THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/1 **PHYSICS 1**

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2012**

Instructions

1. This paper consists of sections Section A, B and C with total of fourteen questions.
2. Answer ten questions choosing four questions from section A and three questions from each of section B and C.

1. (a)(i) briefly explain two types of errors that are likely to occur whenever an experimental measurement is made.

- systematic error: occurs due to consistent inaccuracies in measurement caused by faulty instruments or incorrect calibration.
- random error: occurs due to unpredictable variations in measurement conditions, such as human reaction time or environmental factors.

(ii) the length, l of a simple pendulum which is about 0.5m can be measured within 1mm. what accuracy is required in the measurement of the periodic time, T of 100 oscillations if the errors in L and T are to produce equal percentage in the calculated value of acceleration due to gravity, g?

acceleration due to gravity is given by:

$g = (4\pi^2 L) / T^2$

taking logarithms and differentiating:
$\Delta g / g = \Delta L / L + 2(\Delta T / T)$

since percentage errors must be equal:
$\Delta L / L = 2(\Delta T / T)$

substituting values:
$(0.001 / 0.5) = 2(\Delta T / T)$
$0.002 = 2(\Delta T / T)$
$\Delta T / T = 0.001$
percentage accuracy required in T:
$\%$ error = 0.001×100
$\%$ error = 0.1%

(b)(i) how is a precise physics experiment related to an accurate one?
- a precise experiment gives consistent results upon repetition, while an accurate experiment provides values close to the true or accepted value. a good experiment should be both precise and accurate.

(ii) the diameter of a steel rod is given as (56.47 ± 0.02) mm. what does this mean?
- this means that the true diameter of the rod lies within the range of 56.45 mm to 56.49 mm, with an uncertainty of ± 0.02 mm.

(c)(i) what is meant by the statement that "an equation is homogeneous with respect to its units"?
- an equation is homogeneous if the dimensions on both sides of the equation are the same, ensuring that the equation is dimensionally consistent.

(ii) the stress S, required to fracture a solid can be expressed as $S = k \sqrt{(E / d)}$.

where k is a dimensionless constant, E is the young's modulus, and d is the distance between the planes of atoms separated by the fracture. if the equation is dimensionally consistent, find the dimensions of the physical quantity, λ and suggest the meaning of this quantity.

dimensions of E (young's modulus):
E = stress / strain
= (force / area) / strain
= $(MLT^{-2} / L^2) / 1$
= $ML^{-1}T^{-2}$
dimensions of d:

d = L

verifying $S = k\sqrt{(E / d)}$:

$[S] = [\sqrt{(ML^{-1}T^{-2} / L)}]$
$[S] = \sqrt{(ML^{-2}T^{-2})}$
$[S] = M^{1/2} L^{-1} T^{-1}$

since stress has the same dimension as S, the equation is dimensionally consistent.

λ has dimensions of L (length), suggesting it represents a characteristic length or a fracture-related parameter.

2. (a) distinguish the terms projectile and trajectory as applied to projectile motion.
- a projectile is an object thrown or launched into the air that moves under the influence of gravity.
- a trajectory is the curved path followed by a projectile during its motion.

(b) a meteorite is traced by a radar as it falls through the earth's atmosphere when its altitude is 3.0×10^4 m. the screen shows that the meteorite is travelling with the velocity of 58.3 m/s at an angle of 28.3° below the horizontal. in the absence of air and at re-entry to the earth's atmosphere:

(i) how much time elapse before the meteorite strikes the earth?
using vertical motion equation:
$h = v_0y\ t + (1/2)\ g\ t^2$
where:
$h = 3.0 \times 10^4$ m
$v_0y = 58.3 \sin 28.3°$
$g = 9.81\ m/s^2$

solving for t using quadratic equation:
t = 78.4 s

(ii) what is the magnitude and direction of the velocity of meteorite just before impact with the earth?

using $v_y = v_0y + g t$:

$v_y = 58.3 \sin 28.3° + 9.81 \times 78.4$
$v_y = 770.1$ m/s

resultant velocity:

$v = \sqrt{(v_x^2 + v_y^2)}$
$= \sqrt{((58.3 \cos 28.3°)^2 + (770.1)^2)}$
$= 772.3$ m/s

angle with horizontal:
$\theta = \tan^{-1} (v_y / v_x)$
$\theta = \tan^{-1} (770.1 / 58.3 \cos 28.3°)$
$\theta = 85.7°$

(c)(i) what assumptions are made in the treatment of projectile motion?

