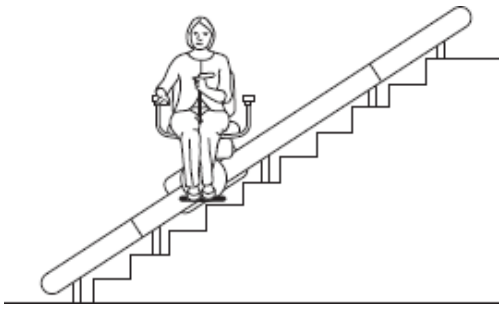
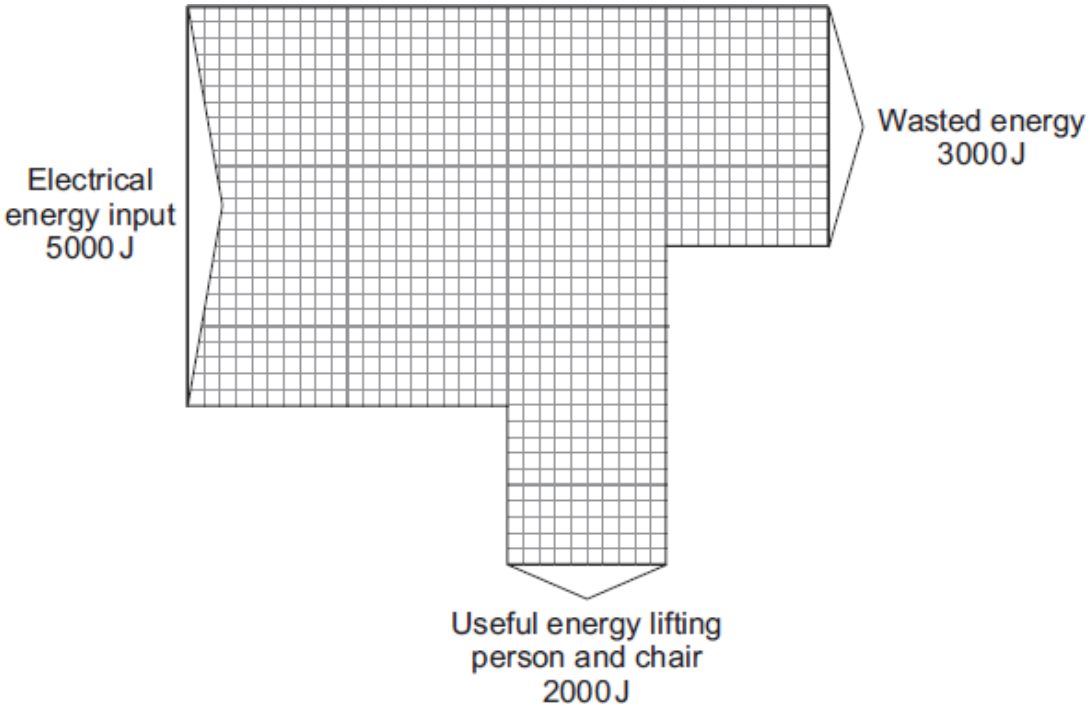
Q1. A person uses a stairlift to go upstairs. The stairlift is powered by an electric motor.



The Sankey diagram shows the energy transfers for the electric motor.



(a) Complete the following sentence.

The electric motor wastes energy as ..... energy.

(1)

(b) Use the equation in the box to calculate the efficiency of the electric motor.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

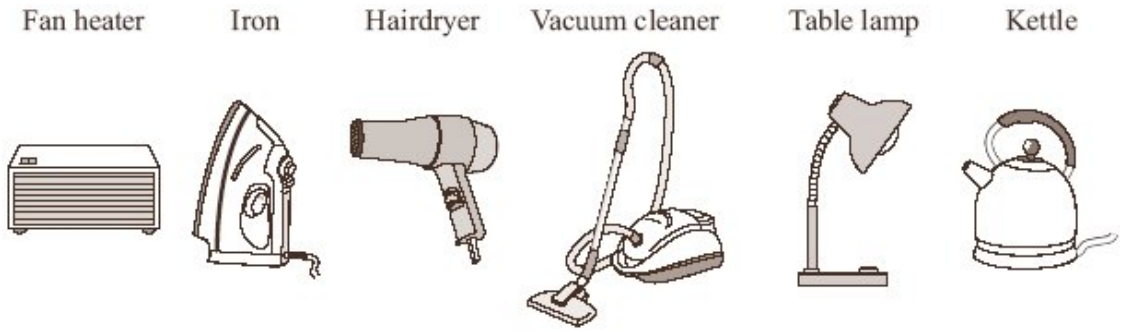
.....

