

GCSE Mock Test 2023

Subject: PHYSICS
Board: AQA
Topic: Paper 2 (Higher)

Student Name: _____

School Name: _____

Date: 28.4.23

Score: 77/100

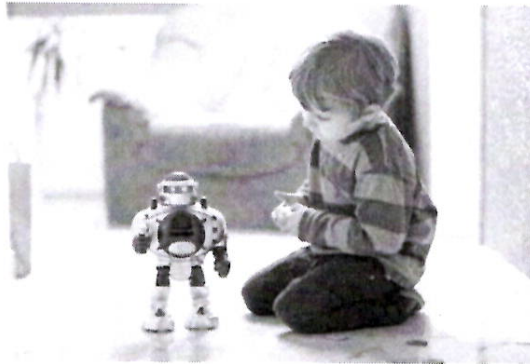
Total Marks: 100 marks

Time Allowed: 1 hour 45 min

Instructions:

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.
- Where appropriate, your answer should be supported with working. Marks might be given for a correct method, even if the answer is wrong.
- Please try all the questions.

1. Given figure, shows a child playing with a remote-controlled robot?



- (a) Remote control transmits radio waves to robot. The transmitted radio waves have a frequency of 250 MHz. Speed of radio waves is $1.5 \times 10^8 \text{ m/s}$.

Calculate the wavelength of the radio waves.

(3)

$$v = f \lambda$$

$$250 \text{ MHz} = 250 \times 1000 = 250 \text{ 000 kHz}$$

$$1.5 \times 10^8 \text{ m/s} = 2.5 \times 10^8 \times \lambda$$

$$\frac{1.5 \times 10^8}{2.5 \times 10^8} = \lambda = 600 \text{ m}$$

$$\text{Wavelength} = 600 \text{ m}$$

$$250 \times 1000 \times 1000$$

$$250 \text{ 000 000 Hz}$$

$$1.5 \times 10^8 = 2.5 \times 10^8 \times \lambda$$

$$\frac{1.5 \times 10^8}{2.5 \times 10^8} = \lambda = 0.6 \text{ m}$$

$$\underline{\underline{0.6 \text{ m}}} = \text{wave length}$$

(b) The robot produces sound waves

Give two ways in which radio waves are different from sound waves

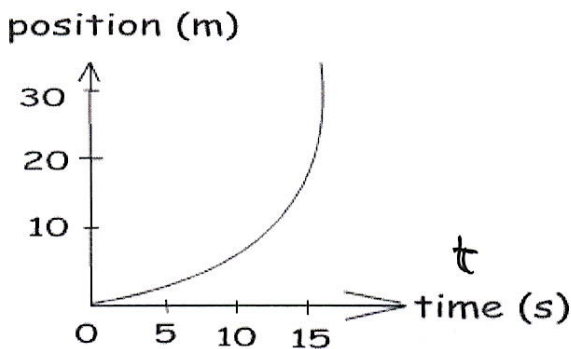
(2)

① radio waves are transverse whereas sound waves are longitudinal. Sound waves change speed when going through different mediums. What about radio waves?? Don't they

Another point - change speed?
could be → [Radio waves require no medium to travel whereas sound waves require medium to travel.]

(c) Fig shows the distance time graph for the first 15 seconds of the robot. Describe the motion of the robot in first 15 s.

(1)



① As the time progresses the robot moves further and faster until it reaches its terminal velocity at which point its speed is constant. Also, it's a non-uniform motion.

(d) Smith and Johnson were fighting over the advantages of the microphone and loudspeaker. Compare and contrast microphone and loudspeaker. (2)

Microphone	Loudspeaker
Microphone uses the generator effect to convert analogue waves to digital signals	Loudspeakers uses motor effect to generate analogue sound waves from electrical signals
Microphones input audio so <u>ie</u> and captures audio	Loudspeakers emits audio

(e) The resultant force on the trolley is 0.225 N. The mass of the trolley is 20 kg. Calculate the acceleration of the trolley. (2)

$$F = ma$$

$$0.225 \text{ N} = 20a$$

$$\frac{0.225}{20} = a = 0.01125 \text{ ms}^{-2}$$

$$0.01125 \text{ ms}^{-2} \quad 0.0113 \text{ ms}^{-2}$$

2. (a) What does CMB stand for?

~~Cosmic~~

Cosmic

Background

Radiation

[write with clarity] (1)



(b) Complete the following sentences using the words given below

(6)

lower, longer, pitch, stretched, frequency, doppler effect.

