AMBITION ACADEMY SECONDARY School

Model Set-1 (XII Physics)

Circle the best alternative to the following questions (11 × 1 = 11)

Group 'A'

1. **K_1 and K_2 are the radii of gyrations of a uniform rod about the axes passing through its center and one end respectively and perpendicular to its length. $K_1 : K_2$ is equal to:**
   (a) 1:1 (b) 1:2 (c) 2:1 (d) $1:\sqrt{3}$

2. **A body executing SHM has a total energy of 'E', the maximum kinetic energy of 'KE_{max}', and the maximum potential energy of 'PE_{max}'. Which of the following correctly represents their relation?**
   (a) $E > KE_{max}$ (b) $E > PE_{max}$ (c) $E = KE_{max} = PE_{max}$ (d) $KE_{max} > PE_{max}$

3. **What happens when the capillary tube of insufficient height is dipped vertically on the surface of the liquid?**
   (a) Liquid does not rise on the tube
   (b) Liquid rises inside the tube and some of the liquid spills out of the tube
   (c) Liquid rises inside the tube and the radius of the meniscus at the top decreases
   (d) Liquid rises inside the tube and the radius of the meniscus at the top increases

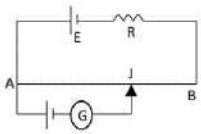
4. **The state of an ideal gas is changed three times at three different temperatures. The diagram represents three different isothermal curves. Which of the following is true about the temperatures?**
   (a) $T_1 > T_2 > T_3$
   (b) $T_1 < T_2 < T_3$
   (c) $T_1 = T_2 = T_3$
   (d) $T_1 > T_2 > T_3$

5. **The maximum efficiency of an engine operating between 30 ^{0}C to 300 ^{0}C is:**
   (a) 4.71% (b) 47.1% (c) 90% (d) 9%

6. **The sources of light are said to be coherent if the waves produced by them have the same**
   (a) wavelength and constant phase difference
   (b) amplitude
   (c) wavelength
   (d) amplitude and same wavelength

7. **What is the phase change in a traveling wave when reflected from the open boundary?**
   (a) π rad
   (b) $\pi/4$ rad
   (c) $\pi/2$ rad
   (d) No change

8. **AB is a wire of potentiometer. With the increase in value of R, the shift in the balance point 'J' will be:**
   (a) Towards A
   (b) Towards B
   (c) Remains at the same position
   (d) First towards B and then back to A



9. **If 'B' represents the magnetic flux density and 'μ' represents the magnetic moment of the coil then, the quantity 'μB' represents:**
   (a) Force on the coil
   (b) Torque on the coil
   (c) Current in the coil
   (d) Current density in the coil

10. **Which pair of elements produces maximum thermos e.m.f. for a give temperature difference?**
    (a) Antimony-Iron
    (b) Nickel-Bismuth
    (c) Iron-Copper
    (d) Antimony-Bismuth

11. **Existence of gravitational waves was predicted by Einstein in his:**
    (a) Special theory of relativity
    (b) General theory of relativity
    (c) Theory of photo-electricity
    (d) Theory of Brownian motion

Group 'B'

Short Answer Questions **[8 x 5 = 40]**

1. Answer the following questions.

a. Define simple harmonic motion and give one an example of it. **[1]**
b. An object executing SHM has instantaneous displacement given by: $y = r \sin \omega t$. Show that the velocity of the object is maximum at the mean position and the acceleration is maximum at the extreme position. **[3]**
c. The bob of a simple pendulum is pulled aside so that the suspension thread makes a relatively large angle (say 20^0) with the vertical. When the bob is released, will its motion consider a simple harmonic? Explain. **[1]**

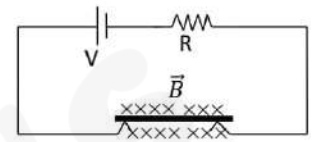
2. Answer the following questions.

a. What do you mean by 'angular momentum' of a rotating body? Is it a scalar or a vector quantity? Why? **[1]**
b. Show that the angular momentum of a rigid about the rotating axis is: $L = I\omega$, where symbols carry their usual meanings. **[2]**
c. A uniform rod is rotated first about an axis passing through its center and perpendicular to its length at some angular velocity. The same rod is again rotated with the same angular velocity about an axis passing through its one end and perpendicular to its length. Compare the angular momentum of the rods in these two cases. **[2]**

OR

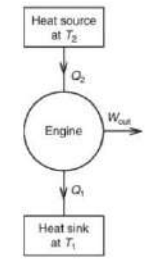
a. Define viscosity. **[1]**
b. Obtain Newton's formula for viscosity. **[2]**
c. A metal plate of area 0.04 m^2 is lying on a liquid layer of thickness 0.002 m. What is the velocity of the plate if a horizontal force of 6 N is applied to it. (coefficient of viscosity of liquid = 12 decapoise) **[2]**

3. A thin, 50.0 cm long metal bar with a mass of 750 g rests on but is not attached to, two metallic supports in a uniform 0.450 T magnetic field, as shown in the figure. A battery and a 25 Ω resistor in series are connected to the supports.



a. In which direction does the wire experience force due to magnetic field? Why? **[0.5 +0.5 = 1]**
b. What is the highest voltage the battery can have without breaking the circuit at the supports? **[2]**
c. The battery voltage has the maximum value calculated in part (b). If the resistor suddenly gets partially short-circuited, decreasing its resistance to 2.0Ω find the initial acceleration of the bar. **[2]**

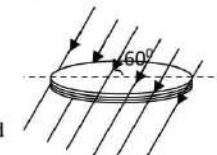
4. The adjacent figure shows the schematic diagram of a heat engine. Study the figure and answer the questions.



