CBSE Sample Question Paper Term 1

Class – XI (Session : 2021 - 22)

SUBJECT - PHYSICS 042 - TEST - 04

Class 11 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 35**

General Instructions:

1. The Question Paper contains three sections.
2. Section A has 25 questions. Attempt any 20 questions.
3. Section B has 24 questions. Attempt any20 questions.
4. Section C has 6 questions. Attempt any 5 questions.
5. All questions carry equal marks.
6. There is no negative marking.

Section A

Attempt any 20 questions

1. Which of the following vectors are conserved for an isolated system? **[0.77]**

   a) The total linear momentum
   b) The linear momentum of a particle
   c) The force on a particle
   d) The angular momentum of a particle

2. SONAR emits which of the following waves? **[0.77]**

   a) radio
   b) ultrasound
   c) none of these
   d) light

3. A truck has a velocity of 2 m/s at time t=0. It accelerates at 2 m / s^2 on seeing police. What is its velocity in m/s at a time of 2 sec? **[0.77]**

   a) 6
   b) 3
   c) 4
   d) 7

4. At a distance L = 400m from the traffic lights, the brakes are applied to a locomotive moving at a velocity v = 54km/hr. Determine the position of locomotive relative to the traffic lights 1 minute after the application of the brakes if its acceleration is -0.3m/s^2? **[0.77]**

   a) 30 m
   b) 40 m
   c) 15 m
   d) 50 m

5. The dimensions of Planck's constant equal to that of **[0.77]**

   a) power
   b) angular momentum
   c) momentum
   d) energy

6. The direction of angular velocity vector is along **[0.77]**

   a) the outward radius
   b) the axis of rotation

c) the tangent to the circular path
d) the inward radius

7. Circular disc of mass m and radius r is rolling forward on the horizontal table with a velocity v. Its total kinetic energy is **[0.77]**

a) $\frac{1}{2}mv^2$
b) mv^2
c) $\frac{1}{4}mv^2$
d) $\frac{3}{4}mv^2$

8. The earth (mass = 6×10^{24} kg) revolves around the sun with an angular velocity of 2×10^{-7} rad/s in a circular orbit of radius 1.5×10^8 km. The force exerted by the sun on the earth, in newton, is: **[0.77]**

a) 18×10^{25}
b) Zero
c) 36×10^{21}
d) 27×10^{39}

9. Two parallel rail tracks run north-south. Train A moves north with a speed of 54 km/ hr, and train B moves south with a speed of 90 km/ hr. What is the velocity of ground with respect to B in m/s? Choose the positive direction of the x-axis to be from the south to the north. **[0.77]**

a) 22 m/s
b) 30 m/s
c) 25.0m/s
d) 28 m/s

10. The vector addition is **[0.77]**

a) associative
b) non-commutative
c) asymmetric
d) intransitive

11. A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 ms^{-1}. To give an inertial upward acceleration of 20 ms^{-2}, the amount of gas ejected per second to supply the needed thrust will be (g = 10 ms^{-2}) **[0.77]**

a) 127.5 kgs^{-1}
b) 137.5 kgs^{-1}
c) 185.5 kgs^{-1}
d) 187.5 kgs^{-1}

12. A proton is kept at rest. A positively charged particle is released from rest at a distance d in its field. Consider two experiments; one in which the charged particle is also a proton and in another, a positron. In the same time t, the work done on the two moving charged particles is **[0.77]**

a) less for the case of a positron, as the positron moves away more rapidly and the force on it weakens.
b) more for the case of a positron, as the positron moves away a larger distance.
c) same, as the same force law is involved in the two experiments.
d) more for the case of a positron, as the positron moves away from a larger distance.

13. A particle performs uniform circular motion with an angular momentum L. If the frequency of particle's motion is doubled and its K.E. is halved, the angular momentum **[0.77]**

becomes:

a) $\frac{L}{4}$ b) 2L

c) 4L d) $\frac{L}{2}$

14. The escape velocity of a 10 g body from the earth is 11.2 kms^{-1}. Ignoring air resistance, the escape velocity of 10 kg of the iron ball from the earth will be: **[0.77]**

a) 0.112 kms^{-1} b) 11.2 kms^{-1}

c) 0.0112 kms^{-1} d) 0.56 kms^{-1}

15. Strong Nuclear Force is: **[0.77]**

a) the strongest of all fundamental forces, about 100 times the gravitational force in strength.

b) the strongest of all fundamental forces, about 100 times the electromagnetic force in strength.

c) the strongest of all fundamental forces, about 10 times the electromagnetic force in strength.

d) the strongest of all fundamental forces, about 10 times the gravitational force in strength.

