG

Cryogenic Vs Semi cryogenic engine

- Unlike a Cryogenic engine, a Semi Cryogenic engine uses Refined kerosene instead of liquid hydrogen.
- The liquid oxygen is used as a Oxidiser.
- That's the advantage of using a Semi Cryogenic engine as it requires **Refined Kerosene which is lighter than liquid fuel** and can be stored in a **normal temperature**.
- Kerosene combined with liquid oxygen provide a higher thrust to the rocket.
- Refined Kerosene occupies less space, making it possible to carry more propellant in a Semi Cryogenic engines fuel compartment.

A semi cryogenic engine is more powerful, environment friendly and cost effective as compared to a cryogenic engine.

Date – 16th May 2023

1. Which among the following is/are correct regarding Aditya L1 mission seen in news recently:

1. It aims to study the dynamic nature of the sun's outer most layers, the corona and the chromosphere.
2. The satellite will travel to the L1 or Lagrange point between the sun and the earth.
3. L1 point will help it to view the Sun without any eclipses and reduce fuel consumption
4. L1 is currently home to the Solar and Heliospheric Observatory Satellite SOHO.

Select the correct answer code:

A. 1,2 and 3 only

B. 1 and 2 only

C. 1,2 and 3 only

D. All of the above

Answer: D

Aditya L1

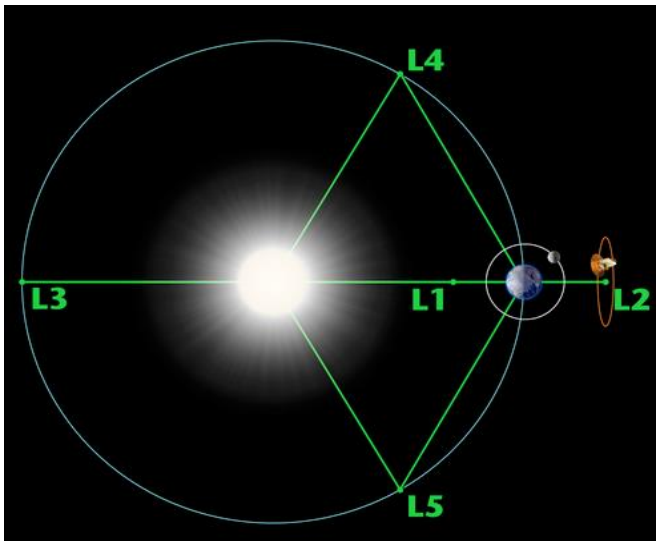
The Indian Institute of Astrophysics, Bengaluru recently handed over the primary payload **Visible Emission Line Coronograph** (VELC)of the country's first mission to sun (Aditya L1) to the Indian Space Research Organisation (ISRO) for integration with the other payloads on board the satellite.

Aditya L1

- Aditya-L1, the mission to **observe the sun from a vantage point 1.5 million kilometres from the earth,** is likely to be launched by June or July this year after being delayed repeatedly through the pandemic.
- The satellite will be carried by India's trusted rocket **Polar Satellite Launch Vehicle**
- To get an unobstructed, continuous view of the sun, the satellite will travel to the **L1 or Lagrange point** between the sun and the earth.
- Not only will it generate high resolution pictures of the corona, it will also **maintain a temperature of 22 degrees C by radiating away the enormous heat and light** from the solar surface. It is also one of the most precise instruments made in India.

Lagrange Points

- are positions in space where **objects sent there tend to stay put**. At Lagrange points, the **gravitational pull of two large masses precisely equals the centripetal force required for a small object to move with them**.
- This mathematical problem, known as the **General Three-Body Problem**



Solar and Heliospheric Observatory Satellite SOHO.

- The L1 point of the Earth-Sun system affords an uninterrupted view of the sun and is currently home to the **Solar and Heliospheric Observatory Satellite SOHO.**
- Launched in December 1995, the joint **NASA-ESA** Solar & Heliospheric Observatory mission -- SOHO -- was designed to **study the Sun** inside out, from its internal structure, to the extensive outer atmosphere, to the solar wind that it blows across the solar system.
- Over more than two decades in space, SOHO has made many new discoveries, adding to scientists' understanding of our closest star.

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2. Recently JUICE mission seen in news, launched by:

A. Indian Space Research Organisation

B. European Space Agency

C. National Aeronautics and Space Administration

D. Japan Aerospace Exploration Agency

Answer: B

Juice mission

The European Space Agency (ESA) plans to **launch the Jupiter Icy Moons Explorer mission in April 2023.**

- **About Juice mission**
- The Juice mission will complete **35 fly-bys near Jupiter** and will make detailed observations about the gas giant and its three large ocean-bearing moons–**Europa, Ganymede and Callisto.**
- Apart from exploring Jupiter's environment in depth using the ten sensors aboard, the mission will also characterise its moons as both planetary objects and potential habitat.The Juice spacecraft will monitor Jupiter's complex environment in depth including its magnetism, radiation and plasma. After it completes its 35 fly-bys near Jupiter and its Moons, it will also become the **first spacecraft to shift its own orbit to another world by moving to Ganymede's orbit.**

---

3. Consider the following matches:

Mission	Country
International Space station	USA
Tiangong	Japan
Mir	China
Gaganyaan	India

Which of the above is/are correct?