- air resistance is negligible
- acceleration due to gravity is constant
- the effect of the earth's rotation is ignored

(ii) find the angle of projection of a projectile at which the horizontal range and the maximum height have equal values.

using standard equations:

$R = (v_0^2 \sin 2\theta) / g$
$H = (v_0^2 \sin^2 \theta) / (2g)$

equating R = H:
$\sin 2\theta = 2 \sin^2 \theta$
solving for θ:
$\theta = 76°$

3. (a)(i) can a sailboat be propelled by air blown at sails from a fan attached to the boat? give reasons for your answer.

- no, because the air exerts equal and opposite forces on both the fan and the sail, resulting in no net force to propel the boat forward.

(ii) "action and reaction forces are equal and opposite to each other". if it is so, why don't they produce a net force on an object?
- action and reaction forces act on different bodies, so they do not cancel each other but instead influence the motion of separate objects.

(b) a child is whirling a 0.012 kg ball on a string in a horizontal circle whose radius is 0.10 m. if the ball travels once around the circle in 0.5 sec:

(i) determine the centripetal force acting on the ball.

velocity of the ball:
$v = 2\pi r / T$
$= (2 \times 3.142 \times 0.10) / 0.5$
$= 1.26$ m/s
centripetal force:
$F = mv^2 / r$
$= (0.012 \times 1.26^2) / 0.10$
$= 0.19$ N

(ii) why does such a force do no work in a circular orbit?
- centripetal force is always perpendicular to the velocity of the object, meaning no displacement occurs in the direction of the force, so no work is done.

(c) if the speed of the ball in (b) is doubled, by what factor does the centripetal force increase?
- centripetal force is proportional to the square of velocity:
$F' = m (2v)^2 / r$
$= 4 mv^2 / r$
$= 4F$
the force increases by a factor of 4.
4. (a)(i) why is it not possible to separate two pieces of paper joined by glue?

- glue forms strong adhesive bonds with the paper surfaces due to intermolecular forces and surface tension, preventing easy separation.

(ii) why is it not sensible to rub the canvas of a tent in wet weather?

- rubbing disturbs the uniform film of water on the tent fabric, reducing surface tension and causing water to penetrate through the material.

(b)(i) mention two factors which may change the value of surface tension.

- temperature: an increase in temperature decreases surface tension.

- impurities: adding surfactants (e.g., soap) lowers surface tension, while some dissolved substances can increase it.

(ii) give comments on the statement that "water droplets are slippery when they fall on an oil surface".

- oil has a lower surface tension than water, preventing water droplets from spreading and forming a stable contact. this causes them to bead up and slide easily.

(c) a particle rests on the horizontal platform which is moving vertically in a simple harmonic motion with an amplitude of 50mm. if above a certain frequency the particle ceases to remain in contact with the platform throughout the motion:

(i) determine the lowest frequency at which this situation will occur.

for the particle to lose contact, the acceleration of the platform must exceed gravitational acceleration:

$a_{max} = \omega^2 A \geq g$

substituting values:

$(2\pi f)^2 \times (0.05) \geq 9.81$

solving for f:

$f = (1 / 2\pi) \times \sqrt{(9.81 / 0.05)}$
$f = (1 / 6.283) \times \sqrt{(196.2)}$
$f = 0.159 \times 14$
$f = 2.23$ hz

(ii) at what position the particle ceases to remain in contact with the platform?

- the particle loses contact when the platform reaches its maximum downward acceleration, which occurs at the highest position in the motion.

5. (a)(i) what is the difference between kelvin temperature scale and celsius temperature scale?

- the kelvin scale is an absolute temperature scale starting at absolute zero, whereas the celsius scale is relative and based on the freezing and boiling points of water.

(ii) mention three basic advantages of a gas thermometer.

- accurate over a wide range of temperatures
- independent of material expansion properties

- follows the ideal gas law, ensuring consistent measurements

(b)(i) what is meant by a "perfect thermal source" as used in thermal radiation?

- a perfect thermal source emits radiation according to planck's law and acts as an ideal black body, absorbing and emitting radiation at all wavelengths.

(ii) the coefficient of volume expansion of glycerine is 4.9×10^{-4} c^{-1}. what is the fractional change in its density for a 30°c rise in temperature?

fractional change in density is given by:

$\Delta\rho / \rho = - \beta \Delta T$

substituting values:

$\Delta\rho / \rho = - (4.9 \times 10^{-4}) \times (30)$
$\Delta\rho / \rho = - 0.0147$

the fractional change in density is **-0.0147**.

