



INDIAN SCHOOL MUSCAT  
ANNUAL EXAMINATION  
**PHYSICS**

CLASS: XI

Sub. Code: 042

Time Allotted: 3 Hrs.

13.02.2020

Max. Marks: 70

**General Instructions:**

- All questions are compulsory. There are 37 questions in all.
- This question paper has four sections: section A, section B, section C and section D.
- Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, Section D contains three questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in two questions of one marks each, two questions of two marks, one question of three marks and in all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- You may use the following value of physical constant wherever necessary:  $g = 9.8 \text{ m/s}^2$ .

**SECTION A**

- 1 A particle projected at  $60^\circ$  to the horizontal with a kinetic energy K. The kinetic energy at the highest point is (1)  
(a)  $K/2$  (b) K (c) Zero (d)  $K/4$
- 2 An object is projected upwards with a velocity of 100 m/s. It will strike the ground after (1)  
(a) 10 s (b) 20 s (c) 15 s (d) 5 s
- 3 Two bodies, one held 30 cm directly above the other, are released simultaneously and fall freely under gravity. After 2 sec their relative separation will be: (1)  
(a) 10 cm (b) 20 cm (c) 30 cm (d) Zero
- 4 A particle is moving along a straight line with constant speed, then (1)  
(a) velocity of particle is constant (b) acceleration of particle is zero  
(c) acceleration of particle is non-zero (d) None of the above
- 5 The magnitude of the resultant of two equal vectors is equal to the magnitude of either vector. Then the angle between the two vectors is (1)  
(a) 150 degree (b) 120 degree (c) 90 degree (d) 60 degree
- 6 Which of the following statements is false for a particle moving in a circular path with constant angular speed? (1)  
(a) The velocity vector is tangent to the circle  
(b) The acceleration vector is tangent to the circle  
(c) The acceleration vector points to the center of the circle  
(d) The velocity and acceleration vectors are perpendicular to each other

- 7 What angle of projection would result in a ball travelling the maximum horizontal distance? (1)  
(a)  $90^\circ$  (b)  $45^\circ$  (c)  $60^\circ$  (d)  $30^\circ$

**OR**

Consider the quantities, force, power, energy, momentum, electrical charge, temperature, area. Out of these, the only vector quantities are

- (a) force, temperature and area (b) power, energy and temperature  
(c) momentum, electrical charge and area (d) force and momentum
- 8 First law of thermodynamics corresponds to (1)  
(a) Law of conservation of energy (b) Law of conservation of angular momentum  
(c) Law of conservation of linear momentum (d) Newton's law of cooling
- 9 The velocity of a body of mass 20 kg decreases from 20 m/s to 5 m/s in a distance of 100 m. Force on the body is (1)  
(a) -27.5 N (b) -47.5 N (c) -37.5 N (d) -67.5 N
- 10 For a wave propagating in a medium, identify the property that is independent of the others. (1)  
(a) Velocity (b) Wave length (c) Frequency (d) All the above

**OR**

In the longitudinal waves the direction of vibration in medium of particle is

- (a) Perpendicular to propagation of wave (b) Parallel to propagation  
(c) Different from each other (d) Variable for time to time
- 11 Materials that show very small plastic range beyond elastic limit are called (1)  
(a) Brittle materials (b) Elastomers (c) Elastic materials (d) Ductile materials
- 12 When the speed of a moving body is doubled (1)  
(a) Its acceleration is doubled (b) Its momentum is doubled  
(c) Its kinetic energy is doubled (d) Its potential energy is doubled
- 13 The S.I unit of torque is (1)  
(a) Nm (b) Nm/s (c)  $\text{m/s}^2$  (d) kgm/s
- 14 If the temperature of the source is increased ,the efficiency of a Carnot engine (1)  
(a) Increases (b) Decreases  
(c) Remains constant (d) First increases then remains constant
- 15 Write the four fundamental forces in nature in the increasing order of their magnitude. (1)
- 16 What is the angle between frictional force and instantaneous velocity of a body moving over a rough surface? (1)
- 17 Which physical quantities are expressed by the following (1)  
(a) Rate of change of angular momentum (b) Moment of linear momentum
- 18 State Wien's displacement law. (1)

