

TEST NO.7

1. The SI unit of spring constant is identical with that of:

- (A) Force (B) Surface tension
(C) Pressure (D) Loudness

Explanatory Answer: (B)

$$\text{Surface tension} = \frac{\text{Force}}{\text{Length of line}} = \text{N m}^{-1}$$

2. π is the ratio of:

- (A) Circumference of a circle to its diameter (B) Diameter of a circle to its circumference
(C) Circumference of a circle to its radius (D) None of these

Explanatory Answer: (A)

$$\frac{\text{circumference}}{2r} = \pi$$

$$\frac{\text{circumference}}{\text{diameter}} = \pi$$

3. In SHM, there is always a constant ratio between displacement of a body and its:

- (A) Velocity (B) Period
(C) Mass (D) Acceleration

Explanatory Answer: (D)

Condition of SHM is $a \propto -x$

$$a = -\text{constant } x \text{ or } \frac{a}{x} = -\text{constant } \pi$$

4. If a given spring of spring constant k is cut into two identical segments, the spring constant of each segment is:

- (A) $\frac{k}{2}$ (B) $2k$
(C) $4k$ (D) None of these

Explanatory Answer: (B)

When a spring is cut into half, the same weight will produce only half extension in it

$$\text{i.e., } x' = \frac{x}{2}$$

$$\text{i.e., } k' = \frac{F}{x'} = \frac{F}{x/2} = \frac{2F}{x} = 2k$$

5. Distance covered during one vibration of an oscillating body in terms of amplitude

A is:

- (A) A (B) $2A$
(C) $3A$ (D) $4A$

Explanatory Answer: (D)

Since amplitude is the displacement from

mean position to either side, hence in one vibration, distance covered is 4.

6. If a body completes 20 vibrations in one minute, its time period will be:

(A) 0.05 sec (B) 1.5 sec
(C) 3.0 sec (D) 20 seconds

Explanatory Answer: (C)

20 vibrations in one minute means $\frac{20}{60}$ vibrations in one second. i.e., $f = \frac{20}{60} = \frac{1}{3}$

$$T = \frac{1}{f} = 3 \text{ seconds}$$

7. A mass attached to a spring completes 60 vibrations in half minute. Its frequency is:

(A) 120 Hertz (B) 60 Hertz
(C) 30 Hertz (D) 2 Hertz

Explanatory Answer: (D)

60 vibrations in half minute means 120 vibrations per minute i.e., $= \frac{120 \text{ vib}}{60 \text{ sec}} = 2$ Hertz.

8. The maximum speed of particle that undergoes SHM with a period of 0.5 seconds and an amplitude of 2 cm is:

(A) π cm/sec (B) 2π cm/sec
(C) 4π cm/sec (D) 8π cm/sec

Explanatory Answer: (D)

Given $T = 0.5$ sec and $x_0 = 2$ cm, $v_0 = ?$

$$v_0 = x_0 \sqrt{\frac{k}{m}} = x_0 \omega = x_0 \frac{2\pi}{T}$$

$$v_0 = 2 \times \frac{2\pi}{0.5} = 8\pi \text{ (cm/sec)}$$

9. If in a mass-spring system, spring is replaced by another spring of twice the spring constant in first case, then the time period of the new system will become:

(A) $\sqrt{2}$ times (B) 2 times
(C) 4 times (D) 0.707 times

Explanatory Answer: (D)

$$K' = 2k$$

$$T' = 2\pi \sqrt{\frac{m}{k'}} = 2\pi \sqrt{\frac{m}{2k}} = \frac{1}{\sqrt{2}} \left[2\pi \sqrt{\frac{m}{k}} \right]$$

$$T' = 0.707 \text{ times } T.$$

10. A body of weight 1 N hung on a spring elongates the spring by 5 cm. When another body is hung on the spring and

set vibrating, its period is 0.628 sec. The mass of this body pulling the string is nearly:

(A) 100 gms (B) 150 gms
(C) 200 gms (D) 225 gms

Explanatory Answer: (C)

$$\text{Weight} = 1 \text{ N, } x = 5 \text{ cm} = 0.05 \text{ m}$$

$$K = \frac{F}{x} = \frac{1}{0.05} = 20 \text{ N m}^{-1}$$

$$\text{Now } T = 0.628 \text{ sec, } m = ?, k = 20 \text{ Nm}^{-1}$$

$$T = 2\pi \sqrt{\frac{m}{k}}$$

$$T^2 = 4\pi^2 \frac{m}{k} \text{ i.e., } m = \frac{T^2 k}{4\pi^2}$$

$$m = \frac{(0.628)^2 \times 20}{4 \times 9.86} = 0.2 \text{ kg} = 200 \text{ grams.}$$

11. If ratio of time periods of two pendulums is 1:2, then the ratio of their lengths will be:

(A) 4:1 (B) 1:2
(C) 1:4 (D) None of these

Explanatory Answer: (C)

Time period is doubled only when length becomes 4 times.

12. A simple pendulum of 3.4 m length vibrates with a time period of 3.7 seconds. The value of g at the place of experiment is nearly:

(A) 9.6 m sec^{-2} (B) 825 cm sec^{-2}
(C) 10.2 m sec^{-2} (D) 9.8 m sec^{-2}

Explanatory Answer: (D)

$$L = 3.4 \text{ m}$$

$$T = 3.7 \text{ sec}$$

$$g = 4\pi^2 \frac{L}{T^2} = \frac{4 \times 9.86 \times 3.4}{(3.7)^2} = 9.8 \text{ m sec}^{-2}$$

13. If length of the second's pendulum is denoted by L , then the length of a pendulum having a period of 1 second is:

(A) $\frac{L}{2}$ (B) $2L$

(C) $\frac{L}{4}$ (D) $4L$

Explanatory Answer: (C)

$$L = \frac{gT^2}{4\pi^2} = \frac{4g}{4\pi^2}$$

$$L' = \frac{gT'^2}{4\pi^2} = \frac{g \times 1}{4\pi^2} = \frac{g}{4\pi^2} = \frac{1}{4} \left(\frac{4g}{4\pi^2} \right) = \frac{1}{4} L$$