16. The dimensions of strain are: **[0.77]**

a) $ML^{-1}T^{-2}$ b) it is dimensionless

c) L^2 d) L

17. Instantaneous velocity or simply velocity v at an instant t equals **[0.77]**

a) $\lim_{t\to 0} \frac{\Delta x}{\Delta t}$ b) $\lim_{t\to \infty} \frac{\Delta x}{\Delta t}$

c) $\lim_{t\to 0} \frac{\Delta x}{2\Delta t}$ d) $\lim_{t\to 1} \frac{\Delta x}{\Delta t}$

18. A swimmer wishes to cross a 500 m wide river flowing at 5 km/hr. His speed with respect to water is 3 km/hr. If he heads in the direction making an angle θ with the flow, find the time he takes to cross the river? **[0.77]**

a) $\frac{10}{cos\theta}$ minutes b) $\frac{10}{sin\theta}$ seconds

c) $\frac{10}{sin\theta}$ minutes d) $\frac{10}{cos\theta}$ seconds

19. What is a force: **[0.77]**

a) qualitative measure of the interaction between two bodies

b) quantitative measure of the momentum between two bodies

c) quantitative measure of the interaction between two bodies

d) qualitative measure of the momentum of two bodies

20. A body of mass 5 kg, moving with a velocity 10 $\frac{m}{sec}$ collides with another body of the mass 20 kg at rest and comes to rest. The velocity of the second body due to collision is **[0.77]**

a) 2.5 $\frac{m}{sec}$ b) 7.5 $\frac{m}{sec}$

c) 5 $\frac{m}{sec}$ d) 10 $\frac{m}{sec}$

21. Two bodies with moments of inertia I_1 and I_2 ($I_1 > I_2$) have equal angular momenta. If K.E. **[0.77]**

of rotation is E_1 and E_2 then:

a) $E_1 < E_2$ b) $E_1 > E_2$

c) $E_1 = E_2$ d) $E_1 \geq E_2$

22. If the mass of earth is 80 times of that of moon and its diameter is double that of moon and g on earth is 98 m/sec^2, then the value of g on moon is: **[0.77]**

a) 9.8 m/s^2 b) 0.98 m/s^2

c) 4.9 m/s^2 d) 0.49 m/s^2

23. A stone thrown from the top of a building is given an initial velocity of 20.0 m/s straight upward. Determine the time in seconds at which the stone reaches its maximum height. (Take g = 9.8 m/sec^2) **[0.77]**

a) 2.8 b) 2.04

c) 1.67 d) 2.7

24. The speed of a projectile when it is at its greatest height is $\sqrt{\frac{2}{5}}$ times its speed at half the maximum height. What is the angle of projection? **[0.77]**

a) 60° b) 90°

c) 15° d) 45°

25. A man of mass 70 kg stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 ms^{-2}. What would be the reading on the scale? **[0.77]**

a) 130 kg b) 120 kg

c) 150 kg d) 105 kg

Section B

Attempt any 20 questions

26. If a sphere is rolling, the ratio of translational energy to total kinetic energy is given by **[0.77]**

a) 2 : 5 b) 10 : 7

c) 7 : 10 d) 5 : 7

27. A wheel has angular acceleration of 3.0 rad/ sec^2 and an initial angular speed of 2.00 rad/ sec. In a time of 2 sec, it has rotated through an angle (in radian) of **[0.77]**

a) 0 b) 4

c) 12 d) 10

28. Two particles of equal mass go around a circle of radius R under the action of their mutual gravitational attraction. The speed v of each particle is: **[0.77]**

a) $\sqrt{\frac{4Gm}{R}}$ b) $\frac{1}{2}\sqrt{\frac{Gm}{R}}$

c) $\sqrt{\frac{Gm}{R}}$ d) $\frac{1}{2R}\sqrt{\frac{1}{Gm}}$

29. The scalar product of vectors is **[0.77]**

a) non commutative and not distributive
b) non commutative and distributive
c) commutative and not distributive
d) commutative and distributive

