



GCSE Physics Question and Answers 2020/2021

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Energy Calculations (Questions)

1. A diver climbs some steps to a diving board. Which two of the statements **P**, **Q**, **R**, **S** and **T** are true?

P: as the diver falls, gravitational potential energy is transferred to kinetic energy

Q: as the diver falls, kinetic energy is transferred to gravitational potential energy

R: the gravitational potential energy of the diver on the board is equal to the energy transferred to the diver when climbing the steps

S: the kinetic energy of the diver on the board is equal to the energy transferred to the diver when climbing the steps

T: when the diver hits the water, all the gravitational potential energy is regained

(Marks available: 2)

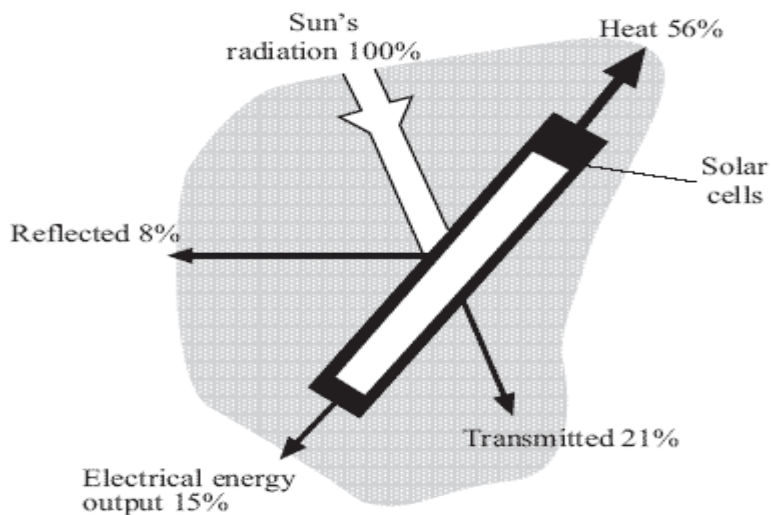
2. The formulae below may be of help with parts of this question.

useful energy transferred by device

efficiency = _____

total energy supplied to device

3. The diagram shows what happens to the Sun's radiation when it falls on a panel of solar cells.



a) What is the overall efficiency of the transfer of light energy from the Sun to electrical energy?

- A** 15%
- B** 36%
- C** 71%
- D** 100%

(1 Mark)

b) Each square metre of the solar panel receives 500 W. The area of the panel is 5m². How much energy falls on the panel in 2 hours?

- A** 5 J
- B** 5000 J
- C** 3,600,000 J
- D** 18,000,000 J

(1 Mark)

c) Another panel of solar cells has an efficiency of only 6%. What is the electrical output of this panel when the input power is 2500 W?

- A** 150 W
- B** 417 W
- C** 15,000 W
- D** 1,500,000 W

(1 Mark)

d) In less developed countries, where fuel is unavailable and where sunshine ratings are high, solar energy is used to drive turbines. An array of mirrors tracks the Sun and focuses its heat on to a container of oil. This heats the oil to 400°C.

How should the hot oil be used to drive the turbines?

- A** The hot oil is burnt to heat water to make steam to drive the turbines
- B** The hot oil flows from a high level to a low level to drive the turbines

C The hot oil heats water, making steam which drives the turbines

D The hot oil is pumped through the turbines

(1 Mark)

(Marks available: 4)

A group of houses uses solar panels and windmills as alternative energy sources.

a) The panels and windmills are expensive to install.

Eventually all the money spent on them will be recovered.

Explain why.

(2 Marks)

b) Jan works out the efficiency of one of the windmills. The energy of the air hitting the blades of the windmills is 20 000 J each second.

The energy transferred to the power lines is 5000 J each second.

Calculate the efficiency of the windmill. Use the equation below:

You must show how you work out your answer.

useful energy out

energy efficiency = _____

total energy input

efficiency =

(2 Marks)

(Marks available: 4)

Energy Calculations (Questions)

Answer outline and marking scheme for question: 1

P and R

(Marks available: 2)

Answer outline and marking scheme for question: 2

a) A

(1 Mark)

b) D

(1 Mark)

c) A

(1 Mark)

d) C

(1 Mark)

(Marks available: 4)

Answer outline and marking scheme for question: 3

a) panels and windmills provide free energy/ no bills/ low running costs

(1 Mark)

save other fuels/ payback covers initial costs

(1 Mark)

b) 5000/20000

(1 Mark)

0.25/25%

(1 Mark)

(Marks available: 4)

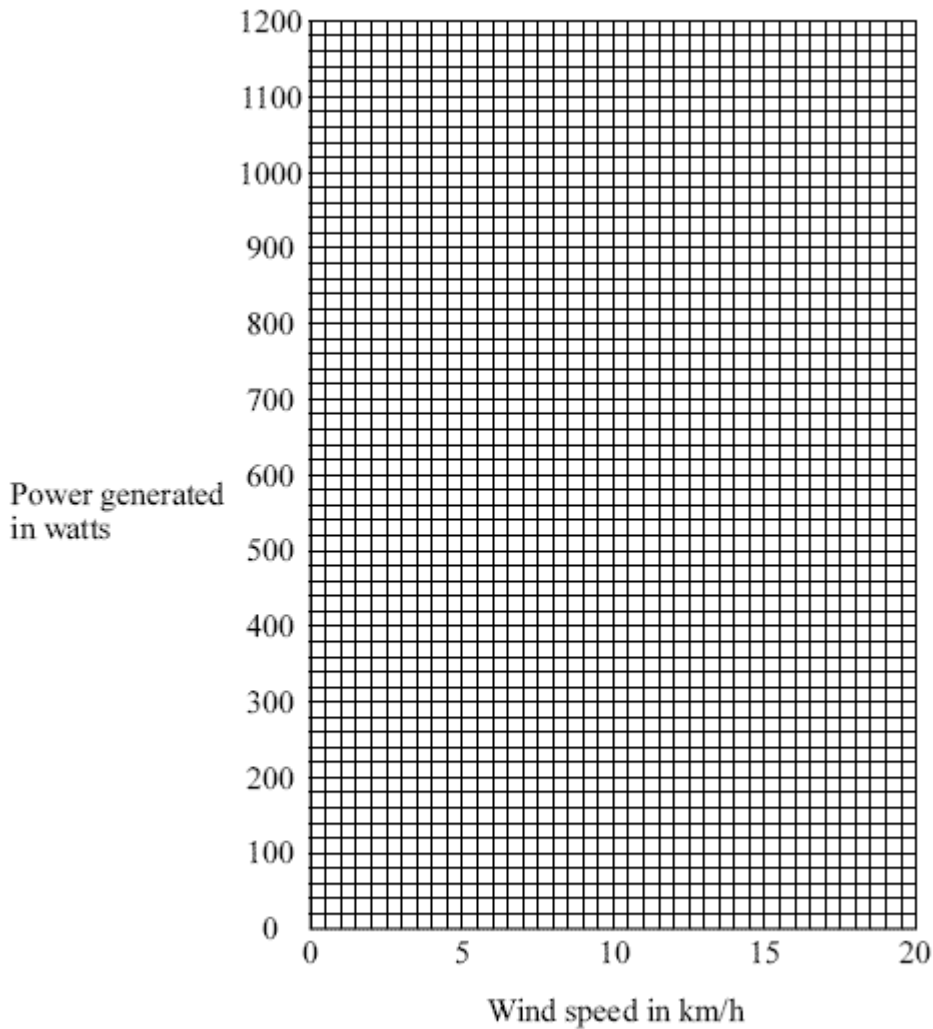
Energy Transfers (Questions)

1. **a)** A wind powered generator is used to produce electrical power when the wind is blowing. The table shows the electrical power generated by the wind for different wind speeds.

Power generated
0 0 140 900 1100 1160 1160
(watts)

Wind Speed
0 25 10 12 15 20
(km/h)

- i)** On the axes below draw a graph to show how the power generated changes with wind speed.



(3 Marks)

ii) What is the lowest wind Speed needed to generate power?

(1 Mark)

iii) What is the maximum power generated by the wind?

(1 Mark)

iv) Explain one disadvantage of using only a wind generator as the source of electrical power

(1 Mark)

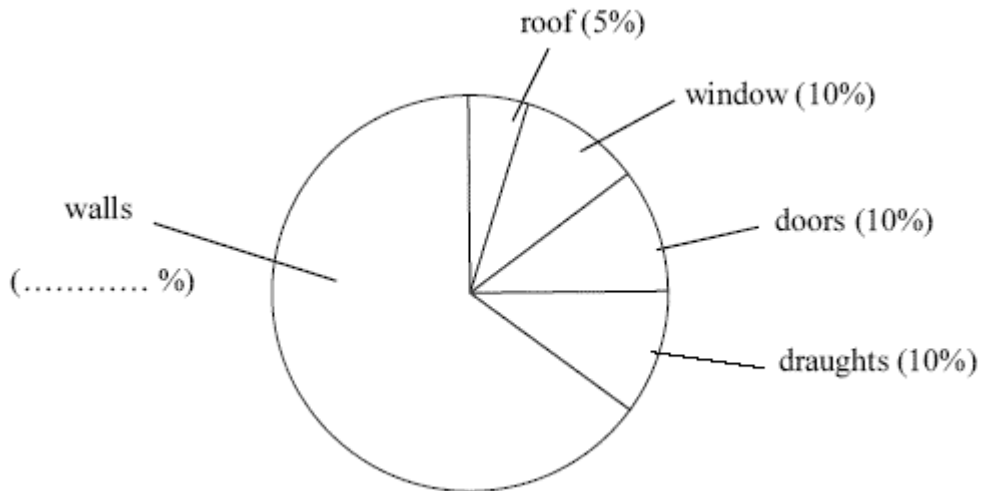
b) Complete the sentence to show the energy transfer taking place in the wind powered generator

..... Energy is transferred toenergy.

