READING MODULE FOR SPM 2013

SMK MERBAU MIRI SARAWAK

PART 1: MASTERING THE DEFINITION

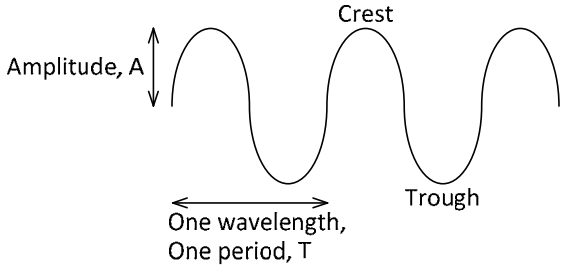
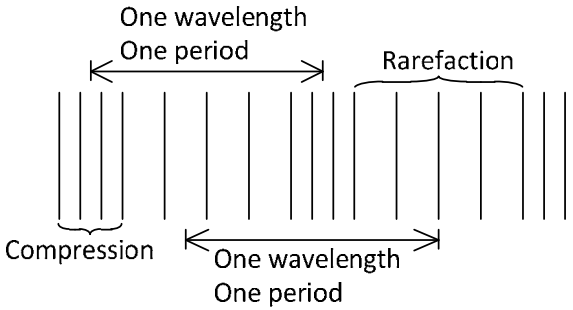
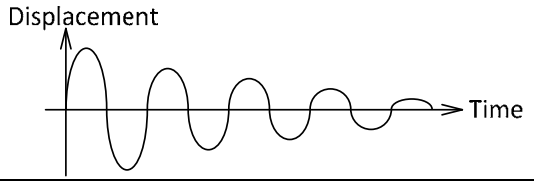
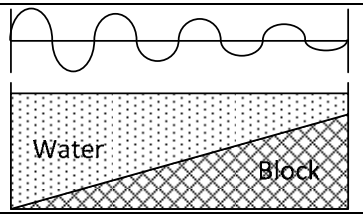
PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
FORM 4 CHAPTER 1 INTRODUCTION TO PHYSICS		
Physical quantity	Is a quantity that can be measured.	
Base quantity	Is a quantity that cannot be defined in other terms of physical quantities.	
Derived quantity	Is a quantity that can be defined in other terms of physical quantities by either multiplication or division or both.	
Scalar quantity	Is a quantity with magnitude only.	Example: distance, speed, time, mass, temperature…
Vector quantity	Is a quantity with both magnitude and direction.	Example: displacement, velocity, acceleration, force…
FORM 4 CHAPTER 2 FORCES AND MOTION		
Distance	Is the total length between two points.	Measure the actual length.
Displacement	Is the total length between two points at certain direction.	Measure the short-cut length
Speed	Is the rate of change of distance.	**Speed** = $\frac{\text{Distance}}{\text{Time taken}}$ Unit of speed is ms^{-1}.
Velocity	Is the rate of change of displacement.	**Velocity, *v*** = $\frac{\text{Displacement}}{\text{Time taken}}$ Unit of velocity is ms^{-1}.
Acceleration	Is the rate of change of velocity.	**Acceleration, *a*** = $\frac{\text{Change of velocity}}{\text{Time taken}}$ Unit of acceleration is ms^{-2}. And $a = \frac{v - u}{T}$
Inertia	Is the tendency of object to resist the sudden change acting on the system OR Is the tendency of object to remain at rest if rest or continue to move with uniform velocity in straight line if moving unless external force acting on it.	No formula as it is not a physical quantity that can be measured. BUT inertia depends on the mass. Bigger mass has bigger inertia.
Momentum	Is the product of mass and velocity.	**Momentum, *p* = *mv*** *m* = mass, *v* = velocity Unit of momentum is $kgms^{-1}$
Principle of conservation of momentum	States that in closed system, total momentum before collision is equal to the total momentum after the collision such that the total momentum is conserved.	**Elastic: $m_1u_1 + m_2u_2 = m_1v_1 + m_1v_2$** **Inelastic: $m_1u_1 + m_2u_2 = (m_1 + m_1)v$** **Explosion: $0 = m_1v_1 + m_1v_2$**
Impulse	Is the change of momentum.	Impulse = *Ft* *F* = force, *t* = time **Impulse = *mv* – *mu*** Unit of impulse is $kgms^{-1}$

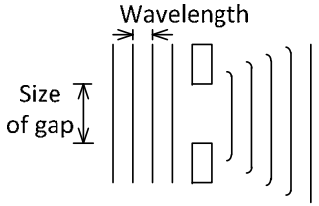
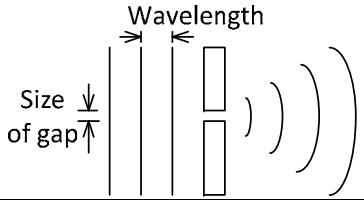
PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Impulsive force	Is the rate of change of momentum.	**Impulsive force, $F = \frac{mv - mu}{t}$** Unit of impulsive force is $kgms^{-2}$ Shorter impact time, bigger impulsive force.
Force	Is the product of mass and acceleration.	**Force, $F = ma$** m = mass a = acceleration Unit of force is $kgms^{-2}$ or Newton or N
Newton's first law of motion	States that a body continues in state of rest or uniform velocity in straight line unless acted upon by an external force.	Always referred to inertia condition!!
Newton's second law of motion	States that the rate of change of momentum of moving object is directly proportional to and in the same direction as the force acting on it.	Always referred to collision systems!!
Newton's third law of motion	States that if one body exerts a force on another, there is an equal but opposite force called reaction exerted on the first body by the second.	Always referred to action and reaction!! (I hit ball – action) (The ball causes my hand pain – reaction)
Energy	Is the ability of doing work.	
Work done	Is the product of force and displacement which is parallel to the displacement of the object.	**Work done, $W = F s$ [no angle]** **Work done, $W = F s \cos \theta$ [if angle]** F = force s = displacement Unit of work done is Joule or J
Potential energy	Is the energy possessed by the object due to its position or location.	**Potential energy, $E_p = mgh$** m = mass g = gravity value = 10 ms^{-2} h = height Unit of potential energy is Joule
Kinetic energy	Is the energy possessed by the object due to its condition of movement.	**Kinetic energy, $E_k = \frac{1}{2} mv^2$** m = mass v = velocity Unit of kinetic energy is Joule
Principle of conservation of energy	States that in a closed system, the energy cannot be created or destroyed but it can be changed from one form to another form that is the total energy is being conserved.	

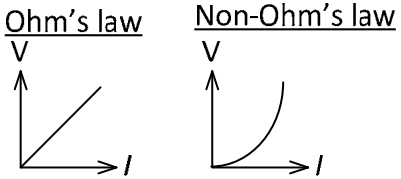
PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Power	Is the rate of work done.	**Power, *P* =** $\frac{WorkDone}{Time}$ OR **Power, *P* =** $\frac{Energy}{Time}$ Unit of power is Watt or W
Efficiency	Is the ratio of output work done to the input energy supplied by the system.	Efficiency, e = $\frac{OutputWork}{InputEnergy}$ x 100%
Hooke's law	States that the extension of spring is directly proportional to the force acting on it such that the elastic limit is not exceeded.	**Force, *F = kx*** *k* = force constant *x* = extension of spring F is to the weight of object where weight = mass x 10
Elasticity	Is the ability of an object to resume to its original state once the applied force is removed.	
Spring constant	Is the force per unit length of extension.	***k = F/x*** Unit of spring constant is Nm^{-1}
FORM 4 CHAPTER 3 FORCES AND PRESSURE		
Pressure	Is the force acting normally to the surface per unit area.	**Pressure, *p = F/A* [if solid]** *F* = force *A* = area Unit of pressure is Nm^{-2} or Pascal or Pa OR **Pressure, *p = hρg* [if liquid]** *h* = depth *ρ* = density of liquid g = gravity value = $10ms^{-2}$ Unit of pressure is Nm^{-2} or Pascal or Pa OR **Pressure, *p* = 76 cmHg + unbalance [mercury]**
Atmospheric pressure	Is the pressure exerted by the atmosphere on the surface of the earth.	

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Pascal's principle	States that in enclosed system, the applied pressure will be transmitted equally to every part of the fluid and also to the wall of the container.	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$ **And $A_1d_1 = A_2d_2$** A = area d = distance moved
Achimedes' principle	States that when an object is immersed partially or wholly into a fluid, the weight of water being displaced due buoyant force is equal to the weight of object being immersed.	**Buoyant force, F = ρVg** ρ = density of liquid V = Immersed volume of the object g = gravity value = 10 ms^{-2} Unit of buoyant force is Newton or N
Bernoulli's principle	States that a region where experiences high air speed will has low air pressure and vice versa.	High speed → low pressure Low speed → high pressure
FORM 4 CHAPTER 4 HEAT		
Thermal equilibrium	Is a condition where two objects in contact have the same temperature and there is no net transfer of heat between two objects.	
Heat	Is a form of energy.	
Temperature	Is the degree of hotness of an object.	
Specific heat capacity	Is the amount of heat required to increase the temperature of 1 kg object by 1 °C without change in physical state.	**Heat, $H = mc\theta$** m=mass, c= specific heat capacity, θ=rise in temperature Unit of heat is Joule or J Low specific heat capacity → faster getting hot High specific heat capacity → slower getting hot Water is a good cooling agent as it has high specific heat capacity
Melting point	Is the maximum temperature point that can be sustained by the object before the object starts to melt.	High melting point → can withstand high temperature before it gets melt
Boiling point	Is the maximum temperature point that can be sustained by the object before the object starts to boil.	
Specific latent heat of fusion	Is the amount of heat required to change the 1 kg object physically from solid to liquid without the change in temperature.	**Heat, $H = mL_f$** m = mass L_f = specific latent heat of fusion Unit of heat is Joule or J
Specific latent heat of vapourisation	Is the amount of heat required to change the 1 kg object physically from liquid to steam without the change in temperature.	**Heat, $H = mL_v$** m = mass L_v = specific latent heat of vapourisation Unit of heat is Joule or J

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Boyle's law	States that for a fixed mass of gas, the pressure of gas is inversely proportional to its volume such that the temperature of gas is kept constant.	$P_1V_1 = P_2V_2$ P = pressure, V = volume
Charles' law	States that for a fixed mass of gas, the volume of gas is directly proportional to its absolute temperature such that the pressure of gas is kept constant.	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ V = volume, T = temperature must be in unit Kelvin T = (θ + 273) K
Pressure law	States that for a fixed mass of gas, the pressure of gas is directly proportional to its absolute temperature such that the volume of gas is kept constant.	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ P = pressure, T = temperature must be in unit Kelvin T = (θ + 273) K
FORM 4 CHAPTER 5 LIGHT		
Snell's law	States that the angle of incidence, angle of reflection and the normal to the surface all lie in the same plane such that the angle of incidence is equal to the angle of reflection.	
Mirror	Is an object with only one side of focus/view where it will reflect the incident ray.	
Lens	Is an object with two sides of focus/view where it allows the refraction of light.	
Refractive index	Is the ratio of sine of incidence angle to the sine of refracted angle.	**Refractive index, n =** $\frac{\sin i}{\sin r}$ ***i° must be in air and r° in medium***
Apparent depth	Is the distance of the virtual image from the surface of the water.	
Real depth	Is the distance of the real object from the surface of the water.	**Refractive index, n =** $\frac{\text{Real Depth}}{\text{Apparent Depth}}$
Critical angle	Is defined as the angle of incidence in the denser medium when the angle of refraction in the less dense medium is 90°.	**Refractive index, n =** $\frac{1}{\sin c}$ **c = critical angle**
Total internal reflection	States that when the angle of incidence is further increase so that it is greater than the critical angle, then the light is no longer refracted but it is reflected internally.	Example: mirage, optical fibre
Focal point	Is a point where all the rays will focus at.	
Focal length, f	Is the distance between the centre of the lens with the principle F.	
Power of lens	Is the reciprocal of the focal length of a lens.	**Power of lens, P = 1/f** f = focal length (must convert to unit metre) Unit of power of lens is Dioptre or D
		Formula of lens: $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ u = object distance, v = image distance, f = focal length Image magnification, $m = v/u$

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
FORM 5 CHAPTER 1 WAVES		
Wave	Is the vibration or oscillation of particle which transfers energy without transferring matter and these vibrations are repeated periodically.	
Transverse wave	Is a wave where the direction of vibrations of particles is perpendicular to the propagation of wave #produce crests and troughs	Any types of waves except sound wave!! For example: electromagnetic wave, light, water wave 
Longitudinal wave	Is a wave where the direction of vibrations of particles is parallel to the propagation of wave #Produce a series of compressions and rarefactions	Sound wave only 
Damped oscillations	Is an oscillation where its amplitude decreases with time but the frequency remains constant and this vibration will come to a stop.	
Resonance	Is the vibration where is forced frequency is equal to the natural frequency of the object.	Example: Bridge falls by wind blow
Loudness of sound	A sound where it depends on its amplitude	
Pitch of sound	A sound where it depends on its frequency	
Phenomenon of wave	Refraction, diffraction, reflection and interference	
Refraction	Refraction → passes through/see through the medium → frequency constant → decrease in speed, wavelength(deep to shallow or less dense to denser)	

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Diffraction	Diffraction → passes through the gap or hole → frequency, wavelength and speed constant → change in shape **only** depends on size of gap	Wavelength is smaller than size of gap → diffraction effect is less obvious → stronger energy of wave entering the gap  Wavelength is bigger than size of gap → diffraction effect is more obvious → lesser energy of wave entering the gap 
Reflection	Diffraction → go and rebounded by shinny surface or reflector → frequency, wavelength and speed constant → change in direction of moving **only**	
Interference	Interference → resultant of all waves	Antinode → A line joining all the constructive points Node → A line joining all the destructive points **Wavelength, λ =** $\frac{ax}{D}$ a = size of gap/distance between source x = distance between two adjacent bright fringe OR distance between two adjacent dark fringe D = distance between the screen with gaps
Monochromatic light	Is one wavelength or one colour of light	
Coherent	Same frequency and same phase	
Electromagnetic spectrum	Is the continuous spread of light ray into seven colours with different wavelengths and frequencies. #Gamma, X-ray, ultraviolet, visible light, infrared, microwave, radiowave	Gamma ray (high frequency, low wavelength) dangerous and kills cancer cells X-ray (Scanning), ultraviolet(detect forge note), infrared(short distance linking), microwave(heating and satellite), radiowave(aerial/signal receiver)