30. A particle moves along the x axis. Its position is given by the equation $x = 2.00 + 3.00t - 4.00t^2$ with x in meters and t in seconds. Determine its velocity in m/s when it returns to the position it had at t = 0. **[0.77]**

a) -5.54m/s
b) -3.0m/s
c) -2.75m/s
d) -4.02m/s

31. The basic difference between a scalar and vector is one of **[0.77]**

a) magnitude
b) direction
c) origin
d) polar angle

32. A force vector applied on a mass is represented as $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with 1 m/s^2. What will be the mass of the body? **[0.77]**

a) 20 kg
b) $10\sqrt{2}$ kg
c) $2\sqrt{10}$ kg
d) 10 kg

33. In general motion of a rigid body: **[0.77]**

a) both translation and rotation can be present
b) only translation is present
c) only rotation is present
d) particles on the body always move around an axis in circles

34. The separation between C and O atoms in CO is 1.2 A. The distance of carbon atom from the centre of mass is **[0.77]**

a) $0.7\ \mathring{\text{A}}$
b) $0.5\ \mathring{\text{A}}$
c) $0.3\ \mathring{\text{A}}$
d) $0.9\ \mathring{\text{A}}$

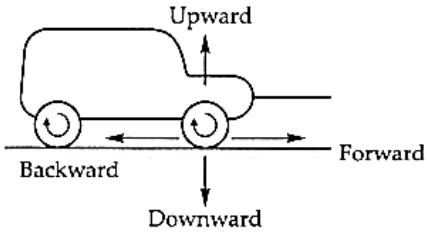
35. A jet lands on an aircraft carrier at 63 m/s. What is its acceleration in $\mathrm{m/s^2}$ if it stops in 2.0 s? **[0.77]**

a) -35
b) 34
c) -31.5
d) -33

36. A body is projected with a velocity of 20ms^{-1} at 50° to the horizontal. Find Range of the projectile. **[0.77]**

a) 45.2 m
b) 40.2 m
c) 41.2 m
d) 39.2 m

37. Direction of frictional force between wheel of the car and road is **[0.77]**



a) forward
b) backward
c) upward
d) downward

38. Physics is a **[0.77]**

a) Applied Science
b) Mathematical Science
c) Engineering Science
d) Natural Science

39. The unit of permittivity of free space ε_0 is **[0.77]**

a) newton-metre^2/coulomb^2
b) coulomb^2/newton-metre^2
c) coulomb/newton-metre
d) coulomb^2/(newton-metre)^2

40. A nucleus is at rest in the laboratory frame of reference. If it disintegrates into two smaller nuclei _____ . **[0.77]**

a) the products must move at an angle in same direction
b) the products must move in same direction
c) the products must move at an angle in opposite directions
d) the products must move in opposite directions

41. A satellite revolves very near to the earth surface. Its speed should be around: **[0.77]**

a) 8 km/s
b) 2 km/s
c) 5 km/s
d) 11 km/s

42. For a satellite to be in a circular orbit 780 km above the surface of the earth, what orbital speed must it be given? **[0.77]**

a) 7260 m/s
b) 7160 m/s
c) 7360 m/s
d) 7460 m/s

43. Newton's law of universal gravitation states that the gravitational force of attraction between any two particles of masses m_1 and m_2 separated by a distance r has the magnitude equal to: **[0.77]**

a) $\left|\overrightarrow{F}\right| = \frac{m_1 m_2}{r^2}$
b) $\left|\overrightarrow{F}\right| = G\frac{m_2}{r^2}$
c) $\left|\overrightarrow{F}\right| = G\frac{m_1 m_2}{r^2}$
d) $\left|\overrightarrow{F}\right| = G\frac{m_1}{r^2}$

44. According to the first law of motion: **[0.77]**

a) body acted on by no net force moves with constant velocity (which may be zero) and zero acceleration
b) body acted on by zero net force moves with non zero acceleration

c) body acted on by no net force moves with increasing velocity and negative acceleration

d) body acted on by net force moves with constant velocity (which may be zero)

45. **Assertion:** The speed of a body can be negative. **[0.77]**
Reason: If the body is moving in the opposite direction of positive motion, then its speed is negative.

a) If both assertion and reason are true and the reason is the correct explanation of assertion.

b) If both assertion and reason are true but the reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

46. **Assertion (A):** If the sum of the two unit vectors is also a unit vector, then magnitude of their difference is root of three. **[0.77]**
Reason (R): To find resultant of two vectors, we use square law.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

47. **Assertion (A):** Parallax method is used for measuring distances of nearby stars only. **[0.77]**
Reason (R): With increase of distance of star, parallactic angle becomes too small to be measured accurately.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

48. **Assertion (A):** If the ice on the polar caps of the earth melts, then length of day will increases. **[0.77]**
Reason (R): Moment of inertia of earth increase, as ice on polar caps melts.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

49. **Assertion (A):** The handle of the watch-maker's screw-driver is much thicker than the handle of a carpenter's screwdriver. **[0.77]**
Reason (R): Watchmaker requires small torque than the carpenter.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section C

Attempt any 5 questions

50. In Kinematics we study ways to **[0.77]**

a) find jerk without going into the

b) find acceleration without going into

causes of motion.

c) find velocity without going into the causes of motion.

the causes of motion.

d) describe motion without going into the causes of motion.