(2 Marks)

(Marks available: 8)

2. The main heat energy losses from a house are shown in the diagram.



a) Complete the diagram to show the percentage heat energy loss through the walls.

(1 Mark)

b) Complete the table below to show how the heat energy loss from each part of the house can be reduced. The first one has been done for you.

Part of the house **Method used for reducing heat energy loss**

roof	glass-fibre insulation in the loft
walls
floor

(2 Marks)

(Marks available: 3)

3. **a)** name a renewable energy resource.

(1 Mark)

b) Describe three main advantages that renewable energy resources have over non-renewable resources for the generation of electricity.

(3 Marks)

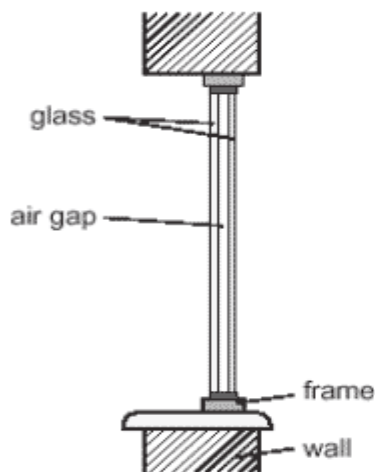
c) You are a scientist who wants to use more renewable energy.

Suggest how you would persuade people to want more renewable energy sources

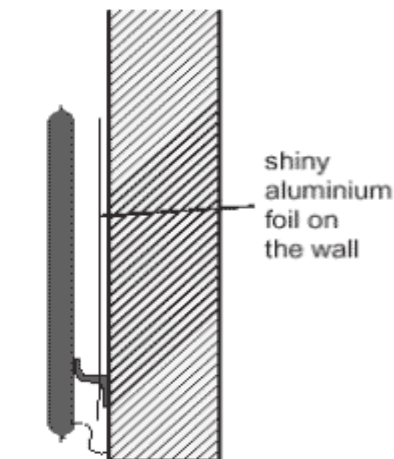
(4 Marks)

(Marks available: 8)

4. This question is about keeping a house warm. A house has been insulated in these two ways.



The windows are double glazed



There is shiny aluminium foil on the wall behind the radiators

Describe how each of these ways helps to keep the house warm. Use your ideas about conduction, convection and radiation.

a) Double glazing.

(2 Marks)

b) Putting shiny aluminium foil on the wall behind a radiator.

(2 Marks)

(Marks available: 4)

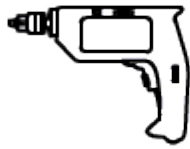
5. a) The devices shown below transfer electrical energy in different ways.

Bedside Lamp



1

Drill



2

Iron



3

Bell



4

The list gives the useful form of energy the devices are designed to produce.

Match words from the list with the devices numbered 1-4

Heat (thermal energy)

Light

Movement (kinetic energy)

Sound

(4 Marks)

b) Match words from the list with the numbers 1-4 in the sentences.

Conduction

Convection

Insulation

radiation

Energy travels from the Sun the Earth by1.....

In a kettle hot water rises by.....2.....

Thermal energy passes through the walls of a room by3.....

To reduce heat loss from a house, the cavity walls are fitted with4.....

(4 Marks)

(Marks available: 8)

a) The supply of energy from oil is decreasing. The supply from coal is increasing.

Why is this a problem for the environment?

(1 Mark)

b) We have relied on fossil fuels to supply most of our energy needs. Why must we find alternative energy sources?

(1 Mark)

c) On average, the energy use of each family in the UK releases over 25 tonnes of carbon dioxide and 4 kilograms of sulphur dioxide into the air every year.

i) State one environmental effect which is increased by releasing carbon dioxide into the atmosphere

(1 Mark)

ii) State a different environmental effect caused by releasing sulphur dioxide into the atmosphere

(1 Mark)

d) Electricity may be generated using nuclear fuels. Apart from the cost of the electricity, what are the advantages and disadvantages of doing this?

(5 Marks)

(Marks available: 9)

Energy Transfers (Answers)

Answer outline and marking scheme for question: 1

a)

i) points plotted correctly;

smooth curve drawn

(3 Marks)

ii) about 3km/h

(1 Mark)

iii) 1160 watts

(1 Mark)

iv) not always windy/variable output/too much land needed

(1 Mark)

b) kinetic/movement; electrical

(2 Marks)

(Marks available: 8)

Answer outline and marking scheme for question: 2

a) 65°

(1 Mark)

b) Walls: draught excluder/curtain/cavity walls insulation

Floor: carpets/wooden floors

(2 Marks)

(Marks available: 3)

Answer outline and marking scheme for question: 3

a) Any of these: wind, wave, tidal, geothermal, solar , wood

(1 Mark)

b)

Will not run out;

No waste;

No fuel cost;

No transportation cost

(3 Marks)

c) present/communicate scientific evidence for use of:

renewable energy sources **(1)**

saves using other resources **(1)**

limitless supply **(1)**

no pollution / clean / environmental issues **(1)**

or arguments based on use of non-renewable sources.

(4 Marks)

(Marks available: 8)

Answer outline and marking scheme for question: 4

a) trapped air

(1 Mark)

poor conductor/convecton

(1 Mark)

b) reflects

(1 Mark)

radiation

(1 Mark)

(Marks available: 4)

Answer outline and marking scheme for question: 5

a)

- Light
- Movement (kinetic energy)
- Heat (thermal energy)
- Sound

(4 Marks)

b)

- Radiation
- Convection
- Insulation
- Conduction

(4 Marks)

(Marks available: 8)

1. Answer outline and marking scheme for question: 6

a) coal gives more CO₂ than oil (for same energy)

(1 Mark)

b)

the demand is rising (too rapidly)

(1 Mark)

resources insufficient to meet (future) demand

(1 Mark)

c)

i) greenhouse (effect)

(1 Mark)

ii) (produces) acid rain

(1 Mark)

d) any five from: (there must be at least 2 advantages and 2 disadvantages for full marks)

- no polluting gases released
- large energy
- so no increase in greenhouse effect/acid rain
- when running normally very little radiation escapes
- if an accident occurs (large) amounts of radiation may be released
- waste radioactive
- waste has to be stored (safely) for a longtime/underground
- take a long time to start up

(5 Marks)

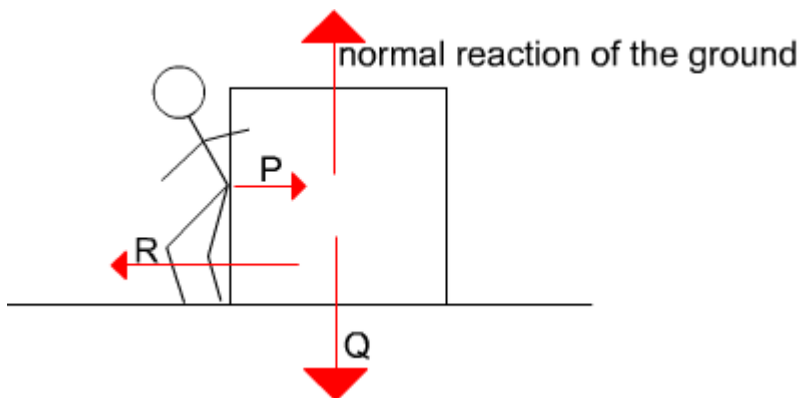
(Marks available: 9)

Forces, Moments and Pressure (Questions)

1. a) State two effects a force can have on an object.

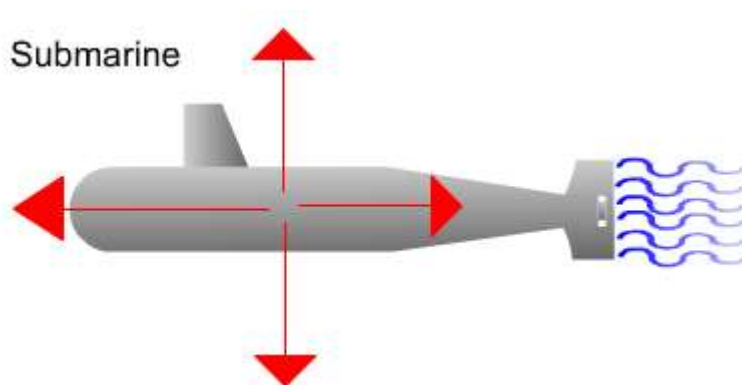
(2 marks)

- b) Name each of the forces labelled P, Q and R.



(3 marks)

- c) Describe the motion of the submarine.



(2 marks)

- d) If the forces on the cyclist are balanced then describe its motion.



Equal Balanced Forces

(1 mark)

e) State two ways of reducing the drag forces on the bicycle.

(2 marks)

(Marks available: 10)

2. a) An Ice Hockey player hits a 2kg puck with a force of 24N and it moves off with an initial acceleration of 12 m/s².



