# Physics

# Self-Test Review Questions

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## Grade-11

## Preparatory Students

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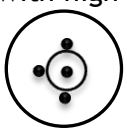
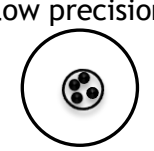
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**Use the following constants whenever necessary:**

- Acceleration due to gravity, $\mathbf{g = 10\ m/s^2}$
- Density of water, $\boldsymbol{\rho = 1000\ kgm^{-3}}$
- Specific heat capacity of water, $\boldsymbol{c = 4200\ J/kg.K}$
- For water; Latent heat of fusion, $\boldsymbol{L_F = 80\ cal/gm = 3.3 \times 10^5 J/kg}$
  Latent heat of vaporization, $\boldsymbol{L_V = 540\ cal/gm = 2.3 \times 10^6 J/kg}$
- Moment of Inertia Uniform Bodies about their Center of Mass
  - Hoop, $\mathbf{I = MR^2}$, Solid Disc, $\mathbf{I = \frac{1}{2}MR^2}$, Solid Sphere, $\mathbf{I = \frac{2}{5}MR^2}$
  - Spherical Shell, $\mathbf{I = \frac{2}{3}MR^2}$, Thin Cylindrical Shell, $\mathbf{I = MR^2}$
  - Long Thin Rod of length L, $\mathbf{I = \frac{1}{12}ML^2}$
- $\mathbf{\sin 37^0 = \cos 53^0 = 0.6}$ and $\mathbf{\sin 53^0 = \cos 37^0 = 0.8}$
- $\mathbf{\sin 30^0 = \cos 60^0 = 0.5}$ and $\mathbf{\sin 60^0 = \cos 30^0 = 0.9}$
- $\mathbf{\sin 0^0 = \cos 90^0 = 0.0}$ and $\mathbf{\sin 90^0 = \cos 0^0 = 1.0}$
- $\boldsymbol{\pi = 3.14}$ *and* $\boldsymbol{\pi^2 = 10}$

## SECTION-1: MEASUREMENTS

1. Which one of the following group of quantities represents a set of fundamental scalar quantities?
   - **A.** (Mass, Power, Time)
   - **B.** (Second, Meter, Kelvin)
   - C. (Velocity, Force, Acceleration)
   - D. (Temperature, Mass, Time)
2. The measurements of quantity $\boldsymbol{Q}$ is based on a simple linear equation $\boldsymbol{Q = xyz}$ such that the dimensions of $[x]$, $[y]$, **and** $[z]$ are $\boldsymbol{LT^{-2}}$ , $\boldsymbol{ML^{-3}}$ and $\boldsymbol{L}$, respectively? What might be quantity **Q?**
   - **A.** Force **B.** Work **C.** Pressure **D.** Power
3. Which one of the following is **CORRCT** about the units and dimension of angular displacement $\boldsymbol{\theta}$ and coefficient of friction ?
   - **A.** Both $\boldsymbol{\theta}$ and $\boldsymbol{\mu}$ have units and dimensions.
   - **B.** Both $\boldsymbol{\theta}$ and $\boldsymbol{\mu}$ have no units and dimensions.
   - **C.** $\boldsymbol{\theta}$ has a unit but not dimension.
   - **D.** $\boldsymbol{\mu}$ has a dimension but not unit.
4. When finding the area of a rectangle of dimensions 600m by 46m, the result should be reported as:-
   - **A.** 27,600 $m^2$ **B.** 28,000 $m^2$ **C.** 27,000 $m^2$ **D.** 30,000 $m^2$
5. The number of decimal places of the result of addition of numbers is:-
   - **A.** equal to the smallest number of decimal places of any term in the sum.
   - **B.** less than the smallest number of decimal places of any term in the sum.
   - **C.** equal to the highest number of decimal places of any term in the sum.
   - **D.** greater than the highest number of decimal places of any term in the sum.
6. A particular Ohmmeter provides the measurement readings: $3.89\ \Omega$, $3.81\ \Omega$, and $3.79\ \Omega$. If the actual resistance is $5.86\ \Omega$ , then the measurements taken most probably considered as:
   - **A.** Imprecise and Inaccurate
   - **B.** Precise but Inaccurate
   - **C.** Imprecise but accurate
   - **D.** Precise and Accurate
7. Which one of the following has the largest number of significant figures?
   - **A.** 20.000 **B.** 0.000002 **C.** $2 \times 10^5$ **D.** 20.02
8. Which one of the following is used to describe a quantitative measure of how much your measured values deviate from a standard or expected value?
   - **A.** Precision **B.** Accuracy **C.** Uncertainty **D.** Approximation
9. One Ammeter provides the current readings: 1.84 **A**, 1.65 **A** and 1.24 **A**. Which one of the following is the average reading of the current with appropriate uncertainty?
   - **A.** $1.58 \pm 0.04$ A **B** . $1.6 \pm 0.6$ A **C.** $1.6 \pm 0.3$ A **D.** $1.58 \pm 0.08$ A
10. Which one of the following cannot be considered as a significant figure?
    - **A.** Any number of trailing zeros.
    - **B.** All non-zero digits in a number.
    - **C.** Zeros used to position the decimal point.
    - **D.** Zeros between two non-zero numbers.
11. Which one of the following types of errors generally caused by a bias in measurements?
    - **A.** Zeros error **B.** Random error **C.** Parallel error **D.** Systematic error
12. Two points are 2 m far apart. What will be the result when a meter that has millimeter scale is used?
    - **A.** 2.000 m **B.** 2.00 m **C.** 2.0 m **D.** 2 m
13. The four small black dots represent four successive readings of measurements taken by four students, such that the smaller inner circle is the true value of the measurement. Which of the four students' falls on the kind of measurement with high accuracy and low precision?

    **A.**  **B.**  **C.**  **D.** 

14. When the volume of a sphere is measured its radius has an uncertainty reading of $\pm \boldsymbol{0.05cm}$ . What is the percentage uncertainty of the volume?
    - **A.** $\boldsymbol{4.25cm \pm 1.2\%}$ **B.** $\boldsymbol{4.25cm \pm 2.4\%}$ **C.** $\boldsymbol{4.30cm \pm 3.2\%}$ **D.** $\boldsymbol{4.25V \pm 3.5\%}$
15. When the number 8673 is rounded to the nearest hundreds will be equal to:-
    - **A.** 8000 **B.** 8700 **C.** 8670 **D.** 8600

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## SECTION -2: VECTORS

**1.** Which one of the following is CORRECT about vector $\vec{A} = \hat{\imath} + \hat{\jmath}$ ?

**A.** The magnitude of the vector $\vec{A}$ is one.
**B.** $\vec{A}$ makes an angle of 90° with the x-axis.
C. A unit vector in the direction of $\vec{A}$ is $\frac{1}{\sqrt{2}}(\hat{\imath} + \hat{\jmath})$.
D. Vector $\vec{B} = \hat{\imath} - \hat{\jmath}$ is opposite to vector $\vec{A}$.

**2.** Which one of the following operation of unit vectors in clockwise system gives a null vector?

**A.** $\hat{\imath} \times (\hat{\imath} \times \hat{k})$ **B.** $\hat{\imath} \cdot (\hat{\jmath} + \hat{k})$ **C.** $\hat{\imath} \times (\hat{\imath} + \hat{k})$ **D.** $\hat{\imath} \cdot (\hat{\jmath} \times \hat{k})$

**3.** Which one of the following statement is **FALSE** for two non-zero vectors $\vec{a}$ and $\vec{b}$ ?

**A.** If $|\vec{a}| = |\vec{b}| \implies \vec{a} = \vec{b}$ .
**B.** $\vec{a} \cdot (\vec{a} \times \vec{b}) = 0$
**C.** If $|\vec{a} + b| = |\vec{a} - \vec{b}| \implies \vec{a} \perp \vec{b}$
**D.** If $\vec{a} \perp \vec{b}$ , then $\vec{a} \cdot \vec{b} = 0$.

**4.** Given three vectors , $\vec{A} = \hat{\imath} - 2\hat{k}$, $\vec{B} = 2\hat{\imath} + \hat{k}$ and $\vec{C} = -2\hat{\jmath}$ ,then what is the value of $(\vec{A} \times \vec{B}) \cdot \vec{C}$?

**A.** -10 **B.** 20 **C.** 10 **D.** 8

**5.** Which vector describes a displacement of 10 units in a direction 37° below the negative x-axis?

**A.** $6\hat{\imath} + 8\hat{\jmath}$ **B.** $-6\hat{\imath} - 8\hat{\jmath}$ **C.** $6\hat{\imath} - 8\hat{\jmath}$ **D.** $-6\hat{\imath} + 8\hat{\jmath}$

**6.** If vector $\vec{A}$ points northward and $\vec{B}$ points eastward, then what is the direction of $\vec{B} - \vec{A}$?

**A.** North of East. **B.** South of East **C.** South of West **D.** North of West

**7.** If $\vec{a} = \hat{\imath} + \hat{\jmath} - 2\hat{k}$ , $\vec{b} = -\hat{\imath} + 2\hat{\jmath} + \hat{k}$ and $\vec{c} = \hat{\imath} - 2\hat{\jmath} + 2\hat{k}$, then which one of the following is a unit vector parallel to $\vec{a} + \vec{b} + \vec{c}$ ?

**A.** $\frac{\hat{\imath}+\hat{\jmath}+\hat{k}}{3}$ **B.** $\frac{\hat{\imath}-2\hat{\jmath}+\hat{k}}{\sqrt{6}}$ **C.** $\frac{2\hat{\imath}+\hat{\jmath}+\hat{k}}{\sqrt{6}}$ **D.** $\frac{\hat{\imath}-\hat{\jmath}+\hat{k}}{\sqrt{3}}$

**8.** What is scalar projection of vector $\vec{A} = 3\hat{\imath} + \hat{\jmath} + \hat{k}$ along vector $\vec{r} = 2\hat{\imath} + 2\hat{\jmath} + \hat{k}$ ?

**A.** 2 **B.** 3 **C.** 4 **D.** 7

**9.** Two dimensional non-zero vectors $\vec{a}$ and $\vec{b}$ both lie on xz-plane of the coordinate system. Which one of the following could be a unit vector perpendicular to $\vec{a} \times \vec{b}$ ?

**A.** $\hat{\imath}$ **B.** $\hat{\jmath}$ **C.** $\hat{k}$ **D.** $\hat{\imath}$ **or** $\hat{k}$

**10.** Which one of the following vector's operation gives a null vector?

**A.** The vector product of two non-zero equal vectors.
**B.** The scalar product of two non-zero parallel vectors.
**C.** The cross product of two non-zero perpendicular vectors.
**D.** The dot product of a non-zero vector with its self.

**11.** For what positive values of $m$ & $n$, where $n = 3m$, vector $\hat{u} = \frac{m\hat{\imath}++\sqrt{6}\hat{\jmath}+n\hat{k}}{4}$ will be a unit vector?

**A.** $m = 2, n = 6$ **B.** $m = 3, n = 9$ **C.** $m = 0, n = 0$ **D.** $m = 1, n = 3$

**12.** If vector $\vec{A}$ points northward and vector $\vec{B}$ points eastward, then what is the direction of $\vec{B} - \vec{A}$?

**A.** North of East. **B.** South of East **C.** South of West **D.** North of W

**13.** If $\vec{A} + \vec{B} = \hat{\imath} + \hat{\jmath}$ and $\vec{A} - \vec{B} = \hat{\imath} - \hat{\jmath}$, then what is vector $\vec{A} \cdot \vec{B}$?

