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Q.1) Consider the following statement(s) with regard to a simple machine –

1. It helps a person in doing same amount of work with lesser force.
2. It helps a person in doing same amount of work with lesser energy.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.1) Solution (a)

A simple machine is a mechanical device that changes the direction or magnitude of a force. In general, they can be defined as the simplest mechanisms that use mechanical advantage (also called leverage) to multiply force.

Usually the term refers to the six classical simple machines –

- Lever
- Wheel and axle
- Pulley
- Inclined plane
- Wedge
- Screw

A simple machine uses a single applied force to do work against a single load force. Ignoring friction losses, the work done on the load is equal to the work done by the applied force.

It should be noted that **simple machines do nothing to change the amount of energy used, just how hard it is to use that energy**.

Q.2) Consider the following statements –

1. The tendency of a liquid drops to contract and occupy minimum surface area due to viscosity.
2. The working principle of washing machine is centrifugation.
3. Diamond sparkles more than glass due to higher refractive index.

Select the correct option –

a) 3 only
b) 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.2) Solution (b)

The tendency of a liquid drops to contract and occupy minimum surface area due to ***surface tension.***

Surface tension is the property among liquids due to which they tend to occupy minimum surface area. That's why water droplet appears spherical because for a given volume, a sphere has minimum surface area. Due to this property of surface tension liquid surface stretches and behaves like a stretched membrane.

Centrifugation is a process by which washing machine separate dust from cloth by the force called centrifugal force. Washing machine content equipment call centrifugate which helps in rotatory motion.

The fast spinning around of the clothes in the drum creates a large centrifugal force from center to the edge of the drum, and the wet clothes are flung outwards to the drum edge and the water escapes through the drum holes.

The whole reason behind the sparkle of a diamond or glass is the Refractive index. This is not to be confused with ordinary reflection. Higher the RI, more the sparkle. A diamond has a large refractive index and very small critical angle as against glass, which has a lower refractive index and large critical angle.

It wouldn't matter if a diamond and glass were cut identically in shape. It is based on the difference in the amount of light that is totally reflected from their lower facets. For total internal reflection to take place, light must peregrinate from an optically denser medium to a relatively more infrequent medium. However one shouldn't forget that there is a variation in shine based on the shape which the diamond has been cut.

Q.3) For which of the following capillarity is the reason?

1. Blotting of ink.
2. Rising of underground water through the soil.
3. Spread of water drop on cotton cloth.
4. Formation of Bubble
5. Rising of water from the roots of the plant to its foliage.
6. Lighting through kerosene lamp.

Select the correct option –

a) 1, 3 and 5 only
b) 1, 2, 3 and 5 only
c) 1, 2, 3, 5 and 6 only
d) All of the above

Q.3) Solution (c)

Capillary action, or capillarity, is a phenomenon where liquid spontaneously rises in a narrow space such as a thin tube, or in porous materials such as paper or in some non - porous materials such as liquefied carbon fibre. This effect can cause liquids to flow against the force of gravity or the magnetic field induction.

Kerosene oil rises in a wick of lantern because of capillary action in the wick. Capillarity is the ability of a liquid to flow in narrow spaces without the assistance of external forces.

Most of the wicks are made up of cotton or threads of cotton. The small pores act as small capillaries, causing it to absorb a large amount of fluid.

Capillarity is the primary force that enables the soil to retain water, as well as to regulate its movement. The phenomenon of capillarity also occurs in the soil. In the same way that water moves upwards through a tube against the force of gravity; water moves upwards through soil pores, or the spaces between soil particles. The height to which the water rises is dependent upon pore size. As a result, the smaller the soil pores, the higher the capillary rise.

Q.4) Three identical vessels A, B and C are filled with water, mercury and kerosene respectively, upto an equal height. The three vessels are provided with identical taps at the bottom of the vessels. If the three taps are opened simultaneously, then which vessel is emptied first?

a) Vessel A
b) Vessel B
c) Vessel C
d) All Vessels will be emptied simultaneously.

Q.4) Solution (c)

Kerosene has least viscosity among all three liquids. So it has more tendency to flow and its vessel will get emptied first.

Q.5) Assertion (A) - The boiling point of water decreases as the altitude increases.
Reason (R) - The atmospheric pressure decreases with altitude.

Select the correct option –

a) Both A and R are correct and R is the correct explanation of the A
b) Both A and R are correct but R is not the correct explanation of the A.
c) A is correct but R is false
d) Both A and R are incorrect.

Q.5) Solution (a)

As elevation increases, atmospheric pressure decreases because air is less dense at higher altitudes. Because the atmospheric pressure is lower, the vapour pressure of the liquid needs to be lower to reach boiling point. Therefore, less heat is required to make the vapour pressure equal to the atmospheric pressure.

