# Step Academy official

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| STUDENT NAME | |
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| CLASS | 1st Year |
| SUBJECT | Physics |
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**Q1. Choose the correct answer.**

**1.**
The mean diameter of a wire is found to be (0.50±0.02) mm. The percentage uncertainty in the diameter is:

**(A)** 2% **(B)** 4% **(C)** 6% **(D)** 8%

**2.**
Three different people weigh a standard mass of 2.00 g on the same balance. Each person obtains a reading of exactly 7.32 g for the mass of the standard. These results imply that the balance that was used is

**(A)** both accurate and precise **(B)** neither accurate nor precise **(C)** accurate but not precise **(D)** precise but not accurate.

**3.** Dimension of universal gravitational constant is

**(A)** $[M^{-2}L^{3}T^{-2}]$ **(B)** $[M^{3}L^{-1}T^{-2}]$ **(C)** $[M^{-1}L^{3}T^{-2}]$ **(D)** $[M^{-3}L^{3}T^{-2}]$

**4.** A measurement which on repetition gives same or nearly same result is called

**(A)** Accurate **(B)** average **(C)** precise **(D)** estimated

**5.**
A student is measuring the time of an event by using stopwatch. He takes 5 measurements as: 3.0 s, 3.2 s, 3.4 s, 2.8 s, 3.1 s. What is the uncertainty in the results?

**(A)** ±0.3s **(B)** ±0.6s **(C)** ±3.1s **(D)** ±7.75s

**6.** Which of the following quantity has different dimension?

**(A)** Force **(B)** weight **(C)** Modulus of elasticity **(D)** estimated

**7.** If the dimensions of a physical quantity are given by $[L^{a}M^{b}T^{-c}]$, then the physical quantity will be

**(A)** force, if a = - 1, b = 0 ,c = - 2 **(B)** pressure, if a = - 1, b = 1, c = - 2 **(C)** velocity, if a = 1, b = 0, c=1 **(D)** acceleration, if a = 1, b = 1, c = - 2

**8.** Order of magnitude of $(10^{6} + 10^{3})$ is

**(A)** $10^{18}$ **(B)** $10^{9}$ **(C)** $10^{6}$ **(D)** $10^{3}$

**9.**
Which of the following may be used as a valid formula to calculate speed of ocean waves? [v = speed, g = acceleration due to gravity, $\lambda$ = wavelength, *p*-density, h-depth].

**(A)** $v = \sqrt{\lambda g}$ **(B)** C. $v = \rho gh$ **(C)** C. $v = gh/\lambda$ **(D)** D. $v = \lambda gh$

**10.** The number of perpendicular components of a force (in 2-D) are:

**(A)** 1 **(B)** 2 **(C)** 3 **(D)** 4

**11.** $\hat{j} \times \hat{i} =$

**(A)** 0 **(B)** 1 **(C)** $\hat{k}$ **(D)** $-\hat{k}$

**12.** A force of 10 N is making an angle of 30" with the horizontal. Its x-components will be:

**(A)** 4 N **(B)** 5 N **(C)** 1 N **(D)** Null vector

**13.**
if two forces of magnitude 3 N and 4 N are acting at right angle to each other than their resultant force will be:

**(A)** 7 N **(B)** 5 N **(C)** 1 N **(D)** Null Vector

**14.** Angle between two vectors A and B can be easily determined by:

**(A)** dot product **(B)** cross product **(C)** head to tail rule **(D)** right hand rule

**15.** For which angle the equation $|\vec{A}.\vec{B}| = |\vec{A} \times \vec{B}|$ is correct?

**(A)** 30° **(B)** 45° **(C)** 60° **(D)** 90°

**16.**
A projectile thrown upward moves in its parabolic path, the velocity and acceleration vectors for the projectile are perpendicular to each other at:

**(A)** no where **(B)** the highest point **(C)** the launch point **(D)** the landing point

**17.**
A truck driving along a highway road has a large quantity of momentum. If it moves at the same speed but has twice as much mass, its momentum is_____.

**(A)** zero **(B)** quadrupled **(C)** doubled **(D)** unchanged

**18.**
A 5 N force is applied to a 3 kg ball to change its velocity from 9 m/s to 3 m/s. This impulse causes the momentum change of the ball to be_____ kgm/s.