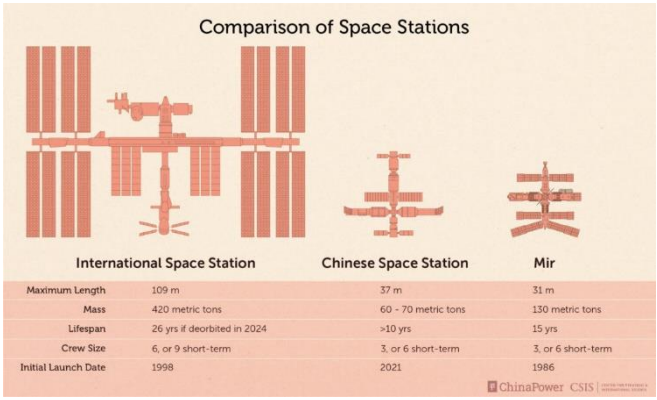
A. 1, 3 and 4 only

B. 1, 2 and 4 only

C. 1 and 4 only

D. All of the above

Answer: C

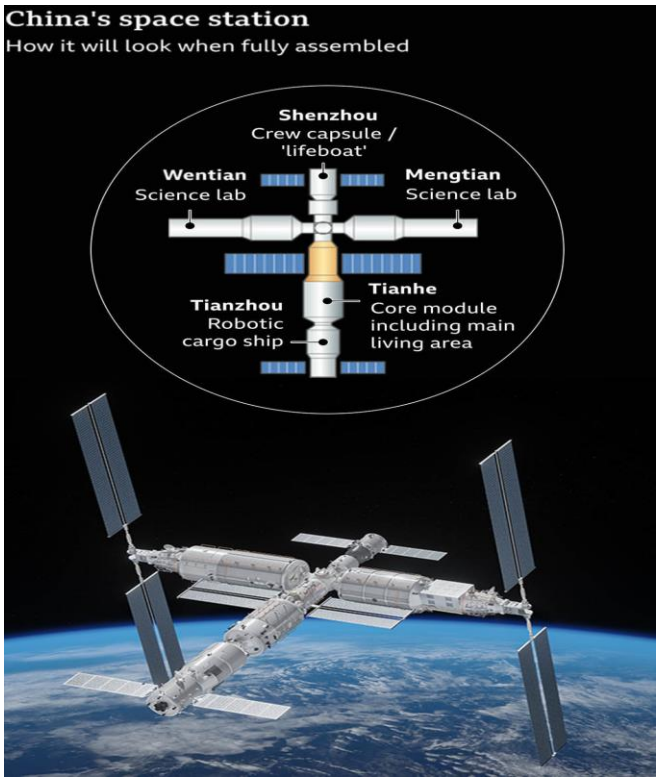


Tiangong space station

China selects mystery astronauts for 2023 missions to Tiangong space station

About

- China will later this year send two crews to the now fully operational Tiangong to spend six months in orbit conducting science experiments and keeping the space station maintained.
- Two three-person crews have been selected for the **Shenzhou 16 mission, due to launch in May, and the following Shenzhou 17 mission**, launching six months later. The missions will lift off atop Long March 2F rockets from Jiuquan in the Gobi Desert
- Tiangong, which means **"Heavenly Palace**," will consist of **Tianhe** the main habitat for astronauts, and two modules dedicated to hosting experiments, **Mengtian and Wentian**
- Tiangong will be much smaller than the International Space Station (ISS)
- Tiangong will also be **lighter than the ISS,** which weighs about 400 tons (450 metric tons)
- China is **only the third country** in history to have put both astronauts into space and to build a space station, after the Russia and the US.



4. Consider the following statements regarding NISAR mission seen in news recently:

1. It is an earth-observation satellite jointly developed by NASA and ISRO
2. It carries L and S dual band Synthetic Aperture Radar (SAR)
3. In Synthetic Aperture a sequence of acquisitions from a shorter antenna are combined to simulate a much larger antenna

Select the correct answer code:

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. All of the above

Answer: D

NISAR Mission

ISRO-NASA built NISAR satellite ready to be shipped to India for launch

About NISAR

- An **earth-observation satellite jointly developed by NASA and ISRO** that will help study **Earth's land and ice surfaces in greater detail**
- This mission will be a powerful demonstration of the **capability of radar as a science tool and help us study Earth's dynamic land and ice surfaces** in greater detail than ever before
- **ISRO and NASA joined hands in 2014 to** build the 2,800 kg satellite. In March 2021, **ISRO sent its S-Band SAR payload** developed in India to NASA for integration with the L-Band payload built by JPL (NASA's Jet Propulsion Laboratory)
- This marks an important milestone in our shared journey to better understand planet Earth and our changing climate. NISAR will **provide critical information on Earth's crust, ice sheets, and ecosystems**
- NISAR will gather radar data with a drum-shaped reflector antenna almost 12 meters in diameter. It will use a signal-processing technique called interferometric synthetic aperture radar, or InSAR, to observe changes in Earth's land and ice surfaces down to fractions of an inch.
- The satellite will help researchers detect slow-moving variations of a land surface that can precede earthquakes, landslides, and volcanic eruptions.

Benefits

- Data about such movements could help communities **prepare for natural hazards such as the Joshimath land subsidence**.
- Measurements of **melting sea ice and ice sheets will improve understanding of the pace** and impacts of climate change, including sea level rise.
- Over the course of its three-year prime mission, the satellite will observe nearly the **entire planet every 12 days**, making observations day and night, in all weather conditions

What's Synthetic about SAR?

- The spatial resolution of radar data is **directly related** to the **ratio of the sensor wavelength to the length of the sensor's antenna**.
- For a given wavelength, the **longer the antenna, the higher the spatial resolution**.
- From a satellite in space operating at a wavelength of about **5 cm** (C-band radar), in order to get a **spatial resolution of 10 m**, you would need a radar antenna about **4,250 m long.**
- An antenna of that size is not practical for a satellite sensor in space. Hence, scientists and engineers have come up with a clever workaround – the synthetic aperture. In this concept, a sequence of acquisitions from a **shorter antenna are combined to simulate a much larger antenna, thus providing higher resolution data**

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5. Consider the following matches:

Mission	Country
Hayabusa	China
OSIRIS-Rex	India
Muse and Helioswarm	Japan
DART	USA

Which of the above is/are correct?

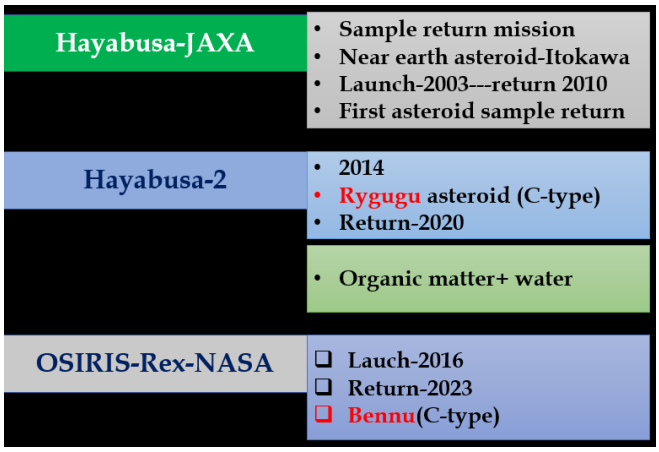
A. One pair only

B. Two pairs only

C. Three pairs only

D. Four pairs only

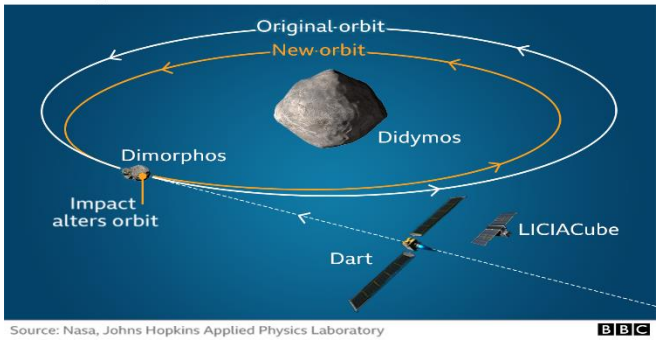
Answer: A



Double Asteroid Redirection Test (DART) Mission

- **Double Asteroid Redirection Test (DART) Mission:** NASA's DART (Double Asteroid Redirection Test) has **successfully crashed into the asteroid Dimorphos.** Scientists expect the impact to alter the asteroid's orbit. However, it will take a few weeks before NASA can determine how much the asteroid's path was changed due to the impact.