- 19 Sound travels faster on a rainy day than on a dry day. Why? (1)
- 20 Which physical quantity is represented by the area under stress-strain graph? (1)

### SECTION B

- 21 Can a body have energy without having momentum and have momentum without having energy? Explain. (2)
- 22 (a) Can a bomb initially at rest, explode into three pieces which fly in mutually perpendicular direction. Justify? (1 mark) (2)
- (b) A cricket player lowers his hands to catch the ball safely. Explain why?( 1 mark)
- 23 Using the expression for pressure exerted by a gas deduce the relation between kinetic energy and absolute temperature T of an ideal gas. (2)

OR

Write any four postulates of kinetic theory of gases

- 24 a) Show graphically how acceleration due to gravity varies as we move from the centre of the earth to great heights above the surface of the earth. (1) (2)
- b) The potential energy of an artificial satellite is  $-30 \times 10^9$  J. Calculate its kinetic energy and total energy. (1 m)
- 25 A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 m in 20 s. Calculate the acceleration of the truck and force acting on it, if its mass is 7 metric ton. (2)

OR

A mass of 6 kg is suspended by a rope of 2m from a ceiling. A force of 50 N in the horizontal direction is applied at the midpoint of the rope. What is the angle the rope makes with the vertical in equilibrium

- 26 A physical quantity P is given by (2)

$$P = \frac{a^3 b^2}{(\sqrt{cd})}$$

The percentage errors in a, b, c and d are 1%, 3%, 4% and 3% respectively. Find the percentage error in P.

- 27 Explain how in a thermos flask the loss of heat due to three modes is minimized. (2)

### SECTION C

- 28 (a) Is uniform circular motion an example of accelerated motion? Give reason. (3)
- (b) Derive the expression for centripetal acceleration for an object under uniform circular motion, along a path of radius r with speed v.
- 29 (a) Draw velocity-time graph for an object thrown vertically upwards returning to the point of projection. (1 mark) (3)
- (b) Can a distance- time graph of an object be parallel to time axis? Give reason. (1 mark)

(c) Can an object's velocity change direction when its acceleration is constant? Support your answer with an example. (1 mark)

- 30 Three bodies a ring, a solid cylinder and a solid sphere starting from rest roll down the same inclined plane without slipping. The radii of the bodies are identical. Which of the bodies reach the ground with maximum velocity? (3)
- 31 (a) Define escape velocity of an object. (1) (3)  
(b) Derive the expression for the escape velocity of an object from the earth. (2)

**OR**

Derive an expression for acceleration due to gravity at a depth  $d$  below the surface of the earth of radius  $R$  in terms of acceleration due to gravity  $g$  on the surface of the earth. Assume the earth to be a perfect sphere of uniform density  $\rho$ .

- 32 State law of equipartition of energy .For one mole of a diatomic gas derive the expression for  $C_p$  and  $C_v$  and calculate the ratio of  $C_p/C_v$ . (3)
- 33 Discuss about the harmonics formed in a stretched string and obtain the ratio of the frequencies of the harmonics in the string. (3)
- 34 (a) State two difference between adiabatic and isothermal process. (3)  
(b) Why efficiency of a heat engine cannot be 100% or unity?  
(c) Calculate the coefficient of performance of a refrigerator working between  $-3^{\circ}\text{C}$  and  $27^{\circ}\text{C}$ .