51. The momentum of a body is: **[0.77]**

a) a vector equal in magnitude to the product of mass and instantaneous velocity and direction being that of instantaneous velocity

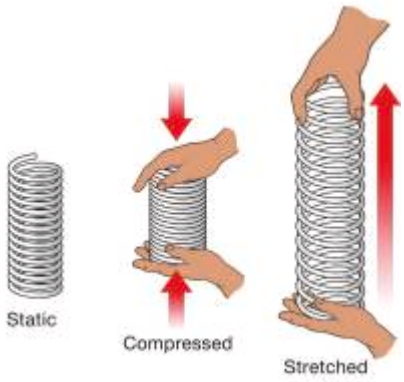
b) a scalar equal in magnitude to the product of mass and velocity

c) a vector equal in magnitude to the product of mass and average speed and direction being that of velocity

d) a vector equal in magnitude to the product of mass and acceleration and direction being that of velocity

Question No. 52 to 55 are based on the given text. Read the text carefully and answer the questions:

Elastic potential energy is Potential energy stored as a result of the deformation of an elastic object, such as the stretching of a spring. It is equal to the work done to stretch the spring, which depends upon the spring constant k as well as the distance stretched



52. If stretch in spring of force constant k is doubled, then the ratio of final to initial forces is: **[0.77]**

a) 4:1

b) 1:4

c) 2:1

d) 1:2

53. A light body and a heavy body have the same kinetic energy. which one has greater linear momentum? **[0.77]**

a) light body

b) both heavy and light body

c) none of these

d) heavy body

54. A spring is cut into two equal halves. How is the spring constant of each half affected? **[0.77]**

a) becomes double

b) none of these

c) becomes 1/4th

d) becomes half

55. What type of energy is stored in the spring of a watch? **[0.77]**

a) potential energy

b) none of these

c) mechanical energy

d) kinetic energy

Solution

SUBJECT - PHYSICS 042 - TEST - 04

Class 11 - Physics

Section A

1. **(a)** The total linear momentum
   Explanation: The rate of change of the total momentum of a system does not change i.e., this quantity is constant. When there is no net external force acting on a system of particles the total momentum of the system is conserved.
2. **(b)** ultrasound
   Explanation: SONAR emtis ultrasound.
3. **(a)** 6
   Explanation: Initial velocity is given by, u = 2 m/s
   Final velocity is given by , = v m/s
   Time duration is = final time - initial time = 2 - 0 = 2 s
   Acceleration, a = 2 m/s^2
   We know, v = u + at
   $\Rightarrow$ v = $2 + 2 \times 2$
   $\Rightarrow$ v = 6 m/s
4. **(b)** 40 m
   Explanation: Initial velocity u = 54 km/h = 15 m/s
   Let Final velocity v = 0
   Acceleration a = -0.3 m/s^2
   Time taken to stop = t
   Using v = u + at
   $\Rightarrow$ 0 = 15 + (-0.3)t
   $\Rightarrow$ t = 50 sec
   It means it has been stopped before 1 minute.
   So distance covered in 1 minute is given by
   s= ut +1/2 at^2
   = 15 $\times$ 60 + 1/2 $\times$ (-0.3) $\times$ (60)^2
   = 360 m
   Position of locomotive relative to the traffic lights = 400 - 360 = 40 m
5. **(b)** angular momentum
   Explanation: $[h] = \frac{\text{Energy}}{\text{Frequency}}$
   $= \frac{\left[\mathrm{ML^2\ T^{-2}}\right]}{\left[\mathrm{T^{-1}}\right]}$ = [ML^{2}T^{-1}]
6. **(b)** the axis of rotation
   Explanation: If we wrap the right hand around the axis of rotation with the fingers pointing in the direction of rotation, then the thumb points in the direction of angular velocity.
7. **(d)** $\frac{3}{4}mv^2$
   Explanation: Total K.E. of rolling circular disc
   $= E_{\text{tran}} + E_{\text{rot}} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$
   $= \frac{1}{2}mv^2 + \frac{1}{2} \times \frac{1}{2}mr^2 \times \frac{v^2}{r^2} = \frac{3}{4}mv^2$
8. **(c)** 36 $\times$ 10^{21}
   Explanation: Force exerted by the sun = Centripetal force
   F = $Mr\omega^2$
   = 6 $\times$ 10^{24} $\times$ 1.5 $\times$ 10^{11} $\times$ (2 $\times$ 10^{-7})^2 = 36 $\times$ 10^{21} N

