

## Physics

1. *Explain why smoke particles move in this manner*  
**It is due to the movement of air molecules, which bombard the smoke particles from all sides. As the smoke particle is relatively small, the number of air molecules hitting it on one side is not balanced by an equal number hitting it on the opposite sides, thus it moves in the resultant direction.**
2. *What does Brownian motion prove?*  
**That air molecules are in constant, random motion.**
3. *When smoke particles are replaced with smaller and lighter particles, state and explain the subsequent motion.*  
**The smoke particles would collide at higher velocity and frequency as they have a smaller mass, therefore lesser inertia, hence less energy is needed to cause a change in its motion.**
4. *Explain by using kinetic theory of gases*
  - a. *Why the pressure in the car tyre increases as the tyre becomes hotter*  
**When the tyre gets hotter, the particles in the tyre gain kinetic energy and begin to move at higher velocity, hence they bombard on the inner surface of the tyre more vigorously and frequently. The average force per unit collision between the air molecules and the wall of the tyre increases, therefore increasing the pressure.**
  - b. *Why the pressure of the tyre increases as more air is pumped into the tyre.*  
**When more air is pumped into the tyre, the space between each molecule is lesser, resulting in higher frequency of collisions and average force per unit area between the air molecules between the tyre, increasing the pressure.**
5. *Explain in terms of density changes to the gas in the glass vessel, how energy is transferred from the bottom of the glass vessel to the top? (Diagram shows glass vessel being heated at the base)*  
**When the bottom of the glass vessel is heated, the gas gets heated and becomes less dense, and the air at the bottom gets heated too and rises up, pushing the cooler molecules and making them go down, heating them at the bottom too, resulting in a series of convection currents.**

6. *When the balloon rises higher, what would happen to it?*  
**The balloon would burst as the pressure outside the balloon would be lesser as it moves up while the pressure inside would be greater than the pressure acting outside, causing a force to be exerted on the inner surface, making it burst when the limit has been reached.**
7. *State and explain why the balloon has to be half inflated when it leaves the ground.*  
**When the balloon rises, the atmospheric pressure decreases, hence the pressure inside the balloon would be greater than outside, therefore there would be a net force acting on the balloon, pushing it upwards, to allow for room for expansion.**
8. *Explain why the water moves up the tube when the suction pump is turned on*  
**When the suction pump is turned on, air gets sucked out of the tube, creating a partial vacuum, hence the atmospheric pressure becomes greater than the pressure inside the pump, therefore there would be a net force pushing the water up the tube.**
9. *The gas in the cylinder is then cooled and the piston is observed to move inwards again. Explain, using the Kinetic Theory of Matter, why this happens.*  
**When the gas is cooled, the KE of each gas molecule decreases, therefore there would be lower frequency of collisions, resulting in a lower average force per unit area exerted on the walls of the gas syringe, therefore Patm would be greater than the pressure inside the syringe, causing a net force to push the piston inwards.**
10. *Some water evaporates as the temperature rises. Explain, in terms of molecular behavior, why energy is needed for this evaporation.*  
**Energy is needed for evaporation for the water molecules to overcome the intermolecular forces of attraction between them.**
- 11.
- a. *Why is energy needed to evaporate a liquid?*  
**There are intermolecular forces between the liquid molecules. Therefore, heat energy is required to overcome these intermolecular forces of attraction.**
  - b. *State the conditions required for molecules in a liquid to be able to leave the liquid surface.*  
**The molecules must have sufficient kinetic energy.**

c. *Why is cooling a result of evaporation?*

**Molecules in the liquid would move about continuously and randomly as they collide with one another. Some molecules would gain kinetic energy at the expense of other molecules. Molecules with higher kinetic energy, near the surface of the liquid are able to break away from the intermolecular forces between the molecules and escape from the liquid. This will leave behind slow moving molecules that have lower average kinetic energy. As a result, the average kinetic energy of the molecules of the liquid decreased, causing the temperature of the liquid to drop.**

12. *List 3 advantages of using a thermocouple thermometer over the liquid-in-glass thermometer*