3 As an emergency vehicle's siren travels away from you, its pitch gets ~~stretched~~ ^{lower}. This is the ~~doppler effect~~ ^{Check Spelling}. The pitch of the sound depends on the ~~frequency~~ ^{frequency} of the sound wave. The sound waves behind the moving sound source become ~~longer~~ ^{longer} which makes their wavelength ~~longer~~ ^{longer}. This in turn lowers their frequency, and so we hear the sound as lower ~~pitch~~ ^{pitch}.

~~stretched~~
longer

~~longer~~
stretched

(c) Describe how astronomers describe the CMB.

(3)

3 Cosmic Background Radiation is the ~~entire~~ radiation in the universe that has come from the rapid expansion of the universe from one point, the Big Bang. ~~theory~~ Radiation that is passive across the whole universe and passes through each atom in the universe.

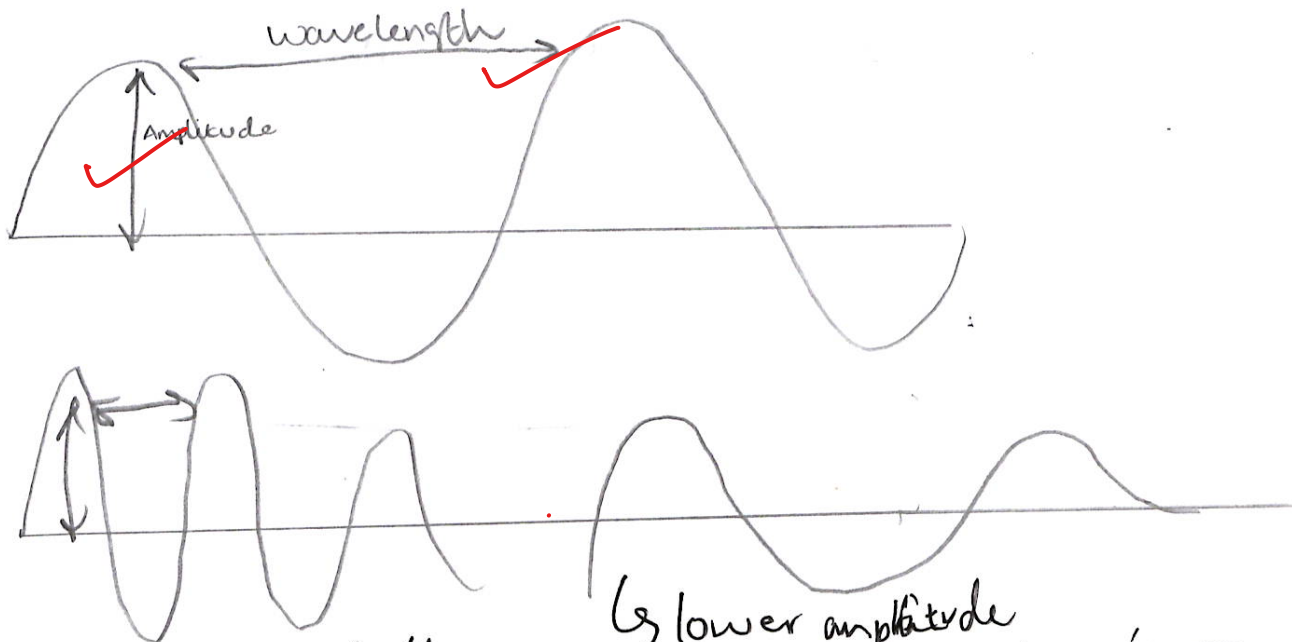
3.(a) Explain your understanding of period, wavelength, and amplitude in waves using a wave diagram (3)

Period is the ~~time~~ ^{time} amount of waves that it takes for one wave to pass through a certain point. Amplitude can affect the sound is the distance from the trough to crest and when adjusted can alter a pitch of sound wave for example. Wavelength is the distance from one trough to another ~~eri~~ and can affect its frequency. ~~making~~ ^{making} it ~~more~~.

Can be written as in this way too..

The maximum displacement of a particle from its equilibrium position is defined as its amplitude.

Diagram:



↳ shorter wavelength
↳ higher frequency
There are more ~~waves~~ ^{waves} in same ~~space~~ ^{space} amount of time

↳ lower amplitude
↳ longer wavelength

↳ slower frequency

(b) Write the relation between velocity, frequency and wavelength of the wave.