(c)(i) define thermal conduction.

- thermal conduction is the transfer of heat energy through a material due to temperature differences, without the movement of the material itself.

(ii) an aluminium saucepan in contact with a hot plate has a base of diameter 20.0 cm and thickness of 0.5 cm. if the saucepan contains water boiling away at the rate of 0.15 g/s, estimate the temperature at the lower surface of the saucepan vessel.

given:
diameter = 20 cm = 0.2 m
thickness = 0.5 cm = 0.005 m
mass flow rate of water = 0.15 g/s = 0.00015 kg/s
latent heat of vaporization of water = 2.26×10^6 j/kg
thermal conductivity of aluminium = 237 w/mk

heat required to vaporize water:

$Q = mL$
$Q = 0.00015 \times 2.26 \times 10^6$
$Q = 339$ j/s

heat conduction equation:

$Q = k A (\Delta T / d)$

area:

$A = \pi d^2 / 4$
$A = \pi (0.2)^2 / 4$
$A = 0.0314 m^2$

substituting values:

$339 = (237 \times 0.0314 \times \Delta T) / 0.005$

solving for ΔT:

$\Delta T = (339 \times 0.005) / (237 \times 0.0314)$
$\Delta T = 1.8°c$

temperature at the lower surface:

$T_{lower} = T_{water} + \Delta T$
$T_{lower} = 100 + 1.8$
$T_{lower} = 101.8°c$

6. (a)(i) what is a perfectly black body?

- a perfectly black body is an idealized object that absorbs all incident radiation and emits radiation according to planck's law without reflecting any light.

(ii) give one limitation of newton's law of cooling.

- newton's law of cooling is valid only when the temperature difference between the object and its surroundings is small and convection is the dominant mode of heat transfer.

(b)(i) why does a good absorber of radiant energy appear black?

- a black surface absorbs almost all incident radiation and reflects very little, making it appear black.

(ii) why two sheets of similar glass insulate much more effectively when separated by a thin layer of air than when they are in contact?

- air is a poor conductor of heat, and a thin air layer reduces heat transfer by conduction, enhancing insulation.

(c) a roof measures 20 m × 50 m is blackened. if the temperature of the sun's surface is 6000 k, calculate the solar energy incident on the roof per minute, assuming that half of it is lost when passing through the earth's atmosphere.

using stefan-boltzmann law:

$P = \sigma A T^4$

given:
$\sigma = 5.67 \times 10^{-8}$ w/m²k⁴
$A = 20 \times 50 = 1000$ m²
$T = 6000$ k

$P = (5.67 \times 10^{-8}) \times (1000) \times (6000)^4$
$P = (5.67 \times 10^{-8}) \times (1000) \times (1.296 \times 10^{15})$
$P = 7.35 \times 10^{10}$ w

power reaching the roof after atmospheric loss:

$P_{actual} = (1/2) \times 7.35 \times 10^{10}$
$P_{actual} = 3.68 \times 10^{10}$ w

energy incident per minute:

$E = P_{actual} \times 60$
$E = (3.68 \times 10^{10}) \times 60$
$E = 2.21 \times 10^{12}$ j

the solar energy incident on the roof per minute is 2.21×10^{12} j.

7. (a) define beat frequency.

- beat frequency is the difference in frequencies between two sound waves of nearly equal frequencies that interfere with each other, producing periodic variations in amplitude.

(b)(i) list down four necessary conditions for a stationary wave to be formed.

- two waves of the same frequency and amplitude must travel in opposite directions
- reflection of waves must occur at a boundary
- superposition of incident and reflected waves should occur

- interference leads to the formation of nodes and antinodes

(ii) an open pipe of length 15 cm and a pipe of length 11.5 cm closed at one end are both sounding their first overtones. if their notes are of the same frequency, what will be the end correction of the two pipes? state any assumption made in arriving at your answer.

To determine the end correction for the two pipes, we use the given condition that their first overtones produce the same frequency.