9. **(c)** 25.0m/s
Explanation: Choose the positive direction of the x-axis to be from the south to the north.
Then, v_A = +54 km h^{-1}= +15 ms^{-1}
v_B= –90 km h^{-1}= –25 ms^{-1}
The relative velocity of B with respect to A = $v_B - v_A$ = -25 − (15) = -40 ms^{-1}, i.e. the train B appears to A to move with a speed of 40 ms^{-1} from north to south.
The relative velocity of ground with respect to B = 0 – v_B = 0 − (−25) = 25ms^{-1}.

10. **(a)** associative
Explanation: Vector addition is the operation of **adding** two or more **vectors** together into **a vector sum.** Associative law of vector addition. The law states that the sum of vectors remains the same irrespective of their order or grouping in which they are arranged.
$\vec{A} + (\vec{B} + \vec{C}) = (\vec{A} + \vec{B}) + \vec{C}$
This is known as the associative law of vector addition**.**

11. **(d)** 187.5 kgs^{-1}
Explanation: Initial acceleration,
$a = \frac{u}{m_0}\frac{dm}{dt} - g$
$20 = \frac{800}{5000} \times \frac{dm}{dt} - 10$
$\frac{dm}{dt} = \frac{30 \times 50}{8}$
= 187.5 kg s^{-1}

12. **(d)** more for the case of a positron, as the positron moves away from a larger distance.
Explanation: The force between two protons is equal to the force between a proton and a positron. As positron is much lighter than a proton, it moves away from a larger distance compared to a proton. As work done = force $\times$ distance, therefore at the same time t, work done for the case of the positron is more than that in case of the proton.

13. **(a)** $\frac{L}{4}$
Explanation: $K = \frac{1}{2}I\omega^2 = \frac{1}{2} \times I\omega \times \omega$
$K = \frac{1}{2}L\omega$
$\frac{K_1}{K_2} = \frac{L_1\omega_1}{L_2\omega_2}$
K_1 = K, $K_2 = \frac{K}{2}$
n_1 = n, $\omega_1 = 2\pi n = \omega$
n_2 = 2n, $\omega_2 = 2\pi \times 2n = 2\omega$
L_1 = L, L_2 = ?
$\frac{2K}{K} = \frac{L\omega}{L_2 \times 2\omega}$
$L_2 = \frac{L}{4}$

14. **(b)** 11.2 kms^{-1}
Explanation: Escape velocity is independent of the mass of the body projected provided the air resistance is neglected.

15. **(b)** the strongest of all fundamental forces, about 100 times the electromagnetic force in strength.
Explanation: In particle physics, the strong interaction is the mechanism responsible for the strong nuclear force (also called the strong force or nuclear strong force), and is one of the four known fundamental interactions, with the others being electromagnetism, the weak interaction, and gravitation. At the range of 10^{-15} m (femtometer), the strong force is approximately 100 times as strong as electromagnetism, a million times as strong as the weak interaction, and 10^{38} times as strong as gravitation.

16. **(b)** it is dimensionless
Explanation: Strain is a dimensionless physical quantity.

17. **(a)** $\lim_{t\to 0} \frac{\Delta x}{\Delta t}$

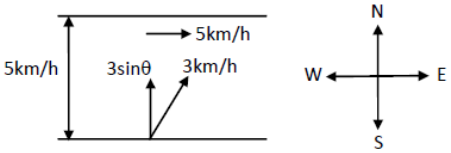
Explanation: Instantaneous velocity is the velocity of an object in motion at a specific point in time. This is determined similarly to average velocity, but we narrow the period of time so that it approaches zero. The formula for instantaneous velocity is the limit as t approaches zero of the change in position over the change in t. Mathematically,

$\lim_{t\to 0} \frac{\Delta x}{\Delta t}$

The Instantaneous Velocity is expressed in m/s.

18. **(c)** $\frac{10}{sin\theta}$ minutes

Explanation:



The velocity of man w.r.t. water = 3 kmph. Thus the velocity of water is not necessary here because the velocity of man includes the contribution of the velocity of water because the given velocity of man is with respect to the flowing water which is the resultant velocity. The breadth of the river = 500 m = 0.5 km.