14. At the centre of the Earth, the simple pendulum will:
- (A) Vibrate with same period
(B) Vibrate with double time period
(C) Not move
(D) None of them

Explanatory Answer: (C)

At centre of Earth, $g = 0$
Hence $T = 2\pi \sqrt{\frac{l}{g}} = \infty$

- i.e.*, it will take infinite time to complete one vibration.
15. Product of time period of a simple pendulum and its frequency is given by:
- (A) π
(B) One
(C) $\sqrt{\pi}$
(D) 2π

Explanatory Answer: (B)

Since $T = \frac{1}{f}$, hence $T \times f = \text{one}$

TEST NO.8

1. Transverse wave motion is possible in:
- (A) Air
(B) A mixture of NH_3 and O_2
(C) Strings
(D) All of these

Explanatory Answer: (C)

Both types of waves can be set up in solids. In fluids (liquid and gas), however, transverse waves die out very quickly and usually cannot be produced at all. This is also the reason why sound waves in air are longitudinal in nature.

2. The distance covered by sound waves in air at 0°C in the time of 0.1 seconds is:
- (A) 332 m
(B) 33.2 m
(C) 3.32 m
(D) 3320 m

Explanatory Answer: (B)

Since speed of sound = 332 m/sec at 0°C ,
therefore $s = vt = 332 \times 0.1 = 33.2$ m

3. The ratio of speed of sound in hydrogen to the speed of sound in oxygen is:
- (A) 4:1
(B) 1:4
(C) 8:1
(D) 1:8

Explanatory Answer: (A)

We should know that $v = \sqrt{\frac{rP}{\rho}}$

If ρ and P are same for two gases, then $v \propto \frac{1}{\sqrt{\rho}}$.

Since density of oxygen is 16 times that of hydrogen, hence speed of sound in hydrogen is 4 times its speed in oxygen.

4. One degree Celsius _____ in temperature produces approximately 0.61 m/sec _____ in the speed of sound.
- (A) Fall, decrease
(B) Rise, decrease
(C) Fall, increase
(D) None of them

Explanatory Answer: (A)

In the formula $v_t = v_0 + 61t$, the symbol t denotes change in temperature. Thus one degree rise in temperature will increase the velocity by 61 cm/sec and vice versa.

5. For transmission of both transverse and longitudinal waves, we can use:
- (A) Solid
(B) Gas
(C) Plasma
(D) None of these

Explanatory Answer: (A)

Both types of waves can be set up in solids. In fluids (liquid and gas), however, transverse waves die out very quickly and usually cannot be produced at all. This is also the reason why sound waves in air are longitudinal in nature.

6. Binomial expansion converts $\sqrt{1 + \frac{t}{273}}$ into as follows:
- (A) $1 + \frac{t}{546}$
(B) $1 + \frac{2t}{273}$
(C) $2 + \frac{t}{546}$
(D) None of these

Explanatory Answer: (A)

Binomial expansion of $(1 + x)^n = 1 + nx + \dots$ (when $x \ll 1$)

Following this, we get

$$\sqrt{\left(1 + \frac{t}{273}\right)} = \left(1 + \frac{t}{273}\right)^{1/2}$$

$$= 1 + \frac{1}{2} \frac{t}{273} = 1 + \frac{t}{546}$$

7. Through which medium sound waves travel faster?
- (A) CO_2
(B) H_2

- (C) O₂ (D) He

Explanatory Answer: (B)

The same reasoning as in Q. 33 applies to this question. Since hydrogen is the lightest, hence speed of sound through hydrogen is the greatest.

8. Two degree Celsius rise in temperature of the medium, produces approximately increase in the speed of sound equal to:
 (A) 0.61 cm/sec (B) 0.61 m/sec
 (C) 1.22 m/sec (D) 0.61 mm/sec

Explanatory Answer: (C)

In the formula $v_t = v_o + 61t$, unit of "61" is cm/sec. Thus for rise in temperature, the increase in speed of sound is 61 cm/sec or 0.61 m/sec. Therefore for 2°C rise, the increase is 1.22 m/sec.

9. Speed of sound in vacuum (in m/sec) is:
 (A) 330 (B) Zero
 (C) 156 (D) 1000

Explanatory Answer: (B)

Since sound waves cannot travel through vacuum, hence we can say that their speed is zero in vacuum.

10. Sound waves are:
 (A) Stationary waves (B) Transverse waves
 (C) Longitudinal waves (D) None of these

Explanatory Answer: (C)

For explanation, see answer to Q. 33.

11. At what temperature, the speed of sound in air is double its value at 0°C:
 (A) 1090°C (B) 819°C
 (C) 546°C (D) 273°C

Explanatory Answer: (B)

use $\frac{v_t}{v_o} = \sqrt{\frac{T}{T_o}}$

i.e., $\frac{2v_o}{v_o} = \sqrt{\frac{T}{273}}$

$\frac{T}{273} = 4$ or $T = 1092 \text{ K} = 819^\circ\text{C}$

12. The speed of sound in air at 4 atmospheres and that at 1 atmosphere pressure will be:
 (A) 1:4 (B) 4:1
 (C) 1:1 (D) 3:1

Explanatory Answer: (C)

Since speed of sound is not affected by change of pressure, hence is the answer.

13. If the difference between frequencies of the tuning forks is n , then number of beats produced in two seconds are:
 (A) n (B) $2n$
 (C) $3n$ (D) $4n$

Explanatory Answer: (B)

The rule is that if difference between frequencies of the tuning forks is n , then number of beats will be produced in one second. Thus for 2 seconds, answer will be $2n$.

14. Two identical tuning forks vibrate at 256 c/sec. After loading one of them, 6 beats/sec are heard when forks are sounded together. The period of the loaded fork is:
 (A) 2×10^{-3} sec (B) 3×10^{-3} sec
 (C) 4×10^{-3} sec (D) 0.006 sec

Explanatory Answer: (C)

$f_1 = 256 \text{ c/sec}$, $f_2 = 256 \pm 6 = 262, 250 \text{ c/sec}$
 According to the options, $f_2 = 250$ is correct because then

$$T_2 = \frac{1}{f_2} = \frac{1}{250} = 0.004$$

$$= 4 \times 10^{-3} \text{ seconds}$$

15. The fork A of frequency 100 hertz is sounded with another tuning fork B. The number of beats produced is two. On putting some wax on the prong of B, the number of beats reduces to one. The frequency of fork B is:
 (A) 101 (B) 99
 (C) 98 (D) 102

Explanatory Answer: (D)

$f_A = 100$, $f_B = 100 \pm 2 = 102, 98$
 Let us take the pair $f_A = 100$, $f_B = 98$

Then by loading B, the number of beats will increase than two which is not allowed in the question.

