Reg. No. :

FY-24

Name :

FIRST YEAR HIGHER SECONDARY EXAMINATION, MARCH 2020

Part – III

PHYSICS

Maximum : 60 Scores

Time : 2 Hours

Cool-off time : 15 Minutes

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 4 questions from 1 to 5. Each carries 1 score. **(4 × 1 = 4)**

1. Which one of the following fundamental forces in nature binds protons and neutrons in a nucleus ?

   (a) Gravitational force (b) Electro-magnetic force

   (c) Strong nuclear force (d) Weak nuclear force

2. Four pairs of initial and final positions of a body along an x axis are given. Which pair gives a positive displacement of the body ?

   (a) –10 m, +15 m (b) –5 m, –12 m

   (c) 2 m, –5 m (d) 2 m, 1m

3. Newton's first law of motion describes the ……..

   (a) energy (b) work

   (c) inertia (d) momentum

4. The rotational analogue of force is

   (a) energy (b) work

   (c) inertia (d) torque

5. The Young's modulus of rubber is

   (a) greater than that of steel.

   (b) less than that of steel.

   (c) equal to that of steel;.

Answer any 8 questions from 6 to 15. Each carries 2 scores. **(8 × 2 = 16)**

6. The centripetal force on a body of mass 'm' and velocity 'v' moving in circular orbit of radius 'r' is given by $F = \frac{mv^2}{r}$

   (a) Write the dimensional formula of force.

   (b) Using the formula of centripetal force write an equation to find percentage error in centripetal force.

7. State the law of conservation of linear momentum.

8. Find out the sign of work done in the following cases :

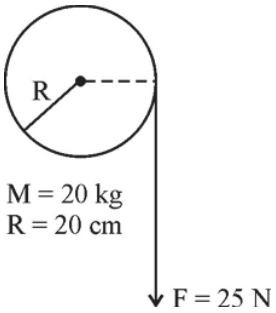
   (a) Work done by a man in lifting a bucket out of a well.

   (b) Work done by friction on a body sliding down an inclined plane.

   (c) Work done by an applied force on a body moving on a rough horizontal plane.

   (d) Work done by the resistive force of air on a vibrating pendulum.

9. A cord of negligible mass is wound round the rim of a flywheel mounted on a horizontal axle as shown in figure :



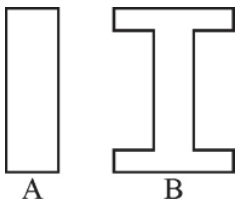
   Calculate the angular acceleration of the wheel if steady pull of 25 N is applied on the cord. Moment of inertia of flywheel about its axis $= \frac{MR^2}{2}$.

10. The escape speed of an object from the earth is 11.2 km/s.

   (a) Define escape speed of an object.

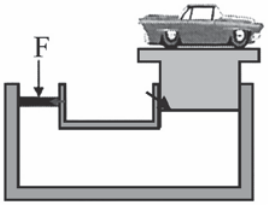
   (b) How escape speed is related to the mass of the object ?

11. Beam of different cross-sectional shapes are shown in figure.



   Why the beam B is using in the construction of bridges ?

12. The given figure shows the principle behind the hydraulic lift.



The radius of small piston is 5.0 cm and that of larger piston is 15 cm. Calculate the force F, if the mass of the car to be lifted is 1350 kg ($g = 9.8\ ms^{-2}$).

13. What do you mean by capillary rise ? What is the phenomenon responsible for it ?

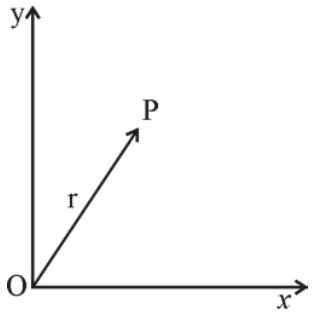
14. Show that the function ($\sin \omega t - \cos \omega t$) represents simple harmonic motion.

15. A steel wire has a length of 12.0 m and a mass of 2.10 kg. What is the tension in the wire if speed of a transverse wave on the wire is 343 ms^{-1} ?