Component of the velocity of man w.r.t. river along horizontal axis, v = 3sin(θ)

Now time is taken to cross the river, t = $\frac{Distance}{velocity\ along\ horizontal\ axis}$ = $\frac{0.5}{3sin\theta}$ hrs

$= \frac{0.5\times 60}{3sin\theta} = \frac{10}{sin\theta}$ minutes

19. **(c)** quantitative measure of the interaction between two bodies

Explanation: Newton's second law of motion gives the quantitative definition of force. The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object.

20. **(a)** 2.5 $\frac{m}{sec}$

Explanation: By conservation of momentum,

5 $\times$ 10 + 20 $\times$ 0 = (10 + 20) $\times$ v

$\therefore$ v = $\frac{50}{20}$ = 2.5 ms^{-1}

21. **(a)** $E_1 < E_2$

Explanation: K.E. of rotation

E = $\frac{L^2}{2I}$

E $\propto \frac{1}{I}$

$I_1 > I_2$

$E_1 < E_2$

22. **(d)** 0.49 m/s^2

Explanation: For earth, g = $\frac{GM}{R^2}$ = 9.8 ms^{-2}

For moon, $g' = \frac{G(\frac{M}{80})}{(\frac{R}{2})^2} = \frac{1}{20}\frac{GM}{R^2}$

= $\frac{1}{20}\times$ = 0.49 m/s^2

23. **(b)** 2.04

Explanation: Initial velocity is given by , u = 20.0 m/s

At maximum height it will stop, so final velocity is given by , v = 0 m/s

Acceleration due to gravity g = 9.8 m/s^2

Time taken to reach maximum height is = t

We know that, v = u + at

$\Rightarrow 0 = 20 + (-9.8)t$

$\Rightarrow t = \frac{-20}{-9.8} = 2.04\ s$ [g is taken as negative because it is in the opposite direction of motion]

24. **(a)** 60°

Explanation: Suppose the particle is projected with velocity u at an angle theta with the horizontal.
Horizontal component of its velocity at all height will be u cosθ.
At the greatest height, the vertical component of velocity is zero, so the resultant velocity is
$v_1 = u\cos\theta$
At half the greatest height during upward motion,
y = $\frac{h}{2}$, a_y = -g, $u_y = u\sin\theta$
Using $v_y^2 - u_y^2 = 2a_y y$
We get, $v_y^2 - u^2\sin^2\theta = 2(-g)\frac{h}{2}$
or $v_y^2 = u^2\sin^2\theta - g \times \frac{u^2\sin^2\theta}{2g} = \frac{u^2\sin^2\theta}{2}$ $\left[\because h = \frac{u^2\sin^2\theta}{2g}\right]$
or $v_y = \frac{u\sin\theta}{\sqrt{2}}$
Hence, resultant velocity at half of the greatest height is
$v_2 = \left(\sqrt{v_1^2 + \left(v_y^2\right)}\right)$
$= \left(\sqrt{u^2\cos^2\theta + \left(\frac{u^2\sin^2\theta}{2}\right)}\right)$
Given, $\frac{v_1}{v_2} = \left(\sqrt{\frac{2}{5}}\right)$
$\therefore \frac{v_1^2}{v_2^2} = \frac{u^2\cos^2\theta}{u^2\cos^2\theta + \left(\frac{u^2\sin^2\theta}{2}\right)} = \frac{2}{5}$
or $\frac{1}{1+\frac{1}{2}\tan^2\theta} = \frac{2}{5}$
or $2 + \tan^2\theta = 5$ or $\tan^2\theta = 3$
or $\tan\theta = (\sqrt{3})$
$\therefore \theta = 60^\circ$

25. **(d)** 105 kg

Explanation: When the lift moves upward with acceleration = 5 ms^{-2} the net force acting upward
R - mg = ma
R = mg + ma
R = m(g + a)
R = 70(10 + 5)
R = 1050N
(We experience weight due to reaction)
therefore Apparent weight = $\frac{1050}{g} = \frac{1050}{10}$ = 105 kg

Section B

26. **(d)** 5 : 7

Explanation: $E_{\text{tran}} = \frac{1}{2}mv^2$
$E_{\text{rot}} = \frac{1}{2}I\omega^2 = \frac{1}{2} \times \frac{2}{5}mr^2 \times \omega^2 = \frac{1}{5}mv^2$
$E_{\text{tot}} = E_{\text{tran}} + E_{\text{rot}} = \left(\frac{1}{2} + \frac{1}{5}\right)mv^2 = \frac{7}{10}mv^2$
$\frac{E_{\text{tran}}}{E_{\text{totai}} = \frac{1}{2}mv^2}\frac{7}{10}mv^2 = \frac{5}{7}$ = 5 : 7

