Reg. No. : .....

Name : .....

FY-24

FIRST YEAR HIGHER SECONDARY EXAMINATION, JUNE 2022

Part – III

PHYSICS

Time : 2 Hours

Cool-off time : 15 Minutes

Maximum : 60 Scores

General Instructions to Candidates :

- There is a 'Cool-off time' of 15 minutes in addition to the writing time.
- Use the 'Cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary.
- Electronic devices except non-programmable calculators are not allowed in the Examination Hall.

വിദ്യാർത്ഥികൾക്കുള്ള പൊതുനിർദ്ദേശങ്ങൾ :

- നിർദ്ദിഷ്ട സമയത്തിന് പുറമെ 15 മിനിറ്റ് 'കൂൾ ഓഫ് ടൈം' ഉണ്ടായിരിക്കും.
- 'കൂൾ ഓഫ് ടൈം' ചോദ്യങ്ങൾ പരിചയപ്പെടാനും ഉത്തരങ്ങൾ ആസൂത്രണം ചെയ്യാനും ഉപയോഗിക്കുക.
- ഉത്തരങ്ങൾ എഴുതുന്നതിന് മുമ്പ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- നിർദ്ദേശങ്ങൾ മുഴുവനും ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- കണക്ക് കൂട്ടലുകൾ, ചിത്രങ്ങൾ, ഗ്രാഫുകൾ, എന്നിവ ഉത്തരപേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ചോദ്യങ്ങൾ മലയാളത്തിലും നല്കിയിട്ടുണ്ട്.
- ആവശ്യമുള്ള സ്ഥലത്ത് സമവാക്യങ്ങൾ കൊടുക്കണം.
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും പരീക്ഷാഹാളിൽ ഉപയോഗിക്കുവാൻ പാടില്ല.

Answer any 5 questions from 1 to 7. Each carries 1 score. **(5 × 1 = 5)**

1. The branch of physics that deals with the study of light is;

   (Mechanics, Optics, Electrodynamics)

2. The restoring force developed in a spring extended by a length x is, $F = -kx$. The dimensional formula of k is ?

3. $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between vectors $\vec{A}$ and $\vec{B}$ is _____.

4. Write the value of escape velocity of an object from the surface of moon.

5. Pick the correct one :

   When the temperature of a liquid increases, its surface tension _____.

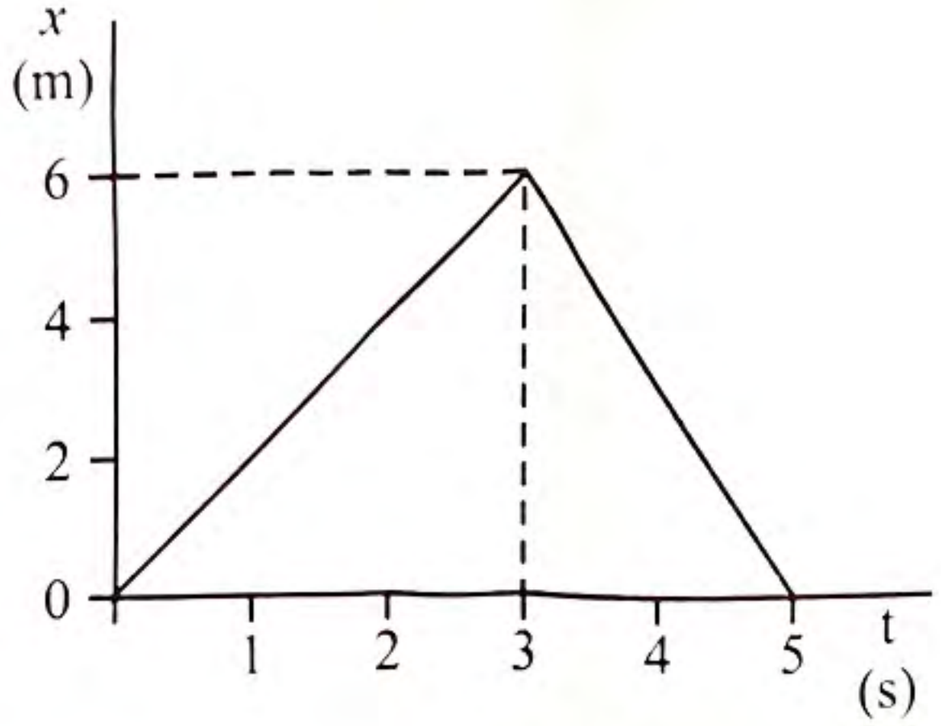
   (increases, decreases, remains the same)