However, for the pair $f_A = 100$, $f_B = 102$, the situation is favourable.

16. A 100 cm long string fixed at its two ends is plucked from the middle. The wavelength of the stationary waves generated is:
 (A) 0.5 m (B) 1 m
 (C) 2 m (D) 3 m

Explanatory Answer: (C)

Given $l = 1$ m,
Plucking from the middle means that there is formed one anti-node at the plucking point. Since at the ends, there are nodes, thus there will be one loop for which, the equation

$$l = \frac{\lambda}{2} \text{ holds i.e., } \lambda = 2l = 2 \times 1 = 2 \text{ m.}$$

17. Given for (cylindrical) metal wire, $\rho = 10^3$ kg/m³, diameter = 2mm, $l = 32$ cm, find out its mass:
(A) 1 gram (B) 10 gms

(C) 100 gms (D) 1 kg
Explanatory Answer: (A)

Given diameter = 2 mm
Radius = 1 mm = 10^{-3} m
 $\rho = 10^3$ kg/m³
 $\rho = 32$ cm = 0.32 m
mass density \times volume
 $= l \times \pi r^2$
 $= 10^3 \times 3.14 \times 10^{-6} \times 0.32 = 10^{-3}$ kg = 1 gram.

TEST NO.9

1. Wavelength of red colour as compared to that of violet colour is:
(A) Smaller (B) Longer
(C) Equal (D) None of these

Explanatory Answer: (B)

The word VIBGYOR can help which is in the order of increasing wavelength i.e., red colour has longer wavelength.

2. If $\lambda = 400$ nm, its value in angstrom unit ($=10^{-10}$ m) is given as:
(A) 4×10^3 (B) 4×10^{-17}
(C) 4×10^{17} (D) 4×10^{-3}

Explanatory Answer: (A)

Given $\lambda = 400$ nm = $4 \times 10^2 \times 10^{-9}$ m = 4×10^{-7} m
Since $1 \text{ \AA} = 10^{-10}$ m or $1 \text{ m} = 10^{10} \text{ \AA}$
Hence $\lambda = 4 \times 10^{-7} \times 10^{10} \text{ \AA} = 4 \times 10^3 \text{ \AA}$

3. The path difference and phase difference are related to each other as:
(A) Phase difference = 2π \times path difference (B) Phase difference = $\frac{2\pi}{\lambda}$ \times path difference
(C) Phase difference = $\frac{\lambda}{2\pi}$ \times path difference (D) Phase difference = $\frac{2\lambda}{\pi}$ \times path difference

Explanatory Answer: (B)

Phase difference = $\frac{2\pi}{\lambda}$ (path difference)
If path difference = λ ,
Then phase difference = $\frac{2\pi}{\lambda} \lambda = 2\pi$

- Thus λ corresponds to 2π (Rule)
4. Phase change of 180° is equivalent to a path difference of:
(A) 2λ (B) λ
(C) $\lambda/2$ (D) $\lambda/4$

Explanatory Answer: (C)

Phase change of 360° (full circle) means full wavelength λ
Therefore 180° corresponds to $\lambda/2$.

5. In case of YDS experiment, the distance between adjacent bright fringes is given by:
(A) $\Delta y = \frac{\lambda L}{d}$ (B) $\Delta y = \frac{L}{\lambda d}$
(C) $\Delta y = \frac{d}{\lambda L}$ (D) None of these

Explanatory Answer: (A)

Note that the distance between adjacent bright fringes is called fringe spacing i.e., space between two bright fringes and this space is dark fringe and has the same width as that of one bright fringe itself. Similarly, space between two dark fringes is a bright and has the same width as that of one dark fringe itself.

6. In case of YDS experiment, the fringe

spacing varies _____ with slit separation d and varies _____ with distance L between slits and screen.

- (A) Directly, directly (B) Inversely, inversely
(C) Inversely, directly (D) Directly, inversely

Explanatory Answer: (C)

We know that fringe spacing = $\frac{\lambda L}{d}$ and the answer is evident.

7. The fringe width in YDS experiment can be increased by decreasing:

- (A) Width of slits (B) Wavelength of light
(C) Slits separation (D) Distance between slits and screen

Explanatory Answer: (C)

Fringe width and fringe spacing are the same thing and represented by Δy .

The answer is clear from the formula $\Delta y = \frac{\lambda L}{d}$.

8. If the slits in YDS experiment are made closer, fringe spacing will:

- (A) Increase (B) Decrease
(C) Remain same (D) None of above

Explanatory Answer: (A)

By making the slits closer, means to decrease 'd'. Then from the formula $\Delta y = \frac{\lambda L}{d}$, it is clear that fringe spacing will increase.

9. Fringe spacing in YDS experiment will be maximum if we use:

- (A) Red light (B) Green light
(C) Violet light (D) Blue light

Explanatory Answer: (A)

Red light has greater wavelength as compared to those of all visible colours and thus $\Delta y = \frac{\lambda L}{d}$ tells that fringe spacing will be maximum.

10. In YDS experiment, data given is $\lambda = 500$ nm, $d = 1$ mm, $L = 100$ cm, Δy comes out to be:

- (A) 0.5 cm (B) 0.5 mm

- (C) 0.5 nm (D) 0.5 m

Explanatory Answer: (B)

Given $\lambda = 500$ nm = 500×10^{-9} m

11. In Michelson's Interferometer, a bright fringe will be replaced by next bright fringe if we move the movable mirror by an amount equal to:

- (A) λ (B) $\lambda/2$
(C) $\lambda/4$ (D) None of these

Explanatory Answer: (B)

If the movable mirror is moved by an amount equal to $\lambda/2$, the path travelled by the ray is λ . Thus if we have bright fringe in front of us, then again, there will be next bright fringe according to condition of constructive interference.