**A.** 0 **B.** 1 **C.** 2 **D.** -2

**14.** Vectors $\vec{a} = 3\hat{\imath} + 2\hat{\jmath} - m\hat{k}$ and $\vec{b} = m\hat{\imath} + 5\hat{\jmath} - 2\hat{k}$ will be perpendicular to each other if $m$ equals:

**A.** $\pm 2$ **B.** 0 **C.** $\pm 4$ **D.** $\pm 1$

**15.** If $\hat{u}$, $\hat{v}$ and $\hat{w}$ are unit vectors such that $\hat{u} + \hat{v} = \hat{w}$ , then the angle between $\hat{u}$ and $\hat{v}$ *is:-*

**A.** 90° **B.** 60° **C.** 0° **D.** 120°

**16.** Which one of the following mathematical operation on unit vectors is **INCORRECT**?

**A.** $\hat{\imath} \cdot (\hat{\jmath} \times \hat{k}) = 1$ **B.** $\hat{\imath} \times (\hat{\jmath} + \hat{\imath}) = -\hat{k}$ **C.** $\hat{\imath} \times (\hat{\jmath} \times \hat{k}) = 0$ **D.** $(\hat{\imath} \times \hat{k}) \cdot (\hat{\imath} \times \hat{\jmath}) = 0$

**17.** Which one of the following mathematical operation on system of vectors is legitimate?

**A.** $(\vec{P} \cdot \vec{Q}) + \vec{R}$ **B.** $\vec{P} \times (\vec{Q} \cdot \vec{R})$ **C.** $\vec{P} \cdot (\vec{Q} \times \vec{R})$ **D.** $(\vec{P} \times \vec{Q})\vec{R}$

**18.** Given two non-zero vectors $\vec{a}$ and $\vec{b}$, the value of $(|\vec{a} \cdot \vec{b}|)^2 + (|\vec{a} \times \vec{b}|)^2$ equals:

**A.** 1 **B.** *ab* **C.** $a^2 b^2$ **D.** $2\, a^2 b$

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**19.** Suppose $\vec{a} + \vec{b} = \vec{c}$ and $\vec{a} \cdot \vec{b} = -|a||b|$, such that the components of $\vec{c}$ are $c_x = +12, c_y = -8$ and $c_z = -4$. If the magnitude of vector $\vec{a}$ is one-third that of $\vec{b}$, then what are the components of $\vec{a}$?

**A.** $a_x = +6,\ a_y = -4\ \&\ a_z = -2$ **C.** $a_x = +3,\ a_y = -2\ \&\ a_z = -1$

**B.** $a_x = -6,\ a_y = +4\ \&\ a_z = +2$ **D.** $a_x = -3,\ a_y = +2\ \&\ a_z = +1$

**20.** Which one of the following vectors is **NOT** a unit vector?

**A.** $\hat{\imath} + \hat{\jmath} + \hat{k}$ **B.** $0.8\hat{\imath} - \sqrt{0.2}\hat{\jmath} + 0.4\hat{k}$ **C.** $\frac{4\hat{\imath} - \hat{\jmath} - \hat{k}}{3\sqrt{2}}$ **D.** $\frac{\sqrt{3}}{4}\hat{\imath} - 0.5\hat{\jmath} + 0.75\hat{k}$

## SECTION -3: KINEMATICS (ONE DIMENSIONAL)

**1.** Which one of the following is WRONG about uniformly rectilinear motion?

**A.** The body covers equal distance in equal intervals of time.
**B.** The average and instantaneous velocities have the same magnitude.
**C.** The velocity of the body changes uniformly throughout the motion.
**D.** The velocity and the speed of the body have the same magnitude.

**2.** Two cars start to move at once from the same point in the same direction with a velocity of 20 m/s and 25 m/s. What is the separation distance between the cars after one minute?

**A.** 1200 m **B.** 1500 m **C.** 300 m **D.** 2700 m

**3.** A car goes the first and the second half of its path at speeds of 12 m/s and 20 m/s, respectively, along a straight rod. What is the average speed for the whole trip?

**A.** 15 m/s **B.** 8 m/s **C.** 18 m/s **D.** 16 m/s

**4.** A body goes at 15 m/s for the first 8 sec and then a distance of 300 m at 25 m/s along a straight line, and then what is its average speed for the whole path?

**A.** 10 m/s **B.** 21 m/s **C.** 20 m/s **D.** 14 m/s

**5.** An object can have a:-

**A.** constant velocity even through its acceleration is non-zero.
**B.** constant velocity and still have varying speed.
**C.** zero velocity even though its acceleration is not zero.
**D.** constant speed even though its acceleration is non-zero.

**6.** A body initially moving at 4 m/s accelerates at the rate of 2 m/s$^2$. What is the average velocity of the body during the first 5 sec of its motion?

**A.** 6 m/s **B.** 7 m/s **C.** 14 m/s **D.** 10 m/s

**7.** Initially moving at a speed 6 m/s along a straight road, a body attains a speed of 30 m/s in 12 sec. What is its displacement during the 5$^{th}$ sec of its motion?

**A.** 40 m **B.** 55 m **C.** 95 m **D.** 15 m

**8.** Which one of the following is **FALSE** about the kinematics of a particle in space?

**A.** A body can have eastward velocity while having westward acceleration.
**B.** The direction of the velocity might change when its acceleration is constant.
**C.** There can be motion in two dimensions with an acceleration is only in one dimension.
**D.** The acceleration and velocity of a body have the same direction for decelerated motion.

**9.** The displacement of a particle along the x-direction as a function of time is given by $x(t) = 6t^2 - t^3$, where $x$ is in meter and $t$ s in second. What are the stopping time and stopping distance?

**A.** 2 s and 16 m **B.** 4 s and 32 m **C.** 8 s and 64 m **D.** 3 s and 24 m

**10.** The velocity of a uniformly accelerated object at time $t = 2\ s$ and then two seconds later are $20\ m/s$ and $28\ m/s$, respectively. What are its initial velocity and acceleration?

**A.** 12 m/s, 4 m/s$^2$ B. 24 m/s, 8 m/s$^2$ **C.** 24 m/s, 4 m/s$^2$ **D.** 12 m/s, 8 m/s$^2$

**11.** A ball thrown vertically upward with a speed of 5 m/s from the top of a tower takes 4 sec to reach to the ground. What is the height of the tower?

**A.** 60 m **B.** 80 m **C.** 20 m **D.** 100 m

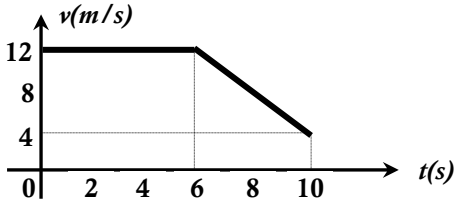
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**12.** The position of a body along the $x-axis$ in SI units is given by the equation $x(t) = -t^2 + 10t$. Which one of the following is **INCORRECT** about the kinematic of the body?

**A.** The initial velocity is 10 m/s.
**B.** The stopping time is 5 sec.
**C.** The acceleration is -1.0 m/s$^2$.
**D.** The stopping distance is 25 m.

**13.** What is the total displacement of a body shown in velocity-time graph for the first 10 s of motion?

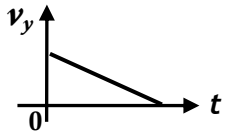
**A.** 64 m
**B.** 72 m
**C.** 96 m
**D.** 120 m

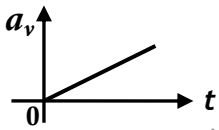


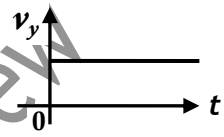

**14.** Standing on a roof, you simultaneously throw one RED ball straight up and drop another BLUE from rest. Which hits the ground first? Which hits the ground moving faster?

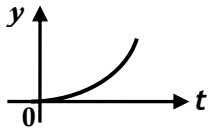
**A.** The RED ball hits first; the BLUE ball hits moving faster.
**B.** The BLUE ball hits first; the RED ball hits moving faster.
**C.** The BLUE ball hits first and also it hits moving faster.
**D.** The RED ball hits first and also it hits moving faster.

**15.** A body is dropped from a certain height above the ground in the absence of air resistance. Which one of the following graph most describes the motion the body?

**A.** 


**B.** 


**C.** 


**D.** 


**16.** At instant a red ball is dropped from a point 30 m above the ground, a black ball is thrown upward from the ground at 15 m/s along the same line. At what point above the ground do they collide?

**A.** 20 m **B.** 10 m **C.** 15 m **D.** 5 m

**17.** A ball falls freely from the height 7.2 m and rebounds to a height of 5.0 m relative to the ground. If the time contact between the floor and the ball lasts for 0.50 s, then what is the average acceleration of the ball during the contact time?

**A.** 20 m/s$^2$ **B.** 4 m/s$^2$ **C.** 10 m/s$^2$ **D.** 44 m/s$^2$

**18.** A man standing in an elevator toss upward a coin with a speed of 2 m/s at a height 2.4 m above the floor of the elevator. If the elevator is ascending upward with a constant speed of 3 m/s, how long does it take for the coin to strike the floor?

**A.** 0.6 s **B.** 0.8 s **C.** 1.0 s **D.** 1.5 s

**19.** A car and a motorist depart simultaneously when the motorist is 50 m behind the car along a straight road. The car moves at constant velocity of 15 ms$^{-1}$ while the motorist uniformly accelerates at the rate of 2 ms$^{-2}$. How long does the motorist take to surpass the car?

**A.** 15 s **B.** 25 s **C.** 10 s **D.** 5 s

**20.** An object is released from rest from a 180 m high tower? What is the total displacement covered by the object in the last seconds of its motion?

**A.** 125 m **B.** 55 m **C.** 45 m **D.** 1550 m

## SECTION-4: DYNAMICS OF TRANSLATION

**1.** Consider the following two statements.

**I.** It is possible for an object to have motion in the absence of forces on the object.
**II.** It is possible to have forces on an object in the absence of motion of the object.

Which one of the following is **CORRECT** about the above two statements?

**A.** Both statements are correct.
**B.** Neither statement is correct.
**C.** Only statement 'I' is correct.
**D.** Only statement 'II' is correct.

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**2.** Which one of the following is **CORRECT** about the inertia of a body?

**A.** Inertia always opposes state of motion. **C.** Bodies of large masses usually have high inertia.
**B.** The SI unit of inertia is the kilogram. **D.** Inertia is the measure of the mass of the body.

**3.** Which one of the following is **WRONG** about Newton's law of motion?

**A.** Forces in nature do always exist in pair.
**B.** Force is the main cause of acceleration.
**C.** A constant force provides a constant velocity.
**D.** No net force is needed to keep motion with constant velocity.

**4.** Which one of the following does NOT affect the magnitude of the normal force?

**A.** The orientation of the plane of the surface. **C.** The weight of the object.
**B.** The degree of the roughness of the surface. **D.** The direction of the applied force.

**5.** You press your physics textbook flat to the right against a vertical wall with your hand. What is the most likely direction of the friction force exerted by the wall on the book?

**A.** Right **B.** Upward **C.** Left D. Downward

**6.** An object is moving on a smooth horizontal surface due to the action of two equal and opposite horizontal forces. Which one of the following is **INCORRECT** about the dynamics of the object?

**A.** The resultant force acting on the object is zero. **C.** The object's velocity does not change.
**B.** The forces satisfy Newton's third law of motion. **D.** The acceleration of the body is zero.

**7.** If the apparent weight of a man standing on a scale of an elevator is greater than his true weight, then the elevator is moving:-

**A.** Upward with constant acceleration. **C.** downward with constant acceleration
**B.** Downward with constant velocity. **D.** upward with constant velocity.

**8.** A 50 kg body is accelerated upward with an acceleration of 2 $m/s^2$ by a means of a light inextensible cord. What is the tension force in the cord?