Efficiency = ...

(2)

(Total 3 marks)

Q2. The pictures show six different household appliances.



(a) Four of the appliances, including the fan heater, are designed to transform electrical energy into heat.

Name the other **three** appliances designed to transform electrical energy into heat.

1 .....

2 .....

3 .....

(3)

(b) Complete the following sentence using **one** of the words from the box.

chemical	**heat**	**kinetic**	**sound**

Energy that is not usefully transformed by the fan heater is wasted as

..... energy.

(1)

(c) The table gives information about two different fan heaters.

	Useful energy transferred each second in joules	**Wasted energy transferred each second in joules**
Fan heater **L**	1200	10
Fan heater **M**	1200	20

Complete the following sentence by drawing a ring around the line in the box that is correct.

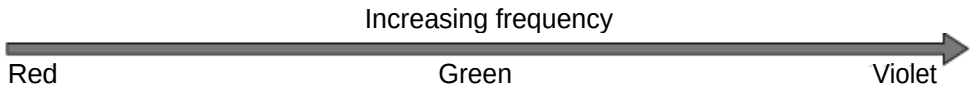
Fan heater **L** | is more efficient than / has the same efficiency as / is less efficient than | fan heater **M**.

(1)
(Total 5 marks)

Q3. (a) The visible light spectrum has a range of frequencies.

Figure 1 shows that the frequency increases from red light to violet light.

Figure 1



Use the correct answers from the box to complete the sentence.

decreases	**stays the same**	**increases**

As the frequency of the light waves increases, the wavelength

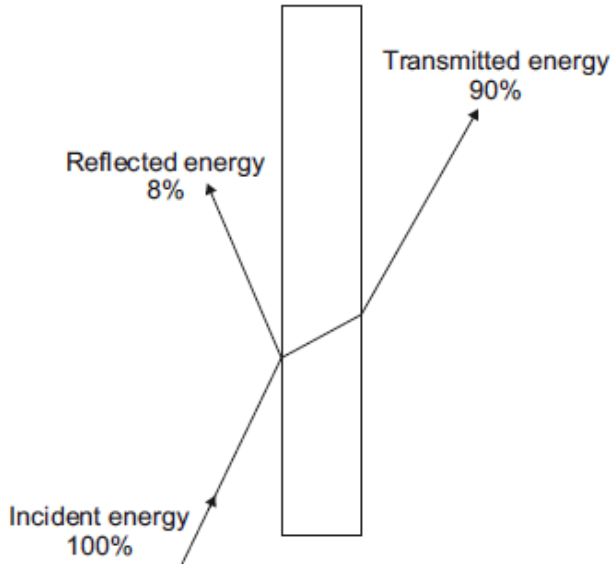
of the light waves ..... and

the energy of the light waves ..... .

(2)

(b) **Figure 2** shows what happens to the light energy when a ray of light hits a glass block.

Figure 2



98% of the incident energy is either reflected or transmitted by the glass block.

What happens to the other 2% of the incident energy?

.....