Q.6) Optical fibre work on the principle of –

1. Total Internal Reflection
2. Refraction
3. Scattering
4. Interference

Select the correct option –

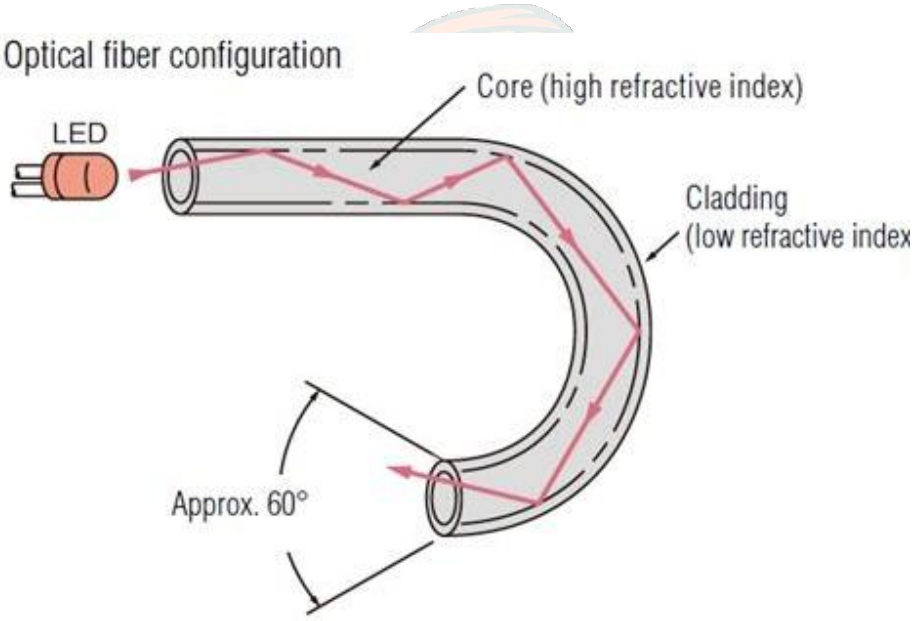
a) 1 only
b) 1 and 2 only
c) 1 and 4 only
d) 1, 2 and 4 only

Q.6) Solution (a)

The Optical Fibre is working on the principle of Total Internal Reflection, which helps the light signals to be transmitted from one place to another with a negligible amount of loss of energy.

The light is reflected back over and over because of total internal reflection until it emerges at the other end of the cable. This is possible by keeping the refractive index of core higher than that of cladding.

e)



Q.7) Suppose a rocketship is receding from earth at very high speed. A light in the rocketship appears orange to a passenger on the ship. What colour would it appear to an observer on the earth?

a) Blue
b) Orange
c) Yellow
d) Red

Q.7) Solution (d)

If the passenger sees the colour as orange, the observer on earth will see a colour of higher wavelength due to redshift effect. The only option with higher wavelength is Red.

Q.8) A person in a spaceship located halfway between the earth and the sun will notice that the –

1. Sky is jet black
2. Starts do not twinkle
3. Temperature outside the spaceship is much higher than on the surface of the earth.

Select the correct option –

a) 1 and 2 only
b) 2 only
c) 1 and 3 only
d) All of the above

Q.8) Solution (d)

There is a presence of atmosphere at earth's surface which consists of thick and moving layers of air. The dust particles, particulates, smog, water vapour and smoke are also present in air. Stars twinkle when we see them from the Earth's surface because we are viewing them through thick layers of turbulent (moving) air in the Earth's atmosphere. As their light travels through the many layers of the Earth's atmosphere, the light of the star is bent (refracted) many times in random directions (light is bent when it hits a change in density –like a pocket of cold air or hot air). This random refraction results in the star as its twinkling but for a person in spaceship no such refractions are possible as there is vaccum in space. Thus, star will not twinkle. Similarly, sky will appear blue to us due to Rayleigh scattering which is again due to presence of atmosphere on earth's surface. The shorter wavelength light is absorbed by the gas molecules of atmosphere. The absorbed blue light is then radiated in different directions. It gets scattered all around the sky. Some of this scattered blue light reaches you. Since, you see, the sky looks blue. Whereas no atmosphere is there in space thus, no absorbing and scattering is possible that's why for a person in spaceship sky appears black. Temperature outside the spaceship is higher in comparison to earth's surface because of being nearer to sun.

Q.9) Consider the following

1. Electromagnetic radiation
2. Geothermal energy
3. Gravitational force
4. Plate movements
5. Rotation of the earth

6. Revolution of the earth

Which of the above are responsible for bringing dynamic changes on the surface of the earth?

a) 1, 2, 3 and 4 only
b) 1, 3, 5 and 6 only
c) 2, 4, 5 and 6 only
d) 1, 2, 3, 4, 5 and 6

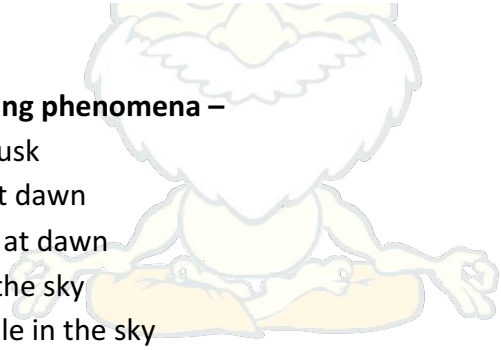
Q.9) Solution (d)

Tides occur due to gravitational pull of the Moon. Tides cause coastal erosion. **(Statement 3 is correct)**

Earthquake brings dynamic change on earth surface **(Statement 4 is correct)**

Geothermal energy movements causes volcanos which brings dynamic change on earth surface. **(Statement 2 is correct)**

