

AMBITION ACADEMY
MODEL QUESTIONS, 2078
GRADE – XI (PHYSICS)

SET A

Group A

Circle the best alternative to the following.

[11 × 1 = 11]

1. The time dependence of some physical quantity P is given by: $P = P_0 e^{\alpha t^2}$ where P_0 is the peak value of P. The dimensional formula of α is:
(a) $[M^1 L^{-2} T^0]$ (b) $[M^0 L^{-2} T^0]$ (c) $[M^0 L^2 T^0]$ (d) $[M^0 L^0 T^{-2}]$
2. The trajectory of projectile is given by: $y = ax - bx^2$ where a and b are constants. The maximum height attained by the projectile is:
(a) $\frac{a}{b}$ (b) $\frac{a^2}{2b}$ (c) $\frac{a^2}{4b}$ (d) $\frac{b^2}{2a}$
3. Action and reaction do not cancel each other because they:
(a) Have unequal magnitude
(b) Act on same direction
(c) Have same line of action
(d) Act on different bodies
4. A gun fires a bullet of mass 50 g with the velocity of 30 m/s. The gun is pushed back with the velocity of 1 m/s. The mass of gun is:
(a) 15 kg (b) 1.5 kg (c) 30 kg (d) 20 kg
5. A heavy uniform chain lies on a horizontal table top. If the coefficient of friction between the chain and the table is 0.25 then the maximum fraction of length of chain that hung over on the edge is:
(a) 1/3 (b) 1/4 (c) 1/5 (d) 1/8
6. The refractive index for a piece of glass is greatest for:
(a) Red (b) Violet (c) Green (d) Yellow
7. The focal length of the convex lens is 'f'. An object is placed at a distance 'x' from its first focus. The ratio of size of real image to that of the object is:
(a) $\frac{f}{x^2}$ (b) $\frac{x^2}{f}$ (c) $\frac{f}{x}$ (d) $\frac{x}{f}$
8. A ray of light is incident normally on one of the faces of right angled isosceles prism is found totally reflected from hypotenuse. The refractive index of the material is:
(a) 1.2 (b) $\sqrt{2}$ (c) $\sqrt{3}$ (d) 1.8
9. The phenomenon of looming is due to:
(a) Total Internal Reflection (b) Refraction (c) Diffraction (d) Dispersion
10. There are 'n' resistors each of resistance 'R'. What is the ratio of maximum to the minimum resistance can be formed from them?
(a) $n^2:1$ (b) $1:n^2$ (c) 1:1 (d) 2:1
11. The forbidden energy gap of semiconductor is in the order of:
(a) 1 MeV (b) 1 keV (c) 1 eV (d) 1 meV

Group B

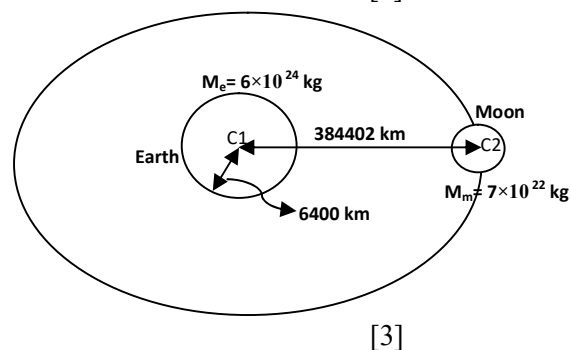
Answer all questions.

[8 × 5 = 40]

1. (a) State work-energy theorem. [1]
- (b) You throw a 20 N rock vertically into the air from ground level. You observed that when it is 15m above the ground. It is travelling at 25 m/s upward. Use work-energy theorem to find the speed of rock as it left the ground. [2]
- (c) Suppose a spring is held vertically at certain height above the ground and it is released such that it strikes the ground vertically. Can you apply work-energy theorem to calculate the velocity of spring when it strikes the ground? Explain. [2]

OR

- (a) Distinguish between center of mass and center of gravity. [2]
- (b) In astronomy, the *barycenter* is the center of mass of two or more bodies that orbit one another. In a two body problem, if one is more massive than the other and bodies are relatively close to each other, the barycenter typically lies within the massive body. In this case, the less massive body will appear to orbit about the more massive body. The same case happens in the earth-moon system. On the basis of the given figure, show that barycenter of earth-moon system lies within the earth. [3]



2. (a) Ice has formed on a shallow pond and a steady state has been reached with the air above the ice at -5.20°C and the bottom of the pond at 3.98°C . If the total depth of ice + water is 1.42m, how thick is ice? (Thermal conductivities of ice and water are 1.67 and 0.502 W/m.K respectively.) [3]