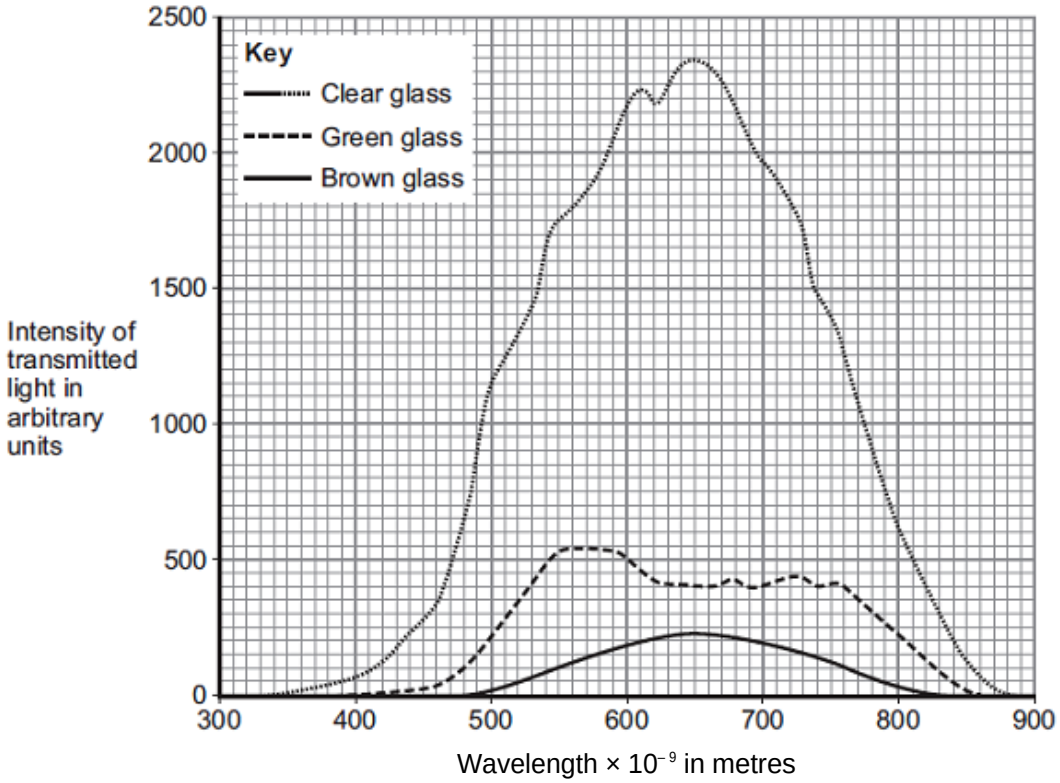
.....

(1)

(c) Bottled beer will spoil if the intensity of the light passing through the glass bottle into the beer is too high.

Figure 3 shows the intensity of the light that is transmitted through three different pieces of glass.

Figure 3



(i) The pieces of glass all had the same thickness.

Suggest why.

.....

.....

(1)

(ii) Bottles made of brown glass are suitable for storing beer.

Suggest why.

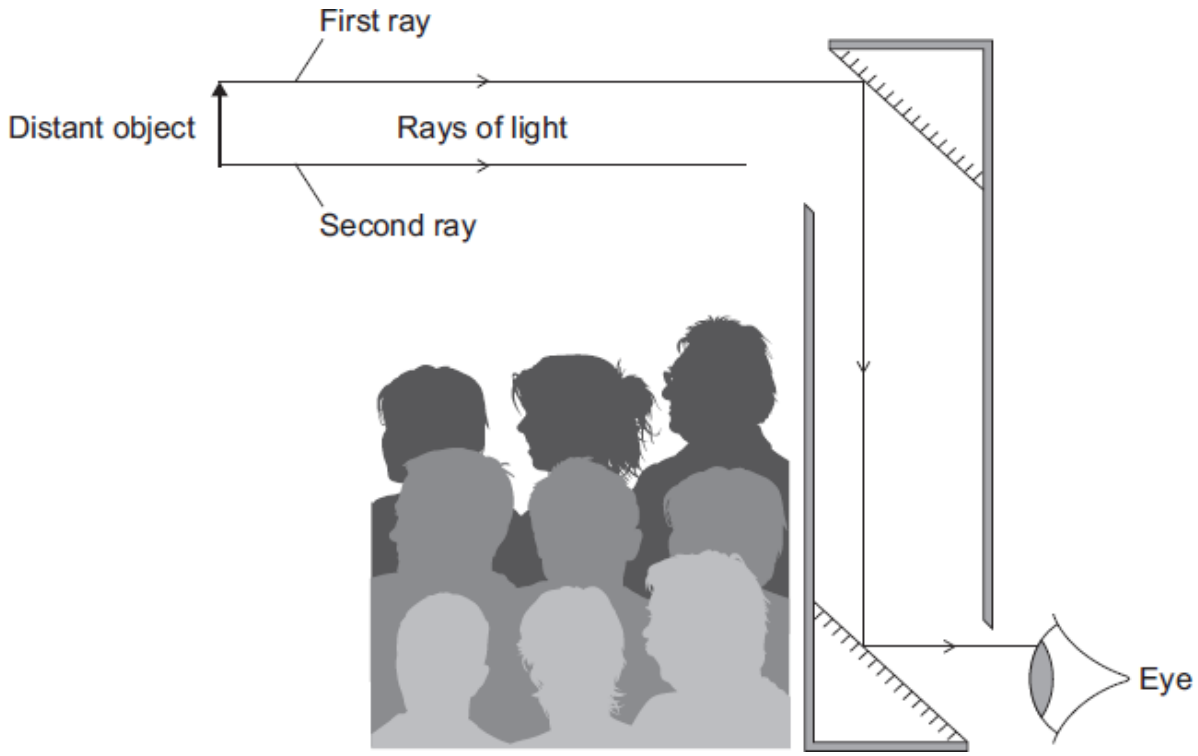
.....

