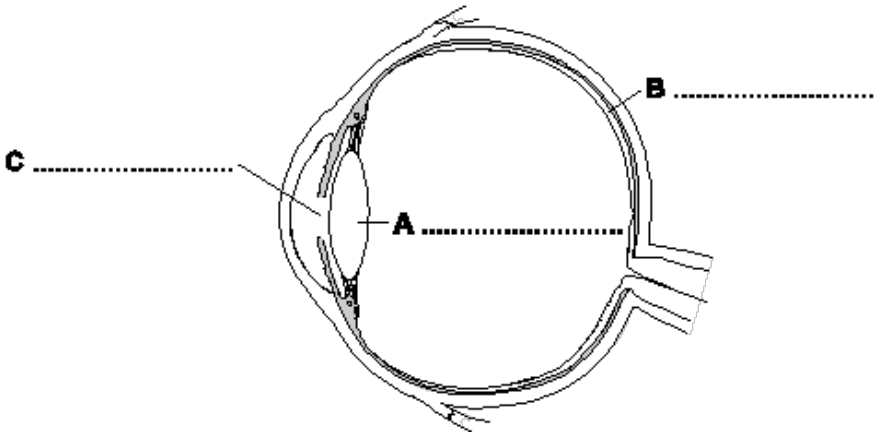
Q1. (a) The diagram shows the cross-section of an eye.

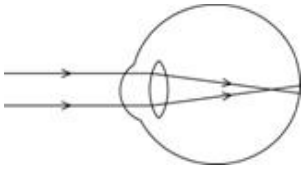


Use words from the box to label the parts, **A**, **B** and **C.**

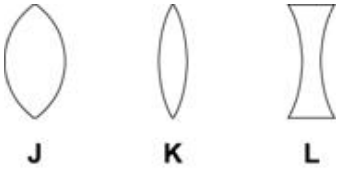
cornea	**iris**	**lens**	**pupil**	**retina**

(3)

(b) The diagram shows one of the eyes of a person who is short-sighted.



Which **one** of the following lenses, **J**, **K** or **L**, could be used to correct the person's eyesight?



Lens .....

Give a reason for your choice.

.....

.....

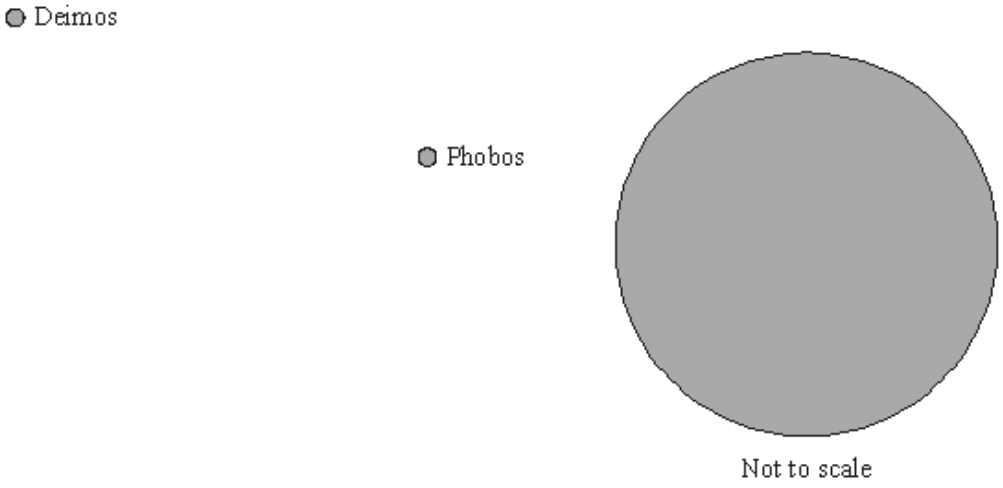
(2)
(Total 5 marks)

Q2. This page is from a science magazine.

The Red Planet

The two natural satellites, or moons, of Mars are Phobos (fear) and Deimos (terror). They are named after the horses which pulled the chariot of Mars, the god of war in the mythology of Ancient Greece.

Phobos takes less than eight hours to orbit Mars and gets slightly closer every time it does so. Scientists predict that in about 100 million years time it will either be ripped apart by the gravitational force or will crash onto the surface of Mars.



(a) Suggest how scientists have arrived at their prediction of about 100 million years.

.....

.....