12. In Michelson's interferometer, the plates are placed in front of incident ray at an angle of:

- (A) 45° (B) 60°
(C) 90° (D) 120°

Explanatory Answer: (A)

Angle of 45° is must because reflected ray must be perpendicular to incident ray so as to fall on movable mirror.

13. In Michelson's Interferometer, the movable mirror is moved by 0.5000 mm and shift of 200 fringes is observed, the wavelength for light used is:

- (A) 5×10^{-7} m (B) 5×10^{-4} m
(C) 5×10^{-6} m (D) None of above

Explanatory Answer: (C)

We shall use the formula $L = m \lambda/2$

$$\text{or } \lambda = \frac{2L}{m}$$

Given $L = 0.5$ mm = 0.5×10^{-3} m

$m = 200$ fringe

$$\lambda = \frac{2L}{m} = \frac{2 \times 0.5 \times 10^{-3}}{200} = 0.5 \times 10^{-3} \times 10^{-2} \text{ m}$$

$$= 5 \times 10^{-1-3-2} \text{ m}$$

$$= 5 \times 10^{-6} \text{ m}$$

14. A grating has 5000 lines per centimeter. Then grating element will be given as:

- (A) 2×10^{-6} m (B) 2×10^{-8} m
(C) 2×10^{-10} m (D) 2×10^{-4} m

Explanatory Answer: (A)

$N = 5000 \text{ lines/cm}$

$= \frac{5000 \text{ lines}}{10^{-2} \text{ m}} = 5 \times 10^3 \times 10^2 \frac{\text{lines}}{\text{meter}} = 5 \times 10^5$

Grating element $= \frac{L}{N} = \frac{1}{5 \times 10^5} = 0.2 \times 10^{-5}$

$m = 2 \times 10^{-6} \text{ m}$

15. $\sin \theta = 0.5$ for first order maximum in a diffraction grating. The value of angle θ is equal to:

- (A) 3° (B) 15°
- (C) 30° (D) 60°

Explanatory Answer: (C)

When $\sin \theta = 0.5$, $\theta = 30^\circ$ (without any other explanation)

16. Given that grating element $= 0.2 \times 10^{-3} \text{ cm}$ in case of a diffraction grating. Then number of lines per centimeter will be:

- (A) 5000 (B) 500
- (C) 50 (D) 5

Explanatory Answer: (A)

$N = ? \text{ grating element} = 0.2 \times 10^{-3} \text{ cm}$

Grating element $= \frac{L}{N}$

$N = \frac{L}{\text{grating element}} = \frac{1}{0.2 \times 10^{-3} \text{ cm}} = 5 \times 10^3 \text{ lines per cm}$

$= 5000 \text{ lines/cm}$

17. Given that number of lines per meter $= 5 \times 10^5$. Its grating element will be:

- (A) $0.2 \times 10^{-3} \text{ cm}$ (B) $0.2 \times 10^{-3} \text{ m}$
- (C) $0.2 \times 10^{-3} \text{ nm}$ (D) None of above

Explanatory Answer: (A)

$N = 5 \times 10^5 \text{ lines per meter}$

Grating element $= \frac{L}{N} = \frac{1}{5 \times 10^5} = 0.2 \times 10^{-5}$

$m = 0.2 \times 10^{-3} \text{ cm}$

TEST NO.10

1. A convex lens acts as diverging lens when the object is placed:

- (A) Between F and 2F (B) At 2F
- (C) With focal length (D) Beyond 2F

Explanatory Answer: (C)

Convex lens acts as a diverging lens only when object is placed within the focal length or at its focus.

2. How is the image formed by a convex lens affected if the upper half of the lens is covered with a paper:

- (A) The upper half of the image is cut off (B) The brightness of the image is reduced
- (C) The brightness of the image is increased (D) No effect at all

Explanatory Answer: (B)

By covering half of the objective lens, only brightness is reduced to half, due to entry of half the amount of incident light.

If the focal length of a convex lens is 5 cm,

then to get real and inverted image of the same size as that of object, the object should be placed at:

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

Explanatory Answer: (B)

To get the image of the same size as that of the same size as object, the object must be placed at a distance equal to $2f$, which is 10 cm in this case.

4. A grating with high resolving power can distinguish _____ difference in wavelengths:

- (A) Smaller (B) Larger
- (C) Zero (D) None of these

Explanatory Answer: (A)

We can use the formula $R = \frac{\lambda}{\Delta\lambda}$ for finding

the resolving power of a grating. Smaller the difference in the wavelengths to be resolved, greater is the resolving power of the grating.

5. A lens of 2 cm focal length is to be used as a magnifying glass. Its magnification is:

- (A) 13.5
(C) 0.5

- (B) 12.5
(D) 2.5

Explanatory Answer: (A)

$$M = 1 + \frac{d}{f} = 1 + \frac{25}{2} = 13.5.$$

6. When an angle α in a right angled triangle is very small, then approximately

- (A) $\alpha = \tan \alpha$ (B) $\alpha = \sin \alpha$
(C) Both A and B are correct (D) None of these is correct

Explanatory Answer: (C)

Let P, B and H denote the perpendicular, base and hypotenuse of a right angled triangle. Then $\sin \alpha = \frac{P}{H}$, $\cos \alpha = \frac{B}{H}$ and $\tan \alpha = \frac{P}{B}$. When angle α becomes smaller and smaller, actually perpendicular becomes smaller and approaches zero. But base becomes nearly equal to hypotenuse.

So when $\alpha \rightarrow 0$, $\sin \alpha \rightarrow 0$, $\tan \alpha \rightarrow 0$ but $\cos \alpha \rightarrow 1$.

Hence for smaller angles, $\alpha = \sin \alpha$, $\alpha = \tan \alpha$.

7. The eye-piece of a compound microscope acts as:

- (A) Converging lens (B) Converging mirror
(C) Magnifying glass (D) None of these

Explanatory Answer: (C)

The real image made by the objective of the compound microscope is made to exist within the focal length of the eye-piece so that eye-piece acts as magnifying glass.