Given Data:
Open pipe length: $L_1 = 15$ cm
Closed pipe length: $L_2 = 11.5$ cm

Step 1: Frequency of the Open Pipe (First Overtone)
For an open pipe, the first overtone corresponds to the second harmonic, with a wavelength:

$\lambda = L_1 + 2e$

Frequency:

$f_1 = v / (L_1 + 2e)$
$f_1 = v / (15 + 2e)$

Step 2: Frequency of the Closed Pipe (First Overtone)
For a closed pipe, the first overtone corresponds to the third harmonic, with a wavelength:

$\lambda = 4(L_2 + e) / 3$

Frequency:

$f_2 = v / (\lambda)$
$f_2 = v / (4(L_2 + e) / 3)$
$f_2 = 3v / (4(L_2 + e))$
$f_2 = 3v / (4(11.5 + e))$

Step 3: Equating the Frequencies
Since the problem states that the first overtones have the same frequency:

$f_1 = f_2$

$v / (15 + 2e) = 3v / (4(11.5 + e))$

Cancel v:

$1 / (15 + 2e) = 3 / (4(11.5 + e))$

Step 4: Solving for e
Cross multiply:

$4(11.5 + e) = 3(15 + 2e)$

Expanding:

$46 + 4e = 45 + 6e$

Rearrange:

$46 - 45 = 6e - 4e$
$1 = 2e$
Solve for e:
$e = 0.5$ cm

Assumptions:
- Same End Correction: The end correction
e is assumed to be the same for each open end of both pipes, regardless of their differing geometries (open vs. closed). In reality, e depends on the pipe's diameter, but no diameter is provided, so this is a standard simplification.
- Speed of Sound: The speed of sound v is the same in both pipes (e.g., same temperature, medium, etc.), allowing it to cancel out.
- Ideal Conditions: The pipes are assumed to behave as ideal one-dimensional resonators, with no additional effects like air viscosity or complex boundary conditions.

(c) a transverse sinusoidal wave is generated at one end of a long horizontal string of linear density of 1.8×10^{-3} kg/m and is kept under a tension of 12.0 n by a bar which moves up and down repeating regularly twice each second through a distance of 0.25m. determine the:

(i) amplitude.
- the amplitude is half the total distance of vibration:

$A = 0.25 / 2$
$A = 0.125$ m

(ii) wavelength of the wave.
wave speed:
$v = \sqrt{(T / \mu)}$
$= \sqrt{(12.0 / 1.8 \times 10^{-3})}$
$= \sqrt{(6666.67)}$

= 81.7 m/s

frequency f = 2 hz
wavelength:
$\lambda = v / f$
= 81.7 / 2
= 40.85 m

8. (a) define the following terms:

(i) curie temperature.
- the temperature above which a ferromagnetic material loses its permanent magnetism and becomes paramagnetic.

(ii) remanence.
- the residual magnetism left in a material after an external magnetic field is removed.

(iii) coercive force.
- the reverse magnetic field required to reduce the magnetization of a material to zero.

(b)(i) what is meant by electrical oscillation as used in electric circuits?
- electrical oscillation refers to the periodic variation of current and voltage in an LC circuit due to energy exchange between the inductor and capacitor.

(ii) briefly explain how a permanent magnet and a current in a conductor can be used to demonstrate electromagnetic induction.
- when a conductor moves through a magnetic field or a magnet moves near a conductor, a changing magnetic flux induces an electromotive force (emf) in the conductor, demonstrating electromagnetic induction.

(c) a toroid of mean circumference of 0.5m has 500 number of turns, each bearing a current of 0.15a. if the core is filled with iron of relative permeability of 5000, calculate the:
(i) magnetic field intensity.
H = NI / L
substituting values:
H = (500 × 0.15) / 0.5
H = 75 / 0.5
H = 150 A/m

(ii) magnetic flux density.

$B = \mu_0 \mu_r H$

substituting values:
$B = (4\pi \times 10^{-7}) \times (5000) \times (150)$
$B = (6.283 \times 10^{-3}) \times 150$
$B = 0.942$ T

9. (a)(i) define the term drift velocity.
- drift velocity is the average velocity of charge carriers in a conductor due to an applied electric field.

(ii) a copper wire of cross-sectional area 3.0mm² carries a current of 5.0 a. find the magnitude of the drift velocity of electrons in the wire.

using the formula:
$I = n A v_d e$
solving for v_d:
$v_d = I / (n A e)$

where:
$n = 8.5 \times 10^{28}$ electrons/m³
$A = 3.0 \times 10^{-6}$ m²
$e = 1.6 \times 10^{-19}$ C

$v_d = (5) / ((8.5 \times 10^{28}) \times (3.0 \times 10^{-6}) \times (1.6 \times 10^{-19}))$
$v_d = (5) / (4.08 \times 10^{4})$
$v_d = 1.225 \times 10^{-4}$ m/s

(b)(i) the resistance of an electric conductor varies linearly with its temperature. write down the equation for this variation.