(2)

(b) The centripetal force on Phobos is gradually changing as it orbits Mars.

Is the force increasing or decreasing?

.....

Explain your answer.

.....

.....

.....

(2)

(c) Scientists expect that the mass of Mars and the mass of Phobos will not increase.

Explain what will happen to the gravitational force on Phobos as it orbits Mars.

.....

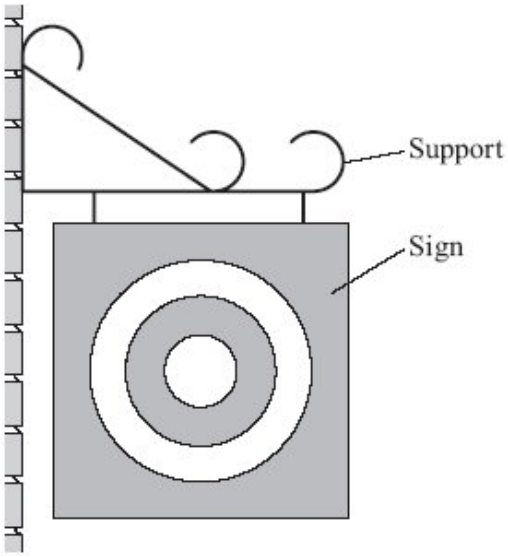
.....

.....

.....

(2)
(Total 6 marks)

Q3. The drawing shows a sign which hangs outside a shop.



(a) Draw an **X** on the sign so that the centre of your **X** is at the centre of mass of the sign.

(1)

(b) Use a ruler to draw **one** axis of symmetry on the sign.

(1)

(c) One force which acts on the sign is its weight.

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

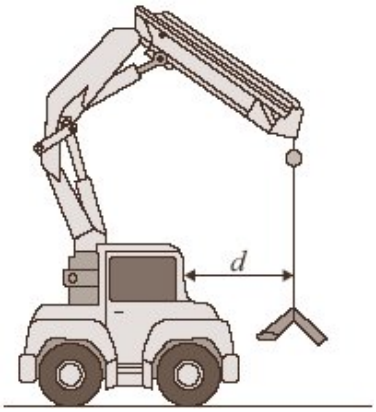
The moment of the weight produces

an accelerating
a balancing
a turning

effect.

(1)
(Total 3 marks)

Q4. The diagram shows a small mobile crane. It is used on a building site.



The distance, *d*, is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	**Maximum safe distance, *d*, in metres (m)**
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

(a) What is the relationship between the load and the maximum safe distance?

.....

.....

.....

(2)

(b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, *d*, of 2.0 metres.

Is the driver correct?

Explain your answer.

.....

.....

.....

.....

(2)

(c) What is the danger if the driver does not follow the safety instructions?

.....

.....

(1)

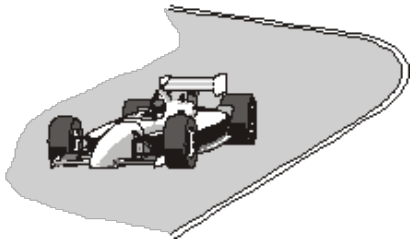
(d) How should the data in the table have been obtained?

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

average results from an opinion poll of mobile crane drivers	☐
copied from a handbook for a similar crane	☐
results of experiments on a model mobile crane	☐
results of experiments on this mobile crane	☐

(1)
(Total 6 marks)

Q5. (a) Complete the following sentence by drawing a ring around the correct line in the box.



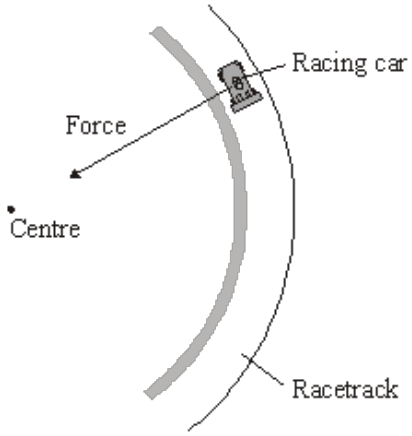
A racing car can accelerate by changing

its direction only
its speed only
either its direction or its speed

.

(1)

(b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

Complete the following sentences by drawing a ring around the correct line in each of the boxes.

(i)

The force is caused by

electrostatics
friction
gravity

.

(1)

(ii)

The force is a

centripetal force
circular force
perpendicular force

.

