

APT TALENT SEARCH EXAMINATION 2022-23, PART B

25 February 2023

Time: 1 Hr

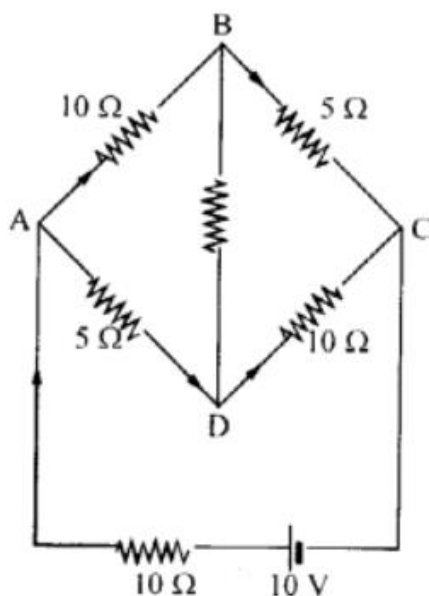
Max Score: 100

Instructions

1. Each Question Carries 10 Marks.
2. Answer All Questions
3. Calculators are NOT Allowed

1. A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into oscillation. The speed of the bob at its mean position is 1 ms^{-1} . What is the trajectory of the bob if the string is cut when the bob is
(a) at one of its extreme positions, (b) at its mean position ?
2. (a) How will you 'weigh the sun', that is, estimate its mass? The mean orbital radius of the earth around the sun is $1.5 \times 10^8 \text{ km}$.
(b) A Saturn year is 29.5 times the Earth year. How far is the Saturn from the Sun if the Earth is $1.50 \times 10^8 \text{ km}$ away from the Sun?.
3. Explain why
(a) To keep a piece of paper horizontal, you should blow over, not under, it.
(b) When we try to close a water tap with our fingers, fast jets of water gush through the openings between our fingers.
(c) The size of a needle of a syringe controls flow rate better than the thumb pressure exerted by a doctor while administering an injection.
(d) A fluid flowing out of a small hole in a vessel results in a backward thrust on the vessel.
(e) A spinning cricket ball in air does not follow a parabolic trajectory.
4. A cylinder with a movable piston contains 3 moles of hydrogen at standard temperature and pressure. The walls of the cylinder are made of a heat insulator, and the piston is insulated by having a pile of sand on it. By what factor does the pressure of the gas increase if the gas is compressed to half its original volume?
5. Show that for a particle in linear SHM, the average kinetic energy over a period of oscillation equals the average potential energy over the same period.
6. A train, standing at the outer signal of a railway station blows a whistle of frequency 400 Hz in still air. (i) What is the frequency of the whistle for a platform observer when the train (a) approaches the platform with a speed of 10 ms^{-1} . (b) recedes from the platform with a speed of 10 ms^{-1} (ii) What is the speed of sound in each case? The speed of sound in still air can be taken as 340 ms^{-1} .

7. A regular hexagon of side 10cm has a charge 5micro coulomb at each of its vertices. Calculate the potential at the centre of the hexagon.
8. Determine the Current in each branch of the network



9. (a) Is there any difference between the colours emerging from a prism and the colours of a soap film seen in sunlight? Explain.
 (c) Two slits in Young's double slit experiment are illuminated by two different lamps emitting light of the same wavelength. Will you observe the interference pattern? Justify your answer.
10. (a) Show graphically, the variation of the de- Broglie wavelength (λ) with the potential (V) through which an electron is accelerated from rest.
 (b) Draw a graph showing the variation of stopping potential with frequency of incident radiation for two photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$).