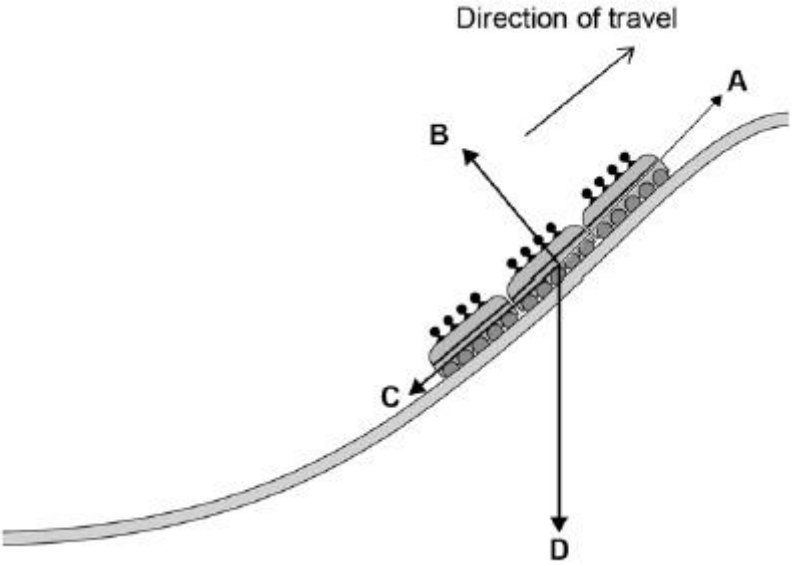
60 Minutes on Physics Exam on Thursday 29th February (14 days time)

Q1.

Figure 1 shows a rollercoaster train as it is pulled up a slope on the track.

The arrows, **A**, **B**, **C** and **D**, represent the forces acting on the rollercoaster train.

Figure 1



(a) Give **two** ways that the force arrows show that forces are vector quantities.

1. _____

2. _____

(2)

(b) Which arrow shows the weight of the rollercoaster train?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Which arrow shows the normal contact force?

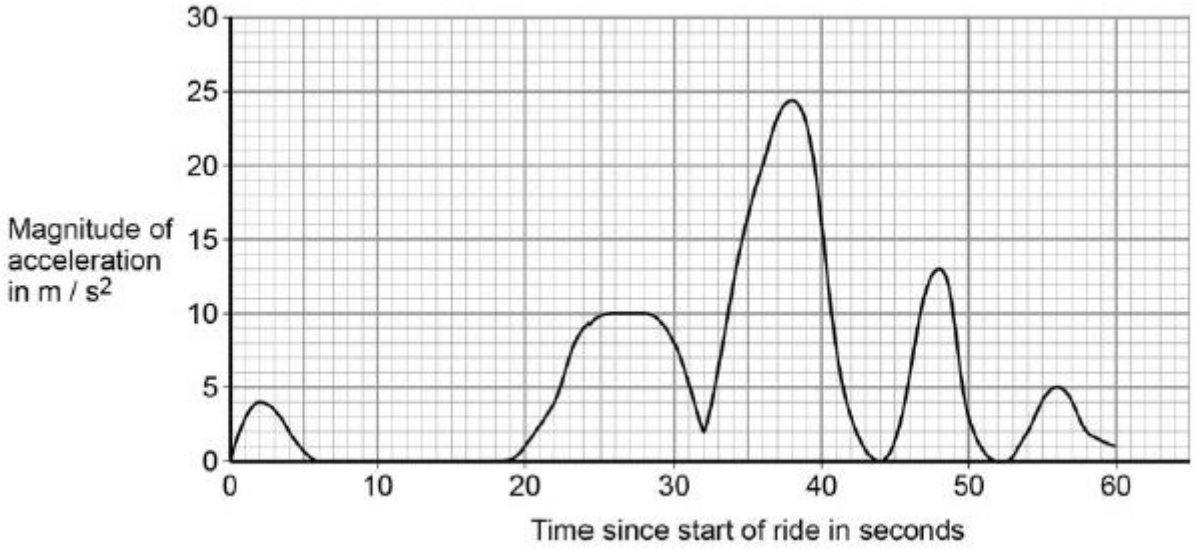
Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

Figure 2 shows the magnitude of the acceleration of the rollercoaster train during the ride.