(1)

(iii) If another racing car has a greater mass and travels at the same speed

around the same racetrack, then the force will need to

decrease
stay the same
increase

.

(1)

(iv)

When the racing car goes faster, the force will need to

decrease
stay the same
increase

.

(1)

(c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars.''

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents'', said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

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

Yes ☐ No ☐ Not sure ☐

.....

.....

.....

.....

(2)

(Total 7 marks)

Q6. (a) This information is from a science magazine.

Electronic systems can be used to produce ultrasonic waves.

These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

20	**2000**	**20 000**	**200 000**

The upper limit for hearing in humans is a frequency of ..... Hz.

(1)

(b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

.....

(1)

(c) (i) State **one** industrial use for ultrasound.

.....

(1)

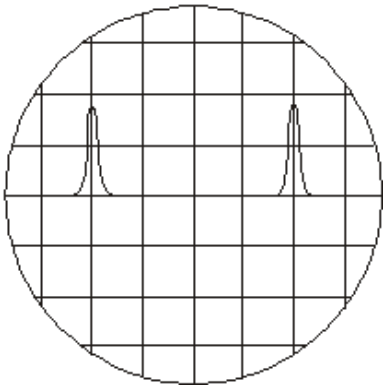
(ii) State **one** medical use for ultrasound.

.....

(1)

(d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen. Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = ... microseconds

(1)

(e) Ultrasounds are partially reflected when they reach a boundary between two different media.

The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

.....

.....

(2)

(f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

.....

.....

.....

(2)

(Total 9 marks)

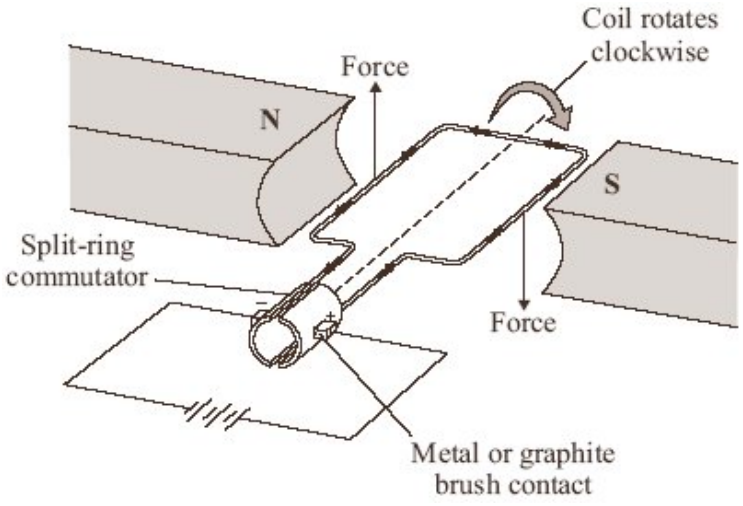
Q7. Many electrical appliances use the circular motion produced by their electric motor.

(a) Put ticks (✓) in the boxes next to **all** the appliances in the list which have an electric motor.

electric drill	☐
electric fan	☐
electric food mixer	☐
electric iron	☐
electric kettle	☐
electric screwdriver	☐

(2)

(b) One simple design of an electric motor is shown in the diagram. It has a coil which spins between the ends of a magnet.



(i) Give **two** ways of reversing the direction of the forces on the coil in the electric motor.

1 .....

.....

2 .....

.....

(2)

(ii) Give **two** ways of increasing the forces on the coil in the electric motor.

1 .....

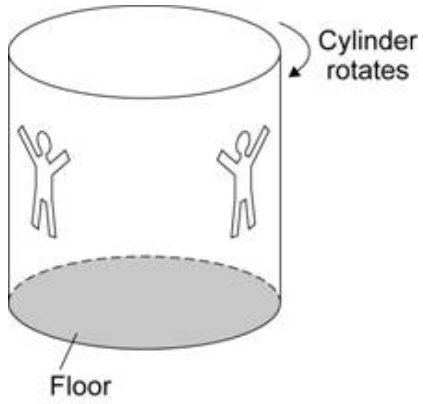
.....

2 .....

.....

(2)
(Total 6 marks)

Q8. The fairground ride called 'The Rotor' is a large cylinder which rotates. When the cylinder reaches its maximum speed the floor drops away and the riders inside the cylinder are left against the cylinder wall.