Electromagnetic radiation, rotation, revolution cause seasonal changes. **(Statements 1, 5 and 6 are correct)**



Q.10) Consider the following phenomena –

1. Size of the sun at dusk
2. Colour of the sun at dawn
3. Moon being visible at dawn
4. Twinkle of stars in the sky
5. Polestar being visible in the sky

Which of the above are optical illusions?

a) 1, 2 and 3
b) 3, 4 and 5
c) 1, 2 and 4
d) 2, 3 and 5

Q.10) Solution (c)

An optical illusion also called a visual illusion is characterized by visually perceived images that differ from object than reality. The information gathered by the eye is processed in the brain to give a perception that does not tally with a physical measurement of the stimulus source. Moon being visible in dawn and polestar being visible in sky are not any illusion. Size of the sun which appears big, color of the sun at dawn and twinkle of stars in the sky are not actual phenomenon but happens due to various factors such as refraction, different density of the air layers etc.

Q.11) Rainbow is produced when sunlight falls on drops of rain. Which of the following physical phenomena are responsible for this?

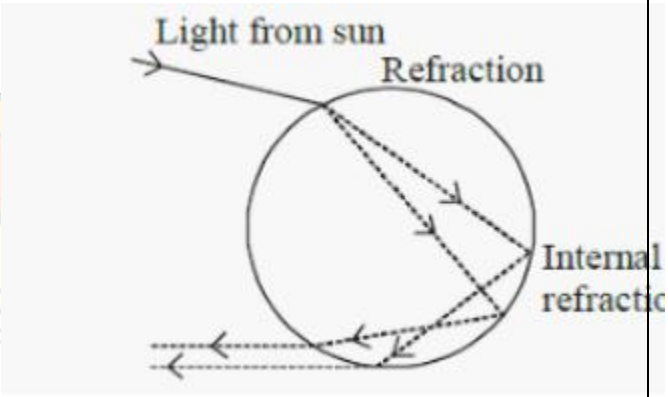
1. Dispersion
2. Refraction
3. Internal reflection

Select the correct Solution using the codes given below.

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.11) Solution (d)

A rainbow is always formed in a direction opposite to that of the Sun. The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop Due to the dispersion of light and internal reflection; different colours reach the observer's eye.



Hence all the 3 phenomena i.e. Dispersion, Refraction, and Internal reflection are responsible for rainbow formation

Q.12) What is/are the implication/ implications of the creation of anti-matter?

1. It will make mineral prospecting and oil exploration easier and cheaper.
2. It will help probe the possibility of the existence of stars and galaxies made of anti-matter.
3. It will help understand the evolution of the universe.

Select the correct answer using the codes given below:

a) 1 only
b) 2 and 3 only
c) 3 only
d) 1, 2 and 3

Q.12) Solution (b)

Antimatter contains the same set of subatomic particles as matter but with opposite charges. Protons have antiprotons; neutrons, antineutrons; and electrons, antielectrons. When the two come in contact, they annihilate each other.

Scientists do not have a definitive answer to why matter won the war and the universe is composed only of matter. But it is believed a slight asymmetry gave matter an edge over antimatter, knocking it out almost entirely.

Seeing the birth of antimatter in conditions that simulate the aftermath of Big Bang provide insight into how antimatter popped and vanished in the early universe.

Antimatter can also help search new phenomena in the cosmos. Just as heavier matter like carbon, sodium and iron are signatures of evolved life forms, heavier antimatter could help probe possibility of similar complex systems of universe made of antimatter. The discovery of even small amounts of anti-helium nucleus in the cosmic ray would point towards the existence of stars and even entire galaxies made of antimatter.

Antimatter could find use in medical diagnostics, where positrons can be used to identify different diseases. Antiprotons can be used in propulsion technology for providing direct thrust, energise a propellant or heat a solid core.

Q.13) The efforts to detect the existence of Higgs boson particle have become frequent news in the recent past. What is /are the importance/importance of discovering this particle?

1. It will enable us to understand as to why elementary particles have mass.
2. It will enable us in the near future to develop the technology to transferring matter from one point to another without traversing the physical space between them.
3. It will enable us to create better fuels for nuclear fission.

Select the correct answer using the codes given below:

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.13) Solution (a)

The Higgs Boson gives idea on how each particle has mass. It doesn't give better fuels for nuclear fission or for inter-space travel.

Q.14) Which of the following is /are cited by the scientists as evidence/ evidences for the continued expansion of universe?

1. Detection of microwaves in space
2. Observation of redshift phenomenon in space
3. Movement of asteroids in space
4. Occurrence of supernova explosions in space

Select the correct answer using the codes given below:

a) 1 and 2

b) 2 only
c) 1, 3 and 4
d) None of the above can be cited as evidence

Q.14) Solution (a)

Cosmic Microwave Background Radiation

- Immediately after the big bang, the universe was so hot that the thermonuclear reactions (that are usually seen in stars today) happened everywhere in the universe leading to formation of primodial elements, hydrogen and helium.
- The thermonuclear fusion of hydrogen into helium atoms led to release of high-energy shortwave photons which is known to be cosmic background radiation.
- As the universe expanded this radiation also expanded becoming long-wave (microwave) which is why it is called cosmic microwave background radiation which fills the entire space.
- Thus CMB is an evidence for expansion of universe.