8. The working of compound microscope is based on the principle of:

- (A) Reflection (B) Refraction
(C) Both A and B (D) None of these

Explanatory Answer: (B)

Since no mirror is used in compound microscope, hence no reflection takes place. Lenses always refract the rays.

9. The limit to which a microscope can be used to resolve details of an object, depends upon:

- (A) Wider objective and light of (B) Narrow objective and

short wavelength light of short wavelength

- (C) Narrow objective and light of longer wavelength (D) None of these

Explanatory Answer: (A)

Wider objective is necessary to allow maximum amount of light whereas light of shorter wavelength produces lesser diffraction effects and hence maximum details of object can be clearly seen without any scattering of light rays.

10. The magnifying power of an astronomical telescope increases with:

- (A) Decreasing f_o (B) Increasing f_e
(C) Increasing f_o (D) None of these

Explanatory Answer: (B)

$$M = \frac{f_o}{f_e} \text{ (for telescope)}$$

11. When the mirror rotates in Michelson method, any of its faces takes the position of very next face, then the angle subtended at the centre is:

- (A) 30° (B) 45°
(C) 60° (D) 75°

Explanatory Answer: (B)

Since there are 8 faces of the rotational mirror used in Michelson's method, hence the angle subtended by the motion of one face to the position of next face is $\frac{360^\circ}{8} = 45^\circ$.

12. In case of reflection of ray within a denser medium, angle of incident is _____ angle of reflection.

- (A) Greater than (B) Smaller than
(C) Equal to (D) None of these

Explanatory Answer: (C)

It does not matter whether the reflection is taking place within denser medium or rarer medium. It is always true that within any medium; angle of incidence is equal to angle of reflection.

13. The refractive index of a medium is the:

- (A) Ratio of speed of light in that medium to its speed in air (B) Ratio between frequencies of light in both media

- (C) Ratio of speed of light in air to its speed in that medium
 (D) None of these

Explanatory Answer: (C)

We use the formula $n = \frac{c}{v}$ for the answer.

14. We know that $\theta_2 = 90^\circ$ when $\theta_1 = \theta_c$. Then Snell's law takes the form:

- (A) $\sin \theta_c = \frac{n_1}{n_2}$ (B) $\sin \theta_c = n_1 n_2$
 (C) $\sin \theta_c = \frac{n_2}{n_1}$ (D) None

Explanatory Answer: (C)

Snell's law is

$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

when $\theta_1 = \theta_c$, then $\theta_2 = 90^\circ$

Putting the values, we get $\frac{\sin \theta_c}{\sin 90^\circ} = \frac{n_2}{n_1}$

$$\text{i.e., } \sin \theta_c = \frac{n_2}{n_1}$$

15. The property of light which makes light possible to be transmitted into

inaccessible places is:

- (A) Interference (B) Diffraction
 (C) Polarization (D) None of these

Explanatory Answer: (B)

Diffraction means bending of light when it meets an obstacle. Thus diffraction makes the light possible to be transmitted into inaccessible places.

16. Let a ray of light enters from air into two media of different refractive indices. The speed of light will be _____ proportional to refractive index.

- (A) Directly (B) Inversely
 (C) Sometimes directly (D) None of these sometimes inversely

Explanatory Answer: (B)

Formula $n = \frac{c}{v}$ tells that speed of light (v) in certain medium varies inversely to the refractive index of that medium.

TEST NO.11

1. At constant temperature, if the volume of a given mass of a gas is doubled, then the density of gas becomes:

- (A) Double (B) Remains constant
 (C) Half (D) None of these

Explanatory Answer: (C)

By making the volume doubled, the same amount of gas will occupy double space. Thus mass per unit volume is halved.

2. In the theory of dimensional analysis, heat may be properly represented by:

- (A) ML^2T^{-2} (B) MT^{-2}
 (C) $ML^{-1}T^{-1}$ (D) None of these

Explanatory Answer: (A)

Heat is a form of energy and thus it has dimensions of energy or work.

$$\text{Work} = Fd = \text{kg m sec}^{-2} \times \text{m} = \text{kg m}^2 \text{ sec}^{-2}$$

3. In an ideal gas, the molecules have: $= [ML^2T^{-2}]$

- (A) Kinetic energy only (B) Potential energy only
 (C) Both KE and PE (D) None of these

Explanatory Answer: (A)

This is assumption of kinetic theory that molecules of an ideal gas do not exert force on each other. Thus they have no potential energy.

4. At constant temperature, if the density of the gas is increased, its pressure will:

- (A) Decrease (B) Increase
 (C) Remains unchanged (D) None of these

Explanatory Answer: (B)

Increasing the density means increasing number of molecules per unit volume and

thus pressure exerted on the walls of the vessel will increase.

5. The nature of thermal radiation is similar to:

- (A) Ultraviolet rays (B) Light rays
(C) Both of them (D) None of them

Explanatory Answer: (C)

Thermal radiations, ultraviolet rays and light rays are all members of electromagnetic wave spectrum.

6. Pressure may be defined as _____ per second per unit area.

- (A) Change in force (B) Change in momentum
(C) Change in energy (D) Work done

Explanatory Answer: (B)

$$\text{Pressure} = \frac{\text{Force}}{\text{area}} = \frac{\text{Change of momentum}}{\text{time} \times \text{area}}$$

7. If a molecule with momentum mv strikes a wall and rebound then the change in momentum will be:

- (A) $-2mv$ (B) Zero
(C) $2mv$ (D) mv

Explanatory Answer: (A)

initial momentum = mv
final momentum = $-mv$
change in momentum = Final value - initial value
 $= (-mv) - (mv) = -2mv$

8. If N denotes the total number of molecules in a cubic vessel such that m is mass of each molecule and l is length of each side of vessel, then $\frac{mN}{l^3}$ gives the:

- (A) Force (B) Density
(C) Work done (D) Pressure

Explanatory Answer: (B)

mN is equal to total mass of all the molecules in the vessel and l^3 is volume of vessel. Thus $\frac{mN}{l^3}$ decides the density of gas in the vessel.