#### **SECTION D**

- 35 (a) Show that in case of one dimensional elastic collision of two bodies, the relative velocity of separation after collision is equal to the relative velocity of approach before collision. (5)  
(b) In a ballistics demonstration a police officer fires a bullet of mass 50 g with speed 200 m/s on a soft plywood of thickness 2 cm. The bullet emerges with only 10 % of its KE. What is the emergent speed of the bullet? (2 marks)

**OR**

- (a) State the law of conservation of mechanical energy.  
(b) Show that the total mechanical energy of a freely falling body under gravity is conserved.  
(c) .Show the variations in kinetic energy, potential energy and total energy graphically.
- 36 (a) Show that the oscillations of a simple pendulum are simple harmonic and derive the expression for time period of the simple pendulum. (3 marks) (5)  
(b) Why soldiers are asked not to march over old bridges. (1 mark)  
(c) Draw a graph showing the variation of energy with respect to time for a harmonic oscillator executing damped oscillations. (1 mark)

**OR**

- (a) Define Simple harmonic motion.  
(b) Derive the differential equation for a simple harmonic motion.  
(c) The equation of a particle in SHM is as given as  $Y = 0.05 \sin (50 \pi t + \pi/3)$ , where  $y$  is in

meter and  $t$  is in second. Calculate its (i) time period (ii) amplitude and (iii) velocity amplitude

- 37 (a) State and prove Bernoulli's principle. (3 marks) (5)
- (b) When air is blown between two balls suspended close to each other, they are attracted towards each other. Why? (1 mark)
- (c) How does the ploughing of fields help in preservation of moisture in the soil? (1 mark)

**OR**

- (a) Define terminal velocity.
- (b) Derive an expression for the terminal velocity attained by a spherical body falling through a viscous medium.
- (c) A spherical rain drop of radius 0.2 mm has a terminal velocity in air 2 m/s. The viscosity of air is  $18 \times 10^{-5} \text{ Nm}^{-2} \text{ s}$ . Find the viscous force on the rain drop.

**End of the Question Paper**



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- You may use the following value of physical constant wherever necessary:  $g = 9.8 \text{ m/s}^2$ .

#### SECTION A

- 1 An object is projected upwards with a velocity of 100 m/s. It will strike the ground after (1)  
 (a) 10 s                      (b) 20 s                      (c) 15 s                      (d) 5 s
- 2 A particle is moving along a straight line with constant speed, then (1)  
 (a) velocity of particle is constant                      (b) acceleration of particle is zero  
 (c) acceleration of particle is non-zero                      (d) None of the above
- 3 Which of the following statements is false for a particle moving in a circular path with constant angular speed? (1)  
 (a) The velocity vector is tangent to the circle  
 (b) The acceleration vector is tangent to the circle  
 (c) The acceleration vector points to the center of the circle  
 (d) The velocity and acceleration vectors are perpendicular to each other
- 4 First law of thermodynamics corresponds to (1)  
 (a) Law of conservation of energy                      (b) Law of conservation of angular momentum  
 (c) Law of conservation of linear momentum                      (d) Newton's law of cooling
- 5 A particle projected at  $60^\circ$  to the horizontal with a kinetic energy K. The kinetic energy at the highest point is (1)  
 (a)  $K/2$                       (b) K                      (c) ZERO                      (d)  $K/4$

- 6 Two bodies, one held 30 cm directly above the other, are released simultaneously and fall freely under gravity. After 2 sec their relative separation will be: (1)  
 (a) 10 cm (b) 20 cm (c) 30 cm (d) Zero
- 7 If the temperature of the source is increased, the efficiency of a Carnot engine (1)  
 (a) Increases (b) Decreases  
 (c) Remains constant (d) First increases then remains constant
- 8 The magnitude of the resultant of two equal vectors is equal to the magnitude of either vector. Then the angle between the two vectors is (1)  
 (a) 150 degree (b) 120degree (c) 90degree (d) 60 degree
- 9 Materials that show very small plastic range beyond elastic limit are called (1)  
 (a) Brittle materials (b) Elastomers (c) Elastic materials (d) Ductile materials
- 10 When the speed of a moving body is doubled (1)  
 (a) Its acceleration is doubled (b) Its momentum is doubled  
 (c) Its kinetic energy is doubled (d) Its potential energy is doubled
- 11 The S.I unit of torque is (1)  
 (a) Nm (b) Nm/s (c) m/s<sup>2</sup> (d) kgm/s
- 12 For a wave propagating in a medium, identify the property that is independent of the others. (1)  
 (a) Velocity (b) Wave length (c) Frequency (d) All the above

