

GULF SAHODAYA (SAUDI CHAPTER) EXAMINATION - 2021

GRADE : XI

SUBJECT: PHYSICS (042)

Maximum Marks: 70 Marks

Time Allowed: 3 hours

General Instructions:

1. All questions are compulsory. There are **33 questions** in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. **Section A** contains ten very short answer questions and four assertion reasoning MCQs of **1 mark each**, **Section B** has two case based questions of **4 marks each**, **Section C** contains nine short answer questions of **2 marks each**, **Section D** contains five short answer questions of **3 marks each** and **Section E** contains three long answer questions of **5 marks each**.
4. There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

SECTION A

1. State the number of significant figures in the following:
(i) 3.66×10^{24} kg (ii) 0.00007098 m² 1

2. What do you mean by 'resonance' in oscillation? 1

OR

What are beats?

3. Name the physical quantity which is expressed as dot product of force and velocity. Is it a scalar or vector quantity? 1
4. The percentage errors in the measurement 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 ? 1

OR

A physical quantity Q is found to depend on observables x, y and z, obeying relation $Q = x^3 y^2 / z$. The percentage error in the measurements of x, y and z are 1%, 2% and 4% respectively. What is percentage error in the quantity Q?

5. Two springs A and B are identical except that A is stiffer than B; i.e. force constant $k_A > k_B$. In which spring more work is expended, if they are stretched by the same amount? 1
6. Why is the tip of the nib of a pen split? 1
7. Two straight lines drawn on the same velocity - time graph make angles 30° and 60° with time axis respectively. Find the ratio of the accelerations. 1

OR

If $|\mathbf{A} \times \mathbf{B}| = \mathbf{A} \cdot \mathbf{B}$, what is the angle between \mathbf{A} and \mathbf{B} ?

8. Two gases oxygen and hydrogen are in thermal equilibrium. What is the ratio of kinetic energies of oxygen and hydrogen molecules, when oxygen is 16 times heavier than hydrogen? 1
9. Why is force applied at right angles to a door at its outer edge, while closing or opening it? 1

OR

How does a ballet dancer vary her angular speed by outstretching her hands and legs?

10. What is the ratio of maximum acceleration to maximum velocity of a simple harmonic oscillator? 1

For question numbers 11, 12, 13 and 14, two statements are given - one labelled **Assertion (A)** and the other labelled **Reason (R)**. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- 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 and R is also false

11. **Assertion:** The internal energy of an ideal gas does not change during an isothermal process.
Reason: The decrease in volume of a gas is compensated by a corresponding increase in pressure, when its temperature is held constant. 1

12.**Assertion:** When temperature of a black body is halved, wavelength corresponding to which energy radiated is maximum becomes twice.

Reason: This is as per Wien's law. 1

13.**Assertion:** A large number of concurrent forces acting at the same point of the object, then the object will be in equilibrium, if sum of all the forces is equal to zero.

Reason: Equilibrium of a particle in mechanics refers to the situation when the net external force on the particle is non-zero. 1

14.**Assertion:** Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.

Reason: Gravitational forces are conservative forces. 1

SECTION B

Questions 15 and 16 are Case Study based questions and are compulsory.

Attempt any 4 sub parts from each question. Each question carries 1 mark.

15. In February of 2018, Elon Musk launched his \$100,000 Tesla Roadster into space on the SpaceX Falcon Heavy rocket. At the time of its launch, the Falcon Heavy was the most powerful operational rocket in the world. You might be wondering about how hard it is to launch something that large. Surprisingly, getting anything into deep space from the surface of the Earth – the Falcon Heavy, a Roadster, or even a baseball – requires the same launch speed. This speed is called escape velocity, since it's just enough speed to escape the gravitational pull of the Earth. 4



- 1) The escape velocity of an object projected from the surface of a given planet is independent of
 - a) mass of the planet
 - b) mass of the object
 - c) radius of the planet
 - d) height from the planet

- 2) How many times is escape velocity v_e , of orbit velocity v_o for a satellite revolving near the Earth?
 - a) 2 times
 - b) $\sqrt{2}$ times
 - c) 3 times
 - d) 4 times

- 3) A missile is launched with a velocity less than the escape velocity. The sum of its kinetic and potential energies
 - a) is zero
 - b) is positive
 - c) is negative
 - d) may be positive or negative depending upon its initial velocity

- 4) For a rocket, escape speed from the Earth is
 - a) 11.2 km/s
 - b) 112 km/s
 - c) 1.12 km/s
 - d) 11.2 cm/s

- 5) The escape velocity from the surface of Earth is v_e . Its value on a planet whose mass and radius are 3 times that of the Earth will be
 - a) v_e
 - b) $3 v_e$
 - c) $9 v_e$
 - d) $27 v_e$

16. When a vehicle tends to make a turn along a curved road, there is a probability of it to skid. For making a safe turn, the outer edge of a road is lifted up such that it is higher than the inner edge and the surface of the road looks like a slightly inclined plane. This is called banking of road.