.....

(1)
(Total 5 marks)

Q4. The diagram shows a periscope being used to see over the heads of a crowd of people.

The periscope has been made using two plane mirrors.



(a) Using a ruler, complete the diagram to show how the second ray of light from a distant object reaches the person's eye.

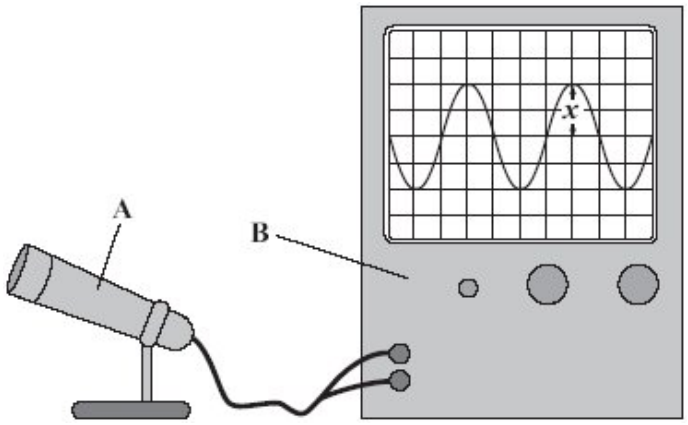
(2)

(b) How big is the image produced by the periscope compared to the size of the object?

.....

(1)
(Total 3 marks)

Q5. (a) A student uses two pieces of equipment, **A** and **B**, to display a sound wave.



(i) Use words from the box to complete the sentence.

a loudspeaker	a microphone	an oscilloscope	a screen

A is ..... and **B** is ..... .

(2)

(ii) Use words from the box to complete the sentence.

the amplitude	half the amplitude	the frequency	half the frequency

The distance ***x*** marked on the diagram measures ..... of the sound wave.

(1)

(iii) Complete the sentence.

The distance ***x*** becomes smaller. This is because the sound has

become ..... .

(1)

(b) There is no air in space.

Astronauts in space cannot hear sounds from outside their spacesuits.

Explain this.

.....

.....

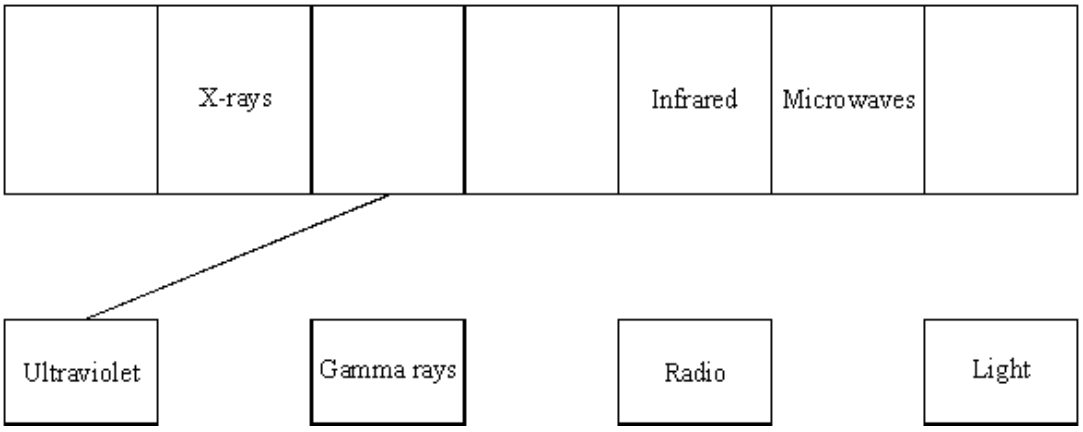
.....