Nasa spacecraft crashes into asteroid's moon



Date – 23rd May 2023

CAPF 2022

1.

One way of incorporating desired characters into crop varieties is hybridization. In this process, there is crossing between genetically dissimilar plants. Which one of the following crossings will ***not*** refer to hybridization?

(a) Intervarietal

(b) Interspecific

(c) Intergenic

(d) Intragenic

Answer : D

2.

Depending on the requirements, plant nutrients are classified as micronutrients and macronutrients. Which one of the following is an example of a macronutrient?

(a) Manganese

(b) Copper

(c) Magnesium

(d) Chlorine

Answer : C

3.

Phloem tissues are mostly responsible for transport of

(a) water

(b) oxygen

(c) minerals

(d) food

Answer : D

4.

The optical phenomenon responsible for the blue colour of sky is

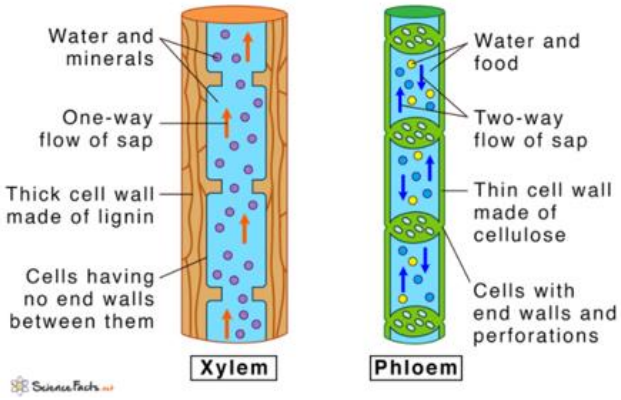
(a) dispersion

(b) reflection

(c) refraction

(d) scattering

Answer : D



5.

The electrical device used for converting mechanical energy into electrical energy is called

(a) voltmeter

(b) ammeter

(c) motor

(d) generator

Answer : D

6.

Which of the following makes bread soft and spongy when baking soda is added?

(a) Sodium salt of acid

(b) $NaHCO_3$

(c) CO_2

(d) H_2O

Answer: C

7.

Consider the following missiles :

1. Agni-I
2. BrahMos
3. Dhanush

Which of the above is/are cruise missile/missiles?

(a) 1 and 2

(b) 2 only

(c) 1 and 3

(d) 3 only

Answer: B

Ballistic Missile	Cruise Missile
propelled only for a brief duration after the launch.	Self-propelled till the end of its flight.
Similar to a rocket engine.	Similar to a jet engine.
Long-range missiles leave the earth's atmosphere and reenter it.	The flight path is within the earth's atmosphere.
Low precision as it is **unguided for most of its path** and its trajectory depends on gravity, air resistance and Coriolis Force.	Hits targets with high precision as it is constantly propelled.
Can have a very long range (300 km to 12,000 km) as there is no fuel requirement after its initial trajectory.	The range is generally small (below 500 km) as it needs to be constantly propelled to hit the target with high precision.
Prithvi , Agni	**Brahmos missile**

8.

A sprinter feels cramps and pain in the thigh muscles after a run. This is due to accumulation of

(a) lactic acid

(b) CO_2

(c) pyruvic acid

(d) ethanol

Answer: A

9.

The blood pressure of a normal human being is found to be 120/80 mmHg. These 'numbers' represent the blood pressure at

(a) ventricular contraction and ventricular relaxation, respectively

(b) ventricular relaxation and ventricular contraction, respectively

(c) auricular contraction and auricular relaxation, respectively

(d) ventricular contraction and auricular contraction, respectively

Answer: A

10.

The hydrogen bomb and the uranium bomb are based, respectively on

(a) nuclear fusion and fission

(b) fission and thermonuclear fusion

(c) geothermal fission and fusion

(d) geothermal fusion and fission

Answer: A

Date – 7th June 2023

Basic science Questions from NCERT

1. Consider the following statements:

1. Toilet soaps are prepared by dissolving the soap in ethanol and then evaporating the excess solvent.
2. Transparent soaps are made by using better grades of fats and oils and care is taken to remove excess alkali.
3. Soap chips are made by running a thin sheet of melted soap onto a cool cylinder and scraping off the soaps in small broken pieces.

How many of the above statements are correct?

A. Only one
B. Only two
C. All three
D. None

Answer: A

Explanation

Types of soaps Basically all soaps are made by boiling fats or oils with suitable soluble hydroxide. Variations are made by using different raw materials.

- **Toilet soaps** are prepared by **using better grades of fats and oils and care is taken to remove excess alkali.** Colour and perfumes are added to make these more attractive. Soaps that float in water are made by beating tiny air bubbles before their hardening.
- **Transparent soaps** are made by **dissolving the soap in ethanol** and then evaporating the excess solvent.
- **Soap chips** are made by running a **thin sheet of melted soap onto a cool cylinder** and scraping off the soaps in small broken pieces. . Soap granules are dried miniature soap bubbles. Soap powders and scouring soaps contain some soap, a scouring agent (abrasive) such as powdered pumice or finely divided sand, and builders like sodium carbonate and trisodium phosphate. Builders make the soaps act more rapidly.

---

2. Consider the following pairs :

Drugs	Action
Aspirin	Analgesics
Metal hydroxides	Antacids
Penicillin	Antibiotics

How many of the above pairs are correctly matched?