**A.** 500 N **B.** 600 N **C.** 400 N **D.** 100 N

**9.** A 20 kg body is subjected to the following forces; $\vec{F}_1 = (50\hat{\imath} - 40\hat{\jmath} + 30\hat{k})N$, $\vec{F}_2 = (-30\hat{\imath} + 50\hat{\jmath} - 20\hat{k})N$ and $\vec{F}_3 = (20\hat{\imath} - 30\hat{\jmath} - 50\hat{k})N$. What is the magnitude of the acceleration of the body?

**A.** 9 $m/s^2$ **B.** 2 $m/s^2$ **C.** 3 $m/s^2$ **D.** 6 $m/s^2$

**10.** A 400 gm mass falls vertically downward with an acceleration of 7.5 $m/s^2$. What is the air drag force?

**A.** 1.0 N **B.** 3.0 N **C.** 4.0 N **D.** 7.0 N

**11.** A 6 kg object moves along the $x$-direction according to the equation $x(t) = 2t^3 - 10t^2 + 12t$, where $x$ is in meter and $t$ is in seconds. What is the instantaneous force exerted on the object at $t = 2\ s$?

**A.** 12 N **B.** 36 N **C.** 24 N **D.** 48 N

**12.** A 100 N force gives an acceleration of 10 $m/s^2$ to a mass $m_1$ and an acceleration of 2.5 $m/s^2$ to a mass $m_2$. What acceleration will it give on the masses when they are fastened together?

**A.** 10 $m/s^2$ **B.** 2 $m/s^2$ **C.** 4 $m/s^2$ **D.** 6 $m/s^2$

**13.** A block pushed horizontally with a velocity of 8 m/s and then comes at rest after sliding a horizontal distance of 16. What is the coefficient of kinetic friction between the block and the ground?

**A.** 0.20 **B.** 0.50 **C.** 0.25 **D.** 0.40

**14.** For the two blocks shown in Fig-1, neglecting frictional forces, if $\vec{F}_1 > \vec{F}_2$, the magnitude of the mutual force of interaction between the blocks at their contact face is:-

**A.** Greater than both forces $\vec{F}_1$ and $\vec{F}_2$. **C.** Less than $\vec{F}_2$ and greater than $\vec{F}_1$
**B.** Less than both forces $\vec{F}_1$ and $\vec{F}_2$. **D.** Less than $\vec{F}_1$ and greater than $\vec{F}_2$

**15.** Consider a 20 kg box dragged horizontally by a force $\vec{F} = (-160\hat{\imath})N$ on a rough surface with friction coefficient 0.5 as shown in Fig-2. Identify the **INCORRECT** statement.

**A.** The normal force is equal to $(+200\hat{\jmath})N$ **C.** The resultant force is equal to $(+60\hat{\imath})N$.
**B.** The friction force is equal to $(+100\hat{\imath})N$ **D.** The acceleration is equal to $(-3\hat{\imath})\ m/s^2$

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Fig-(1)

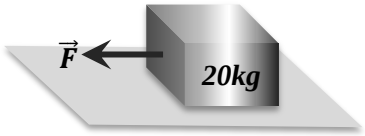
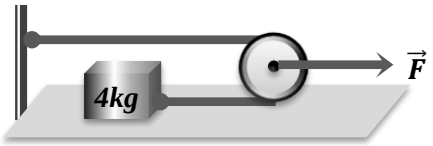



Fig-(2)

Fig-(3)




**16.** In Fig-3, a 16 N horizontal force is applied on the block. If the pulley and the ropes are massless, then what is the acceleration of the block in the absence of any frictional losses?

**A.** 2 m/s$^2$ **B.** 8 m/s$^2$ **C.** 4 m/s$^2$ **D.** 1 m/s$^2$

**17.** In Fig-4, the coefficient of friction at the top and bottom of the 6 kg block is 0.2. What maximum horizontal force $\vec{F}$ must be exerted on the 6 kg block for the upper block does not slide on the top of the lower block?

**A.** 50 N **B.** 60 N **C.** 40 N **D.** 10 N

**18.** In Fig-(5), the system is released from rest in the absence of any frictional forces when $m_1$ is 1.6 m above the floor. If $\boldsymbol{m_1 = 3m_2}$, then with what speed does block $\boldsymbol{m_1}$ strike the floor?

**A.** 12 m/s **B.** 2 m/s **C.** 8 m/s **D.** 4 m/s

Fig-(4)

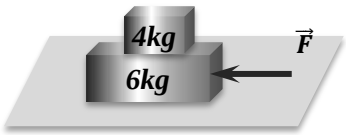



Fig-(5)

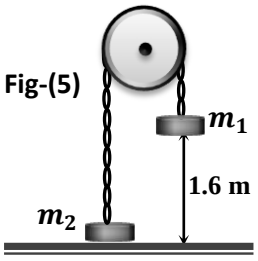



Fig-(6)

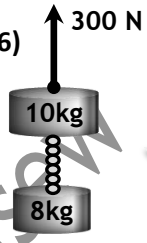
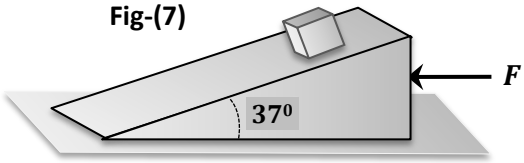



Fig-(7)




**19.** In Fig-(6), if the rope that connects the two blocks is uniform and weighs 2-kg, then what is the tension force at the midpoint of the rope?

**A.** 150 N **B.** 120 N **C.** 30 N **D.** 270 N

**20.** In Fig-(7), What horizontal force $\boldsymbol{F}$ must be applied on a 10-kg triangular block to keep a 2-kg rectangular block at rest relative to the plane of the rectangular block in the absence of any friction?

**A.** 90 N **B.** 160 N **C.** 120 N **D.** 60 N

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## SECTION-5: KINEMATICS (TWO DIMENSIONAL)

**1.** A jet aircraft is flying horizontally with a speed of 200 m/s at a height of 180 m. What horizontal distance from the target must the pilot release the bomb to hit the target on the ground?

**A.** 3.6 km **B.** 2.4 km **C.** 3.0 km **D.** 1.2 km

**2.** A projectile thrown horizontally at a speed of $\boldsymbol{v_0}$ falls vertically downward for a height of 20 m while covering a horizontal displacement of 30 m. What is the initial horizontal speed $\boldsymbol{v_0}$ of the projectile?

**A.** 15 m/s **B.** 60 m/s **C.** 30 m/s **D.** 6 m/s

**3.** Which one of the following quantity is zero at the maximum height of a projectile?

**A.** The resultant velocity. **C.** The x-component of the velocity.
**B.** The acceleration. **D.** The vertical component of the velocity.

**4.** A body is shot in air at a velocity of $(\boldsymbol{20\hat{i} + 15\hat{j}})\ m/s$ from the ground. What is its range?

**A.** 30 m **B.** 40 m **C.** 60 m **D.** 80 m

**5.** A body shot horizontally from a 50 m high tower and then hits a vertical wall at a point 30 m above the ground. If the wall is 30 m from the tower, which one of the following is WRONG about the kinematics of the body?

**A.** Its vertical fall height is 10 m. **C.** The initial speed is 15 m/s.
**B.** The time of flight is 2 sec. **D.** The final striking speed is 20 m/s.

**6.** Which one of the following is **FALSE** about the velocity of a body under uniform circular motion?
- **A.** The velocity vector at a point directed towards the center of the rotation.
- **B.** The velocity vector at a point is perpendicular to the acceleration.
- **C.** The tangential component of the velocity vector is zero.
- **D.** The magnitude of the velocity is constant throughout the motion.

**7.** Which of the following pairs have the same direction for an object moving in a horizontal circle?
- **A.** Displacement & centripetal acceleration.
- **B.** Centripetal acceleration and centripetal force.
- **C.** Centripetal force & velocity.
- **D.** Velocity & centripetal acceleration.

**8.** A 5-kg body rotates in a horizontal circle of radius 20 m with a period of revolution 4 sec. What is the centripetal force exerted on the body?
**A.** 125 N **B.** 500 N **C.** 250 N **D.** 320 N

**9.** A 5 kg body attached at the end of a 2 m long light inextensible rope is rotating in a vertical circle with constant speed of 6 m/s. The tension force in the rope as the body just passes the lowest point is:-
**A.** 140 N **B.** 40 N **C.** 90 N **D.** 50 N

**10.** A 1.8-kg body attached at the end of a light inextensible string rotates in a vertical circle of fixed radius under a constant tension force of 82 N. What is the ratio of the speed of the body at the top to its speed at the bottom?
**A.** 5:4 **B.** 25:16 **C.** 16:25 **D.** 4:5

**11.** An automobile rounds a curved flat road of curvature 64 m at a speed of 16 m/s. What minimum coefficient of friction must exist for the car not to slip?
**A.** 0.80 **B.** 0.50 **C.** 0.25 **D.** 0.40

**12.** A 0.5-kg ball attached at the end of a 1.0 m long light inextensible cord swings in a vertical circle. The center of rotation is 4.0 m above the ground. If the ball leaves off its path at the highest point where the tension in the cord is 3.0 N, then how long does it take and how far horizontal distance travels just before it lands on the ground?
- **A.** 2 sec & 4.0 m
- **B.** 1 sec & 4.0 m.
- **C.** 1 sec & 8.0 m
- **D.** 2 sec & 8.0 m

**13.** Two identical objects **X** and **Y** are in circular orbits about the center of the earth, with **Y** at a greater altitude. Which one of the following statements is **TRUE** about objects **X** and **Y**?
- **A.** Object **X** has greater period.
- **B.** Object **Y** has greater speed.
- **C.** Object **X** has greater total energy.
- **D.** Object **Y** has lesser kinetic energy;

**14.** The relative velocity of body X relative to Y is $(-12\hat{\imath})m/s$ and another body Z relative to body Y is $(8\hat{\imath})m/s$. What is the relative velocity of body X relative to Z?
**A.** $(20\hat{\imath})\ m/s$ **B.** $(-20\hat{\imath})\ m/s$ **C.** $(-4\hat{\imath})\ m/s$ **D.** $(4\hat{\imath})\ m/s$

**15.** The relative velocity of two cars when they are moving in the same and in the opposite directions are 12 Km/h and 20 km/h, respectively. What are the velocities of the two cars?
- **A.** $10\ km/h\ and\ 10\ km/h$
- **B.** $16\ km/h\ and\ 4.0\ km/h$
- **C.** $18\ km/h\ and\ 6.0\ km/h$
- **D.** $8.0\ km/h\ and\ 12\ km/h$

**16.** While a long train is traveling to the right at a speed of 30 m/s, a boy is running with a speed of 8 m/s to the left on the top of the train and at the same time a man is jogging with a speed of 4 m/s to the right on the ground. What is the velocity of the boy with respect to a man?
- **A.** 18 m/s to the right
- **B.** 26 m/s to the right
- **C.** 18 m/s to the left
- **D.** 26 m/s to the left

**17.** A passenger sitting by the window of a train which is moving with a velocity of 72 km/h sees a second train from end-to-end for 4 s. If the velocity of the second train is 108 km/h in the opposite direction, then what is the length of the second train?
**A.** 200 m **B.** 120 m **C.** 40 m **D.** 80 m

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**18.** Two objects shot in air in the absence of air resistance with the same speed at elevation angles of $\boldsymbol{\theta}$ and $\boldsymbol{\alpha}$, such that $\boldsymbol{\theta + \alpha = 90^0}$. If $\boldsymbol{\theta > \alpha}$, then which one of the following comparison is **CORRECT** about the range **R** and maximum height **H** of the two objects?