- (b) Why does the water at temperature of 3.98°C lie at the bottom of the pond? Does it have any advantage on aquatic life? Explain. [1+1]

3. (a) State any four postulates of the **Kinetic Molecular Model** of the gas. [2]
- (b) Although ideal gas does not actually exist in nature, how can we realize ideal gas in practice? [1]

- (c) What is the r.m.s. speed of nitrogen at NTP given that the density of nitrogen at NTP is 1.29 kg/m^3 ? [2]

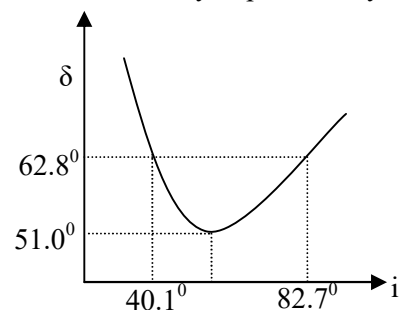
4. Study the given table and answer the following questions.

- a) Write down the relation between linear, superficial and cubical expansivities for the solid. [1]
- b) Equal length of all materials Lead, copper and steel are heated equal rise in temperature. Which expands more, why? [1]
- c) The linear expansivity of copper is 17×10^{-6} per $^{\circ}\text{C}$. What does it mean? [1]
- d) If you have to make a measuring scale using these three materials, which material will you prefer, why? [2]

Substance	α (10^{-6} per $^{\circ}\text{C}$)
Lead	29
Copper	17
Steel	11

to

5. The adjacent figure shows i-D curve for some glass prism. Study the graph and answer the following questions.
 - (a) What do you mean by angle of minimum deviation in prism? At what condition minimum deviation occurs? [1+1]



(b) Calculate the refracting angle of prism, angle of incidence at minimum deviation and refractive index of the material of prism (i.e. glass). [1+1+1]

OR

(a) Distinguish between real and virtual image. [2]

(b) Does a convex mirror ever form real image? Show with ray diagram. [1]

(c) A real image three times the size of object is formed by a concave mirror of focal length 30cm. Calculate the position of object. [2]

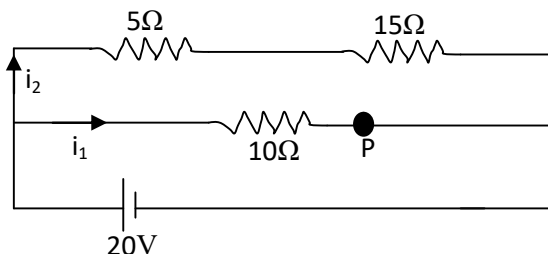
6. Consider the given circuit and answer the questions.

a) Which type of combination is there between 5Ω and 15Ω resistors? Write one feature of such combination. [0.5+0.5]

b) Which law is useful to calculate current and voltage in this circuit? State that law. [0.5 +1]

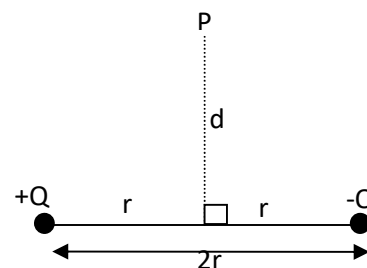
c) Calculate the current i_2 . [1]

d) What is the potential difference across 5Ω resistor? [1.5]



7. (a) What do you mean by equipotential surface? Can we say Gaussian surface is necessarily an equipotential surface? Explain. [1+1]

(b) In the figure, two point charges $+Q$ and $-Q$ are located ' $2r$ ' distance apart in air. Point 'P' is at a distance ' d ' away from the mid point of line joining the charges. Find the expression for resultant electric field strength at point 'P' due to the system of two charges in terms of the given variables. [3]



8. (a) How parallel plate capacitor stores charge? Explain. [2]

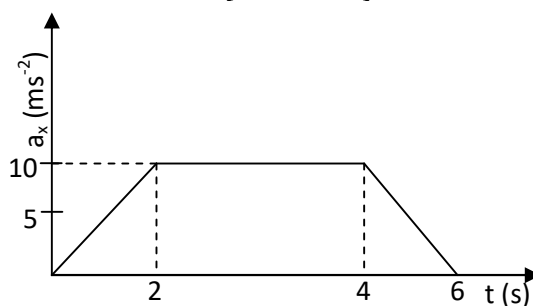
(c) A parallel plate capacitor has plates each of size 2×2 cm separated at a distance of 2mm from each other. Find its capacitance if thick mica plate of dielectric constant 6 is placed in the region between the plates. [3]

Group C

Give long answers to the following questions.