A. Only one
B. Only two
C. All three
D. None

Answer: C

Explanation

Antibiotics

- Antibiotics are used as drugs to treat infections because of their low toxicity for humans and animals. Initially **antibiotics were classified as chemical substances produced by microorganisms** (bacteria, fungi and molds) that inhibit the growth or even destroy microorganisms.
- The development of **synthetic methods** has helped in synthesising some of the compounds that were originally discovered as products of microorganisms. Also, some **purely synthetic compounds have antibacterial activity**, and therefore, definition of antibiotic has been modified.
- **An antibiotic now** refers to a **substance produced wholly or partly by chemical synthesis**, which in low **concentrations inhibits the growth or destroys microorganisms** by intervening in their metabolic processes.

Antibiotics have either cidal (killing) effect or a static (inhibitory) effect on microbes. A few examples of the two types of antibiotics are as follows:

Bactericidal	Bacteriostatic
Penicillin	Erythromycin
Aminoglycosides	Tetracycline
Ofloxacin	Chloramphenicol

Analgesics

- Analgesics **reduce or abolish pain** without causing impairment of consciousness, mental confusion, incoordination or paralysis or some other disturbances of nervous system.

Antacid

- Over production of acid in the stomach causes irritation and pain. In severe cases, ulcers are developed in the stomach.
- Until 1970, only treatment for acidity was administration of antacids, such as sodium hydrogencarbonate or a mixture of aluminium and magnesium hydroxide.
- However, excessive hydrogencarbonate can make the stomach alkaline and trigger the production of even more acid.
- Metal hydroxides are better alternatives because of being insoluble, these do not increase the pH above neutrality. These treatments control only symptoms, and not the cause.

---

3. Consider the following statements:

1. Antiseptics are applied to the living tissues such as wounds, cuts, ulcers and diseased skin surfaces
2. Disinfectants are applied to inanimate objects such as floors, drainage system, instruments, etc.
3. Antiseptics are not ingested like antibiotics.
4. Same substances can't act as an antiseptic as well as disinfectant

Select the correct answer using the codes given below:

A. One is correct, two is incorrect

B. Two is correct, three is incorrect

C. Three is correct, four is incorrect

D. Four is correct, One is incorrect

Answer: C

Explanation

Antiseptics and disinfectants

- Antiseptics and disinfectants are also the chemicals which **either kill or prevent the growth of microorganisms.**
- **Antiseptics** are applied to the **living tissues** such as wounds, cuts, ulcers and diseased skin surfaces. Examples are **furacine, soframicine**, etc. These are **not ingested like antibiotics**. Commonly used antiseptic, **dettol** is a mixture of chloroxylenol and terpineol.
- **Bithionol** (the compound is also called bithional) is **added to soaps to impart antiseptic** properties.
- **Iodine** is a powerful antiseptic. **Its 2-3 per cent solution in alcoholwater mixture** is known as **tincture of iodine**. It is applied on wounds.
- **Iodoform** is also used as an antiseptic for wounds. Boric acid in dilute aqueous solution is weak antiseptic for eyes

Disinfectants

- are applied to **inanimate objects such as floors, drainage system, instruments**, etc.
- **Same substances can act as an antiseptic** as well as disinfectant by varying the concentration. For example, **0.2 per cent solution of phenol is an antiseptic** while its **one percent solution is disinfectant**.

---

4. With reference to sweetness value in comparison to cane sugar, consider the following Artificial Sweetening Agents :

1. Aspartame
2. Saccharin
3. Sucralose
4. Alitame

Select the correct answer using the codes given below:

A. One is sweeter than three

B. Two is less sweeter than four

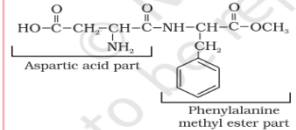
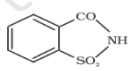
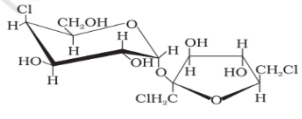
C. Three and four are less sweeter than Two

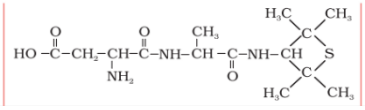
D. One and two are sweeter than four

Answer: B

Explanation

Table 16.1: Artificial Sweeteners

Artificial sweetener	Structural formula	Sweetness value in comparison to cane sugar
Aspartame		100
Saccharin		550
Sucralose		600

Alitame		2000

5. 'Biolistics method'is sometimes talked about with reference to which one of the following?

A. Transfer of foreign DNA into the host cell.

B. Producing biodegradable plastic

C. Producing bio energy from rice straw

D. Producing biochar from thermochemical conversion of biomass

Answer: A

Explanation

- In a method known as **micro-injection,** recombinant DNA is directly injected into the nucleus of an animal cell.

In another method, suitable for plants, cells are **bombarded with high velocity micro-particles of gold or tungsten coated with DNA** in a method known as **biolistics or gene gun**.

Date – 21st June 2023

1. Consider the following pairs :

Satellite launch vehicle	Number of stages
Satellite Launch Vehicle-3 (SLV-3)	Three
Augmented Satellite Launch Vehicle (ASLV)	Five
Polar Satellite Launch Vehicle (PSLV)	Four
Small Satellite Launch Vehicle (SSLV)	Two

How many of the above pairs are correctly matched ?

A. Only one

B. Only two

C. All three

D. None

Answer: B

Explanation

Satellite Launch Vehicle-3 (SLV-3)	It was India's first experimental satellite launch vehicle, which was an **all solid, four stage vehicle** weighing 17 tonnes with a height of 22m and capable of placing 40 kg class payloads in Low Earth Orbit (LEO (Low Earth Orbit)). SLV-3 was successfully launched on July 18, 1980 from Sriharikota Range (SHAR), when Rohini satellite, RS-1, was placed in orbit
Augmented Satellite Launch Vehicle (ASLV)	With a lift off weight of 40 tonnes, the 24 m tall ASLV was configured as a **five stage, all-solid propellant vehicle**, with a mission of orbiting 150 kg class satellites into 400 km circular orbits. Under the ASLV programme four developmental flights were conducted. The first developmental flight took place on March 24, 1987 and the second on July 13, 1988

Polar Satellite Launch Vehicle (PSLV)	It is the third **generation four stage** launch vehicle of India. It is the first Indian launch vehicle to be equipped with **liquid stages**. After its first successful launch in October 1994, PSLV emerged as a reliable and versatile workhorse launch vehicle of India.
Geosynchronous Satellite Launch Vehicle Mark II	It is the launch vehicle developed by India, to launch communication satellites in geo transfer orbit using cryogenic third stage. Initially Russian GK supplied cryogenic stages were used. Later cryogenic stage was indigenously developed and inducted in Jan 2014 from GSLV D5 onwards. This operational fourth generation launch vehicle is a three stage vehicle with four liquid strap-ons. The flight proven indigenously developed Cryogenic Upper Stage (CUS), forms the third stage of GSLV Mk II.
Small Satellite Launch Vehicle (SSLV)	It is a 3 stage Launch Vehicle configured with three Solid Propulsion Stages and liquid propulsion based Velocity Trimming Module (VTM) as a terminal stage. SSLV is 2m in diameter and 34m in length with lift off weight of ~120 tonnes. SSLV is capable of launching ~500kg satellite in 500km planar orbit from SDSC/SHAR. The key features of SSLV are Low cost, with low turn-around time, flexibility in accommodating multiple satellites, Launch on demand feasibility, minimal launch infrastructure requirements, etc.