Ever since 1929, when Edwin Hubble discovered that the Universe is expanding, we have known that most other galaxies are moving away from us. Light from these galaxies is shifted to longer (and this means redder) wavelengths - in other words, it is 'red-shifted'.
Supernova explosions help to determine distance of the galaxy. This distance is used to compare expansion distance and hence bring to light the history of expansion in the universe. This showed that the universe expansion is increasing and hence get us to know that the expansion of the universe is increasing or accelerating.

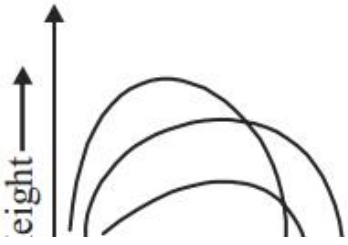
Q.15) The known forces of nature can be divided into four classes, viz, gravity electromagnetism, weak nuclear force and strong nuclear force. With reference to them, which one of the following statements is not correct?

a) Gravity is the strongest of the four
b) Electromagnetism act only on particles with an electric charge
c) Weak nuclear force causes radioactivity
d) Strong nuclear force holds protons and neutrons inside the nuclear of an atom.

Q.15) Solution (a)

Option a) is wrong because gravity is the weakest force among the four fundamental forces. Rest of the statements is correct.
The strong nuclear force is one of the four fundamental forces in nature; the other three are gravity, electromagnetism and the weak force. As its name implies, the strong force is the strongest force of the four. It is responsible for binding together the fundamental particles of matter to form larger particles.

Q.16) A boy standing at point O in the given diagram throws a ball three times with the same force, but projecting it along the



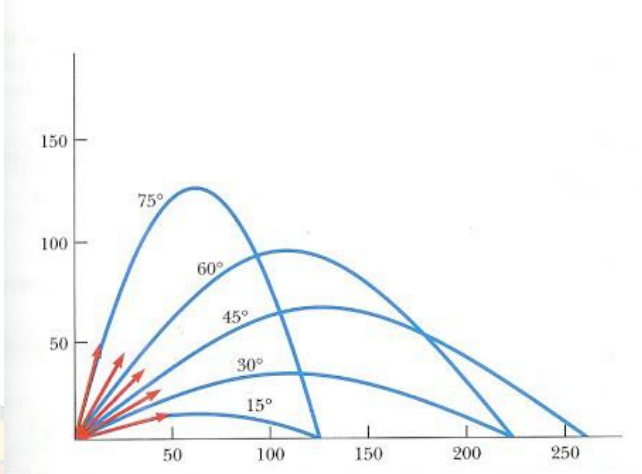
different inclination from the ground. The results of the throw have been plotted in the diagram. Which of the following is a valid conclusion?

a) The larger the initial inclination, the longer the throw.
b) The larger the height reached, the longer the throw.
c) The larger the height reached, the shorter the throw.
d) The larger the initial inclination, the greater the height reached.

Q.16) Solution (d)

In a projectile motion for the given initial speed –

1. There exist two inclinations for the same range. (So statement 1, 2 and 3 will be incorrect)
2. The larger the initial inclination, the greater the height reached. (This can be seen from the diagram)



Q.17) Fusion reaction takes place at high temperature because

a) nuclei break up at high temperature
b) atoms are ionized at high temperature
c) molecules break up at high temperature
d) kinetic energy is high enough to overcome repulsion at high temperature

Q.17) Solution (d)

Fusion reaction takes place at high temperature because Kinetic energy is high enough to overcome repulsion at high temperature

Q.18) Assertion – Temperature of a metal wire rises when electric current is passed through it.
Reason – Collision of metal atom with each other releases heat energy.
Select the correct option –

a) Both A and R are correct and R is the correct explanation of the A
b) Both A and R are correct but R is not the correct explanation of the A.
c) A is correct but R is false
d) Both A and R are incorrect.

Q.18) Solution (c)

Collision of metal atom does not happen. Atoms remain stationary in the 'sea of outer electron'. Collision with electron happens during electrical conductivity.

Q.19) In which of the following there is likely application of LASER (Light Amplification by Stimulation Emission of Radiation)?

1. Storage device
2. Drilling
3. Distance measurement
4. Mineral exploration

Select the correct option –

a) 2 and 3 only
b) 1, 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.19) Solution (d)

Audio compact discs, using infrared lasers, were introduced around 1980; CD-ROMs (compact disc read-only memory) for computer data soon followed. Newer optical drives use more powerful lasers to record data on light-sensitive discs called CD-R (recordable) or CD-RW (read/write), which can be played in ordinary CD-ROM drives. DVDs (digital video, or versatile, discs) work similarly, but they use a shorter-wavelength red laser to read smaller spots, so the discs can hold enough information to play a digitized motion picture. A newer generation of discs called Blu-ray uses blue-light lasers to read and store data at an even higher density

Fiber-optic communication systems that transmit signals more than a few kilometers also use semiconductor laser beams.