[8 × 3 = 24]

9. (a) A 4.50 kg toy cart undergoes acceleration in a straight line (the x-axis). The graph shows this acceleration as a function of time. (a) Find the maximum net force on this cart. (b) When does this maximum force occur? (c) During what times is the net force on the cart constant? (d) When the net force equal to zero? [1+1+1+1 = 4]

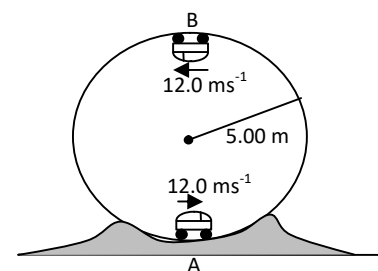


(b) Draw the velocity-time (v-t) graph which represents the motion of body with: [2+2]

- i. Uniform velocity
- ii. Uniform acceleration

OR

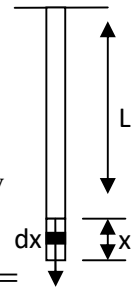
(a) A small car of mass 0.800 kg travels at constant speed on the inside of a track that is a vertical circle of radius 5.00 m as shown in the figure. (a) Although the speed is constant, why is it accelerating? (b) If the normal force exerted by the track on the car when it is at the top of the track (point



- B) is 6.00N, what is the normal force on the car when it is at the bottom of the track (point A)? [2 + 2 = 4]
 (b) What do you mean by banking of road? What is the advantage of banking of road in the hilly regions? Explain with figure. [2+2]

10. (a) A stone projected from a catapult has kinetic energy. What is the source from which this energy is derived? [2]

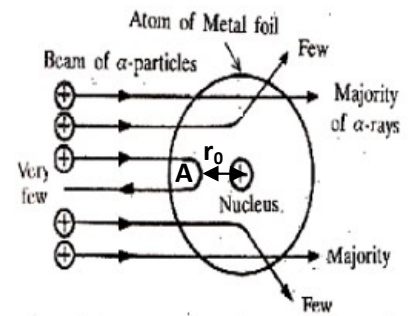
(b) Consider a uniform wire of some material having cross sectional area 'A' and unstretched length 'L' as shown in figure. The wire is to be stretched through 'x' so that work has to be done on it against the restoring force. Calculate the total work done (which is equal to energy stored by the wire) and show that it is equal to: $= \frac{1}{2}Fx$. [4]



(c) Why is not the total work done equal to: $W = Fx$ as per the definition of work, **work = force · displacement**? Explain. [2]

11. Study the given diagram and answer the questions.

- Which experiment is represented in the given figure? [1]
- In this experiment, majority of alpha particles are found to pass undeviated. What conclusion can be drawn from this observation?[2]
- What is the reason behind the deflection of very few particles by an angle of 180° as shown in the figure?[2]
- In the figure, r_0 is the distance between point A and center of a nucleus (also called distance of closed approach). Let 'Z' is the atomic number of element used and 'E' is the K.E. of incident alpha particle. The charge of an alpha particle is equal to '2e' (e = charge of an electron). Show that, [3]



$$r_0 = \frac{1}{4\pi\epsilon_0} \frac{2Ze^2}{E}$$

SET B

Group A

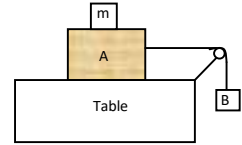
Circle the best alternative to the following.

[11 × 1 = 11]

12. For two vectors \vec{A} and \vec{B} which of the following relationship is incorrect?

- (a) $\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$ (b) $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$ (c) $\vec{A} + \vec{B} = \vec{B} + \vec{A}$ (d) $(\vec{A} - \vec{B}) \times (\vec{B} - \vec{A}) = 0$

13. A block A of mass 10 kg is connected with block B of mass 5 kg with the inextensible rope which passes over the frictionless pulley as shown in the figure. The coefficient of friction between block A and table is 0.2. Then the minimum mass 'm' of the object to be kept over block A to prevent it from sliding is:



- (b) 10 kg (b) 5 kg (c) 15 kg (d) 25 kg

14. Which of the statement for KE of a projectile is true?

- (e) Remains constant
(f) Maximum at maximum height
(g) Minimum at maximum height
(h) Minimum at point of projection

15. The length of wire is L_1 when tension T_1 is applied on it and it becomes L_2 when the tension T_2 is applied. What is the original length of the wire?

- (b) $\frac{L_2 T_1 - L_1 T_2}{T_1 - T_2}$ (b) $\frac{L_2 T_1 - L_1 T_2}{T_2 - T_1}$ (c) $\frac{L_1 T_2 - L_2 T_1}{L_1 - L_2}$ (d) $\frac{L_2 T_1 - L_1 T_2}{L_1 - L_2}$

16. A small planet is revolving around a very massive star in a circular orbit of radius 'R' with the time period of 'T'.