Answer any 6 questions from 16 to 23. Each carries 3 scores. **(6 × 3 =18)**

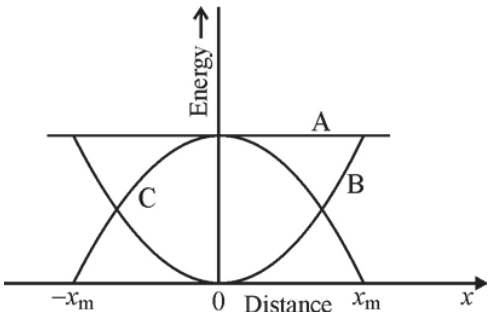
16. The volume of water flowing out through a pipe in a given time is $\mathbf{V = KA^2ut}$, where A is the area of cross-section of the pipe, u is the speed of flow, t is the time and K is a dimensionless constant.
    (a) Name the principle that can be used to check the dimensional correctness of this equation.
    (b) Check the correctness of the equation. **(1+2)**

17. The position vector r of a particle P located in an *x*-y plane is shown in figure.



    (a) Redraw the figure by showing the rectangular components .
    (b) Write the position vector in terms of rectangular components.
    (c) Write an equation to find the magnitude of the resultant of two vectors A and B.
    (1+1+1)

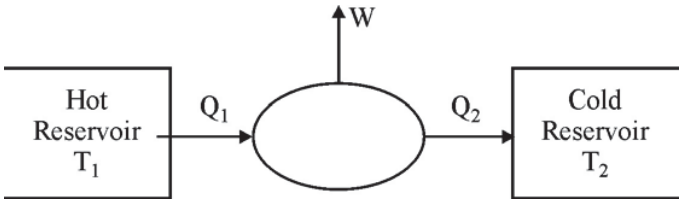
18. Graphs of the potential energy, kinetic energy and total energy of an oscillating spring is shown in figure :



(a) Find out the potential energy, kinetic energy and total energy from the graph.

(b) Derive an expression to find the potential energy of a spring. **(1½ + 1½)**

19. Observe the given figure.



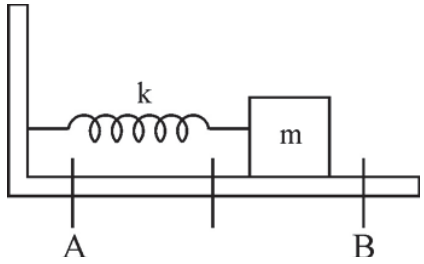
(a) Is this a heat engine or refrigerator ?

(b) Write the 4 steps of operation in the Carnot cycle. **(1+2)**

20. A refrigerator is to maintain eatables kept inside at 9 °C. If room temperature is 36 °C, calculate the coefficient of performance.

21. Prove that the average kinetic energy of a molecule is proportional to the absolute temperature of the gas.

22. Simple harmonic motion of a block of mass m attached to a spring is shown in figure. The distance between extreme points A and B is 10 cm.



Take the direction from A to B as the positive. Redraw the given table and give the signs of velocity, acceleration and force.

	Point	**Velocity**	**Acceleration**	**Force**
(a)	at the end B	0		
(b)	at the mid-point of AB going towards A		0	0
(c)	at 2 cm away from B going towards A			

23. A transverse harmonic wave on a string is described by

$$y(x, t) = 3.0 \sin (36\, t + 0.018\, x + \pi/4)$$

where x and y are in cm and t in s.

(a) Is this a travelling wave or a stationary wave ?

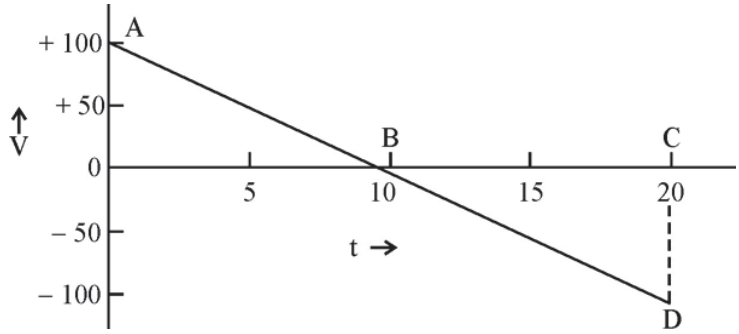
(b) What are its amplitude and frequency ?