**(A)** -2.5 **(B)** -10 **(C)** -18 **(D)** -45

**19.** Which of the following statement is Not True for the horizontal motion of projectiles?

**(A)** A projectile with a horizontal component of motion will have a constant horizontal velocity.

**(B)** The horizontal velocity of a projectile is 0 m/s at the peak of its trajectory.

**(C)** The horizontal velocity of a projectile is unaffected by the vertical velocity; these two components of motion are independent of each other.

**(D)** The horizontal displacement of a projectile is dependent upon the time of flight and the initial horizontal velocity.

**20.** The vertical component of velocity of a projectile is smallest at:

**(A)** The instant it is thrown.

**(B)** Halfway to the top.

**(C)** The top.

**(D)** The landing point.

**21.** A 4 kg object has a momentum of 12 kg m/s. The object's speed is_____ m/s.

**(A)** 3

**(B)** 4

**(C)** 12

**(D)** 48

**22.**
A bomb of mass 9 kg explodes into 2 pieces of mass 3kg and 6kg. The velocity of mass 3 kg is 1.6 m/s, the kinetic energy of mass 6 kg is:

**(A)** 3.84 J

**(B)** 9.6 J

**(C)** 1.92 J

**(D)** 2.92 J

**23.** which of the following statement is true about the projectile motion?

**(A)** Projectile motion is the motion of an object projected vertically upward into the air and moving under the influence of gravity.

**(B)** Projectile motion is the motion of an object projected into the air and moving independently of gravity.

**(C)** Projectile motion is the motion of an object projected into the air and moving under the influence of gravity.

**(D)** Projectile motion is the motion of an object projected horizontally into the air and moving independently of gravity.

**24.**
What is the force experienced by a projectile after the initial force that launched it into the air in the absence of air resistance?

**(A)** The gravitational force

**(B)** The nuclear force

**(C)** The contact force

**(D)** The electromagnetic force

**25.** If a projectile is launched on level ground, what launch angle maximizes the range of the projectile?

**(A)** 0°

**(B)** 30°

**(C)** 45°

**(D)** 90°

**26.** The change in angular momentum of a rod, when a torque of 2.5 Nm is acted upon it for 2 seconds, is

**(A)** 1.25 Js

**(B)** 2.5 Js

**(C)** 5 Js

**(D)** Zero

**27.**

If size (length) of the wings of a fan is increased, its rotational speed, for the same voltage and current, will

**(A)** increase **(B)** decrease **(C)** may increase or decrease **(D)** remain constant

**28.** In a body, angular acceleration is produced by

**(A)** net force **(B)** power **(C)** pressure **(D)** not torque

**29.**
An astronaut feels weightless inside the International Space Station. It is because the International Space Station is

**(A)** outside the gravitational field of earth **(B)** freely falling **(C)** at rest **(D)** in motion

**30.** Which of the following is NOT correct?

**(A)** $v = r\omega$ **(B)** **(C)** $a = r\alpha$ **(D)** $\alpha = \frac{\Delta\omega}{\Delta t}$

B. $\alpha = \omega \times r$

**31.** A car turns around a curve at 30 km/h. If it turns at double the speed, the tendency to overturn is

**(A)** doubled **(B)** quadrupled **(C)** halved **(D)** unchanged

**32.**
if the unit of force and displacement travelled each be increased five times, then the unit of work will be increased by

**(A)** 25 times **(B)** 10 times **(C)** 5 times **(D)** 0 times

**33.** The force that acts on a body but does no work is

**(A)** gravitational force **(B)** frictional force **(C)** elastic force **(D)** centripetal force

**34.** The odd force from the following is

**(A)** gravitational force **(B)** elastic force **(C)** frictional force **(D)** electric force

**35.**
The work done by a body while covering a vertical height of 10 m is 500 J. By how much amount does the energy of the body change?

**(A)** 500 J **(B)** -500 J **(C)** 50 J **(D)** -50 J

**Q2. Write short answers of the following questions.**

**1 .**

Create a table to show reasonable estimate of some physical quantities.

**2 .** Express the units of the following derived quantities in term of base units. (a) Force (b) Work(c) Power (d) Pressure(e) Electric charge.