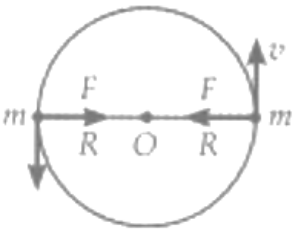
27. **(d)** 10

Explanation: $\theta = a_0 t + \frac{1}{2}\alpha t^2$
= 2 $\times$ 2 + $\frac{1}{2}\times$ 3.0 $\times$ 2^2 = 4 + 6 = 10

28. **(b)** $\frac{1}{2}\sqrt{\frac{Gm}{R}}$

Explanation:

The two masses, separated by a distance 2 R, revolve about the common centre of mass O.



Centripetal force = Mutual gravitational attraction

$\frac{mv^2}{R} = \frac{Gm \times m}{(2R)^2}$

or $v^2 = \frac{GM}{4R}$

$\therefore\ v = \frac{1}{2}\sqrt{\frac{Gm}{R}}$

29. **(d)** commutative and distributive

Explanation: The scalar product is:

a) Commutative:

$\vec{A}.\vec{B} = \vec{B}.\vec{A}$

$|A||B|\cos\theta = |B||A|\cos\theta$

b) Distributive

$\vec{A}.(\vec{B} + \vec{C}) = \vec{A}.\vec{B} + \vec{A}.\vec{C}$

30. **(b)** -3.0m/s

Explanation: The given equation is $x = 2.00 + 3.00t - 4.00t^2$

At t = 0, we have x = 2,

$\therefore$ 2 = 2 + 3.0t - $4t^2$

$t(3 - 4t) = 0$

$t = 0\ and\ t = \frac{3}{4}$

Now Velocity is given by , v = $\frac{dx}{dt} = 3 - 8t$

= 3 - $8 \times \frac{3}{4}$ = 3 - 6 = - 3 m/s

Negative sign shows direction of velocity is opposite.

31. **(b)** direction

Explanation: Scalar quantity gives you an idea about how much of an object there is, but vector quantity gives you an indication of how much of an object there is and that also in which direction. So, the main difference between these two quantities is associated with the direction, i.e. scalars do not have direction but vectors do.

32. **(b)** $10\sqrt{2}$ kg

Explanation: $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$

$F = |\vec{F}| = \sqrt{36 + 64 + 100} = 10\sqrt{2}$ N

$m = \frac{F}{a} = \frac{10\sqrt{2}}{1\ \text{ms}^{-2}} = 10\sqrt{2}$ kg

33. **(a)** both translation and rotation can be present

Explanation: In the general motion of the body can be seen as the combination of pure translation of the center of mass and pure rotation of the body about the center of mass like the motion of a wheel.

34. **(a)** 0.7 $\mathring{\text{A}}$

Explanation: $x_{CM} = \frac{12\times0+16\times1.2}{12+16} \simeq 0.7\ \mathring{\text{A}}$

35. **(c)** -31.5

Explanation: Initial velocity, u = 63 m/s

As it stops, so final velocity, v = 0 m/s

Time t = 2.0 s

We know that, v - u = at

$|\Rightarrow a = \frac{v-u}{t}$
$\Rightarrow a = \frac{0-63}{2}$
$\Rightarrow a = -31.5\ m/s^2$

36. **(b)** 40.2 m
Explanation: Initial Velocity v_0 = 20 ms^{-1} and $\theta = 50^\circ$ |
Horizontal Range, R = $\frac{v_o^2 sin2\theta}{g} = \frac{400 \sin\ 100^\circ}{9.8}$ = 40.2 m

37. **(a)** forward
Explanation: The wheels of a moving vehicle push the ground backwards, while force of friction acts in the forward direction.

38. **(d)** Natural Science
Explanation: The natural sciences seek to understand how the world and universe around us works. There are five major branches: Chemistry, astronomy, earth science, physics, and biology.