(1)

Velocity = frequency \times wavelength of the wave

①

(c) With a wavelength of 20 m, Emily can hear thunder. Determine the sound's frequency. (Speed of sound is 330 m/s)

(3)

$$\frac{20}{330} = 0.060606 \text{ s}$$

$$\frac{2}{33} = t$$

$$\frac{1}{\frac{2}{33}} = f = \frac{33}{2} = 16.5 \text{ Hz}$$

$$S = \frac{d}{t}$$

$$\frac{d}{S} = t$$

$$\frac{1}{t} = f$$

Wavespeed = frequency \times wavelength

$$\frac{\text{wavespeed}}{\text{wavelength}} = \text{frequency}$$

$$\frac{330}{20} = 16.5 \text{ Hz}$$

③

move from dense to less dense = away

(d) The light waves bend toward normal when they pass from water to air. (1)

True ☐

False ☒

(e) What term do we use when a wave bounces off the surface? (1)

reflection

(f) What is the frequency range of human hearing? (1)

20 Hz - 20000 Hz

Generator effect electromagnetic

4. (a) What is the name of the effect being produced by a moving magnet? (1)

~~Doppler's effect~~

~~Electromagnetic induction~~

~~Electronic effect~~

~~None of the above~~

electromagnetic induction

Try to keep
paper neat
& tidy.

23 + 4

(b) Describe the working of an electric motor with the help of suitable diagram.

(5)

~~When the wire is immersed~~

The wire coil solenoid is in the magnetic field. To solenoid at first is not in parallel with the field lines so a force acts on it. At south pole, the force moves ~~the~~ ^{anticlockwise} whereas the north goes clockwise causing the solenoid to rotate. When it has done

a full 180°, the coil will move in opposite direction back due to force causing it to not do a full 360° rotation unless split-ring commutators are used. When wire

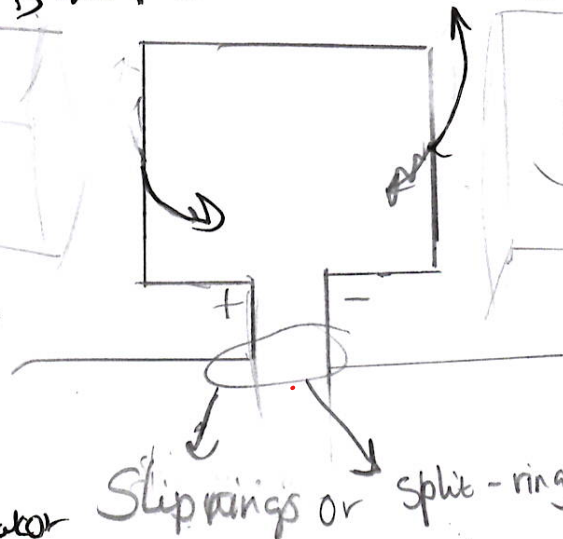
is in parallel with the field lines, no force acts on it as it doesn't intercept any field lines whereas when it is perpendicular to the field lines are acting on the wire causing

Diagram

force.

Will generate AC with slip rings

Will generate DC with split ring commutator



Good Explanation but the diagram needs to be improved.

(c) Explain how the following changes in the motor affect the working of the motor?

(4)

(i) When the current is doubled.

1 The force is double as the $F = BIL$ where B and L are constant in this case so if I increases then F will double. Resulting in double the force. So the motor rotates faster and works quicker. (Not clear answer)

As the current doubles, power will go by 4 times and the motor will go faster (up until you break it.)

(ii) When the magnets moved further apart.

2 When the magnets move further apart, the strength of the magnet decreases so this will result in the force acting on the ~~motor~~ wire to decrease so the motor will work slower.

$F = BIL$ where I & L are constants
 $\therefore F \uparrow = B \uparrow$ if $F \downarrow = B \downarrow$ so as force

5. (a) What property of light changes when it is refracted?