**OR**

In the longitudinal waves the direction of vibration in medium of particle is

- (a) Perpendicular to propagation of wave (b) Parallel to propagation  
 (c) Different from each other (d) Variable for time to time.
- 13 The velocity of a body of mass 20 kg decreases from 20 m/s to 5 m/s in a distance of 100 m. Force on the body is (1)  
 (a) -27.5 N (b) -47.5 N (c) -37.5 N (d) -67.5 N
- 14 What angle of projection would result in a ball travelling the maximum horizontal distance? (1)  
 (a) 90° (b) 45° (c) 60° (d) 30°

**OR**

Consider the quantities, force, power, energy, momentum, electrical charge, temperature, area. Out of these, the only vector quantities are

- (a) force, temperature and area (b) power, energy and temperature  
 (c) momentum, electrical charge and area (d) force and momentum
- 15 Which physical quantity is represented by the area under stress-strain graph? (1)
- 16 Which physical quantities are expressed by the following (i) Rate of change of angular (1)

momentum (ii) Moment of linear momentum

- 17 What is the angle between frictional force and instantaneous velocity of a body moving over a rough surface? (1)
- 18 Sound travels faster on a rainy day than on a dry day. Why? (1)
- 19 State Wien's displacement law. (1)
- 20 Write the four fundamental forces in nature in the increasing order of their magnitude. (1)

### SECTION B

- 21 Using the expression for pressure exerted by a gas deduce the relation between kinetic energy and absolute temperature  $T$  of an ideal gas. (2)

**OR**

Write any four postulates of kinetic theory of gases.

- 22 (a) Show graphically how acceleration due to gravity varies as we move from the centre of the earth to great heights above the surface of the earth. (1) (2)
- (b) The potential energy of an artificial satellite is  $-30 \times 10^9 \text{ J}$ . Calculate its kinetic energy and total energy. (1 m)
- 23 Can a body have energy without having momentum and have momentum without having energy? Explain. (2)
- 24 Give reason for the following (2)
- (a) Chinaware is wrapped in straw paper before packing.
- (b) Proper inflation of tyres of vehicles saves fuel.
- 25 The percentage errors in the measurements of mass and speed are 2% and 3 % respectively. How much will be the maximum error in the estimate of kinetic energy obtained by measuring mass and speed. (2)
- 26 Explain how in a thermos flask the loss of heat due to three modes is minimized. (2)
- 27 A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 m in 20 s. Calculate the acceleration of the truck and force acting on it, if its mass is 7 metric tons. (2)

**OR**

A mass of 6 kg is suspended by a rope of 2m from a ceiling. A force of 50 N in the horizontal direction is applied at the midpoint of the rope. What is the angle the rope makes with the vertical in equilibrium?

### SECTION C

- 28 (a) Is the rocket in flight, an example of projectile? Give reason. (3)



- (b) Show that the path followed by a projectile is a parabola when it is projected at an angle  $\theta$  with the horizontal.
- 29 Three bodies a ring, a solid cylinder and a solid sphere starting from rest roll down the same inclined plane without slipping. The radii of the bodies are identical. Which of the bodies reach the ground with maximum velocity? (3)
- 30 (a) Draw velocity-time graph for an object thrown vertically upwards returning to the point of projection. (1 mark) (3)  
 (b) Can a distance- time graph of an object be parallel to time axis? Give reason. (1 mark)  
 (c) Can an object's velocity change direction when its acceleration is constant? Support your answer with an example. (1 mark)
- 31 Derive an expression for acceleration due to gravity at a height  $h$  above the surface of the earth of radius  $R$  in terms of acceleration due to gravity  $g$  on the surface of the earth. Assume the earth to be a perfect sphere of uniform density  $\rho$ . (3)

**OR**

State and prove law of periods for planetary motion.