Figure 2



(d) Why has a line graph been drawn instead of a bar chart?

Tick **one** box.

Acceleration is a control variable. ☐

Both variables are continuous. ☐

Line graphs are easier to read. ☐

Time is a categoric variable. ☐

(1)

(e) What conclusion can be made from **Figure 2** about the motion of the rollercoaster train between 10 and 15 seconds?

Tick **one** box.

It is moving at a constant velocity. ☐

Its velocity is decreasing. ☐

Its velocity is increasing. ☐

(1)

(f) What is the maximum acceleration of the rollercoaster train?

Use **Figure 2**.

Acceleration = _____ m/s^2

(1)

(g) The maximum safe acceleration for most people is 5 times the acceleration due to gravity.

Acceleration due to gravity = 9.8 m/s^2

Explain whether the acceleration of this rollercoaster train is safe for most people

_____

_____

_____

_____

_____

_____

(3)

(h) One of the passengers on the rollercoaster train has a mass of 58 kg

Calculate the maximum force experienced by the passenger during the ride.

Use the equation:

force = mass × acceleration

Give the unit.

_____

_____

_____

_____

_____

_____

Maximum force = _____ Unit _____

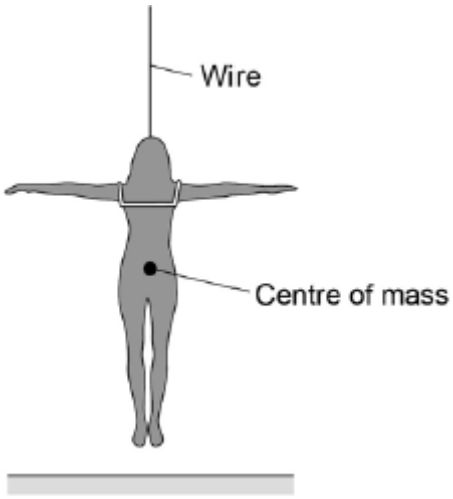
(3)

(Total 13 marks)

Q2.

An actor is attached to a wire so that she can hang above the stage.

Look at the figure below.



(a) On The figure above draw two arrows to show the forces acting on the actor.

(2)

(b) Which **two** forces are acting on the actor?

Tick **two** boxes.

Air resistance force	☐
Electrostatic force	☐
Gravitational force	☐
Magnetic force	☐
Tension force	☐

(2)

(c) The actor hangs above the stage in a stationary position.

What is the resultant force on the actor?

Resultant force = _____ N

(1)

(d) The actor has a mass of 70 kg.

Gravitational field strength = 9.8 N / kg

Use the following equation to calculate the weight of the actor.

Weight = mass × gravitational field strength

Give your answer to 2 significant figures.

_____

_____

_____

Weight of actor = _____ N

(2)

(e) A motor pulls vertically upwards on the wire with a force of 720 N.

Calculate the resultant force on the actor.

_____

Resultant force = _____ N

(1)

(f) Another actor has a mass of 65 kg.

This actor is attached to the wire and the motor pulls her vertically upwards.

The resultant force on the actor is 25 N.

Write down the equation that links acceleration, mass and resultant force.

Equation _____

(1)

(g) Calculate the acceleration of the actor.

_____

_____

_____

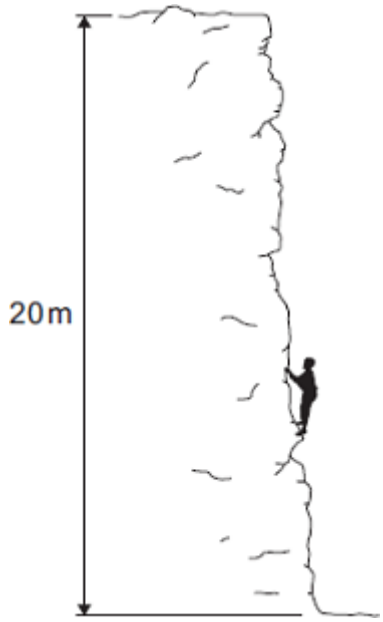
Acceleration of actor = _____ m / s^2

(3)

(Total 12 marks)

Q3.

