PHYSICS NOTES
SPM

CHARACTERISTICS OR PROPERTIES MARKING SCHEME
FOR MODIFICATIONS DAN MAKING DICISIONS QUESTIONS

Chapter 1/2/3 (FORCES AND MOTION/PRESSURE)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	The small reading of scale 0.01 cm	More sensitif/ accurate/suitable to measure a small length
2	Front and rear crumple zones	To increase time of impact //To reduce impulsive force.
3	Air bags	Will inflate during collision/to prevent driver and passenger colliding with steering wheel and dashboard.
4	Dashboard - made of soft material	To lengthen the time of impact so as to reduce impulsive force.
5	Seat belt	To prevent passengers thrown foward due to it inertia
6	Headrest	To prevent head thrown back due to its inertia
7	Thicker wall at the base	To withstand greater pressure at the bottom as the pressure increases with depth
8	The wall is constructed using stronger materials //Using reinforce concrete	To avoid the wall from breaking //To increase the strength of the wall //To avoid leaking
9	Equipped with the water overflow system	To avoid flooding //To channel away the overflow water
10	The mass must be high	So that the vehicles becomes more stable
11	The types of engine is diesel	So the cost is low
12	The diameter of the tyre must be bigger	So the pressure is low // more stable
13	Streamline	Reduce the resistance of water
14	Low Density	Higher buoyant force
15	Specific heat capacity high	Absorbs heat slowly
16	High strength	Difficult to damage
17	Material made from glass	Glass does not corrode with acid
18	Small diameter of capillary tube	To increase the sensitivity of the hydrometer
19	High density of shots/added more	Makes the hydrometer stays upright//Lower center of gravity
20	Big diameter of bottom bulb	To obtain a bigger upthrust/stability
21	Aerodynamics //Cone shape at top	Reducing of air friction
22	Small mass	Higher rate of acceleration//Easy to carry
23	Less than half of the bottle filled with water(water roket)	Enough space for increasing air pressure//Big buoyant force
24	3 or 4 wings	The stability of the rocket
25	Angle of projection = 45 degree	Increase the flight distance
26	Low density of an object	So that it is lighter//Accelerate faster
27	Higher density	Bigger inertia/stability
28	High engine power	To produce high acceleration//High resultant force
29	High spring constant //Stiffer spring	So that the spring is stiffer //Motorcycle bounce less //Less vibration
30	Wide tyre //Smooth tyre	To increase stability//To reduce friction
31	Use a spring with a bigger diameter	So that *k* is bigger
32	The spring is made from steel a larger *k*(spring constant)	the type of material influences *k* produces a bigger elastic PE. Elastic PE. changes to KE.
33	Spring is greatly compressed	So that elastic Potential Energy is bigger
34	Slope of inclined plane is 45 degrees	So that distance is maximum
35	The melting point should be high	To be able to withstand high temperature

36	The material must be very strong	To be able to withstand very strong force
37	Shaped with a curved surface at the top and a flat surface at the bottom (aerodynamic)	To achieve an upward lifting force when moving at high speed
38	Run with higher speed	To increase kinetic energy
39	Bend pole greater //Jump when the pole is maximum bend	Increase elastic potential energy
40	Elastic pole // strong material // low density	So that the pole can return to it original shape // So that it will not break // light
41	Wear fit attire	Reduce air resistance
42	Use mattress/soft material	Increase time of collision // reduce impulsive force//increase landing time
43	Made of concrete	Stronger // Not easy to break // metal can rust easily
44	Thicker wall at the bottom	Able to withstand the higher pressure at the bottom
45	Height from ground is high (dam)	To produce a greater difference in pressure
46	Wide base cross section area	So that ship can float//prevent from overturn // ship more stable // ship not sink deeper
47	High volume of air space in the ship	Produce bigger buoyant force// ship can float
48	Spring arrange in parallel	The spring sistem is stiffer/less extension/less elastic
49	Spring with thicker wire	The spring is stiffer/wire not easily break
50	Spring with smaller diameter of coil	Increase the stiffness of the spring//can with stand higher force
51	Rope with small diameter (parachute)	Accupy less space/less mass
52	Long stem(for hydrometer)	Cover a wider range of densities
53	Stem with smaller diameter	Sink more and increase the sensitivity
54	Low rate of rusting	To ensure tha material last longer
55	Semicircular curve shaped(for slope)	Exchange between KE and GPE easily
56	Smooth surface	Easily to move/reduce frictional force
57	Synthetic material	Light weight/air-proof material

Chapter 4 (HEAT)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	The lid of the pan designed to lower the air pressure inside the pan	The boiling point of water decreased
2	The lid of the pan made of substance which has weak conductivity of heat	Heat will not absorbed by the the lid, so heat will not lost to surrounding
3	Made from material with low specific heat capacity	Temperature in the pot can be increased quickly when heated. This saves fuel / cooking gas.
4	Made from a low density material	Pot is light and more portable
5	Made from material that is not easily corroded or oxidized	Pot is more durable and will not contaminate the food with dangerous material
6	The handle of the pot is made from material with high specific heat capacity	The handle becomes hot slower and can be held without scorching the hand
7	The pot is designed to have vertical compartments which can be added or removed	This makes the pot versatile because different food can be cooked at the same time
8	High melting point	Does not melt easily if there is an increase in temperature.
9	Liquid that difficult to compress.	Pressure will be transmited uniformly in all directions/ flows easily
10	High degree of hardness	Can withstand great force // does not break easily
11	Large numbers of fin blade (Engines)	Increase surface area // release heat quickly // engine cools quickly
12	Big size of fan	Can suck more air // more air can be blow to the engine /Can cool down a larger area
13	High boiling point	Not easily to vaporize // the volume of liquid reduce slowly // takes a longer time to boil
14	High specific heat capacity	Takes a longer time to become hot // the rise in temperature is slow
15	Increase the length/area of cooling coil	Increase the resistance/Can transfer the heat faster to the surrounding
16	A storage tank must be place at a higher level	To give higher pressure
17	Pipe embedded in plate must be long	Will enlarge surface area will absorbs heat faster
18	The pipe inside the plate must be made of metal	Metal is a good heat conductor,so it will transmit heat to water easily
19	Thermometer is made from strong transparent glass	Not easily broken
20	Thermometric liquid chosen is mercury	Because it easily expands uniformly
21	Capillary tube is made narrow and thin	More sensitive
22	Shape of the thermometer is round	Has magnifying effect
23	Thermometer is placed in melting ice	To obtain the lower point
24	Thermometer is placed in steam	To obtain the upper point
25	Low specific heat capacity of ice cream box	Easy get cold // becomes cool quickly
26	Smaller size of ice cream box	Easier to carry // easy too become cool
27	Plastic PVC	Poor conductor of heat
28	Bright colour of outer box	Does not absorb heat from surrounding quickly
29	Use insulator behind the absorber panel	To prevent the loss of heat energy
30	Use an absorber panel which is painted black.	A black surface is a good absorber of radiation so it will absorb heat faster

Chapter 5 (LIGHT)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	Small critical angle.	Allow more light to involve in total internal reflection
2	Strong material	Not easily broken.
3	Flexible material.	Can easily change the shape.
4	Fine diameter	Can enter small holes.
5	High refractive index	Total internal reflection can occur easily
6	Optical fibre in a bundle	Large number of signal/higher intensity of light can propagate
7	Material with weak rigidity	The optical fibre can be bent easily
8	Material with great strength	The optical fibre can last longer//not easily spoil
9	A plane mirror mounted on an adjustable arm	Reflects light to the vertical screen, corrects lateral and vertical inversion
10	Use a converging mirror instead of plane mirror	Focus the light directly to the lens // increase the intensity of light.
11	Place the filament at the centre of curvature of the converging mirror // use high powered lens	Light goes directly from the lamp and reflect back on the same path // increase the intensity of light towards the transparency // to get brighter image
12	Use heat filter	To absorb excess heat to the transparency
13	Electric fan operates during and after the lamp is switched on	Cooling system to stabilize the temperature (heat energy produced by filament bulb)
14	Shorter // smaller size of binocular	easy to carry
15	Use prism to make the total internal reflection occur	Produce upright image
16	Higher density	Higher refractive indeks
17	Objective lens with larger diameter	More light passes through the lens
18	Eyepiece with higher power	Shorter focal length
19	Shorter focal length	Higher power/increase the magnification
20	Convex lens	Can produce real image
21	u a bit bigger than f	Produce maximum magnification
22	Periscope	Cheaper than CCTV
23	2 plane mirror/prism	Can reflect light from object
24	Casing to hold the mirror	Easier to handle periscope
25	Convex mirror	Wider field view
26	Optical fibre with higher densities/ refractive index inner compare than outer	To ensure total internal reflection occur

Form 5
Chapter 6 (WAVE)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	Build near bay	Waves are calmer due to divergence of energy// Convergence of waves at the cape//The bay is shallower//The speed of waves decreases//The amplitude of waves at the bay is small
2	Build retaining walls	Reduce direct impact of the waves on the shore. To reflect the waves from the shore//Protect the area from large waves //Avoid erosion
3	Concrete barrier structure with a gap in between	Waves passing through the gap will be diffracted in the children's area/the smaller amplitude of the diffracted waves causes the sea to be calmer there energy of waves decreases.
4	Build high retaining wall	To ensure the water not overflow.
5	Thick area at the base of the wall	To withstand high pressure at the base
6	Long wavelength	Easy to diffract
7	Short Slit	Diffraction more obvious
8	Ultrasonic wave	Can transfer more energy