Laser energy can be focused in space and concentrated in time so that it heats, burns away, or vaporizes many materials. Although the total energy in a laser beam may be small, the concentrated power on small spots or during short intervals can be enormous. Although lasers cost much more than mechanical drills or blades, their different properties allow them to perform otherwise difficult tasks. A laser beam does not deform flexible materials as a mechanical drill would, so it can drill holes in materials such as soft rubber nipples for baby bottles. Likewise, laser beams can drill or cut into extremely hard materials without dulling bits or blades.

Pulsed laser radar can measure distance in the same manner as microwave radar by timing how long it takes a laser pulse to bounce back from a distant object. For example, in 1969 laser radar precisely measured the distance from the Earth to the Moon. Laser range finding is now widely used for remote sensing. Instruments flown on aircraft can profile the layers of foliage in a forest, and the Mars Global Surveyor used a laser altimeter to map elevations on the Martian surface.

Laser-induced breakdown spectroscopy (LIBS) represents an emerging geochemical tool for mineral exploration that can provide rapid, in situ, compositional analysis and high-resolution imaging in both laboratory and field and settings

Q.20) Which of the following are related to Einstein's work?

1. Photoelectric effect
2. Brownian motion

3. Mass-energy equivalence
4. Black hole information paradox
5. Quantum theory

Select the correct option

a) 1, 2 and 3 only
b) 1, 2, 3 and 4 only
c) 1, 2, 3and 5 only
d) 1, 3, 4 and 5 only

Q.20) Solution (c)

In 1905 Einstein published four groundbreaking papers, on the photoelectric effect, Brownian motion, special relativity, and the equivalence of mass and energy, which were to bring him to the notice of the academic world, at the age of 26.

Einstein was awarded the 1921 Nobel Prize in Physics "for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect".

He is best known to the general public for his mass–energy equivalence formula ($E = mc^2$), which has been dubbed "the world's most famous equation".

Einstein played a major role in developing quantum theory, beginning with his 1905 paper on the photoelectric effect. However, he became displeased with modern quantum mechanics as it had evolved after 1925, despite its acceptance by other physicists.

The black hole information paradox is a puzzle resulting from the combination of quantum mechanics and general relativity. Calculations suggest that physical information could permanently disappear in a black hole, allowing many physical states to devolve into the same state. This was propounded by Stephen Hawking and others.

Q.21) Chemputer are a type of computers where data are represented by

a) Spin of the molecules.
b) Potential energy of the system
c) Varying concentrations of chemicals.
d) Orientation of the molecules.

Q.21) Solution (c)

A chemputer, chemical computer, is an unconventional computer based on a semi-solid chemical "soup" where **data are represented by varying concentrations of chemicals.** The computations are performed by naturally occurring chemical reactions.

A radical new method of producing drug molecules, which uses downloadable blueprints to easily and reliably synthesise organic chemicals via a programmable 'chemputer', could be set to democratise the pharmaceutical industry.

This approach is a key step in the digitization of chemistry and will allow the universal assembly of complex molecules on demand, democratizing the ability to discover and make new molecules using a simple software app and a modular chemputer.

Q.22) Which of the following is/are disadvantage(s) of RO water purifier?

1. Besides impurities, RO water purifier also removes essential natural mineral like sodium, iron, calcium, and magnesium.
2. It does not work well in case of hard water.
3. Home RO filters waste nearly 80% of the water during treatment.

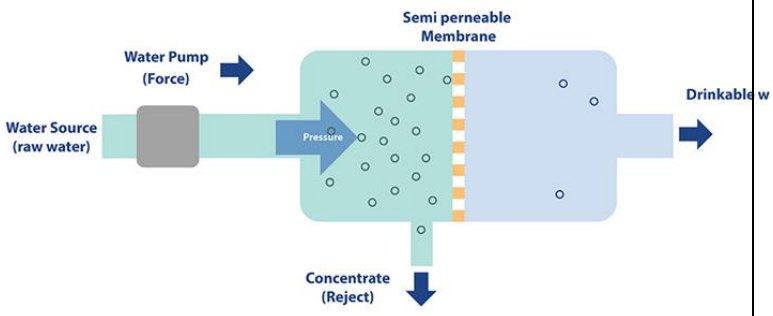
Select the correct option –

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.22) Solution (c)

The Central government has drawn up plans to ban the use of membrane-based water purification systems (MWPS) – primarily reverse osmosis (RO) systems – in areas where the source of water meets the Bureau of Indian Standards' drinking water norms.

HOW DO YOU LOWER THE TDS IN YOUR WATER? USING REVERSE OSMOSIS (RO) PURIFIERS!



- RO is a type of filtration that uses a semi-permeable, thin membrane with pores small enough to pass pure water through while rejecting larger molecules such as dissolved salts (ions) and other impurities **(bacteria, colloids, organics etc)**. A membrane rejects contaminants based on their size and charge.
- *RO membranes do not remove gases like CO2 or O2 because these gases are not highly ionized (charged) while they're in solution and have a very low molecular weight. RO removes the concentration of TDS which is comprises of charged ions in the water.*

- In an RO system, pressure (usually from a pump) is used to overcome natural osmotic pressure, forcing impure water through the membrane that removes a high percentage of impurities.
- To avoid build-up of contaminants, cross-flow filtration allows water to sweep away contaminants.
- **Usage**: To produce highly purified drinking water, used in industrial boilers, food and beverage processing, cosmetics, pharmaceutical production, seawater desalination.