What could be done to make the puck move with higher acceleration?

(2 marks)

b) What force would be needed to give an acceleration of 9 m/s²?

(2 marks)

c) A sports car and a motorbike both have good acceleration.

The car is mass 1200 kg and provides a driving force of 7200 N. What is its acceleration?

(2 marks)

d) The bike is mass 300 kg and provides a driving force of 2700 N. What is its acceleration?

(2 marks)

e) If the car crashes and the driver is not wearing a seatbelt he will go through the windscreen.

Why is it wrong to say that he has been 'thrown forward'?

(2 marks)

(Marks available: 10)

3. **a)** An aid plane is flying over a remote part of Africa and it has to drop an aid package as there is no landing strip.



There are two forces on the falling package - its weight and air resistance.

What causes the weight?

(1 mark)

b) What causes the air resistance?

(1 mark)

c) A parachute opens as the package falls. How does the shape of the parachute help the drop?

(2 marks)

d) Which of the weight and air resistance is greater when the package first falls out of the plane?

(1 mark)

e) Which of the weight and air resistance is greater when the parachute on the package first opens?

(2 marks)

f) Describe a shape that would fall quickly through the air with low air resistance.

(1 mark)

g) Why does it make little difference if you fall out of a plane without a parachute at 700 m and at 7000 m?

(2 marks)

(Marks available: 10)

4. **a)** A car has to stop on a stretch of road. The overall stopping distance is made up of the thinking distance and the braking distance.

What exactly is the driver doing during the thinking distance?

(1 mark)

b) What exactly is the driver doing during the braking distance?

(1 mark)

c) Names two factors that affect the thinking distance.

(2 marks)

d) State two weather conditions that would affect the stopping distance.

(2 marks)

e) Why is oil on the road a danger?

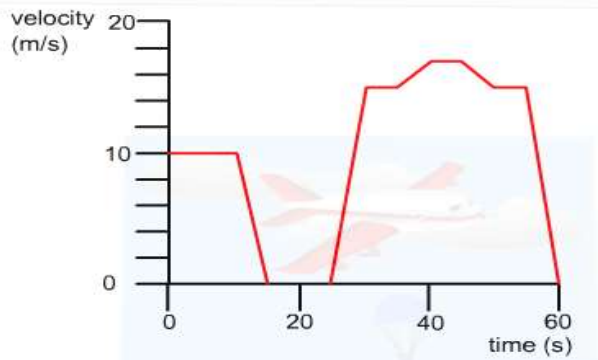
(2 marks)

f) Name two safety features that a car has.

(2 marks)

(Marks available: 10)

5. The diagram shows a graph of velocity against time for the journey of a motorbike.



a) Between what times was the bike stopped at a traffic light?

(1 mark)

b) Between what times was the bike overtaking?

(1 mark)

c) What was the fastest speed reached?

(1 mark)

d) For how long was the bike travelling at this speed?

(1 mark)

e) Between what two bits of time was the bike accelerating?

(2 marks)

f) At 10 seconds the bike began to slow. What was the deceleration?

(2 marks)

g) How fast had the bike travelled in the first 15 seconds?

(2 marks)

(Marks available: 10)

6. A transit van is leaking oil and drips every two seconds. It leaves a pattern along a road as shown in the diagram.



- a)** Describe the motion of the van between S and T where the drips are equal distances apart.

(1 mark)

- b)** What is the velocity of the van between S and T?

(2 marks)

- c)** How is velocity different from speed?

(1 mark)

- d)** What is the velocity of the van between P and Q?

(1 mark)

- e)** Using earlier answers and the diagram, calculate the acceleration of the van.

(3 marks)

- f)** If the engine cut out and the brake was not applied state what would happen to the van and why.

(2 marks)

(Marks available: 10)

Forces, Moments and Pressure (Answers)

Answer outline and marking scheme for question: 1

a) Change the objects shape, break the object, change the speed or direction of the objects motion.

(2 marks)

b) P = pushing force. Q = Weight / Gravitational force. R = Frictional force.

(3 marks)

c) Accelerating both up and forward.

(2 marks)

d) Balanced forces occur at a steady speed (and when stationary - less likely in this case).

(1 mark)

e) Oil wheels, Sit in a streamlined position, cycle downhill, use a smoother road.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 2

a) Provide more force from the stick or reduce the mass of the puck.

(2 marks)

b) Provide more force from the stick or reduce the mass of the puck.

$$\text{Force} = 2 \times 9 = 18 \text{ N}$$

(2 marks)

c) Acceleration = force / mass

$$\text{For the car: accel} = 7200 \text{ N} / 1200 \text{ kg} = 6 \text{ m/s}^2.$$

(2 marks)

d) For the bike: accel = 2700 N / 300 kg = 9 m/s².

(2 marks)

e) The driver continues forward because without the seat belt there is no force to stop him until he hits the windscreen.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 3

a) Weight is caused by the gravitational attraction of the object to earth.

(1 mark)

b) Friction with the air causes air resistance.

(1 mark)

c) The large area of the parachute creates a lot of air resistance, which slows the descent.

(2 marks)

d) At first the weight is greatest.

(1 mark)

e) When the parachute opens the air resistance is greatest.

(2 marks)

f) A rounded or pointed shape will cut through the air with minimum air resistance.

(1 mark)

g) When you fall you reach a terminal velocity. This is at a low height so the speed at which you hit the ground will be the same at both heights.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 4

a) Driver is realising he must stop and moving his foot to the brake pedal.

(1 mark)

b) Driver is pressing the brake pedal.

(1 mark)

c) Tiredness, alcohol, drugs, medication, distractions in the car, driver experience.

(2 marks)

d) Ice, snow, rain, sleet, hail.

(2 marks)

e) Lubricant, which reduces the friction between wheels and road.

(2 marks)

f) Crumple zones, seat belts, side impact bars, air bags.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 5

a) Between 15 and 25 s

(1 mark)

b) Between 40 and 45 s

(1 mark)

c) 17.5 m/s

(1 mark)

d) 5 seconds

(1 mark)

e) Between 25 and 30 s and between 35 and 40 s

(2 marks)

f) Deceleration = change in velocity / time

$$\text{deceleration} = 10 / 5 = 2 \text{ m/s/s}$$

(2 marks)

g) Distance travelled equals the area under the graph.

$$\text{Distance} = (10 \times 10) + (0.5 \times 10 \times 5) = 100 + 25 = 125 \text{ m}$$

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 6

a) A steady speed.

(1 mark)

b) Velocity = displacement / time

$$\text{velocity} = 42 \text{ m} / 6 \text{ s} = 7 \text{ m/s}$$

(2 marks)

c) Velocity is the speed in a specified direction.

(1 mark)

d) Vel = $24 / 6 = 4 \text{ m/s}$

(1 mark)

e) Acceleration = change in vel / time

The time between the start of PQ to the start of ST is 6 spaces, which is 12 seconds.

$$\text{Acceleration} = (7 - 4) / 12 = 0.25 \text{ m/s/s}$$

(3 marks)

The van would decelerate to a stop because of friction.

(2 marks)

(Marks available: 10)

Magnetism and Electromagnetism (Questions)

1. Define the **motor effect**.

(Marks available: 1)

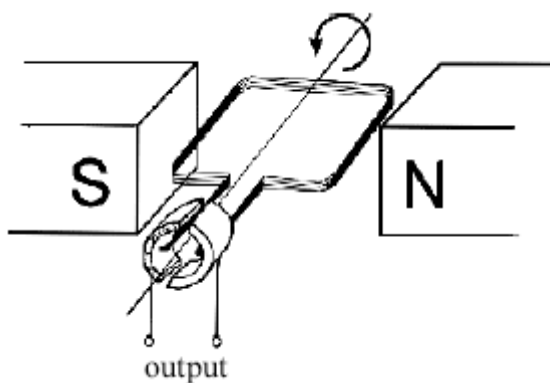
2. State the **two** main ways to generate electricity.

(Marks available: 2)

3. The **three** ways of increasing the strength of an electric motor are:

(Marks available: 3)

4. **a)** The diagram shows the construction of a simple electrical generator. When the coil is rotated, an alternating voltage is produced at the output.



- i)** Explain what is meant by an alternating voltage.

(1 Mark)

- ii)** State two ways in which the voltage output could be increased.

(2 Marks)

- b)** The generators at a power plant produce a voltage of 25,000 V. For long distance transmission, on overhead power lines, this is stepped up to 400,000 V. It is later stepped down to 240 V for domestic use.

- i)** Explain why the voltage is stepped up to 400,000 V,

(2 Marks)

ii) A transformer is used to step up the voltage. Calculate the ratio of primary turns to secondary turns needed for this transformer.

(3 Marks)

c) Give one advantage and one disadvantage of increasing the thickness of overhead power lines.

(2 Marks)

(Marks available: 10)

5. A wire passing down through a hole in a card. If iron filings are sprinkled on the card they form a circular pattern as soon as the current in the wire is switched on.

Why does this happen?

(2 Marks)

b) Give two ways that you can increase this electromagnetic effect.

(2 Marks)

c) What is the main energy change in the motor?

(2 Marks)

d) The motor is not 100% efficient. What happens to the wasted energy?

(1 Mark)

d) Explain why the motor turns.

(3 Marks)

(Marks available: 10)

6. **a)** What does the term 'electromagnetic induction' mean?