(a) Explain how the cylinder is rotating at a constant speed but at the same time the riders inside the cylinder are accelerating.

.....

.....

.....

.....

.....

.....

(3)

(b) In which direction do the riders accelerate?

.....

(1)

(c) What name is given to the resultant force that causes the riders to accelerate?

.....

(1)

(d) At the end of the ride the floor goes back into place and the cylinder slows down and stops.

How does the resultant force on the riders change as the cylinder slows down?

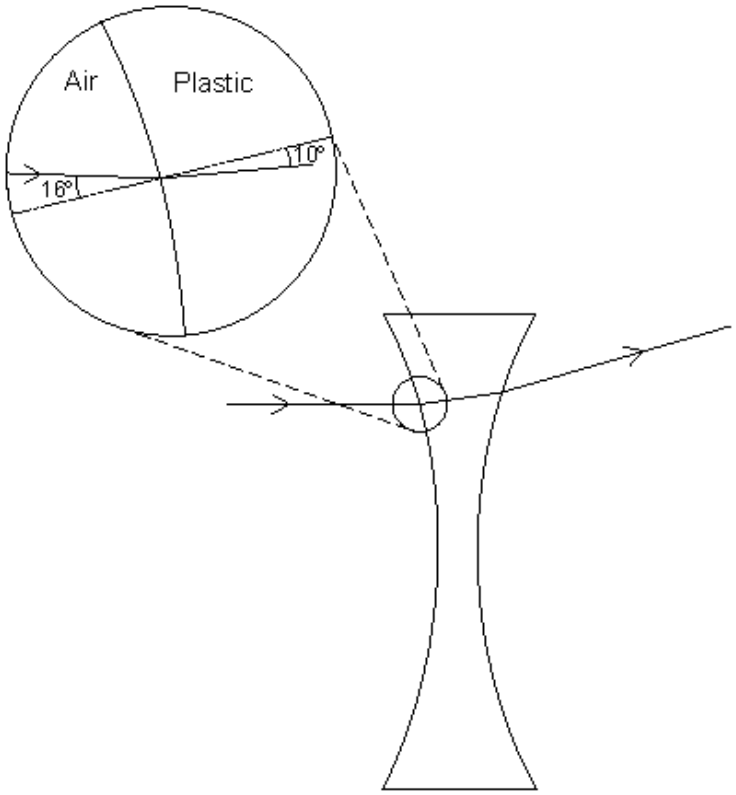
.....

.....

(1)

(Total 6 marks)

Q9. The diagram shows a ray of light passing through a diverging lens.



(a) Use the information in the diagram to calculate the refractive index of the plastic used to make the lens.

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

.....

.....

.....

.....

.....

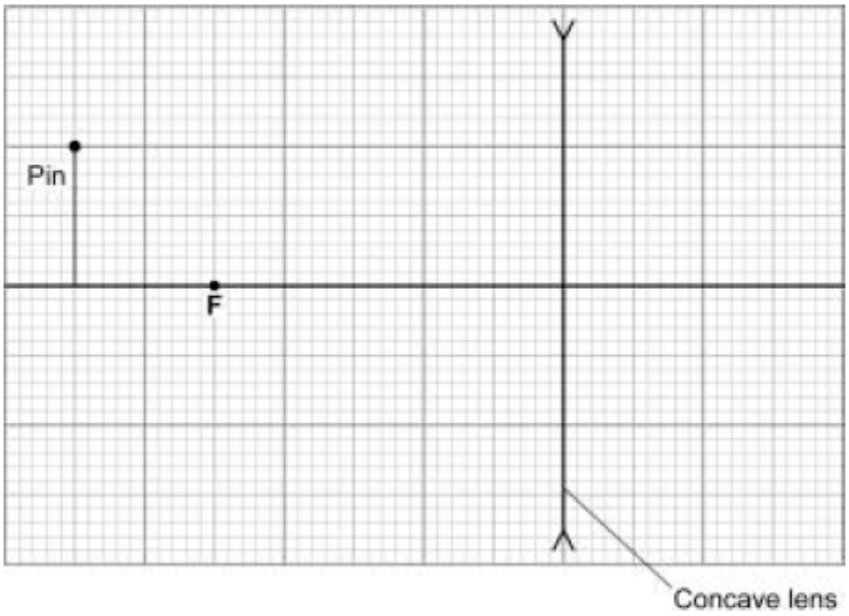
.....