Chapter 7/8 (ELECTRIC & ELECTROMAGNET)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	The electric appliances are connected in parallel	Allow each electric appliances to be switched on and off independently/Higher voltage One appliaces damage the another can still function
2	Fit fuse at the live wire in the fuse box/Use miniature circuit breakers (mcb's)	To stop the flow of current by melting when a high voltage of electric current flows through the circuit // switches itself off very quickly if the current exceeds
3	Earth connection to the metal case of electrical appliances	Earth wire connected to earth, so that when a fault occurs and a current flows through the live wire and the earth wire, the fuse in the live wire will blow and cut off the supply.
4	Use low power lamps / install fluorescent lamp	To reduce the energy use Do not waste the electrical energy
5	Regularly cleaning and removing dust from the air filters of air conditioners	To make sure the appliaces function effectively
6	Low power lamp	Save cost//electric bill
7	High efficiency	The room looks brighter//high output power//less power wastage
8	Long life span	No need to replace often
9	Low price/cost	Save money/cost
10	Smaller surface area	The resistance is higher
11	High melting point	Not easy to melt
12	Long (coiled) metal	To increase the resistance
13	Low rate of oxidation	Does not oxidize easily / can be used for a longer period
14	Low resistance	Current will increase / more heat will be produced
15	Low resistivity	To reduce heat loss in the cables
16	Low rate of thermal expansion	The cables will not expand under hot weather
17	Use thin diaphragm	Easy to vibrate

18	Use strong material	Not easy to break
19	More number of turns of coil	Increase the rate of change of magnetic flux linkage // The magnitude of the induced current or is also increased
20	Thicker diameter of wire of coil	Reduce the resistance of the coil
21	Using more powerful magnet to increase the strength of the magnetic field	Increase the rate of change of magnetic flux linkage //The magnitude of the induced current or induced electromotive force is also increased
22	Change slip rings with commutator	To reverse contact with brushes so that the current flow in same direction in external circuit
23	Use stronger magnet	To increase the magnetic field strength
24	Use more number of turn for the coil/ Increase the speed of rotation	Increase the rate of change of magnetic field/increase the induced current
25	Diameter should be large	To reduce the resistance of the cables
26	The rate of expansion should be low	So there is less expansion and less sagging in the cables during hot days
27	Use capacitor	To smoothen the current produced/to store electric charge
28	Using concave surface soft iron	Produce radial magnetic field to ensure smooten rotatation
29	Using a laminated iron core	Reduce *Eddy* current in iron core
30	Thick copper wire	Reduce the resistance of the coil
31	Using soft iron for the core	Reduce the *hysterisis* loss. Easy to magnetize and demagnitize
32	Winding the secondary and primary coils on top each other.	Reduce Leakage of Magnetic Flux

Chapter 9 (RADIOACTIVE)

NO	ASPECT/CHARACTERISTIC/MODIFICATION	REASON/EXPLANATION
1	The half-life should be a few days long	This allows for the location to be detected and the radioactive contamination is reduced
2	The source should emit γ particles	This enables the radiation to be detected above the ground/high penetrating power
3	The detector should be able to detect γ particles (low ionising particles)	High ionising particles like α and β particles are absorbed by the ground
4	Has a long half-life	Can be used for a long time hence save cost
5	Emits beta	Can penetrate box and liquid and is less dangerous than gamma
6	Solid form	Easy to handle and contain.
7	Low ionising power	Does not change the state and taste of juice
8	Higher ionising power	Easy for the medium to conduct electricity

UNDERSTANDING Questions
Form 4

CHAPTER 1

1. Explain the differences between accuracy and consistency of a measuring instrument by using suitable examples.

- Accuracy is the ability of the instrument to give readings close to the actual value.
- The value determined is accurate if it is near to the actual value
- The consistency of a measuring instrument is the ability of instrument to record consistent readings for each measurement with little deviation among readings.
- The measurement is consistent if the values determined are close to each other.

CHAPTER 2

2. To accelerate 2 objects with the same acceleration, the heavier object needs a bigger force. Explain the statement.

- Higher mass, higher inertia
- To accelerate an object, need to overcome the inertia first.
- Therefore, more force is needed for heavier object.

3. Can you explain why the passenger thrown forward when the bus suddenly stop and the head of the passenger were thrown back when the car started moving?

- When the bus was moving, the passenger were also moving at the same speed as the bus.
- When the bus stopped, the passengers continued moving. Hence, they were thrown foward.
- The people in the car tried to remain in their state of rest when the car started moving. Hence, they were thrown back.
- In both situations, the passengers were resisting a change in their state of motion and also known as Inertia.
- The concept of inertia also known as Newton's First Law of Motion, which states that "an object will remain at rest or continue with a constant speed in a straight line unless an external forces acting on it"

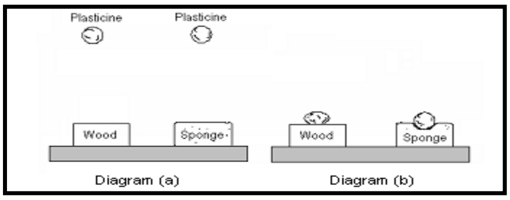
4. Can you explain why a maximum speed of supertanker might need to stop its engine over a distance of about 3 km before it can come to stop?

- A supertanker at a state of motions and have a maximum velocity.
- A supertanker has a larger mass.
- A larger mass have a larger inertia.
- When the engine stop, the supertanker will continue it state of motions.
- So it take a longer distance/time to stop due to its has a larger inertia.

5. Explain why a softball player moves his hand backwards while catching a fast moving ball. Other situation: bend our knee after jump?

- A soft ball has a high velocity.
- A soft ball has a high momentum.
- The soft ball player moves his hand backward to increase time impact.
- The higher the time impact will reduce impulsive force.
- So we will not feel hurt.

6. Diagram (a) shows two identical spherical plasticine balls before being released from the same height. Diagram (b) shows the state of



the plasticine balls when they hit the wood and the sponge. It was observed that the plasticine stopped more quickly when it hit the wood.
Explain the changes in energy that occur from the moment the plasticine ball is released until reaches the position in Diagram (b)

- Before released, the plasticine has Gravitational Potential energy.
- When falling, Gravitational Potential energy changes to Kinetic energy
- When the plasticine hits the surface of wood, the Kinetic energy changes to Heat energy / / Sound energy
- The energy / work done is use to changes the shape of sponge

7. Explain how the forces between the molecules caused the elasticity when the spring is compressed and stretched.

- There are two types of force; attraction and repulsive force between the particles of the solid.
- When the solid is stretched, the molecules displaced away from each other
- Attractive forces are acting to oppose the stretching
- When the solid is compressed, the molecules displaced closer to each other
- Repulsive forces are acting to oppose the compression

8. Explain how you can determine the density of cork stopper.

- Measure the mass of the cork stopper
- Tie the stopper with string and put it into a measuring cylinder filled with water
- Change in volume of water displaced equal to the volume of the stopper.
- Density of stopper = Mass/Volume

9. Using the principle of conservation of momentum, explain the working principle of the rocket.

- Fuel burns in the combustion chamber
- Hot gases expelled at high speed backwards
- A large backwards momentum is produced
- Based on the principle of conservation of momentum, the rocket gains forwards momentum of equal magnitude

10. Why the boy with mass 40kg slides down the flume when the angle of inclination is 30° and remains stationary when the angle of inclination is 17.5°.(the frictional force is 120N)

- Boy slide down when component of weight parallel to the slope is higher than frictional force
- Resultant force acting to produced acceleration
- Boy remain stationary when component of weight parallel to the slope is equal to frictional force
- Resultant force is equal to zero make the boy in force equilibrium

11. Explain why the boat moves away from the jetty as a boy jumps out of the boat onto the river bank.

- When the boy jumps onto the river bank, his momentum is forward.
- Using the Principle of conservation of momentum
- the total momentum before and after jumping is equal
- The boat moves backward to balance the forward momentum

12. Explain why the need of steel structure and the separate compartments to build in lorry carrying heavy load.

- The inertia of lorry and load is very big when it is moving
- The separate compartments make the load divided into smaller mass, thus reducing the inertia of each unit.
- The momentum of lorry and load is very big when it is moving and produce a bigger impulsive force.
- The steel structure will prevent the loads from smashing into the driver's compartment during emergency braking.

13. Why we feel easier to pull the wheel barrow compared to push the load?

- The object on the wheel barrow has a weight
- When we push the wheel barrow there is force acting on the ground in the same direction as the weight.
- So the total force acting on the ground is the weight and the force produced when we push the wheel barrow.
- When we pull the wheel barrow the force produced is in opposite direction with the weight.
- So the total force acting on the floor is a weight less the force produced when we pull the wheel barrow

CHAPTER 3

14. Explain why the wooden block move upwards and then float on the water surface when it release from the above of the water surface.