The gravitational force between planet and star is proportional to the $R^{-\frac{5}{2}}$ then the time period is proportional to which of the following?

- (b) $R^{\frac{3}{2}}$ (b) $R^{\frac{3}{5}}$ (c) $R^{\frac{7}{2}}$ (d) $R^{\frac{7}{4}}$

17. If an upright virtual object is placed between the pole and the principal focus of a convex mirror, the nature of image formed by it will be:

- (b) Real, magnified and upright (b) Virtual, diminished and inverted (c) Virtual, diminished and upright (d) Real, diminished and inverted

18. The radius of curvature of biconvex lens made of material of refractive index 1.5 is 40 cm. What is the power of lens?

- (b) 2D (b) 2.5D (c) 3D (d) 3.5D

19. The light is incident normally on shortest face of $30^\circ-60^\circ-90^\circ$ glass prism ($\mu=1.5$). When some liquid is placed on the hypotenuse of the prism, the light reflects totally internally. What is the refractive index of the liquid?

- (b) 1.1 (b) 1.2 (c) 1.3 (d) 1.4

20. We see the sun little before it rises on the horizon a little after it sets below the horizon. This is explained on the basis of which of the following phenomenon?

- (b) Total Internal Reflection (b) Refraction (c) Diffraction (d) Dispersion

21. Two charges 2Q and -Q are placed as shown in the figure below. The null point will be:

- (b) Somewhere on the left of -Q
(c) Somewhere on the right of 2Q
(d) Somewhere in between -Q and 2Q
(e) The information is insufficient to determine the position of null point

22. The mass of Li nucleus is 7.0163 amu. What is the value of binding energy per nucleon? ($m_p = 1.0076$ amu and $m_n = 1.0089$ amu)

- (b) 25.6 MeV (b) 5.6 MeV (c) 39.25 MeV (d) 1 MeV

Group B

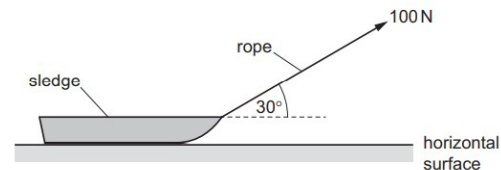
Answer all questions.

[8 × 5 = 40]

12. (a) Algebraic rule of addition can not be applied in the addition of vector quantities, why? [1]

(b) Define vector resolution. Give an example of the physical phenomenon where we use the idea of vector resolution to calculate the physical properties associated with that system. [2]

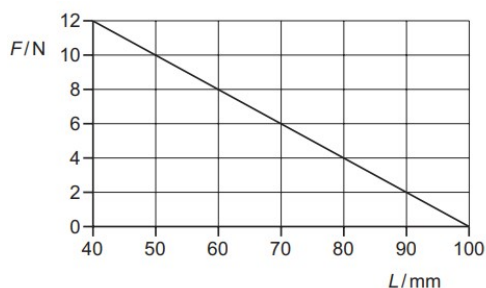
(c) A rope is attached to a sledge and a boy uses the rope to pull the sledge along a horizontal surface with a constant velocity as shown in the figure. The tension in the rope is 100 N and the rope is held at 30° to the horizontal. How much work does the boy do on the sledge when he pulls it a distance of 5.0 m along the surface? [2]



OR

(a) Distinguish between stress and strain. [2]

(b) According to Hooke's law, the elongation (or compression) produced on a body is directly proportional to the force applied on it within the elastic limit. This is shown graphically in the adjacent figure. A spring of original length 100 mm is compressed by a force. The graph shows the variation of the compressing force F with the length L of the spring. Calculate the energy stored in the spring when its length is 70 mm. [3]



13. (a) What is the fundamental difference between the process of conduction and convection in terms of molecular (or atomic) motion? [1]

(b) A body is heated to a temperature of around 95°C and allowed to lose the heat to the surrounding. You note the temperature of the body at equal intervals of 5 minutes till the body comes in equilibrium with the surrounding (35°C) taking a total time of 30 minutes. Now you plot the graph of temperature (along y-axis) and time (along x-axis). What will be the nature of the graph? Sketch it. [2]

(c) Which serves as a good insulator, wood or the dust of the same wood? Why? [2]

14. (a) State Stefan's law of black body radiation. How much heat does the body radiate when it is at absolute zero? (Given: $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^{-4}$) [2]

(b) What do you mean by 'ideal black body'? What is the value of emissivity for such body? [1]