(a) Give Kelvin's statement of the second law of thermodynamics. **[1]**
(b) What does Q_1 and Q_2 represent in the figure? **[1]**
(c) Obtain the thermal efficiency of the given heat engine. **[1]**
(d) State the condition at which the engine does not perform any work. **[1]**
(e) The temperature of sink is decreased by keeping all other parameters constant. What would be its effect in the efficiency of the engine? **[1]**

5. Answer the following questions.

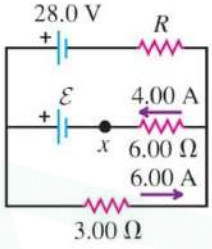
a. Define the term 'magnetic flux'. **[1]**
b. Calculate the amount of magnetic flux linked with the following coil. **[1.5]**



B=3×10⁻³ T, r = 20cm
Number of turns = 20

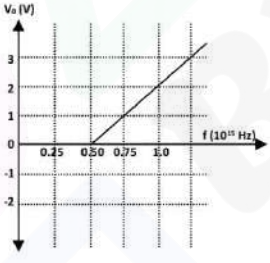
c. A conductor of length 'l' moves in the uniform magnetic field of flux density 'B' with velocity 'v' at right angles to the direction of magnetic field.
   i. Describe why an emf is induced in the conductor. **[2]**
   ii. Show that the value of induced emf across the ends of the rod is: $\boldsymbol{E = Blv}$. **[3.5]**

6. **In the circuit shown in figure below find**:



   a. The current in resistor R. **[0.5]**
   b. The resistance R. **[1.5]**
   c. The unknown emf . **[1.5]**
   d. If the circuit is broken at point x, what is the current in resistor R? **[1.5]**

7. **The figure shows a graph between stopping potential and frequency of incident radiation for some metal surface. Study the graph and answer the following questions.**



   a. What are the values of threshold frequency and threshold wavelength? [use c = 3 $\times 10^8$ m/s] **[2]**
   b. Obtain the value of Planck's constant from the graph. **[1.5]**
   c. The metal surface is illuminated by the radiation of frequency 10^{15} Hz. What would be the maximum kinetic energy of the emitted electrons? **[1.5]**

8. **The following figure is of PN junction diode in real practice. Answer the following questions on the basis of the figure.**

   a. How do you identify P and N side of the PN junction diode in the figure above? **[0.5]**
   b. Describe shortly the formation of depletion layer in the PN junction diode by making an appropriate diagram. **[3]**
   c. State any one application of PN junction diode. **[0.5]**
   d. Draw a circuit diagram to show forward bias characteristics of PN junction diode. **[1]**

OR

   a. State Bohr's frequency condition. **[1]**
   b. How would you say that the energy of electron in the hydrogen atom is quantized? Explain. **[2]**
   c. What is the quantum number of the state to which the ground state electron of hydrogen atom would excite by absorbing the photon of energy 2.04 x 10^{-18} J? **[2]**

Long answer questions **[3 x 8 = 24]**

9. **The displacement $y(x,t)$ of a vibrating particle as a function of both location and time is given by**:

$$y(x,t) = A\ cos\left[\frac{2\pi}{\lambda}(x - vt)\right]$$

   a. Use y(x, t) to find the expression of transverse velocity $\boldsymbol{v_y}$ of a particle in the string on which the wave travels. **[2]**
   b. Find the maximum speed of the particle of the string. **[1]**
   c. Show that the particle vibrate simple harmonically. **[2]**
   d. Under what circumstance $\boldsymbol{v_y}$ is equal to the speed of the wave $\boldsymbol{v}$? **[1]**
   e. Under which condition, $\boldsymbol{v_y < v}$ **and** $\boldsymbol{v_y > v}$**?** **[2]**

10. **Answer the following questions.**
   a. Write down the mathematical form of Biot-Savart's law. **[0.5]**
   b. A wire carrying current 'I' is bent in the form of a circle of radius 'a'. Using Biot-Savart's law, find the expression of the magnetic field (B) at the center of the wire. **[2]**
   c. Plot a graph to show the variation of 'B' with the radius 'a' of the ring. **[2]**

d. A copper wire 66 cm long is wound into a flat circle of 7 cm diameter. If the current flowing in the wire is 4.5 A, what is the magnetic induction at the center? **[1.5]**

e. Copy the following solenoid and draw the magnetic lines of forces around it. State which point A and B acts as the North and the South Pole. **[2]**

OR

a. What do you mean by 'resonance' is LCR series circuit? **[1]**
b. Obtain the expression of resonating frequency in LCR series circuit. **[2]**
c. Mention any one application of LCR resonating circuit. **[1]**
d. Draw a graph showing how the impedance of LCR series circuit changes with the frequency of the applied alternating current. Also, mention the region where the circuit is inductive and capacitive. **[2]**
e. Calculate the impedance of LCR series circuit containing a capacitor of 50 μF, indictor of 0.8 H, and a resistor of 20 Ω. **[2]**

11. The radioactive isotope of polonium, $_{81}Po^{218}$, decays by the emission of an α-particle with a half-life of 183 s. [Avagadro's numbr = 6.023×10^{23}/mole]

a. Mention any four properties of α-particle. **[2]**
b. How does a nucleus change when it emits an α-particle? **[1]**
c. In an accident at a reprocessing plant some of this isotope, in the form of dust, is released into the atmosphere. Explain why a spillage in the form of dust is very much more dangerous to health than a liquid spillage. **[0.5]**
d. It is calculated that 2.4 g of the isotope is released into the atmosphere. Calculate the initial activity of the released polonium. **[2.5]**
e. It is felt that it would be safe to re-enter the laboratory when the activity falls to the background, about 10 Bq. Calculate how many hours must pass before it is safe to re-enter the laboratory. **[2]**