- Buoyant force increase when the volume of water displace increase.
- Buoyant force higher than weight of block.
- Boyant force pushed the wooden block upward.
- The wooden block then float because the buoyant force is equal to the weight of the wooden block
- Archimedes principle

15. Exlplain how the brake system operates when the car needs to slow down.

- When the brake is pressed, a force is applied to the piston and pressure is exerted.
- Pressure is transmitted uniformly throughout the brake fluid.
- Force is exerted on the piston of the brake pads
- Brake pads will press against the brake discs.

16. The toothpaste flows out of it's tube while squeezing at the bottom end
Explain how the toothpaste flows out and name a physics principle related to it.

- Force is applied to the toothpaste (tube)
- Will produced a pressure
- The toothpaste carry the pressure
- and apply the pressure of the equal magnitude to the whole tube
- Pascal's principle

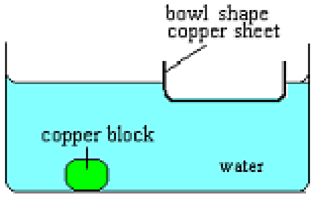
17. Explain how a submarine is able to submerge into deep sea water

- Valve release air from ballast tank.
- Sea water flooded ballast tank
- The weight of water displaced is smaller.
- Buoyant force < Weight of the submarine

18. Explain why a balloon filled with helium gas rises up in the air.

- The balloon acted by two forces: Buoyant force and the weight of the balloon
- The density of helium gas is less than the density of surrounding air
- Buoyant force equals to the weight of the air displaced by the balloon
- Buoyant force is higher than the weight of the balloon

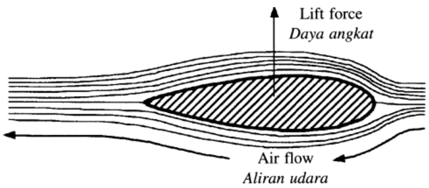
19. Diagram shows a copper block and a bowl shape copper sheet of same mass.



Explain why the copper block sink in water but the bowl shape copper sheet floats on water

- two forces act on the copper block and bowl are buoyant force and weight
- Buoyant force small because small volume // vise versa
- The average density of cooper sheet is smaller than density of water. Cooper sheet will float.
- Block sink because weight > Buoyant force
- Sheet float because weight = Buoyant force

20. Diagram shows a cross-sectional of a wing of a moving aeroplane. The wing of the aeroplane experiences a lift force. Explain why the lift force acts on the wing of the aeroplane.



- Higher velocity on the upper surface and lower velocity on the lower surface
- Thus produced lower pressure on the upper surface and higher pressure on the lower surface
- Lift force = difference in pressure x area of surface
- Bernoulli's principle

21. Explain the principle of Insect Piston Spray

- When the piston is pushed, air is forced out through the jet of gas at a high speed.
- According to Bernoulli's Principle, the pressure of the moving air decreases as the speed of the air increases.
- The higher atmospheric pressure in the insect poison container will push
- the insect poison liquid up through the narrow metallic tube.

22. Explain how the vacuum cleaner is able to remove dust from the floor

- the fan blow air out of the vent
- produce a partial vacuum area in the vacuum cleaner
- difference in pressure occurs/atmospheric pressure is higher than the pressure inside the vacuum cleander
- forced is exerted in/pushed in the dirt.
- Bernoulli's principle

23. Bunsen burner burning with yellow flame . Explain how a blue flame can be produced.

- High velocity of gas flow in narrow passage of burner creating region of low pressure
- Higher atmospheric pressure pushes outer air inside and mix with the gas
- Complete mixture of combustion will produce blue flame
- Enlarge the orifice to allow more air
- Bernoulli's principle

24. The roof of a house being lifted by strong winds. Explain why.

- The strong wind above the roof is moving very fast
- While the air in the house is at rest
- According to Bernoulli's principle, the higher the velocity, the lower the pressure
- pressure inside the house is higher than the outside.
- a force is generated by the difference in pressure which is strong enough to lift the roof.

25. Explain why the hovercraft moves with constant velocity in terms of the force acting on it

- The forward force = friction // forward thrust = drag
- The resultant force is zero
- The hovercraft is in force in equilibrium

CHAPTER 4

26. Water is used as a cooling agent in a radiator. Explain how water is used as a cooling agent in the radiator.

- Water has high specific heat capacity
- When water in tube passes through the engine it can absorb large amount of heat energy
- Once water reach the radiator, the heat of the water absorbed by the fin blade of the radiator
- The same time the fan in the radiator push the heat out of the car.

27. Explain how the evaporation process resulting in reduced fluid temperature.

- In the water, molecules are constantly moving at different velocities
- At water surface, high moving molecules gain high kinetic energy
- The bond between molecules overcome and water is released to the air.
- Losing of high moving water molecules, water pressure will decrease and thus the temperature decreases

28. According to the principle of thermal equilibrium and the working principle of a thermometer, explain how a doctor can check his patient temperature during medical treatment.

- Thermometer is placed in the mouth of patient,
- Heat is transferred from patient's body to the thermometer.
- Thermal equilibrium between the thermometer and patient's body is reached when the net rate of heat transfer is zero.
- The thermometer and the patient's body are at the same temperature.
- The thermometer reading shows the temperature of the patient's body.

29. Explain the changes which occur in the liquid naphthalene when it is cooled until it changes from the liquid to the solid state.

- As liquid naphthalene cools, it loses energy to surroundings
- Its temperature begins to fall until it reaches freezing point 80^0C
- At its freezing point, naphthalene begins to solidify as molecules become closely packed.
- Heat energy is lost to surrounding.(Latent heatof fusion)
- Temperature remains constant
- Kinetic energy remains constant

30. Why the ice cube stick to the wet finger. Not to dry Finger?

- Melting of ice cube will absorb heat(Latent heat of fusion)
- The finger has small amount of heat when it is wet and it will be absorbed by the ice cube.

- The heat release from water causes it to be frozen.
- So the ice cube and finger will stick together due to the frozen of water
- Furthermore, finger have a rough surface and it helps the ice stick to our finger

31. When a few drops of ether hand contact with a student, his hands felt cold. Explain how this happens.

- Boiling point of ether is low
- Temperature of hands higher than the temperature of ether
- Cause heat flowing from hand to ether
- Ether evaporates // bring the latent heat of vaporization
- causes the low temperature and cold hands

31. Your body sweats when you are feeling hot.How does sweating helps to cool down your body?

- When we do the activity involving body movement, sweat will be produced.
- Water evaporates from the skin during sweating.
- During evaporation, change of phase of matter from liquid to steam occur.
- The heat is needed to change this phase is call the latent heat of vapourisation.
- So we feel cool when evaporation occur due to the release of heat from our body.
- Factor influence the process: air velocity, temperature and humidity.

32. We cannot use a cooling system of a refrigerator to cool the hot room. Explain why?

- Cooling system of a refrigerator is smaller
- Less cool air from refrigerator flow out compare to the hot air flow in
- Position of refrigerator is on the floor
- The cool air does not flow upward

33. Why we put the fishes in the ice cube rather than cold water?

- Ice melts need heat known as latent heat of fusion
- Heat is absorbed from the fish.
- Fish will release heat until $0^{o}C$
- Cold water not experience a change of phase
- Only process of thermal equilibrium will happen when they in thermal contact.
- The lower temperature is not $0^{o}C$

34. The coldest weather experienced in late winter, when snow began to melt. Explain why?

- Heat needed to melt snow
- Latent heat of fusion is absorbed to convert solid into liquid phase
- More heat is absorbed from the environment

34. Using kinetic theory of gasses, explain how the pressure increase when the temperature increase in the pressure cooker.

- Molecules moving freely in random motion
- When temperature increase, kinetic energy//velocity increase
- Molecules strike the walls of pressure cooker more frequently
- The rate of change of momentum increase
- Force exerted on the walls increase, pressure ($P = F/A$) increase

35. In the morning feel hot at the sea .Explain why this phenomenon happens?

- During the day,the land and the sea receive the same amount of heat from the sun
- Water has a higher specific capacity than the land
- The land is heated to a higher temperature than the sea
- The density of the air above the sea is higher than the density of the air above the land
- The air above the land flows up and the air above the sea flows towards the land

CHAPTER 5

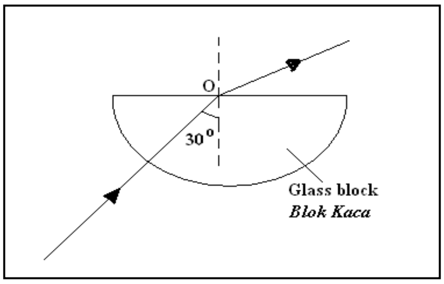
36. Tousrist at a beach observing the sunset. Explain why the tourist can still able to see the sun even though it has already set.

- Refraction of light ray occurs
- Light travels from less dense to a denser medium
- The light will bend towards the normal
- In the observer eyes, the sun is still not setting as they can still see the image from refraction

37. While driving a car on a hot day, you may see a mirage on the road. Explain how mirage occurred.

- The layers of air nearer the road warmer.
- The density of air decrease nearer to the road surface.
- The light travel from denser to less dense area.
- The light refract away from the normal
- When the angle of incidence exceed the critical angle, total internal reflection occurs

38. Diagram shows a ray of light directed perpendicularly at a side of the semi circular glass block. The ray passes through the glass block to a point O before leaving the glass block. The angle of incidence in the glass block is 30°.