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2. Consider the following pairs:

Aditya L1 Payload	Capability
VELC	Corona/Imaging & Spectroscopy
SUIT	Soft X-ray spectrometer: Sun-as-a-star observation

PAPA	Solar wind/Particle Analyzer Electrons & Heavier Ions with directions

How many of the above pairs are correctly matched ?

A. Only one

B. Only two

C. All three

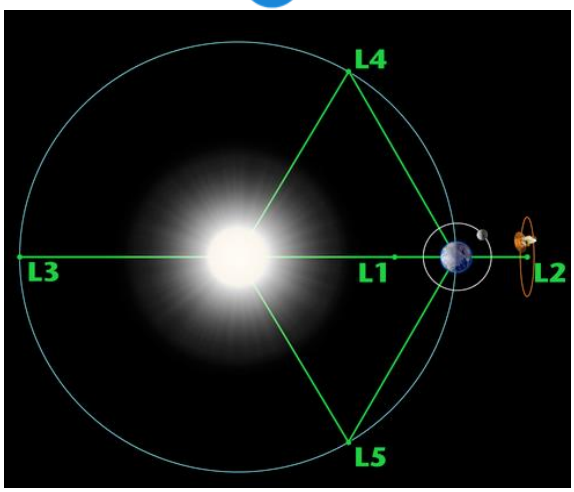
D. None

Answer: B

Explanation

Aditya L1 shall be the first space based Indian mission to study the Sun.

- The spacecraft shall be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth.
- A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any occultation/eclipses.
- This will provide a greater advantage of observing the solar activities and its effect on space weather in real time.



Science Objectives:

The major science objectives of Aditya-L1 mission are:

- Study of Solar upper atmospheric (chromosphere and corona) dynamics.
- Study of chromospheric and coronal heating, physics of the partially ionized plasma, initiation of the coronal mass ejections, and flares
- Observe the in-situ particle and plasma environment providing data for the study of particle dynamics from the Sun.
- Physics of solar corona and its heating mechanism.
- Diagnostics of the coronal and coronal loops plasma: Temperature, velocity and density.
- Development, dynamics and origin of CMEs.
- Identify the sequence of processes that occur at multiple layers (chromosphere, base and extended corona) which eventually leads to solar eruptive events.

- Magnetic field topology and magnetic field measurements in the solar corona.
- Drivers for space weather (origin, composition and dynamics of solar wind .

Payloads along with their major capability of scientific investigation.

Type	Sl. No.	Payload	Capability
Remote Sensing Payloads	1	Visible Emission Line Coronagraph(VELC)	Corona/Imaging & Spectroscopy
	2	Solar Ultraviolet Imaging Telescope (SUIT)	Photosphere and Chromosphere Imaging- Narrow & Broadband
	3	Solar Low Energy X-ray Spectrometer (SoLEXS)	Soft X-ray spectrometer: Sun-as-a-star observation
	4	High Energy L1 Orbiting X-ray Spectrometer(HEL1OS)	Hard X-ray spectrometer: Sun-as-a-star observation
In-situ Payloads	5	Aditya Solar wind Particle Experiment(ASPEX)	Solar wind/Particle Analyzer Protons & Heavier Ions with directions
	6	Plasma Analyser Package For Aditya (PAPA)	Solar wind/Particle Analyzer Electrons & Heavier Ions with directions
	7	Advanced Tri-axial High Resolution Digital Magnetometers	In-situ magnetic field (Bx, By and Bz).

---

3. Consider the following statements regarding impact of microgravity:

1. In microgravity presence of convective flows causes a candle flame to be teardrop-shaped
2. It weakens heart with time leading to cardiac problems
3. Developing foetus is likely to sit high up in the mother's womb

How many of the above statements are correct?

A. Only one

B. Only two

C. All three

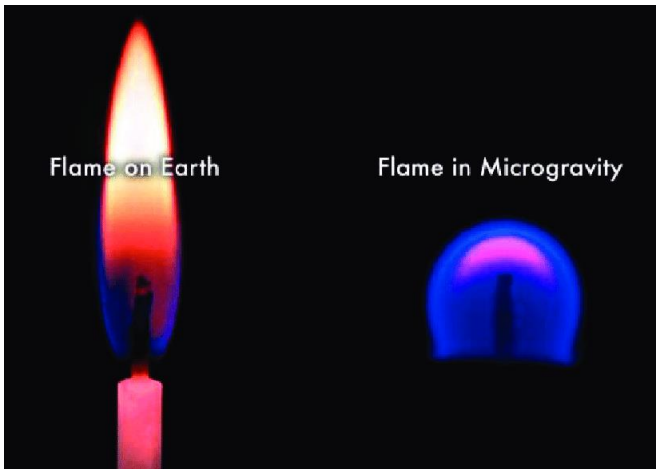
D. None

Answer: B

Explanation

Impact of microgravity

- **Microgravity** of space leads to **loss of bone density and muscle mass** resulting in osteopenia and fractures.
- Another problem is that while on Earth the human heart has to pump against gravity, in space, it does not have to do that. So it **weakens with time leading to cardiac problems, low red blood cells**, immunodeficiency, etc.
- Microgravity in space also **affects eyeball movement** and brain affecting a person's sense of balance and body orientation.
- The severity of these problems at the reduced gravity of Mars is not known.
- On Earth, the **entire developing foetus – its bone, muscle, circulation system** – all work against gravity. In the low gravity of Mars, the developing **foetus is likely to sit high up in the mother's womb**, pressing on the lungs and making it difficult for her to breathe.