.....

(2)

(Total 6 marks)

Q6. (a) The diagram represents the electromagnetic spectrum. Four of the waves have not been named. Draw lines to join each of the waves to its correct position in the electromagnetic spectrum. One has been done for you.



(2)

(b) Complete the following sentence by choosing the correct answer and crossing out in the box the two lines which are wrong.

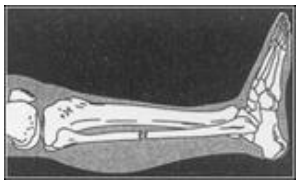
The speed of radio waves through a vacuum is

faster than
the same as
slower than

the speed of light through a vacuum.

(1)

(d) The diagram shows an X-ray photograph of a broken leg.



Bones show up white on the photographic film. Explain why.

.....

.....

.....

(2)

(Total 5 marks)

Q7. (a) Scientists use telescopes to observe stars and galaxies.
Some telescopes are on Earth, but some are on satellites in space.

Why do telescopes in space give better images than telescopes on the Earth?

.....

.....

(1)

(b) Scientists have observed that the wavelengths of the light given out from galaxies that are moving away from the Earth are longer than expected.

(i) What name is given to this observation?

Put a tick (✓) in the box next to your answer.

blue-shift	☐
green-shift	☐
red-shift	☐

(1)

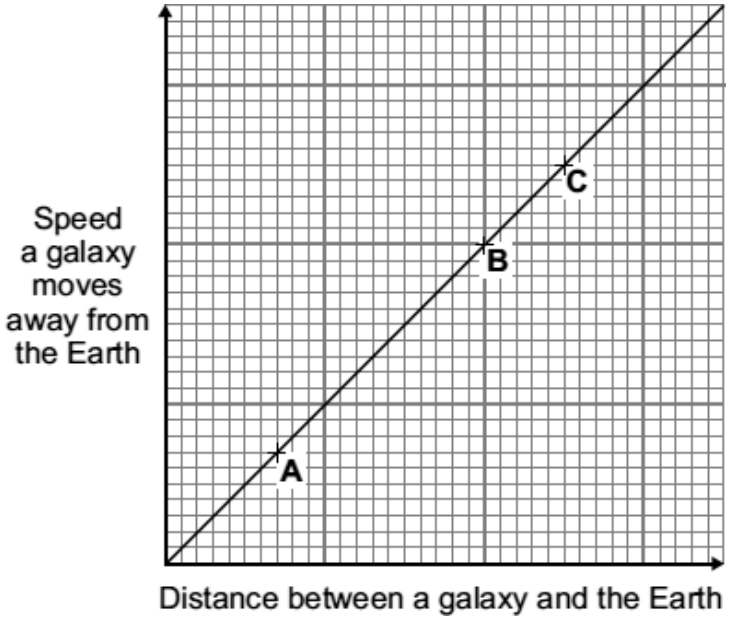
(ii) Complete the following sentence by drawing a ring around the correct line in the box.

This observation gives evidence for the idea that the universe is

shrinking.
not changing.
expanding.

(1)

(c) Use the graph to answer the following questions.



(i) What is the link between the speed that a galaxy moves away from the Earth and the distance between the galaxy and the Earth?

.....

.....

(1)

(ii) The positions of three galaxies, **A**, **B** and **C**, are marked on the graph.

From which galaxy, **A**, **B** or **C**, would the wavelength of the light reaching the Earth seem to have changed the most?

Galaxy .....

Give a reason for your answer.

.....

.....

.....

.....

(2)
(Total 6 marks)

Q8. (a) Scientific research carried out in 13 countries has tried to find out if there are any links between using a mobile phone and developing different types of cancer.

About 13 000 people, half with cancer and half in good health, were interviewed about their mobile phone use.