Explain how total internal reflection occurs in diagram above?

- Increase the angle of incidence, then angle of refraction will also increase
- Keep on increasing the angle of incidence until angle of refraction is 90°
- The angle of incidence is called critical angle
- Increase the angle of incidence more than the critical angle, the ray will be reflected internally.

39. Explain why a piece of paper burns when placed under a convex lens aimed towards hot sun rays.

- The parallel rays of the sun will pass through the a convex lens
- After entering the lens, the light rays is focused at the principal focus of the lens
- At the principal focus, the light ray is focused on one small area
- Heat energy causes an increase in temperature, the paper starts to burn

40. Explain how you would estimate the focal length of a convex lens in your school laboratory.

- The convex lens is aimed/focused to a distant object (infinity)
- The screen is adjusted until a sharp image is formed on the screen
- The distance between the screen and the lens is measured
- Focal length = distance between the screen and the lens

41. It is known that the sky is red during sunset and the formation of rainbow on the sky always appeared after raining. Explain these phenomena.

- Light consisting of seven colours.
- Red has the longest wave length and the last to be refracted during sunset.
- A droplet of water trap in the atmosphere after raining acts a lens.
- Light travel through this water droplet and undergo the process of refraction ,total internal reflection and dispersion of light occurred.

42. The sound wave from the train(etc) can be heard loudly and clearly at night. Why?

- Air near the ground colder tha above air
- Air layer the ground more denser
- Sound travel slower in cold air/wavelength decrease in cold air
- Sound bend toward the observer/sound bend away to normal

Form 5

CHAPTER 6

43. Explain how the depth of the sea can be measured.

- ocean depths can be measured using equipment and hydrophone OSK
- hydrophone can detect ultrasonic waves in water that are emitted
- OSK can measure the time after the transmitted and reflected waves back to the receiver.
- The depth can be calculated using the formula d=(vt)/2

44. Can you explain why the wave front of sea water will follow the shape of the shore when it approaches the shore?

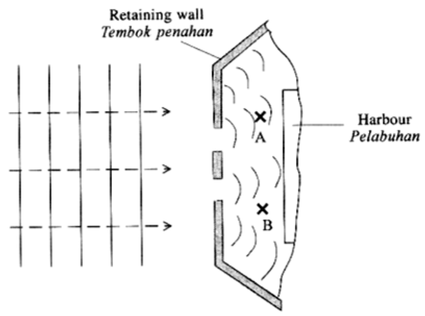
- The depth of the water decreasing as it travel towards the shore.
- The velocity and wavelength is decreasing due to the wave travel from the deeper to the shallow area.
- The wave will bend and change their direction(refraction occurs).
- So, wave front of sea water will follow the shape of the shore.

45. Explain why strong double-glazed glass is used as walls of the observation tower in an airport.

- All particles in a material/matter/glass vibrate at its natural frequency
- The airplane engine produces noise which cause the air to vibrate
- Due to resonance, the glass vibrate at a higher/maximum amplitude
- Need strong glasses to withstand the effect of resonance which vibrate with high amplitude
- so that it does not brek easily

46. How can when the oprah singer sing can make the glass break.

- The singer sing with a certain frequency and produce sound energy
- The energy is transferred to the glass
- Resonance occures when the sound frequency made by the singer is the same as the natural frequency of the glass
- The glass will vibrate with maximum amplitude
- Increase in energy transferred may cause the glass to break



47. Descibe the movement of two similiar ships that are located at A and B. Explain?

- The ship at A will move up and down
- Because constructive inteference(Antinodal line) happens at point A
- The ship will remain calm at location B
- Because destructive inteference(Nodal line) happens at point B

CHAPTER 7

48. Explain the advantages of parallel circuit in a house wiring system.

- A parallel circuit can run several devices using the full voltage of the supply.
- If one device fails, the others will continue running normally
- If the device shorts, the other devices will receive no voltage, preventing overload damage.
- A failure of one component does not lead to the failure of the other components.
- More components may be added in parallel without the need for more voltage.
- Each electrical appliance in the circuit has it own switch

49. Explain why a three pin plug is more suitable compared with a two pin plug.

- Two pin plug has no earth wire while three pin plug has earth wire
- Using 2 pin plug, if there is leakage of current it will also flow through the metal body while using 3 pin plug if there is leakage of current it will flow to the ground
- The person who touches the metal body will experiences electric shock while using 3 pin plug, the current will be earthed
- Using 2 pin is not safe to the consumer while using 3 pin plug is more safer to the consumer

50. What happen to the candle flame when it place between 2 metal plate supply with Extra High Tension (EHT).

- Candle flame spread into two
- Heat from candle split neutral air molecules into + and - ions
- Positive charge will attracted to negative plate while negative charge will atracted to positive plate
- Candle flame spread wider to negative plate because positive charge is more haviear than negative charge

51. Toaster T marked 240 V, 650 W and toaster U marked 240 V, 840 W.
Determine Which toaster has a heating element with a smaller resistance.

- toaster U
- both the toaster has equal voltage
- Power = V^2/R
- toaster with a higher power has a heating element with a smaller resistance

52. Explain why the bulb connected to two dry cells lights up brighter than one bulb connected to one dry cell.

- The two dry cells are connected in parallel
- The effective e.m.f. remains the same
- The effective internal resistance of the two cells is smaller
- A larger current will flow through the bulb to make it brighter

53. A battery consists of two 1.5 V dry cells connected to a bulb labeled 2.5V, 0.3 A. Found that the bulb is lit with a normal brightness when the switch is turned on. Explain why the bulb is lit with a normal brightness even EMF of battery is greater than that metol.

- battery has a internal resistance
- some of the battery EMF is lost to overcome internal resistance
- So, voltage supplied to the bulb is almost similar to voltage needed to light the bulb

CHAPTER 8

54. The acceleration of a magnet that drops vertically into a solenoid is much smaller than the gravitational acceleration. Explain the statement.

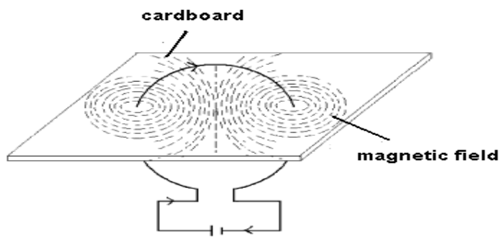
- Magnetic flux change in the solenoid
- Induced current generates in the solenoid
- Direction of induced current always flows in the direction to generate magnetic pole to oppose the pole of the falling magnet. (Lenz's law)
- Therefore, acceleration is lower

55. Explain how the electromagnet crane can be used to lift scrap metal.

- Current flow through the solenoid, magnetic field is produced
- Soft iron core will be magnetized
- The scrap metal attracted to the iron core
- No current flow, soft iron demagnetized and metal scrap fall down

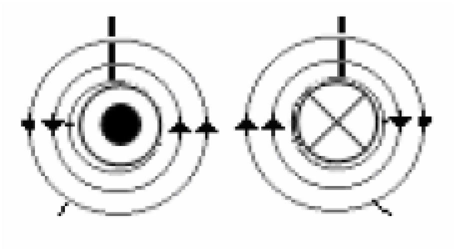
56. Most of our electric energy comes from hydroelectric power stations and thermal power station. These power stations are connected by cables to transmit electricity to users in industries, offices, schools and houses. This system is called the national grid network.
Explain briefly the importance of the national grid network system in distributing electric energy to the users.

- The electrical supply is continuous, although there is faulty in one of the power station
- The electrical energy from other station is directed to the affected areas
- The electrical energy from other area is directed to the areas that need more energy
- The overall cost of production of electricity can be reduced



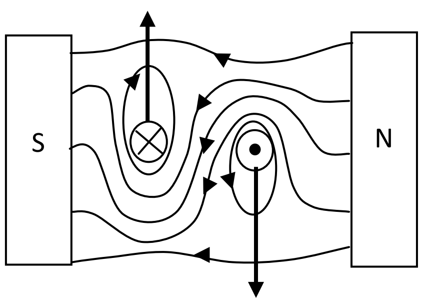
57. Diagram shows the pattern of magnetic field formed when current flows in a coil.
Explain why the magnetic field strength is greater at the center compared to the edge.

- The direction of the magnetic field on the left coil is anti clockwise
- The direction of the magnetic field on the right coil is clockwise



- As the result the magnetic fields in the middle of the coil are in the same direction, ie upward.
- So the magnetic field will be stronger in the middle.

58. Using the concept of the magnetic effect of an electric current, explain with the aid of diagrams how forces are produced on a wire in the coil of direct current electric motor?

- The magnets produce a magnetic field / diagram
- The current in the wire produces a magnetic field / diagram
- The two magnetic fields interact/combine to form a resultant / catapult field / diagram
- The motor will rotate due to the differences of force produce//turning effect from this two forces
- 

59. Explain how the generator works to produce direct current.

- rotate the coil in clockwise direction
- the coil cut across the magnetic field
- current is induced in the coil
- The commutator change the direction in the coil so that the direction of current in external circuit always the same.