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
FORM 5 CHAPTER 2 ELECTRICITY		
Charge	Is the total amount of electrons flow	**Charge, Q = ne** n=number of electrons, e = 1.67×10^{-19} C **Charge, Q = It** I = current, t = time in seconds Unit for charge is coulomb or C
Current	Is the rate of electron flow	***I* = Q/t** Unit for current is ampere or A ## Low current if high resistance!!
Resistance	Is the opposition of current flow. Note: Resistance, R = $\rho L/A$ Higher resistance → higher resistivity, longer wire length but thinner wire Copper → good conductor of electricity Aluminium → good as electric cable as cheap and low rusting rate Tungsten → good as filament bulb as it can ionize easily to give out ray Copper → very high resistance and thus it is good as heating element	Higher resistance → produce more heat → more voltage → lower current Unit for resistance is ohm or Ω
Voltage **Potential difference**	Is the work done when **one coulomb** of charge passes from one point to another point	**Voltage, V = IR** ##More voltage if high resistance!! ##High voltage does not mean high current!! ##High voltage can say high resistance!!
Ohm's law	States that the potential difference across an ohmic conductor is directly proportional to its current flow such that the temperature and other physical quantity are kept constant!	**Ohm's law means V = IR** ##Any types of wires obey Ohm's law ##Bulb and heating materials does not obey ohm's law 
Electrical energy	Total work done to move one coulomb of charge in one second	**Electrical energy, E = VIt** t in second In unit Joule or J
Electric power	Is the rate of electric energy	**Power, P = IV = V^2/R = I^2R** In unit Watt or W

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
'240 V, 300W'	Means the device is supplied with potential difference of 240 V and releases the power at 300 Joules in one second	'240 V, 300W' → V = 240 → P = 300 From P = IV 300 = I(240) I = 1.25 A
Fuse	Is an electric component installed in electric socket to surge the power down once the current is overloaded by burning the fuse itself	**Fuse → must can get hot easily** **→ can be burnt easily** **→ low melting point** **→ high resistance and produces heat fast**
FORM 5 CHAPTER 3 ELECTROMAGNETISM		
Electromagnet	Is the flow of electric around the coil of wire which produce magnet	
Right hand grip rule	State that for a current-carrying conductor, the thumb will point to the direction of current flow whereas the rest of finger will point to the magnetic direction	
Fleming's left hand rule	State that when the thumb, forefinger and middle finger are extended at the right angle to each others for system which carries current, then the thumb will show the magnetic force, the forefinger will point to the direction of magnetic field and the middle finger will point to the current direction.	For <u>electric motor which carries current</u> **Thumb → direction of force** **Forefinger → direction of magnet (from north to south)** **Middle finger → current direction**
Fleming's right hand rule	State that when the thumb, forefinger and middle finger are extended at the right angle to each others for system generating current, then the thumb will show the magnetic force, the forefinger will point to the direction of magnetic field and the middle finger will point to the current direction.	For <u>electric dynamo which generate electric current</u> Thumb → direction of force Forefinger → direction of magnet (from north to south) Middle finger → current direction
Lenz' s law	States that the direction of induced current is always opposing to the direction which produces the current.	→determine the direction of induced current →determine the magnetic pole (north or south)
Faraday's law	States that the magnitude of induced current is always directly proportional to the rate of magnetic flux being cut by moving magnet in solenoid	→determine the magnitude of induced current
Induced current	Is the produce of current by movement of magnet bar in solenoid and there is no physical contact between them	
FORM 5 CHAPTER 4 ELECTRONICS		
Thermionic emission	Is the process of releasing electrons from the heated cathode	More electrons can be released if → cathode is heated at high temperature → more surface area is exposed to heat → type of material which can produce more electrons
Cathode ray oscilloscope	Is a device used to display waveform, measure short time intervals or to measure the potential difference	

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Rectification	Is the process of changing alternating current to direct current	Use diode
Semiconductor	Is a material which has the conductivity between the conductor and insulator and its conductivity can be improved by increasing its temperature.	p-type semiconductor → silicon doped with trivalent →majority charge carrier of hole n-type semiconductor → silicon doped with pentavalent →majority charge carrier which is called electron
Logic gate	Is gate which has one or more than one inputs but with only one output and logic gates are referred to switch	
FORM 5 CHAPTER 5 RADIOACTIVITY		
Radioisotopes	Is unstable substance which has same proton number but different nucleon number	
Radioactivity	Is the spontaneous and random disintegration of unstable substance to become stable nucleus by emitting radiations and huge energy	
Spontaneous	Means happen automatically by itself without triggered by any external source like temperature or pressure	
Random	Means there is no way to tell which radioisotope will undergo the decay process and when it will happen	
Half-life	Is the time taken for half of the radioactive substance to disintegrate or decay	
What is alpha	Alpha is helium particle	→Range 0 – few cm (can be stopped by paper) →high ionizing power (can change the structure of …) →positive heavy charge with small deflection toward negative plate →deflect up from the magnetic field →low penetrating power →moves straight in
What is beta	Beta is a fast moving electron beam	→Range 0 – few m (can be stopped by aluminium foil) →medium ionizing power and penetrating power →negative light charge with big deflection toward positive plate →deflect down from the magnetic field
What is gamma	Gamma is an energetic electromagnetic ray	→Range 0 –few hundred m (can be stopped only by lead) →low ionizing power →very high penetrating power (kill the….) →no charge and no deflection neither in electric field nor magnetic field

PHYSICS TERM	DEFINITION	EXAMPLE/QUESTION
Nuclear fusion	is the combining of two lighter nuclei to form a heavier nucleus, releasing a vast amount of energy during the process	
Nuclear fission	is the splitting of a heavy nucleus into two lighter nuclei after the nucleus of an atom is bombarded with a neutron with the release of a large amount of energy during the process.	${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{91}_{36}Kr + {}^{142}_{56}Ba + 3{}^{1}_{0}n + Energy$
Chain reaction	is a self-sustaining reaction in which the products of a reaction can initiate another similar reaction. For instance, as uranium atoms continue to split, a significant amount of energy is released during each reaction. The heat released is harnessed and used to generate electrical energy.	The process is expanding and non-stop as the number of neutrons keeps on multiplying with time

PART 2: MASTERING THE PROBLEM SOLVING [EXPLAINING THE PROCESS]

1 **Diagram 1 shows the phenomenon of sea breeze.**

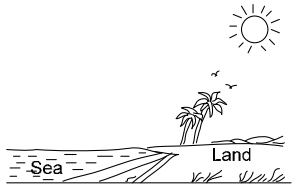


Diagram 1

Using the concept of specific heat capacity, explain how the phenomenon of sea breeze occurs.

Answer

Sea breeze	*Land breeze [Extra note]*
1st: Sea breeze happens during daytime. *2nd: The land has lower specific heat capacity than the sea.* *3rd: The land is faster getting hot than the sea when exposed to sunlight.* *4th: The air molecules at land are faster heated up.* *5th: The hot air molecules at land will rise up and replaced with cool air from the sea.* *6th: Movement of cool air molecules from the sea to the land is called the sea breeze.*	*1st: Land breeze happens during nighttime.* *2nd: The land has lower specific heat capacity than the sea.* *3rd: The sea is slower getting cold than the sea at nightime.* *4th: The air molecules at sea are slower being cooled down.* *5th: The hot air molecules at sea will rise up and replaced with cool air from the land.* *6th: Movement of cool air molecules from the land to the sea is called the land breeze.*

2 Diagram 2 shows a relay used in an electrical circuit.

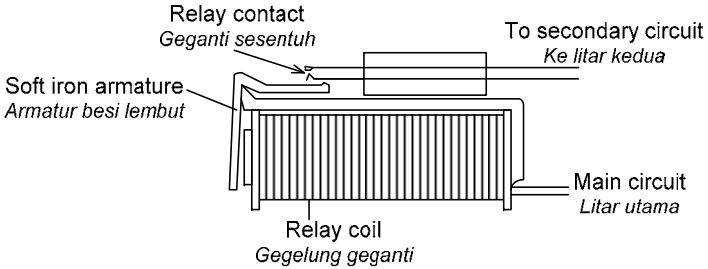


Diagram 2

Explain the working principle of relay switch.

Answer

1st: The working principle of relay switch is based on the electromagnet concept.
2nd: The relay switch has the soft iron core inside with the coil of wire.
3rd: When a small current flows into the relay switch, the system is magnetized and produces magnetic force.
4th: The magnetic force will pull the switch and complete the circuit.
5th: When the current to the relay switch is cut-off, the system is demagnetized and the switch is released.

3 Explain the arrangement of the paper thickness detector apparatus and state how radioactivity is used to detect the thickness of the paper.
Explain the process of detection of paper thickness in factory with use of one named radioisotope.

Answer

1st: Beta is used for paper detection as it has medium penetrating power and its penetration power varies with the thickness of paper.
2nd: Beta is located underneath the paper. The ratemeter(Geiger-Muller tube) which is connected to the signal generator is located above the paper.
3rd: The detector is moved along the paper to detect the amount of radioisotopes which has penetrated through the paper.
4th: The region where shows high reading indicates that the paper is very thin as most of the beta can penetrate through it. So, the compressor will be triggered to stop compressing the paper.
5th: The region where shows low reading will indicate that the paper is very thick as most of the beta cannot penetrate through it. So, the compressor will be triggered to compress the paper

4 **Diagram 4 shows a Bunsen burner.**

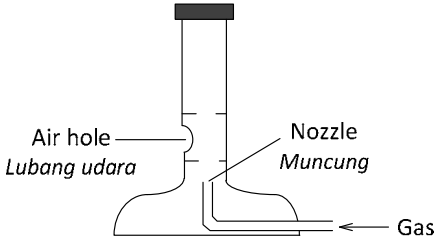


Diagram 4

Explain how the Bunsen burner can produce a small blue flame or big yellow-reddish flame.

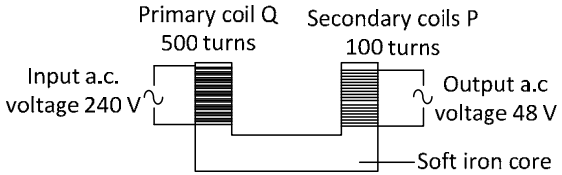
Answer

Small blue flame	*Big yellow-reddish flame*
-When the air hole is opened, there is a high air speed flow between the inner of Bunsen burner with the surrounding air. *-According to Bernoulli's principle, high air speed will result in low pressure inside the Bunsen burner.* *-This low air pressure cannot push up the flame high and causes a small flame* *-The flame is blue because there is a complete combustion as the air hole is opened*	*-When the air hole is closed, there is no air speed flow between the inner of Bunsen burner with the surrounding air.* *-According to Bernoulli's principle, low air speed will result in high pressure inside the Bunsen burner.* *-This high air pressure can push up the flame high and result in big flame* *-The flame is yellow-reddish because the combustion is not complete as the air hole is closed.*

5 **You are given two coils, *P* and Q, with 100 turns and 500 turns respectively, a solid core and a 240 V a.c. power supply. Using all the materials supplied and with the aid of labeled diagram, shows how you can build a simple step-down transformer**.

Answer

A simple step-down transformer can be constructed using a soft U-shape iron core with number of input coils is more than the output core which is using an a.c. input voltage as shown below:



Remember: Transformer **must** use input a.c voltage

6 Explain how you would go to escape from being chased by a bull based on one concept.

Answer

1st: I will perform my run in zig-zag directions with no definite direction of run.
2nd: The bull has bigger mass if compared to me.
3rd: This means that the bull will has bigger inertia as the inertia depends on the mass.
4th: Due to inertia, the bull is harder to change its direction and will lose control and fall

7 Diagram 7.1 and 7.2 show two identical block *A* and block *B* hanging by string *X* and string *Z*. In Diagram 7.1, the string *W* is given by an increasing gradually of pulling force. In Diagram 7.2, the string *Y* is given by a sharp pull and fast.

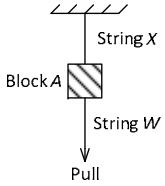


Diagram 7.1: Pulled gently

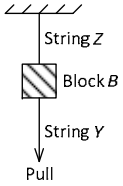


Diagram 7.2: Pulled very fast

(a) In Diagram 7.1, explain what will happen if the string *W* is given by an increasing gradually of pulling force.

Answer

If the string W is given by an increasing gradually of pulling force, the string X will crack.
Reason:
The pulling force will be transferred from string W to the string X.
String X has to support the pulling force and also has to support the weight of block A at the same time. So, string X will crack.

(b) In Diagram 7.2, explain what will happen if the string W is given by a sharp pull and fast.

Answer

If the string W is given by a sharp pull and fast, the string Y itself will crack.
Reason:
If the string Y is given by a sharp pull and fast, the string Y will possess an inertia which will tend to resist the sudden pull exerting onto it. As a result, string Y will crack.

8 Diagram 8.1 and Diagram 8.2 shows an experiment to study the relationship between the pressure and volume of air trapped in an air-tight container. The pistons for both diagrams are pushed down slowly.

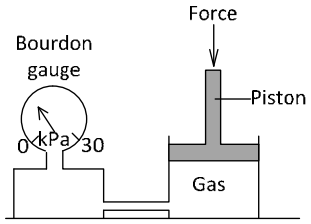


Diagram 8.1

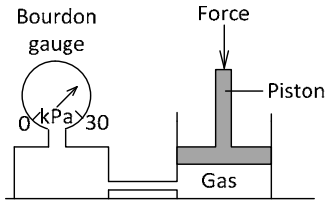


Diagram 8.2

The experiment above is usually applicable if a gas expands or compressed slowly. Why is this so?

Answer

1st: The Boyle's law is applicable if the temperature of the gas is constant.
2nd: The gas must be expanded or compressed slowly as to reduce the collision between the molecules of gas.
3rd: The collision of molecules increase the friction of molecules between them and this friction will produce heat.
4th: If the heat produced, then the temperature of the gas is not constant already.

9 Large generators are used to generate the electricity that will be used in the country. Electricity is distributed throughout the country by the National Grid Network. State four advantages in the use of the National Grid Network to distribute electricity to the consumers.

Answer

1st: reduces power loss during transmission
2nd: the supply of electricity is more stable and reliable
3rd: electricity can be distributed to different users according to the voltage requirement
4th: maintenance and repair work of power stations, cable and pylons can be done at anytime

10 **Explain why a spring is elastic**?