**3 .** Why is it important to use an instrument of smallest resolution?

**4 .** What is the difference between precision and accuracy?

**5 .** What is the principle of homogeneity of dimensions?

**6 .**
A ball is thrown in the air and 5 different students are individually measuring the time it takes to fall back down using stopwatches. The times obtained by each student are the following: 6.2 s , 6.0 s, 6.4 s, 6.1 s, 5.8 s.

(1) What is the uncertainty of the results? (2) How should the resulting time be expressed?



**7 .**
The energy of a photon is given by E = hf, find the dimensions of Plank's constant h, where *f* is frequency.

**8 .** If the cross product of two vectors vanishes, what will you say about their orientation?

**9 .** Find the dot product of unit vectors with each other at (a) 0° and (b) 90°.

**10 .** Show that scalar product obeys commutative property.

**11 .** Find the dot product of unit vectors with each other at (a) 0° and (b) 90°.

**12 .** Show that scalar product obeys commutative property.

**13 .** Solve by using the properties of dot and cross product:

(a) $\hat{i} \cdot (\hat{j} \times \hat{k})$ (b) $\hat{j} \times (\hat{j} \times \hat{k})$?

**14 .**
If both the dot product and the cross product of two vectors are zero. What would you conclude about the individual vectors?



**15 .** What are rectangular components of a vector? How they can be found?

**16 .** What units are associated with the unit vectors î, j, and k?

**17 .** What are the conditions for using the equations of motion?

**18 .**
You through a small ball vertically up in the air. How are the velocity and acceleration of the ball oriented with respect to one another

(a) when the ball is going upward (b) when the ball is coming downward?

**19 .**
Construct motion diagrams showing the velocity and acceleration of a projectile at several points along its path, assuming (a) the projectile is launched horizontally and (b) the projectile is launched at an angle 8 with the horizontal.

**20 .**
An aeroplane while flying horizontally drops a bomb when reaches exactly above the target, but missed it. Explain why?

**21 .** What is the difference between explosion and collision? Give one example of each.

**22 .** Why do a slow-moving loaded truck and a speeding rifle bullet each have a large momentum?

**23 .** What is the difference between elastic and inelastic collision?

**24 .**
An object that has a small mass and an object that has a large momentum. Which object has the largest kinetic energy?

**25 .**

Can objects in a system have momentum while the momentum of the system is zero? Explain your answer.

**26 .**
For any specific velocity of projection, prove that the maximum range is equal to four times of the corresponding height.

**27 .** Is momentum conserved when a bat hits a ball.

**28 .** What is the value of angular acceleration of the minute hand of your wrist watch?

**29 .** Define the following angular quantities: Displacement, velocity, acceleration.

**30 .** Determine the relation between(a) linear and angular displacement.(b) linear and angular velocity

(c) linear and angular acceleration.



**31 .**
Is centripetal force a fundamental force or a force provided by any of the fundamental forces? Can any combination of the fundamental forces provide centripetal force?

**32 .**
There are generally double tyres in heavy vehicles on one side of an axle. Will its moment of inertia be different from that of a single tyre?

**33 .**
if diameter of earth becomes half and there is no change in its mass, what affect will be there on the rotational speed of earth around its own axis?

**34 .**
Why does in circular motion, a tangential acceleration can change the magnitude of the velocity but not its direction?

**35 .** Why does usually the value of artificial gravity is smaller than 9.8 $m/s^2$?

**36 .** How the rotation of a flywheel helps to even out the power delivery from the engine?

**37 .**
Is it possible that a force is acting on a body and the body is in motion due to this force but the work done after certain time is zero?

**38 .**
Kinetic energy and work are related. Can kinetic energy ever be negative? Can work ever be negative?



**39 .** Differentiate between conservative and non-conservative forces.

**40 .** What is the work done by the moon as it revolves around the Earth?

**Q3. Write detailed answers of the following questions.**

**1 .** Define and explain the term uncertainty.

**2 .** Discuss the rules for calculating uncertainty propagation in the final results in different cases.

**3 .**
What does the dimension of a physical quantity mean? What are its advantages, explain with the help of examples?

**4 .** What is meant by estimation of a physical quantity? Explain with the help of an example.

**5 .** Estimate number of heartbeats in a lifetime?

**6 .** Estimate that how many protons are there in a bacterium?

**7 .** Estimate that how many hydrogen atoms does it take to stretch across the diameter of the Sun?

**8 .** The pressure (P) at a depth (h) in an incompressible fluid of density (p) is given by $P = \rho g h$

Where g is acceleration due to gravity. Check the homogeneity of this equation.

