DO YOU KNOW?

1	Microwave oven works on the principle of torque acting on an electric dipole. The food we consume has water molecules which are permanent electric dipoles. Oven produces microwaves that are oscillating electromagnetic fields and produce torque on the water molecules. Due to this torque on each water molecule, the molecules rotate very fast and produce thermal energy. Thus, heat generated is used to heat the food.
2	Sometimes we notice that the ceiling fan does not start rotating as soon as it is switched on. But when we rotate the blades, it starts to rotate as usual. Why it isso? We know that to rotate any object, there must be a torque applied on theobject. For the ceiling fan, the initial torque is given by the capacitor widely known as a condenser. If the condenser is faulty, it will not give sufficient initial torque to rotate the blades when the fan is switched on.
3	Computer keyboard keys are constructed using capacitors with a dielectric. When the key is pressed, the separation between the plates decreases leading to an increase in the capacitance. This in turn triggers the electronic circuits in the computer to identify which key is pressed.
4	Electric current is not only produced by batteries. In nature, lightning bolt produces enormous electric current in a short time. During lightning, very high potential difference is created between the clouds and ground and hence charges flow between the clouds and ground.
5	The human body contains a large amount of water which has low resistance of around 200 Ω and the dry skin has high resistance of around 500 k Ω. But when the skin is wet, the resistance is reduced to around 1000 Ω. This is the reason why repairing the electrical connection with the wet skin is always dangerous.
6	This temperature is known as critical temperature or transition temperature. The materials which exhibit this property are known as superconductors. This phenomenon was first observed by Kammerlingh Onnes in 1911. He found that mercury exhibits superconductor behaviour at 4.2 K. Since R = 0, current once induced in a superconductor persists without any potential difference.
7	The electrical power produced (dissipated) by a resistor is I2R. It depends on the square of the current. Hence, if current is doubled, the power will increase by four times. Similar explanation holds true for voltage also.
8	The Tamilnadu Electricity Board is charging for the amount of energy you use and not for the power. A current of 1A flowing through a potential difference of 1V produces a power of 1W.
9	When the car engine is started with headlights turned on, they sometimes become dim. This is due to the internal resistance of the car battery.
10	A galvanometer is an instrument used for detecting and measuring even very small electric currents. It is extensively useful to compare the potentialdifference between various parts of the circuit.
11	Many birds and animals have magnetic sense in their eyes using Earth's magnetic field for navigation. Magnetic sensing in eyes - for Zebra finch bird, due to protein cryptochromes Cry4 present in retina; the bird uses Earth's magnetic field for navigation
12	William Gilbert in 1600 proposed that Earth itself behaves like a gigantic powerful bar magnet. But this theory is not successful because the temperature inside the Earth is very high and so it will not be possible for a magnet to retain its magnetism. Gover suggested that the Earth's magnetic field is due to hot rays coming out from the Sun. These rays will heat up the air near equatorial region. Once air becomes hotter, it rises above and will move towards northern and southern hemispheres and get electrified. This may be responsible to magnetize the ferromagnetic materials near the Earth's surface. Till date, so many theories have been proposed. But none of the theorium completely explains the cause for the Earth's magnetism.
13	People living at high latitude regions (near Arctic or Antarctic) might experiencedazzling coloured natural lights across the night sky. This ethereal display on the sky is known as aurora borealis (northern lights) or aurora australis (southern lights). These lights are often called as polar lights. The lights are seen above the magnetic poles of the northern and southern hemispheres. They are called as "Aurora borealis" in the north and "Aurora australis" in the south. This occurs as a result of interaction between the gaseous particles in the Earth's atmosphere with highly charged particles released from the Sun's atmosphere through solar wind. These particles emit light due to collision and variations in colour are due to the type of the gas particles that take part in the collisions. A pale yellowish – green colour is produced when the ionized oxygen takes part in the collision and a blue or purplish – red aurora is produced due to ionized nitrogen molecules.
14	(a) Why a freely suspended bar magnet in your laboratory experiences only torque (rotational motion) but not any translatory motion even though Earth has nonuniform magnetic field? It is because Earth's magnetic field is locally (physics laboratory) uniform. (b) Suppose we keep a freely suspended bar magnet in a non-uniform magnetic field. What will happen? It will undergo translatory motion (net force) and rotational motion (torque)