Answer

1st: Under normal circumstances, the spring has its attractive and repulsive forces between neighbouring atoms which are balancing one another.
2nd: When the spring is stretched, the attractive forces between neighbouring atoms act to against the force that tries to separate them.
3rd: When the spring is compressed, the repulsive forces between neighbouring atoms act to resist the force that tries to bring them together.
4th: It is the combined action of the attractive and repulsive forces that enable the spring to resume to its original shape and size when the external force that acts on it is removed.

11 A small amount of impurities are normally added into the pure crystal of semiconductor as to improve the conductivity of semiconductor.

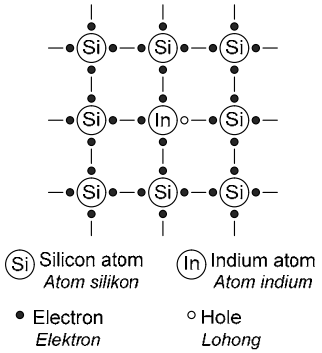
(a) With aid of diagram, explain how you go to produce a *p*-type semiconductor.

Answer

1st: A semiconductor likes silicon has four valence electrons.

2nd: To produce a p-type semiconductor, it must be doped with element which has three valence electrons.

3rd: Element with indium atom is doped into the silicon and produces an empty space in indium as shown below,



4th: This empty space is called the hole and become the majority charge carrier to the semiconductor.

5th: As a result, the semiconductor becomes p-type with majority charge carrier which is called the hole.

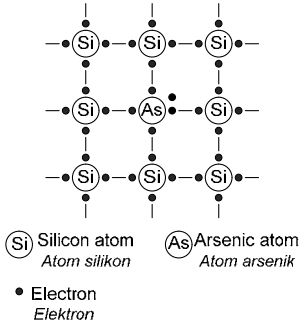
11 **(b)** With aid of diagram, explain how you go to produce *n*-type semiconductor.

Answer

1st: A semiconductor likes silicon has four valence electrons.

2nd: To produce a n-type semiconductor, it must be doped with element which has five valence electrons.

3rd: Element with arsenic atom is doped into the silicon and produces an extra electron around the arsenic as shown below,



4th: This extra electron will move freely and become the majority charge carrier to the semiconductor.

5th: As a result, the semiconductor becomes n-type with majority charge carrier which is called the electron.

12 Diagram 12 shows the pattern of sea waves when approaching the beach.

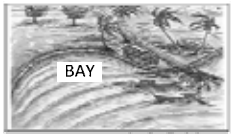


Diagram 12

Explain in terms of the wave phenomena in Diagram 12, why the water waves follow the shape of the beach as it approaches the shore.

Answer

1st:When the waves refract from deep sea to shallower sea, both the wavelength and energy decrease.

2nd: Therefore, it becomes weaker and follows the shape of the beach.

13 Diagram shows a sound wave produced by vibration of a tuning fork. The sound wave travels in air.

With the help of Diagram 13, explain how the sound wave is produced.

Answer

1st : When a tuning fork vibrates, air molecules will vibrate.

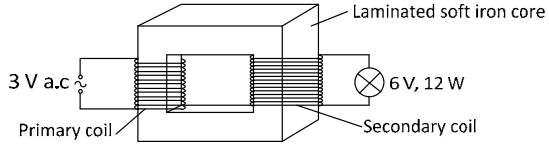
2nd : When the tuning fork moves forwards, the air is compressed.

3rd : When the tuning fork moves backwards, the air layers are pulled apart and cause the rarefaction.

4th : Therefore, a series of compression and rarefactions will produce sound.

5th : The sound energy is propagated through the air around it in the form of waves.

14 Diagram shows a transformer. A transformer is operated based on the principle of electromagnetic induction.



Explain the working principle of transformer.

1st: The working principle of transformer is based on electromagnetic induction with the input voltage must be alternating current.

2nd: When an alternating input current flows in primary coil, it induces a magnetic flux around the coil.

3rd: This induced magnetic flux will be induced to the secondary coil.

4th: The magnitude of e.m.f. induced to the secondary coils depends on the number of secondary coils besides the core is laminated or soft or not.

5th: This induced e.m.f will produce an induced voltage and also induced current to the bulb to light on.

PART 3: QUESTION-ANSWER ORIENTATED [SELECTED TOPICS]

1 Diagram 1.1 shows an vernier callipers.

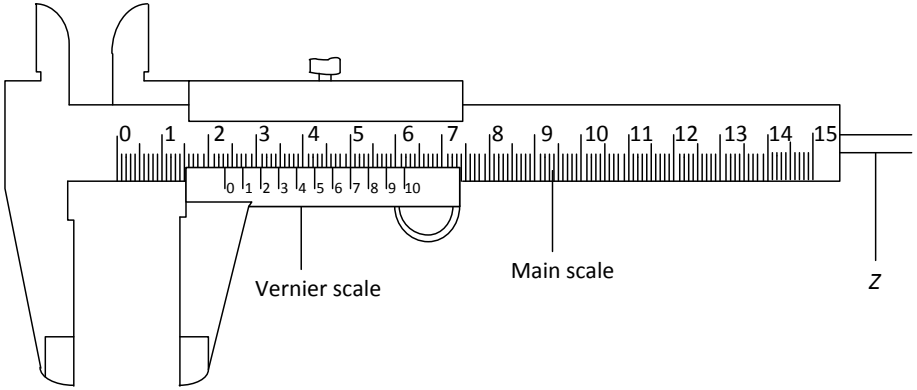


Diagram 1.1

(a) Name the physical quantity being measured by vernier calipers.
Diameter

(b) **(i)** Name the part labeled Z.
Tail

(ii) State the function of part Z.
To measure the depth

(c) What is the sensitivity of the vernier calipers?
0.01 cm

(d) Name one measuring instrument which is more sensitive than vernier calipers.
Micrometer screw gauge

(e) Diagram 1.2 shows the reading of the vernier calipers when the jaws is closed.

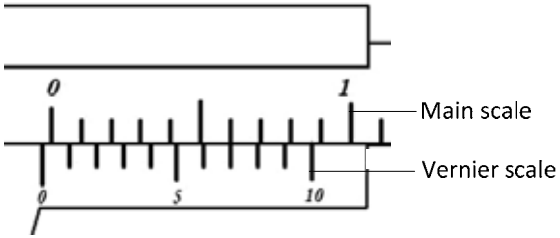


Diagram 1.2

Based on Diagram 1.2:

(i) Name the type of error occurred.
Zero error

(ii) State the value of the error.
Value is – 0.03 cm [Remember: Negative →read from behind]

2 Diagram 2.1 shows a student taking the reading of thermometer at three different positions, *P*, *Q* and *R*.

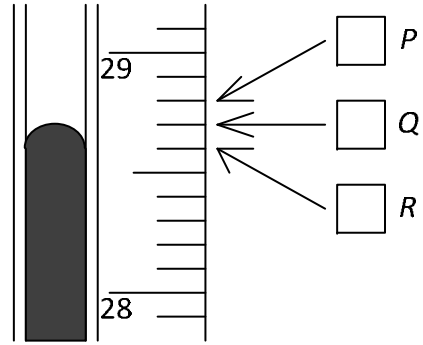


Diagram 2.1

(a) Name the physical quantity being measured by thermometer.
Temperature

(b) What is the type of physical quantity you name in **2**(a)? Tick the correct answer in the box provided.

Scalar quantity	√
Vector quantity	

(c) What is the smallest scale division of the scale of the thermometer in Diagram 2.1?
0.1 ℃

(d) What is the correct position of the student to take the reading of the scale of thermometer?
At position Q

(e) What is the reading of the thermometer based on your position in **2**(d)?
28.7℃

(f) Explain why the mercury is used in thermometer?
It is sensitive to the heat.
It does not stick to the wall of capillary tube in thermometer.
It is sensitive to wide range of temperature.
It is a good heat conductor

(g) Name one principle involved for the measuring of thermometer.
Thermal equilibrium concept

(h) State a way to increase the sensitivity of thermometer being made?
Make the capillary tube narrower with thinner stem.

(i) Name a type of error due to the wrong positioning of eyes during scale reading.
Parallax error

3 Diagram 3.1 shows an image is formed by a curved mirror.

Diagram 3.1

(a) Name the light phenomenon involved.
Reflection

(b) Name the type of mirror as shown in Diagram 3.1.
Convex mirror

(c) **(i)** Complete the ray diagram in Diagram 3.2 to show the formation of image.

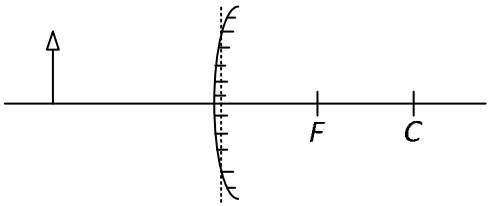
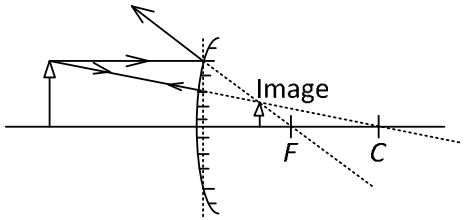


Diagram 3.2

Answer



(ii) State **one** characteristic of the image formed.
Upright //Diminished //Virtual

(d) State one use of this mirror in daily life
As mirror at sharp corner of road//parking area
As mirror inside the supermarket to view unwanted activities of shoplifter

(e) Why this mirror is used in **3**(d) instead of other types of mirrors?
Has wider view of vision

(f) What happen to the size of image if the object is placed nearer to the mirror?
Size of image increases

4 **(g)** Explain how to use a concave mirror to heat up water in a container using solar energy.
1st: concave mirror can reflect the parallel sunlight.
2nd: The reflected rays are converging to focal point
3rd: The focal point is placed with the water to be heated

(h) Diagram 3.3 shows a microscope. You are given two convex lenses *P* and *Q*, with focal lengths of 20 cm and 5 cm respectively. Both of the lenses are used to build a microscope.

Diagram 3.3

What is meant by focal length?
Focal length is the distance between the centre of lens with the principal F.

Using an appropriate physics concept, suggest and explain suitable modifications to enable the microscope to form brighter and clear image. Your modifications can be emphasized on the following aspects:
· The selection of lens as objective lens and as an eyepiece
· The diameter of the lens
· The distance between the objective lens and eyepiece
· Condition of the place to store the microscope
. Additional component to the microscope

Answer

Suggestion	*Reason*
Shorter focal length as objective lens *Longer focal length as eyepiece lens*	*Produce big image magnification*
Diameter of lens must be big	*More refraction of lights and thus the image is bright and clearq*
Distance between the objective and eyepiece lens must be bigger than the sum of focal lengths of both lens	*At normal adjustment*
Store the microscope at cool and dry place	*Prevent the activities of fungus on the lenses*
Install one concave mirror underneath the slaid	*The reflected ray is converging to the slaid*

5 Diagram 5.4 shows an astronomical telescope to be used to view distant objects.

Diagram 5.4

Table 5.4 shows the characteristics of four different telescopes.

Telescope	Type of lens	Focal length of objective lens	Power of lens	Diameter of lens
S	Convex	40	10	5.0
T	Concave	10	40	5.0
U	Convex	10	40	2.5
V	Concave	40	10	2.5

Explain the suitability of each characteristic of the telescope and determine the most suitable telescope to be used to observe very far object. Give reason for your choice.

Answer

Characteristics	*Reason*
Use convex lens	*The light is converging to one point*
Focal length of objective lens must be big	*To view distant object*
Power of lens is big	*To produce big magnification of image*
Diameter of lens must be big	*More refraction of lights and thus the image is brighter and clearer*

So, the telescope S is chosen because it uses convex lens, focal length of the objective lens is long, power of the lens is big and the diameter of the lens is big.

6 Diagram 6.1 and Diagram 6.2 show two identical objects located at different positions in front of identical convex lens. Real images with different height are produced.

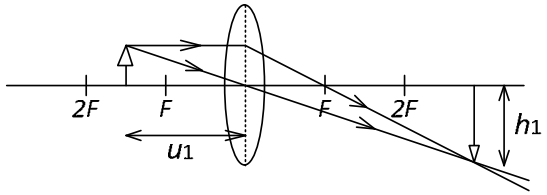


Diagram 6.1

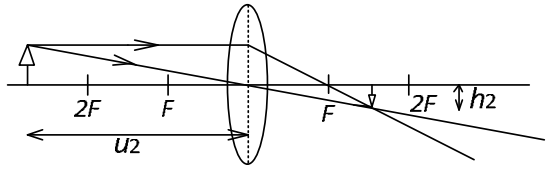


Diagram 6.2

(a) What is meant by focal length?

Focal length is the distance between the centre of lens with its principal F.

(b) Using Diagram 6.1 and Diagram 6.2, compare;

(i) The focal length of the lens.

Both the lenses have the same focal length.

(ii) The object distance, u_1 and u_2.

u_1 is shorter than u_2.

(iii) The height of image, h1 and h2.

h1 is longer than h2.

(iv) State the relationship between the object distance and the height of image.

Shorter the object distance, longer the height of image.

(v) Name the light phenomenon that occurs in Diagram 6.1 and Diagram 6.2.

Refraction

(c) Diagram 6.3 shows an object, **O** placed at the front of a concave lens of focal length 2 cm. The light rays of the object passing through the lens using the light phenomenon in **6**(b)(ii).

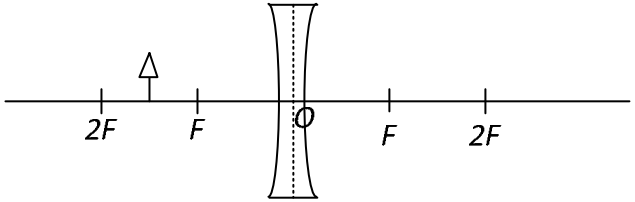
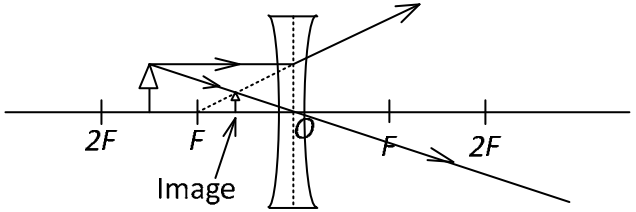


Diagram 6.3

(i) Sketch ray diagram of the object to show an image is formed.



(ii) State **three** characteristics of the image formed.

Upright //Diminished //Virtual

(iii) State one use of concave lens.