(i) Suggest why people in good health were interviewed.

.....

.....

.....

(1)

(ii) Interviewing 13 000 people gave the researchers a large sample size.

Give **one** advantage, in any research project, of having a large sample size rather than a small sample size.

.....

.....

.....

(1)

(b) The following information was included in a newspaper article about the research project.

- It may be difficult to prove there is a link simply by asking people how much they use a mobile phone. People's memories are not always accurate.
- Scientists in Israel found that people who use a mobile phone a lot are 50% more likely to develop a cancer on the salivary gland just in front of the ears.
- The cost of the research, £20 million, has been partly paid for by mobile phone companies.
- No children were included in the research.

(i) Draw a ring around the correct answer to complete the following sentence.

Using children in scientific research raises (environmental / ethical / social) issues.

(1)

(ii) Suggest **two** reasons why some people are concerned that the research was partly paid for by mobile phone companies.

.....

.....

.....

.....

.....

(2)

(iii) In Germany, mobile phones that emit very low levels of radiation are marked with a special symbol.

Explain why low emission mobile phones should be marked in this way.

.....

.....

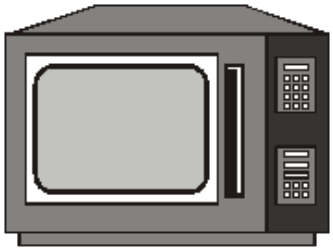
.....

.....

.....

(2)
(Total 7 marks)

Q9. Microwave ovens can be used to heat many types of food.



(i) Describe, in as much detail as you can, how microwaves heat food.

.....

.....

.....

.....

(2)

(ii) Microwaves have a frequency of 10 000 million Hz. Their wavelength is 0.03 m.

Calculate the speed of microwaves.

Show clearly how you work out your answer.

.....

.....

.....

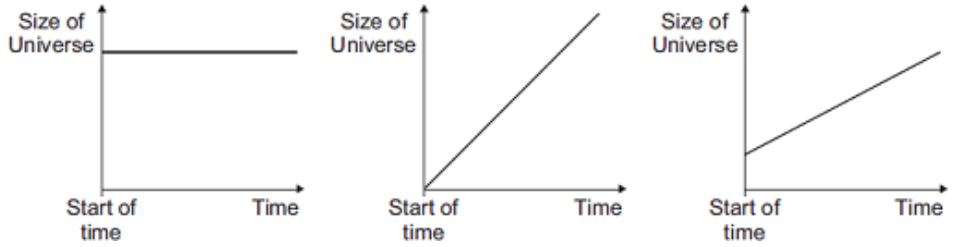
Speed of microwaves..... m/s

(2)

(Total 4 marks)

Q10. The 'big bang' theory is one theory explaining the origin of the Universe.

(a) The graphs **X**, **Y** and **Z**, show how the size of the Universe may have changed with time.



Which graph would the 'big bang' theory suggest is correct?

Write your answer, **X**, **Y** or **Z**, in the box. ☐

Explain the reason for your answer.

.....

.....

.....

.....

(3)

(b) In 1948, an alternative to the ‘big bang’ theory, called the ‘steady state’ theory, was developed.
The ‘steady state’ theory suggested that the Universe, although expanding, has always existed without a beginning in time.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

The measurement of red-shift in the light from distant galaxies provides evidence

to support

only the ‘big bang’ theory.
only the ‘steady state’ theory.
both the ‘big bang’ and ‘steady state’ theories.

(1)

(ii) In 1965, scientists rejected the ‘steady stat’ theory in favour of the ‘big bang’ theory.

Suggest what might cause scientists to stop supporting one theory and to start supporting an alternative theory.

.....

.....

.....