**A.** $R_\theta = R_\alpha$ and $H_\theta = H_\alpha$ **C.** $R_\theta = R_\alpha$ and $H_\theta > H_\alpha$

**B.** $R_\theta > R_\alpha$ and $H_\theta > H_\alpha$ **D.** $R_\theta > R_\alpha$ and $H_\theta = H_\alpha$

**19.** A boy wishes to cross river of width $\boldsymbol{w}$ that flows at a speed of $\boldsymbol{v_R}$. If the speed of the boy still in water is $\boldsymbol{v_B}$, then how long does it take for the boy to cross to a point directly opposite to him?

**A.** $t = \frac{w}{\sqrt{v_B{}^2 - v_R{}^2}}$ **B.** $t = \frac{w}{\sqrt{v_B{}^2 + v_R{}^2}}$ **C.** $t = \frac{\sqrt{v_B{}^2 + v_R{}^2}}{w}$ **D.** $t = \frac{\sqrt{v_B{}^2 - v_R{}^2}}{w}$

**20.** A ball attached at the end of a 1.2 m long light inextensible chord and set into motion in a horizontal circle of fixed radius (Conical Pendulum). If the chord makes an angle of $37^0$ with the vertical, then what is the speed of the ball?

**A.** 9 m/s **B.** 3 m/s **C.** 4 m/s **D.** 6 m/s

## SECTION-6: WORK AND POWER

**1.** A force $\vec{F} = (400\hat{\imath} + 200\hat{\jmath})N$ is applied on a 40 kg body through a displacement of $\Delta\vec{r} = (4\hat{\imath})m$ on a rough horizontal surface with friction coefficient 0.5. What is the total work done on the body?

**A.** 1200 J **B.** 1600 J **C.** 2000 J **D.** 800 J

**2.** A non-zero work is done by the

**A.** force gravity on a body moving on a horizontal surface.

**B.** centripetal force on a body moving in a horizontal circle.

**C.** friction force on a body sliding on a rough inclined plane.

**D.** normal force on a body moving a smooth horizontal plane.

**3.** A 32 N force parallel to the surface of a smooth inclined plane of slope angle $37^0$ is used to drag up a 4-kg box along the plane. What is the work done by the force on the box after 1.0 s starting from rest?

**A.** 16 J **B.** 32 J **C.** 8 J **D.** 24 J

**4.** A 10 m long and an 80 kg uniform log lies on the ground. How much work must be done to raise slowly the log from horizontal position on the ground to the vertical position?

**A.** 800 J **B.** 5000 J **C.** 8000 J **D.** 4000 J

**5.** A 25 kg body is dragged up a frictionless inclined plane of slope angle $53^0$ with constant speed of 4 m/s. What is the work done on the body in time 2.0 s?

**A.** 2000 J **B.** 1600 J **C.** 1200 J **D.** 1000 J

**6.** A 5 kg body is lifted upward by a means of a rope with constant acceleration of 2 $m/s^2$ from rest. How much work is done by the rope during the first four seconds?

**A.** 960 J **B.** 640 J **C.** 800 J **D.** 480 J

**7.** The $\boldsymbol{x}$-component of conservative force acting on a body initially at rest is governed by the equation $\boldsymbol{F_x = (5x + 20)\ N}$. What is the change in the kinetic energy of the body for the first 8 m of its motion?

**A.** 160 J **B.** 800 J **C.** 120 J **D.** 320 J

**8.** Two forces $\boldsymbol{F_1(x) = x}$ and $\boldsymbol{F_2(x) = x^2}$ are allowed to displace a body from $\boldsymbol{x = 0}$ to $\boldsymbol{x = 1m}$ one at a time. Which one of the following is **TRUE** about the work done on the body by each force?

**A.** Force $\mathbf{F_1}$ does the more work. **C.** Both forces do the same work.

**B.** Force $\mathbf{F_2}$ does the more work. **D.** Impossible to determine

**9.** A spring is compressed by a distance $x$ for the first loading. For the next loading, the spring is compressed a distance $2x$. How much work is required to load the second compared with that required to load the first?

**A.** Four times as much **C.** Two times as much

**B.** One-fourth as much **D.** Half as much

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**10.** What is the power input of a force $\vec{F} = (-20\hat{i} - 10\hat{j} + 15\hat{k})N$ on a particle that undergoes with a velocity of $\vec{v} = (4\hat{i} - 6\,\hat{j} + 8\,\hat{k})\,m/s$?

**A.** 140 W **B.** 20 W **C.** 100 W **D.** 80 W

**11.** Referring Fig-(1), calculate the average power developed by the force on a body through a displacement of 8 m in 12 sec.

**A.** 10 W

**B.** 5 W

**C.** 15 W

**D.** 20 W

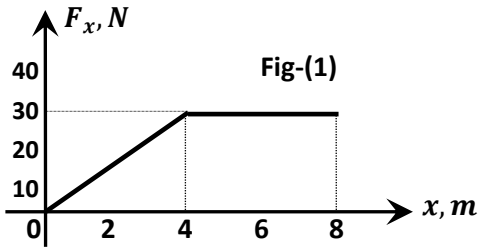


Fig-(1)

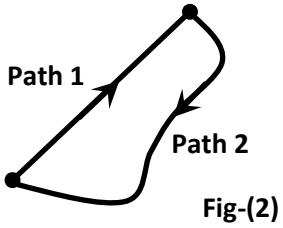


Fig-(2)

**12.** An object moves between two points through a closed path under the action of a conservative force system as shown in Fig-(2). Which one of the following is **FALSE** about the work done on the object?

**A.** The work is done through Path-2 is greater than that through Path-1.
**B.** The total work done on the object over the closed path is zero.
**C.** The work done on the object along Path-1 and Path-2 are equal.
**D.** The work done on the object does not change its mechanical energy.

**13.** A 40 N constant force is applied on a 20 kg object initially at rest at t=0. How much power is delivered by the force at time 5.0 s?

**A.** 200 W **B.** 400 W **C.** 600 W **D.** 800 W

**14.** A 40 kg object falls from a very great height with a constant terminal speed. How much work is done by the air-resistance force on the object for each 15 m of fall?

**A.** 600 J **B.** 300 J **C.** 150 J **D.** 450 J

**15.** A body is moving up with constant velocity by means of a light inextensible string. Which one of the following is TRUE about the work done by the force gravity and by the tension in the string?

**A.** Both do positive work.
**B.** Both do negative work.
**C.** The work done by force of gravity is positive.
**D.** The work done by the tension is positive

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## SECTION-7: ENERGY

**1.** Consider a physics book placed on the surface of a table. Which one of the following choice of reference surface will give negative gravitational potential energy for the book?

**A.** The Ground. **C.** The surface of the table.
**B.** The ceiling. **D.** Either of the wall

**2.** A ball shot in air at elevation angle of $30^0$ above the ground in the absence of air resistance. The energy form possessed by the ball at its maximum height is:

**A.** Only kinetic energy **C.** both kinetic and potential energy
**B.** Only potential energy **D.** neither kinetic nor potential energy

**3.** Which one of the following is TRUE about the kinetic energy and the potential energy changes of a system in the absence of any dissipative force?

**A.** $|\Delta E_K| = |\Delta E_P|$ B. $|\Delta E_K| > |\Delta E_P|$ **C.** $|\Delta E_K| < |\Delta E_P|$ **D.** $|\Delta E_K| \neq |\Delta E_P|$

**4.** A system is pushed horizontally on rough horizontal surface. Which one of the following is CORRECT about the mechanical energy $E_M$ and heat energy $E_H$ of the system?

**A.** Both $E_M$ and $E_H$ are increase. **C.** $E_M$ increases and $E_H$ decrease.
**B.** Both $E_M$ and $E_H$ are decrease. **D.** $E_M$ decreases and $E_H$ increase.

**5.** At what height above the ground a 5-kg stationary object will have the same mechanical energy as that of a 2 kg ball moving at a velocity of $\vec{v} = (-8\,\hat{\imath} + 6\,\hat{\jmath})\,m/s$ on the ground?

**A.** 2.0 m **B.** 5.0 m **C.** 1.0 m **D.** 1.5 m

**6.** A block pushed horizontally with a velocity of 8 m/s and then comes at rest after sliding a horizontal distance of 16 m. What is the coefficient of kinetic friction between the block and the ground?

**A.** 0.20 **B.** 0.50 **C.** 0.25 **D.** 0.40

**7.** A 2-kg block is placed against a spring (k=800 N/m) on a frictionless surface is compressed by $20\ cm$ at point $\boldsymbol{M}$ and the released (Fig-(8). The block leaves off the spring at point $\boldsymbol{O}$ at the bottom of a smooth curved track $\boldsymbol{OP}$ when $x = 0\ cm$ and then stops at $P$. The maximum height $\boldsymbol{RP}$ raised by the block is:-

**A.** 40 cm **B.** 80 cm **C.** 160 cm **D.** 120 cm

**8.** A block (Fig-9) is released from rest at point 1.8 m above the ground slides a smooth curved track AB and over a horizontal rough surface with friction coefficient 0.6 until it comes to halt at point C. What is the distance of halt from B to C?

**A.** 2.0 m **B.** 4.0 m **C.** 3.0 m **D.** 1.5 m

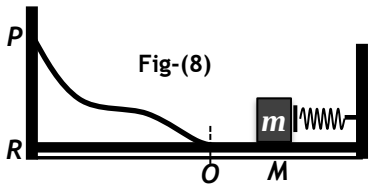


Fig-(8)

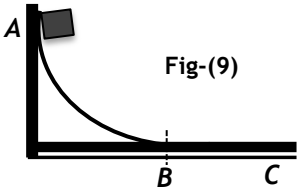


Fig-(9)

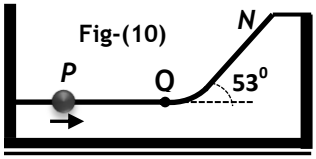


Fig-(10)

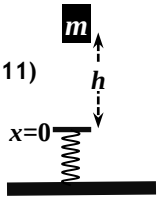


Fig-(11)

**9.** A 200 gm bead shown in Fig-(10) is sliding along a wire with a horizontal speed of 4 m/s at point P which is a distance 30 cm from point Q and then it slides along the slope to point N a distance of 50 cm from point Q before stopping. What is the average friction force retarding its motion?

**A.** 1.2 N **B.** 1.5 N **C.** 1.0 N **D.** 2.0 N

**10.** A 1.0-kg mass released from rest from a point $\boldsymbol{h = 80\ cm}$ above a vertically oriented uncompressed spring of elastic constant $\boldsymbol{k = 500\ N/m}$ shown in Fig-(11). If then the mass hits the spring, what is the maximum compression of the spring in the absence any frictional force?

**A.** 40 cm B. 20 cm **C.** 10 cm **D.** 15 cm

**11.** A rock of mass $\boldsymbol{m}$ is dropped to the ground from a tower. A second rock, with mass $\boldsymbol{2m}$, is also dropped from the same tower. When the second rock strikes the ground, what is its kinetic energy?

**A.** Twice that of the first rock **C.** The same as that of the first rock
**B.** Four times that of the first rock **D.** Half as much as that of the first rock

**12.** A ball is thrown vertically upward has a kinetic energy of 200 J when it reaches three-fourth of its maximum height. What is the mechanical energy of the ball?

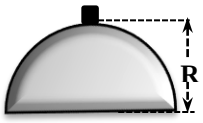
**A.** 200 J **B.** 800 J **C.** 400 J **D.** 600 J

**13.** A body lands on top of the frictionless spherical bowl of radius 60 cm. It begins to slide down the surface as shown in Fig-(12). What is the speed of the body when it just leaves the surface?