(1)

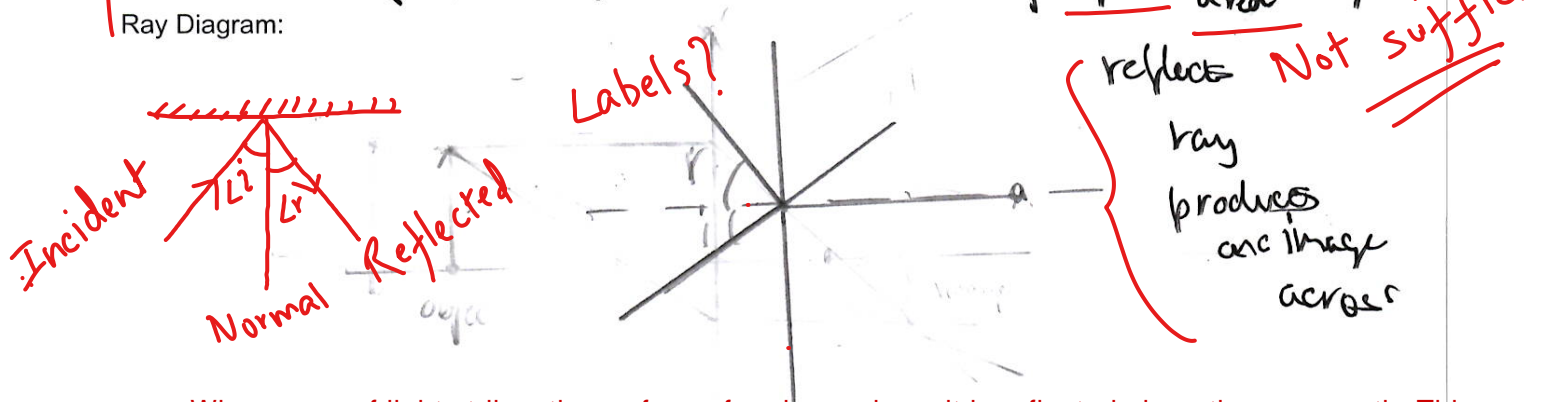
- 1
- ☐ Colour
 - ☒ Velocity
 - ☐ Wavelength
 - ☐ None of the above

30+4

(b) John was doing an experiment in which he made the light strike the plane mirror. Explain what will happen when a light ray strikes the plane mirror using a ray diagram. (2)

~~When the light strike the plane mirror, the light rays are refracted reflected create a virtual image from virtual rays. which light rays form an image~~

Ray Diagram:

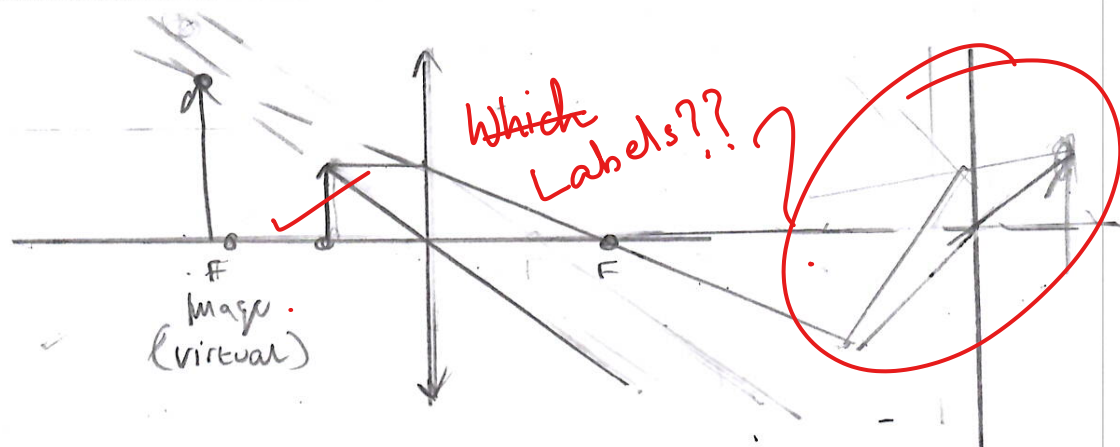


When a ray of light strikes the surface of a plane mirror, it is reflected along the same path. This process is known as reflection.