6. A light body and a heavy body have equal momentum. Which one has greater kinetic energy ?

7. In the case of stationary waves, the displacement of a particle at positions of node is _____.

Answer any 5 questions from 8 to 14. Each carries 2 scores. **(5 × 2 = 10)**

8. The position – time graph of an object is shown below. Draw the velocity – time graph and find total displacement.



9. A javeline is projected at an angle of 30° with an initial velocity of 5 ms^{-1} from the ground. What are its velocity and acceleration at highest point ?

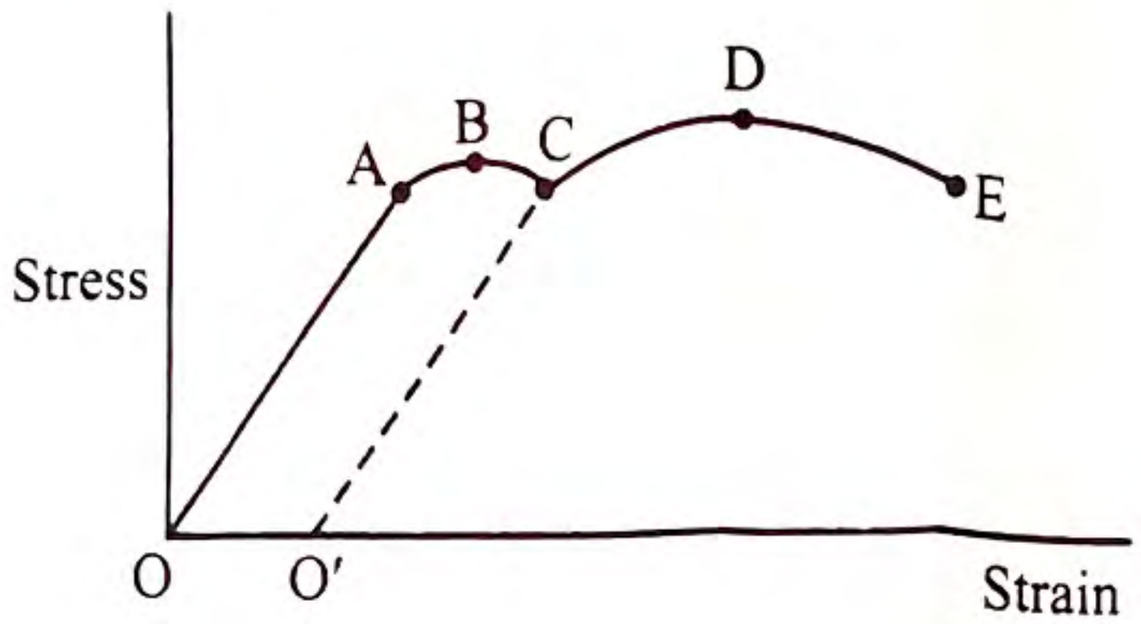
10. A person firing a bullet from a gun experiences a backward jerk :

(a) Write the principle behind this. **(½)**

(b) A bullet of mass 15 g fired with a velocity of 100 ms^{-1} from a gun of mass 2 kg. Find the recoil speed of gun. **(1½)**

11. Draw the variation of kinetic energy and potential energy of a freely falling body, with height.

12. Stress-Strain curve of steel wire is shown below. From the plot, identify the following :



(a) A (b) B

(c) E (d) OO'

13. Draw the block diagram of a refrigerator and write an expression for its coefficient of performance.

14. The angular speed of a rotating body changes from ω_1 to ω_2 without applying an external torque but due to change in moment of inertia. Find the ratio of radii of gyration in the two cases.

Answer any 6 questions from 15 to 22. Each carries 3 scores. **(6 × 3 = 18)**

15. Check the dimensional correctness of the relation :

$$v = \sqrt{\frac{GM}{R}}$$

where v is orbital velocity, G is gravitational constant and R is radius of Earth.