ADVANTAGES OF RO SYSTEM	DISADVANTAGES OF RO SYSTEM
• Removes toxin like chlorine, Fluoride, lead (cause of brain damage and anaemia), mercury, and Arsenic that makes our body unwell. • Cryptosporidium which is found in public supply water, lakes and rivers can be removed by RO filter. • Best solution for purifying hard water.	• **Demineralization**: Besides impurities, RO water purifier (when TDS level in water is less than 50) also removes essential natural mineral like sodium, iron, calcium, and magnesium that are essential for our body. • A very low concentration of TDS has been found to give water a flat taste, which is undesirable to many people. • **Wastage of water (environmental concern)**: To avoid build-up of contaminants, cross-flow filtration allows water to sweep away contaminants.

Q.23) Consider the following –

1. Oxide of Hydrogen
2. Oxide of Nitrogen
3. Oxide of Sulphur
4. Oxide of Carbon

Which of the above cause/causes acid rain?

a) 2 and 3 only
b) 1, 2 and 3 only
c) 2, 3 and 4 only
d) All of the above

Q.23) Solution (a)

Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxides are released into the air. These substances can rise very high into the atmosphere, where they mix and react with water, oxygen, and other chemicals to form more acidic pollutants, known as acid rain.

Oxide of water i-e H_2O or oxide of carbon i-e CO_2 or CO are not the cause of acid rain.

Q.24) Consider the following statements -

1. One molecule of urea can release two nitrogenous molecules in the soil.
2. Excessive use of nitrogenous fertilizers in agriculture can cause proliferation of nitrogen-fixing microorganisms in soil.

Select the correct option -

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.24) Solution (a)

Statement 1 is correct - The chemical formula of urea is **CO(NH2)2**. So urea has two nitrogen atoms. On hydrolysis urea will form two ammonia molecules.

Statement 2 is absurdly incorrect. If use of nitrogen based fertilizer would have increased proliferation of nitrogen-fixing microorganisms in soil, then there would be no further need of nitrogen-based fertilizer.

Q.25) Photochemical smog is a resultant of the reaction among –

a) NO2, 03 and peroxyacetyl nitrate in the presence of sunlight
b) CO, 02 and peroxyacetyl nitrate in the presence of sunlight
c) CO, CO2 and N02 at low temperature
d) High concentration of N02, O3 and CO in the evening

Q.25) Solution (a)

Photochemical smog is a unique type of air pollution which is caused by reactions between sunlight and pollutants like hydrocarbons and nitrogen dioxide (NO and NO2). Other components of the photochemical smog include Ozone (O3) formaldehyde, peroxy benzoyl nitrate (PBzN), peroxy acetyl nitrate (PAN) and acrolein. The formation of photochemical smog can be expressed in the simple terms as: Hydrocarbons + NOx + sunlight

Q.26) Consider the following examples regarding 'green crackers' –

1. It has been developed by Indian Council of Scientific and Industrial Research (CSIR).
2. It does not have poisonous chemicals and uses only the rapid chemical reaction with nitrogen and water as the chief final product.
3. The reaction in green crackers is endothermic.

Select the correct option -

a) 1 only
b) 1 and 2 only

c) 1 and 3 only
d) All of the above

Q.26) Solution (a)

Indian Council of Scientific and Industrial Research (CSIR) has developed green crackers, which are new and improved formulations of the previous sound-emitting crackers and other fireworks.

They are known as 'green' firecrackers because **they have a chemical formulation that produces water molecules, which substantially reduces emission levels and absorbs dust.**

- It promises a reduction in particulate matters and harmful gases, like nitrous oxide and sulfur oxide, by 30- 35 per cent.
- The green crackers will be 25-30 per cent cheaper to manufacture and manufacturers would not have to make any changes in their facilities.

Reaction that produces heat and light are always **exothermic** – i-e absorbs heat. t

Q.27) Consider the following statements regarding cloud seeding?

1. Silver Iodide is commonly used for cloud seeding.
2. Free radicals are generated by the chemicals used and that helps in gathering more water vapour to form clouds.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.27) Solution (a)

The most common chemicals used for cloud seeding include silver iodide, potassium iodide and dry ice (solid carbon dioxide).

The chemicals used in cloud seeding provide only the surface for condensation of water vapour. There is no chemical reaction what so ever.

Q.28) The definition of Kilogram (kg) has changed recently. How is the new definition fundamentally different from the old one?

a) The new definition will allow multiple standard mass of 1 kg and will be helpful in calibrations worldwide.
b) The new definition is more precise and given upto ten decimal.
c) The new definition has been arrived at by consensus.
d) The new definition is related to a constant of nature.

Q.28) Solution (d)

The definition of the kilogram changed fundamentally; the previous definition defined the kilogram as the mass of the international prototype of the kilogram, which is an artefact rather than a constant of nature. The new definition relates the kilogram to, amongst things, the equivalent mass of the energy of a photon given its frequency, via the Planck constant.