9. Tick the correct pair when M denotes molecular mass and other symbols carry usual meanings:

- (A) $N = nN_A$, $m = MN_A$ (B) $n = N N_A$, $M = mN_A$

- (C) $M = \frac{N_A}{N}$, $N_A = \frac{m}{M}$ (D) $N = nN_A$, $M = mN_A$

Explanatory Answer: (D)

Note that n denotes number of moles
 m = mass of a molecule
 M = molecular mass = mass of one mole of a gas
 N_A = Avogadro number
= number of molecules in one mole

$$\text{Thus } nN_A = N \text{ and } m = \frac{M}{N_A}$$

10. Average KE of a gas molecule has:

- (A) Direct relation with absolute temperature and inverse relation with pressure
(B) Direct relation with both absolute temperature and pressure
(C) Inverse relation with both absolute temperature and pressure
(D) None of these

Explanatory Answer: (B)

We should know that $P = \frac{2}{3} N_0$

$$\left\langle \frac{1}{2} mv^2 \right\rangle$$

$$T = \frac{2}{3k} \left\langle \frac{1}{2} mv^2 \right\rangle$$

11. When a gas is compressed:

- (A) Its internal energy decreases
(B) Its temperature decreases
(C) Its temperature increases
(D) None of these

Explanatory Answer: (C)

Compression of a gas raises its temperature and expansion of gas lowers its temperature.

12. In an isothermal process, the internal energy of the system:

- (A) Increases (B) Decreases
(C) Remains constant (D) None of these

Explanatory Answer: (C)

In an isothermal process, temperature remains constant and hence internal energy also remains constant.

13. Tick which of the following is not a state variable?

- (A) Heat energy (B) Pressure
(C) Entropy (D) Volume

Explanatory Answer: (A)

Heat energy is the energy in transit and cannot be measured unless its transfer is complete. Hence heat energy is not a state variable.

14. If P is the pressure and V is the volume, then PV will represent:

- (A) Power (B) Work
(C) Force (D) None of these

Explanatory Answer: (B)

Let us build up unit of PV

$$\text{i.e., } \frac{\text{Force}}{\text{Area}} \times \text{volume} = \text{N m}^{-2} \times \text{m}^3 = \text{Nm} =$$

Joule i.e., work

15. If A is the area and Δy is the distance moved by the piston, then $A\Delta y$ will represent:

- (A) Change in pressure (B) Density
(C) Change in volume (D) None of them

Explanatory Answer: (C)

Let us build up unit of $A\Delta y$

$$\text{i.e., } \text{m}^2 \times \text{m} = \text{m}^3 \text{ i.e., change in volume}$$

16. Given that $P = 10^4 \text{ N/m}^2$, Area of the piston = 0.1 m^2 and distance moved by the piston = 10^{-1} cm , then the work done by the gas is:

- (A) 1 J (B) 10^5 J
(C) 10^4 J (D) 10 J

Explanatory Answer: (A)

$$\text{Use work} = p A \Delta y = 10^4 \times 0.1 \times (10^{-3} \text{ meters}) = 1 \text{ Joule}$$

17. Suppose volume of gas in a cylinder is 3 c.c. If the piston is kept fixed and gas is heated from 5°C to 12°C , then the work

done is:

- (A) 2.3 J (B) 21 J
(C) Zero (D) None of these

Explanatory Answer: (C)

Since piston is fixed, no work will be done.

Since $C_v \Delta T = \Delta U$, hence $C_v \Delta T$ represents energy.

18. If the temperature difference between hot and cold body is greater, the heat engine is:

- (A) Not efficient (B) Less efficient
(C) More efficient (D) None of above

Explanatory Answer: (C)

$$\text{For heat engine } \eta = 1 - \frac{T_2}{T_1} = \frac{T_1 - T_2}{T_1}$$

$$\text{i.e., } \eta \propto (T_1 - T_2), \text{ hence}$$

the answer.

19. As the working substance of a heat engine completes a cycle, there is no change in:

- (A) Internal energy (B) Pressure
(C) Volume (D) None of these
(E) All of these

Explanatory Answer: (E)

When a cycle is complete, state variables like volume, temperature and pressure attain their initial values.

20. What will be efficiency of a carnot engine when it is operated between the temperatures 47°C and 127°C :

- (A) 20% (B) 50%
(C) 60% (D) 75%

Explanatory Answer: (A)

$$T_1 = 127^\circ\text{C} + 273 = 400 \text{ K,}$$

$$T_2 = 47^\circ\text{C} + 273 = 320 \text{ K}$$

$$\text{Now use } \eta = \left(1 - \frac{T_2}{T_1}\right) \times 100$$

TEST NO.12

1. Which of the following is the dielectric constant of metals?
- (A) Zero (B) One
(C) Infinity (D) Greater than one but finite

Explanatory Answer: (C)

2. Two charges q_1 and q_2 are placed in vacuum at distance d and force between them is F . If a medium of relative permittivity is introduced between them then new force will be:

- (A) $\frac{F}{4}$ (B) $\frac{F}{2}$
(C) $2F$ (D) $4F$

Explanatory Answer: (A)

$$F_{\text{med}} = \frac{F_{\text{vac}}}{\epsilon_r} = \frac{F}{4}$$

3. A charge Q is divided into two parts q_1 and q_2 . The maximum coulomb repulsion between the two parts is obtained when

ratio $\frac{q_1}{q_2}$ is:

- (A) 1 (B) $\frac{1}{2}$
(C) $\frac{1}{4}$ (D) $\frac{2}{3}$

Explanatory Answer: (A)

4. A metallic ball having charge 10^{-8}C moves from a point A at potential 600V to a point B at zero potential. Which of the following is the change in its K.E?

- (A) 6×10^{-6} erg (B) 6×10^{-6} J
(C) 6×10^6 J (D) -6×10^6 J

Explanatory Answer: (B)

$$\Delta V = 600 - 0 = 600\text{V}$$

$$q = 10^{-8}\text{C}$$

$$\Delta K.E = q\Delta V = 10^{-8} \times 600$$

$$\Delta K.E = 6 \times 10^{-6} \text{ J}$$

5. Electric field and electric potential inside hollow charged conducting sphere are respectively:

- (A) Zero, non zero (B) Non zero, zero

- (C) $0, \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$ (D) $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}, \frac{1}{4\pi\epsilon_0} \frac{q}{r}$

Explanatory Answer: (A)

6. Two point charges are $+2\text{C}$ and $+6\text{C}$ repel each other with a force of 12N. If a charge of -4C is given to each of these charges, the force now is:

- (A) Zero (B) 4N repulsion
(C) 4N attractive (D) 12N attractive

Explanatory Answer: (C)

New charges

$$q_1 = -2\text{C} \text{ \& } q_2 = 2\text{C}$$

$$F \propto q_1q_2$$

$$F = 4\text{N}$$

As q_1q_2 are opposite charges therefore force is attractive.