15	Magnetic levitated train is also called Maglev train. This train floats few centimetres above the guideway because of electromagnet used. Maglev train does not need wheels and also achieve greater speed. The basic mechanism of working of Maglev train involves two sets of magnets. One set is used to repel which makes train to float above the track and another set is used to move the floating train ahead at very great speed. These trains are quieter, smoother and environmental friendly compared conventional trains and have potential for moving with much higher speeds with technology in future.
16	Magnetism plays interesting role in various aspects of life. It has connection with archeological place Keezhadi too. To find whether any archeological structure exists under the surface of a given place, well established technique called 'magnetometer surveying' is used. In this technique, the variation of the magnetic field in comparison with the neighbouring place is studied. The magnetic field variation is due to the presence of magnetic mineral magnetite and its related minerals present in the archeological structures like buried wall, pottery, bricks, buried tombs, monuments and inhabited sites. Those minerals are either diamagnetic or paramagnetic or ferromagnetic in nature and each type has different range of magnetic susceptibilities. Indian Institute of Geomagnetism (IIG), Mumbai conducted magnetometer survey on Keezhadi site and found out that there were archeological structures like wall, pottery etc. From the picture (Figure 1), there was magnetic field variation in the range of 10 to 100nT over the particular area (coloured portion). In fact, the existence of massive brick structures at Keezhadi has been revealed through magnetism.
17	Like mass and charge for particles, spin is also another important attribute for an elementary particle. Spin is a quantum mechanical phenomenon which is responsible for magnetic properties of the material. Spin in quantum mechanics is entirely different from spin we encounter in classical mechanics. Spin in quantum mechanics does not mean rotation; it is intrinsic angular momentum which does not have classical analogue. For historical reason, the name spin is retained. Spin of a particle takes only positive values but the orientation of the spin vector takes plus or minus values in an external magnetic field. For an example, electron has spin s=1/2. In the presence of magnetic field, the spin will orient either parallel or anti-parallel to the direction of magnetic field.
18	This implies that the magnetic spin ms takes two values for an electron, such as ms =1/2 (spin up) and ms = −1/2 (spin down). Spin for proton and neutron is s =1/2. For photon, spin s = 1.
19	MRI is Magnetic Resonance Imaging which helps the physicians to diagonise or monitor treatment for a variety of abnormal conditions happening within the head, chest, abdomen and pelvis. It is a non-invasive medical test. The patient is placed in a circular opening (actually interior of a solenoid which is made up of superconducting wire) and large current is sent through the superconducting wire to produce a strong magnetic field. So, it uses more powerful magnet, radio frequency pulses and a computer to produce pictures of organs which helps the physicians to examine various parts of the body.
20	For common household appliances, the voltage rating and current rating are generally specified in terms of their RMS value. **The domestic AC supply is 230V, 50 Hz. It is the RMS or effective value. Its peak value will be** $V_m = \sqrt{2}\ V_{rms} = \sqrt{2}$ **x 230 = 325 V .**
21	ELI is an acronym which means that EMF (voltage) leads the current in an inductive circuit.
22	ICE is an acronym which means that the current leads the EMF (voltage) in a capacitive circuit.
23	It is surprising to realize that EM waves have linear momentum and angular momentum like particles. In the year 2018, Nobel prize in physics was awarded for the invention of optical tweezers and production of high intense light pulses. Optical tweezer is nothing but a laser light, used to move micro sized particles or molecules from one location to another location. It has a lot of applications in the medical field. The bacteria and virus can alone be separated from regular tissue using this optical tweezer and cancerous cells can be separated from normal healthy cells. The optical tweezer utilizes momentum property of EM waves. In fact, the comet has tail shape because the sun light imparts large amount of linear momentum which pushes the masses of the comet away from the sun. Angular momentum of EM waves can be understood in simple way. Consider a setup of oppositely-charged coaxial cylindrical shells and in between them a solenoid is kept. An AC current is flowing through it and when the current in the solenoid is reduced to zero, then the inner and outer cylindrical shells start to rotate in opposite directions. The rotation of these cylinders is due to the impart of angular momentum from the electromagnetic field produced by the AC current
24	Production of optical surfaces capable of refracting as well as reflecting is possible by properly coating the surfaces with suitable materials. Thus, a glass can be made partially see through and partially reflecting. These glasses are commercially called as two-way mirror, half-silvered mirror, semi-silvered mirror etc. This gives a perception of regular mirror if the other side is made dark. But, still hidden cameras can be kept behind such mirrors. We need to be cautious when we stand in front of mirrors kept in unknown places. There is a method to test the two-way mirror. Place the finger nail on the mirror surface. If there is a gap between nail and its image, then it is a regular mirror. If the fingernail directly touches its image, then it is a two-way mirror.
25	Atmospheric refraction: Due to refraction of light through different layers of atmosphere which vary in refractive index, the path of light deviates continuouslywhen it passes through the atmosphere. For example, the Sun is visible a littlebefore the actual sunrise and also until a little after the actual sunset due torefraction of light through the atmosphere. What we mean by actual sunrise isthe actual crossing of the sun at the horizon. Figure shows the actual and apparent positions of the sun with respect to the horizon. The figure is highlyexaggerated to show the effect. The apparent shift in the direction of the sun isaround half a degree and the corresponding time difference between the actualand apparent positions is about 2 minutes. Sun appears flattened (oval shaped)during sun rise and sunset due to the same phenomenon.The same