16. Obtain an expression for centripetal acceleration of a body in uniform circular motion.

17. Show that the total mechanical energy of a freely falling body is constant.

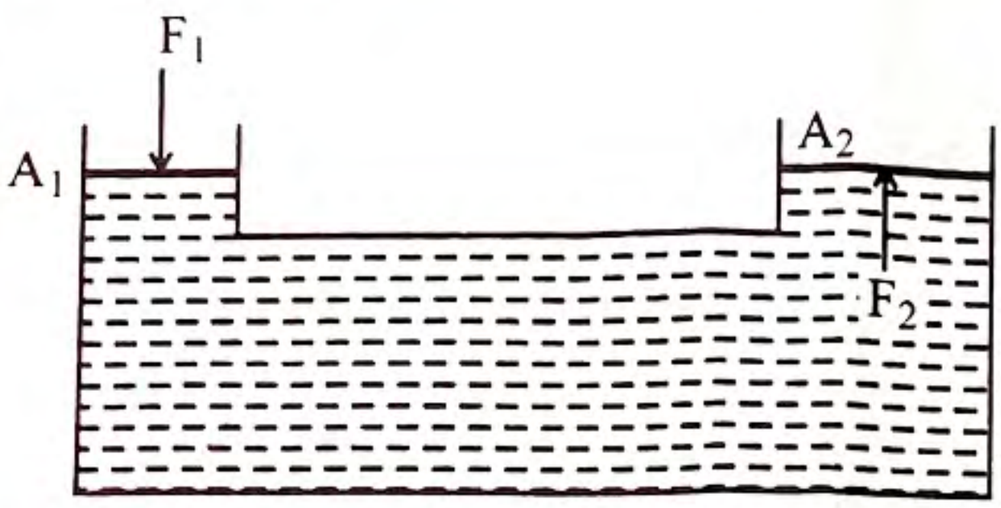
18. The value of acceleration due to gravity decreases with depth.

(a) Derive an expression for acceleration due to gravity (g) at a depth 'd' below the surface of Earth. **(2)**

(b) What is the weight of a body at the centre of Earth ? **(1)**

19. (a) State Pascal's law. **(1)**

(b)



The schematic diagram of a hydraulic lift is shown in figure. Using Pascal's law, find the value of F_2 in terms of A_1 and A_2. (A_1 and A_2 are the areas of pistons). **(2)**

20. (a) Among the various modes of heat transfer, which one is the fastest ? **(1)**

(b) A pan filled with hot food cools from 94 °C to 86 °C in 2 minutes, when the room temperature is at 20 °C. How long will it take to cool from 71 °C to 69 °C ? **(2)**

21. The pressure exerted by a gas is given by the equation :

$$P = \frac{1}{3} nm\overline{V}^2$$

n is the number density of molecules, m is mass of each molecule and $\overline{V}^2$ is the mean of squared speed. Find the average kinetic energy of a molecule.

22. The displacement of a particle executing SHM is,

$y = A \sin \omega t$

$A \rightarrow$ amplitude $\omega \rightarrow$ angular frequency

(a) Draw the variation of velocity of the particle with time. **(1)**

(b) A 2 kg body performs SHM of amplitude 20 cm and the restoring force acting at that position is 50 N. Find the acceleration and kinetic energy of the particle when the displacement is 10 cm. **(2)**

Answer any 3 questions from 23 to 27. Each carries 4 scores. **(3 × 4 = 12)**

23. A particle is moving along X-axis with uniform positive acceleration.

(a) Obtain an expression for displacement by drawing v-t graph. **(2)**

(b) A ball is thrown vertically upwards with a velocity of 20 m/s from the top of a tower of height 25 m from ground. How long does it remain in air ? ($g = 10\ ms^{-2}$) **(2)**

24. A child of mass 30 kg is standing inside a lift.

(a) What happens to the apparent weight of the child if the lift is moving up with a uniform acceleration ? **(1)**

(b) Write an expression for the apparent weight of the child. **(1)**

(c) Find the apparent weight of the child, if the lift is moving down with constant acceleration of $5\ ms^{-2}$. **(2)**

25. (a) 'τ' is the torque and 'L' is the angular momentum of rotating rigid body, show that

$$\tau = \frac{dL}{dt}$$ **(2)**

(b) Calculate the duration of a day when Earth shrinks to $\frac{1}{8}^{th}$ of its initial volume. **(2)**

26. A solid sphere of radius 'r' and density 'ρ' is falling through a viscous medium of density σ and coefficient of viscosity 'η'.