**9 .** What is scalar product? Explain. Also write the properties of scalar product.

**10 .** What is vector product? Explain. Also write the properties of vector product.

**11 .**
If the magnitude of cross product between two vectors is $\sqrt{3}$ times the dot product, find angle between them.

**12 .**
A force is acting on a body making an angle of 30° with the horizontal. The horizontal component of the force is 20 N. Find the force.

**13 .**
A vector having magnitude 5.5 N makes 10° with x-axis and vector $\vec{r}$ with magnitude 4.3 m makes 80° with x-axis. What is the magnitude of their dot and cross products?

**14 .** Derive the equations of motion.

**15 .**
Discuss the motion of a projectile under the following situations (a) an object launched at some angle with horizontal (b) an object launched horizontally.

**16 .** What is projectile motion? Explain with the help of examples.

**17 .** A projectile is launched with an initial speed of 21.8 m/s at an angle of 35° above the horizontal.

(a) Determine the time of flight of the projectile.(b) Determine the peak height of the projectile.

(c) Determine the horizontal displacement of the projectile.

**18 .**

A 0.5 kg ball traveling at a speed of 4 m/s to the right collides elastically with another ball of 3.5 kg which is initially at rest. Find velocities of both the balls after collision?

**19 .**
A 17.5 g bullet is fired at a muzzle velocity of 582 m/s from a gun with a mass of 8.0 kg and a barrel length of 75.0 cm.

(a) How long is the bullet travelled in the barrel?(b) What is the force on the bullet while it is in the barrel?

(c) Find the impulse exerted on the bullet while it is in the barrel.

(d) Find the bullet's momentum as it leaves the barrel.

**20 .**
What is centripetal force? Explain. Write down at least two applications where centripetal force plays its vital role.

**21 .** What is moment of inertia? Derive its relation for rigid body.

**22 .**
Define and derive expression for angular momentum of a body. Also deduce the relation between angular momentum and torque.

**23 .** Explain conservation of angular momentum using practical life examples.

**24 .** Derive the relation between torque and angular acceleration.

**25 .**
Why do astronauts feel weightless in a satellite? What is meant by artificial gravity? How can artificial gravity be produced in a satellite?

**26 .** What will be the angular velocity of fly wheel of an engine if it travels 3000 revolutions in a minute?

**27 .**
A car is passing through a turn that is in the form of an arc of a circle of radius 14.5 m. What will be the maximum speed limit (the speed at which the car can cross the bridge without losing contact with the road) if the centre of gravity of the car is 0.5 m from the ground?

**28 .**
A PT teacher rotates his stick at the axis that passes through its centre. If mass of the stick is 200 g and its length is 0.8 m, find its moment of inertia?

**29 .**
A football of mass 450 g rotates with an angular speed of 10 revolution/s. If its radius is 11 cm, compute its angular momentum?

**30 .**
A boy exerts a force of 200 N at the edge of the 30.0 kg merry-go-round, which has a 2.0 m radius. Calculate the angular acceleration produced (a) when no one is on the merry-go- round and (b) when the boy having 20.0 kg weight sits 1.5 m away from the center. (ignore friction).

**31 .**

A wheel shape space station provides an artificial gravity of 5.00 m/s² to its inhabitants. If it has a diameter of 100 m, find its angular speed in rpm.

**32 .**
What is work-energy theorem. Explain in detail. Also, write some implications of energy loses in practical devices and efficiency.

**33 .**
A car carrying truck unloads a 1500 kg car using a plank as shown in figure. If the plank makes an angle of 30° with the ground and its upper end is at 2 m height, what will be the work done by gravitational force? Also, draw the force-displacement graph for.

**34 .**
A car, having a total mass of 1500 kg (including the driver), is travelling at a speed of 40 kph through a straight path. How much work will be required to stop the sald car if its brakes fail and engine turns off?

**35 .**
A ball of mass 100 g is released from a height of 30 m. If the ball encounters an air resistance of 0.4 N, find the kinetic energy of the ball just before striking the ground.