1. For safe turning, roads are banked with an angle θ . If m is the mass of the vehicle, r is the radius of turning and v is the velocity of vehicle, then $\tan \theta$ is proportional to
 - a) m
 - b) r
 - c) m^2
 - d) r^2
2. A car moving on a horizontal road may be thrown out of the road in taking a turn due to
 - a) the gravitational force
 - b) the rolling frictional force between the tyre and the road
 - c) the reaction of the ground
 - d) the lack of proper centripetal force
3. Two turns of a smooth road are banked with the same angle. What is the ratio of maximum velocities for the two turns if the ratio of radii of curvature is 1:5?
 - a) 1 : 5
 - b) 1 : $\sqrt{5}$
 - c) 5 : 1
 - d) 1 : 25
4. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45° , the speed of the car is
 - a) 20 m/s
 - b) 30 m/s
 - c) 5 m/s
 - d) 10 m/s

5. When a vehicle is moving along the banked curved road, centripetal force is provided by
- a) vertical component of normal reaction
 - b) horizontal component of normal reaction
 - c) both a and b
 - d) none of these

SECTION C

17. Define degrees of freedom. State law of equipartition of energy. 2
18. Deduce the relation between angle of repose and coefficient of friction.

OR

State and prove law of conservation of linear momentum. 2

19. State second law of thermodynamics. 2

OR

State first law of thermodynamics and apply it to obtain the condition for adiabatic process.

20. State and prove work - energy theorem for variable force. 2

21. The velocity ' v ' of water waves depends on the wavelength ' λ ', density of water ' ρ ' and the acceleration due to gravity ' g '.

Deduce an expression for velocity by the method of dimensions. 2

22. A body of mass ' m ' moving with speed ' v ' collides elastically head - on with another body of mass ' m ' initially at rest.

Show that the two bodies exchange their velocities as a result of this collision. 2

23. Plot the variation of stress with strain for a metal wire and define the terms 'yield point' and 'ultimate tensile strength'. 2

24. Three point masses of 1 kg, 2 kg and 3 kg lie at (1, 2), (0, -1) and (2, -3) respectively. Locate the centre of mass of the system. 2

OR

A grinding stone of radius 2m revolving at 120 rpm accelerates to 660 rpm in 9 s. Find the angular acceleration.

25. Show that the coefficient of area expansion of a rectangular sheet of the solid is twice its coefficient of linear expansion. 2

SECTION D

26. Obtain the relation between torque and angular momentum. 3

27. Rain is falling vertically with a speed of 30 m/s. A woman rides a bicycle with a speed of 10 m/s in north to south direction. What is the relative velocity of rain with respect to the woman? What is the direction in which she should hold her umbrella? 3

OR

A police van moving on a highway with a speed of 30 km/h fires a bullet at a thief's car speeding away in the same direction with a speed of 192 km/h. If the muzzle speed of the bullet is 150 m/s, with what speed does the bullet hit the thief's car?

28. a) Derive the expression for total energy of a particle executing S.H.M.
b) Two exactly identical pendulums are oscillating with amplitudes 2 cm and 6 cm. Calculate the ratio of their energies of oscillation. 3

29. The position of a particle is given by $\mathbf{r} = 3t \hat{i} + 2t^2 \hat{j} + 5\check{k}$. Find the speed and acceleration of the particle at time $t=1$ seconds. 3

OR

A particle is moving along a straight line and its position is given by the relation $x = (t^3 - 6t^2 - 15t + 40)$ metre

Find (a) The time at which velocity is zero.

(b) Acceleration at that time.

30. State the principle on which hydraulic lift work and explain its working. 3

SECTION E

31. (a) Define simple harmonic motion. Show that oscillation of simple pendulum is a simple harmonic and hence derive its time period.
- (b) A force of 6.4 N stretches a vertical spring by 0.1 m. Find the mass that must be suspended from the spring so that it oscillates with a period of $\pi/4$ second. 5

OR

- (i) Give two differences between progressive waves and stationary waves.
- (ii) A progressive wave is given by $y(x, t) = 8 \cos(300t - 0.15x)$ where x and y are in m and t in second. What is its wavelength, frequency and wave speed?
32. State and prove Bernoulli's theorem. Explain how Bernoulli's principle is important during the take-off of aeroplanes. 5

OR

- (i) Define coefficient of viscosity and give its S.I. unit.
- (ii) What is meant by terminal velocity? Derive an expression for terminal velocity of a spherical ball falling through a viscous liquid. What is the acceleration of a body falling through a viscous medium after terminal velocity is reached?
33. (a) A projectile is fired at an angle θ with the horizontal. Show that its trajectory is a parabola. Draw velocity - time graphs of projectile for
- (i) horizontal velocity and (ii) vertical velocity.
- (b) Find the angle of projection of projectile if the horizontal range and maximum height are equal. 5

OR

- (i) Establish a relation between linear velocity and angular velocity.
- (ii) An object of mass 'm' is moving in a circular path of radius R at a uniform speed 'v'. Obtain an expression for the acceleration of the body. What is the angle between velocity vector and acceleration vector in uniform circular motion?