60. Explain how the speed of coil (force) of generator can be increased.

- Increased input current
- Increase strength of magnetic field
- Increase length of conductor

61. Explain how to increase induced current in a generator.
- Increase the speed of conductor
- Increase strength of magnetic field
- Increase length of conductor

62. Explain the working principle of a transformer.

- When a.c. voltage is supplied to primary coil, (alternating current will flow) and
- The soft iron core is magnetized.
- The magnet produced varies in magnitude and direction.
- This causes a changing magnetic flux pass through the secondary coil.
- An induced EMF across the secondary coil is produced

63. Explain the working principle of an electric bell.

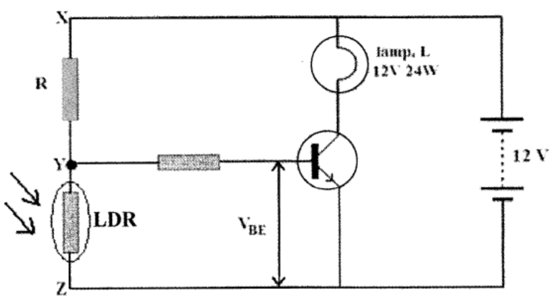
- When the bell is pressed, a current flows in the coils of the electromagnet, causing the electromagnet to be magnetized.
- The magnetized electromagnet attracts the soft-iron armature, causing the hammer to strike the gong.
- The movement of the armature breaks the circuit and causes the electromagnet to lose it magnetism.
- The light spring pulls the armature back, remaking the contact and completing the circuit again.
- The cycle is repeated so long as the bell push is pressed and continuous ringing occurs.

64. Explain how to increase the sensitivity of a moving coil meter?
- Increase the strength of magnetic field
- Increase the number of turns of coil
- Increase the stiffness of hairsprings
- Decrease the mass of the coil and pointer

CHAPTER 9

65. Explain how the green shadow produced in the CRO screen?

- 6V heater supply produced electron on it surface
- When 3 kV power supply are connected Cathode rays/electron accelerate in a straight line.
- Cathode rays carry kinetic energy and
- Converts to light energy when they hit the screen.



66. Explain why the bulb light up at night

- At night resistance LDR increases
- V_{BE} increases (higher than 0.7 V for Si)
- I_b increases and switch on transistor
- I_c, increases and lights up bulb

67. Explain how to increase rate of thermionic emission.
- Increase the temperature of metal
- Increase surface area
- Copper has higher rate of thermionic emission then iron.
- Coat with matal oxides. Matal oxides emit electron at lower temperature.

CHAPTER 10

68. Radioisotope Strontium-90 is used to measure the thickness of paper in a paper industry Explain how Strontium-90 is used to measure the thickness piece of paper?

- Put the radioactive source opposite the detector
- Detector is connected to the thickness indicator
- Detector detect the reading of the changes in counts
- Thickness is measured with the thickness indicator
- If the reading of the detector is less than the specified value, the thickness of the paper
- is too tick/ vice versa

69. Nuclear fission produces a chain reaction. Describe how the chain reaction occurs in a nuclear fission of an atom of Uranium- 235.

- Neutron bombarded a uranium nucleus and produced three neutral neutron
- The new neutron bombarded a new uranium nucleus
- For every reaction, the neutrons produced will generate a chain reaction
- Diagram of chain reaction

70. Alpha particles can observed by using clod chamber. Explain why the tracks formed is thick and straight tracks.
- The tracks are thick due to strong ionising effect of alpha particles.
- A lot of alcohol droplets are formed on the ions produced along the track.
- The tracks are straight because the alpha particles are not easily deflected due to its greater mass

71. Explain how radioisotopes can be used to detect the location of the leakage

- Radioisotope is injected into the pipe
- The water in the pipe flow with the radioisotope
- G-M tube as detector is used to find the leakage across the pipe
- Reading on detector increases when near a leakage

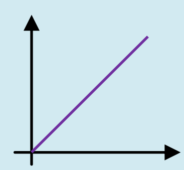
KNOWLEDGE/DEFINATION

Chap.	ITEM	DEFINATION
1	**Derived quantity**	A physical quantity derived from **combinations of base quantities** through multiplication or division or both multiplication and division.
1	**Base quantity**	A physical quantity that **cannot be defined** in terms of other quantities.
1	**Scalar quantity**	A physical quantity that has **magnitude only.**
1	**Vector quantity**	A physical quantity that has **magnitude and direction**.
1	**Physical quantity**	A quantity that can be measured.
1	**Error**	The difference between the measured value and the actual value.
1	**Random error**	Error due to mistakes made when making measurement either through **incorrect positioning** of the eye or the instrument when making measurement. **Repeat and calculate average reading** to minimise.
1	**Systematic error**	An error which may be due to the error in the **calibration of an instrument**.
1	**Zero error**	Error due to non-zero reading when the actual reading should be zero
1	**Sensitivity**	The ability of a measuring instrument to detect a **small change** in the quantity to be measured.
1	**Accuracy**	**How close the measurement** made is to the actual value.
1	**Consistency**	The ability of the instrument to measure a **quantity** with **little** or no **deviation among measurements.**
1	**Hypothesis**	A statement of an expected outcome that usually states the relationship between two or more variables intended to be given a direct experimental test.
1	**Inference**	An initial interpretation or explanation concerning the observation.
1	**Variable**	A physical quantity that can be varied in an experiment. There are three types of variables; manipulated variable, responding variable and fixed variable.
1	**Prefix**	A word, letter or value used to simplify the description of the magnitude of a physical quantity that either very big or very small.
1	**Scientific notation/Standard form**	A way to write a numerical magnitude in the form A x 10", where 1 A < 10 and n is an integer.
2	**Distance**	The **total length** of the path **travelled** from one location to another.
2	**Displacement**	The length of the straight line connecting the two locations, in a **specified direction.**
2	**Speed**	The **distance travelled per unit time**. It is also defined as the rate of change of distance.
2	**Velocity**	The speed in specified direction. The **rate of change of displacement**.
2	**Acceleration**	The **rate of change of velocity**.
2	**Formula**	$\mathbf{v = u + at}$ $\mathbf{v^2 = u^2 + 2as}$ $\mathbf{s = ut + \frac{1}{2}at^2}$ $\mathbf{s = \frac{1}{2}(u+v)t}$ $\mathbf{a = \frac{v-u}{t}}$
2	**Inertia**	The inertia of an object is the **tendency of the object to remain at rest** or, if moving, to continue its **uniform motion** in a straight line.
2	**Newton's First Law of Motion**	An object will remain **at rest** or continue with a **constant speed** in a straight line **unless an external forces** acting on it
2	**Newton's Second Law of Motion**	The **acceleration** of a body is **parallel and directly proportional** to the **net force** and **inversely proportional** to the **mass** *m*, i.e., F = *m*a.

2	**Newton's Third Law of Motion**	The **mutual forces** of **action** and **reaction** between two bodies are **equal, opposite and collinear.**
2	**Momentum**	The momentum of an object is defined as the **product of its mass and its velocity**. **[Momentum=mv]/ms^{-1}**
2	**Principle of Conservation of Momentum**	The **total momentum** if a system remains **constant** in the **absence of external force.**
2	**Elastic collision**	Momentum, kinetic energy and **total energy are conserved**. **[$m_1u_1+m_2u_2=0$]**
2	**Inelastic collision**	**Momentum and total energy are conserved** but the **kinetic energy** after the collision is **less** than the kinetic energy before the collision. **[$m_1u_1+m_2u_2= (m_1+m_2)v$]**
2	**Force**	Constant F: **Acceleration inversely proportional to mass**. Constant m: **Acceleration directly proportional to force**. **[F=ma]/N**
2	**Impulse**	The quantity of impulsive force multiplied by time. **[Impulse=Ft/Ns]//[Impulse=mu-mv]/cms^{-1}**
2	**Impulsive force**	The **rate of change of momentum**. **[(mv-mu)/t]**
2	**Resultant force**	A single force that represents the **combined effect of two or more forces** by taking into account both the magnitude and the direction of the forces.
2	**Mass**	The **amount of matter** in an object.
2	**Weight**	The **force of gravity acting** on an object. **[Weight= mg]/N**
2	**Work**	The **product of an applied force and displacement** of an object in the direction of the applied force. **[Work=Fs]/J**
2	**Power**	**Rate of work done**. **[P=Work done/t]/W//Js^{-1}**
2	**Energy**	The **capacity of a system** to enable it to **do work.**
2	**Kinetic energy**	The **energy** of an object due to its **motion**. **[KE= $\frac{1}{2}$ mv^2] /J**
2	**Gravitational potential energy**	The **energy** of an object due to its **higher position in the gravitational field**. **[GPE= mgh]/J**
2	**Gravitational acceleration**	The acceleration of an object due to the pull of the gravitational force.
2	**Gravitational field**	A region in which an object experiences a force due to the gravitational attraction towards the centre of the Earth.
2	**Gravitational field strength**	The gravitational force acting on a mass of 1 kg placed at a point in the gravitational field.
2	**Free fall**	The motion when an object is acted upon by a gravitational force in the gravitational field.
2	**Elastic potential energy**	The **energy stored** in an object when it is **extended or compressed** by a force. **[EPE= $\frac{1}{2}$ Fx]/J**
2	**Principle of Conservation of energy**	Energy can be transformed to **one form to another** but i **cannot** be **destroyed or created.**
2	**Efficiency**	The percentage of the input energy that is transformed into useful energy. **Efficiency =** $\frac{Useful\ energy(Power)output}{Total\ energy(Power)\ input}$ **x 100%**
2	**Non-renewable energy resource**	An energy resource that cannot be replaced once it has been used.