To make spectacle lens

7 Diagram 7.1 shows a method used to detect leakage of pipes lay underground. A little radioisotope substance is dissolved in the water that flows in the pipes. A Geiger-Muller tube which is connected to the rate meter is then moved over the pipes according to the layout plan of the underground pipes.

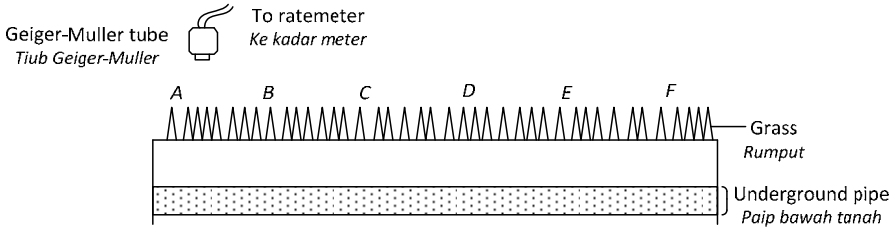


Diagram 7.1

Table 7.1 shows the readings of the rate meter at the different locations.

Location of Geiger-Muller Tube	*A*	*B*	*C*	*D*	*E*	*F*
Reading of the ratemeter (counts per minute)	290	295	284	372	290	216

Table 7.1

(a) What is meant by radioisotope?

Radioisotope is an unstable nucleus which has same proton number but different nucleon number.

(b) Based on Table 7.1, state the location on the pipe where the leakage takes place. State reason for your answer.

Location D shows the leakage takes place.

Because sudden increase in the reading of ratemeter showing that the radioisotope is coming out from the leakage to be detected by ratemeter.

(c) Diagram 7.2 shows a nuclide Thorium-234, $^{234}_{90}Th$ is placed in a container. Thorium-234 nuclide decays to a nuclide Radium-226, $^{226}_{88}Ra$ by emitting α particle and β particle.

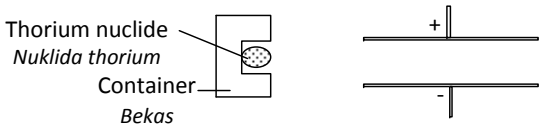
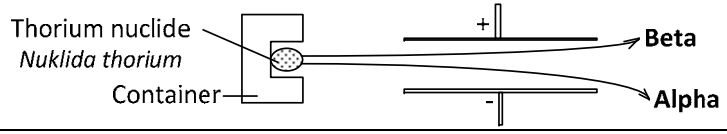


Diagram 7.2

(i) In Diagram 7.2, draw the path of α particle and β particle.

Answer



(ii) Explain your answer in **7**(d)(i).

Alpha is positive charge and thus deflected to negative plate.

Beta is negative charge and thus deflected to positive plate.

(iii) Calculate the number of α particle and β particle that emitted in the Thorium-234 decays after writing the decay equation.

Answer

$^{234}_{90}Th \rightarrow {}^{226}_{88}Ra + 2(^{4}_{2}He) + 2(^{0}_{-1}e) + Energy$

So, release two alphas and two betas.

(iv) Thorium-234 has half-life of 20 days and initial mass of 48 g. Calculate the mass of undecayed Thorium-234 after 60 days.

48 g $\rightarrow$ 24 g $\rightarrow$ 12 g $\rightarrow$ 6 g

20 20 20

So, mass undecayed is 20 g.

(v) Define the meaning of half-life.

Half-life is the time taken for half of the radioactive substance to decay.

(d) Table 7.1 shows the characteristics of five radioisotopes *P*,*Q*, *R*, *S* and *T*.

Radioisotope	Half-life	Ionizing power	Radiation	State of matter
P	5minutes	Low	Gamma	Liquid
Q	8 days	High	Alpha	Solid
R	6 hours	Low	Gamma	Liquid
S	5 years	Low	Beta	Solid
T	7 hours	High	Alpha	Liquid

Table 7.1

As a medical officer, you are required to determine the most suitable radioisotope as a radiotherapy treatment for a brain tumor. Explain the characteristics of all the five radioisotopes given and then, choose the most suitable radioisotope to be used. Justify your choice.

Answer

Characteristics	*Reason*
Use short half-life	*Does not give long term effect to the patient as it decays fast*
The ionizing power must be low	*Does not change the structure of substantial cells*
Use gamma radiation	*Has high penetrating power which can kill the cancer cells*
State of matter is liquid	*Easy to put into the area of tumor by injection*

So, the radioisotope P is chosen as its half-life is short, has low ionizing power, use gamma radiation and is in liquid state.

8 Neptunium-239 ($^{239}_{93}Np$) has 93 protons and decays to nuclide X with proton number of 94.

The mass of Neptunium=239.04251am.u

mass of nuclide X =239.02312a.m.u

Mass of electron = 0.00054 a.m.u, 1 a.m.u = 1.67 x 10^{-27} kg,

Speed of light, c = 3 x 10^{8} ms^{-1}

(a) What is the meaning of proton number?

Proton number is the total number of proton contained in nucleus.

(b) Name the radiation given out in the decay of Neptunium-239.

Beta particle

(c) Write the decay equation for the decay of Neptunium-239.

$^{239}_{93}Np \rightarrow {}^{239}_{94}X + {}^{0}_{-1}e$ + *Energy*

(d) **(i)** State the type of nuclear process for 8(c).

Nuclear fission

(ii) Calculate the mass defect, in kg, in this nuclear process.

Total mass before = 239.04251 a.m.u

Total mass after = 239.02312 a.m.u + 0.00054 a.m.u

= 239.02366 a.m.u

Total mass defect = 239.04251 a.m.u – 239.02366 a.m.u

= 0.01885 a.m.u

= 0.01885 x 1.67 x 10^{-27} *kg*

= 3.14795 x 10^{-29} *kg*

(iii) Calculate the total energy released in this process.

From Einstein's theory, $E = mc^2$

So, energy = $(3.14795 \times 10^{-29})(3 \times 10^{8})^2$ *J*

= 2.83×10^{-12} *J*

(e) Diagram 8.1 shows the schematic diagram of a nuclear reactor at a nuclear power station.

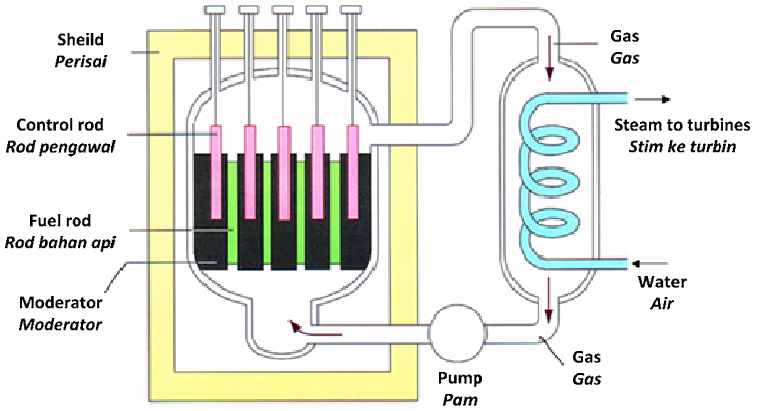


Diagram 8.1

Table 8.1 shows the four designs P, Q, R and S of nuclear reactor with different specifications.

Design	Type of reaction	Half-life of nuclear fuel	Specific heat capacity of gas	Material of shield
P	Fusion	Long	Low	Brick
Q	Fission	Short	High	Concrete
R	Fission	Long	Low	Concrete
S	Fusion	Short	High	Brick

Table 8.1

You are required to determine the most suitable design of nuclear reactor so that the nuclear energy can be used efficiently and safely in the generation of electricity. Determine the most suitable design and justify your choice.

Answer

Characteristics	*Reason*
Type of reaction is fission	*Reaction can occur at low temperature*
Half-life of nuclear fuel must be long	*Can be used for longer time with the least of replacement*
Specific heat capacity must be low	*Heat up faster*
Material of shield must be concrete	*Less leakage of radiation*

So, the design R is chosen because its type of reaction is fission, half-life of the fuel is long, specific heat capacity of gas is low and material of the shield is concrete.

(f) Table 8.2 shows the characteristics of four radioisotopes P, Q, R and S.

Radioisotope	Half-life	Types of ray	State of matter	Ionising power
P	7 hours	Alpha	Solid	High
Q	7 years	Gamma	Solid	Low
R	10 days	Gamma	Liquid	High
S	8 years	Beta	Solid	Low

Table 8.2

As a factory engineer, you are required to determine the most suitable radioisotope that can be used to detect the volume of guava juice in tin. Determine the most suitable radioisotope and give the reason for your choice. Answer

Characteristics	*Reason*
Use long half-life	*Can be used for longer time with less refillment cost*
Use gamma ray	*Can penetrate the tin to see*
Physical state is solid	*Easy to handle*
Ionizing power is low	*Does not change the taste of juice inside*

So, radioisotope Q is chosen as its half-life is short, use gamma ray, in solid state and has low ionizing power.

9 Diagram 9.1 and Diagram 9.2 show movements of identical bar magnet into the solenoid with the same force as to produce current. Both solenoids are made of same wires which are connected to a zero-centered galvanometer.

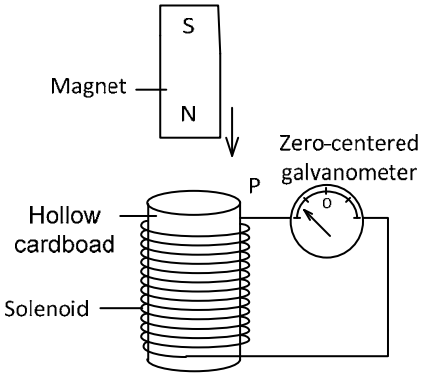


Diagram 9.1

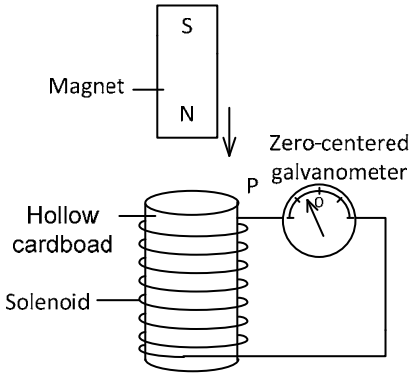


Diagram 9.2

(a) *Underline the correct answer in the bracket to complete the sentence below.*

The method of producing current without electrical supply is called (electromagnet, electromagnetic induction).

(b) On Diagram 9.1 and Diagram 9.2:

(i) State the polarity of region *P*.

North pole

(ii) Name the law used to determine the polarity in **9**(b)(i).

Lenz's law

(c) Based on Diagram 9.1 and Diagram 9.2, compare:

(i) The number of turns of coils

Number of turns of coils in Diagram 9.1 is more than in Diagram 9.2

(ii) Deflection of the pointer of the galvanometer

Deflection of pointer of galvanometer is higher in Diagram 9.1 than in Diagram 9.2

(d) State the relationship between the number of turns of coils and

(i) deflection of the pointer of the galvanometer

More number of turns of coils, more deflection of the pointer of galvanometer

(ii) magnitude of induced current

More number of turns of coils, higher magnitude of induced current

(e) State what will happen to the deflection of galvanometer if a soft magnet is used?

Deflection of galvanometer will increase

(f) Diagram 9.3 shows a cross-section of a bicycle dynamo which has two magnets with difference pole, a coil of insulated copper wire. The output of the dynamo is connected to the bicycle lamp.

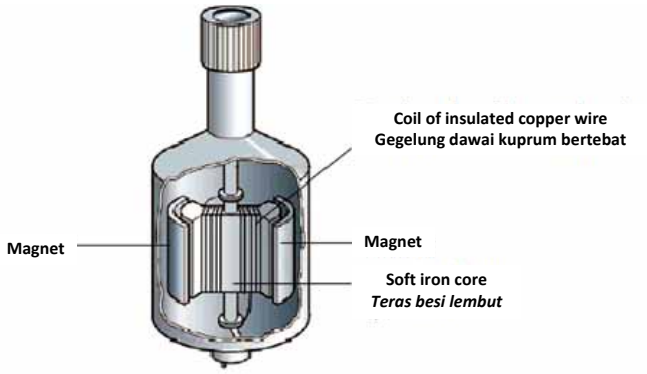


Diagram 9.3

Explain how the bicycle dynamo works to produce alternating current to light up the lamp.

1st: The coil rotates within the magnetic field.
2nd: Magnetic field lines cut by the coil.
3rd: Cut of magnetic field lines causes the induced current flow in the circuit

(g) Diagram 9.4 shows a moving coil ammeter which is less sensitive.

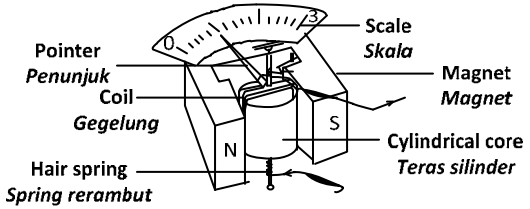


Diagram 9.4

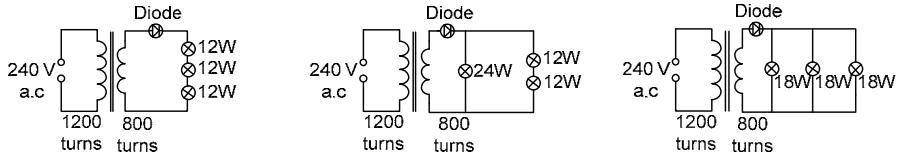
Explain how you would design a moving coil ammeter that can function better. In your explanation, emphasize the following aspects:

-Number of turns of coil -Material of core
-Shape of the magnet -Stiffness of hair spring
-Type of the ammeter scale
-Additional component to give accurate reading

Answer

Suggestion	*Reason*
More number of turns of coils	*Increase magnetic field strength*
Soft iron core material	*Can be magnetised or demagnetized easily*
Curve magnet	*Produce radial magnetic field*
Low stiffness of hair spring	*The pointer is easier to deflect*
Strip mirror under the pointer *Has adjustment screw*	*To avoid parallax error* *To correct the zero error*

10 Diagram 10.1 shows three transformers X, Y and Z. Each transformer has its own specific number of turns of primary and secondary coils respectively. Each transformer is connected to 240 V alternating current suppliers. The output for each transformer is connected to electric filament bulbs in different arrangement.



Transformer X Transformer Y Transformer Z

Diagram 10.1

(a) What is transformer?