7. Two copper spheres of same radii one hollow and other solid are charged to the same potential then:

- (A) Both will hold same charge (B) Solid will hold more charge
(C) Hollow will hold more charge (D) Hollow cannot be charged

Explanatory Answer: (A)

8. The magnitude of an electric field E , such that an electron placed in it would experience an electric force equal to its weight, is given by:

- (A) Mge (B) $\frac{e}{mg}$
(C) $\frac{me}{g}$ (D) $\frac{mg}{e}$

Explanatory Answer: (D)

$$F_e = w$$

$$eE = mg$$

$$E = \frac{mg}{e}$$

9. When, 10^{14} electrons are removed from a neutral metal sphere then which of the following is the charge on sphere?
- (A) $16\mu\text{C}$ (B) $-16\mu\text{C}$
 (C) $32\mu\text{C}$ (D) $-32\mu\text{C}$

Explanatory Answer: (A)

$$n = 10^{14}$$

$$q = ne$$

$$q = 10^{14} \times 1.6 \times 10^{-19}$$

$$q = 16 \times 10^{-6}\text{C} = 16\mu\text{C}$$

10. Which of the following is not the energy stored between the plates of condenser?

- (A) $U = \frac{CV^2}{2}$ (B) $U = 2qV$
 (C) $U = \frac{q^2}{2C}$ (D) $U = \frac{qV}{2}$

Explanatory Answer: (B)

$$\text{As } U = \frac{1}{2} qv = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

Therefore $2qV$ is not the energy stored in capacitor

11. Which material sheet should be placed between the plates of parallel plate capacitor in order to increase its capacitance?

- (A) Mica (B) Copper
 (C) Tin (D) Iron

Explanatory Answer: (A)

12. A capacitor is charged to store energy U . The charging battery is disconnected. An identical capacitor is now connected in parallel to the first capacitor. The energy in each capacitor is:

- (A) $\frac{3U}{2}$ (B) U
 (C) $\frac{U}{2}$ (D) $\frac{U}{4}$

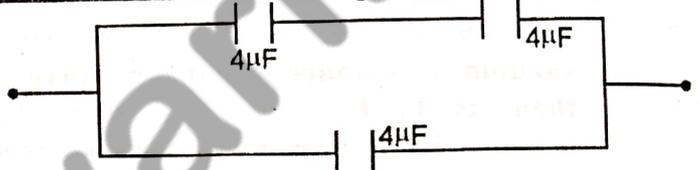
Explanatory Answer: (D)

$$\text{As } U = \frac{Q^2}{2C}$$

When charge reduces half then from above eq energy reduces one fourth

13. Three capacitors of $4\mu\text{F}$ each are to be connected in such a way that the net capacitance is $6\mu\text{F}$. Then
- (A) All the three be in series (B) All the three be in parallel
 (C) Connect two in series and one in parallel (D) Connect two in parallel and one in series

Explanatory Answer: (C)



14. When air is replaced by a dielectric medium of relative permittivity ϵ_r , the maximum capacity of the condenser _____.

- (A) Decreases ϵ_r times (B) Increases ϵ_r times
 (C) Increases ϵ_r^2 times (D) Remains unchanged

Explanatory Answer: (B)

$$C_{\text{med}} = C_{\text{vac}} \epsilon_r$$

15. If a charged capacitor is connected to earth, its charge:
- (A) Decreases (B) Increases
 (C) Remain same (D) none of above

Explanatory Answer: (A)

16. Time constant of fig (a). is t . which of the following is time constant of fig (b).

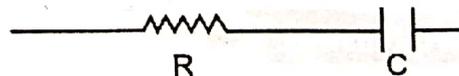


Fig.(A)

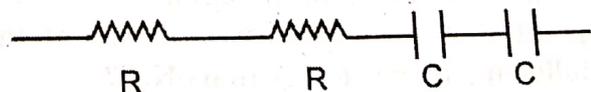


Fig.(B)

- (A) $4t$ (B) $2t$
 (C) t (D) $\frac{t}{2}$

Explanatory Answer: (C)

in fig (b)

$$R_{\text{eq}} = 2R$$

$$C_{\text{eq}} = \frac{C}{2}$$

$$R_{eq} \times C_{eq} = 2R \left(\frac{C}{2} \right)$$

$$= RC$$

$$= t$$

17. If a metal plate is placed between two point charges then electrostatic force between them:

- (A) remains constant (B) increases
(C) decreases (D) becomes zero

Explanatory Answer: (D)

$$F_{med} = \frac{F}{\epsilon_r}$$

For metal $\epsilon_r = \alpha$

$$F_{med} = \frac{F}{\alpha} = 0$$

18. An alpha particle is accelerated through potential difference of 10^6 V. Which of the following is its K.E?

- (A) 1MeV (B) 2MeV
(C) 4MeV (D) 8MeV

Explanatory Answer: (B)

$$K.E = q\Delta V$$

$$q = 2e = 2 \times 1.6 \times 10^{-19} C$$

$$\Delta V = 10^6 V$$

$$K.E = 2 \times 1.6 \times 10^{-19} \times 10^6 J$$

$$K.E = \frac{2 \times 1.6 \times 10^{-19} \times 10^6}{1.6 \times 10^{-19}} \text{ ev}$$

$$K.E = 2 \times 10^6 \text{ ev}$$

$$K.E = 2 \text{ MeV}$$

19. A parallel plate capacitor with oil between the plate ($\epsilon_r = 2$) has a capacitance "C". If oil is removed then capacitance of capacitor becomes:

- (A) C (B) $\frac{C}{2}$
(C) $\frac{C}{\sqrt{2}}$ (D) $\sqrt{2}C$

Explanatory Answer: (B)

$$C_{vac} = \frac{C_{med}}{\epsilon_r}$$

20. A parallel plate capacitor is first charged and then a dielectric slab is introduced between the plates. Which of the following quantity remains unchanged?