**A.** $\boldsymbol{20\ cm/s}$ **C.** $\boldsymbol{10\sqrt{3}\ cm/s}$

**B.** $\boldsymbol{10\ cm/s}$ **D.** $\boldsymbol{20\sqrt{3}\ cm/s}$

Fig-(12)




**14.** Which one of the following is necessarily TRUE about the relationship between the kinetic energy $\boldsymbol{K}$ of an object and a constant force $\boldsymbol{F}$ exerted on it?

**A.** If $K = 0 \Rightarrow F = 0$. **B.** If $F = 0 \Rightarrow \Delta K = 0$. **C.** If $F = 0 \Rightarrow K = 0$. **D.** If $\Delta K = 0 \Rightarrow F = 0$.

**15.** The work on a body by unbalanced force to change the velocity of the body from $v_i = 0$ to $v_f = v$ as compared to that to change its velocity from $v_i = v$ to $v_f = 2v$ is:-

**A.** equal **B.** two fold **C.** four fold **D.** three fold

**16.** A 2-kg metal ball is released from rest from a height of 6.0 m above the surface of sand. The ball hits the sand ground and penetrates to the depth of 3.0 cm before coming to rest. What is the average retarding force exerted by the sand to stop the ball?

**A.** 2000 N **B.** 1000 N **C.** 4000 N **D.** 6000 N

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## SECTION-8: LINEAR MOMENTUM AND CENTER OF MASS

1. One ball is at rest on a level floor. A second ball collides elastically with the first, and the two move off separately but in the same direction. What can you conclude about the masses of the two balls?
   **A.** The ball initially at rest is less massive. **C.** Both balls have the same mass.
   **B.** The ball initially moving is less massive. **D.** Impossible to determine.
2. Two bodies moving towards each other collide and suddenly come in state of rest. Which one of the following is **necessary** the same for the two bodies?
   **A.** Mass **B.** Velocity **C.** Momentum **D.** Kinetic energy.
3. The motion of a 2-kg body along the positive x-axis is governed by the equation $x(t) = 12 + 4t + 2t^2$, where both $x$ and $t$ are in SI units. What is its instantaneous momentum at $t = 2$ sec?
   **A.** 32 kgm/s **B.** 24 kgm/s **C.** 16 kgm/s **D.** 64 kgm/s
4. An object has a translational kinetic energy of 16 J. What will be its kinetic energy if the linear momentum is doubled?
   **A.** 4 J B. 64 J **C.** 32 J **D.** 8 J
5. A 500-gm hard rubber moving at a speed of 6 m/s to the left hits a vertical wall and rebounds to the left at speed of 4 m/s on the same line. What is the magnitude of the impulse of the force imparted by the wall on the ball?
   **A.** 5.0 Ns **B.** 1.0 Ns **C.** 3.0 Ns **D.** 6.0 Ns
6. A sell moving to the right explodes into two fragments of equal masses. If both fragments move with same velocity to the right, then what can it said to be about the total kinetic energy and total momentum of the shell after explosion?
   **A.** Both increases. **C.** Only the momentum increases.
   **B.** Both decrease. **D.** Both remain constant.
7. A particular rocket burns 0.080 kg of fuel every second and ejecting a gas with a velocity of 2000 m/s relative the rocket. What is the thrust of the rocket?
   **A.** 250 N **B.** 160 N **C.** 320 N **D.** 500 N
8. A 6-kg body moving at 3 m/s to the right makes a perfectly elastic head-on collision with a 2-kg body moving at 5 m/s in the opposite direction. What is the velocity of the 2-kg body after collision?
   **A.** 1.5 m/s **B.** 0.5 m/s **C.** 3.0 m/s **D.** 2.5 m/s
9. The displacement of a body in $x$-direction in SI units is given by the equation $x(t) = 2t^3 + t^2 + 3$. What is the ratio of the kinetic energy to the linear momentum of the particle at time $t = 1.0\ s$?
   **A.** 8 **B.** 16 **C.** 4 **D.** 2
10. A 30-kg boy jumps off from the top of a 10-kg stationary box with a velocity of $\vec{v}_0 = (2\hat{i} + 4\hat{j})m/s$. If the coefficient of kinetic friction between the box and the surface of the ground is 0.6, then what is the stopping distance of the box?
    **A.** 24 m **B.** 12 m **C.** 6 m **D.** 3 m

Fig-(7)

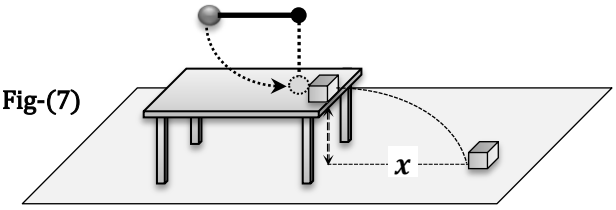
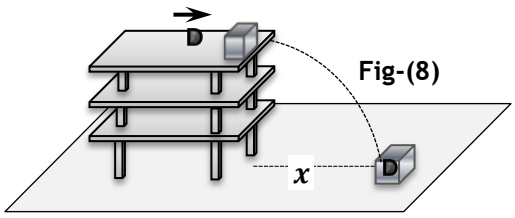



Fig-(8)




11. In Fig-(7), a 500 gm ball attached at the end of a 80 cm long light inextensible cord is released from rest when the cord is essentially horizontal and then makes a perfectly elastic collision at its lowest position with a 1.5 kg stationary wooden block that is placed at the edge of a 1.8 m high table. How far horizontal distance $x$ does the block move just before striking the floor?
    **A.** 2.4 m **B.** 1.2 m **C.** 1.0 m **D.** 1.6 m

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**12.** In Fig-(8), a 200 gm bullet moving to the right at a speed of 300 m/s strikes a 15.8 kg stationary wooden block that is placed at the edge of a 3.2 m high shelf. If the bullet embedded in the block, how far horizontal distance $x$ do the block-bullet system move just before striking the floor?

**A.** 2.0 m **B.** 1.0 m **C.** 3.0 m **D.** 2.4 m

**13.** A block of mass $m_1$ moving to the right with a velocity of $\vec{u}$ collides with a stationary block of mass $m_2$ and stick together. What is the ratio of their final kinetic energy to initial kinetic energy?

**A.** $\frac{m_1}{m_1+m_2}$ **B.** $\frac{m_1-m_2}{m_1}$ **C.** $\frac{m_1}{m_1-m_2}$ **D.** $\frac{m_1+m_2}{m_1}$

**14.** Three particles of equal masses of 2-kg are located at position, $2\hat{\imath}+\hat{k}$ , $\hat{\imath}+2\hat{\jmath}$ and $\hat{\jmath}+2\hat{k}$. Which one of the following are the co-ordinates of their center of mass?

**A.** ( 0 , 0 , 0 ) **B.** ( 1 , 1 , 1 ) **C.** ( 1 , 1 , 0 ) **D.** ( 1 , 0 , 1 )

**15.** Two particles of masses $m_1$= 3.0-kg and $m_2$=2.0-kg are located on the x-axis at positions $x_1 = +10\ cm$ and $x_2 = +50\ cm$, respectively. Where is the position of their center of mass?

**A.** $x = +26\ cm$ **B.** $x = +16\ cm$ **C.** $x = +24\ cm$ **D.** $x = +34\ cm$

**16.** A stationary body suddenly explodes into to three pieces. The first piece of mass of 2.0 kg moves with a velocity of $\begin{bmatrix}+4\\-5\end{bmatrix}$ m/s. The second and the third pieces of unknown masses move with a velocity of $\begin{bmatrix}-5\\+4\end{bmatrix}$ m/s and $\begin{bmatrix}+4\\-2\end{bmatrix}$ m/s, respectively. What is the mass of the third piece?

**A.** 5.0 kg **B.** 4.0 kg **C.** 7.0 kg **D.** 3.0 kg

**17.** The position of the center of mass of two masses $m_1$ and $m_2$, such that $m_1 < m_2$, is a distance $r_1$ from $m_1$ and a distance $r_2$ from $m_2$. Which one of the following is CORRECT about $r_1$and $r_2$?

**A.** $r_1 > r_2$ **B.** $r_1 \geq r_2$ **C.** $r_1 < r_2$ **D.** $r_1 = r_2$

**18.** Two balls of masses $m_1$ and $m_2$, such that $m_2 = 3m_1$, are connected by a light rod of length 40 cm. where is their center of mass relative to mass $m_1$?

**A.** 20 cm **B.** 10 cm **C.** 30 cm **D.** 35 cm

**19.** A ball of mass moving to the right makes a head-on collision with a stationary ball of equal mass. If the first ball comes in state of rest after collision, then what is the coefficient of restitution?

**A.** 1 **B.** 0 **C.** ½ **D.** 0.25

**20.** A ball is moving with a velocity of 5 m/s in a direction of $37^0$ North of East when it strikes a smooth vertical wall. If the ball bounces at right angle with the initial direction of motion, then which one of the following is the velocity of the ball after impact?

**A.** $(4\hat{\imath}+3\hat{\jmath})$ **B.** $(-4\hat{\imath}-3\hat{\jmath})$ **C.** $(-4\hat{\imath}+3\hat{\jmath})$ **D.** $(4\hat{\imath}-3\hat{\jmath})$

## SECTION-9: ROTATION

**1.** The angular displacement of a rigid body is ruled by the equation $\boldsymbol{\theta = (2t^2 + 10)\ rad}$. What is its velocity at the end of 5.0 sec of its motion?

**B.** 20 rad/s **B.** 24 rad/s **C.** 30 rad/s **D.** 12 rad/s

**2.** If a ball rolls at 20 rad/s for 30 sec and then at 10 rad/s for the next displacement of 200 rad, then what is the average angular velocity of the ball?

**A.** 15 rad/s **B.** 8 rad/s **C.** 16 rad/s **D.** 30 rad/s

**3.** Two particles of masses $m_1 = 2\ kg$ and $m_2 = 4\ kg$ are 6 m far apart. At what point relative to mass $m_1$ the total moment of inertia is equal to 48-kgm$^2$?

**A.** 3 m **B.** 4 m **C.** 2 m **D.** 1 m

**4.** A solid disc and a rectangular block are both released from rest on the top of a rough inclined plane of slope angle $37^0$. What must be the coefficient of kinetic friction between the block and the inclined plane for both the disc and cube to have the same linear speed at the bottom of the inclined plane?

**A.** 0.20 **B.** 0.50 **C.** 0.25 **D.** 0.40

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**5.** A rigid body rolls without slipping horizontally with a velocity of 4 m/s. It then rolls up a hill to the maximum height of 1.2 m without slipping. What might be the body?

**A.** Solid sphere **B.** Solid disc **C.** Hoop **D.** Spherical Shell

**6.** Which one of the following motion of a rigid body is impossible?

**A.** Rolling on a smooth surface. **C.** Sliding on a smooth surface.

**B.** Rolling on a rough surface. **D.** Sliding on a rough surface.

**7.** A solid sphere and a solid cube are both released from rest on the top of a smooth inclined plane. At the bottom of the inclined plane the speed of the sphere as compared to that of the cube is:-

**A.** Larger **B.** Smaller **C.** Same **D.** Undecided

**8.** A body uniformly accelerated at the rate of 16 rad/s$^2$ starting from rest. At what time the magnitude of the tangential and centripetal acceleration of a point on the body are equal?

**A.** 0.25 s **B.** 0.50 s **C.** 1.0 s **D.** 1.25 s

**9.** What is the direction of the angular velocity of a disc rotating in counter clockwise direction on ***xz***-horizontal plane as shown in figure-(1)?