2	**Renewable energy resource**	An energy resource that is continually replaced and will not run out.
2	**Elasticity**	A property of matter that enables an object to **return to its original size** and **shape** when the **force** that was acting on it is **removed**.
2	**Hooke's law**	The **extension of a spring** is **directly proportional** to the **applied force** provided the elastic limit is not exceeded.
3	**Pressure**	**Force acting per unit area** on the surface. **[Pressure = $\frac{F}{A}$]/Pa//Nm^{-2}**
3	**Pressure in liquid**	**[Pressure = *ρ*hg]/ Pa//Nm^{-2}**
3	**Pascal's principle**	Pressure applied to an enclosed liquid is **transmitted uniformly** to every part of the liquid (and to the walls of the container of the liquid)
3	**Archimedes' principle**	For a body wholly or partially immersed in a fluid, the **upward buoyant force** acting on the body is **equal** to the **weight of the fluid** it **displaces**.
3	**Bernoulli's principle**	Where the **speed** of a fluid is **high**, the **pressure** is **low** and vice versa.
3	**Buoyant force**	An **upward force**, resulting from an object being wholly or partially immersed in a fluid. **[BF = V*ρ*g]/N**
3	**Atmospheric pressure**	The pressure exerted by the atmosphere on the surface of the Earth as well as all objects on the Earth.
4	**Temperature**	The measure of the **degree of hotness** of an object.
4	**Thermometer**	An instrument that measures temperature or the degree of hotness.
4	**Boiling point**	The **temperature** at which a substance changes from a liquid to a gaseous state, where the change occurs throughout the liquid.
4	**Melting point**	The **temperature** at which a substance changes its state from a solid to a liquid.
4	**Thermal equilibrium**	A condition where two objects in thermal contact have **no net flow of heat** energy between each other.
4	**Heat capacity**	The amount of heat that must be supplied to a body to increase its temperature by 1°C. **[J°C^{-1}]**
4	**Specific heat capacity**	The amount of heat that must be supplied to increase the temperature by 1°C for a mass of 1 kg of the substance. **[c = J°C^{-1} kg^{-1}]**
4	**Latent heat**	The heat **absorbed** or the heat **released** at constant temperature during a change of phase.
4	**Specific latent heat of fusion**	The amount of heat required to change 1 kg of a substance from the **solid to liquid** phase without a change in temperature. **[$Q=mL_f$] /J**
4	**Specific latent heat of vaporisation**	The amount of heat required to change 1 kg of a substance from the **liquid to gaseous** phase without a change in temperature. **[$Q=mL_v$] /J**
4	**Boyle's law**	For a fixed mass of gas, the pressure of the **gas is inversely proportional to its volume** when the temperature is kept constant. **[PV=Constant]**
4	**Charles' law**	For a fixed mass of gas, the **volume** of the gas is **directly proportional to its absolute temperature** when its pressure is kept constant. **[$\frac{V}{T}$ = Constant]**
4	**Pressure law**	For a fixed mass of gas, the **pressure** of the gas is **directly proportional to its absolute temperature** when its volume is kept constant. **[$\frac{P}{T}$ = Constant]**
5	**Concave lens**	A lens that is thinnest at its centre. It causes parallel rays of light to diverge after passing through this lens.
5	**Convex lens**	A lens that is thickest at its centre. It causes parallel rays of light to converge after passing through this lens.

5	**Angle of incidence**	The angle between the incident ray and the normal.
5	**Angle of reflection**	The angle between the reflected ray and the normal.
5	**Focal length, *f***	The distance between the centre of a lens to its focal point.
5	**Focal point, F**	A point to which all rays parallel to the principle axis converge or appear to diverge from, after reflection by the mirror(refraction by lens).
5	**Refraction of light**	The bending of a light ray at the boundary as it travels from one medium to another.
5	**Critical angle**	The angle of incidence in the **denser** medium when the angle of refraction in the **less dense** medium is equal to 90°.
5	**Total internal reflection**	The condition where the angle of incidence, i is increased further so that it is **greater than the critical angle**, c. The light is no longer refracted but is internally reflected.
5	**Real depth**	The distance of the real object, 0 from the surface of the water or medium.
5	**Apparent depth**	The distance of the virtual image, I from the surface of the water.
5	**Real image**	An image that can be displayed on a screen.
5	**Virtual image**	An image that can be seen by the observer but not be displayed on a screen.
6	**Period, T**	The time taken to complete one oscillation.
6	**Frequency, *f***	The number of complete oscillations in one second. **[$f = 1/t$]/s^{-1}**
6	**Amplitude, a**	The maximum displacement from the mean position.
6	**Transverse wave**	A wave in which the particles of the medium oscillate in the direction **perpendicular** to the direction in which the wave moves.
6	**Longitudinal wave**	A wave in which the particles of the medium oscillate in the direction **parallel** to the direction in which the wave moves.
6	**Wave**	A way of **transmission of energy** from one point to another **without transfering of matter.**
6	**In Phase**	Waves that vibrate in **same direction and same distance** from the equilibrium position.
6	**Wavefront**	A line of plane which the oscillation of **every points** on it are **in phase** and the points are at **same distance from the source** of the waves.
6	**Wavelength**	The horizontal distance between two adjacent points of the same phase on a wave. **[$v = f\lambda$]/ms^{-1}**
6	**Damping**	When the system **loses energy to the surrounding** in the form of **heat.** **Amplitude decreases.**
6	**Resonance**	When a system is made to **oscillate at a frequency equivalent to its natural frequency** by an external force.
6	**Reflection of waves**	Angle of **reflection** = Angle of **incident** **Same speed, wavelength, frequency** but **direction** of propagation of wave **changes**. **Amplitude decreases** due to **heat lost**.
6	**Refraction of waves**	Refraction of waves occurs when there is **change of direction** of the propagation of waves travelling from a medium to another medium due to a **change of speed**. From shallow region**(denser)** to deep region **(less dense)** ⌗ **Speed increases** ⌗ **Wavelength increases** ⌗ **Wave refracted from normal** ⌗ **Frequency constant**

6	**Diffraction of waves**	**Spreading** of waves after passing through **a gap** or a small obstacle.
6	**Interference of waves**	Caused by **superposition** of waves from 2 coherent sources, resulting in **constructive and destructive interference**. **[** $\lambda = \frac{ax}{D}$ **]**
6	**Principle of Superposition**	When 2 waves interfer, the **resultant displacement** of the waves is the **sum of the displacements** of the individual waves.
6	**Antinode**	A point where a **contructive** interference occurs.
6	**Node**	A point where a **destructive** interference occurs.
6	**Coherent waves**	Waves having the **same frequency, wave length,amplitude and in phase.**
6	**Electromagnetic spectrum**	A group of waves with similar natures. The members of the electromagnetic spectrum arranged in increasing frequencies (decreasing wavelengths) are radio waves, microwaves, infrared rays, visible light, ultraviolet rays, X-rays and gamma rays.
6	**Angle of refraction**	The angle between the refracted ray and the normal.
7	**Electric current**	The **rate of charge flow** in a circuit. **[** $I = \frac{Q}{t}$ **]/A**
7	**Potential difference**	**Energy needed to move 1 electric charge**,C around a **complete circuit. (Between 2 points) [** $V = \frac{E}{Q}$ **]/V**
7	**Resistance**	**Ratio of potential difference to current. [** $R = \frac{V}{I}$ **]/ Ω**
7	**Power**	**The rate of work done.**
7	**Electric field**	A region in which an **electric charge experiences** an **electrostatic force.**
7	**Ohm's Law**	The **current** in a conductor is **proportional** to the **potential differences** across the ends of the conductor if the psysical conditions remain constant. Psysical conditions: ⌑ **Length** ⌑ **Temperature** ⌑ **Cross-sectional area** ⌑ **Types of materials** 
7	**Ohmic Conductor**	**Conductor which obey Ohm's Law**.
7	**Series circuit**	A circuit where all the electrical components are connected **one end after the other** to a cell to form a single pathway for a current to flow.
7	**Parallel circuit**	A circuit where all the electrical components are **connected side by side** and their corresponding ends are joined together to a cell to form separate and parallel paths for a current to flow.
7	**Open Circuit**	**The battery is connected to a voltmeter only. (Test EMF)**
7	**Electrical energy**	The **energy supplied** by source of electricity **when current flows in a close circuit. [E = Pt]/J**
7	**Electric power**	**The rate of transfer of electrical energy.**
7	**Electromotive force**	**Energy needed to move 1 electric charge**,C around a **complete circuit. (Between 2 terminals)**
7	**Internal resistance**	The **resistance against the moving charge** due to the **electrolyte** in the cell.
8	**Magnetic field**	A **region** in which the magnetic materials **experience a force**.
8	**Electromagnet**	A **device** which its **magnetism** is produced **by electric current**.
8	**Right-hand grip rule**	Determine the **magnetic pole** of a current-carrying solenoid/direction of magnetic field.