(c) What happens if a light ray strikes the mirror surface normally. Explain with the help of a ray diagram. (3)

~~light rays form a virtual rays which create a virtual image~~

Ray Diagram:

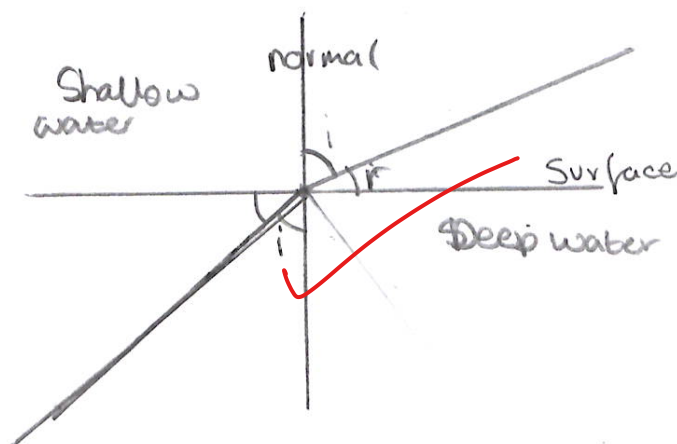


34 + 3

(d) What will happen if light rays pass from deep water to shallow water. Explain with the help of ray diagram. (2)

The light ray refracts away from normal.

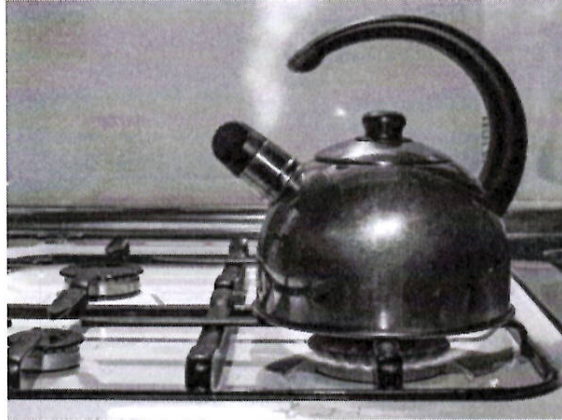
Ray Diagram:



(e) State the factors that influence the speed of sound. (1)

Density of medium

6. Shasha was learning about the different modes of heat transfer using a kettle on gas stoves.



(a) Explain what are the different modes of heat transfer on this kettle which is on a gas stove.

(3)

There is a mode of heat transfer which
Heat is being transferred via conduction from the
gas stove emitting heat to the kettle bottom of
the kettle. Convection occurs from the heating of
the fluid in the kettle releasing steam. Out radiation
occurs from the kettle releasing infrared radiation to the
surroundings as it has more thermal energy →
How??

37 + 2

(b) Write examples of conduction, convection and radiation.

(3)

Conduction

Transferring heat from a ~~heating~~ element to car seat
(car seat heater)

Convection

~~Boiling water in a kettle to~~
Using an oven to ~~bake~~ a cake.

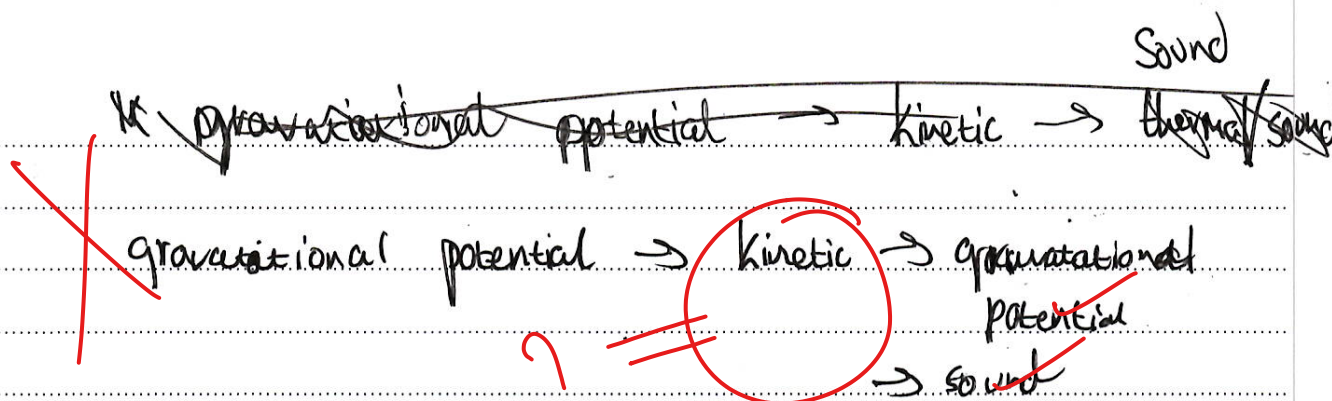
Radiation

Hot food ~~is heating~~ food up. House emits
heat via radiation. ~~Sun emits radiation~~ A barbeque
transfers heat via radiations

39 + 3

(c) Draw the energy transfer diagram for a child at the top of the slide until he reaches the ground.