**A.** Positive $y-$ axis **C.** Clockwise

**B.** Negative $y-$ axis **D.** Counter-clockwise

**10.** In Fig-(2), a 2-kg block is released from rest at a point $h = 1.8\,m$ above the center of a 5-kg stationary uniform solid disc fixed about its center. If the block just barely touches the edge the disc and causes it to rotates, then what is the speed of the block just after the contact with the cylinder?

**A.** 4 m/s **B.** 3 m/s **C.** 2 m/s **D.** 6 m/s

Fig-(1)

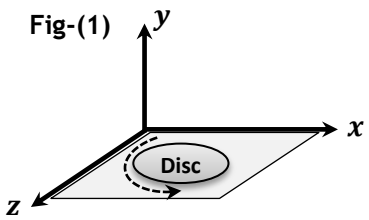



Fig-(2)

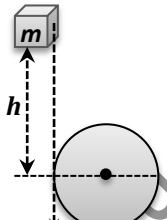



Fig-(3)

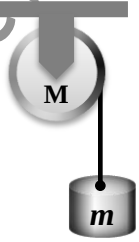
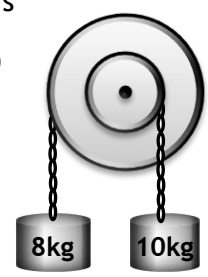



Fig-(4)




**11.** In Fig-(3), a uniform disc of mass ***M*** and radius ***R*** is on an axle supported in fixed frictionless bearings and a block of mass m hang from the cord. What is the tension in the string?

**A.** $T = \left(\frac{Mm}{m-2M}\right)g$ **B.** $T = \left(\frac{Mm}{m+2M}\right)g$ **C.** $T = \left(\frac{Mm}{M-2m}\right)g$ **D.** $T = \left(\frac{Mm}{M+2m}\right)g$

**12.** In Fig-(4), the moment of inertia of the pulley system is 7.6 kg.m$^2$. If the outer and inner radiuses of the pulleys are 50 cm and 20 cm, respectively, then what is the acceleration of the 8-kg block?

**A.** 2.0 m/s$^2$ **B.** 1.0 m/s$^2$ **C.** 0.4 m/s$^2$ **D.** 1.2 m/s$^2$

**13.** A solid disc of mass $M$ is spinning at a speed of $\omega_0$ in a horizontal plane when a small body of mass $m$ drops and sticks at its edge. What is the new angular speed of the disc?

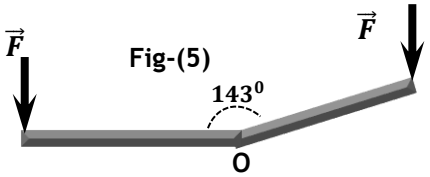
**A.** $\left(\frac{2M}{M+m}\right)\omega_0$ **B.** $\left(\frac{M}{m+M}\right)\omega_0$ **C.** $\left(\frac{M}{2M+m}\right)\omega_0$ **D.** $\left(\frac{M}{M+2m}\right)\omega_0$

**14.** A 4 long rigid plank with moment of inertia 10 kgm$^2$ is bent at its middle and fixed at that point "O" as shown In Fig-(5). If a force of $\vec{F} = (-50\hat{j})\,N$ is applied at its two ends, then what is the magnitude of the angular acceleration of the plank?

**A.** Zero 20 rad/s$^2$

**B.** 2 rad/s$^2$ 18 rad/s$^2$

Fig-(5)




**15.** What can be said about the type equilibrium the object will have when it is pushed and allowed to slide on a smooth horizontal surface in the absence of frictional forces?

**A.** Stable **B.** Unstable **C.** Neutral **D.** Not in equilibrium

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**16.** A hoop is rotating at 12 rad/s on a horizontal plane about an a vertical axis that passes through its edge when a second body with mass one quarter of the disc's is placed safely on it just opposite of the pivot. What is the percentage change of the kinetic energy of the hoop?

**A.** 20% **B.** 80% **C.** 36% **D.** 64%

**17.** What is the kinetic energy of a 6 kg and 2 m long thin rod that rotates with angular velocity of 10 rad/s about an axis that passes at its edge?

**A.** 2400 J **B.** 1200 J **C.** 200 J **D.** 800 J

**18.** What will happen to the mechanical energy of a rolling sphere on the surface a rough inclined plane?

**A.** Increases **B.** Decreases. **C.** Unchanged **D.** Undetermined

**19.** A particle has angular momentum of $200\,Js$ at a particular angular speed and radius. What will be its angular momentum if the radius of rotation is doubled at constant angular speed?

**A.** $200\,Js$ **B.** $400\,Js$ **C.** $50\,Js$ **D.** $800\,Js$

**20.** A 5-kg particle moves with a velocity of $\vec{v} = (8\hat{\imath} + 6\,\hat{\jmath})\,m/s$ at a radial position of $\vec{r} = (2\hat{\imath} - \hat{\jmath})m$ from the pivot. What is the magnitude of its angular momentum?

**A.** $20\,Js$ **B.** $50\,Js$ **C.** $100\,Js$ **D.** $110\,Js$

## SECTION-10: EQUILIBRIUM

**1.** Which one of the following is CORRECT about translational velocity $v$ and angular velocity $\omega$ of a particular rigid body under the conditions of static equilibrium?

**A.** Both $v$ and $\omega$ are zero.
**B.** Both $v$ and $\omega$ are non-zero constant.
**C.** $v$ is non-zero constant and $\omega$ is zero.
**D.** $\omega$ is non-zero constant and $v$ is zero.

**2.** Figure 12 shows a ball in four different equilibrium situations. Which one of the following is the correct order of the stability of the ball from left to right?



**A.** Unstable, Stable, Neutral and Metastable.
**B.** Stable, Neutral, Metastable and Unstable.
**C.** Unstable, Metastable, Neutral and Stable.
**D.** Metastable, Unstable, Stable, and Neutral.

**3.** Which one of the following dynamics conditions of a rigid body is necessarily true?

**A.** Zero net torque means no rotation.
**B.** Zero net force means no rotation.
**C.** Zero net force means no translational motion.
**D.** Zero net torque means no angular acceleration.

**4.** Which one of the following is **FALSE** about the types of equilibrium of a body?

**A.** The stability of a body can be increased by decreasing its base area.
**B.** The stability of a body can be increased by lowering its center of gravity.
**C.** The potential energy of a body in state of neutral equilibrium is constant.
**D.** The center of gravity of a body in stable equilibrium is closest to the ground.

**5.** A body is subjected to two forces $\vec{F}_1 = (300\hat{\imath} + 100\hat{\jmath} - 500\hat{k})N$ and $\vec{F}_2 = (-200\hat{\imath} + 300\hat{\jmath} + 200\hat{k})N$.What additional third force $\vec{F}_3$ is needed to bring the body in state of equilibrium?

**A.** $\vec{F}_3 = (100\hat{\imath} + 400\hat{\jmath} - 300\hat{k})N$
**B.** $\vec{F}_3 = (500\hat{\imath} - 400\hat{\jmath} + 200\hat{k})N$
**C.** $\vec{F}_3 = (-100\hat{\imath} - 400\hat{\jmath} + 300\hat{k})N$
**D.** $\vec{F}_3 = (-500\hat{\imath} + 400\hat{\jmath} - 200\hat{k})N$

**6.** A 100 gm uniform meter stick is pivoted at its 30 cm mark and a 400 gm object placed at the 10 cm mark. At what mark must a 200 gm object be placed to keep the stick in state of equilibrium?

**A.** 40 cm **B.** 50 cm **C.** 70 cm **D.** 90 cm

**7.** An elastic light rope is starched horizontally between two poles 2 m far apart. When a 60-kg object hangs at its middle the rope lowered to a distance of 75 cm at that point. What is the tension in each half of the straight rope on each side of the object?

**A.** 300 N **B.** 500 N **C.** 375 N **D.** 600 N

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**8.** A rigid object pivoted at its center of mass (CM) and is subjected to two horizontal forces of equal magnitude in the opposite directions as shown in Fig-(1). The object is in:-

**A.** rotational equilibrium but not translational equilibrium.
**B.** translational equilibrium but not rotational equilibrium.
**C.** both translational equilibrium and rotational equilibrium.
**D.** neither translational equilibrium nor rotational equilibrium.

**9.** As shown in fig-(2), the system is in equilibrium if the tension in the horizontal rope $T_1$ is one and-half times that of $T_2$. What is the magnitude of $T_1$ and $T_2$?

**A.** $T_1 = 150N$ and $T_2 = 200N$
**B.** $T_1 = 150N$ and $T_2 = 300N$
**C.** $T_1 = 300N$ and $T_2 = 150N$
**D.** $T_1 = 200N$ and $T_2 = 150N$

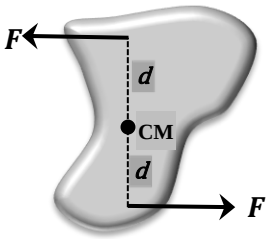


Fig-(1)

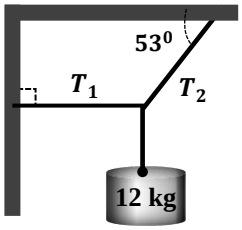


Fig-(2)

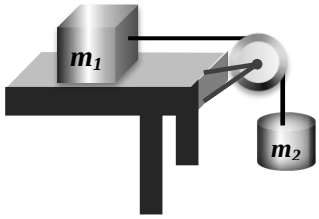


Fig-(3)

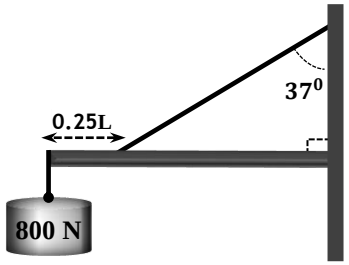


Fig-(4)

**10.** What must be the minimum coefficient of static friction between the block with mass $m_1$ and the horizontal table for the cylinder-block system shown in Fig-(3) to be in state of equilibrium?

**A.** $\frac{m_1}{m_2}$ **B.** $\frac{2m_2}{m_1}$ **C.** $\frac{2m_1}{m_2}$ **D.** $\frac{m_2}{m_1}$

**11.** An 800 N object is suspended at the end of a 400 N uniform beam of length **L** as shown in Fig-(4). What are the horizontal $\mathbf{R_H}$ and vertical $\mathbf{R_V}$ reaction forces of the hinge on the beam?

**A.** $R_H = 400\ N$ and $R_V = 600\ N$
**B.** $R_H = 200\ N$ and $R_V = 300\ N$
**C.** $R_H = 300\ N$ and $R_V = 200\ N$
**D.** $R_H = 600\ N$ and $R_V = 400\ N$

**12.** In Fig-(5), the friction coefficient between the 5-kg block and the table is 0.25. What additional mass must be placed on the top of the 5-kg block to bring the friction less pulley system in equilibrium?

**A.** 3.0 kg **B.** 4.0 kg **C.** 1.0 kg **D.** 8.0 kg

**13.** A 10-m long non-uniform log supported by a wall at one end and a cable attached 2.0 m from the other end "$p$" lies horizontally, as shown in Fig-(6). The log weighs 400 N and the tension in the supporting cable is 200 N. Where is the center of gravity of the log relative to end $p$?