Transformer is a device used to step-up or step-down the input a.c voltage.

(b) **(i)** State the type of transformer used in Diagram 10.1.

Step-down transformer

(ii) State one reason why the a.c. voltage is supplied.

So that the voltage can be alternated according to the changing magnetic flux being induced to secondary coil in transformer

(iii) State the function of diode in the circuit.

To change the a.c voltage to d.c voltage

(b) State the principle applied for the working principle of transformer.

Electromagnetic induction

(c) When the switch is on, 0.25 A current flows through the primary coil in each transformer. All the bulbs lights up normally.

(i) Calculate the input power.

Input power, P = IV = 0.25 x 240

= 60 W

(ii) All the transformers in Diagram 10.1 have the same output voltage. Calculate its output voltage.

By ratio: 1200 turns → 240 V

800 turns → ?

So, 1200/800 = 240/?

? = 160 V

(iii) Calculate the output power for all the transformers X, Y and Z.

Output power for transformer X = 12 W + 12 W + 12 W = 36 W

Output power for transformer Y = 24 W + 12 W + 12 W = 48 W

Output power for transformer Z = 18 W + 18 W + 18 W = 54 W

(iv) Between transformer X, Y and Z, which one has the highest efficiency? Why?

Transformer Z. Because its output power is closed to input power with its efficiency of 90%

(d) A student wants to build a simple transformer. Table 10.1 shows the characteristic of four cores.

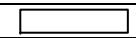
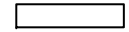
Core	Shape of the core	Material of core	Type of core	Thickness of wire
A		Soft iron	Laminated	Thick
B		Steel	Single	Thin
C		Steel	Single	Thin
D		Soft iron	Laminated	Thick

Table 10.1

Explain the suitability of the characteristics given so that it can produce the most efficient transformer. Choose the best core and justify your choice.

Answer

Characteristics	*Reason*
Shape of core is U-shape	*Centralize the magnet from leaking*
Use soft iron core material	*Can be magnetized or demagnetized easily*
The core is laminated	*To reduce eddy current*
Use thick wire	*Low resistance*

So, core D is chosen because it core is U-shape, made of soft iron, laminated and use thick wire.

(e) Diagram 10.2 shows a cross section of a moving coil microphone.

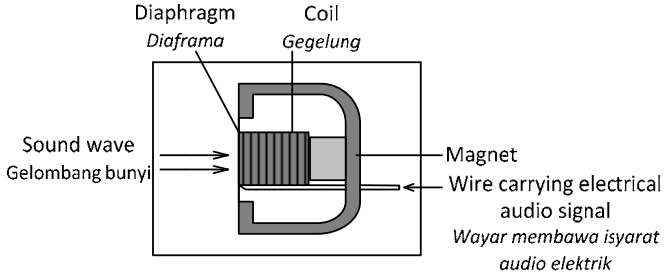


Diagram 10.2

Using an appropriate concept in physics, suggest and explain suitable modifications or ways to enable the microphone to detect sound effectively and generate bigger current based on the following aspect:

(i) thickness of diaphragm (ii) strength of the material for diaphragm

(iii) number of turns of coil (iv) diameter of the wire of coil

(v) strength of magnet

Characteristics	*Reason*
Use thicker diaphragm	*Can withstand high pressure of sound vibrations*
High strength of diaphragm	*Long lasting*
Use more turns	*more magnetic flux cut*
Bigger diameter of wire coil	*Reduce resistance*
Higher strength of magnet	*Produce stronger magnetic flux*

11 Diagram 11.1 shows an apparatus used to investigate one physics concept. When an air is blown from region *P*, the water level in the arms of tube changes as shown.

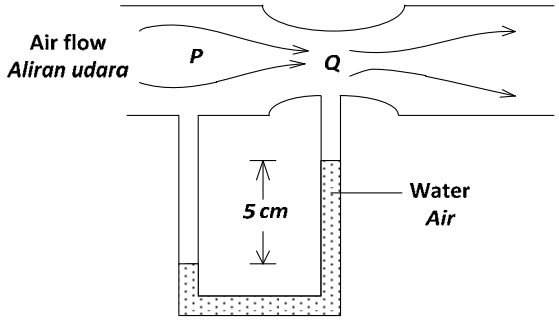


Diagram 11.1

(a) Name the physics principle involved.

Bernoulli's principle

(b) **(i)** Compare the air speed at region *P* and region *Q*.

Air speed at region P is lower than at region Q.

(ii) Compare the air pressure at region *P* and region *Q*.

Air pressure at region P is higher than at region Q.

(iii) Explain why there is a difference in air pressure at region *P* and region *Q*.

According to Bernoulli's principle, region which has high air speed will has low pressure and vice-versa.
At region P, the air speed is low but with high pressure.
At region Q, the air speed is high but with low pressure.

(c) Calculate the difference in water pressure between region *P* and region *Q*. Given the density of water is 1000 kgm^{-3}.

Difference in water pressure = hpg
= (0.05)(1000)(10) Pa
= 500 Pa

(d) Suggest three ways by which the difference in water pressure can be increased. Give reasons for your answers.

Suggestion 1: increase the speed of air flow
Reason: difference in air pressure between P and Q will be bigger
Suggestion 2: reduce the diameter of tube Q.
Reason: higher speed produce at Q result in lower pressure at Q
Suggestion 3: reduce the diameter of arms
Reason: the arms will be more sensitive to small change in pressure

(e) What will happen to the water level if the non-uniform horizontal tube is replaced with uniform horizontal tube?

The difference in water level will be reversed.

(f) Table 11.1 shows four Bunsen burners, *P*, *Q*, *R* and *S*, with different specifications.

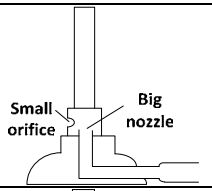
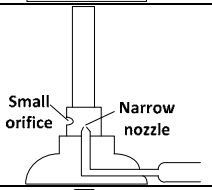
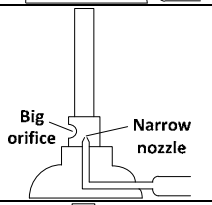
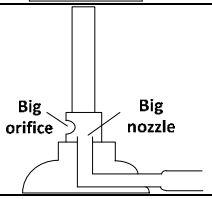
Bunsen burner	Structure of Bunsen burner	Melting point of material	Density of material
P		High	High
Q		High	Low
R		High	Low
S		Low	Low

Table 11.1

You are required to determine the most suitable Bunsen burner that can produce bigger blue flame and portable.

Study the specifications of all the four Bunsen burners from the following aspects:

(a) Size of gas nozzle (b) Size of orifice

(c) Melting point of the material (d) Density of the material

Explain the suitability of the aspects. Justify your choice.

Characteristics	*Reason*
Small gas nozzle	*Produce high air speed*
Size of orifice is big	*More air flow into the Bunsen burner*
High melting point	*Can withstand high temperature without melt*
Low density	*Lighter and portable*

So, Bunsen burner R is chosen because its small gas nozzle, small orifice, has high melting point and low density material.

12 Diagram 12.1 shows an ordinary bicycle.

Diagram 12.1

You are required to give some suggestions to enable the cyclist to ride the bicycle safely at higher speed. Your explanations are based on following characteristics:

(i) Mass of bicycle
(ii) Type of material for the body of bicycle
(iii) Width of tyres
(iv) Type of braking distance
(v) The attire or accessories for the cyclist

Answer

Suggestion	*Reason*
The mass of bicycle must be small	*Small mass produce higher acceleration*
Material for body must be low density	*Lighter for cyclist to ride*
Width of tyres must be big	*Stable while riding*
Use hydraulic disc brake	*Can stop the bicycle in shorter distance and shorter braking time*
Wear tight attire *Wear glove* *Wear helmet*	*Reduce air friction* *Better grip on handles* *Protect the head of cyclist once fall*

(b) Diagram 12.2 and Diagram 12.3 shows the situation of the canopy of the lorry before lorry moves and when the lorry moves at a high speed.

Diagram 12.2

Diagram 12.3

Explain why the canopy of the lorry lifts up when the lorry moves at a high speed. Name the principle involved.

1st: Before lorry moves, the air speed outside and inside the canopy is same.
2nd: When the lorry moves, the air speed outside the canopy is high causing low pressure outside. Inside the canopy, the air speed is low but with high pressure.
3rd: High pressure inside the canopy pushes up the canopy as shon in Diagram 12.3
4th: Physics principle involved is the Bernoulli's principle.

(c) Diagram 12.4 shows a water rocket made from an empty 1.5 litre plastic bottle by adding water and pressurizing it with air for launching.

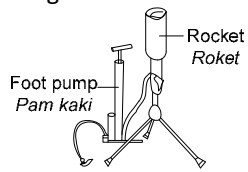


Diagram 12.4

The objective is to travel the rocket as far as possible. Using the appropriate physics concepts, suggest and explain the following aspects:
(i) The shape of the rocket (ii) Volume of water to be filled to bottle
(iii) The stability of the motion (iv) Density of material to the rocket
(v) Angle of launching

Answer

Suggestion	*Reason*
The shape of rocket is aerodynamics	*Reduces air friction while flying*
1/3 of the bottle is filled with water	*Gain momentum to launch*
Add wings to the body	*Stable while flying and not wobble*
Density of the material is low	*Not too heavy to fly*
Launch at 45° from horizontal	*Get maximum projectile with maximum distance traveled.*

(d) Diagram 12.5 shows four racing cars, *P*,*Q*,*R* and *S*, with different specifications.

Car	**Shape**	**Ridges on tyre**	**Engine power**	**Material for the car body**
P	 Aerodynamics	Yes	518 kW	Light and elastic
Q	 Aerodynamics	None	745 kW	Heavy and stiff
R	 Inverted aerofoil	Yes	518 kW	Heavy and elastic
S	 Inverted aerofoil	None	745 kW	Light and stiff

Diagram 12.5

You are required to investigate the specifications given so that the car can run very fast. Determine the most suitable car and justify your choice.

Characteristics	*Reason*
The shape is inverted aerofoil	*Produce downward force*
No ridge on tyre	*Can move fast*
Engine power is big	*Produce big acceleration*
Material is light and stiff	*Not too heavy to move but yet can withstand force*

So, car S is chosen because it is inverted aerofoil, no ridge on tyres, engine power is big and material of body is light and stiff.

13 Diagram 13.1 shows a submarine floating in sea water due to the effect of buoyant force.

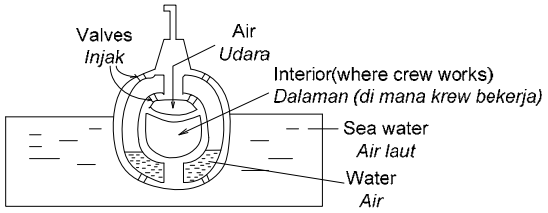


Diagram 13.1

(a) What is the meaning of *buoyant force*?

Buoyant force is an upthrust to the object from water causing the object to float.

(b) Explain how a submarine is able to submerge into deep sea water.

1st: To submerge, the lower valve of the ballast tank is opened to let in the water.
2nd: The upper valve is open to let out the trapped air inside the ballast tank
3rd: When the weight of submarine is higher than buoyant force, the submarine starts to submerge.
4th: The lower and upper valves are closed when the submarine has reached the depth required.

(c) Diagram 13.2 shows the air balloon which is used as a weather balloon to carry a radiosonde instrument for collecting data about the atmosphere.

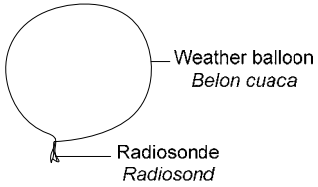


Diagram 13.2

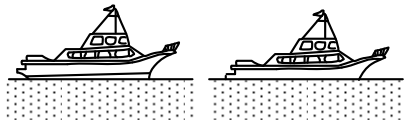
(i) State the Archimedes' principle.

Archimedes' principle states that the when the object is immersed partially or wholly into fluid, the weight of water displaced is equal to the weight of object being immersed.

(ii) Explain why a weather balloon that is rising up in the air will stop at certain altitude.

1st: Density of air decreases as the altitude increases
2nd: Buoyant force become smaller
3rd: At certain height, the weight of air displaced is equal to the weight of balloon.
4th: Therefore, no net force to push the balloon up.

(d) Diagram 13.3 shows two boats of the same weight floating on the surface of water in the sea and in the river.



Sea River

Diagram 13.3

(i) Name the principle applied for the floating of the boat.

Archimedes' principle

(ii) Explain why the boat is able to float?

The boat displaces the water and thus gains the same buoyant force to float.

(iii) Deduce the relationship between the weight of the ship and the weight of the water displaced.

Weight of the ship is equal to the weight of water displaced

(iv) A ship that travels round the world will has Plimsoll symbol as shown in Diagram 13.4.

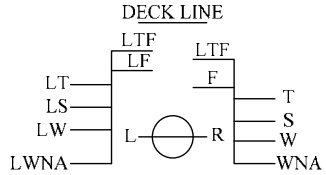


Diagram 13.4

State the common function of the Plimsoll line.

To guide navigator the maximum weight load limits that can still be safely loaded by the ship before it starts to sink.

(e) You are required to give some suggestions on how to design the boat in Diagram 13.3 as to increase the floating force and safer. Explain the suggestions based on the following aspects:
-Material used
-Shape of boat
-Density of boat
-Additional components
-Safety feature

Answer

Suggestion	*Reason*
Material used must be with low rusting rate (fibre composite)	*Long lasting without rust*
Shape of boat is streamline	*Reduce water friction while flying*
Density of boat is light	*Can carry more load before it sinks*
Has life jacket and tyre	*For passenger to float in emergency case*
Install periscope	*To view hidden object which may collide the boat*

14 **(a)** Table 14.1 shows four hot air balloons *P*, *Q*, *R* and *S* with different features.

Balloon	Size and volume	Number of burners	Type of balloon fabric	Temperature of air inside
P	Small and 800 m^3	1	Synthetic nylon	100˚C
Q	Large and 2500 m^3	2	Synthetic nylon	120˚C
R	Large and 2500 m^3	1	Canvas	60˚C
S	Small and 800 m^3	2	Canvas	70˚C

Table 14.1

You are required to investigate the hot air balloon which is able to carry three or four people to a higher altitude in a shorter time. Determine the most suitable balloon and justify your choice.