$R = R_0 (1 + \alpha \Delta T)$

(ii) state the significance of the slope per unit resistance for the variation in (b)(i) above.

- the slope represents the temperature coefficient of resistance, indicating how resistance changes with temperature.

(c) a cell of e.m.f, E and internal resistance, r is used to drive the current, I through a load of resistance, R. show that for the maximum electric power to be transferred to the load, a load resistance, R must be equal to the internal resistance, r of a cell.

power delivered to load:

$P = I^2 R$

using ohm's law:

$I = E / (R + r)$
substituting:

$P = (E^2 R) / (R + r)^2$
to maximize P, differentiate with respect to R and set $dP/dR = 0$:

$dP/dR = [(E^2 (R + r)^2 - E^2 R (2(R + r))] / (R + r)^4 = 0$

solving:
$(R + r)^2 = 2 R (R + r)$
$R + r = 2R$
$R = r$
for maximum power transfer, $R = r$.
10. (a)(i) distinguish between "frequency modulated" and "amplitude modulated" radio waves.

- frequency modulation (fm): varies the frequency of the carrier wave based on the audio signal.
- amplitude modulation (am): varies the amplitude of the carrier wave based on the audio signal.

(ii) explain why is fm radio broadcasting currently preferred than am radio broadcasting?
- fm provides better sound quality due to reduced noise and interference compared to am.

(b) the speech signals in the frequency range of 300 hz to 3400 hz are used to amplitude modulate a carrier wave of frequency 200 khz. determine the:

(i) bandwidth of the resultant modulated signals.
bandwidth = 2 × highest frequency of modulation

= 2 × 3400
= 6800 hz

(ii) frequency range of the lower sideband.
lower sideband = carrier frequency - modulation frequencies
= 200 khz - (3400 to 300)
= 196.6 khz to 199.7 khz

(c) the switching and amplifying action of a transistor was done by the circuit diagram below.
(i) briefly explain how does the circuit above can act as a switch.
- when the transistor is in saturation, it acts as a closed switch, and when it is in cutoff, it acts as an open switch.
(ii) briefly explain how does the circuit above can act as an amplifier.
- a small input current at the base controls a larger current at the collector, amplifying the input signal.

11. (a)(i) define electric potential at a point.

- electric potential at a point is the work done per unit charge in bringing a positive test charge from infinity to that point in an electric field.

(ii) two capacitors of capacitance 1×10^{-6} f and 1×10^{-9} f are charged to the same potential. give comments on which capacitor will give more intense electric shock if touched.

- the capacitor with larger capacitance (1×10^{-6} f) stores more charge, but the capacitor with smaller capacitance (1×10^{-9} f) has less stored charge. since electric shock intensity depends on charge release and energy stored ($u = 1/2\ cv^2$), the larger capacitor will deliver a stronger shock.

(b)(i) what is meant by relative permittivity.

- relative permittivity (dielectric constant) is the ratio of the permittivity of a material to the permittivity of free space, representing how much the material reduces the electric field within it.

(ii) the spherical shell of a van de graaff generator is to be charged to a potential of 10^6 v. calculate the minimum radius of the shell if the dielectric strength of air is 3×10^6 v/m.

using the relation:

$e = v / r$

rearrange for r:

$r = v / e$

substituting values:

$r = (10^6) / (3\times10^6)$
$r = 0.33$ m

the minimum radius of the shell is 0.33 m.

(c)(i) sketch a graph to show how a charge, q varies with time, t during charging process of a capacitor.

- the graph should show an exponential increase of charge with time, approaching a maximum limit asymptotically.

(ii) what is the significance of the gradient at any point along your graph in (c)(i) above.

- the gradient represents the charging current, which decreases over time as the capacitor reaches full charge.

12. (a)(i) compare the electrostatic and gravitational forces that exist between an electron and a proton.

- electrostatic force: attractive force given by coulomb's law $f = k\ q_1q_2 / r^2$, where k is the electrostatic constant.
- gravitational force: attractive force given by newton's law $f = g\ m_1m_2 / r^2$, where g is the gravitational constant.
- electrostatic forces are significantly stronger than gravitational forces for atomic particles.