Refractive index = ...

(2)

(b) The focal length of the lens is 5 cm. A student looking through the lens sees the image of a pin.

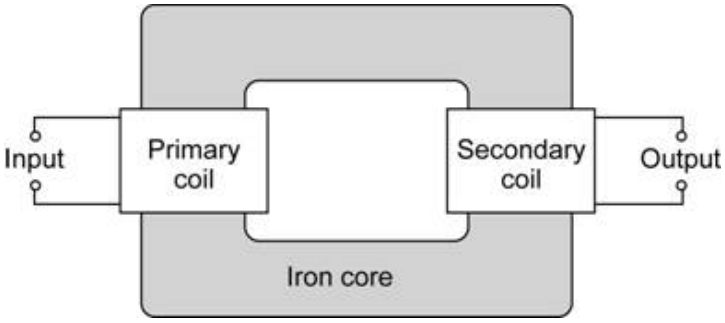
Complete the ray diagram below to show how the image of the pin is formed.



(3)

(Total 5 marks)

Q10. The diagram shows the basic structure of a transformer.



(a) Explain how a transformer works.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5)

(b) A transformer is used to change the 230 volt mains electricity supply to the 12 volts needed to operate a low voltage halogen lamp. The current through the halogen lamp is 4 amps.

Calculate the current drawn by the transformer from the mains electricity supply.

Assume that the transformer is 100 % efficient.

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

.....

.....

.....

.....

.....

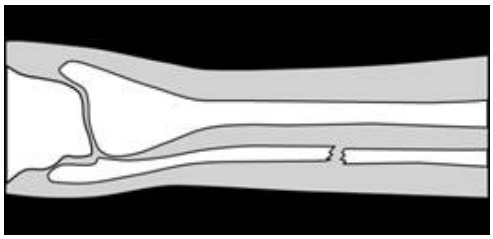
Current = ... amps

(2)

(Total 7 marks)

Q11. Both X-ray machines and CT scanners are used to produce images of the body.

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



Before switching on the X-ray machine, the radiographer goes behind a screen.

Explain why the radiographer does this.

.....

.....

.....

.....

.....

.....

.....

(3)

(b) The following is an extract from a newspaper article.

> **X-rays cause 700 new cancers each year in the U.K.**
>
> Each year there are about 125 000 new cancer cases in the UK, of which, about 700 may be due to the use of X-rays to diagnose illness.

The article was reporting on a scientific research project first published in a medical journal.

What evidence would the scientists have collected to come to the conclusion that X-rays can cause cancer?

.....

.....

.....

.....

.....

(2)

(c) Explain the advantage of a CT scan compared to an X-ray.

.....

.....

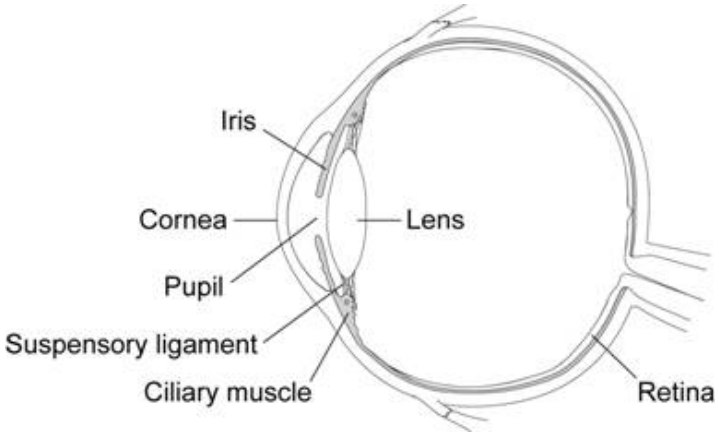
.....

.....

.....

(2)
(Total 7 marks)

Q12. The diagram shows the cross-section of an eye.



(a) Use words from the box to complete each sentence.

ciliary muscle	**cornea**	**iris**	**pupil**

The shape of the lens is changed by the ..... ,

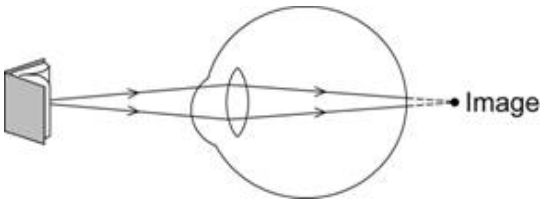
this allows the lens together with the ..... to focus light

onto the retina.