The diagram shows a climber part way up a cliff.



(a) Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational _____ energy.

(1)

(b) The climber weighs 660 N.

(i) Calculate the work the climber must do against gravity, to climb to the top of the cliff.

_____

_____

Work done = _____ J

(2)

(ii) It takes the climber 800 seconds to climb to the top of the cliff.
During this time the energy transferred to the climber equals the work done by the climber.

Calculate the power of the climber during the climb.

_____

_____

Power = _____ W

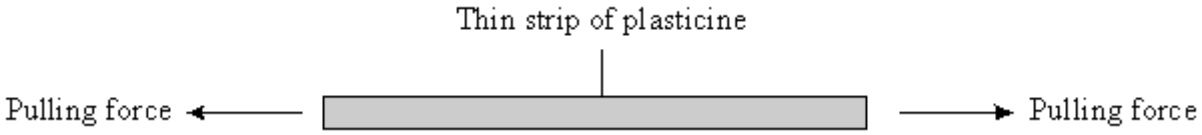
(2)

(Total 5 marks)

Q4.

The diagrams show pairs of forces acting on different objects. In each case describe what happens when the forces are increased. Then describe what happens when the forces are removed.

(a)



When the forces are increased _____

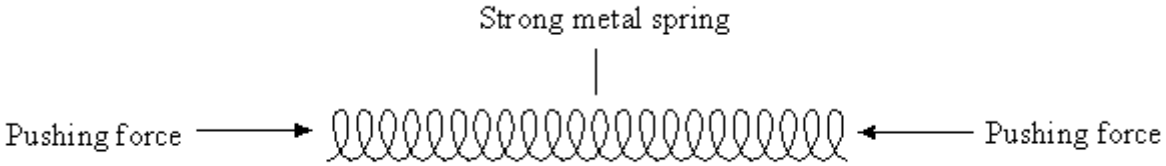
_____

When the forces are removed _____

_____

(2)

(b)



When the forces are increased _____

_____

When the forces are removed _____

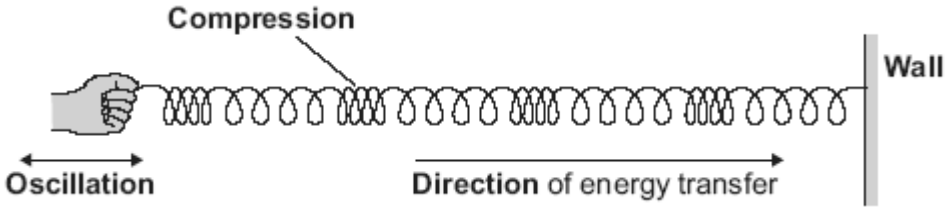
_____

(2)

(Total 4 marks)

Q5.

(a) The diagram shows a longitudinal wave being produced in a stretched spring.



(i) Use the bold words from the diagram to complete the following sentence. Put only **one** word in each space.

A longitudinal wave is one in which the _____ causing the wave is parallel to the _____ of energy transfer.

(2)

(ii) Name the type of energy that is transferred by longitudinal waves.

_____

(1)

(b) The diagram shows water waves made by a wave machine in a swimming pool.

Every second, two waves go past a person standing in the swimming pool.

The waves have a wavelength of 0.8 metres.

Calculate the speed of the water waves.

Write down the equation you use, and then show clearly how you work out your answer.

Give the correct unit in your answer.