8	**Fleming's Left hand rule**	Determine the **direction of motion** of current-carrying conductor in a magnetic field.
8	**Fleming's Right hand rule**	Determine the **direction of induced current**.
8	**Direct current motor**	Convert electric energy into mechanical energy.
8	**Electromagnetic induction**	Production of **electromotive force** in a conductor due to a **change in magnetic flux** linking the conductor.
8	**Transformer**	A device which **steps up or steps down** alternating current **voltages.**
8	**Direct current**	A current which flows in **one direction** only.
8	**Alternating current**	A current which **flows to and fro in two opposite directions** in a circuit. It **changes** its **direction periodically**. @ **Used to transfer current as its voltage can be step up or down easily by tansformer**.
8	**Electrical power lost**	**$P = VI = I^2R$**
8	**Faraday's law**	The **magnitude** of the **induced e.m.f**, is **directly proportional** to the **rate of change of the magnetic flux.**
8	**Lenz's law**	The **direction of the induced current** always **oppose** the **change producing it.**
8	**National Grid Network**	A network system of cables which connects all the power stations and substations in the country to the consumers in a closed network to transmit electricity.
9	**Thermionic emission**	The **emission of electrons** from the **surface of a heated metal**.
9	**Cathode rays**	**Beam of fast-moving electrons.**
9	**Semiconductor**	A material which can conduct electricity **better** than **insulator,** but **not** as **well as conductor.**
9	**Doping**	A process of **adding a small amount of specific impurities** called dopants to **semiconductors** to increase their conductivity.
9	**Emitter current**	The current that flows through the emitter terminal of a transistor. It is **equal to the sum of the base current and the collector current.**
9	**Cathode ray oscilloscope**	An instrument that **converts electronic and electrical signals to a visual display.**
9	**Maltese Cross tube**	A special cathode ray tube with a Maltese Cross in it which is used to investigate the properties of cathode rays.
9	**Diode**	A device that allows current to flow in **one direction** only.
9	**Forward biased**	A state when a diode **allows** current to flow.
9	**Reverse biased**	A state when a diode **does not allow** current to flow
9	**Rectification**	A process to **convert** an **alternating** current **into** a **direct current** by using a diode or diodes.
9	**Half-wave rectification**	A process where only **one half** of every cycle of an alternating current is made to flow in one direction only.
9	**Full-wave rectification**	A process where both halves of **every cycle** of an alternating current is made to flow in the same direction using **bridge rectifier**.
9	**Transistor**	An electronic device which has three terminals labelled as **base, collector and emitter.**
9	**Base current**	The current that flows through the base terminal of a transistor.

9	**Collector current**	The current that flows through the collector terminal of a transistor. It will only flow when a suitable base current flows through the circuit.
9	**Capacitor**	A device used for **storing charges** and to **smooth out output current** in a rectifier circuit.
9	**Logic gate**	Switching circuit that is applied in computers and other electronic devices.
10	**Nucleus**	A very small core of an atom which contains most of the mass and all of the positive charge of the atom.
10	**Proton number**	The **total number of protons** in a nucleus.
10	**Nucleon**	A subatomic particle found in the nucleus.
10	**Nucleon number**	The **total number of protons and neutrons** in a nucleus.
10	**Isotopes**	Atoms of an element which have the **same proton number** but **different nucleon numbers.**
10	**Radioisotope**	**Unstable** isotopes which **decay** and give out **radioactive emissions**.
10	**Radioactivity**	The **spontaneous disintegration** of an **unstable** nucleus accompanied by the **emission of energetic particles** or photons.
10	**Alpha particle**	Helium nucleus emitted by an unstable nucleus.
10	**Beta particle**	High energy electron emitted by an unstable nucleus.
10	**Gamma rays**	Electromagnetic waves with very high frequency and short wavelength.
10	**Alpha decay**	A radioactive decay which emits an alpha particle. **[** $^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$ **]**
10	**Beta decay**	A radioactive decay which emits a beta particle. **[** $^{A}_{Z}X \rightarrow {}_{Z+1}^{A}Y + {}_{-1}^{0}e$ **]**
10	**Gamma decay**	A radioactive decay which emits a gamma ray photon. **[** $^{A}_{Z}X \rightarrow {}^{A}_{Z}X + \gamma$ **]**
10	**Half-life**	The time taken for the number of undecayed nuclei to be reduced to half of its original number.ie. mass, number of nuclei and activity.
10	**Nuclear energy**	Energy released by a nuclear reaction as a result of a mass defect. **[E = mc^2]**
10	**Nuclear fission**	The **splitting** of a **heavy** nucleus **into** two or more **lighter** nuclei.
10	**Nuclear fusion**	The **combining** of two or more **lighter** nuclei **to** form a **heavier** nucleus.
10	**Chain reaction**	A **self-sustaining reaction** in which the products of a reaction can **initiate** another similar reaction.
10	**Somatic effect**	The effect of radiation that appears in a person exposed to radiation.
10	**Genetic effect**	The effect of radiation that appears in the future generations of the exposed person as a result of radiation damage to reproductive cells.

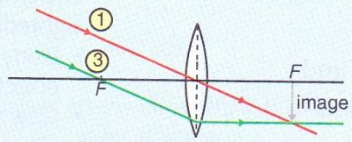
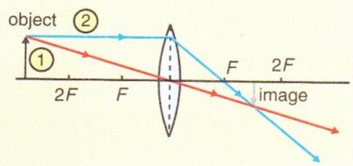
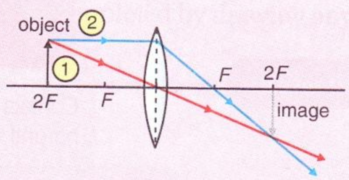
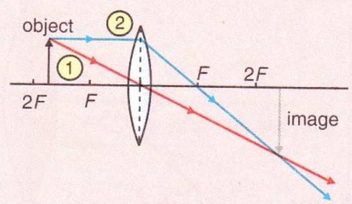
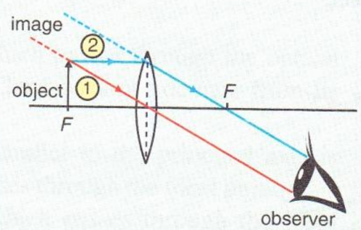
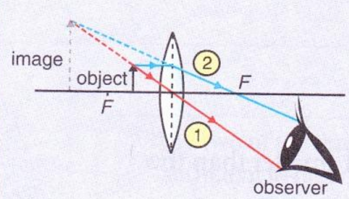
Base Quantity	S.I. Unit
1. Length	m
2. Mass	kg
3. Time	s
4. Current	A
5. Temperature	K

2. Differences between the compound microscope and the telescope

Aspect	Compound microscope	Telescope
Type of lens	Two high powered convex lenses	A low powered convex lens and a high powered convex lens
Focal length	$f_e > f_o$	$f_o > f_e$
Power of lenses	Objective lens > Eyepiece	Eyepiece > Objective lens
First image	Magnified	Diminished
Position of final image	At near point to the observer's eye	At infinity
Distance between lenses	Greater than $f_o + f_e$	Equal to $f_o + f_e$ (at normal adjustment)
Linear magnification, m	$m = \dfrac{\text{image height, I}}{\text{object height, I}_0}$	$m = \dfrac{f_o}{f_e}$

Images Formed by Convex Lenses

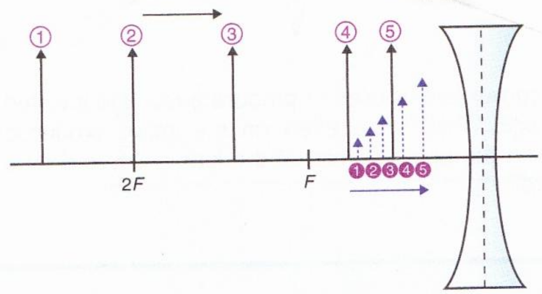
SPM '04/P1 SPM '05/P2(C) SPM '07/P1

Object distance	*Ray diagram*	*Position of image*	*Characteristics of image*
(a) Distant object ⇒ u = infinity		Image distance: $v = f$	• Real • Inverted • Diminished in size • On the opposite side of the object
(b) Object distance is more than $2f$ ⇒ $u > 2f$		Image distance: $f < v < 2f$	• Real • Inverted • Diminished in size • On the opposite side of the object
(c) Object distance is equal to $2f$ ⇒ $u = 2f$		Image distance: $u = 2f$	• Real • Inverted • Same size as the object • On the opposite side of the object
(d) Object distance is between f and $2f$ ⇒ $f < u < 2f$		Image distance: $v > 2f$	• Real • Inverted • Magnified • On the opposite side of the object
(e) Object distance is equal to f ⇒ $u = f$		Image is at infinity v = infinity	• Virtual • Upright • Magnified • On the same side as the object
(f) Object distance is less than f ⇒ $u < f$		Object distance: $v > u$	• Virtual • Upright • Magnified • On the same side as the object

Application	
• Objective lens of a telescope	
• Lens of a camera • Lens of the human eye	
• Photocopying machine	
• Projector lens • Objective lens of a microscope	
• Eyepiece of an astronomical telescope	
• Magnifying lens • Spectacle lens to correct hypermetropia (long-sightedness) • Eyepiece of microscope	

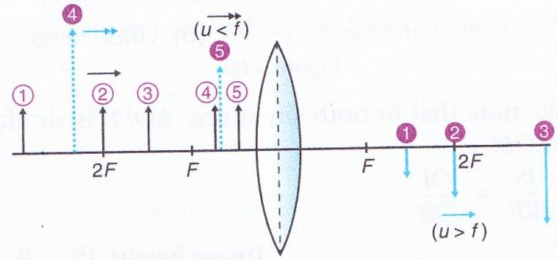
Recap!