(3)



42+0

(d) Which of the following is the unit of heat.

Joules

(1)

- ~~Newton~~
- Joule
- m/s
- None of the above

Joules per Kilogram

J/kg

7. (a) What do you understand about the "Law of conservation of energy"?

(1)

Energy can't be created nor or destroyed, only transferred.

(b) John uses a 100 W bulb in his house. He wants to save energy as he is getting a huge electricity bill. What are the ways in which he can resolve this issue?

(2)

Use a bulb that has a lower power usage.

Use light bulb less often / restrict its usage.

42+3

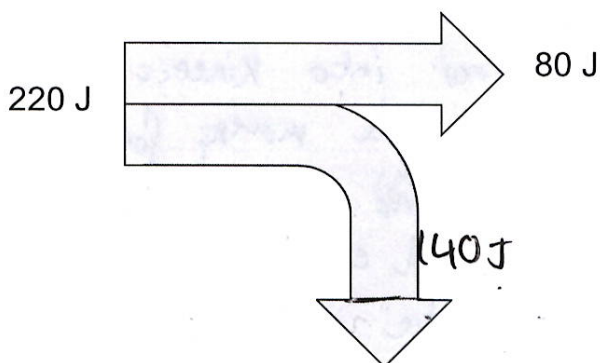
(c) Mike is taking part in a cycling contest. He is extremely interested in how energy is transformed while riding a bicycle. Describe the response below for Mike, and add an explanation of how wasted energy is transmitted into the environment. (3)

As the cyclist puts in effort, chemical energy from the cyclist is being transferred into kinetic energy which is the process of the cycle moving forward. The kinetic energy is then transferred into waste? energy such as thermal or sound energy due to friction between the bike and the ground.

47 + 3

(d) Calculate the wasted energy and the energy efficiency from the Sankey diagram given below:

(3)



$$220 \text{ J} - 80 \text{ J} = 140 \text{ J wasted}$$

$$\therefore \frac{80 \text{ J}}{220 \text{ J}} = 0.36 \text{ energy efficient}$$

$$\text{or } 36\% \text{ energy efficient}$$

(3)

50+3

8. (a) The sun is an average star. Explain the life cycle of stars much bigger than the sun.

(5)

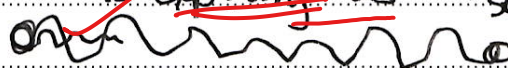
(5) First a nebula with dust & gas condenses due to gravity forming a protostar. As the cycle progresses the star becomes bigger and developed forming into the main sequence star in which the fusion of hydrogen is in balance with the force of gravity. After hydrogen has been used up, the star turns into a red super giant which expands and helium is used for fusion. All elements are produced through fusion until iron which is too heavy. This causes the red super giant to collapse under the force of gravity where it will either blow up and a supernova will occur creating elements heavier than iron or it will collapse into a black hole.

Good Job!
This is a
very good
answer! 😊

53+5

(b) How does the red-shift confirm that the universe is expanding? Draw a diagram to support your answer. (3)

~~red shift when a star moves away~~
 Red-shift occurs when the light wave is stretched.
 It tells us ~~the~~ the universe is expanding as we can look
 at the ~~stars~~ light we receive from other stars and compare
 the wave lengths to see if they have shifted causing
 them to appear more red. This proves that ~~the stars are the~~
 universe ~~is~~ is expanding as the ~~star~~ distance for the light to travel increases.



↳ wavelength gets stretched causing
 it to become more red.

(c) Compare and contrast red-shift and blue-shift.

(2)

Red-shift	Blue-shift
longer wavelength	shorter wavelength
Object moving away	Object moving towards
Object appears red more red	Object appears more blue

9. (a) After 4 seconds, a ship on the surface of the ocean transmits a signal and receives it from an underwater submarine. Determine the submarine's distance from the ship. (The sound speed in water is 1500 m/s) (3)

$E = 4$

half time for one journey

$S = 1500$

$2 \times 1500 = \text{distance of journey}$
 $3000 \text{ m for returning}$
 distance

- (b) Compare and contrast ultrasound and x-rays in medical science. (3)

Ultrasound	X-rays
Used for looking <u>looking</u> ? a stomach	Used in cancer <u>Cancer</u> treatment radiotherapy ✓
used to look <u>at</u> pregnancies	used to detect bone <u>bone</u> fractures ✓
to <u>an</u> used to look at soft tissue	used to sterilise equipment <u>equipment</u> ✓

(c) Describe how the human ear works with the help of a diagram.