_____

_____

_____

_____

_____

_____

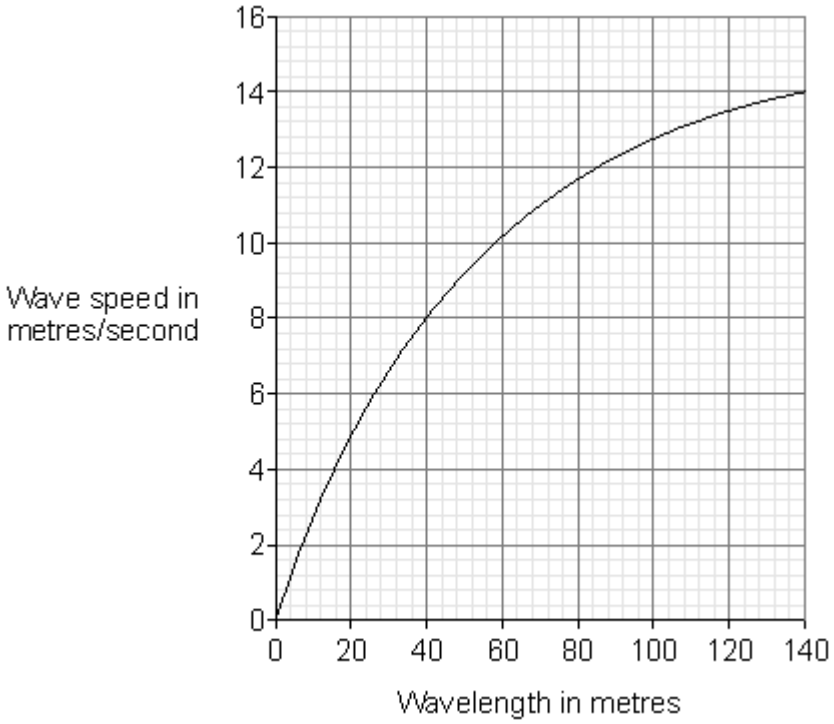
_____

_____

Wave speed = _____

(3)

(c) The graph shows how the speed of deep ocean waves depends on the wavelength of the waves.



What can you conclude from the graph?

_____

_____

_____

_____

_____

(2)

Q6.

The area around a magnet is called the magnetic field.

(a) The Earth has a magnetic field.

What causes the Earth's magnetic field?

Tick **one** box.

The movement of liquid iron in the Earth's outer core ☐

The gravitational field of the Earth ☐

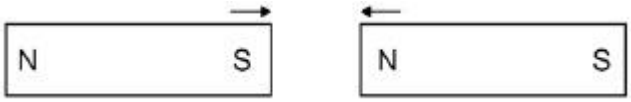
The permanent magnet in the Earth's core ☐

(1)

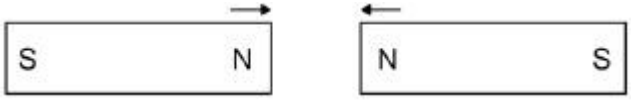
(b) Look at **Figure 1**.

Figure 1

Opposite poles brought together



Same poles brought together



What will happen in each case when the poles of two magnets are brought close together?

Opposite poles brought together _____

_____

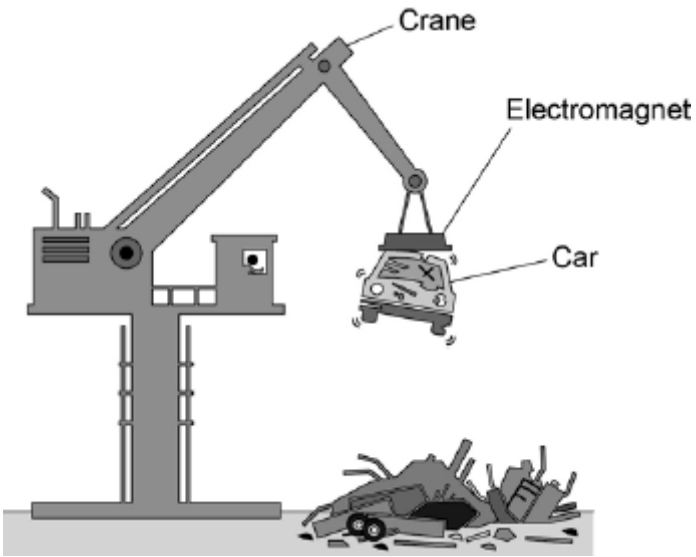
Same poles brought together _____

_____

(2)

(c) **Figure 2** shows an electromagnet being used to lift a car in a scrapyard.

Figure 2



An electromagnet is a solenoid.

Explain why it is better to use an electromagnet rather than a permanent magnet in a scrapyard.

You should include a comparison of the properties of electromagnets and permanent magnets in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q7.

(a) The diagram below shows six of the seven types of wave that make up the electromagnetic spectrum.