	is also applicable for the positions of stars as shown in Figure. Actually,the stars do not twinkle. They appear twinkling because of the movement of theatmospheric layers with varying refractive indices which is clearly seen in thenight sky.
26	An endoscope which has a bundle of optical fibres is an instrument used bydoctors to see inside of a patient's body. Endoscopes work on the phenomenonof total internal reflection. The optical fibres are inserted into the body throughmouth, nose (or) a special hole made in the body. Even operations could becarried out with the endoscope cables which have the necessary instrumentsattached at their ends.
27	Rainbow appears in sky during mild shower (or) near the fountains/falls wherethere are water droplets remain suspended in air. A rainbow is seen when the sunis at the back of the observer. Dispersion occurs when sunlight enters a waterdroplet and the white light is split into its constituent seven colours.A primary rainbow is formed when the light entering a droplet undergoes onetotal internal reflection inside it. Sometimes, a secondary rainbow is also formedenveloping the primary rainbow. The secondary rainbow is formed when lightentering a raindrop undergoes two total internal reflections. The order of colourin primary rainbow is from violet to red whereas in secondary rainbow it is fromred to violet. The angle of view in primary rainbow from violet to red is from 40oto 42o. The angle of view for secondary rainbow from red to violet is from 52oto 54o.
28	Dazzling colours are exhibited by thin films of oil spread on the surface ofwater and also by soap bubbles. These colours are due to interference of whitelight undergoing multiple reflections from the top and the bottom surfaces of thinfilms. The colour depends upon the thickness of the film, refractive index of thefilm and also the angle of incidence of the light.
29	A compact disc (CD) always appears colourful. On the read/writable side whichlooks shining, there are many narrow circular tracks with widths comparable tothe wavelength of visible light. Hence, the diffraction takes place after thereflection of incident white light to give colourful appearance. The tracks act asreflecting grating.
30	It is interesting to note that the experiment of Hertz confirmed that light is anelectromagnetic wave. But the same experiment also produced the first evidencefor particle nature of light.
31	A reader may find it difficult to understand how light can be both a wave and astream of particle. This is the case even for great scientist like Albert Einstein.Einstein once wrote a letter to his friend Michel Besso in 1954 expressing hisfrustration: "All these fifty years of conscious brooding have brought me no closer to answerthe question, 'What are light quanta?' Of course today everyone thinks he knowsthe answer, but he is deluding himself"
32	A single teaspoon of nuclear matter would weigh about trillion tons.
33	A very interesting application of alpha decay is in smoke detectors whichprevent us from any hazardous fire. The smoke detector uses around 0.2 mg of man-made weak radioactiveisotope called americium (95Am241). This radioactive source is placed betweentwo oppositely charged metal plates and α radiations from 95Am241 continuouslyionize the nitrogen, oxygen molecules in the air space between the plates. As aresult, there will be a continuous flow of small steady current in the circuit. Ifsmoke enters, the radiation is being absorbed by the smoke particles rather thanair molecules. As a result, the ionization and along with it the current is reduced.This drop in current isdetected by the circuit and alarm starts.The radiation dosage emitted by americium is very much less than safe level, so it can be considered harmless.
34	The world's first computer 'ENIAC' was invented by J. Presper Eckert and JohnMauchly at the University of Pennsylvania. The construction work started in 1943and got over in 1946. It occupied an area of around 1800 square feet. It had18,000 vacuum tubes and it weighed around 50 tons.
35	The n-type and p-type semiconductors are neutral because only neutral atomsare doped to the intrinsic semiconductors.
36	The concept of high (1) and low (0) is not a new one. In fact, it was applied in elephone switching circuits by Shannon in 1938.