(1)
(Total 5 marks)

M1. (a) heat / thermal
or / and
sound

*do **not** accept noise*
other forms of energy eg light negates answer

1

(b) 0.4
or
40 %

*allow **1** mark for* $\frac{2000}{5000}$
or
equivalent fraction
*an answer 0.4 % gains **1** mark*
*answers 0.4 or 40 given with any unit gains **1** mark*
*40 without % gains **1** mark*

2

[3]

M2. (a) iron

1

hairdryer

1

kettle

answers can be in any order

1

(b) sound

1

(c) is more efficient than

1

[5]

M3. (a) decreases

correct order only

1

increases

1

(b) absorbed

makes the glass warmer is insufficient
(energy) is wasted is insufficient

1

(c) (i) intensity (of transmitted light) depends on thickness
or
to enable a valid comparison
or
it is a control variable

accept absorption depends on thickness
it would affect the results is insufficient
fair test is insufficient

1

(ii) transmits the least light
or
absorbs the most light

accept very little light is transmitted
*do **not** accept transmits none of the light*
*do **not** accept absorbs all of the light*
any reference to heat negates this mark

1

[5]

M4. (a) reflection shown at both mirrors

1

ray parallel to given ray

judge by eye

1

(b) same size

1

[3]

M5. (a) (i)

correct order essential

(**A** =) a microphone

1

(**B** =) an oscilloscope

***or** cathode ray oscilloscope **or** CRO*

1

(ii) the amplitude

accept any unambiguous indication

1

(iii) quieter / softer

*do **not** accept less (which could refer to the amplitude, frequency or wavelength)*

1

(b) sound cannot travel through a vacuum / (empty) space / free space

accept there is no medium for the sound to travel through

1

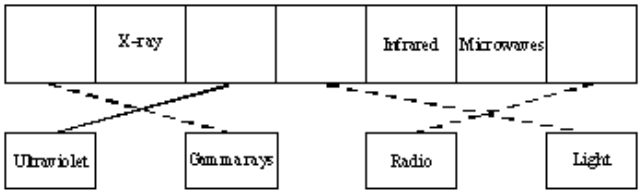
(because) there is / are nothing / no particles to vibrate

accept (because) there is / are nothing / no particles between them and the source (of the sound)

1

[6]

M6. (a) all **three** correct



one *only correct,* ***1*** *mark only*

allow names in boxes

there should be only ***one*** *line from* ***or*** *to each box*

2

(b) the same as

1

(d) any **two** from:

- bones absorb X-rays
- so film not exposed
- X-rays pass through flesh or skin or
- body or tissue (to expose film)

allow X-rays cannot pass through bones

2

[5]

M7. (a) any **one** from:

- above the atmosphere

accept no atmospheric pollution

- no clouds in the way
- no light pollution

answers in terms of being closer to space negate

answers in terms of looking at the Earth negate

1

(b) (i) red-shift

1

(ii) expanding

1

(c) (i) as one gets bigger the other gets bigger

accept (directly) proportional

accept positive correlation

1

(ii) **C**

1

it is furthest from the Earth

*only scores if **C** is chosen*

or

it is furthest away

or

has the largest red-shift

or

it is moving (away) the fastest

1

[6]

M8. (a) (i) to compare mobile phone usage between the two groups

1

(ii) enough data to indicate relationships

or

reduce effect of anomalous data

1

(b) (i) ethical

1

(ii) research may be biased (in favour of companies)

1

negative effects on health may not get published

accept negative effects on health may be played down

1

(iii) it allows people to easily identify lower risk phones

1

and this allows people to make a more informed choice

accept and this allows a comparison to be made

1

[7]

M9. (i) absorbed by water / water heated

1

hot water heats (rest of) food / idea of particle vibration

1

(ii) 300 000 000 / 3×10^8

correct answer with no working = 2
*allow 1 mark for s = f x w **or** correct working i.e., 10000 (000000) × 0.03*
N.B. correct answer from incorrectly recalled relationship / substitution = 0

2

[4]

M10. (a) **Y**

*accept cannot be **X** as size is increasing*

1

shows Universe expanding

*this scores if **Y** or **Z** is chosen*
accept exploding outwards

1

from a (very small) point

*this only scores if **Y** is chosen*
accept from zero (size)
answers in terms of planets
negate the last two mark points

1

(b) (i) both the 'big bang' and 'steady state' theories

1

(ii) (new) evidence that supports / disproves a theory

accept proves for supports

or

(new) evidence not supported by current theory

accept there may be more evidence supporting one (theory) than the other (theory)
accept new evidence specific to this question eg measurement of CBR

or

some types of star only found in distant parts of Universe (steady state suggests should be same throughout Universe)

1

[5]