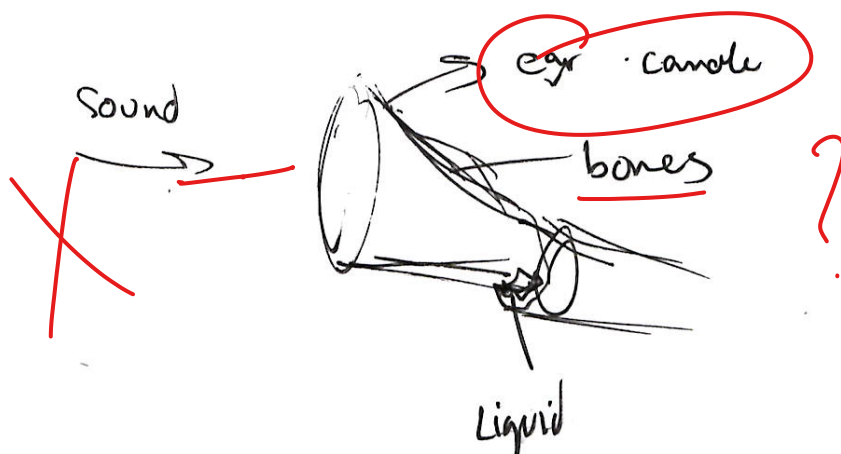
(5)

A sound enters the ear. The bones reflect * the sound back down* which then hits the liquid where the wave speeds up and cause vibrations which trigger an electrical response for the brain to process. (2)

* (Speeds up the ~~wave~~)

[Could have been explained better]

Diagram:



(d) Write the relation between frequency and time period for a wave.

(1)

1

$$\text{time period} = \frac{1}{\text{frequency}}$$

10.(a) Explain why step up transformers are used in the transmission of electricity in the national grid.

(2)

Step-up transformers increases ^{the vol} voltage which causes ~~but~~ means there is a low current so less electricity is lost via ~~thermal~~ heating (electrical).

$$P = VI \quad \text{if } P \text{ is constant} \\ E = VIt$$

(b) A radio runs off the 220 V mains supply but only needs 22 V. Its transformer has 100 turns of wire in the primary coil. How many turns are needed in the secondary coil?

(3)

$$\frac{220}{22} = 10 \quad 220:22$$

$$\frac{100}{10} = 10 \text{ turns in secondary coil}$$

Provide some context on what is being solved & the way it's solved!

(c) Write the relation between electric power, electric current and voltage.

(1)

$P = VI$ Electric power = electric current \times voltage

(d) An electricity substation supplies 2 MW of power to a small housing estate. Electricity is sent to the substation along cables with a resistance of 0.06 Ω . The supply is at 230 V. Calculate the energy wasted every hour.

(4)

$$P = 2 \text{ MW} = 2 \times 1000 \times 1000 = 2\,000\,000 \text{ W}$$

$$= 2\,000\,000 \text{ W} = 2 \times 10^6 \text{ W}$$

$$V = 230 \text{ V}$$

$$V = IR$$

$$\frac{V}{I} = R$$

$$\frac{V}{R} = I$$

$$\frac{230}{0.06} = 3833.33 \dots \text{ A}$$

$$P = 3833.33 \text{ A} \times 230 \text{ V}$$

$$= 881\,666.6 \dots$$

$$2\,000\,000 - 881\,666.6 \dots = 1\,118\,333.3 \dots$$

$$881\,666.6 \dots$$

$$2\,000\,000$$

$$1 \text{ hr} = 60 \text{ min} = 3600 \text{ s}$$

$$3600 \times 1\,118\,333.3 \dots$$

$$= 4\,026\,000\,000 \text{ J}$$

$$4.026 \times 10^9 \text{ J wasted per hour}$$

$$4.026 \times 10^9 \text{ J per hour}$$

$$75 + 2 = 77 \frac{100}{100}$$

Overall feedback:

- Kudos! on scoring this well in this paper.
 - Need to work a bit more on the presentation of your work.
 - Try explaining your points in full sentences, with neat writing.
 - For questions which require mathematical solutions, don't just do the maths. First, ~~then~~ give context of how & what is being done.
 - Overall, this was a good effort, with some scope for progress!
- ★ Keep up the good work.