NOTE

1	The potential due to an electric dipole falls as 1/ r square and the potential due to a singlepoint charge falls as 1/r. Thus the potential due to the dipole falls faster than that due to a monopole (point charge). As the distance increases fromelectric dipole,the effects of positive and negative charges nullify each other.
2	Gauss law is a powerful technique whenever a given charge configurationpossesses spherical, cylindrical or planar symmetry, then the electric field due tosuch a charge configuration can be easily found. If there is no such symmetry, the direct method (Coulomb's law and calculus) can be used. For example, it isdifficult to use Gauss law to find the electric field for a dipole since it has nospherical, cylindrical or planar symmetry.
3	The typical drift velocity of electrons in the wire is 10-4 m s-1. If an electron driftswith this speed, then the electrons leaving the battery will take hours to reach thelight bulb. Then how electric bulbs glow as soon as we switch on the battery? When battery is switched on, the electrons begin to move away from thenegative terminal of the battery and this electron exerts force on the nearbyelectrons. This process creates a propagating influence (electric field) thattravels through the wire at the speed of light. In other words, the energy istransported from the battery to bulb at the speed of light through

	propagatinginfluence (electric field). Due to this reason, the bulb glows as soon as thebattery is switched on.
4	(i) Pole strength is a scalar quantity with dimension [M0LT0A]. its SI unit is N T–1 (newton per tesla) or A m (ampere-metre). (ii) Like positive and negative charges in electrostatics, North Pole of amagnet experiences a force in the direction of magnetic field while SouthPole of a magnet experiences force opposite to the magnetic field. (iii) Pole strength depends on the nature of materials of the magnet, area of cross-section and the state of magnetization. (iv) If a magnet is cut into two equal halves along the length then pole strengthis reduced to half. (v) If a magnet is cut into two equal halves perpendicular to the length, thenpole strength remains same. (vi) If a magnet is cut into two pieces, we will not get separate north and southpoles. Instead, we get two magnets. In other words, isolated monopoledoes not exist in nature.
5	Superconductors are perfect diamagnetic materials. The expulsion of magneticflux from a superconductor during its transition to the superconducting state isknown as Meissner effect.Superconductors behave like perfect diamagnetic materials belowtransition temperature TC.
6	Solenoid can be used as electromagnet. It produces strong magnetic field thatcan be turned ON or OFF. This is not possible in case of permanent magnet.Further the strength of the magnetic field can be increased by keeping iron barinside the solenoid. This is because the magnetic field of the solenoid magnetizesthe iron bar and hence the net magnetic field is the sum of magnetic field of thesolenoid and magnetic field of magnetised iron. Because of these properties,solenoids are useful in designing variety of electrical appliances.
7	This principle is used in Bainbridge mass spectrograph to separate theisotopes.
8	Deutrons (bundles of one proton and one neutron) can be accelerated becauseit has same charge as that of proton. But neutron (electrically neutral particle)cannot be accelerated by the cyclotron. When a deutron is bombarded with a beryllium target, a beam of high energy neutrons are produced. These high-energyneutrons are sent into the patient's cancerous region to break the bonds in theDNA of the cancer cells (killing the cells). This is used in treatment of fastneutroncancer therapy.
9	Alternating emf is generated by rotating a coil in a magnetic field or by rotating amagnetic field within a stationary coil. The first method is used for small AC generators while the second method isemployed for large AC generators. Therotating-field method is the one which ismostly used in power stations
10	The students should remember that in a single slit experiment, the formula, $a\sin\theta = n\lambda$ is condition for minimum with n as order of minimum. But in the gratingexperiment, the formula, $\sin\theta = Nm\lambda$ is condition for maximum with m as the orderof diffraction
11	The SI unit of energy is joule. But electron volt is a commonly used unit ofenergy in atomic and nuclear physics. One electron volt is defined as the kinetic energy gained by an electron whenaccelerated by a potential difference of 1 V. 1 eV = KE gained by the electron = Work done by the electric field = q V = 1.602 × 10–19 C × 1 V 1 eV= 1.602 × 10–19 J
12	It is to be noted that electrons are not the only particles with which wave naturecan be demonstrated. The waves are associated with particles like neutrons andalpha particles also when they are in motion. They undergo diffraction when theyare scattered by suitable crystals. Neutron diffraction studies are highly useful forinvestigating crystal structures
13	Diffraction is one of the properties of waves. Whenever waves are incident onan obstacle, they bend around the edges of the obstacle. This bending of wavesis called diffraction. The amount of bending depends on the wavelength of thewaves.The wavelength of light is very small; diffraction effects of light are verysmall. In order to study diffraction of light, diffraction gratings are used.Since x-rays and de Broglie waves of electrons have wavelengths (in the order of10–10m) much shorter than that of the light wave, diffraction grating cannot beused in x-ray diffraction studies. In a crystal, the spacing between atomic planesis comparable to the wavelength of x-rays and de Broglie waves of electrons.Hence, in x-ray diffraction studies, the crystals are used which serve as threedimensionalgrating.
14	The specific charge is independent of (a) gas used (b) nature of the electrodes
15	In 1931, H.C. Urey and co-workers noticed that in the shorter wavelength regionof the hydrogen spectrum lines, faint companion lines are observed. From theisotope displacement effect (isotope shift), the isotope of the same element can produce slightly different spectral lines. The presence of these faint linesconfirmed the existence of isotopes of hydrogen atom (which is named asDeuterium).On calculating wavelength or wave number difference between the faint andbright spectral lines, atomic mass of deuterium is measured to be twice that ofatomic mass of hydrogen atom. Bohr atom model could not explain this isotopicshift. Thus by considering nuclear motion (although the movement of the nucleusis much smaller) into account in the Bohr atom model, the wave number or wavelength difference between the lines produces by the hydrogen atom anddeuterium is theoretically calculated which perfectly agreed with thespectroscopic measured values.The difference between hydrogen atom and deuterium is in the number ofneutron. Hydrogen atom contains an