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4. Consider the following statements regarding Dark matter:

1. Dark matter is made up of particles that do not have a charge.

2. These particles are "dark", namely because they do not emit light
3. They possess mass like normal matter and hence interact through electromagnetic interactions
4. As of today, the most sensitive dark matter detector experiment in the world is LUX-ZEPLIN (LZ)

Select the correct answer using the codes given below.

A. Statement 1 is correct, 2 is incorrect
B. Statement 2 is correct, 3 is incorrect
C. Statement 3 is correct, 4 is incorrect
D. Statement 4 is correct, 1 is incorrect

Answer : B

Explanation

Dark matter

- It is made up of particles that do not have a charge — which means they do not interact through electromagnetic interactions. So, these are particles that are "dark", namely because they do not emit light, which is an electromagnetic phenomenon, and "matter" because they possess mass like normal matter and hence interact through gravity.
- There is strong indirect evidence for dark matter, and this evidence is reflected at various levels (or distance scales, as physicists would explain).
- As of today, the most sensitive dark matter detector experiment in the world is LUX-ZEPLIN (LZ) in South Dakota in the U.S.

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5. Consider the following statements in context of Gravitational waves:

1. Every massive object that accelerates produces gravitational waves.
2. Humans, cars and airplanes also produces gravitational waves.
3. They are electromagnetic radiations detected by LIGO observatory.

Select the correct answer using codes given below:

A. 1 and 2 only

B. 2 and 3 only

C. 3 only

D. All of the above.

Answer : A

Explanation

Gravitational waves

- **Gravitational waves are 'ripples' in space-time** caused by some of the most violent and energetic processes in the Universe.
- Albert Einstein predicted the existence of gravitational waves in 1916 in his general theory of relativity.
- Historically, scientists have relied almost exclusively on electromagnetic (EM) radiation (visible light, X-rays, radio waves, microwaves, etc.) to study the Universe. Some are trying to use subatomic particles, called neutrinos, as well. Each of these 'messengers' of information provides scientists with a different *but complementary* view of the Universe.
- **Gravitational waves, however, are completely unrelated to EM radiation**. They are as distinct from light as hearing is from vision.
- The gravitational waves that **LIGO detects are** caused by some of the most energetic events in the Universe—colliding black holes, merging neutron stars, exploding stars, and possibly even the birth of the Universe itself.

Sources and Types of Gravitational Waves

- Every massive object that accelerates produces gravitational waves. This includes **humans, cars, airplanes** etc., but the masses and accelerations of objects on Earth are far too small to make gravitational waves big enough to detect with our instruments. To find big enough gravitational waves, we have to look far outside of our own solar system.

The most powerful gravitational waves are created when objects move at very high speeds. Some examples of events that could cause a gravitational wave are:

- when a star explodes asymmetrically (called a **supernova**)
- when two big stars orbit each other

when two **black holes** orbit each other and merge

Date – 6th July 2023

1. Recently, a submersible named Titan has gone missing in the deep ocean. Consider the following statements regarding use of sound for detection of the missing submersible:

1. Sound is often a more effective means of detection under water compared to light.
2. In the underwater environment sound travels farther than light
3. Sound travels faster in water than in air
4. Sound travels much faster than light through water

How many of the above statements are correct?

A. Only one
B. Only two
C. Only three
D. All of the above.

Answer : C

Explanation

The Speed of Sound

- A sound wave is a pressure disturbance that travels through a medium by means of particle-to-particle interaction.
- As one particle becomes disturbed, it exerts a force on the next adjacent particle, thus disturbing that particle from rest and transporting the energy through the medium
- The speed of sound in a medium depends on **temperature of the medium.**
- The speed of sound decreases when we go from solid to gaseous state. In any medium as we increase the temperature, the speed of sound increases.
- For example, the speed of sound in air is **331 m s–1 at 0°C and 344 m s–1 at 22 °C**

Medium

$V_{solids} > V_{liquids} > V_{gases}$

Sound travels much more slowly than light through water but can travel much further, and so is used for remote sensing and communication in the oceans.

---

2. Why we often find it difficult to localize the source of a sound that we hear underwater.:

A. High water pressure decreases ability to hear
B. Lack of ambient noise in deep ocean
C. Low frequency sounds are absorbed more quickly
D. The difference in the time of arrival of sounds decreases

Answer : D

Explanation

- Sound travels faster through denser materials. Since water is much denser than air, the **speed of sound in water** (about 1500 m/s) is approximately five times faster than the speed in air (around 330 m/s).
- This helps explain why we sometimes have **difficulty localizing the source of a sound** that we hear underwater.
- We **localize sound sources when our brains detect the tiny differences in the time of arrival of sounds** reaching our ears.

- A sound coming from our left will reach our left ear a fraction of a second before reaching our right ear.
- Our brains can process that small difference in time of arrival to recognize the direction from which the sound came.
- **In water**, the sound is so much faster that the **difference in arrival time between our ears becomes too small for us to interpret**, and we lose the ability to localize the source.

---

3. Consider the following statements regarding Sound Fixing And Ranging (SOFAR) channel seen in news in recent times:

1. It is a naturally-occurring ocean "channel" that allows sound to carry great distances.
2. It is also known as zone of maximum speed in ocean.
3. This channel is a strong path for communication used by dolphins, whales, and submarines
4. It could be used to monitor global ocean temperatures.

How many of the above statements are correct?

A. Only one

B. Only two

C. Only three

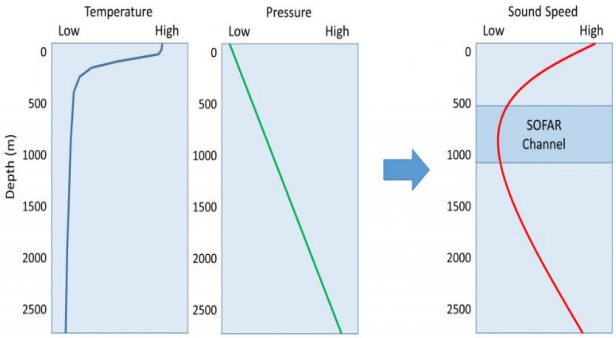
D. All four

Answer: D

Explanation

SOFAR, or Sound Fixing and Ranging Channel, is a **naturally-occurring ocean "channel"** that allows sound to carry great distances.