Previous definition: The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

2019 definition: The kilogram, symbol kg, is the SI unit of mass. It is defined by taking the fixed numerical value of the Planck constant h to be 6.62607015×10−34 when expressed in the unit J · s, which is equal to kg · m2 · s−1, where the metre and the second are defined in terms of c and ΔvCs.

Q.29) The final Agent Orange raid in Vietnam took place in 1970– areas have begun to bloom again. But 19 years after the war's end, it seems plain that Agent Orange is killing and maiming human beings, something it never intended to do. The apparent toxic fallout from those clouds–is a crop of human miseries including cancers, miscarriages and birth defects-that may persist for decades." The offensive substance referred to in this quotation is:

a) DDT used as insecticide
b) A complex mixture of herbicides and weedicides used to increase agricultural output in the South Vietnam under the U.S. aid programme
c) A complex mixture of DDT and other insecticides used at aerial sprays for protection against malaria and other tropical diseases
d) Dioxin used as defoliants

Q.29) Solution (d)

America used Dioxin which is defoliants to clear the forests of Vietnam, so that is could kill the Vietnamese guerilla hiding in the forest. But the Dioxin had many after effects like cancers, miscarriage, and birth defects in after years.

Q.30) Why Barium in a suitable form is administered to patients before an X-ray examination of the stomach?

a) barium allows X-rays to pass through the stomach on account of its transparency to X-rays
b) barium compound, like magnesium sulphate helps in cleaning the stomach before X-ray examination
c) barium is a good absorber of X-rays and this helps the stomach to appear clearly in contrast with the other regions in the picture
d) barium salts are white in colour and this helps the stomach to appear clearly in contrast with other regions in the picture

Q.30) Solution (c)

Barium is given in adequate amount to patients before X-ray examination. The gut (gastrointestinal tract) does not show up very well on ordinary X-ray pictures. However, if you drink a white liquid that contains a chemical called barium sulphate, the outline of the upper parts of the gut (esophagus, stomach and small intestines) shows up clearly on X-ray pictures. This is because X-rays do not pass through barium.

Q.31) Assertion (A): Large cold storage plants use ammonia as refrigerant. While domestic refrigerators use chlorofluorocarbons.
Reason (R): Ammonia can be liquified at ambient temperature and low pressure.
Select the correct option -

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but T is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

Q.31) Solution (c)

Ammonia is used as a large scale refrigerant because it has highest refrigerating capacity per pound of any refrigerant and a number of other excellent thermal properties that make it popular for a number of refrigeration applications in spite of its being toxic, explosive and flammable within certain conditions. Ammonia is used as refrigerant prominently in the refrigeration systems of food industry like dairies, ice creams plants, frozen food production plants, cold storage warehouses, processors of fish, meat and number of other applications. Comparatively chlorofluorocarbon (CFC) chemical, safer refrigerators were possible for home and consumer use.
Ammonia can be liquified at ambient temperature and **high pressure.**

Q.32) Coke is one of the materials of the charge added to the blast furnace for the production of Iron/steel. Its function is to –

1. Act as the reducing agent
2. Remove silica associated with the iron ore
3. Function as fuel – to supply heat
4. Act as an oxidizing agent.

Select the correct option –

a) 1 and 2 are correct
b) 2 and 4 are correct
c) 1 and 3 are correct
d) 3 and 4 are correct

Q.32) Solution (c)

Coke is used as a fuel and a reducing agent in melting iron ore. It also functions as fuel.

Q.33) Which of the following is incorrect?

a) The presence of NaCl increases the rate of setting of plaster of Paris.
b) Gypsum is added to the cement to slow down its rate of setting
c) All alkaline earth metals form hydrated salts
d) Barium and Strontium are found free in nature

Q.33) Solution (d)

Strontium is a relatively abundant element in the Earth's crust. It ranks about 15th among the elements found in the Earth. That makes it about as abundant as fluorine and its alkaline earth partner, barium. The most common minerals containing strontium are Celestine and strontianite.

Q.34) Consider the following pair –

Characteristics	**Particle**
A. Zero Mass	1. Boson
B. Fractional charge	2. Neutrino
C. Fractional spin	3. Quark
D. Integral Spin	4. Photon

Choose the correctly matched pair form the above –

a) A-4, B-2, C-3, D-1
b) A-3, B-2, C-4, D-1
c) A-2, B-3, C-4, D-1
d) A-4, B-3, C-2, D-1

Q.34) Solution (d)

- **Quarks have fractional charges** of one third or two thirds of the basic charge of the electron or proton.
- Particles having net spin 1/2 include the proton, neutron, electron, neutrino, and quarks.
- **Particles with integer spin are called bosons.**

Q.35) Aspartame is an artificial sweetener sold in the market. It consists of amino acids and provides calories like other amino acids. Yet, it is used as a low-calorie sweetening agent in food items. What is the basis of this use?

a) Aspartame is as sweet as table sugar, but unlike table sugar, it is not readily oxidized in human body due to lack of requisite enzymes.
b) When aspartame is used in food processing, the sweet taste remains, but it becomes resistant to oxidation.
c) Aspartame is as sweet as sugar, but after ingestion into the body, it is converted into metabolites that yield no calories.
d) Aspartame is several times sweeter than table sugar, hence food items made with small quantities of aspartame yield fewer calories on oxidation.