Gamma rays		Ultraviolet	Visible light	Infrared	Microwaves	Radio waves

(i) What type of electromagnetic wave is missing from the diagram?

_____

(1)

(ii) Which of the following electromagnetic waves has the most energy?

Draw a ring around the correct answer.

gamma rays **radio waves** **visible light**

(1)

(iii) Which of the following electromagnetic waves is given out by a TV remote control?

Draw a ring around the correct answer.

infrared **microwaves** **ultraviolet**

(1)

(b) Draw a ring around the correct answer in the box to complete the sentence.

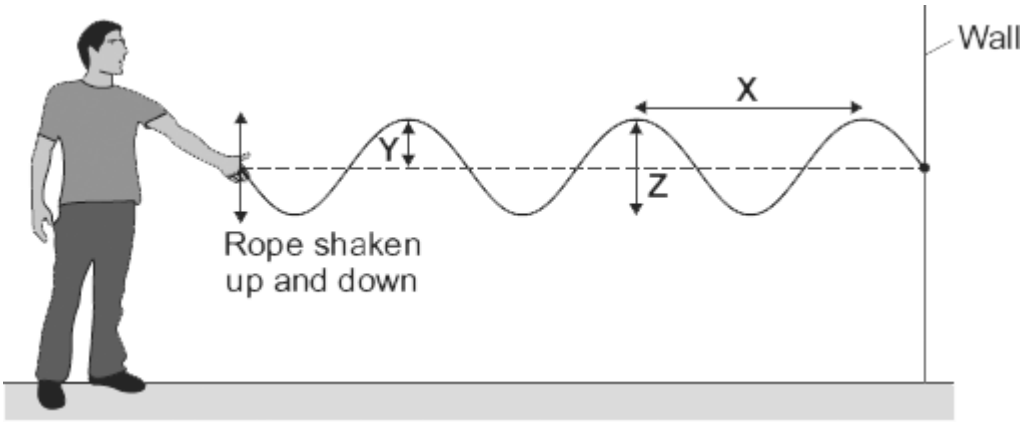
Microwaves travel through a vacuum at

a slower speed than
the same speed as
a faster speed than

radio waves.

(1)

(c) The diagram shows waves being produced on a rope.
The waves are **not** reflected by the wall.



(i) Draw an arrow on the diagram to show the direction in which the waves transfer energy.

(1)

(ii) Which **one** of the arrows, labelled, **X**, **Y** or **Z**, shows the amplitude of a wave?

Write the correct answer in the box. ☐

(1)

(iii) The waves produced on the rope are transverse.

Name **one** other type of transverse wave.

_____

(1)

(d) The rope is shaken up and down, producing 3 waves every second.
The waves have a wavelength of 1.2 metres.

(i) State the frequency of the waves.

_____ Hz

(1)

(ii) Calculate the speed of the waves.

Show clearly how you work out your answer.

_____

_____

Wave speed = _____ m/s

(2)

(Total 10 marks)

Q8.

(a) Complete the sentences.

Choose the answers from the box.

ionising	light	sound	transmitted	waves

X-rays travel at the speed of _____ .

X-rays can cause cancer because they are _____ .

(2)

(b) How do X-rays compare with gamma rays?

Tick **one** box.

X-rays have a longer wavelength and a higher frequency ☐

X-rays have a longer wavelength and a lower frequency ☐

X-rays have a shorter wavelength and a higher frequency ☐

X-rays have a shorter wavelength and a lower frequency ☐

(1)

A scientist measured the radiation dose that a person received at different distances from an X-ray machine.

The table shows the results.

Distance from machine in m	**Dose in millisieverts/**			**Mean dose in millisieverts**
	Test 1	**Test 2**	**Test 3**	
0.5	0.152	0.146	0.155	0.151
1.0	0.039	0.035	0.040	**X**
1.5	0.017	0.018	0.017	0.017
2.0	0.012	0.007	0.007	0.009
2.5	0.007	0.006	0.005	0.006

(c) Calculate value **X** in the table.

_____

_____

_____

Mean dose = _____ millisieverts

(2)

(d) What conclusion can be made from the results in the table?

Tick **one** box.