- The SOFAR channel is important because sounds produced in that region can be propagated over very long distances with little attenuation (loss of energy).
- Sound waves produced in the channel radiate out in all directions. Waves that travel into shallower or deeper water outside of the sound channel are entering a region of faster sound transmission.
- As we saw with seismic waves, when these sound waves encounter a region of differing transmission speed, the waves tend to be refracted or bent back towards the region of lower speed.
- As a result, sound waves moving from **the SOFAR channel into shallower water will be refracted back towards the channel**



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4. Consider the following pairs regarding Permissible noise level in India:

1. The Central Pollution Control Board (CPCB) has laid down the permissible noise levels in India for different areas
2. In industrial areas, the permissible limit is 65 dB for daytime and 55 dB at night.
3. State governments declared 'silent zones' where permissible noise limit is 50 dB during the day and 40 dB during the night

Select the correct answer using the codes given below.

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. All of the above.

Answer: C

Explanation

Permissible noise level in India

- The **CPCB** has laid down the permissible noise levels in India for different areas. Noise pollution rules have defined the acceptable level of noise in different zones for both daytime and night time.
- In **industrial areas**, the permissible limit is 75 dB for daytime and 70 dB at night.
- In **commercial areas**, it is 65 dB and 55 dB
- In **residential** areas it is 55 dB and 45 dB during daytime and night respectively.
- **Additionally, state governments have declared 'silent zones'** which includes areas that lie within 100 meters of the premises of schools, colleges, hospitals and courts. The permissible noise limit in this zone is **50 dB during the day and 40 dB during the night**.

---

5. Consider the following statements:

1. Whales and elephants produce sound in the infrasound range
2. Earthquakes produce low-frequency infrasound before the main shock waves begin which possibly alert the animals
3. Ultrasound is produced by animals such as dolphins, bats and porpoises.

How many of the above statements are correct.

A. Only one
B. Only Two
C. All Three
D. None

Answer: C

Explanation

Range of Hearing

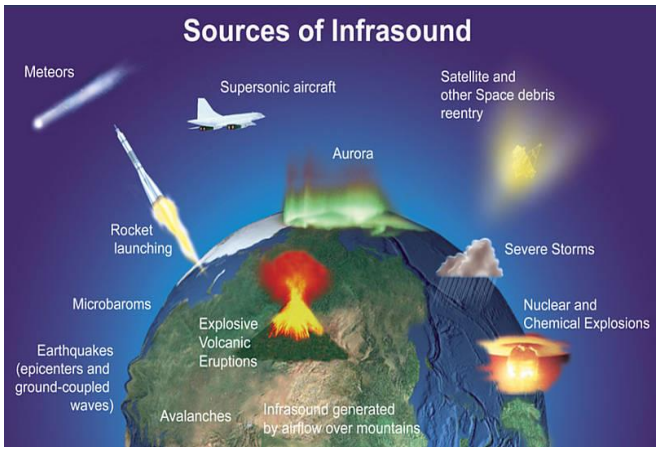
- The audible range of sound for human beings extends from about **20 Hz to 20000 Hz (one Hz = one cycle/s).**
- Children under the **age of five and some animals**, such as **dogs** can hear up to **25 kHz (1 kHz = 1000 Hz).** As people grow older their ears become less sensitive to higher frequencies.

Infrasound

- Sounds of frequencies **below 20 Hz are called infrasonic sound or infrasound**.
- If we could hear **infrasound** we would hear the vibrations of a pendulum just as we hear the vibrations of the **wings of a bee**.
- **Rhinoceroses communicate** using infrasound of frequency as low as **5 Hz.**
- **Whales and elephants** produce sound in the infrasound range.
- It is observed that some animals get disturbed **before earthquakes**.
- **Earthquakes produce low-frequency infrasound** before the main shock waves begin which possibly alert the animals.

Sound Wave

- Avalanches, volcanoes, earthquakes, ocean waves, water falls and meteors generate infrasonic waves. Some sources of man-made infrasound are nuclear and chemical explosions, engines, machinery and airplanes (Figure 1). Infrasonic waves propagate with very little attenuation and hence are capable of propagating over great distances.



Range of Hearing

Ultrasound

- Frequencies **higher than 20 kHz are called ultrasonic sound** or ultrasound.
- Ultrasound is produced by animals such as **dolphins, bats and porpoises**.

Moths of certain families have very sensitive hearing equipment. These **moths can hear the high frequency.**

Date – 19th July 2023

1. Why astronauts and objects float in space?

A. There is no gravity in space

B. In a vacuum all objects to fall at the same rate.

C. Microgravity can't be found on Earth

D. Gravity of stellar bodies does not change

Answer : B

Explanation

What Is Microgravity?

- Microgravity is the condition in which people or objects appear to be weightless. The effects of microgravity can be seen when astronauts and

objects float in space. Microgravity can be experienced in other ways, as well. "Micro-" means "very small," so microgravity refers to the condition where gravity seems to be very small.

- Microgravity is sometimes called "**zero gravity," but this is misleading.**

Why Do Objects Float in Orbit?

- If 90 percent of Earth's gravity reaches the space station, then why do astronauts float there? The answer is because they are in **free fall**. In a **vacuum**, gravity causes all objects to fall at the same rate. The **mass** of the object does not matter. If a person drops a hammer and a feather, air will make the feather fall more slowly. But if there were no air, they would fall at the same acceleration.

---

2. Consider the following statements:

1. Graphene is a naturally occurring material often considered the hardest material in the world
2. There is no evidence of Graphene presence in extra terrestrial materials
3. Carbon nanotubes are cylindrical molecules that consist of rolled-up sheets of graphene

Select the correct answer code:

A. 1 and 2 only

B. 1 and 3 only

C. 1 only

D. 2 and 3 only

Answer : B

Explanation

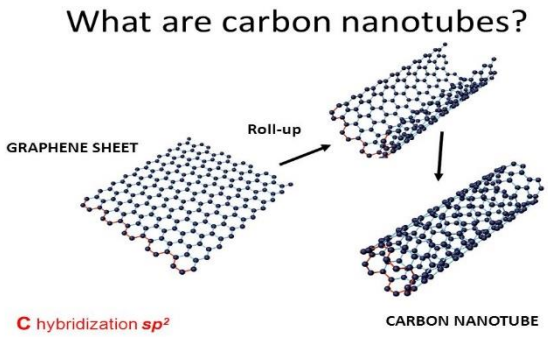
Carbon Nanotubes

Graphene (Strongest material)

- Single layer of carbon atoms.
- It is harder than diamond yet more elastic than rubber
- Tougher than steel yet lighter than aluminium.
- Lowest resistivity substance known at room temperature.
- High thermal stability.
- High elasticity.
- High electrical conductivity.
- Electron mobility is high at room temperature.