(ii) the distance, r between an electron and proton in hydrogen atom is about 5.3×10^{-11} m. compute the electrical and gravitational forces between these two particles.

electrical force:

$f\_e = k\ q_1\ q_2 / r^2$

substituting values:

$f\_e = (8.99 \times 10^9) \times (1.6 \times 10^{-19})^2 / (5.3 \times 10^{-11})^2$
$f\_e = (8.99 \times 10^9 \times 2.56 \times 10^{-38}) / (2.809 \times 10^{-21})$
$f\_e = 8.2 \times 10^{-8}$ n

gravitational force:

$f\_g = g\ m_1\ m_2 / r^2$

substituting values:

$f\_g = (6.67 \times 10^{-11} \times 9.11 \times 10^{-31} \times 1.67 \times 10^{-27}) / (5.3 \times 10^{-11})^2$
$f\_g = (1.014 \times 10^{-66}) / (2.809 \times 10^{-21})$
$f\_g = 3.6 \times 10^{-47}$ n

(b) a capacitor c_1 is charged to a potential difference, v_1. the charging battery is removed and the capacitor is then connected to uncharged capacitor c_2 as shown in figure 2.

(i) what is the final potential difference, v across the combination?

$v = (c_1\ v_1) / (c_1 + c_2)$

(ii) find the stored energy before and after the switch is thrown.

before:

$u_1 = 1/2\ c_1\ v_1^2$

after:

$u_2 = 1/2\ (c_1 + c_2)\ v^2$

(iii) is there any difference between the energy before and after the switch is thrown? give reasons for your answer.

- yes, there is a loss of energy due to redistribution of charge and internal resistance, leading to heat dissipation.

13. (a)(i) define ionization potential.

- ionization potential is the minimum energy required to remove an electron from an atom or ion in its ground state.

(ii) briefly explain the fact that de broglie waves are referred to as matter waves though are not composed of matter.

- de broglie waves describe the wave-like behavior of moving particles, even though they are not composed of traditional waves like sound or water waves.

(b) the three lowest energy levels of the electron in the hydrogen atom have energies of $e_1 = -21.8\times10^{-19}$ j, $e_2 = -5.43\times10^{-19}$ j and $e_3 = -2.43\times10^{-19}$ j. determine:

(i) the wavelength of hα spectral line due to the transition between energy level e_3 and e_2.

$e = h\ c / \lambda$

$\lambda = h\ c / (e_3 - e_2)$

substituting values:

$\lambda = (6.63 \times 10^{-34} \times 3 \times 10^8) / ((-2.43 + 5.43) \times 10^{-19})$
$\lambda = (1.99 \times 10^{-25}) / (3 \times 10^{-19})$
$\lambda = 656$ nm

(ii) the potential difference that enables an electron to be accelerated and cause the emission of hα spectral line.

$v = e / q$

$v = (e_3 - e_2) / e$

substituting values:

$v = (3 \times 10^{-19}) / (1.6 \times 10^{-19})$
$v = 1.88$ v

14. (a)(i) name three layers of the atmosphere.

- troposphere
- stratosphere
- mesosphere

(ii) describe any two major zones of the earth.

- crust: the outermost solid layer of the earth, consisting of rocks and minerals.
- mantle: a semi-solid layer beneath the crust, responsible for convection currents that drive plate tectonics.

(b)(i) what are the factors that influence the velocities of p and s waves?

- the density and elasticity of the medium they travel through.

(ii) the p and s waves from an earthquake with a focus near the earth's surface travel through the earth at nearly a constant speed of 8 km/s and 6 km/s respectively. if there is no reflection and refraction of waves, how long is the delay between the arrivals of successive waves at a seismic monitoring station at 90° in the latitude from the epicentre of the earthquake?

distance traveled = circumference of the earth / 4

d = (40,000 km) / 4
d = 10,000 km

time for p waves:

$t_p = d / v_p$
$t_p = 10{,}000 / 8$
$t_p = 1250$ s

time for s waves:

$t_s = d / v_s$
$t_s = 10{,}000 / 6$
$t_s = 1667$ s

delay time:

$t_s - t_p = 1667 - 1250$
$t_s - t_p = 417$ s

15. (a)(i) what do you understand by the word environmental physics?

- environmental physics is the study of physical processes and their interactions within the environment, including climate, energy, and pollution.

(ii) briefly explain three effects of seismic waves.

- destruction of buildings and infrastructure
- triggering of landslides and tsunamis
- alteration of groundwater flow

(b)(i) mention three types of environmental pollution.

- air pollution
- water pollution
- noise pollution

(ii) explain on the following climatic factors which influence plant growth: temperature, relative humidity and wind.

- temperature affects metabolic activities and photosynthesis.
- relative humidity influences transpiration rates and water uptake.
- wind affects pollination and seed dispersal.