The dose decreases if you stand further from the machine.	☐
The dose is directly proportional to the distance.	☐
The dose is the same at all distances from the machine.	☐
There is a linear relationship between dose and distance.	☐

(1)

(e) An X-ray gives a radiation dose of 0.180 millisieverts.

Natural sources give a dose of 0.012 millisieverts per day.

Calculate the time it would take for natural sources to give a dose of 0.180 millisieverts.

_____

_____

_____

Time = _____ days

(2)

(f) Suggest why doctors use X-rays even though this increases the risk of cancer to the patient.

_____

_____

(1)

(g) X-rays can also be used to treat cancer.

A patient receives a dose of 20 millisieverts from an X-ray.

Proton beam therapy delivers 40% of this dose.

Calculate the dose delivered by proton beam therapy.

_____

_____

_____

Dose = _____ millisieverts

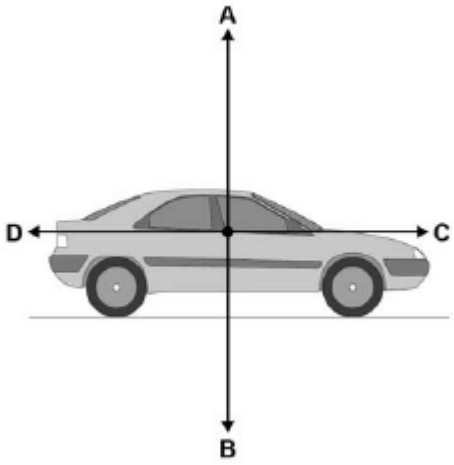
(2)

(Total 11 marks)

Q9.

Figure 1 shows the forces acting on a car moving at a constant speed.

Figure 1



(a) Which force would have to increase to make the car accelerate?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(b) The car travels a distance of 2040 metres in 2 minutes.

Use the following equation to calculate the mean speed of the car.

$$\text{mean speed} = \frac{\text{distance}}{\text{time}}$$

_____

_____

Mean speed = _____ m / s

(2)

(c) The car makes an emergency stop.

Figure 2 shows the thinking distance and braking distance of the car.

Figure 2

What is the stopping distance?

_____

(1)

(d) The person driving the car is tired.

What effect will this have on the thinking distance and braking distance?

Tick **one** box for thinking distance.

Tick **one** box for braking distance.

	decreases	increases	stays the same
thinking distance	☐	☐	☐
braking distance	☐	☐	☐

(2)

(Total 6 marks)

Q1.

(a) the arrows have different lengths

allow forces can have different sizes

1

the arrows point in different directions

allow forces can have different directions

1

(b) **D**

1

(c) **B**

1

(d) both variables are continuous

1

(e) it is moving at a constant velocity

1

(f) 24.5 (m/s^2)

1

(g) 5 g = 49 (m/s^2)

1

49 m/s^2 > 24.5 m/s^2

1

so the ride is safe

allow ecf from (f) (ie if their answer to (f) was greater than 49, then the ride is unsafe)

1

(h) force = 58 × 24.5

allow ecf from (f)

1

force = 1421

1

Newtons

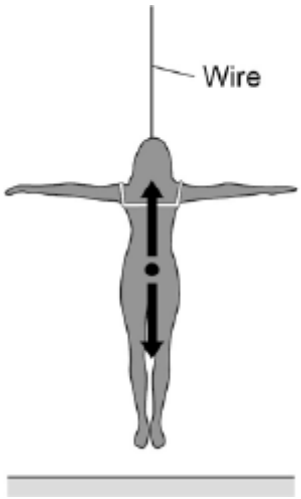
allow N

1

[13]

Q2.

(a)



arrow pointing vertically upwards

1

arrow pointing vertically downwards

1

(b) Gravitational force

*if more than **two** boxes ticked apply list principle*

1

Tension force

1

(c) 0 (N)

1

(d) weight = 70 × 9.8 (= 686)

1

weight = 690 (N)

1

*allow 690 (N) with no working shown for **2** marks*
*allow 686 (N) with no working shown for **1** mark*

(e) 34 (N) / 30 (N)

allow ecf from 05.4 correctly calculated

1

(f) resultant force = mass × acceleration

accept F = ma

1

accept equation correctly rearranged for a

(g) 25 = 65 × a

1

a = 25 / 65

1

a = 0.38(4615…) (m / s^2)

1

*allow 0.38 (m / s^2) with no working for **3** marks*

[12]

Q3.