(2 Marks)

b) What is the main energy change in a simple generator?

(2 Marks)

c) Name three ways to increase the amount of electricity induced in the generator.

(3 Marks)

d) Name three ways of turning a generator in real electricity production.

(3 Marks)

((Marks available: 10))

7. **a)** What do we call the system of pylons that carry electricity from power stations?

(1 Mark)

b) What is the voltage of the mains electricity in UK houses?

(1 Mark)

c) Power stations produce electricity at a different voltage to that used in houses. Transformers are used to change the voltage. What might the core be made from?

(1 Mark)

d) What is the difference between a step-up transformer and a step-down transformer?

(2 Marks)

e) Why does a transformer not work with a battery?

(2 Marks)

f) 24,000 Volts is supplied to the input of a transformer that has 6000 primary coils. If the transformer has 60 secondary coils then how much voltage is supplied from the output?

(3 Marks)

((Marks available: 10))

Magnetism and Electromagnetism (Answers)

Answer outline and marking scheme for question: 1

If a wire carrying a current is placed in a magnetic field a force is produced.

(1 mark)

Answer outline and marking scheme for question: 2

Moving a wire in a magnetic field.

Moving a magnet in a coil of wire.

(Marks available: 2)

Answer outline and marking scheme for question: 3

Increase the current in the coil.

Increase the number of loops on the spinning coil.

Increase the strength of the magnet.

(Marks available: 3)

Answer outline and marking scheme for question: 4

a) i) changing polarity

(1 Mark)

ii) Any two from:

- stronger magnet
- more turns
- increase speed rotation
- placing coil on soft iron core

(2 Marks)

b) i) An explanation to include

- higher V, less I
- less I, lower heating effect

(2 Marks)

ii)
$$\frac{N_P}{N_S} = \frac{V_P}{V_S}; = \frac{25000}{400\ 000} = \frac{1}{16}$$

(3 Marks)

c) Advantage: less resistance

Disadvantage: heavier

(2 Marks)

(Marks available: 10)

Answer outline and marking scheme for question: 5

a) The flowing current produces a magnetic field. The iron filings are affected by the magnetic field.

(2 Marks)

b) Increase the current. Have more coils. Put an iron core inside the coil.

(2 Marks)

c) Electrical energy to Kinetic energy.

(2 Marks)

d) Heat energy.

(1 Mark)

e) The magnetic fields of the wire and of the magnets do not want to be in the same place so they interact. This pushes them apart. The coiled wire is free to move so it starts to turn.

(3 Marks)

(Marks available: 10)

Answer outline and marking scheme for question: 6

a) The generating of electricity, by movement of a magnetic field and a wire.

(2 Marks)

b) Kinetic energy to Electrical energy.

(2 Marks)

c) More coils of wire, stronger magnets, faster motion.

(3 Marks)

d) High pressure steam; wind; moving water; diesel engine.

(3 Marks)

(Marks available: 10)

Answer outline and marking scheme for question: 7

a) The national grid.

(1 Mark)

b) 240 Volts.

(1 Mark)

c) Iron.

(1 Mark)

d) Step-up increases voltage whereas step-down reduces it.

(2 Marks)

e) Transformers only work with ac and batteries produce dc.

(2 Marks)

f) Number of prim. coils / prim. voltage = no. of sec. coils / sec. Voltage

$$6000 / 24,000 = 60 / \text{sec. Voltage}$$

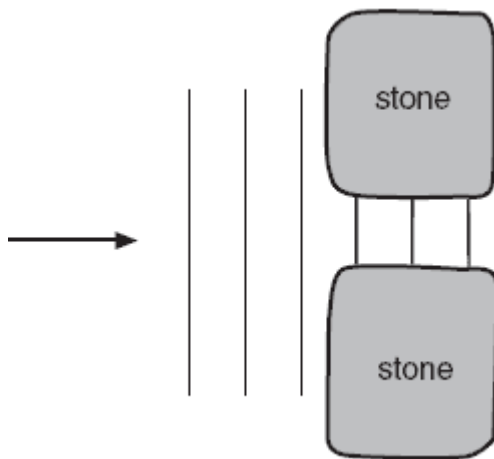
$$\text{secondary voltage} = 240 \text{ Volts}$$

(3 Marks)

(Marks available: 10)

Properties of Waves (Questions)

1. Some water waves pass through a gap between two stepping stones across a small stream.



- a)** Finish the diagram to show what happens to these waves after they pass through the gap.

(2 Marks)

- b)** Write down two factors that affect the amount of diffraction of the waves.

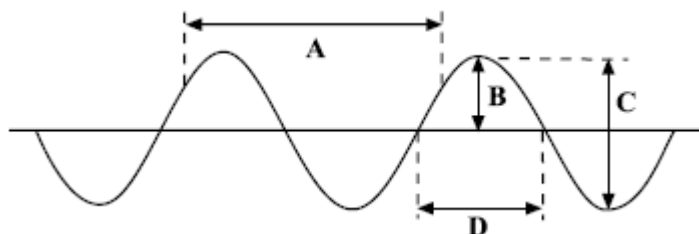
Factor 1.....

Factor 2.....

(2 Marks)

(Marks available: 4)

2. The diagram shows a transverse wave.



a) Which of A, B, C or D is:

i) the wavelength

ii) the amplitude

(2 Marks)

b) Light waves carry different information to sound waves.

Give two other ways in which light waves are different to sound waves

(2 Marks)

(Marks available: 4)

Properties of Waves (Answers)

Answer outline and marking scheme for question: 1

a) Curved waves (1)

consistent wavelength **(1)**

(2 Marks)

b) Diameter / width of gap (1)

wavelength / frequency of waves **(1)**

(2 Marks)

(Marks available: 4)

Answer outline and marking scheme for question: 2

a) i) A

(1 Mark)

ii) B

(1 Mark)

b) any two from:

- light waves are transverse/ sound waves are longitudinal
- light waves can travel through a vacuum/ sound waves cannot travel through a vacuum
- light waves travel (much) faster/ different speeds
- light waves are part of the electromagnetic spectrum
- light waves have a (much) higher frequency or light waves have a much smaller wavelength

(2 Marks)

(Marks available: 4)

Radioactivity (Questions)

- a)** Explain what the following represent:

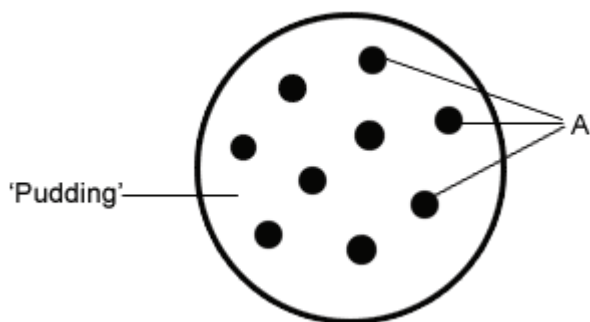
 - The **Mass** or **Nucleon** number.
 - The **Proton** or **Atomic** number.

b) State the **two** possible causes of radioisotopes.

c) What charges do Alpha, Beta and Gamma radiation possess?

(Marks available: 7)

- The diagram shows the 'plum pudding' model of an atom.



- Scientists thought that the 'pudding' was positively charged.
 - Name the particles labelled **A** in the diagram.

(1 Mark)

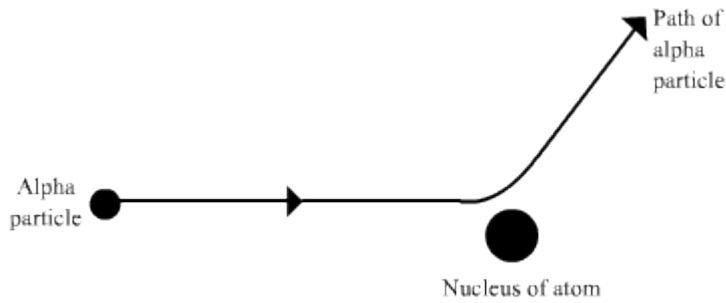
- Complete this sentence by choosing the correct words from the box.

negatively Charged positively charged uncharged

The particles labelled **A** are

(1 Mark)

- A new model of an atom was suggested by Rutherford and Marsden. They fired alpha particles at thin metal foil. Alpha particles are positively charged. In their model each atom has a nucleus. The diagram below shows the path of an alpha particle as it passes the nucleus of an atom.



Explain why the alpha particle changes direction

(2 Marks)

(Marks available: 4)

3. Radon is a radioactive gas. It escapes from the underground rocks and causes a large part of the natural background radiation in the United Kingdom.

a) Radon-220

220

(Rn)

86

is an isotope of radon

i) How many protons are there in a nucleus of radon-220?

(1 Mark)

ii) How many neutrons are there in a nucleus of radon-220?

(1 Mark)

iii) Explain what is meant by the statement: "This element has three isotopes".

(2 Marks)

b)

- Radon-220 has a short half-life and emits a-particles
- Alpha particles are easily stopped by material and only travel a short distance in air.
- Radon gas is thought to produce harmful effects.

When home owners, in areas where radon gas is produced, were told of the risks, very few too notice.

i) Explain why the presence of radon gas in buildings is a health hazard.

