

General Science & Ability

MOCK JANUARY 2024

Section - 1

QUESTION NO: 03

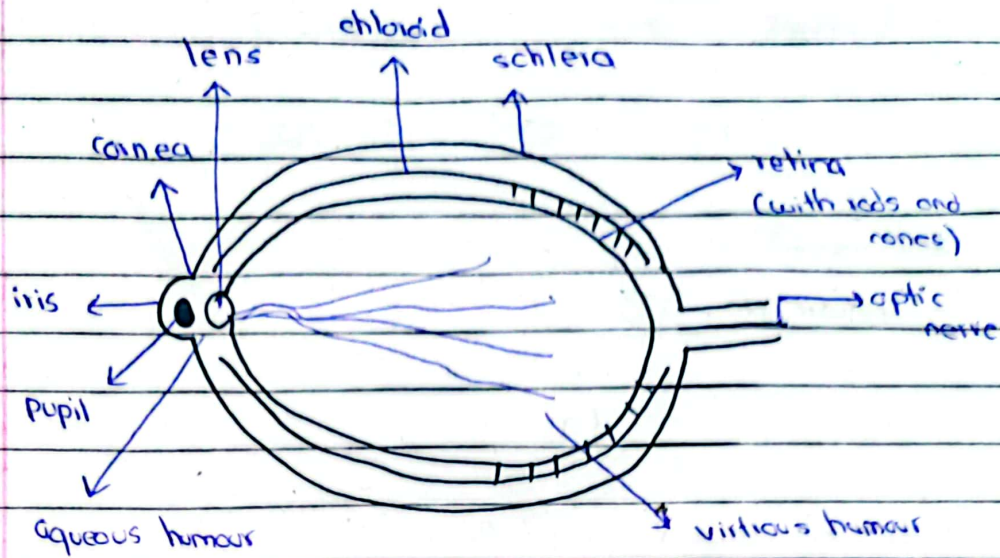
(a)

Parts of eye:

The human eye is a sensory organ which contains sensory information/visuals in order to see.

There are different parts of the eye which perform different functions. The cornea is the outermost transparent part of eye which bends the light waves. Iris is a pigmented muscle which controls the movement of the pupil. Pupil is a small hole from where the light enters into the eye, through the lens. The lens is responsible for focusing the light onto the retina.

Retina is the innermost, most sensitive part of the eye which contains photoreceptors called rods and cones which are responsible for converting light into an image. The optic nerve transfers the image towards the brain. Moreover, the eye also contains sclera, a layer for protection and aqueous humour and vitreous humour which are fluid-filled regions.



~ Diagram of Human Eye ~

Correction of farsightedness:

Farsightedness (hyperopia) can be corrected by the use of concave (diverging) lenses which are denoted by a minus (-) sign.

Correction of nearsightedness:

Nearsightedness (myopia) can be corrected by the use of concave (diverging) lenses denoted by (-) minus sign.

Correction of far-sightedness: (hyperopia)

Farsightedness can be corrected by use of convex (converging) lenses denoted by a (+) plus sign.

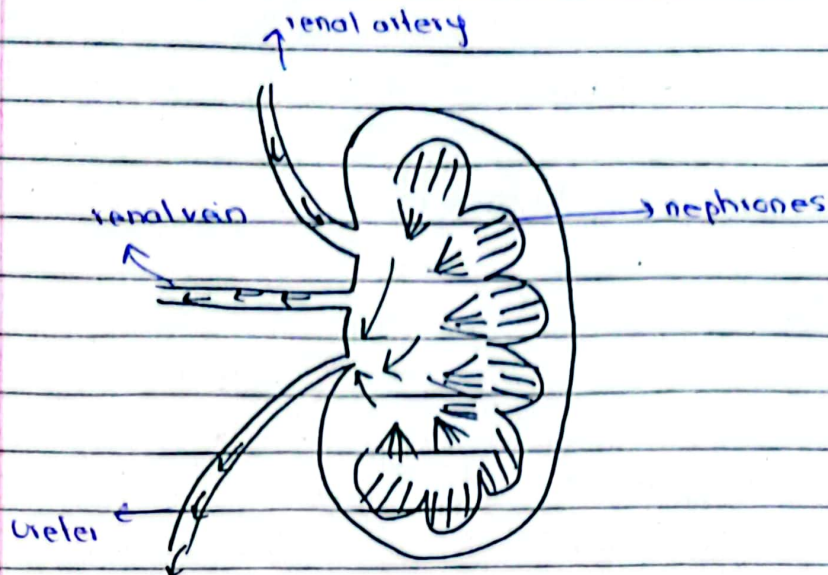
(b)

Functioning of a kidney:

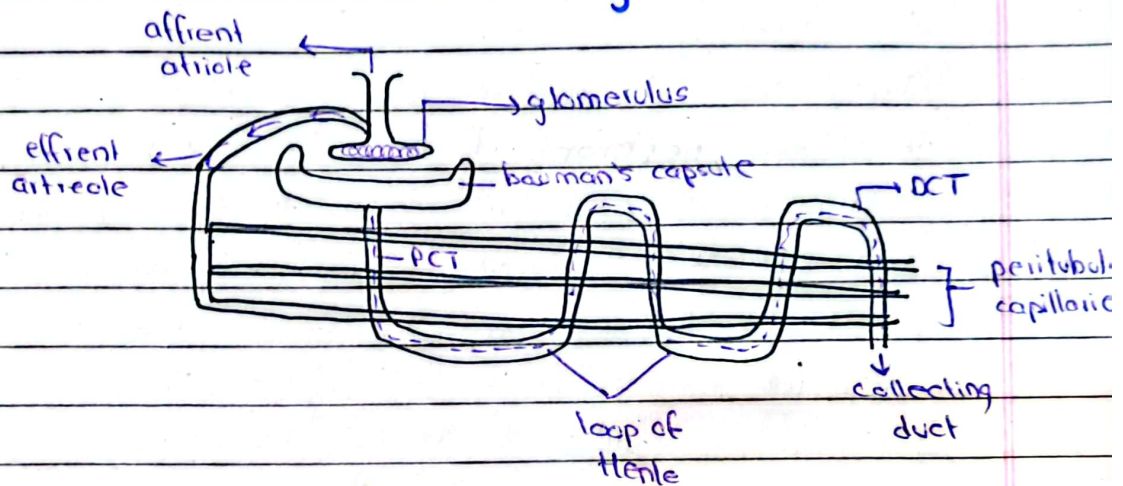
The renal artery carries blood towards the kidney for filtration. Inside the kidney there are around one million nephrones (two million total in both kidneys) which are the basic structural and functional unit of kidneys and are tasked with filtering the blood.

There is intense working mechanism inside a nephrone. It consists of afferent arteriole which carries blood into the nephrone and onto the glomerulus where the filtration of blood takes place. The glomerulus is supported by the Bowman's capsule. The proximal convoluted tubule and the distal convoluted tubule are attached to the Bowman's capsule which together with the Loop of Henle contain the filtrate. The peritubular capillaries however contain clean blood and reabsorb necessary water, salts or minerals. Ultimately the filtrate goes to the collecting duct, while the clean blood goes out of the efferent arteriole, the renal vein then carries out the filtered blood into the body.

Diagram of kidney:



~ Kidney ~



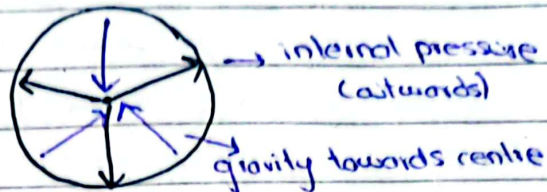
~ Nephron ~

(c)

Formation of Black Holes:

Black holes are objects of extreme density and even strong gravitational pull that even light cannot escape from it. Black holes are also called "collapsar", i.e. the collapse of star.

Stars are spherical in which $H_2 + H_2 \rightarrow H_2$ i.e. the fusion process occurs to release energy. This develops internal pressure in the star while another factor is gravity of star, and both these factors are opposite to each other.



As long as the two factors are balanced, the star will live but whenever there occurs an imbalance, it will collapse. For example imbalance might occur because Helium despite being a stable element, is not the most stable therefore it keeps converting into even heavier elements like C, O and ultimately Iron which is the most stable. But this all slows down the fusion process.

Internal pressure is decreased due to slowdown of fusion reaction but gravity remains same which leads to imbalance. Hence, the star collapses within its centre and its density increases creating a black hole.

(d)

Isotopes:

Isotopes are atoms of the same material having same atomic number but different mass number. e.g. Hydrogen has three isotopes protium, deuterium and tritium. Δ

Isobars:

Isobars are atoms of some elements that have the same mass number (sum of protons and neutrons) but different atomic numbers (number of protons). e.g. Carbon-14 and Nitrogen-14

Isotones:

Isotones are atoms that have the same number of neutrons but different number of protons and consequently different atomic numbers. e.g. - chlorine 35 and potassium - 39.

Isotopes of Hydrogen:

Hydrogen has three isotopes

- 1) Protium
- 2) Deuterium
- 3) Tritium

They all have one proton, but different number of neutrons i.e. protium has none, deuterium has one and tritium has two neutrons.

Question no: 05

(a)

RAM	ROM
→ RAM stands for 'Random Access Memory.'	ROM stands for 'Read Only Memory'
→ It is a volatile memory which stores data as long as power is supplied.	It is a non-volatile memory which retains data even when power is turned off.
→ Data stored in RAM can be retrieved and altered.	Data stored in ROM can only be read.
→ It has a high-speed memory.	It is much slower than RAM.
→ large size with higher capacity.	Small size with less capacity.
→ Used to store data that has to be currently processed by CPU temporarily.	Used to store the instructions required during the bootstrap of computer.
→ Costly as compared to ROM.	Cheaper than RAM.