- a. **It can measure a large temperature range of -200 to 1500 by choosing suitable types of metal wires**
- b. **As the wire junctions are very small, the thermometer can be used to measure temperature at a point**
- c. **It is responsive to rapidly changing temperatures due to its low specific heat capacity due to its small mass and because metals are good conductors of heat.**

13. *Explain how the icebox at the top of the refrigerator keeps the whole of the food compartment cool*

**Warm air from the bottom, being less dense would rise and get cooled by the freezer. The cooled, denser air sinks to replace it. A convection current will be set up due to the difference in densities. This results in the cooling of the food compartment.**

14. *Why should the refrigerator door not be kept open for too long?*

**The convection currents are affected. Cool air is lost to the surroundings and is replaced by warm air. Heat enters the refrigerator and disrupts the convection currents. This wastes electricity as more energy is required to reform the convection currents and keep the refrigerator cool.**

15. *Explain why the fins are black?*

**Black objects are good emitters of radiation and so heat is lost at a faster rate. The fins can radiate heat away from the pipes containing fluid faster.**

16. *Why are wired shelves used instead of solid shelves?*

**To allow the convection currents to flow unimpeded by increasing the exposed surface area.**

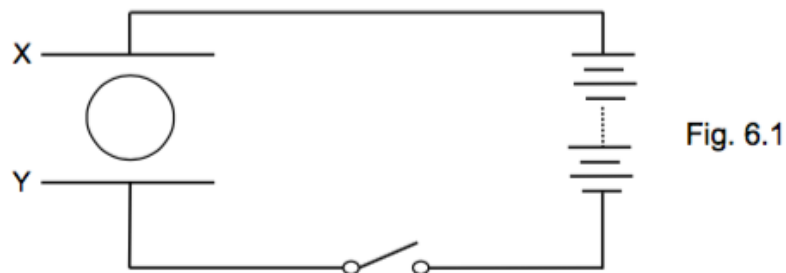
17. *The refrigerator walls are insulated using expanded polystyrene and aluminum foil. Explain how these 2 materials reduce the amount of heat energy entering the refrigerator.*

**Aluminum reflects heat entering the refrigerator by radiation. Polystyrene is a good insulator, thus preventing heat entering by conduction.**

18. *Explain the difference between conduction and convection*  
**Conduction refers to the transfer of heat energy from one medium to another through the vibration of particles without any bulk movement of the medium. Convection is the transfer of heat energy from one medium to another through bulk movement of the medium.**
19. *Define the moment of a force*  
**The product of a force and distance perpendicular from the line of action of force from the pivot.**
20. *Explain why the man is moving at a constant speed (for terminal velocity questions)*  
**The man has reached terminal velocity, as the drag force is equal to the forward force, therefore there is no net force and hence no acceleration, therefore the man moves at constant velocity.**
21. *The box now moves from the rough surface to a smooth surface. Assuming there is no change to the applied horizontal force, state and explain the motion of the box on the smooth surface.*  
**The box would accelerate constantly as there is a net force acting in the same direction as the motion of the box.**
22. *While the box is still moving on the smooth surface and with the horizontal force remaining constant, a force of 22N is applied in the opposite direction. State and explain the immediate motion (initial force was 20N in the first motion).*  
**The box would decelerate as there is a net force acting opposite to the original direction.**
23. *Give one useful application of electrostatics*  
**Photocopier.**
24. *Electric charges will be produced on the surface of the car as the car moves. Do the electric charges produced have a path to escape? Explain.*  
**No. There is no earthing material to transfer the charges to the ground.**
25. *Explain the working principle of the electrostatic paint spray.*  
**When the paint particles are released from the spray nozzle, they are all like charges, hence they would repel each other and go in different directions.**
26. *Give one advantage of this method*  
**Uniform colouring.**

28.

Fig. 6.1 below shows two horizontal plates X and Y connected to a source of high voltage. An uncharged copper sphere is placed in the region between the plates.