	electron and a proton, whereas deuteriumhas an electron, a proton and a neutron.
16	Using **Einstein's mass-energy equivalence, the energy equivalent of one atomic mass unit** $1u = 1.66x10^{-27} \times (3x\ 10^{8})^2$; $14.94 \times 10^{-11}J$; ≈**931 MeV**
17	India has 22 nuclear reactors in operation. Nuclear reactors are constructedin two places in Tamilnadu, Kalpakkam and Kudankulam. Even though nuclearreactors are aimed to cater to our energy need, in practice nuclear reactors noware able to provide only 2% of energy requirement of India
18	Passive components: components that cannot generate power in a circuit.Active components: components that can generate power in a circuit.
19	The energy of the orbiting electrons is measured in electron volts (eV).
20	Ideal diode: It acts like a conductor when it is forward biased. When it is reversebiased, it acts like an insulator. For ideal diodes, the forward resistance is zeroand barrier potential is considered negligible.
21	Centre tap transformer: There is a facility to tap at halfway point in the secondarywindings. This helps to measure the induced voltage from one end of thesecondary to the centre point. If the centre tap point is grounded, then the voltageacross the secondary will be divided into two halves. For example, if the voltageacross the secondary is 240 V, then the voltage across one end and the centretap point is +120 V and at the other end it is –120 V.
22	In Avalanche breakdown, the minority charge carriers gain sufficient energy fromexcessive reverse bias voltage to break covalent bond in order to produce newcharge carriers. But Zener breakdown occurs due to the direct rupture of covalentbonds because of the existence of the strong electric field. Since depletion regionis thin, Zener breakdown occurs usually at lesser reverse bias voltage comparedto Avalanche breakdown voltage.
23	The maximum reverse bias that can be applied before entering into the Zenerregion is called the peak inverse voltage, commercially referred as PIV rating.
24	NAND and NOR gates are known as universal gates because any other logic gate can be made from NAND or NOR gates.

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With regards,

SS PRITHVI,(XII STD),

PRIT-EDUCATION,

COVAI.