Nibble:

A nibble is a unit of digital information that consists of four binary digits, also known as bits. Nibble is derived from 'half a byte' as a byte typically consists of eight bits.

USB:

USB stands for Universal Serial Bus. It is a standard interface used for connecting diverse devices to computers or other hosts.

USB connectors come in different types with USB type C being increasingly common.

(b)

Revolution of world by AI:

Artificial Intelligence (AI) has revolutionized the world in various ways impacting various industries and aspects of our daily lives. It has automated processes and enhanced efficiency across industries.

In health care, it aids in early disease detection and accelerates drug discovery.

AI has revolutionized customer service with chatbots and improved financial services through fraud detection and algorithmic trading.

In transportation, autonomous vehicles and route optimization benefit logistics.

Chat-GPT has revolutionized each and every sector by providing instant information and content.

Education sector benefits from adaptive learning platforms and scientific research is expedited through AI-driven data analysis.

Overall, AI has become integral to modern life, influencing how we work, learn and interact with technology.

(c)

Working of an optical fibre:

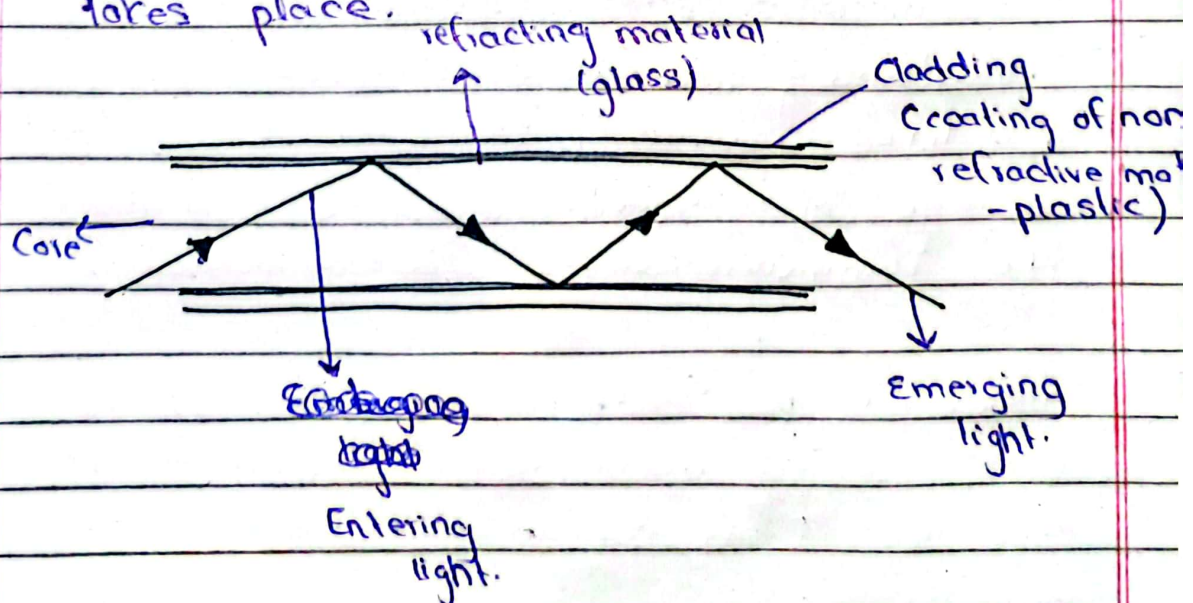
An optical fibre consists of two main parts:

a) core

b) cladding

→ Core is the inner part of the optical fibre with high density and high refractive index while cladding is the outer part with low density and low refractive index.

Optical fibre works through the process of total internal reflection of light. When the angle between the core-cladding boundary is greater than the refractive angle (90°), then total internal reflection takes place.



Advantages of Optical Fibre:

Optical fibres have several advantages:

- High Bandwidth:

They can transmit & carry large amount of data, providing high bandwidth for communication, internet and data transfer.

- Low Signal loss:

They have minimal signal loss over long distances ensuring efficient and reliable data transmission.

- Long transmission distances:

Optical fibres transmit data over long distances without significant signal degradation, ideal for extensive telecommunication networks.

(d)

Critical Speed of a Satellite:

Critical speed of a satellite refers to its 'orbital velocity', which is the minimum velocity a satellite must attain to achieve a stable orbit around a celestial body such as Earth. The critical speed depends upon mass of celestial body and the altitude of the satellite's orbit.

$$V_{\text{orbital}} = \sqrt{\frac{GM}{R}}$$

V = orbital velocity

G = gravitational constant

M = mass of celestial body

R = distance from centre of celestial body to the satellite.