**A.** 4 m **B.** 5 m **C.** 6 m **D.** 8 m

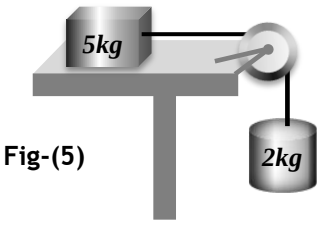


Fig-(5)

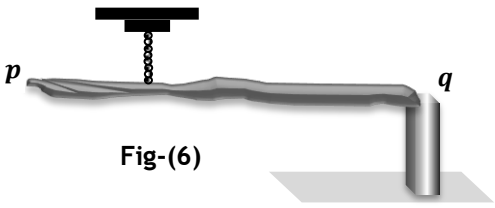


Fig-(6)

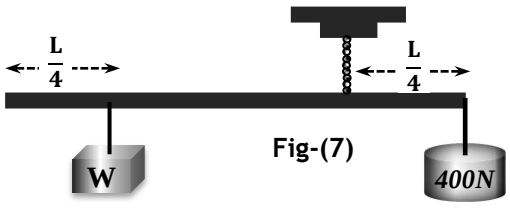


Fig-(7)

**14.** A uniform bar of weight 100 N and length **L** is in state of equilibrium as shown in Fig-(7). What are the weights **W** and the tension force **T** in the rope?

**A.** $W = 200\ N$ and $T = 700\ N$
**B.** $W = 100\ N$ and $T = 600\ N$
**C.** $W = 150\ N$ and $T = 650\ N$
**D.** $W = 300\ N$ and $T = 800\ N$

**15.** A 10.0 m long uniform wooden plank with mass 60-kg rests on two pillars separated by a distance 2-m which are equidistant from the center of the plank. What is the maximum mass that can be placed at one end of the plank such that the plank remains in state of equilibrium?

**A.** 15 kg **B.** 10 kg **C.** 12 kg **D.** 24 kg

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**16.** A 40 kg uniform ladder leans against a smooth vertical wall by making an angle of $53^0$ with the horizontal. A 50 kg man stands at a distance four-fifth of the length of the ladder from the lower end of the ladder. What is the friction force between the ladder and the horizontal floor?

**A.** 450 N **B.** 600 N **C.** 150 N **D.** 800 N

**17.** In Fig-(8), a 5-kg block is at rest relative to the plane of rough wedge with friction coefficient 0.4. What is the maximum deformation of the spring of force constant 400 N/m?

**A.** 10 cm **B.** 3 cm **C.** 5 cm **D.** 7 cm

Fig-(8)

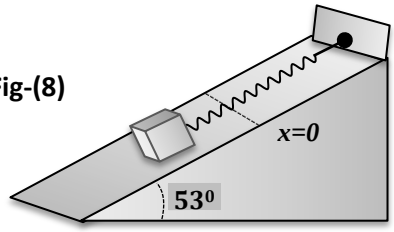



Fig-(9)

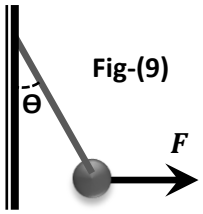



Fig-(10)

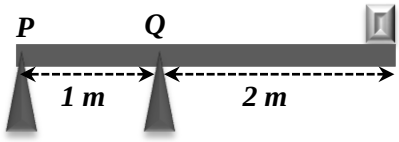
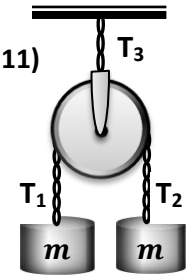



Fig-(11)




**18.** The system shown in Fig-(9) is in state of equilibrium under the action of a horizontal force ***F***. Which one of the following is the expression of the mass $\boldsymbol{m}$ of the ball attached at the end of a light inextensible cord?

**A.** $\boldsymbol{m = \frac{F}{g}}$ **B.** $\boldsymbol{m = \frac{F}{g\sin\theta}}$ **C.** $\boldsymbol{m = \frac{F}{g\cos\theta}}$ **D.** $\boldsymbol{m = \frac{F}{g\tan\theta}}$

**19.** A 200 N block is positioned at the right end of a 3 m long uniform light plank as shown in Fig-(10). What is the force exerted by pedestal Q at the left end of the plank?

**A.** 600 N, Up **B.** 200 N, Down **C.** 600 N, Down **D.** 200 N, Up

**20.** Two blocks of equal mass $\boldsymbol{m}$ hang from a chord that passes over a frictionless pulley. If the pulley weighs twice that of each block, then what is the tension force $T_3$ in the upper chord?

**A.** $T_3 = 4mg$ **B.** $T_3 = 2mg$ **C.** $T_3 = 6mg$ **D.** $T_3 = 3mg$

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## SECTION-11: MODULUS

**1.** Which one of the following is **INCORRECT** about Stress?

**A.** Stress the measure of the force's ability to deform a body.
**B.** The larger the applied force the higher the stress it produces.
**C.** Stress varies inversely with the area upon which the force is exerted.
**D.** Stress is a dimensionless physical quantity.

**2.** Which one of the following is **INCORRECT** about Stress and Strain?

**A.** Stress is proportional to the force producing a deformation.
**B.** Strain is a measure of the degree of deformation.
**C.** Stress is directly proportional to strain.
**D.** The ratio of Strain to the Stress is the elastic modulus.

**3.** Which one of the following conditions of applied forces on a particular metal rod is responsible for the formation of tensile deformation?

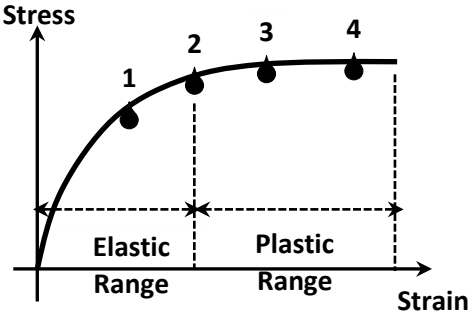
**A.** A single force parallel to the length of the rod.
**B.** A single force perpendicular to the length of the rod.
**C.** Two equal and opposite forces along the length of the rod.
**D.** Two equal forces in same direction along the length of the rod.

**4.** A force produces a 40 mm change in length when it is applied on a cylindrical rod. If the same force is applied to another cylindrical rod of double size in each dimension, the change in the length is:-

**A.** 80 mm **B.** 20 mm **C.** 40 mm **D.** 160 mm

5. Which one of the following states of substance less effortlessly subjected to Bulk deformation?
   **A.** Gas **B.** Liquid **C.** Solid **D.** Plasma
6. Two wires, with Young Modulus $5 \times 10^{10}\ Pa$ and, $3 \times 10^{10}\ Pa$ having the same length and cross-sectional area of 2 m and $4 \times 10^{-6}\ m^2$ are joined end to end and a tensile force of 800 N is applied on the combination. What is the elongation of the system?
   **A.** $6\ mm$ **B.** $2\ mm$ **C.** $4\ mm$ **D.** $10\ mm$
7. The type of deformation caused by a friction force on a sliding solid block on a horizontal floor is:-
   **A.** Young's modulus **B.** Shear modulus **C.** Bulk modulus **D.** Hooke's Law
8. When a cube is completely immersed in a fluid, then the deformation that the object undergoes is:-
   **A.** both a change in volume and shape. **C.** a change in volume but no change in shape.
   **B.** with no change in volume and shape. **D.** a change in shape but no change in volume.
9. A $0.8\ m^3$ solid sphere $(B = 2 \times 10^{11}\ Pa)$ is taken from air into a water $(\rho_{water} = 1000\ kg/m^3)$ to a depth of $\mathbf{50}\boldsymbol{m}$. What is the change in the volume of the sphere? $(P_{atm} = 10^5\ Pa)$
   **A.** $4.0 \times 10^{-6}\ m^3$ **B.** $3.0 \times 10^{-6}\ m^3$ **C.** $2.4 \times 10^{-6}\ m^3$ **D.** $2.0 \times 10^{-6}\ m^3$
10. If a particular body of length **L** and cross sectional area **A** is stretched elastically along its length, then which one of the following the formula for the elastic constant $\boldsymbol{k}$ in terms of Young's Modulus?
    **A.** $\boldsymbol{k = \frac{YA}{L}}$ **B.** $\boldsymbol{k = \frac{YL}{A}}$ **C.** $\boldsymbol{k = \frac{LA}{Y}}$ **D.** $\boldsymbol{k = \frac{YA}{L^2}}$
11. A spherical solid metal ball of radius 12 mm and bulk modulus $8 \times 10^{10}\ Pa$ is subject to a 6000 N force applied perpendicularly throughout its entire surface. What is the change in the volume of the sphere?
    **A.** $6 \times 10^{-10}\ m^3$ **B.** $2 \times 10^{-10}\ m^3$ **C.** $4 \times 10^{-10}\ m^3$ **D.** $3 \times 10^{-10}\ m^3$
12. If a thin metal rod $(\alpha = 5 \times 10^{-6} K^{-1})$ is heated from 2000 K to 4000 K, then what is the strain?
    **A.** 0.02 **B.** 0.03 **C.** 0.01 **D.** 0.04
13. A tensile force of 400 N is applied on a wire of length 1.8 m and cross-sectional area of $1.2 \times 10^{-6}\ m^2$. If the Young Modulus of the wire is $4 \times 10^{11}\ Pa$, then what is the strain energy of the wire?
    **A.** 3 J **B.** 6J **C.** 9 J **D.** 12 J
14. Liquids have:-
    **A.** Both Shear and Young modulus **C.** Shear but not have Young modulus
    **B.** No both Shear and Young modulus D. have Young but not Shear modulus
15. The graph of stress versus strain for a particular material is shown in the figure below. Which one of the following set of orders typical represents points 1,2,3 and 4, respectively?

    **A.** Breaking Point, Hook's Law Limit, Elastic Limit, Yield Point.
    **B.** Hook's Law Limit, Elastic Limit, Yield Point, Breaking Point.
    **C.** Elastic Limit, Hook's Law Limit, Yield Point, Breaking Point.
    **D.** Elastic Limit, Breaking Point, Hook's Law Limit, Yield Point.




## SECTION-12: FLUID PRESSURE

1. Which one of the following is **INCORRECT** about the pressure of a fluid?
   **A.** The pressure of a fluid at rest decreases with increasing the depth of the fluid.
   **B.** The pressure due to a moving fluid is greatest where the speed is least.
   **C.** The speed of a liquid in a pipe is greatest where the diameter is largest.
   **D.** The hydrostatic pressure independent of the base area of the container.
2. The pressure at a certain point in a closed pipe that contains motionless water is 60 kPa. What is the pressure at a point 2 m higher than the first?
   **A.** 30 kPa **B.** 20 kPa **C.** 80 kPa D. 40 kPa

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**3.** A pressure increase anywhere is felt throughout the fluid. This statement most likely related to:-
**A.** Archimedes' principle. **C.** Bernoulli's equation.
**B.** Pascal's Principle. **D.** Continuity equation.

**4.** A 3200 N force placed at the larger cylindrical piston is balanced by a 200 N exerted on the smaller piston. What is the ratio of the diameter of the larger piston to that of the smaller piston diameter?
**A.** 16:1 B. 4:1 **C.** 1:4 **D.** 1:16

**5.** Suppose a ball has a volume of 200 $cm^3$ and average density of 0.4 $gm/cm^3$. What force is required to hold it completely submerged under water? ($\rho_{water} = 1000\ kg/m^3$)
**A.** 8.0 N **B.** 2.8 N **C.** 1.2 N **D.** 2.0 N

**6.** A partially immersed body floats freely in a fluid. If the body is less dense than the fluid, then which one of the following is true about the force of gravity $F_G$ and the buoyant force $F_B$?
**A.** $F_G = F_B$ **B.** $F_G > F_B$ **C.** $F_G < F_B$ **D.** $F_G \geq F_B$

**7.** A 600 gm body with density $1200\ kg/m^3$ is totally immersed in a liquid of density $800\ kg/m^3$. Which one of the following is FALSE about the measurements of the quantities?
**A.** The body's volume is $7.5 \times 10^{-4} m^3$. **C.** the volume of the displaced fluid is $5 \times 10^{-4} m^3$.
**B.** The buoyant force is 4.0 N. **D.** the apparent weight of the body is 2.0 N.