Answer

Characteristics	*Reason*
Big size and high volume	*Can displace more air and gains higher buoyant force*
Use more burners	*Faster heating the air inside the balloon*
Use synthetic nylon	*Resistance to heat without melt*
High temperature inside balloon	*Hot air is lighter*

So, the balloon Q is chosen because it is big size with high volume, use more burners, the balloon is made of synthetic nylon and temperature of air inside is high.

(b) The weight of a boat without load is 15000 N. The boat is then loaded with a heavy box. The volume of the immersed portion of the boat is 5.0 m^3.

(i) Calculate the buoyant force exerted to the boat.
[Density of sea water is 1020 kgm^{-3}]

From formula, buoyant force, F = ρVg
= 1020 x 5 x 10
= 51000 N

(ii) Calculate the maximum weight of the box so that the boat will not sink completely.

Weight of boat + weight of load load = buoyant force
15000 N + weight of load = 51000 N
Weight of load = 36000 N

(c) You are asked to investigate the characteristics of four submarines shown in Table 14.2.

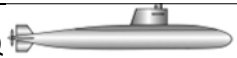
Volume of ballast tank	Number of air tank	Maximum pressure to be tolerated	Shape of submarine
3 000 litre	15	4.5 atm	P 
2 500 litre	30	6.0 atm	Q 
350 litre	3	6.1 atm	R 
400 litre	1	2.0 atm	S 

Table 14.2

Explain the suitability of each characteristic of the submarines and determine the submarine which can travel faster, stay longer in deeper sea water and able to carry more crew. Give reasons for your choice.

Answer

Characteristics	*Reason*
Volume of ballast tank is high	*Can displace more water and thus gains more buoyant force*
Use more air tank	*Can trap more air to gain more buoyant force*
Higher pressure that can be tolerated	*Can submerge deeper without crack due water pressure*
Shape of submarine is streamline	*Reduce water friction while moving*

So, the submarine Q is chosen because it has high volume of ballast tank with more air tanks, can tolerate higher pressure and is in streamline shape.

15 Diagram 15.1 shows one end of a spring is fixed to a wooden block.
Diagram 15.2 shows the spring is compressed by a steel ball of mass 0.52 kg using a force *F*.
Diagram 15.3 shows the steel ball moves after the force, F is removed.
[The spring constant = 50 N m^{-1}]

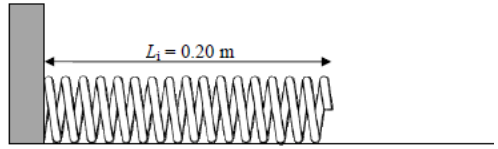


Diagram 15.1

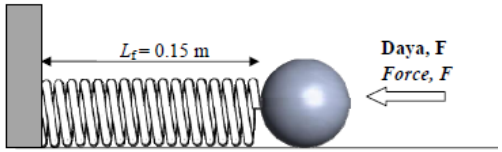


Diagram 15.2

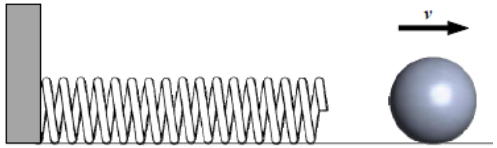


Diagram 15.3

(a) What is meant by force?
Force is the product of mass and acceleration

(b) **(i)** Name the form of energy stored in compressed spring as shown in Diagram 15.2.
Elastic potential energy

(ii) Calculate the value of *F*.
From F = kx
= 50 x (0.20 – 0.15)
= 2.5 N

(iii) State the conversion of energy when the ball is released.
Elastic potential energy is changed to kinetic energy

(iv) Calculate the speed of ball, *v*.
Work done to compress spring = ½ kx^2
= ½ (50)(0.20 – 0.15)^2
= 0.0625 J
From kinetic energy: ½ mv^2 = 0.0625
½ (0.52)v^2 = 0.0625
v = 0.49 ms^{-1}

(v) State the principle you used to find (iv).
Principle of conservation of energy

(c) **(i)** What is meant by elasticity?
Elasticity is the ability of an object to resume to its original state once the applied force is removed with elastic limit is not exceeded.

(ii) The elasticity of a spring can be explained by one law. State that law.
Hooke's law

(d) When the spring is compressed, its length decreases and returns back to its original length after compressive force is removed due to elasticity property of a material. Based on the forces between atoms, explain why the spring is elastic.
Refer to above note Page 13…..

(e) Diagram 15.4 shows a trampoline. It uses the elastic property of a material to rebounce a person upwards.

Diagram 15.4

You are required to give some suggestions to improve the design of the trampoline so that it can be used by the children safely and can jump higher. Explain the suggestions based on the following aspects :
(i) the number of spring used
(ii) spring constant
(iii) the material used for frame
(iv) the material used for fabric
(v) extra fitting or design of the trampoline to ensure safety

Suggestion	*Reason*
Use more spring in parallel	*Increase the elasticity of spring*
Low spring constant	*Can extend or compress more*
Main frame is made of steel	*Strong material which does not break*
Use nylon for fabric	*Does not tear*
Has net around the edge of trampoline	*To prevent the children from slipping out to the floor*

16 A typical torchlight with batteries is shown in Diagram 16.1.

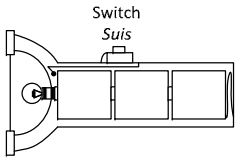
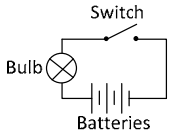


Diagram 16.1

(a) **(i)** Name the type of current used in the torchlight.

Direct current

(ii) Draw a circuit diagram for the torchlight in Diagram 16.1.



(b) Energy efficiency and safety are important considerations in the purchase and use of electrical products and appliances.

(i) A fuse in a power plug is labeled '8 A'.

What does the label '8A' mean?

Means maximum current being loaded to the power plug is 8 A.

(ii) Table 16.1 shows four types of power socket extensions *P*, *Q*, *R* and *S* available in a supermarket.

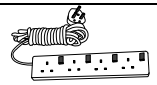
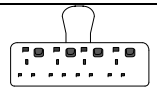
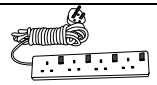
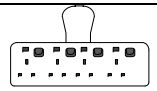
Type	Type	Extension cord length	Number of fuse	Power Surge Protection	Earthing system
P		5 m	Four sockets one fuse	Available	Not available
Q		None	Four sockets one fuse	Not Available	Available
R		5 m	Each socket one fuse	Not available	Not available
S		None	Each socket one fuse	Available	Available

Table 16.1

Using physics concepts, explain the suitability of the power socket extensions for each aspect which can be used safely and efficiently for normal home use. Determine the most suitable socket extension and justify your choice.

Answer

Characteristics	*Reason*
No extension cord length is need	*To reduce the resistance of the power socket extension as the resistance increases with length*
Must have fuse for every socket	*Once one of the fuse is burnt due overloaded of that socket, the rest of the sockets can still function*
There is a power surge protection	*To shut down the whole current to the power socket if there is a electric current leakage*
Must have head plug earthing	*To flow the unused current to the earth so that the user will not be electrocuted*

So, the type S is chosen because it has no extension cord length, have fuse for every socket, has power surge protection and have head plug earthing.

(c) Diagram 16.2 shows a two-door refrigerator for household use.

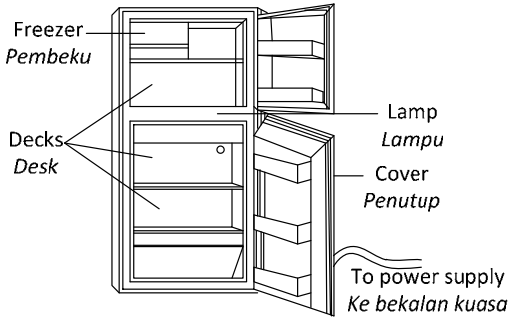


Diagram 16.2

Using the knowledge about heat flows, explain the modification needed to produce a refrigerator which is constantly cold, energy saving and lasting for the purpose of keeping the freshness of the food stored in it. Your modification should be based on the following characteristics: Material used to make the desk, Type of lamp used in refrigerator, Power of the refrigerator, Air circulation in the refrigerator, Specific heat capacity of the cover of refrigerator

Characteristics	*Reason*
The desk is made of plastic	*Does not rust and long lasting*
Use LED lamp or lamp of low power and just light when the door is open	*Does not heat up the refrigerator inside due to the lamp of bulb*
Use high power of refrigerator	*The refrigerator will be more cold to keep the freshness of food stored*
The freezer must be installed at the highest part inside the refrigerator	*The cool air has higher density will move down to cool the lower part of food and thus causes the air circulation. Hot air at lower part will move up and cooled down by the freezer.*
The specific heat capacity of the cover of refrigerator must be high.	*Slower conducting the heat outside into the refrigerator.*

17 Diagram 17.1 shows a hair dryer labelled 240 V, 500 W connected to a three pin plug. Diagram 17.2 shows the fuse in the three pin plug.

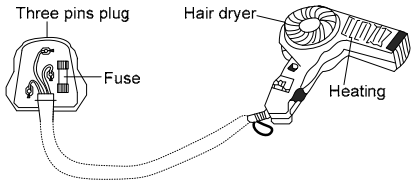


Diagram 17.1

Diagram 17.2

(a) State **three** properties of the material of the heating element in the hair dryer.

Has high melting point, has high resistance, has low specific heat capacity

(b) **(i)** What is the meaning of the label 0.5 A on the fuse?

Maximum current that can be loaded to the fuse is 0.5 A

(ii) Table 17.1 shows the specification of a few metals to be used as a fuse wire.

Metal	Melting point /°C	Specific heat capacity/ J $kg^{-1}°C^{-1}$	Diameter	Resistivity
W	1100	900	Big	Low
X	600	900	Small	High
Y	1100	240	Big	Low
Z	700	240	Small	High

Table 17.1

Explain the suitability of each characteristic of the four metals and determine the most suitable metal to be used as the fuse wire. Give reasons for your choice.

Characteristics	*Reason*
The melting point must be low	*Easy melt when hot*
Specific heat capacity must be low	*Faster getting hot*
The diameter of metal must be low	*Produces higher resistance which can convert current to heat*
The resistivity must be high	*Produces high resistance*

So, the metal Z is chosen because its melting point is low, specific heat capacity is low, small diameter and its resistivity is low.

(c) The hair dryer in Diagram 17.1 is switched on.

(i) Calculate the current flowing through the hair dryer.

Given the hair dryer labelled 240 V, 500 W

↑ ↑

Voltage Power

From Power, P = IV

500 = I(240)

I = 2.08 A

(ii) State whether the 0.5 A fuse is suitable to be used in the plug.

Not suitable. The hair dryer needs 2.08 A to function. This current of 2.08 A which passes to the fuse of 0.5 A will burn the fuse directly before working up the hair dryer.

(iii) Calculate the energy used by the hair dryer when it is switched on for 10 minutes.

Power = Energy/Time

Energy = Power × Time

= 500 × (10 × 60) J

= 300 000 J @ 300 kJ

(d) Fuse takes some time to melt or blow. A fast blowing fuse is required to protect semiconductor equipments which cannot stand high current surge for too long. When a fuse blows, sparking may occur and produces high temperature.

Table 17.2 shows the specifications of five fuses that can be used to protect a semiconductor device.

Fuse	Thickness of fuse wire	Cartridge tye	Rating	Melting point
P	Medium	Rubber	10 A	Medium
Q	Thin	Glass	10 A	Low
R	Thin	Ceramic	13 A	Low
S	Thick	Plastic	10 A	High

Table 17.2

Determine the most suitable fuse to protect a 240V, 2000 W semiconductor material device. Study the specifications of all five fuses given and justify your choice.

Characteristics	*Reason*
The thickness of fuse wire is thin	*Has higher resistance which can get hot faster*
The cartridge tye must be glass	*Easily get broken when hot*
The fuse rating is 10 A	*Enough to break down the 240V, 2000 W semiconductor device which needs only a current of 8.33 A*
The melting point must be low	*Faster getting melt and short-open the circuit when the circuit overheated*

So, the fuse Q is chosen because its thickness of fuse wire is thin, cartridge tye is made of glass, fuse rating is 10 A and the melting point is low.

##Remember: The fuse itself must be can get hot faster with high resistance and easily get melt so that the circuit is short-open and thus protect the electrical component from getting burnt.

18 Diagram 18.1 and Diagram 18.2 shows an experiment to study the relationship between the pressure and volume of air trapped in an air-tight container. The pistons for both diagrams are pushed down slowly.

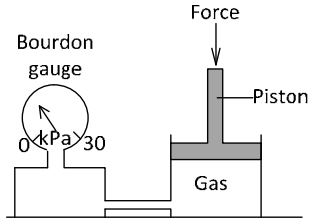


Diagram 18.1

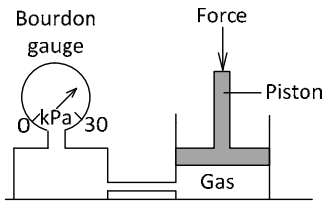


Diagram 18.2

(a) State the physical quantity being measured by Bourdon gauge.
Gas pressure

(b) Based on Diagram 18.1 and Diagram 18.2;

(i) Compare the volume of the gas in the air-tight container
Volume of gas in the air-tight container in Diagram 18.1 is more than in Diagram 18.2

(ii) The reading of Bourdon gauge
The reading of Bourdon gauge in Diagram 18.1 is lower than in Diagram 18.2

(iii) Temperature of the gas in the air-tight container
The temperature of the gas in the air-tight container for both diagram are same.

(c) **(i)** Using your answer in (b)(i) and (b)(ii), state the relationship between the volume of gas and the reading of Bourdon gauge.
Volume of gas is inversely proportional to the reading of Bourdon gauge

(ii) State the gas law involved.
Boyle's law

(iii) Define the gas law you name in (c)(ii).
Boyle's law states that for a fixed mass of gas, the pressure of gas is inversely proportional to its volume at constant temperature.

(d) The experiment above is usually applicable if a gas expands or compressed slowly. Why is this so?
The Boyle's law is applicable if the temperature of the gas is constant. The gas must be expanded or compressed slowly as to reduce the collision between the molecules of gas. The collision of molecules increase the friction of molecules between them and this friction will produce heat. If the heat produced, then the temperature of the gas is not constant already.