*Explain why the sphere falls towards Y.*

**The sum of weight and downward force on the positive charges is greater than the upwards force due to the negative charges, hence it falls downwards.**

29. *What rating should the fuse have?*

**The fuse should have a rating just above the current which the (state name of appliance) will draw under normal working conditions.**

30. *Explain why it is dangerous to use an appliance with damaged insulation.*

**When the insulator is damaged, the conducting wire is exposed. The exposed live wire carries high voltage which would cause an electric shock when touched.**

31. *Why is a lamp that is doubly insulated safe to use?*

**Double insulation means that the lamp has an insulating material to prevent excess current from the live wire to leak to the external circuit, therefore anyone who touches the metal casing would not get an electric shock.**

32. *Explain the function of a split ring*

**It reverses the direction of current in the loop whenever the commutator changes contact from one brush to the other every half rotation, ensuring that the carbon brush would always be in contact with the coil, so that the coil will always be turning in the same direction.**

33. *Explain why the following is wrong: "If the battery in the figure is replaced by a 50 Hz a.c source, the coil will only oscillate to and fro."*

**If the polarities of the battery are reversed, both the direction of the current through the coil and direction of the magnetic field are reversed. As a result, the rotation of the coil is unchanged. Hence,**

even if an a.c is applied, the motor would still rotate in one direction continuously.

34. Describe how the reading on the ammeter will change as the surrounding temperature becomes hotter.

**As the surrounding temperature increases, the resistance of the thermistor decreases and so the current in the circuit would increase, hence the ammeter reading increases.**

35. State one disadvantage of using wind turbines to produce a high proportion of electricity in Singapore.

**As wind is not constantly blowing, the electrical energy generated will not be able to match the varying demand of the country throughout the day.**

37. State and explain one method to reduce the amount of energy wasted in cables.

**Use thicker wires of larger diameter so as to reduce the amount of resistance in the wire, which would reduce power loss through Joule heating.**

**OR**

**Use transformers to generate greater voltage and hence lower current, leading to lesser Joule heating.**

38.

5. Fig 5.1 shows a loudspeaker that is used to project sound to a large audience.

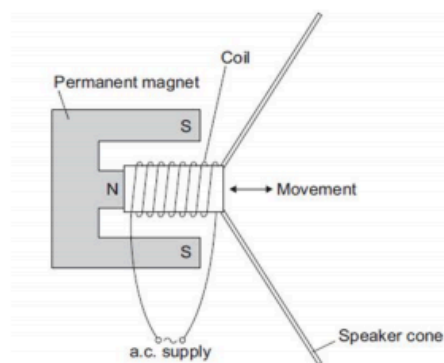


Fig 5.1

a) Describe how sound is transmitted from the loudspeaker to the audience. [3]

**A longitudinal wave have particles vibrating parallel to the direction of the wave motion.**

[1]

**When the cone of the loudspeaker vibrates, the air molecules around it is displaced and causes the air molecules to vibrate more vigorously.**

[1]

**They collide with the neighboring molecules and during collision, energy is transferred to the neighboring molecules.**

[1]

**Hence the vibrations are transmitted until it reaches the ears of the audience.**

b) Describe and explain what happens to the speaker cone when an alternating current flows through the coil.

The current flowing through the coil creates a magnetic field around the coil. Initially when a North pole is induced on the left of the electromagnet, since like poles repel, coil moves to the right. When the direction of current changes, induced poles on the electromagnet changes and cone/coil moves in the opposite direction.

39. (For C.R.O questions) Explain why the 2 pulses are of different magnitudes.

The first wave is coming from the source that gets transmitted, while the second wave is a receiving wave, therefore its magnitude would be smaller as energy is lost to surroundings.

40. Explain why radio stations are needed to boost the radio signals from the receiver stations.

The energy level of the radio signals decreases as it travels over long distances. Radio stations help strengthen the signal so that it can be sent over long distances.

41. Why are radio waves used to transmit communication signals from the signals from the receiving station to users in the city?

Radio waves are able to bend around obstructions such as buildings due to their longer wavelength. Hence the signals can be received by other users.

42. a. What is a bimetallic strip?

They are 2 pieces of metal welded together and they are made of different materials; Brass (top one) and Iron (bottom one), they have different rates of expansion and contraction.

b. Describe how electricity can be successfully turned off during extremely low temperatures.

When temperatures are low, it would cause brass to contract faster than iron, making it curve upwards and creating an open circuit.