(c) As we go away from heat source like heater, the hotness that we feel goes on decreasing. Which law can be used to describe this phenomenon? Write down the mathematical form of that law. [2]

15. (a) Define temperature on the basis of Zeroth law. [1]

(c) What is the principle under which 'thermoelectric thermometers' are based? [1]

(d) It is the common observation that, the temperature of objects increases on heating. Explain this phenomenon using the concept of energy transference. [2]

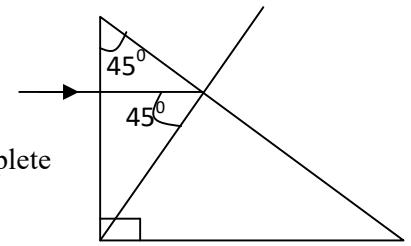
(e) Can you think any process in which the object can be heated without increasing its temperature? If so, give an example. [1]

16. (a) We have observed that the bottom of the pool always appears to be shallower than it actually is. However, if a fish under water is viewing a tree obliquely on the bank of the pool; does the tree look taller or even shorter than its actual height? Explain with figure. [2]

- (c) Using the Lens Maker's equation, $\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$ explain that, the focal length of the lens will measured to be more than that using the blue light. [2]
- (d) Red flower looks black when viewing through blue light, why? [1]

OR

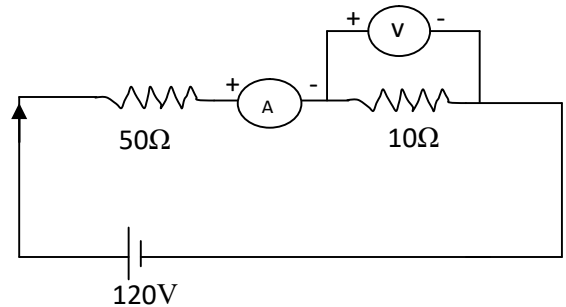
The adjacent figure shows a prism made up of glass of refractive index 1.5. Study the diagram and answer the following questions.



- (a) Identify whether the total internal reflection takes place or not and complete the ray diagram. [2]
- (b) Find the angle of deviation. [1]
- (c) The prism is now immersed inside the water ($\mu = 1.33$) without changing the direction of incident ray. What is the angle of deviation in this case? [2]

17. Consider the given circuit and answer the questions.

- (a) Calculate the voltmeter and ammeter readings in the circuit. [1.5+1.5=3]
- (b) Will the ammeter reading increases or decreases if some other resistor is connected in parallel to the 50Ω resistor in the circuit? [2]



18. (a) In some of region of space, the electric potential (in volt) is varying with distance (in m) along x-axis as, $V(x) = 3x^2 + 5x + 8$. Calculate the magnitude of electric field at a point where $x = 3m$. [2]
- (b) Obtain the expression of Coulomb's law starting from the Gauss' law. [3]
19. (a) State any three ways to increase the capacitance of the parallel plate capacitor. [1.5]
- (c) Eight drops of water of same size are equally and similarly charged. They combine together to form a bigger drop. Compare the capacitance of the bigger drop with the smaller drop. [2]
- (d) Describe shortly the effect of dielectric in the capacitance of the capacitor.

Group C

Give long answers to the following questions.

[8 × 3 = 24]

20.

- (a) Write the mathematical form Newton's second law of motion and show how the Newton's first law of motion can be obtained as a special case of the 2nd law. [2]
- (b) A train of mass 2×10^5 kg moves a a constant speed of 72 km/hr up to a stratght incline against a frictional force of 1.28×10^4 N. The incline is such that the train rises vertically 1.0 m for every 100m travelled along the incline. Calculate the necessary power developed by the train. [4]
- (c) Give any four examples of processes where we can apply the principle of conservation of linear momentm to study the phenomena. [2]

10. What do you mean by Global Positioning-System (GPS)? Describe with the neat diagram showing how its different segments work. Also, write any four four applications of GPS. [1+5+2= 8]

11. Give short answers of the following questions. [8×1 = 8]

- How deos the nuclar radius change with the mass number?
- What is the physical significance of the binding energy per nucleon?
- The electrical conductivity of metal decreases with increase in temperature. What is the effect of increase in temperature to the electrical conductivity of semioconductor?

- iv. How can we distinguish conductor, semiconductor and the insulator by observing their electronic band diagram?
- v. How can we make n-type and p-type semiconductor from intrinsic silicon or germanium?
- vi. How does mesons and baryons different from each other on the basis of their quark combination?
- vii. What is the significance of Hubble's constant?
- viii. What information about the universe can be obtained from the observation of 'red shift'?