(e) A syringe contains 50 m^3 of air at a pressure of 100 kPa. This piston is pulled outwards slowly so that the air expands. What would be the volume of the air when the air pressure drops to 80 kPa?
From Boyle's law: $P_1V_1 = P_2V_2$
$(100)(50) = 80(V_2)$
$V_2 = 62.5\ m^3$

19 Diagram 19.1 shows a Bourdon gauge which is used to measure gas pressure inside a round bottom flask.

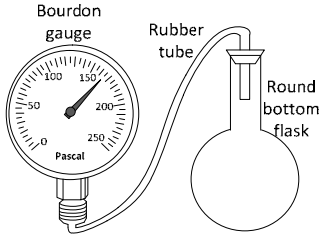


Diagram 19.1

(a) **(i)** What is meant by sensitivity?
Sensitivity is the ability to detect the small change in its reading

(ii) State the sensitivity of the Bourdon Gauge.
5 Pascal [# smallest scale]

(b) **(i)** State the correct position of the eye while taking reading from the Bourdon Gauge?
Perpendicular to the scale

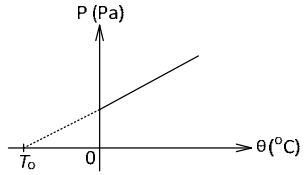
(ii) What is the pressure of the gas inside the round bottom flask as shown by the Bourdon gauge?
165 Pa

(c) The round bottom flask is then heated. Would the reading of the Bourdon gauge increase or decrease?
Increases

(d) **(i)** State one law that you used in (c).
Pressure law

(ii) Define the law you state in (d)(i).
Pressure law states that for a fixed mass of gas, the pressure of gas is directly proportional to its absolute temperature such that the volume of gas is kept constant.

(e) An experiment is carried out to investigate the relationship between the pressure, P and the temperature, ϑ of a fixed mass of a gas as shown in graph below.



(i) What is the value of temperature, T_o when the pressure of the gas is zero?
– 273 °C

(ii) What is the name given to T_o?
Absolute zero temperature

20 Diagram 20.1 shows a car and a lorry stopping at a red traffic light. When the traffic light turns green as in Diagram 16.2, the car is found to move ahead of the lorry.

Diagram 20.1

Diagram 20.2

(a) What is meant by *mass*?

Mass is the quantity of matter contained by an object.

(b) Based on Diagram 20.1 and Diagram 20.2, compare the masses of the vehicles and their ability to speed ahead. Relate the mass of the vehicle and the way it can start moving from rest to deduce a concept in physics with regard to the motion of objects.

The mass of the lorry is more than the car causing the lorry has less ability to speed ahead. The bigger mass of lorry causes the lorry harder to start moving from rest. The physics concept involved is the inertia.

(c) Define the physics concept you name in (b).

Inertia is the tendency of an object to resist the sudden change exerting on the object.

(d) Based on the physics concept stated in (b)(i), explain why a driver lurch forwards when a car he is driving comes to a sudden halt.

When the car comes to a sudden halt, the inertia is very big acting onto the driver. The inertia will cause the driver to continue to move forward although the car has stopped. As a result, the driver will be surged forward.

(e) Explain how you would go to escape from being chased by a bull based on one concept.

1st: I will perform my run in zig-zag directions with no definite direction of run.
2nd: The bull has bigger mass if compared to me. This means that the bull will has bigger inertia as the inertia depends on the mass.
3rd: Due to inertia, the bull is harder to change its direction and will lose control and fall

(f) You are asked to investigate the characteristics of each backhoes in Table 20 and choose a backhoe that can do heavy works, an example of a backhoe is shown in Diagram 20.3. Explain the suitability of the characteristics each backhoes. Determine the most suitable backhoe. Give reason for your choice

Diagram 20.3

Type of Backhoe	Size of tyre	Fluid used in hydraulic system	Mass	Base area	Centre of gravity
P	Large	Liquid	Large	Large	Low
Q	Large	Liquid	Small	Large	Low
M	Large	Gas	Large	Small	High
N	Medium	Liquid	Large	Medium	Low
S	Large	Liquid	Large	Medium	High

Answer

Characteristics	*Reason*
The size of tyre must be big	*To prevent the backhoe from sinking into soft ground*
Fluid used in the hydraulic system is liquid	*Liquid has very low compressibility*
The mass must be big	*The backhoe will be more stable*
The base area must be big	*Ensure that the backhoe will not collide*
The centre of gravity must be low	*Stable from falling*

So, the backhoe P is chosen because its tyre is big, fluid used in hydraulic system is liquid, has large mass, the base area is large and has low centre of gravity.

(g) Diagram 20.4 shows a transformer connected between a 240 V a.c. power supply and two light bulbs. The bulbs are at normal brightness and the reading of the ammeter is 0.25 A.

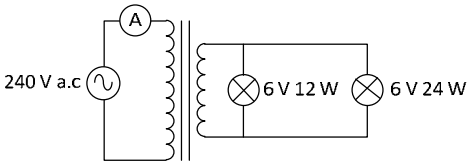


Diagram 20.4

(1) State the type of transformer in Diagram 20.4.

Step-down transformer

(2) What is the output voltage of the transformer?

6 V

(3) Calculate the efficiency of the transformer?

Input power, P = IV = 240 × 0.25 = 60 W
Output power, P = 12 W + 24 W = 36 W
Efficiency = (36/60) × 100% = 60 %

(4) Explain why the transformer must use a.c. input voltage?

So that the voltage can be changed easily

21 Diagram 21.1 shows a bright spot, *M*, formed on the screen on the cathode ray oscilloscope, CRO, when it is switched on.

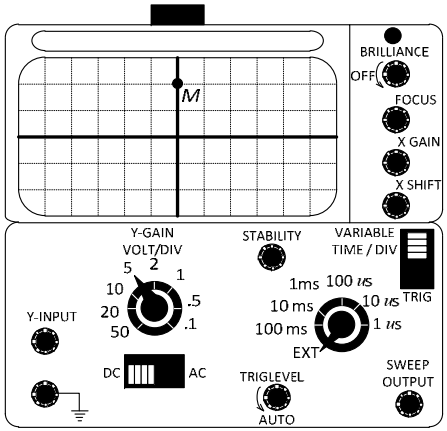


Diagram 21.1

(a) What is the meaning of cathode ray?

Cathode ray is a fast moving electron beam

(b) What is the meaning of *thermionic emission*?

Thermionic emission is the process of releasing electrons from a heated cathode surface.

(c) Name the particle that produces the bright spot, *M*, when it hits the fluorescent screen of the CRO.

Electron

(d) Explain how to produce a bright spot, M on the screen of CRO?

The d.c voltage is supplied to the CRO with the time-base is set off.

(e) Diagram 21.2 shows the bright spot,*N* when a direct current d.c. supply is connected to the Y-input of the CRO.

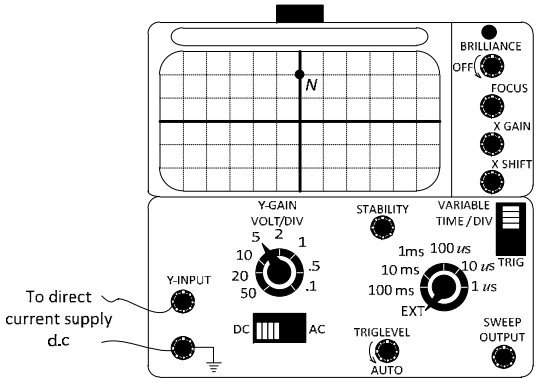


Diagram 21.2

The Y-gain of the CRO is set at 5 V / division with the time-base is set off.

Calculate the value of the voltage shown by *N*.

Value of voltage = 5 V per division × 2 divisions

= 10 V

(f) The CRO in Diagram 21.2 is connected to alternating current supply, a.c and the time-base is set off.

On Diagram 21.3 below, sketch the output waveform that will be displayed on the screen.

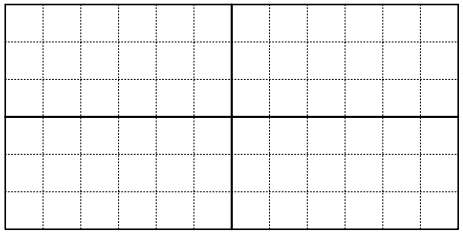
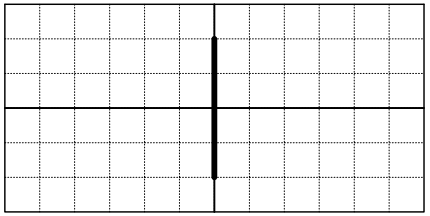


Diagram 21.3

Answer



(g) State one common function of CRO.

To display waveform //To measure short time interval // To measure the potential difference

(h) Diagram 21.4 and Diagram 21.5 show two circuits which consist of identical ammeters, dry cells and semiconductor diodes.

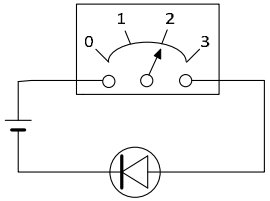


Diagram 21.4

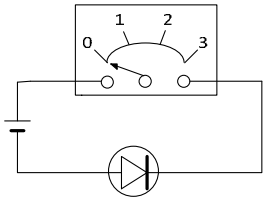


Diagram 21.5

(1) Name an example of pure semiconductor material.

Silicon

(2) Explain the difference in the readings of the ammeters

The current flow is in forward bias in Diagram 21.4 causes an ammeter reading but no reading in Diagram 21.4 due to the reverse of diode which has blocked the current flow

(3) Based on the answer in (h)(2), state the function of diode.

To allow the flow of current in one direction only

22 Diagram 22.1 shows the pattern of sea waves when approaching the beach.

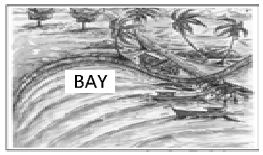


Diagram 22.1

(a) Name the wave phenomenon shown in Diagram 22.1.

Refraction

(b) Explain in terms of the wave phenomena in 22(a), why the water waves follow the shape of the beach as it approaches the shore.

When the waves refract from deep sea to shallower sea, both the wavelength and the energy decrease. Therefore, it becomes weaker and follows the shape of the beach.

(c) Diagram 22.1 shows the seashore of a fishing village. During the rainy season, waves are big. One year the waves eroded the seashore, caused the jetty to collapse and damaged the fishermen's boats.

To prevent similar damage in the future, the fishermen suggest building retaining walls and relocating the jetty. You should use your knowledge of reflection, refraction and diffraction of waves to explain these suggestion, to include the aspects:

i. the design and structure of the retaining wall

ii. the location of the new jetty

iii. the size or energy of the waves.

Answer

Suggestion	Reason
Design an inclined concrete barrier	*Wave is refracted with decreasing wavelength*
Jetty is build at bay	Wave at bay is calmer
Built diffraction barrier (slit very small) for ship passage	Less wave energy passing through
Barrier is built from a strong material/concrete	*Not easily corrosive/broken// can prevent a strong hard wave*
Design the higher barrier	*Water cannot over flow*

(d) Diagram 22.2 shows a Barton's pendulum which consists of five simple pendulums hanging on a horizontal string. When *A* is pulled and released, it will cause the other four pendulums to oscillate.

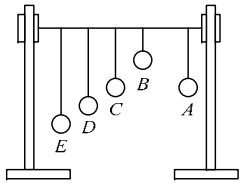


Diagram 22.2

It is observed that the four pendulums *B, C, D* and *E* will oscillate with different amplitudes but with the same frequency

(i) What is the meaning of amplitude?

Amplitude is the maximum displacement of wave from the equilibrium position

(ii) Which pendulum oscillates with the maximum amplitude?

Pendulum C

(iii) State **one** reason for your answer in 22(d)(ii).

Has the same length with the pendulum A

(iv) Name the phenomenon stated in 22(d)(iii).

Resonance

(e) Ultrasonic echoes are wisely used in medicine to 'see' the internal organs of inside the body. Diagram 22.3 shows the use of ultrasound scanner across the mother's womb to see the unborn babies.

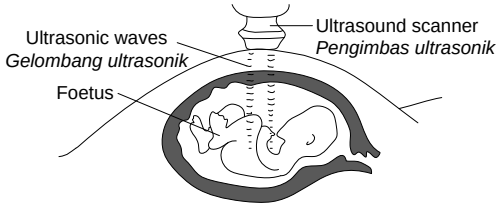


Diagram 22.3

Table 22 shows the characteristics of the ultrasound scanner *W*, *X*, *Y* and *Z*.

Scanner	Type of wave	Frequencies range (Hz)	Penetrating power	Ionizing power
W	Mechanical	< 20 000	High	Low
X	Mechanical	> 20 000	Low	Low
Y	Electromagnet	< 20 000	Low	High
Z	Electromagnet	> 20 000	Low	High

Table 22

Explain the suitability of each characteristic in Table 22 that can be used as ultrasound scanner to scan the image of foetus safely. Determine the most suitable ultrasound scanner to be used and hence, justify your choice.

Characteristics	*Reason*
Use mechanical wave	*Ultrasonic needs medium to travel*
Use high frequency	*The image scanned is clear*
Use low penetrating power	*Does not hurt the foetus*
Use low ionizing power	*Does not change the structure of cells of foetus*

So, scanner X is chosen because it use mechanical wave, use high frequency, low penetrating power and low ionizing power

23 Diagram 23.1 and Diagram 23.2 shows water waves passing through the entrance of two different harbours.

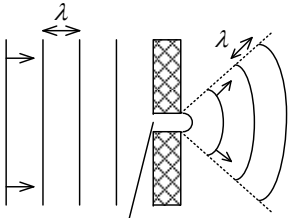


Diagram 23.1

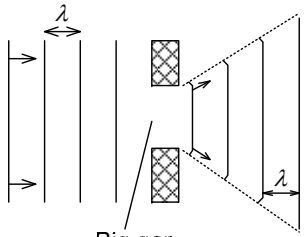


Diagram 23.2

(a) Name the type of wave of water wave.
Transverse wave

(b) **(i)** Name the phenomenon involved in both diagrams.
Diffraction

(ii) What will happen to the frequency, wavelength and speed of wave after passing through the gap?
Frequency : unchanged
Wavelength : unchanged
Speed of wave : unchanged

(c) Between Diagram 23.1 and Diagram 23.2, which one shows the obvious diffraction effect? Explain why?
Diagram 23.1 shows obvious diffraction effect.
Because the size of gap is less than the wavelength of the wave

(d) Between Diagram 23.1 and Diagram 23.2, which one shows the bigger energy wave entering the gap?
Diagram 23.2

(e) Diagram 23.3 shows the waves entering two different mediums.