39. **(b)** $coulomb^2$/$newton\text{-}metre^2$
Explanation: From Coulomb's law,
$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$
or $\varepsilon_0 = \frac{q_1 q_2}{4\pi F r^2}$
SI unit of $\varepsilon_0 = \frac{C \cdot C}{Nm^2}$
= C^2/nm^2

40. **(d)** the products must move in opposite directions
Explanation: Let, M = mass of nucleus at rest. m_1 and m_2 are masses of two smaller nuclei. v_1 and v_2 are the velocities of respective masses
Now, According to the law of conservation of momentum,
Initial momentum before disintegration = final momentum after disintegration
$m_1v_1 + m_2v_2 = 0$
$v_2 = -\frac{m_2}{m_1} \cdot v_1$
As masses, m_1 and m_2 cannot be negative, v_1, and v_2 having opposite signs and so the two smaller nuclei move in opposite directions.

41. **(a)** 8 km/s
Explanation: Near earth's surface,
$v_0 = \sqrt{gR}$ = 7.2 km s^{-1}
= 8 km s^{-1}

42. **(d)** 7460 m/s
Explanation: Mass of the Earth, M_e = 6.0×10^{24}kg
The radius of the Earth, Re = 6.4×10^6m
Universal gravitational constant, G = $6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$
Height of the satellite, h = 780 km = 780 $\times$ 10^3m = 0.78 $\times$ 10^6m
Orbital velocity of the satellite, v = $\sqrt{\frac{GM_e}{R_e+h}}$
$= \sqrt{\frac{6.67\times10^{-11}\times6.0\times10^{24}}{6.4\times10^6+0.78\times10^6}}$
$= \sqrt{\frac{40\times10^{13}}{7.18\times10^6}}$
$= \sqrt{5.57\times10^7}$
$= 10^3 \times \sqrt{5.57\times10}$
$= 7.46\times10^3$
= 7460 m/sec

43. **(c)** $\left|\overrightarrow{\mathrm{F}}\right| = \mathrm{G}\frac{\mathrm{m_1 m_2}}{\mathrm{r^2}}$

Explanation: According to Newton's law of universal gravitation, the force of attraction between two objects is directly proportional to the product of two masses and inversely proportional to the square of the distance between them.

44. **(a)** body acted on by no net force moves with constant velocity (which may be zero) and zero acceleration
Explanation: If net force act on a body then the acceleration of the body will also be zero. Hence velocity will not be changed i.e. it continues in its existing state of rest or uniform motion in a straight line.

45. **(d)** If both assertion and reason are false.
Explanation: If both assertion and reason are false.

46. **(c)** A is true but R is false.
Explanation: Let $\hat{A} + \hat{B} = \hat{R}$, then using parallelogram law of vector, we have
1 = $(1^2 + 1^2 + 2 \times 1 \times 1 \times \cos\theta)^{1/2}$
or 1 = 2 (1 + cos θ)
or $\frac{1}{2} - 1 = \cos\theta$
or $\cos\theta = -\frac{1}{2}$ or θ = 120°
$\therefore \quad |\hat{A} - \hat{B}| = |\hat{A} + (-\hat{B})|$
Now, the angle between $\hat{A}$ and $\hat{B}$ is = 180° - 120° = 60°
$\therefore$ The resultant of
$|\hat{A} + (-\hat{B})|$ = $(1^2 + 1^2 + 2 \times 1 \times 1 \cos 60°)^{1/2}$ = $\sqrt{3}$

47. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation: As the distance of star increases, the parallax angle decreases, and great degree of accuracy is required for its measurement. Keeping in view the practical limitation in measuring the parallax angle, the maximum distance of a star we can measure by parallax method is limited to 100 light year.

48. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation: Earth rotates about its polar axis. When ice of polar caps of earth melts, mass concentrated near the axis of rotation spreads out. Therefore, moment of inertia I increases. As no external torque acts.
$\therefore$ L = $I\omega = I\left(\frac{2\pi}{T}\right)$ = constant.
With increase of I, T will increase i.e., length of the day will increase.

49. **(d)** A is false but R is true.
Explanation: A carpenter drives large screws in hardwood. Therefore the torque required is large, which is obtained by increasing the radius of the handle. The watchmaker requires small torque and a smaller handle.

Section C

50. **(d)** describe motion without going into the causes of motion.
Explanation: Kinematics is a branch of classical mechanics that describes the motion of points, bodies (objects), and systems of bodies (groups of objects) without considering the mass of each or the forces that caused the motion.

51. **(a)** a vector equal in magnitude to the product of mass and instantaneous velocity and direction being that of instantaneous velocity
Explanation: $\vec{p} = m\vec{v}$

52. **(c)** 2:1
Explanation: 2:1

53. **(d)** heavy body
Explanation: heavy body

54. **(a)** becomes double
Explanation: becomes double

55. **(a)** potential energy
Explanation: potential energy