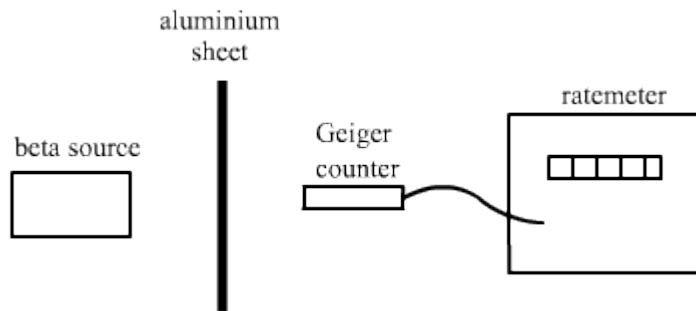
(3 Marks)

ii) Discuss why, you think, so few people took any action to reduce the risks due to radon gas.

(4 Marks)

(Marks available: 11)

4. Kate's teacher wants to find how much beta radiation passes through different thicknesses of aluminium.



First he measures background radiation.

It gives a reading of 60 counts per minute on the ratemeter.

a) Suggest two possible sources of background radiation.

(2 Marks)

b) Write down two safety precautions that he should take when using the beta source.

(2 Marks)

c) Aluminium is rolled into sheets twenty millimetres thick in a rolling mill.

A radioactive source and a detector are used to check the thickness of the sheet as it leaves the rollers.

i) Why is beta radiation not suitable for checking twenty millimetre sheet?

(1 Mark)

ii) Suggest one type of radiation which could be used to check the thickness of twenty millimetre sheet.

(1 Mark)

iii) The radioactive isotope used has a half-life of 5.3 years. Explain what is meant by the term half-life.

(1 Mark)

iv) One rolling mill uses 20 mg of this isotope as the source.

What will be the mass of this radioactive isotope in the source 10.6 years later?

mass = _____ mg

(1 Mark)

v) It would be sensible to use, in the rolling mill, a radioactive isotope with a half-life much shorter than 5.3 years. Explain why.

(2 Marks)

(Marks available: 10)

5. a) Why can some isotopes of atoms be unstable?

(1 Mark)

b) What is a Geiger-Muller?

(1 Mark)

c) List three purposes of using radioactivity and how it is used

(3 Marks)

(Marks available: 5)

6. a) At the end of the nineteenth century, physicists considered that the atom consisted of evenly distributed electrons and protons.

i) Which famous experiment, at the start of the twentieth century, suggested the existence of the nucleus?

(1 Mark)

ii) Give an outline of what the experiment involved and how the results led to this the nuclear model of the atom.

(4 Marks)

iii) Protons and electrons were initially considered to be fundamental particles.

Explain what this term means and state which of the two particles named is still considered to be a fundamental particle.

(2 Marks)

b) The neutron was detected much later than either the electron or the proton although it was known to exist.

i) Suggest why neutrons were much more difficult to detect than protons or electrons.

(2 Marks)

ii) Quarks are fundamental particles. What is the connection between quarks, protons and neutrons?

(2 Marks)

(Marks available: 11)

Radioactivity (Answers)

Answer outline and marking scheme for question: 1

a) i) It tells you how many particles are in the nucleus, i.e. how many protons and neutrons.

ii) It tells you how many protons there are in the nucleus.

(2 Marks)

b) Too much energy.

The wrong number of particles in the nucleus.

(2 Marks)

c) Alpha has a positive +2 charge, Beta has a negative -1 and Gamma has no charge.

(3 Marks)

(Marks available: 7)

Answer outline and marking scheme for question: 2

a) i) electrons

(1 Mark)

ii) negatively charged (no e.c.f)

(1 Mark)

b) nucleus is positive/ alpha and nucleus have same charge

(1 Mark)

(like) charges repel/push away

(1 Mark)

(Marks available: 4)

Answer outline and marking scheme for question: 3

a) i) 86

(1 Mark)

ii) 134

(1 Mark)

iii) An explanation to include particles with:

- same number of protons
- Different number of neutrons

(2 Marks)

b) i) An explanation to include:

- gas breathed in
- a - particles cannot pass through living tissue
- named health risk

(3 Marks)

ii) A discussion to include three of:

- lack of understanding of dangers
- evidence
- cost
- information not widely known
- complacency
- information did not spell out dangers clearly
- regional variation

(4 Marks)

(Marks available: 11)

Answer outline and marking scheme for question: 4

a) cosmic rays/ sun (1)

rocks/ granite (1) power stations (1) radon (1) fallout/ nuclear accidents (1) nuclear weapons testing/ atomic bombs (1)

Choose any two

(2 Marks)

b) distance/ use tongs (1)

suitable reference to shielding (1) short time of exposure (1) minimum source strength (1) pupils not to handle source (1)

Choose any two

(2 Marks)

c) i) beta radiation will not pass through/ stopped by 20 mm thick sheet/ sheet too thick

(1 Mark)

ii) gamma/ x-rays

(1 Mark)

iii) time for decay rate/ number of radioactive nuclei to halve

(1 Mark)

iv) 5 mg

(1 Mark)

v) count rate becomes too low for thickness checking/ becomes too low too quickly (1)

source needs to be frequently changed (1)

detector needs to be frequently calibrated (e.g. appears to be thicker than it is)/ need a fairly constant count rate (1)

sensible consequence e.g. effect on sheet thickness (1)

Choose any two

(2 Marks)

(Marks available: 10)

Answer outline and marking scheme for question: 5

a) too much energy/ wrong number of particles in the nucleus

(1 Mark)

b) Collects the charged ions and can measure the amount of ionisation that is taking place in a certain time by radioactive substances.

(1 Mark)

c) Collects the charged ions and can measure the amount of ionisation that is taking place in a certain time by radioactive substances.

Medicine - to kill cancer

Industry - to detect thickness of materials

Dating Materials - used to find out how old things are

(3 Marks)

(Marks available: 5)

Answer outline and marking scheme for question: 6

a) i) α -particles scattering/ Rutherford. Geiger Marsden experiment

(1 Mark)

ii) An outline to include:

- α particles fired at gold foil
- angles of scatter measured
- a few scattered through large angles

(4 Marks)

iii) An explanation to include:

- cannot be divided/ broken down further
- electrons

(2 Marks)

b) i) A suggestion to include:

- neutrons have no charge/ cannot be deflected by E/B fields
- (difficult to detect) travel through matter easily

(2 Marks)

ii) protons and neutrons contain 3 quarks;

different combinations of up and down quarks

(2 Marks)

(Marks available: 11)

Space (Questions)

1. What planets are known as the **terrestrial planets**?

(Marks available: 2)

2. What **two** effects do the seasons have on the Earth?

(Marks available: 2)

3. The "big bang" theory is one theory of the origin of the Universe.

a) Explain what is meant by the "big bang" theory

(2 Marks)

b) One piece of evidence for the "big bang" theory is "red-shift"

i) What is "red-shift"?

(1 Mark)

ii) Explain how "red-shift" leads to the "big bang" theory.

(4 Marks)

(Marks available: 7)

4. The table shows some data about the planets of the Sun.

Planet	Distance from Sun (millions of km)	Average surface temperature (°C)	Density (kg/m ³)	Surface gravity (N/kg)	Time of orbit (years)
Venus	108	470	5200	9	0.6
Earth	150	15	5500	10	1.0
Mars	228	-30	4000	5	1.9
Jupiter	778	-150	1300	26	12
Saturn	1427	-180	700	11	30
Pluto	5900	-230	500	4	248

Use the information from the table to answer the following questions.

a) Which planet takes the longest time to go round the Sun?

(1 Mark)

b) Pluto is mainly gas.

How can we tell this from the table?

(1 Mark)

c) i) What information suggests that Jupiter has the largest mass?

(1 Mark)

ii) On which planet would you have the least weight?

(1 Mark)

(Marks available: 4)

a) Types of centripetal forces

(3 Marks)

b) i) What are the two main types of satellites

(2 Marks)

ii) What is the role of these satellites

(2 Marks)

c) When does the highest (spring tide) occur

(1 Mark)

(Marks available: 8)

Space (Answers)

Answer outline and marking scheme for question: 1

The four inner planets:

Mercury,

Venus,

Earth,

Mars.

(Marks available: 2)

Answer outline and marking scheme for question: 2

The length of the day and night.

The temperature and weather, due to the intensity of the sun.

(Marks available: 2)

Answer outline and marking scheme for question: 3

a) any two from:

- (may have) started with a (huge) explosion
- billions of years ago
- from one place

(2 Marks)

b) i) light (from galaxies) is moved towards red end of spectrum

(1 Mark)

ii)

- galaxies (1)
- red-shift means galaxies moving away (1)
- the further away the bigger the red-shift
- the bigger the red-shift the faster it's moving
- the furthest galaxies are moving away fastest (any of these 1)
- Universe is expanding (1)

(4 Marks)

(Marks available: 7)

Answer outline and marking scheme for question: 4

a) Pluto

(1 Mark)

b) low density

(1 Mark)

c) i) Largest value of surface gravity

ii) Pluto

(2 Marks)

(Marks available: 4)

Answer outline and marking scheme for question: 5

a) Friction, Gravity, Tension

(3 Marks)

b) i) Geo-stationary orbit satellites

Polar orbit satellites

(2 Marks)

ii) Geo-stationary orbit - communications

Polar orbit satellite - weather forecasting/ spying

(2 Marks)

c) When the moon and Sun are pulling in the same direction

(1 Mark)

(Marks available: 8)

Static and Current Electricity (Questions)

1. Two identical strips of nylon are charged with static electricity and hung from string so that they can swing freely.

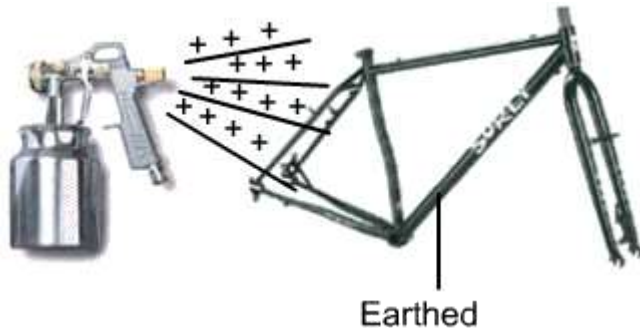
a) How could they have been charged?