(2)

(b) A man, as he gets older, needs to hold a book further from his eyes in order to be able to see the writing clearly.

The diagram shows that his eye lens is not able to focus light on the retina.



(i) How has the 'near point' of the man's eyes changed as he has got older?

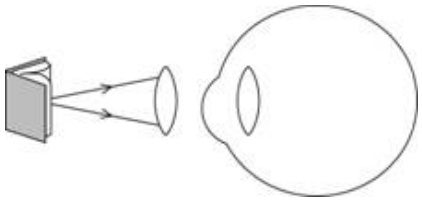
.....

.....

(1)

(ii) The problem can be solved by wearing reading glasses.

Complete the diagram below to show how the lens below is able to correct the man's vision.



(2)

(c) Give **two** similarities between an eye and a camera.

1 .....

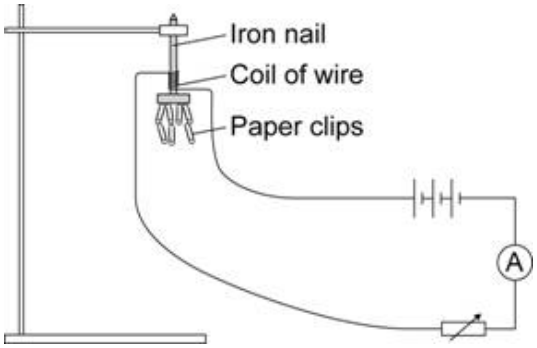
.....

2 .....

.....

(2)
(Total 7 marks)

Q13. The diagram shows the equipment used by a student to investigate the strength of five different electromagnets.



The stronger the electromagnet, the more paper clips it will hold.

(a) Why is it important that the paper clips used in the investigation are all the same size?

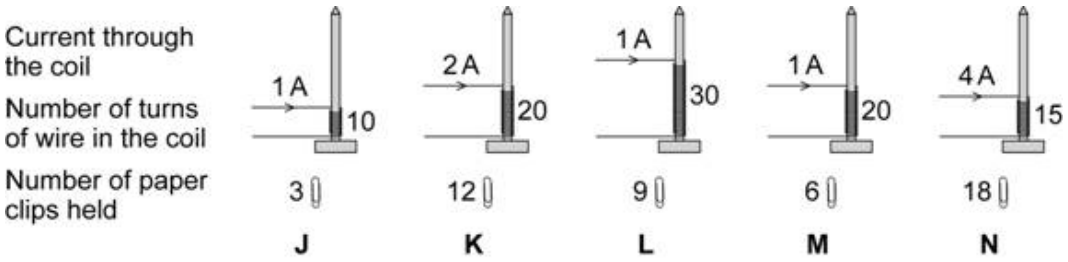
.....

.....

.....

(1)

(b) The five electromagnets, **J**, **K**, **L**, **M** and **N**, used by the student are shown below.
Each electromagnet was made by wrapping lengths of insulated wire around identical iron nails.



The student wants to find out how the strength of an electromagnet depends on the number of turns of wire in the coil.

Which electromagnets should the student compare in order to do this?

.....

(1)

(c) The student concluded:

"The strength of an electromagnet is always directly proportional to the number of turns on the coil."

(i) Explain how the data from the investigation supports the student's conclusion.

.....

.....

.....

.....

.....

(2)

(ii) The student makes one more electromagnet by winding 100 turns onto a nail.

Before testing the electromagnet, the student predicted the number of paper clips that the electromagnet would hold when the current is 1 amp.

How many paper clips should the student predict that the electromagnet would hold?

Show clearly how you work out your answer.

.....

.....

.....

number of paper clips = ...

(2)

(iii) When the student tested the electromagnet it held 20 paper clips.
This is not what the student predicted.

Explain what the student should do when new data does not seem to support the prediction that was made.

.....

.....

.....

.....

.....