Geostationary vs Polar Satellites:

Geostationary satellites orbit above the equator at a fixed position providing continuous coverage of a specific region for applications like communication and weather monitoring.

In contrast, polar satellites orbit from pole to pole, covering broader areas and are often used for Earth observation and environmental monitoring.

Date: _____

Day:

M	T	W	T	F	S
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Geostationary satellites appear stationary relative to a point on Earth while polar satellites have shorter orbital periods and traverse the globe in a North-South direction.

Section II :

Question no: 06

(a)

let the age of son be x , and age of father be y .

Five years ago:

$$\text{father } (y) = 3x$$

Therefore

$$y - 5 = 3x - 5 \quad \text{--- (1)}$$

Since current age of son is 30.

putting value of x in eq (1)

$$y - 5 = 3(30) - 5$$

$$y - 5 = 90 - 5$$

$$y = 90 - 5 + 5$$

$$y = 90 \quad \text{Answer.}$$

Thus, the current age of father is 90 yrs.

(b)

Mean of 10, 30, y and 50 is 50

$$y = ?$$

$$\text{Mean} = \frac{\text{sum of all values}}{\text{total no. of values}}$$

$$50 = \frac{10 + 30 + Y + 50}{4}$$

$$50(4) = 40 + 50 + Y$$

$$200 = 90 + Y$$

$$Y = 200 - 90$$

$$Y = 110 \text{ Answer.}$$

(c)

$$(i) \quad 2, 6, 18, 54, \underline{162}$$

$$\begin{array}{ccccccc} & \curvearrowright & & \curvearrowright & & \curvearrowright & & \curvearrowright \\ & x_3 & & x_3 & & x_3 & & x_3 \end{array}$$

$$(ii) \quad 3125, 2756, \underline{27}, 4, 1$$

$$5^5 \quad \curvearrowleft \quad 4^4 \quad \curvearrowleft \quad 3^3 \quad \curvearrowleft \quad 2^2 \quad \curvearrowleft \quad 1^1$$

(d)

let the two numbers be x and y .

According to condition:

$$xy = 320 \quad \text{--- (1)}$$

$$\frac{x}{y} = \frac{1}{5} \quad \text{--- (2)}$$

$$y^2 = \frac{x^2}{5} \quad ? \quad \text{--- (3)}$$

In eq (2)

$$\frac{x}{y} = \frac{1}{5}$$

$$5x = y$$

putting this value in eq (1)

$$xy = 320$$

$$x(5x) = 320$$

$$5x^2 = 320$$

$$x^2 = \frac{320}{5}$$

$$x^2 = 64$$

$$\sqrt{x^2} = \sqrt{64}$$

$$x = 8$$

In eq (1)

$$xy = 320$$

$$(8)y = 320$$

$$y = \frac{320}{8}$$

$$y = 40$$

putting values of x and y in eq (3)

$$x^2 - y^2 = (8)^2 - (40)^2$$

$$= 64 - 1600$$

$$y^2 - x^2 = (40)^2 - (8)^2$$

$$= 1600 - 64$$

$$y^2 - x^2 = 1536 \text{ Answer.}$$

Question no: 07 :

(b)

	Men	Hours	Days
↑	195	10 ↓	20 ↓
	? x	13 ↓	15 ↓

$$\frac{x}{195} = \frac{10 \times 20}{13 \times 15}$$

$$\frac{x}{195} = \frac{200}{195}$$

$$x = \frac{200 \times 195}{195}$$

$$x = 200 \text{ Answer}$$

200 men are needed to finish the job in 15 days if they work 13 hours a day.

(c)

$$A = \{a, e, i, o, u\}$$

$$U = \{a, b, c, \dots, z\}$$

$$A' = ?$$

$$A' = \{ b, c, d, f, g, h, j, k, l, m, n, \\ p, q, r, s, t, v, w, x, y, z \}$$

(d)

$$\text{Volume} = 372 \text{ cm}^3$$

$$\text{height} = 3 \text{ km}$$

$$\text{perimeter} = ?$$

$$\text{perimeter} = 40$$

$$\text{Volume of pyramid} = \frac{1}{3} \times \text{base area} \times h$$

$$372 = \frac{1}{3} \times \text{base area} \times 3$$

$$\therefore 1 \text{ km} = 100000 \text{ cm}$$

$$3 \text{ km} = 300000 \text{ cm}$$

$$372 = \frac{1}{3} \times \text{base area} \times 300000$$

$$372 = \frac{1}{3} \times l^2 \times 300000$$

$$372(3) = l^2 \times 300000$$

$$1026 = l^2 \times 300000$$

$$l^2 = \frac{1026}{300000}$$

$$l = \frac{1026}{300000}$$

$$l =$$