(c) What is the initial phase at the origin ?

(d) What is the least distance between two successive crests in the wave ? **(½+1+½+1)**

Answer any 3 questions from 24 to 27. Each carries 4 scores. **(3 × 4 =12)**

24. Velocity-time graph of a ball thrown vertically upwards with an initial velocity is shown in figure.

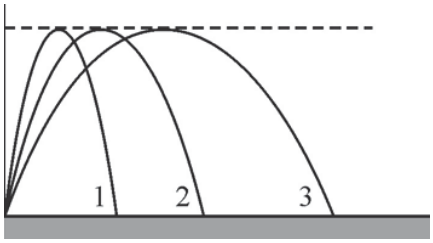


(a) What is the magnitude of initial velocity of the ball ?

(b) Calculate the distance travelled by the ball during 20 s, from the graph.

(c) Calculate the acceleration of the ball from the graph. **(1+1½+1½)**

25. The figure shows three paths for a football kicked from ground level with same velocity. Ignore the effects of air resistance.



(a) Derive an equation for the maximum height of this football.

(b) In which path the horizontal component of velocity is maximum ? **(3+1)**

26. State theorem of perpendicular axes on moment of inertia. Derive an expression to find the moment of inertia of a circular disc about one of its diameters with the help of a neat diagram

27. Temperature is the degree of hotness of a body.

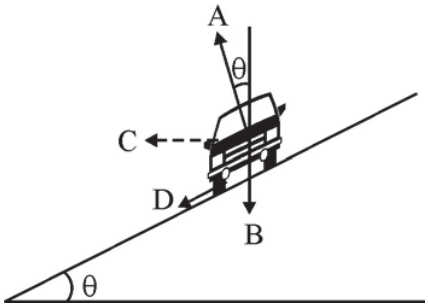
(a) Temperature of a normal human body is 98.6 °F. What is the corresponding temperature in the Celsius scale ?

(b) Define latent heat.

(c) Why a brass tumbler feels much colder than a wooden tray on a chilly day ? **(2+1+1)**

Answer any 2 questions from 28 to 30. Each carries 5 scores. **(2 × 5 =10)**

28. Circular motion of a car on a banked road is shown in figure



(a) Write the name of forces A, B, C, D in the figure.

(b) Write the equation which equate forces on the car along horizontal and vertical direction.

(c) State the law of static friction. **(2+2+1)**

29. (a) Choose the correct alternative :

(i) Acceleration due to gravity increases/decreases with increasing altitude.

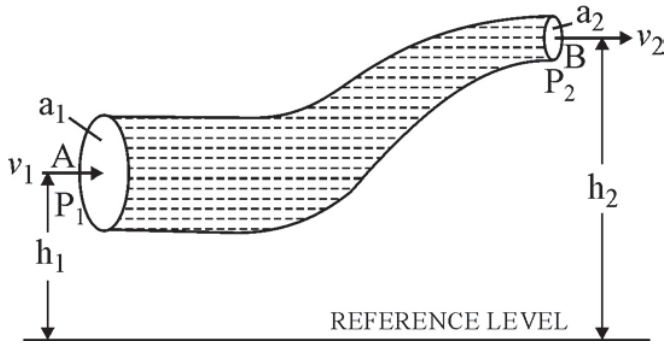
(ii) Acceleration due to gravity increases/decreases with increasing depth.

(iii) The total energy of an orbiting satellite is negative of its kinetic/potential energy.

(iv) The polar satellite go around the earth in a north-south direction/east-west direction.

(b) State Kepler's law of time periods **(3+2)**

30. Consider a fluid moving in a pipe of varying cross-sectional area as shown in figure. a_1, a_2 are cross-sectional areas of pipe and v_1, v_2 are the velocities of fluid.



(a) State Bernoulli's principle.

(b) Derive Bernoulli's equation.

(c) Write the equation of Stoke's law. **(1+3+1)**