What are carbon nanotubes?

- are cylindrical molecules that consist of rolled-up sheets of single-layer carbon atoms (graphene)



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3. Arrange the following states of matter from lowest to highest energy levels:

1. Solid
2. Liquid
3. Gas
4. Plasma
5. Bose Einstein condensate

Which of the above statements is/are correct?

A. 1, 2, 3, 4, 5

B. 4, 1, 2, 3, 5

C. 5, 1, 2, 3, 4

D. 5, 4, 1, 2, 3

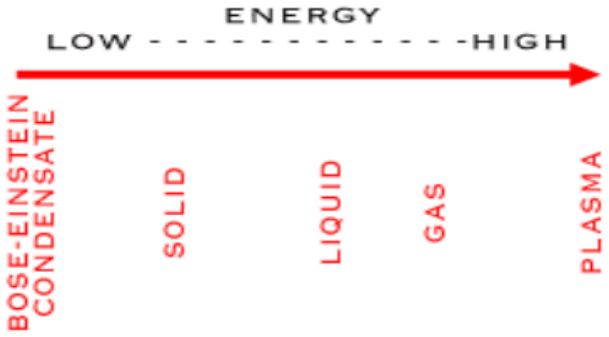
Answer : C

Explanation

States of Matter

Five states of matter

- There are four natural states of matter: Solids, liquids, gases and plasma.
- The **fifth state is the man-made Bose-Einstein condensates.**
- Plasma is a hot ionized gas consisting of approximately equal numbers of positively charged ions and negatively charged electrons.



About Bose-Einstein condensate

- BEC are formed when the atoms of certain elements are **cooled to near absolute zero (0 K or – 273.15°C).**
- At this point, atoms become a **single entity** with quantum property, **whereas each particle also functions as a wave of matter.**
- Scientists have believed that BECs contain **vital clues to mysterious phenomena such as dark energy which is unknown energy thought to be behind the Universe's accelerating expansion.**
- These are **extremely fragile and the slightest interaction with the external world is** enough to warm them past their condensation threshold.
- Because of this condition, **it becomes nearly impossible for scientists to study BECs on Earth as gravity interferes with the magnetic field required to hold them in place for observation**.
- BECs in terrestrial lab generally last a handful of milliseconds before dissipating while aboard ISS, those lasted more than a second.
- Studying BECs in microgravity has opened up a host of opportunities.

Fifth State of Matter

- The existence of **Bose-Einstein condensates (BEC) was predicted by an Indian mathematician Satyendra Nath Bose and Albert Einstein** almost a century ago.

---

4. Consider the following statements in context to Virtual Private Network :

1. It establish a protected network connection when using public networks.
2. It deny access to regional content hence providing more secure data transfer
3. It encrypt your internet traffic and disguise your online identity

How many of the above statements are correct?

A. Only one
B. Only two
C. All three
D. None of the above.

Answer : B

Explanation

Virtual Private Network

- VPN stands for **"Virtual Private Network"** and describes the opportunity to establish a protected network connection when using public networks.
- VPNs encrypt your internet traffic and disguise your online identity. This makes it more difficult for third parties to track your activities online and steal

data. The encryption takes place in **real time**.

Cert-In issued norms under which VPN providers have to record personal information of their customers, including purpose of using service, for five years

New rules

- VPN companies to **record personal information of their users including names, email id, phone number and IP address** for a period of **five years**.
- They also have to **record usage patterns, purpose of hiring services** and various other information.
- Apart from VPN companies, **data centers, virtual service network providers, cloud service providers have also been asked to record and maintain similar data**.
- In the form of Know Your Customer (KYC), virtual asset service providers, virtual asset exchange providers and custodian wallet providers would **also be recording information for the same period along with records of financial transactions**.
- The directives will **take effect the end of June**. And if the data is not handed over to the government by then, the entities would face punitive action.

Government logic behind new rules

- The Centre said these rules will "**enhance overall cyber security** posture and ensure safe & trusted internet in the country".
- It noted that the Indian Computer Emergency Response Team (CERT-In), which serves as a safeguard against cyber attacks, **has identified "gaps" in the way it analyses online threats** due to which it has issued the new norms for reporting cyber incidents.
- CERT-In said **non-availability of data hampers analysis and investigation,** and added that various stakeholders were consulted before notifying the new rules.
- Government defended bew rules as the need of the hour to "**ensure stability and resilience of Cyber Space**

How are VPN providers reacting to the norms?

- With the new rules the government will basically have access to the **personal information of the customers which makes the use of a VPN redundant.**
- Many VPN providers are mulling the implications of the new rules and some have even **threatened to pull back their service from the country**.

---

5. Consider the following statements in context of Gravitational waves:

1. Gravitational waves are ripples in the fabric of spacetime.
2. Every massive object that accelerates produces gravitational waves.
3. They travel at the speed of light

Select the correct answer using codes given below:

A. 1 and 2 only

B. 2 and 3 only

C. 3 only

D. All of the above.

Answer : D

Explanation

Gravitational waves

- **Gravitational waves are 'ripples' in space-time** caused by some of the most violent and energetic processes in the Universe.
- Albert Einstein predicted the existence of gravitational waves in 1916 in his general theory of relativity.
- Historically, scientists have relied almost exclusively on **electromagnetic (EM) radiation (visible light, X-rays, radio waves, microwaves, etc.)** to study the Universe. Some are trying to use subatomic particles, called neutrinos, as well. Each of these 'messengers' of information provides scientists with a different *but complementary* view of the Universe.
- **Gravitational waves, however, are completely unrelated to EM radiation**. They are as distinct from light as hearing is from vision.
- The gravitational waves that **LIGO detects are** caused by some of the most energetic events in the Universe—colliding black holes, merging neutron stars, exploding stars, and possibly even the birth of the Universe itself.

Sources and Types of Gravitational Waves

- Every massive object that accelerates produces gravitational waves. This includes **humans, cars, airplanes** etc., but the masses and accelerations of objects on Earth are far too small to make gravitational waves big enough to detect with our instruments. To find big enough gravitational waves, we have to look far outside of our own solar system.

The most powerful gravitational waves are created when objects move at very high speeds. Some examples of events that could cause a gravitational wave are:

- when a star explodes asymmetrically (called a **supernova**)
- when two big stars orbit each other

when two **black holes** orbit each other and merge.