Q.35) Solution (c)

Aspartame is metabolized by the body into two constituent amino acids and methanol. These hydrolysis products are handled by the body in the same way as aspartic acid, L-

Phenylanine and metanol from other consumed foods. These components yield NO calorie and add nothing new to the diet.

Q.36) 'Micelles formation' is associated with which of the following?

a) Sericulture
b) Saponification
c) Cloud seeding
d) None of the above

Q.36) Solution (d)

Micelles are lipid molecules that arrange themselves in a spherical form in aqueous solutions. The formation of a micelle is a response to the amphipathic nature of fatty acids, meaning that they contain both hydrophilic regions (polar head groups) as well as hydrophobic regions (the long hydrophobic chain).

Micelles contain polar head groups that usually form the outside as the surface of micelles. They face to the water because they are polar. The hydrophobic tails are inside and away from the water since they are nonpolar. Fatty acids from micelles usually have a single hydrocarbon chain as opposed to two hydrocarbon tails.

Cleansing Action of Soaps and Detergents

Most of the dirt is oily in nature and oil does not dissolve in water. The molecule of soap constitutes sodium or potassium salts of long-chain carboxylic acids. In the case of soaps, the carbon chain dissolves in oil and the ionic end dissolves in water. Thus the soap molecules form structures called micelles.

Note - *Saponification* is a process that involves conversion of fat or oil or lipid into soap and alcohol by the action of heat in the presence of aqueous alkali (e.g. NaOH). It is basically a chemical reaction. There is no micelle formation here.

Q.37) Excessive release of the pollutant carbon monoxide (CO) into the air may produce a condition in which oxygen supply in the human body decreases. What causes this condition?

a) When inhaled into the human body, CO is converted into CO2
b) The inhaled CO has much higher affinity for haemoglobin as compared to oxygen
c) The inhaled CO destroys the chemical structure of haemoglobin
d) The inhaled CO adversely affects the respiratory centre in the brain

Q.37) Solution (b)

Haemoglobin have a higher affinity for carbon monoxide in comparison to oxygen

Q.38) Chlorofluorocarbons, known as ozone depleting substances, are used

1. in the production of plastic foams
2. in the production of tubeless tyres
3. in cleaning certain electronic components
4. as pressurizing agents in aerosol cans

Which of the statements given above is/are correct?

a) 1,2 and 3 only
b) 4 Only
c) 1,3 & 4 Only
d) 1,2,3 & 4

Q.38) Solution (c)

Application of Chlorofluorocarbons

- refrigerant gases in air conditioners, freezers and refrigerators.
- plastic insulants
- solvents for cleaning computer parts, printed circuit boards
- 'dry cleaning' agents for clothes.
- fluid in certain fire extinguishers.
- typing correction fluid
- aerosol sprays, blowing agents for foams and packing materials

Q.39) Consider the following statements –

1. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.
2. CFCs have a lifetime in the atmosphere of about 20 to 100 years

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.39) Solution (c)

CFCs have a lifetime in the atmosphere of about 20 to 100 years, and consequently one free chlorine atom from a CFC molecule can do a lot of damage, destroying ozone molecules for a long time.

Methane is relatively short-lived in the atmosphere; a molecule of methane is oxidized to water and carbon dioxide within a decade or so, mainly by reaction with another trace gas, the hydroxyl radical OH-. Thus, unlike the case of carbon dioxide (which stays in the atmosphere longer than methane), a concerted effort to reduce methane emissions would have almost immediate results in terms of reduction of greenhouse effect.

Q.40) Which of the following is/are implication(s) of discovery of cryo-electron microscopy?

1. It will enable structure determination of biomolecules in water-based samples.
2. It will enable scientists to see how biomolecules move and interact as they perform their functions

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.40) Solution (c)

The Nobel Prize in Chemistry 2017 was awarded to Jacques Dubochet, Joachim Frank and Richard Henderson for the development of cryo-electron microscopy, which both simplifies and improves the imaging of biomolecules.

Transmission electron microscopes (TEMs) use a beam of electrons to examine the structures of molecules and materials at the atomic scale. As the beam passes through a very thin sample, it interacts with the molecules, which projects an image of the sample onto the detector (often a charge-couple device; CCD). Because the wavelength of electrons is much shorter than that of light, it can reveal much finer detail than even super-resolution light microscopy.

But some materials – particularly biomolecules – are not compatible with the high-vacuum conditions and intense electron beams used in traditional TEMs. The water that surrounds the molecules evaporates, and the high energy electrons burn and destroy the molecules

Cryo-EM uses frozen samples, gentler electron beams and sophisticated image processing to overcome these problems.

X-ray diffraction can give very high resolution structures of biomolecules, and several Nobel prizes have been awarded for just that. **But to get an x-ray structure, we need to be able to crystallize the molecule.**

Cryo-EM doesn't require crystals, and it also enables scientists to see how biomolecules move and interact as they perform their functions, which is much more difficult using crystallography.

Cryo-EM techniques used water-based TEM samples so rapidly that the water forms a disordered glass, rather than crystalline ice. This is important because ordered ice crystals would strongly diffract the microscope's electron beam, obscuring any information about the molecules being studied.