Concave lens (can form virtual images only)



As the object is gradually moved nearer to the concave lens from infinity, the image also moves nearer to the lens from F. At the same time, the image become larger (but is still smaller than the object).

Convex lens (can form real or virtual images)



1. As the object is gradually moved nearer to the convex lens from infinity to F, the **inverted real image** moves away from the lens (starting from F). At the same time, the image becomes larger.
2. When $u = v = 2f$, the image is of the same size as the object.
3. As the object is gradually moved nearer to the lens from F, the **upright virtual image** also moves nearer to the lens. At the same time, the image becomes smaller (but is still larger than the object).

Keys:

① ... ⑤ positions of object

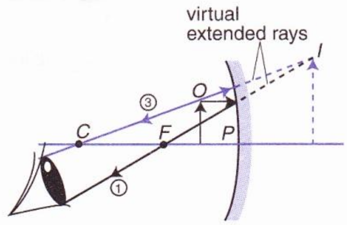
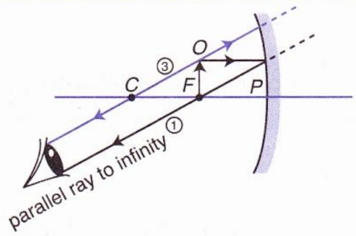
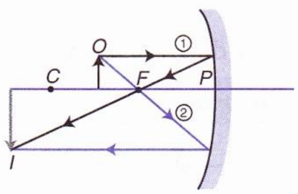
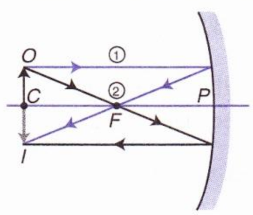
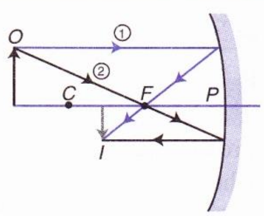
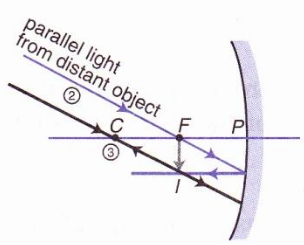
❶ ... ❺ positions of corresponding images

General Information

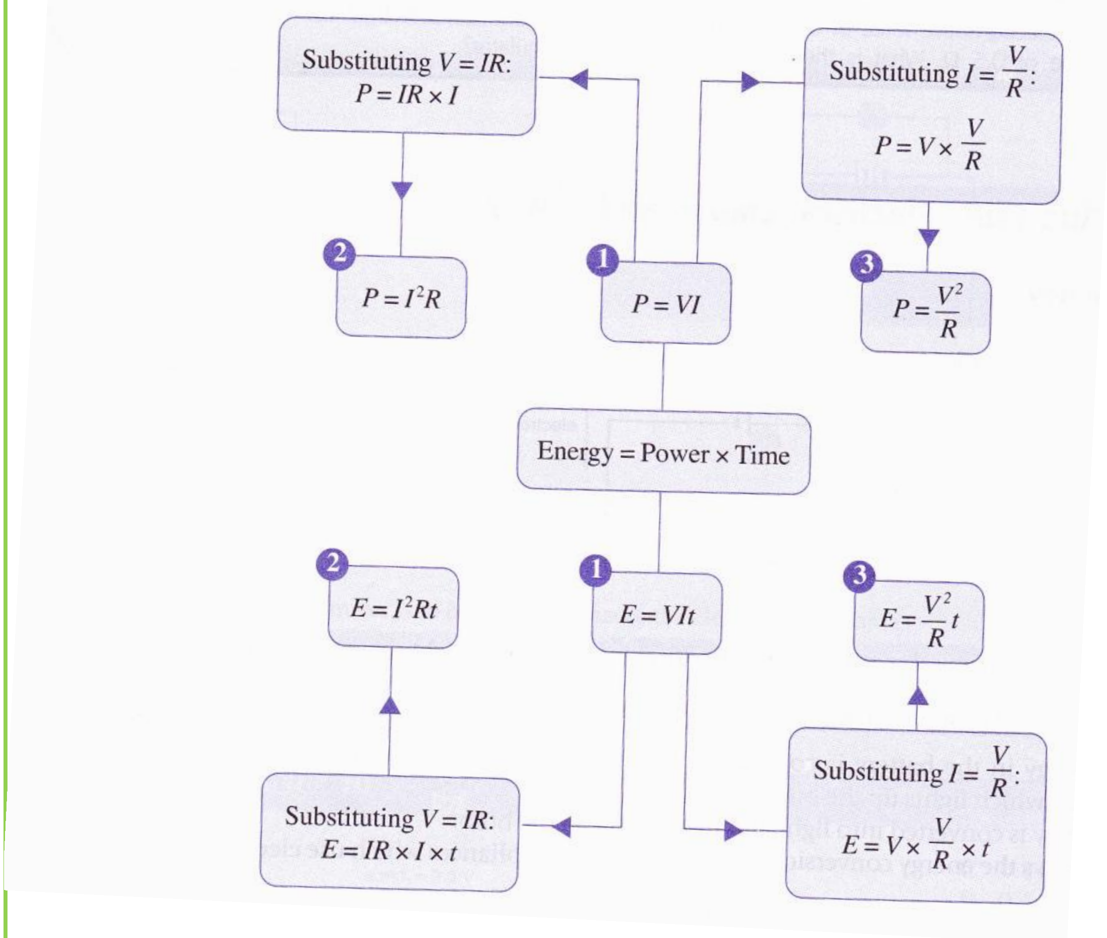
1. The image formed on the **opposite side** of the lens as the object is **real** and **inverted**.
2. The image formed on the **same side** of the lens as the object is **virtual** and **upright**.

Images Formed by a Concave Mirror

SPM '05/P1 SPM '07/P1

	Position of the object	Ray diagram	Position and characteristics of the image
A (SPM '08/P2(A))	Object, O is between F and P ($u < f$)		Image, I is behind the mirror • virtual • upright • magnified Application: make-up mirror
B	Object, O is at F ($u = f$)		Image, I is at infinity • virtual • upright • magnified Application: reflector in torchlight
C	Object, O is between F and C ($f < u < 2f$)		Image, I is beyond point C • real • inverted • magnified
D	Object, O is at C ($u = 2f$)		Image, I is at C ($v = 2f$) • real • inverted • same size as the object Application: reflector in projector
E	Object, O is beyond C ($u > 2f$)		Image, I is between C and F • real • inverted • diminished in size
F	Object at infinity ($u > 2f$)		Image, I is at F ($v = f$) • real • inverted • diminished in size Application: reflecting telescope

Summary:



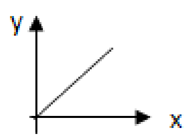
$v = u + at$ | **$v^2 = u^2 + 2as$** | **$s = ut + \frac{1}{2}at^2$**

$s = \frac{1}{2}(u+v)t$ | **$a = \frac{v-u}{t}$**

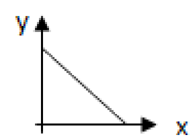
PAPER 3

Precautions:

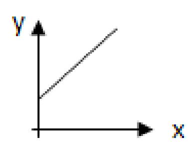
1. The position of eye must be pependicular to the scale reading to aviod error due to parallax error(N/A if instrument is digital stopwatch)
2. Repeat the experiment twice, then calculate the everage to get accurate reading.
3. Check the voltmeter for zero error and make zero adjustment
4. Make sure elastic strings are stretched at constant length.(Force and acceleration)
5. Stir the water gently with the heater to ensure that heat is distributed uniformly to all part of the water.(Heat)
6. Make sure the insulating jacket is covered all part of the beaker to prevent heat loss.(Heat)
7. Assume no heat loss to the surrounding. (Heat)
8. Make sure the experiment is conducted in a dark room.(Light)
9. The wires and electrical components should be connected tightly to avoid current loss.(Electric)
10. The circuit should be switched off when not taking readings to avoid overheating.(Electric)
11. Use small value of current to avoid the wire from getting too hot easily.(Electric)



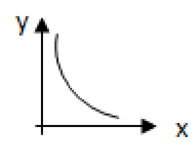
y is directly propotional to x



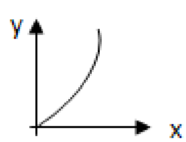
y decrease linearly to x



y increase linearly to x



y is inversely propotional to x



As y increase x also increase