(1 mark)

b) If the two strips are brought near each other, what would happen?

(2 marks)

c) Static can be used in paint spraying. Powdered paint is blown out of the paint gun at high speed and rubs against the side of the gun.



All the powder has a positive charge. Why does the paint spread out into a fine spray?

(2 marks)

d) Why don't you have to turn the bicycle frame around?

(1 mark)

e) Why is so little of the paint wasted?

(1 mark)

f) Another factory makes microprocessor for computers. They don't want static to build up on the workers.

Why do they want to avoid static charge building up?

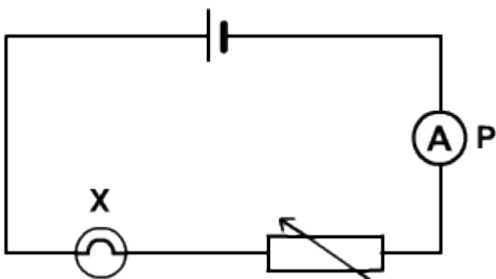
(2 marks)

g) The factory is to have a new carpet fitted. Explain why they should not choose a nylon carpet.

(1 mark)

(Marks available: 10)

2. **a)** A circuit is built with a bulb, a variable resistor and an Ammeter.



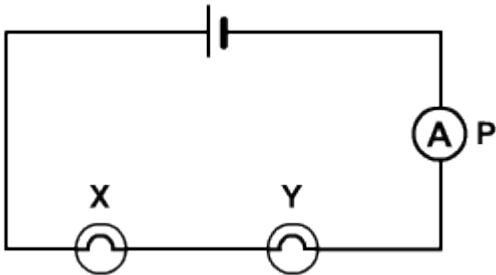
How does adjusting the variable resistor effect the brightness of bulb X?

(1 mark)

b) How does adjusting the variable resistor effect the reading on the Ammeter P?

(1 mark)

c) The variable resistor is replaced by a second bulb Y which is identical to bulb X.



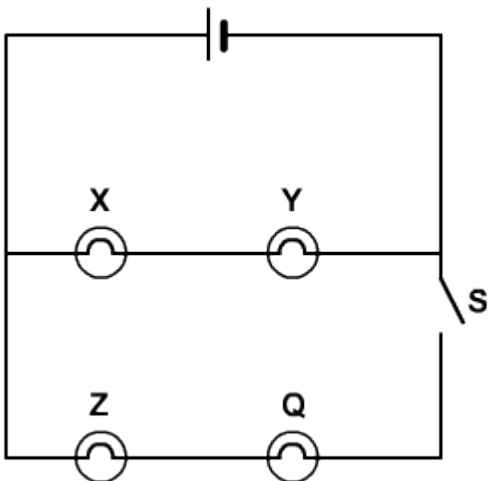
If the battery supplies 6V, how much will the potential difference be across each of the bulbs?

(1 mark)

d) The bulbs both go out. Give two possible reasons for this.

(2 marks)

e) The circuit is repaired and is made into a parallel circuit with a third bulb.



If the reading on Ammeter Q is 3A, then how much current is passing through bulbs X and Y?

(2 marks)

f) What would be the reading on Ammeter P?

(1 mark)

g) Calculate the resistance of bulb Z.

(2 marks)

(Marks available: 10)

3. **a)** A kettle has a power rating of 2000W. It takes 6 minutes (0.1 hours) for it to boil the water when it is full.

What is the kettle's power rating in kiloWatts?

(1 mark)

- b)** How many units of electricity have been used?

(2 marks)

- c)** If each unit costs 6p, then how much does it cost to boil the water in the kettle?

(1 mark)

- d)** In an experiment Sasha coiled up a thin piece of Nichrome wire and placed it in a container of water. He turned on the electricity and measured to see if the water temperature was affected.

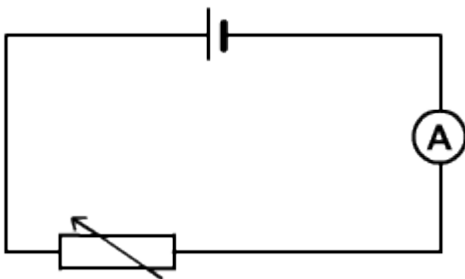
How would Sasha measure the electrical power going into the coil?

(2 marks)

- e)** In five minutes the temperature went up by 6 degrees centigrade. State 2 changes that Sasha could make to get a bigger temperature rise.

(2 marks)

- f)** At the same time, Sasha built another circuit that included a Thermistor.

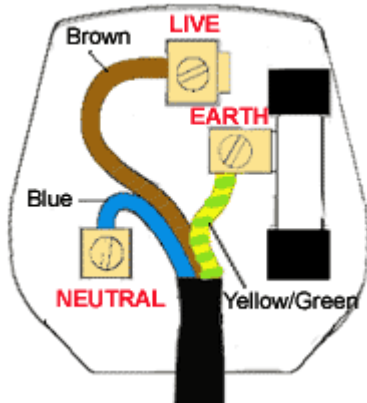


The reading on the Ammeter was 0.2A. The thermistor was lowered into the water heated by the previous circuit. Explain in terms of current and resistance why the ammeter reading would change.

(2 marks)

(Marks available: 10)

4. **a)** Brian has bought an old metal lamp in a junk shop. He is trying to check the wiring. He opens the plug and finds the following:



What is wrong with the wiring in the plug?

(1 mark)

- b)** What danger would this wiring pose?

(2 marks)

- c)** Brian took apart his modern plastic lamp to see how to put the metal lamp right.

He could not find an earth wire. Why was one not fitted?

(2 marks)

- d)** The lamp plugs into the mains which provides 240V. If Brian fits a 60W bulb what current would be drawn?

(2 marks)

- e)** Should the plug have a 13A or a 3A fuse?

(1 mark)

- f)** Explain your choice and say whether it protects well enough.

(2 marks)

(Marks available: 10)

Static and Current Electricity (Answers)

Answer outline and marking scheme for question: 1

a) Rub the strips with a cloth of some kind.

(1 mark)

b) They would repel (push apart) because they have the same charge. A force of repulsion moves them apart.

(2 marks)

c) As they would have the same charge they would repel and would be trying to spread out as much as they could.

(2 marks)

d) The charged paint would be attracted around the back anyway.

(1 mark)

e) Paint doesn't miss the frame because it is attracted to it.

(1 mark)

f) Sparks from the static charge would damage the delicate components.

(2 marks)

f) Nylon carpets would easily get charged up.

(1 mark)

(Marks available: 10)

Answer outline and marking scheme for question: 2

a) The brightness will change.

(1 mark)

b) The reading will go up or down.

(1 mark)

c) Each bulb will have 3V across it.

(1 mark)

d) One of the bulbs is broken / A wire has come loose / The battery is running down.

(2 marks)

e) Two bulbs in series will have twice the resistance so the current will be half. 1.5A

(2 marks)

f) Ammeter P will read 4.5A (3A+ 1.5A)

(1 mark)

g) $R=V/I$. $R=6V/3A=2$ ohms

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 3

a) 2kW

(1 mark)

b) units used = 2kW x 0.1h = 0.2kWh

(2 marks)

c) cost = 0.2kWh x 6p = 1.2p

(1 mark)

d) Measure the current and the p.d. / Using an Ammeter and Voltmeter.

(2 marks)

e) Increase the supplied voltage. / Shorten the coiled up wire.

(2 marks)

f) If heated the resistance of the Thermistor lowers.

(1 mark)

As the resistance lowers more current will flow - higher meter reading.

(1 mark)

(Marks available: 10)

Answer outline and marking scheme for question: 4

a) The live wire is in the earth terminal and the earth wire in the live terminal.

(1 mark)

b) The live current would flow down the earth wire, which is connected to metal casing so there would be a risk of a shock.

(2 marks)

c) There are no exposed metal parts. (double insulated) / So no earth wire is needed.

(2 marks)

c) $I=P/V$

$$I=60W / 240V=0.25A$$

(2 marks)

d) A 3A fuse should be fitted.