- (A) Energy (B) Capacity
(C) Potential (D) Charge

Explanatory Answer: (D)

TEST NO.13

1. The resistance of a wire is R. It is cut into four equal parts and bundled together in parallel. The equivalent resistance will be:

- (A) 4R (B) $\frac{R}{4}$ (C) $\frac{R}{16}$

(D) R

Explanatory Answer: (C)

When cut in: to four equal parts then resistant of each part is $\frac{R}{4}$

When four parts are bundled together in parallel then

$$\frac{1}{R_{eq}} = \frac{1}{R/4} + \frac{1}{R/4} + \frac{1}{R/4} + \frac{1}{R/4}$$

$$\frac{1}{R_{eq}} = \frac{16}{R}$$

$$R_{eq} = \frac{R}{16}$$

2. A wire of resistance R is stretched four times of its length uniformly. Its new resistance will be:

- (A) 16R (B) 4R
(C) $\frac{R}{4}$ (D) $\frac{R}{16}$

Explanatory Answer: (A)

$$\text{New length} = \ell' = 4\ell$$

$$\text{New area } A' = \frac{A}{4}$$

Initial resistance

$$R = \rho \frac{L}{A}$$

New resistance

$$R' = \rho \frac{L'}{A'}$$

$$R' = \frac{\rho(4\ell)}{\frac{A}{2}}$$

$$R' = 16 \left(\ell \frac{L}{A} \right)$$

$$R' = 16R$$

3. A car battery has emf 12V and internal resistance $5 \times 10^{-2} \Omega$. If it draws 60 A current, the terminal voltage of battery will be:

- (A) 3V (B) 5V
(C) 9V (D) 12V

Explanatory Answer: (C)

$$V_t = \mathcal{E} - Ir$$

4. In fig the current I is:

- (A) 1A (B) 2A
(C) 1.5A (D) 3A

Explanatory Answer: (B)

5. Of the two bulbs in a house, one glows brighter than the other. Which of the following has larger resistance?

- (A) The brighter bulb (B) The dim bulb
(C) Both have same resistance (D) Brightness does not depend on resistance

Explanatory Answer: (B)

6. The maximum output power gives the value:

- (A) $\frac{E^2}{4r}$ (B) $\frac{E}{4r}$ (C) $\frac{4E}{r}$ (D) $\frac{4r}{E}$

Explanatory Answer: (A)

7. Two wires of same metal have the same length but their area are in the ratio 3:1. The two wires are connected in series. The resistance of thicker wire is 10Ω . What is total resistance of combination?

- (A) 20Ω (B) $\frac{40}{3} \Omega$

(C) 30Ω (D) 40Ω

Explanatory Answer: (D)

8. How many electrons constitute current of one ampere?

- (A) 6.25×10^{18} (B) 6.25×10^{-18}
(C) 1.6×10^{19} (D) 1.6×10^{-19}

Explanatory Answer: (A)

9. The resistance of a wire is 1Ω . Which of the following is new resistance if length of wire is doubled?

- (A) 2Ω (B) 4Ω
(C) $\frac{1}{2} \Omega$ (D) $\frac{1}{4} \Omega$

Explanatory Answer: (A)

$$R \propto \ell$$

10. A carbon resistance reads red-red-black. What is its resistance?

- (A) 2.2Ω (B) 20Ω
(C) 22Ω (D) 220Ω

Explanatory Answer: (C)

11. Kirchhoff's current rule obeys the conservation of:

- (A) Momentum (B) Energy
(C) emf (D) Charge

Explanatory Answer: (D)

12. The reciprocal of resistance is called:

- (A) Conductivity (B) Conductance
(C) Capacitance (D) Reactance

Explanatory Answer: (B)

13. The amount of heat produced in a resistor when a current is passed through it can be found using:

- (A) Joule's law (B) Kirchhoff's rule
(C) Faraday law (D) Lenz's law

Explanatory Answer: (A)

$$H = I^2 R t$$

14. A uniform resistance wire of length L and diameter D has a resistance R. Another wire of same material has length 4L and diameter 2D, its resistance will be:

- (A) 2R (B) R
(C) $\frac{R}{2}$ (D) $\frac{R}{4}$

Explanatory Answer: (B)

15. In which from is energy in a battery stored?

- (A) Mechanical (B) Electrical
(C) Chemical (D) Kinetic

Explanatory Answer: (C)

16. Mass of substance liberated during electrolysis in a given time depends upon:
(A) Resistance (B) Electric power
(C) Working temperature (D) Electric current

Explanatory Answer: (D)

17. An electric bulb of 100 watt is connected to supply of 220V. Which of the following is the resistance of filament?
(A) 100Ω (B) 484Ω
(C) 2200Ω (D) 22000Ω

Explanatory Answer: (B)

$$R = \frac{V^2}{P}$$

$$R = \frac{(200)^2}{100}$$

$$R = 484\Omega$$

18. Which of the following is commercial unit of electricity?
(A) Watt (B) Kilowatt
(C) Kilowatt hour (D) Horse power

Explanatory Answer: (C)

19. A 100W and 25W bulb are connected in series with a 220 V supply. Which of the following is the net power consumed?
(A) 20W (B) 16W

- (C) 10W (D) 4W

Explanatory Answer: (A)

$$\frac{1}{P} = \frac{1}{P_1} + \frac{1}{P_2}$$

$$P = \frac{P_1 P_2}{P_1 + P_2}$$

$$P = \frac{100 \times 25}{100 + 25}$$

$$P = \frac{2500}{125}$$

$$P = 20W$$

20. A copper wire is connected across a battery. The drift velocity of electron is V . If another wire of same length and double the radius is connected across the same battery, The drift velocity will be:
(A) $4V$ (B) $2V$
(C) V (D) $\frac{V}{2}$

Explanatory Answer: (C)

$$V_d = \frac{I}{nAe}$$

Area increase four time and current also increase four times therefore drift velocity remain same