- 32 Define degrees of freedom. For one mole of a monoatomic gas derive the expression for  $C_p$  and  $C_v$  and calculate the ratio of  $C_p/C_v$ . (3)
- 33 Discuss about the harmonics formed in an open organ pipe and show that the frequencies of the harmonics are in the ratio 1:2:3. (3)
- 34 (a) State two difference between adiabatic and isothermal process. (3)  
 (b) Why efficiency of a heat engine cannot be 100% or unity?  
 (c) Calculate the coefficient of performance of a refrigerator working between  $-3^\circ\text{C}$  and  $27^\circ\text{C}$ .

### SECTION D

- 35 (a) Show that the oscillations of a simple pendulum are simple harmonic and derive the expression for time period of the simple pendulum. (5)  
 (b) Why soldiers are asked not to march over old bridges.  
 (c) Draw a graph showing the variation of energy with respect to time for a harmonic oscillator executing damped oscillations.

**OR**

- (a) Define Simple harmonic motion.  
 (b) Derive the differential equation for a simple harmonic motion.  
 (c) The equation of a particle in SHM is as given by  $y = 0.05 \sin(50\pi t + \pi/3)$ , where  $y$  is in meter and  $t$  is in second. Calculate its (i) time period (ii) amplitude and (iii) velocity amplitude
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 (b) When air is blown between two balls suspended close to each other, they are attracted towards each other. Why?  
 (c) How does the ploughing of fields help in preservation of moisture in the soil?

**OR**

- (a) Define terminal velocity.
  - (b) Derive an expression for the terminal velocity attained by a spherical body falling through a viscous medium.
  - (c) A spherical rain drop of radius 0.2 mm has a terminal velocity in air 2 m/s. The viscosity of air is  $18 \times 10^{-5} \text{ Nm}^{-2} \text{ s}$ . Find the viscous force on the rain drop.
- 37 (a) Show that in case of one dimensional elastic collision of two bodies, the relative velocity of separation after collision is equal to the relative velocity of approach before collision. (5)
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**OR**

- (a) State the law of conservation of mechanical energy.
- (b) Show that the total mechanical energy of a freely falling body under gravity is conserved.
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**SECTION A**

- 1 What angle of projection would result in a ball travelling the maximum horizontal distance? (1)
- (a)  $90^\circ$  (b)  $45^\circ$  (c)  $60^\circ$  (d)  $30^\circ$

**OR**

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- In the longitudinal waves the direction of vibration in medium of particle is  
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be a perfect sphere of uniform density  $\rho$ .

**OR**

State and prove law of periods for planetary motion.

- 30 (a) Is the rocket in flight, an example of projectile? Give reason. (3)  
(b) Show that the path followed by a projectile is a parabola when it is projected at an angle  $\theta$  with the horizontal.
- 31 (a) Draw velocity-time graph for an object thrown vertically upwards returning to the point of projection. (1 mark) (3)  
(b) Can a distance- time graph of an object be parallel to time axis? Give reason. (1 mark)  
(c) Can an object's velocity change direction when its acceleration is constant? Support your answer with an example. (1 mark)
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#### SECTION D

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(b) When air is blown between two balls suspended close to each other, they are attracted towards each other. Why?  
(c) How does the ploughing of fields help in preservation of moisture in the soil?

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(a) Define Simple harmonic motion.

(b) Derive the differential equation for a simple harmonic motion.

(b) The equation of a particle in SHM is as  $y = 0.05 \sin (50 \pi t + \pi/3)$ , where  $y$  is in meter and  $t$  is in second. Calculate its (i) time period (ii) amplitude and (iii) velocity amplitude.

- 37 (a) Show that in case of one dimensional elastic collision of two bodies, the relative velocity of separation after collision is equal to the relative velocity of approach before collision. (5)
- (b) In a ballistics demonstration a police officer fires a bullet of mass 50 g with speed 200 m/s on a soft plywood of thickness 2 cm. The bullet emerges with only 10 % of its KE. What is the emergent speed of the bullet? (2 marks)

**OR**

(a) State the law of conservation of mechanical energy.

(b) Show that the total mechanical energy of a freely falling body under gravity is conserved.

(c) Show the variations in kinetic energy, potential energy and total energy graphically.

**End of the Question Paper**