(1 mark)

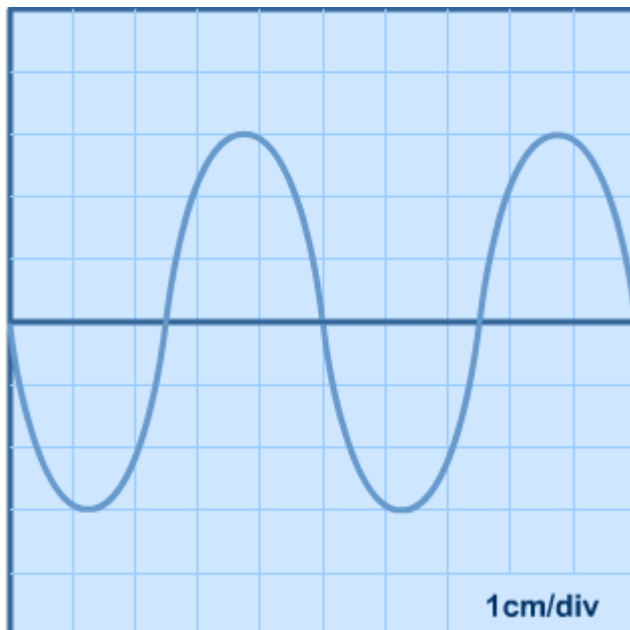
e) 3A is the lowest fuse rating available above the current drawn. 3A is a lot more than 0.25A so there could be a fault that might not blow the fuse.

(2 marks)

(Marks available: 10)

Uses of Waves (Questions)

1. The diagram shows a representation of a sound wave on the screen of an oscilloscope.



a) Name a device that could have been used to capture the sound wave and turn it into the electrical signal for the oscilloscope.

(1 mark)

b) How would the trace change if the frequency of the sound increased?

(2 marks)

c) Each square represents 2×100 ths of a second.

How long does it take for one wave to happen?

(2 marks)

d) How many waves happen in one second?

(1 mark)

e) What is the frequency of the sound wave?

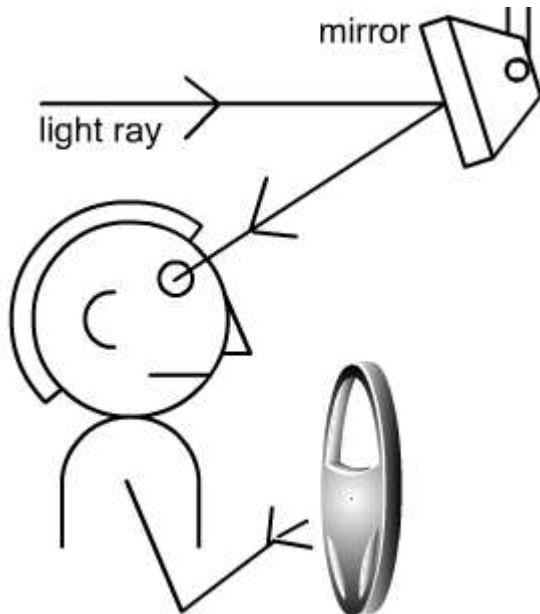
(2 marks)

f) If sound travels at a speed of 330 m/s, then what is the wavelength of the wave?

(2 marks)

(Marks available: 10)

2. **a)** A ray of light approaches the rear view mirror in a car at an angle of 33 degrees to the normal line.



What is the normal line?

(2 marks)

- b)** What would be the size of the angle of reflection?

(1 mark)

- c)** If the mirror is moved to position marked X how would the path of the reflected ray of light be effected?

(1 mark)

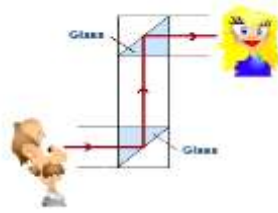
- d)** What would the driver see?

(1 mark)

- e)** If the driver wished to check her make up in what direction might she adjust the rear view mirror?

(1 mark)

- f)** This diagram shows the arrangement of two mirrors in a periscope.



Copy and complete the diagram to show the ray of light passing through the periscope.

(2 marks)

g) State a use for a periscope.

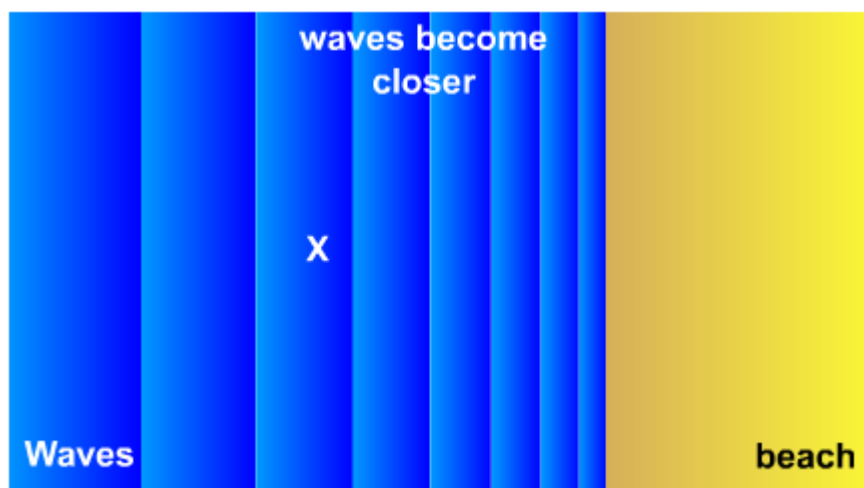
(1 mark)

h) What other optical device could be used instead of mirrors in a periscope?

(1 mark)

(Marks available: 10)

3. Some waves approach a beach.



a) Why do the waves get closer as the waves approach the beach?

(2 marks)

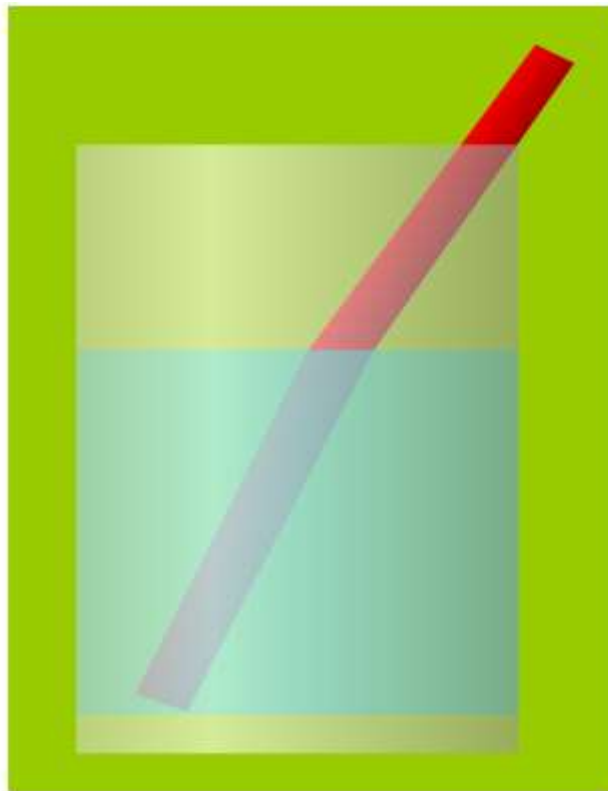
b) If a large rock is placed at X, then what will happen to the waves that pass it?

(2 marks)

c) Nearby the waves pass through a gap between two pier supports. Describe what happens to the waves as they pass through.

(2 marks)

d) Ashia has a glass of lemonade and she notices that the straw looks crooked.



Use ideas of refraction to explain this.

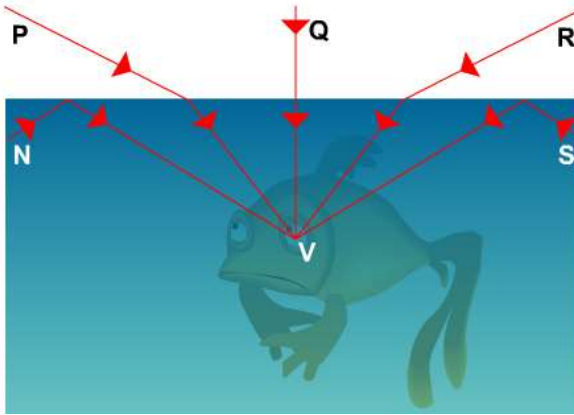
(2 marks)

e) Name two optical devices that work because of refraction.

(2 marks)

(Marks available: 10)

4. The diagram shows the path of light rays entering the eye of a fish.



5.

a) Why does the ray P bend as it enters the water?

(1 mark)

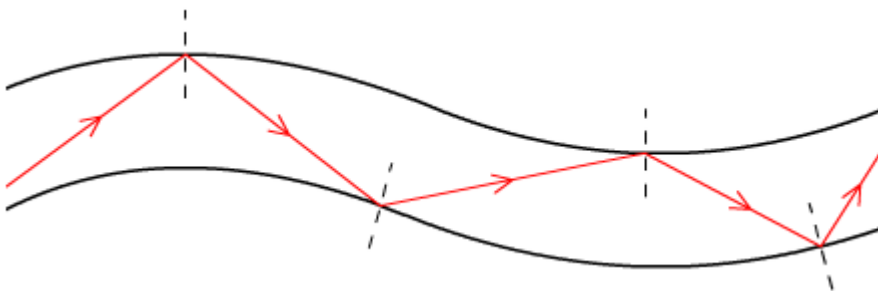
b) What has happened to ray Q as it entered the water?

(1 mark)

c) What is the name of the effect shown by rays N and S?

(1 mark)

d) This effect is used in Fibre Optic communication.



Why does the ray of light not escape the optical fibre?

(2 marks)

e) Fibre optic cables are replacing copper wires in telecommunication links.

Give two advantages fibre optic cables have over copper wire.