(a) potential

1

(b) (i) 13 200

*allow **1** mark for correct substitution, ie 660 × 20 provided no subsequent step shown*

2

(ii) 16.5

allow 1 mark for correct

or

$\frac{\text{their (b)(i)}}{800}$ correctly calculated

substitution, ie $\frac{13\,200}{800}$ ***or*** $\frac{\text{their (b)(i)}}{800}$

provided no subsequent step shown

2

[5]

Q4.

(a) plasticine stretches/snaps
stays stretched/snapped/same

for 1 mark each

2

(b) spring compresses OWTTE
returns to original length/gets longer

for 1 mark each

2

[4]

Q5.

(a) (i) oscillation

1

direction

1

correct order only

(ii) sound

1

(b) 1.6

*allow **1** mark for correct substitution into correct equation ie 2 × 0.8*

2

m/s

1

(c) as the wavelength increases so does the wave speed

1

extra information, eg wave speed increases faster between 0-40 m than between 100-140 m

1

or

not in proportion

[8]

Q6.

(a) The movement of liquid iron in the Earth's outer core

1

(b) will attract

1

will repel

1

(c) **Level 2 (3–4 marks):**
A detailed explanation is provided that includes a coherent comparison of the properties
of the types of magnet and presents a clear argument to support the use of electromagnets. Logical links are made between relevant points and use in a scrapyard

Level 1 (1–2 marks):
Relevant points made about the properties of the magnets. An attempt at comparison
may be made, but logic is unclear and unstructured and links to use in scrapyard may
not be present

0 marks:
No relevant content.

Allow steel or iron for car body throughout

Indicative content

- an electromagnet can be switched on and off
- so it can be used to lift a car body
- and release a car body
- so it can easily be used to move car bodies from one place to another in the scrapyard
- a permanent magnet cannot be switched off to release a car body
- so would not be as useful in the scrapyard
- the strength of the magnetic field of an electromagnet can be varied
- so an electromagnet can lift different masses
- so can deal with different vehicles
- but the strength of the magnetic field of a permanent magnet cannot be varied or is fixed
- so a permanent magnet can only lift up to a certain mass

4

[7]

Q7.

(a) (i) X-ray(s)

1

(ii) gamma rays

1

(iii) infrared

1

(b) the same speed as

1

(c) (i) horizontal arrow drawn pointing to the right

judge by eye
accept drawn anywhere on diagram

1

(ii) **Y**

1

(iii) any **one** from:

- any type of electromagnetic wave
  accept electromagnetic wave(s)
- water (wave)
  *do **not** accept seismic waves*
- (earthquake / seismic) S waves
  *do **not** accept P waves*
  *do **not** accept earthquakes*

1

(d) (i) 3

1

(ii) 3.6

or

their (d)(i) × 1.2 correctly calculated

$v = f \times \lambda$
*allow **1** mark for correct substitution*
ie 3 or their (d)(i) × 1.2 provided that no subsequent step is shown

2

[10]

Q8.

(a) light

1

ionising

1

(b) x-rays have a longer wavelength and a lower frequency

1

(c) $\frac{0.039 + 0.035 + 0.040}{3}$

1

= 0.038 (milllisieverts)

*an answer of 0.038 scores **2** marks*

1

(d) the dose decreases if you stand further from the machine

1

(e) $\frac{0.180}{0.012}$

1

= 15 days

*an answer of 15 days scores **2** marks*

1

(f) the benefit (of a correct diagnosis) outweighs the risk

allow the (increased) risk of cancer is very small for an x-ray

allow for medical imaging, eg to see broken bones

1

(g) $20 \times \frac{40}{100}$

allow 20 × 40%

1

= 8 (millisieverts)

*an answer of 8 (millisieverts) scores **2** marks*

1

[11]

Q9.

(a) C

1

(b) 2040 / 120

1

17 (m / s)

1

*allow 17 (m / s) with no working shown for **2** marks*

(c) the thinking distance and the braking distance combined

accept 36 m

1

(d) thinking distance increases

1

braking distance stays the same

1

[6]