**8.** A body weighs 20.0 N in air and 16.4 N when completely submerged in a liquid of density $900\ kg/m^3$. What is the density of the body?
**A.** $4000\ kg/m^3$ B. $2000\ kg/m^3$ **C.** $5000\ kg/m^3$ **D.** $6000\ kg/m^3$

**9.** The apparent weight an object when completely immersed in a liquid of equal density is.
**A.** equal to zero. **C.** greater than its true weight.
**B.** equal to its true weight. **D.** less than its true weight.

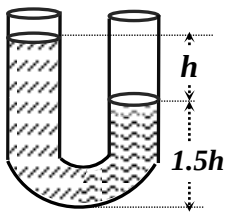
**10.** An incompressible nonviscous fluid is moving with steady flow from wider to narrower section of a pipe. Which one of the following is **CORRECT** about the change in the speed and pressure of the fluid?
**A.** Both increase. **C.** The speed increases while the pressure decreases.
**B.** Both decrease. **D.** The speed decreases while the pressure increases.

**11.** If water flows from a wider pipe of circular cross section to a smaller one with diameter half that of the wider pipe, then the water flow speed in the smaller pipe will be
**A.** one-fourth that in the wider pipe. **C.** $\sqrt{2}$ times that in the wider pipe.
**B.** one-half that in the wider pipe. **D.** four times that in the wider pipe.

**12.** A 30 cm long uniform cylindrical object with diameter 4 cm floats and stands safely along its length in a liquid of density $\rho_f = 3600\ kg/m^3$. If the density of the object is $\rho_0 = 1200\ kg/m^3$, then what is its length just above the surface of the liquid?
**A.** 10 cm **B.** 20 cm **C.** 15cm **D.** 5 cm

**13.** In Fig-(1), a liquid of density $600\ kg/m^3$ filled in the left arm of a U-tube is used to balance a liquid of unknown density filled into the right arm without mixing. What is the density of the second liquid?
**A.** $1000\ kg/m^3$ **B.** $900\ kg/m^3$ **C.** $420\ kg/m^3$ **D.** $240\ kg/m^3$

Fig-(1)



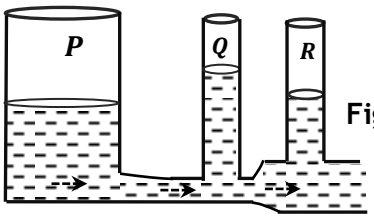




Fig-(2)

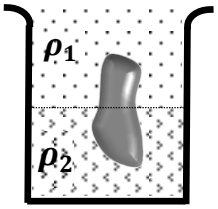



Fig-(3)

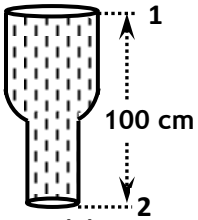



Fig-(4)

**14.** An incompressible fluid of density 500 $kg/m^3$ moves from a horizontal tube of inlet area 20 $cm^2$ into a second horizontal tube of outlet area 60 $cm^2$ at the same elevation. What is the speed of the fluid in the second tube if the pressure difference between the two tubes is 2.0 kPa?
**A.** 0.5 m/s **B.** 3.0 m/s **C.** 1.0 m/s **D.** 2.0 m/s

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**15.** The larger tank P is filled with liquid to the level and it drains through a small pipe whose diameter varies as shown in Fig-(2). The liquid rises at different levels in each vertical pipes Q and R open to the atmosphere. The observed higher level of the liquid in pipe Q than in that pipe R is the result of:-

**A.** higher pressure with lower flow speed. C. lower pressure with higher flow speed.
**B.** higher pressure with higher flow speed. D. lower pressure with lower flow speed.

**16.** An irregularly shaped object with density $\rho_0$ floats in two liquids without mixing each other as shown in Fig-(3). Which one of the following is the correct contrast between the density of the body and with that of the densities of the two liquids?

**A.** $\rho_0 > \rho_1$ and $\rho_0 > \rho_2$ **C.** $\rho_0 > \rho_1$ and $\rho_0 < \rho_2$
**B.** $\rho_0 < \rho_1$ and $\rho_0 < \rho_2$ **D.** $\rho_0 < \rho_1$ and $\rho_0 > \rho_2$

**17.** In Fig-(4); the diameter of the upper larger cylindrical pipe is twice that of the lower smaller one. What is the pressure difference $P_1 - P_2$ if the speed of the water at point 1 is 2.0 m/s?

**A.** 20 kPa B. 30 kPa C. 50 kPa D. 10 kPa

**18.** A 2.6 m high cylindrical open tank is filled with water and a hole is made at a depth 80 cm from the layer of the water. At what horizontal distance R from the base foot of the tank does the emerging water stream strike the floor?

**A.** 1.2 m **B.** 2.4 m **C.** 1.6 m **D.** 0.6 m

**19.** Which one of the following is **NOT** the basic assumption of a ideal fluid?

**A.** An ideal fluid is non-viscous. C. An ideal fluid moves without turbulence.
**B.** An ideal fluid is compressible. D. The motion an ideal fluid is steady.

**20.** Which one of the following is the result of the law of conservation of energy?

**A.** Continuity equation. **C.** Archimedes' Principle.
**B.** Pascal's Principle. **D.** Bernoulli's Principle.

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## SECTION-13: HEAT

**1.** The amount of heat needed to change the temperature of 200 gm of water by one degree kelvin is:-

**A.** Heat capacity **C.** Joule's heat
**B.** Latent Heat **D.** Specific heat Capacity

**2.** About 400 J of heat energy is transferred from mass $\boldsymbol{m_1}$ to mass $\boldsymbol{m_2}$ by conduction. If $\boldsymbol{m_1 = 2m_2}$, the the amount of heat change measured in the second mass is:-

**A.** 800 J **B.** 200 J **C.** 400 J **D.** 100 J

**3.** Two spheres are made of the same metal and have the same radius, but one is hollow and the other is solid. The spheres are taken through the same temperature increase. Which one of the following **TRUE** about the expansions of the sphere?

**A.** The solid sphere expands more. **C.** The hollow sphere expands more.
**B.** They expand by the same amount. **D.** There is not enough information to say.

**4.** Which one of the following is **WRONG** about the critical point of a substance?

**A.** At critical point clear phase boundaries ceases to exist.
**B.** The physical properties of liquid and solid merge together.
**C.** Above the critical point is impossible to form a liquid state.
**D.** At critical point a substance forms a superficial fluid.

**5.** Which one of the following heat transfers involves heat transfer as heated fluid becomes less dense and therefore rises?

**A.** Convection. **B.** Conduction **C.** Radiation **D.** Diffusion

**6.** What will happen to the level of water in a bucket as a floating ice completely melts?

**A.** Increases **B.** decreases **C.** unchanged **D.** Undecided

**7.** How much heat is needed to change the temperature of a 400 gm ice at $-10^0$C to water at $20^0$C?

**A.** 42 Cal. **B.** 32 Cal. **C.** 10 Cal. **D.** 12 Cal.

**8.** The lowest possible temperature at which all molecular motion ceases is:
**A.** Critical point. **B.** Triple point. **C.** Absolute zero. **D.** Boiling point.

**9.** The three slabs as shown in Fig-(1) have the same thickness but different thermal conductivities such that $k_2 > k_3 > k_1$ and the right side is hotter. Which one of the following is the **CORRECT** comparison between the temperatures of the slabs?
**A.** $\Delta T_2 > \Delta T_3 > \Delta T_1$ **B.** $\Delta T_2 < \Delta T_3 < \Delta T_1$ **C.** $\Delta T_1 > \Delta T_2 > \Delta T_3$ **D.** $\Delta T_1 < \Delta T_2 < \Delta T_3$

Fig-(1)

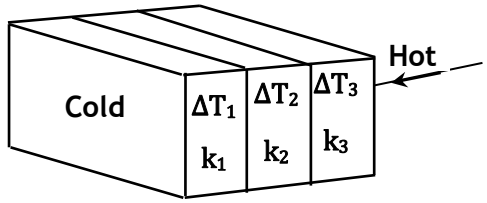
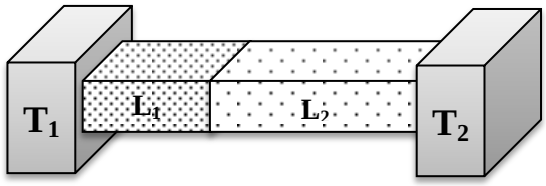



Fig-(2)




**10.** Two metal blocks of the same cross-sectional area are soldered together and temperatures of $T_1$=80°C and $T_2$=0°C are maintained across their other ends, as shown in Fig-2. The length $L_2=3L_1$ while the thermal conductivity $k_1=5k_2$. What is the temperature of the soldering junction?
**A.** 5°C **B.** 15°C **C.** 75°C **D.** 40°C

**11.** The rate of heat lost by a body to the environment at a temperature is 200 K than it was only 100 K is;
**A.** Twice as fast B. four times as fast. **C.** Half as fast **D.** one-fourth as fast

**12.** When ice melts at 0°C, which one of the following is the manifestation of the heat supplied to the ice?
**A.** To increase both the speed of the molecules and their separation distances.
**B.** To decrease both the speed of the molecules and their separation distances.
**C.** To increase the speed of the molecules and to decrease their separation distances.
**D.** To decrease the speed of the molecules and to increase their separation distances.

**13.** A hot copper $(c = 386\,J/kg.K$ is dropped into an equal mass of cool water $(c = 1000\,J/kg.K$. Which one of the following temperature change relationships for copper $\Delta T_C$ and water $\Delta T_W$ is correct?
**A.** $\Delta T_C > \Delta T_W$ **B.** $\Delta T_C = \Delta T_W$ **C.** $\Delta T_C < \Delta T_W$ **D.** Undecided

**14.** Which one of the following conditions of heat transfers where Radiation the dominant form of heat transfer from(from essential book)
**A.** A burner in direct contact with a pan of water.
**B.** A red-hot stove burner with nothing on it.
**C.** The bottom to the top of the water in the pan once it's begun to boil.
**D.** The heat transfer from top to bottom of a lake in summer.

**15.** Which one of the following is correct about a black and white object in terms of radiation?
**A.** A white object is a poor absorber and a good radiator.
**B.** A black object is a good absorber and a poor radiator.
**C.** A black object is a good absorber and a good radiator.
**D.** A white object is a good absorber and a poor radiator.

**16.** A 2-kg metal at 180°C is dropped into a 0.5 kg of water initially at 20°C. If the final equilibrium temperature of the mixed system is 40°C, then what is the specific heat capacity of the metal?
**A.** 200 J/kg.K **B.** 400 J/kg.K **C.** 100 J/kg.K **D.** 300 J/kg.K

**17.** A man fires a bullet (c=250 J/kg.K) at a speed of 200 m/s into the wood. If the whole amount of loss of kinetic energy is used to increase its internal energy, what is the rise in the temperature of the bullet?
**A.** 20°C **B.** 40°C **C.** 60°C **D.** 80°C

**18.** A disk has a circular hole at its center. If the disc as a whole is heated, then the radius of the hole:-
**A.** Increases **B.** Decreases **C.** Unchanged. **D.** Undecided

**19.** Which one of the following properties of water increases as its temperature rises from 0°C to 4°C?
**A.** Mass **B.** Volume **C.** Density **D.** Weight

**20.** What can you say about the temperature change $\Delta T$ of boiling water in a teapot that is placed on a hotplate of high temperature?
**A.** $\Delta T > 0$ **B.** $\Delta T = 0$ **C.** $\Delta T < 0$ **D.** $\Delta T \neq 0$

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