(a) What are the different forces acting on the body ? **(1½)**

(b) Derive an expression for terminal velocity. **(2½)**

27. (a) Draw the pattern of waveforms of the first two harmonics in a closed pipe. **(2)**

(b) Show that in a closed pipe, the frequencies of first two harmonics are in the ratio 1 : 3. **(2)**

Answer any 3 questions from 28 to 32. Each carries 5 scores. **(3 × 5 = 15)**

28. Banking of roads helps to increase the limit of maximum safe speed of a vehicle at a curve.

(a) Draw the schematic diagram of a vehicle on a banked road and mark the various forces acting on it. **(2)**

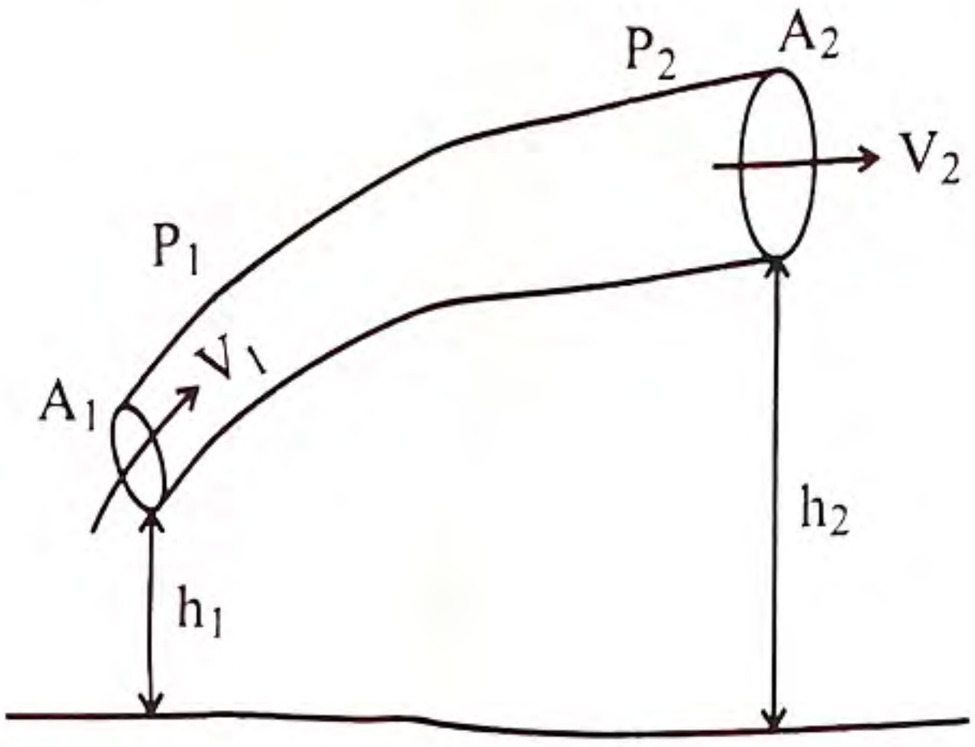
(b) Obtain an expression for the maximum safe speed of a vehicle at a banked road with frictional force. **(3)**

29. Assuming satellite orbits around a planet to be circular,

(a) Obtain expressions for orbital velocity and time period of a satellite around earth. **(3)**

(b) Write one use each for geostationary and polar satellites. **(2)**

30. The flow of an ideal fluid in a pipe of varying cross section is shown below :



(a) State and prove Bernoulli's principle. **(4)**

(b) Write any two characteristics of a fluid that obey Bernoulli's principle. **(1)**

31. (a) Write the equation of an isothermal process. **(1)**

(b) Obtain an expression for work done in an isothermal process. **(3)**

(c) A Carnot engine operates between the temperatures 398 K and 293 K. Find its efficiency. **(1)**

32. (a) Show that the oscillations produced in a simple pendulum are simple harmonic. **(2)**

(b) Write an expression for time period of oscillation. **(1)**

(c) What is seconds pendulum ? Find the length of seconds pendulum. **(2)**