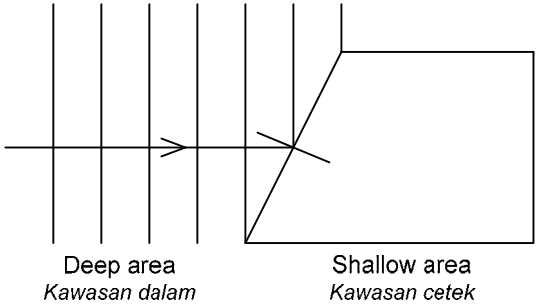
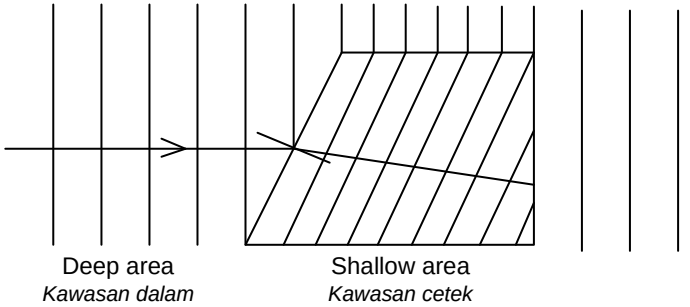


Diagram 23.3

(i) Name the phenomenon involved.
Refraction

(ii) What will happen to the frequency, wavelength and speed of wave after passing through the gap?
Frequency: unchanged
Wavelength: decreases
Speed of wave: decreases

(iii) Complete the wave pattern in Diagram 23.3.



(f) Diagram 23.4 shows a driver that is driving under a hot sun, sees a pool of water appearing on the road ahead, but the pool of water disappears as the car approaches it.

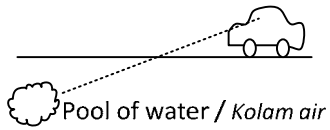


Diagram 23.4

(i) Name this natural phenomenon as observed by the driver.
Mirage

(ii) State the physics concept that is involved in this phenomenon.
Total internal reflection

(iii) When light rays propagates from a denser medium to a less dense medium, state what happen to the direction of the refracted rays.
Refracted away from normal

(iv) State one application of this phenomenon.
Optical fibre

PAPER 3 EXPERIMENTS

1 DEPTH WITH PRESSURE

Diagram 1.1 shows a scuba diving in a sea notices that the water pressure acted on his eardrums is greater when he dives at greater depth.

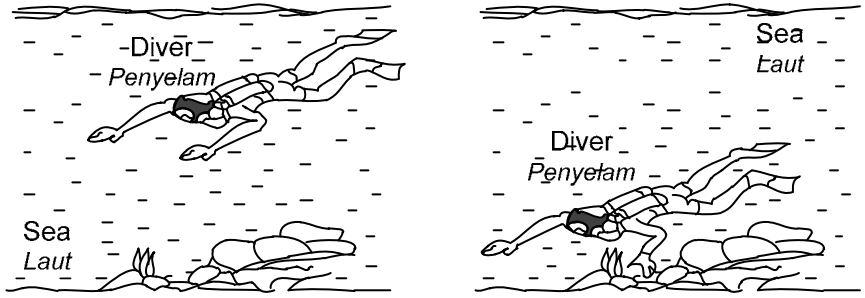


Diagram 1.1

Based on your knowledge of the pressure and observation above:

(a) State **one** suitable inference. [1 *mark*]

(b) State **one** suitable hypothesis. [1 *mark*]

(c) With the use of apparatus such as thistle funnel, a manometer and other apparatus, describe an experiment framework to investigate the hypothesis stated in **1**(b).
In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus and materials

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) The way you would tabulate the data

(vii) The way you would analyse the data [10 *marks*]

ANSWER

(a) The water pressure is influenced by the depth of water

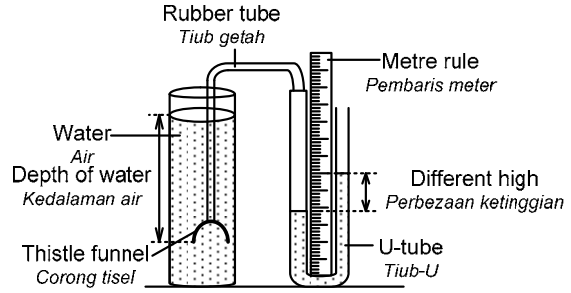
(b) When the depth of water increases, its water pressure increases also

(c) **(i)** To find the relationship between the depth with the water pressure

(ii) Manipulated Variable: depth of water
Responding Variable: water pressure
Constant Variable: density of water

(iii) Apparatus: Metre rule, manometer, water, rubber tube, measuring cylinder, thistle funnel, rubber sheet
Materials: water

(iv)



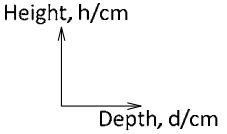
Operational Definitions:
-The depth of water is measured using metre rule
-The water pressure is measured from difference height between the column of water in manometer measured using metre rule

(v) -The experiment is started by lowering the thistle funnel into the water to depth, x = 2 cm. The reading of difference in height of water column, h, of the manometer is recorded.
-The procedure is repeated with the depths of 4 cm, 6 cm, 8 cm, 10 cm and 12 cm and the respective reading of the manometer are read respectively from metre rule.

(vi)

Depth x/cm	Difference in height of column, h/cm
2	
4	
6	
8	
10	
12	

(vii) A graph of difference in height of water column against the depth is plotted.



2 DENSITY OF LIQUID WITH PRESSURE

Diagram 2.1 shows a scuba diving in a sea notices that the water pressure acted on his eardrums is greater compared to fresh water at same depth.

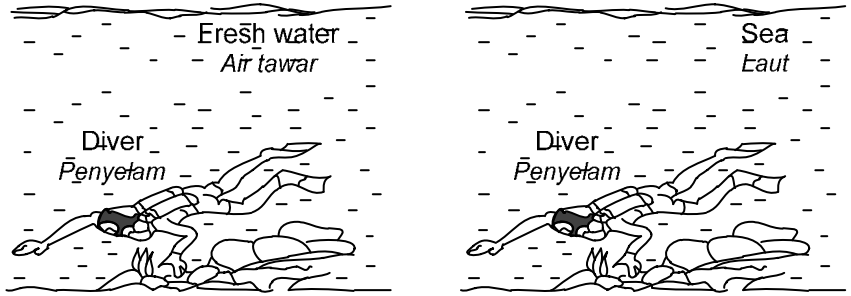


Diagram 2.1

Based on observation above:

(a) State **one** suitable inference. [1 *mark*]

(b) State **one** suitable hypothesis. [1 *mark*]

(c) With the use of apparatus such as thistle funnel, salts, a manometer and other apparatus, describe an experiment framework to investigate the hypothesis stated in **2**(b).
In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus and materials

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) The way you would tabulate the data

(vii) The way you would analyse the data [10 *marks*]

ANSWER

(a) The water pressure is influenced by the density of water

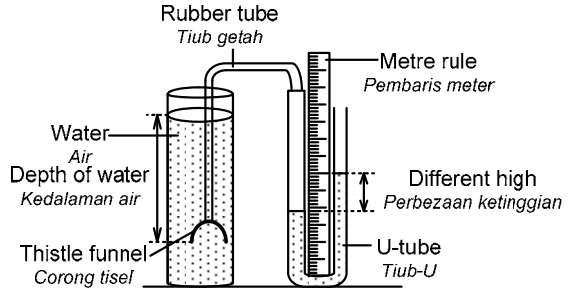
(b) When the density of water increases, its water pressure increases also

(c) **(i)** To find the relationship between the density of liquid with the water pressure

(ii) Manipulated Variable: density of water
Responding Variable: water pressure
Constant Variable: depth of thistle funnel immersed

(iii) Apparatus: Metre rule, manometer, water, rubber tube, measuring cylinder, thistle funnel, rubber sheet
Materials: water, salts

(iv)



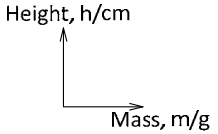
Operational Definitions:
-The depth of thistle funnel is fixed at 10cm.
-The water pressure is measured from difference height between the column of water in manometer measured using metre rule
-Density of water is determined from the mass of salts dissolved

(v) -The experiment is started by dissolving 200g of salt into the water with fixed volume of V. The thistle funnel immersed into the water to depth 10 cm. The reading of difference in height of water column, *h*, of the manometer is recorded.
-The procedure is repeated with the amount of salt dissolved of 400g, 600g, 800g and 1000g and the respective reading of the manometer are read respectively from metre rule.

(vi)

Amount of salt, m/g	Difference in height of column, h/cm
200	
400	
600	
800	
1000	

(vii) A graph of difference in height of water column against the mass of salt is plotted.



3 DEPTH WITH READING OF SPRING BALANCE (BUOYANT FORCE)

Diagram 3.1 shows a boy lifted up a rock in the sea water.
Diagram 3.2 shows the boy lifted up the rock at the surface of the sea water. He feels much heavier than before.

Diagram 10.1

Diagram 10.2

Based on your knowledge of the buoyant force and observation above:

(a) State **one** suitable inference. [1 *mark*]

(b) State **one** suitable hypothesis. [1 *mark*]

(c) With the use of apparatus such as tall beaker, spring balance, a metal rod and other apparatus, describe an experiment framework to investigate the hypothesis stated in **3**(b).
In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus and materials

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) The way you would tabulate the data

(vii) The way you would analyse the data [10 *marks*]

ANSWER

(a) The immerse distance affects the buoyant force

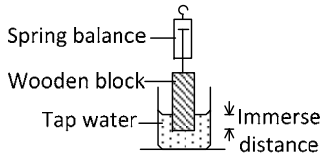
(b) When the immerse distance increases, its buoyant force increases also

(c) **(i)** To find the relationship between the immerse distance with the buoyant force

(ii) Manipulated Variable: immerse distance
Responding Variable: buoyant force (decrease in spring balance reading)
Constant Variable: density of water

(iii) Apparatus: spring balance, beaker, metre rule, load
Materials: string, tap water

(iv)



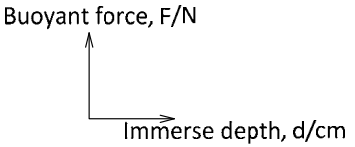
Operational definition
-The immerse distance is measured using metre rule
-The buoyant force is measured from the decrease in spring balance reading (reading in air – reading in water)

(v) -The experiment is started by immersing the load into the water to a depth of, d = 2 cm and the buoyant force acting to the wooden block can be counted by the changes in the reading of spring balance, F_1 is recorded.
-The experiment is then repeated by immersing the load to depth of 4 cm, 6 cm, 8 cm, 10 cm and 12 cm and the respective changes in the reading of spring balance, *F* are recorded.

(vi)

Immerse depth, d/cm	Buoyant force, F/N
2	
4	
6	
8	
10	
12	

(vii) A graph of buoyant force against the immerse distance is plotted.



4 TRANSFORMER (NUMBER OF TURNS OF SECONDARY COILS WITH INDUCED CURRENT/VOLTAGE)

Diagram 4.1 shows a substation in a residential area in Shah Alam. The number of turns of primary coil of the transformer is 200 with the voltage of 450 V while the number of turns of secondary coil of the transformer is 107 with the voltage of 240V.

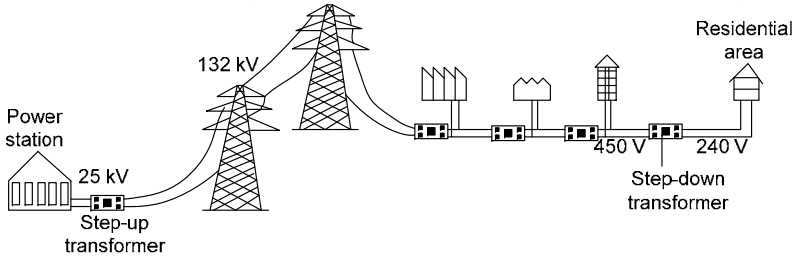


Diagram 4.1

Based on the above observation;

(a) State **one** suitable inference. [1 *mark*]

(b) State **one** suitable hypothesis. [1 *mark*]

(c) With the use of apparatus such as ammeter, voltmeter, constantan wire, metre rule and other apparatus, describe an experiment framework to investigate the hypothesis stated in 4(b).
In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus and materials

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) The way you would tabulate the data

(vii) The way you would analyse the data [10 *marks*]

ANSWER

(a) The magnitude of induced current depends on the number of turns of secondary coils

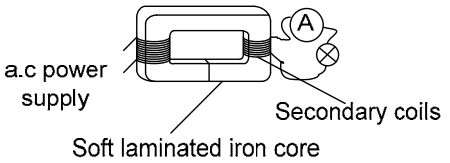
(b) When the number of turns of secondary coils increases, the magnitude of induced current increases also

(c) **(i)** To investigate the relationship between number of turns of secondary coils with the magnitude of induced current

(ii) MV: number of turns of the secondary coil
RV: Magnitude of induced current or potential difference
CV: number of turns of primary coils/ strength of magnet used

(iii) Apparatus: soft iron, ammeters/voltmeter, C-shape magnet bars, a.c power supply, bulb, connecting wires

(iv)



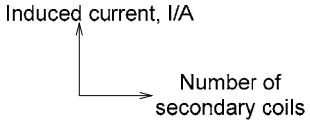
Operational Definitions:
-The induced current is measured using ammeter

(v) -Set up the apparatus as shown, with a 240 V ac current supply with 50 turns on the primary coil.
-Set the secondary coil so that the number of turns *n* = 20
-Switch on the power supply, measure the current, I (with the ammeter) that passes through the secondary coil.
-Repeat step 2 and 3 for n = 40, 60, 80 and 100 turns.

(vi)

Number of secondary coils, n	Induced current, I/A
20	
40	
60	
80	
100	

(vii) Graph of induced current, I/A against the number of secondary coils, *n* is plotted.



5 **ALSO READ**
-SWING OF PENDULUM BOB
-MASS/VOLUME OF WATER WITH BOILING TIME
-ANGLE OF INCIDENT WITH ANGLE OF REFRACTION
-DISTANCE BETWEEN TWO SPEAKERS WITH DISTANCE BETWEEN TWO LOUD SOUNDS
-NUMBER OF TURNS WITH INDUCED CURRENT (LENZ'S LAW)
-SPEED/HEIGHT OF MAGNET BAR DROPPED WITH INDUCED CURRENT (LENZ'S LAW)

END OF READING OF MODULE