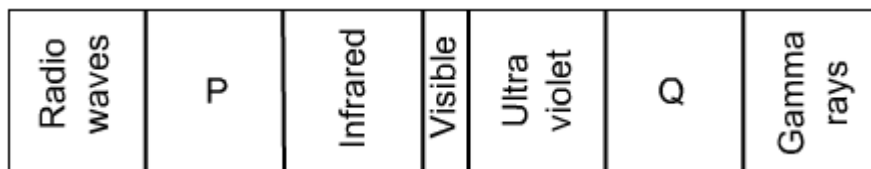
(2 marks)

f) Give two other uses for fibre optics.

(2 marks)

(Marks available: 9)

5. Here is a diagram of the electromagnetic spectrum:



a) What are the missing parts of the electromagnetic spectrum labeled P and Q?

(2 marks)

b) Which end of the spectrum has the longest wavelength?

(1 mark)

c) Which end of the spectrum has the highest energy?

(1 mark)

d) Give one use for the infrared.

(1 mark)

e) Name two detectors of visible light.

(2 marks)

f) Ultra Violet radiation is present in sunlight.

In what way is the Ultra Violet harmful to humans?

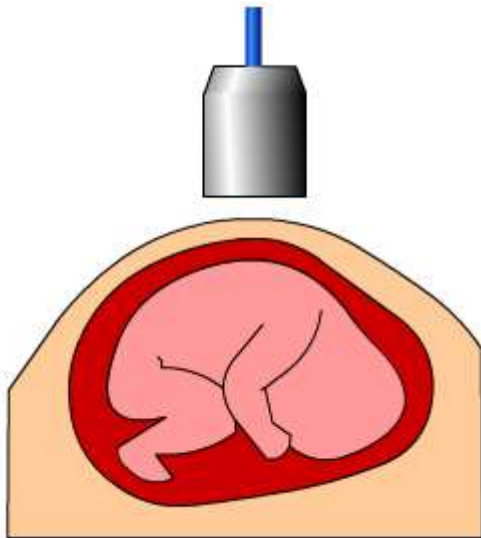
(1 mark)

g) How can the risks be reduced?

(2 marks)

(Marks available: 10)

6. During pregnancy the unborn foetus is monitored using Ultrasound.



a) What is Ultrasound?

(1 mark)

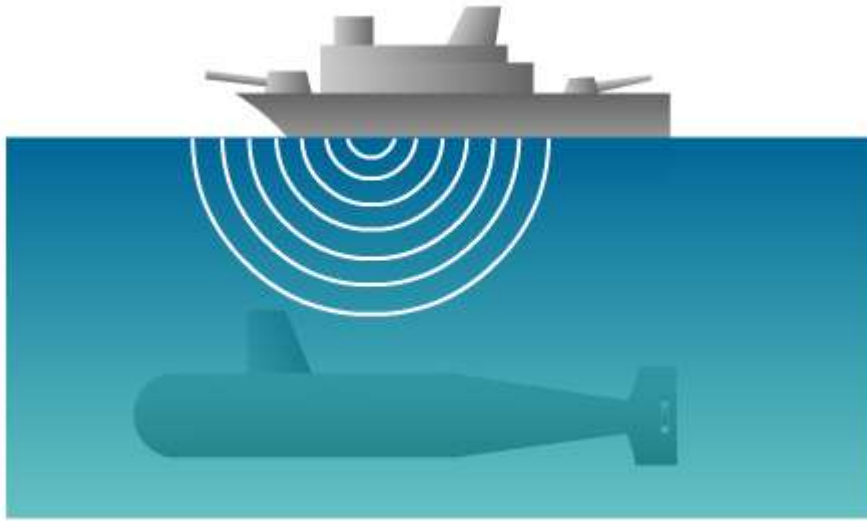
b) Name one animal that might hear ultrasound.

(1 mark)

c) Why would the doctor not use x-rays to monitor the unborn child?

(2 marks)

Ultrasound can also be used to detect shoals of fish, it can be called sonar.



A pulse of ultrasound is sent out from the boat an echo is heard 0.3 seconds later.

d) What is an echo?

(1 mark)

e) The speed of ultrasound in water is 1500 m/s.

Why does ultrasound (and sound) travel faster in water than in air?

(2 marks)

f) Calculate the depth of the shoal of fish.

(3 marks)

(Marks available: 10)

7. **a)** What does a seismometer measure?

(1 mark)

b) Name the scale that describes earthquake intensity.

(1 mark)

c) An earthquake creates S-waves and P-waves.

Which of these is a longitudinal wave and which is a transverse wave?

(2 marks)

d) How is the motion different in a longitudinal and a transverse wave?

(2 marks)

e) Which of S-waves and P-waves can travel through liquids?

(1 mark)

f) On the opposite side of the earth to the earthquake, only one type of wave is detected.

Which type is detected?

(1 mark)

g) What does this tell us about the core of the earth?

(2 marks)

(Marks available: 10)

Uses of Waves (Answers)

Answer outline and marking scheme for question: 1

a) Microphone.

(1 mark)

b) The wave should become more compressed but the wave height remains the same.

(2 marks)

c) 0.08 s

(2 marks)

d) 12.5 waves

(1 mark)

e) 12.5 Hz

(2 marks)

f) Wavelength = wave speed / frequency

Wavelength = $330 / 12.5 = 26.4$ m

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 2

a) Imaginary line at right angles to the mirror from which all angles are measured.

(2 marks)

b) 33 degrees.

(1 mark)

c) The ray would reflect upwards.

(1 mark)

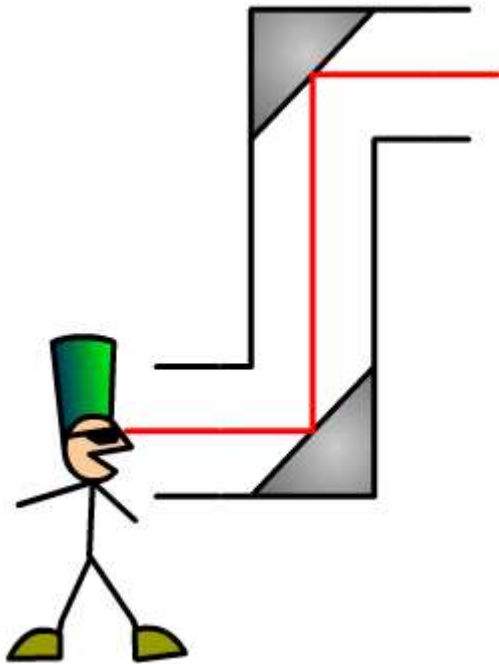
d) The driver would see the ceiling.

(1 mark)

e) Tilt the top downwards.

(1 mark)

f)



Light rays at 45 degrees to mirrors, with direction marked correctly.

(2 marks)

g) Any valid use, for example, looking over walls. Driver seeing upper deck on double decker buses.

(1 mark)

h) Prisms.

(1 mark)

(Marks available: 10)

Answer outline and marking scheme for question: 3

a) They slow down because the water is getting shallower - refraction.

(2 marks)

b) Waves diffract as they pass curving around into the space behind the rock.

(2 marks)

c) Waves diffract as they go between the supports spreading into a curved wave.

(2 marks)

d) Light rays from the straw in the air come straight to the eye. Rays from the straw in the water are refracted as they leave the water. This change of direction means they appear to come from somewhere else.

(2 marks)

e) Lens, Prism.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 4

a) It refracts - a decrease in speed makes it bend inwards.

(1 mark)

b) It slows but does not deviate because it met the boundary at right angles.

(1 mark)

c) Total internal reflection.

(1 mark)

d) It meets the boundary at an angle greater than the critical angle.

(2 marks)

e) Greater data capacity, fewer signal repeaters, smaller and lighter, cheaper raw materials, more secure data transmission.

(2 marks)

f) Endoscopy, intranet links, novelty items.

(2 marks)

(Marks available: 9)

Answer outline and marking scheme for question: 5

a) P-microwaves, Q-xrays.

(2 marks)

b) Radio waves.

(1 mark)

c) Gamma rays.

(1 mark)

d) Heat therapies, thermal imaging cameras.

(1 mark)

e) The eye, photographic film, ldr, photo voltaic cell.

(2 marks)

f) Causes sunburn and skin cancers.

(1 mark)

g) Wearing sunscreen and limiting time in the sun.

(2 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 6

a) Sound vibrations too high for humans to hear.

(1 mark)

b) Bats, dogs...

(1 mark)

c) X-rays would harm the developing foetus.

(2 marks)

d) An echo is wave a sound wave reflects off something.

(1 mark)

e) The particles in a liquid are closer allowing better interaction between particles in the longitudinal wave.

(2 marks)

f) Speed = distance / time. Distance = speed x time.

Distance = $1500 \times 0.3 = 450$ m

Half this to get depth.

Depth = 225 m.

(3 marks)

(Marks available: 10)

Answer outline and marking scheme for question: 7

a) Vibrations in the earth, earthquakes.

(1 mark)

b) Richter scale

(1 mark)

c) S-waves are transverse and p-waves are longitudinal.

(2 marks)

d) Transverse motion has particles oscillating across the direction of travel, whereas in longitudinal the oscillations are parallel to the direction of travel.

(2 marks)

e) P-waves.

(1 mark)

f) P-waves.

(1 mark)

g) The core is liquid as the waves that get through can go through liquid.

(2 marks)

(Marks available: 10)