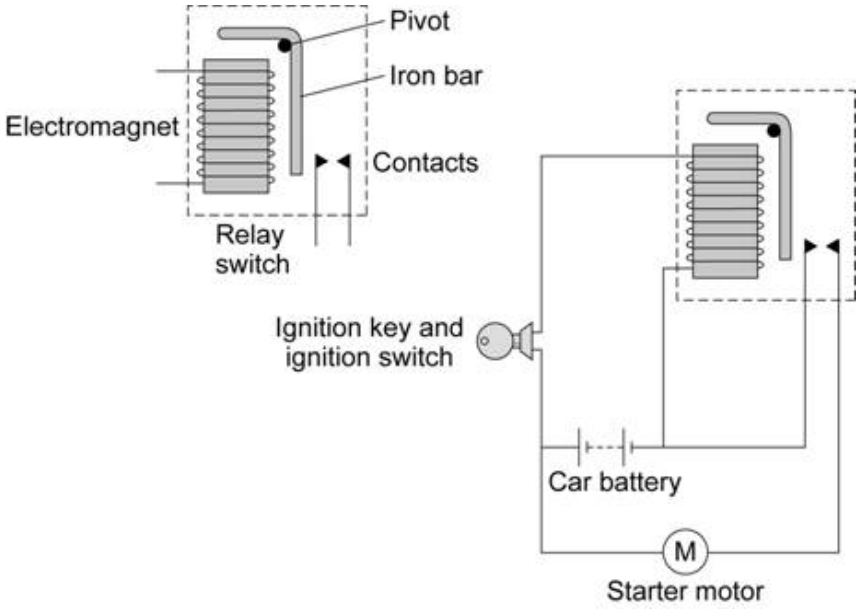
.....

.....

(3)
(Total 9 marks)

Q14. *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The diagrams show a relay switch and how it is used in a car ignition circuit.



Turning the ignition key closes the ignition switch.
Explain how this causes the starter motor to operate.

.....

.....

.....

.....

.....

.....

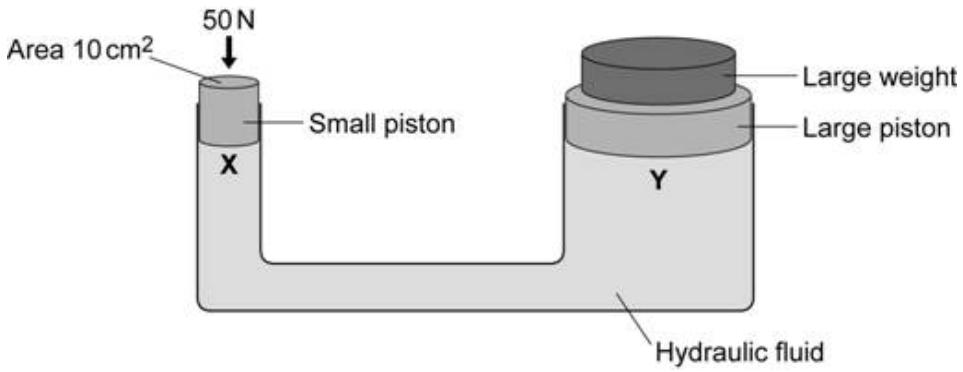
.....

.....

.....

(Total 6 marks)

Q15. The diagram shows a simple hydraulic jack. The jack is designed to lift a large weight using a much smaller force.



(a) Complete the following sentence.

A hydraulic jack is an example of a ..... multiplier.

(1)

(b) Calculate the pressure, in N/cm^2, created on the small piston by the force of 50 N pushing downwards.

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

.....

.....

.....

.....

.....

.....

Pressure = ... N/cm^2

(2)

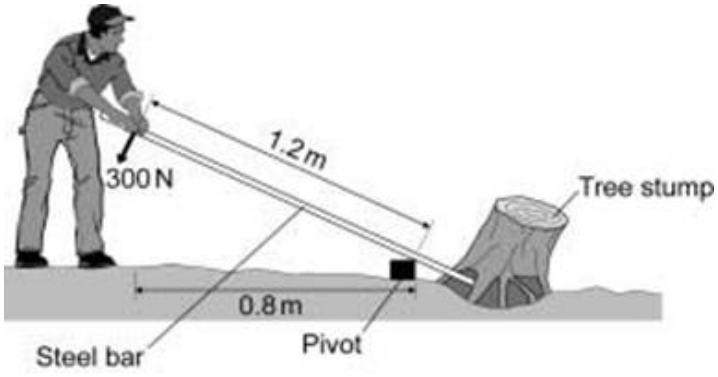
(c) Complete the following sentence.

The pressure at **Y** will be ..... the pressure at **X**.

(1)

(Total 4 marks)

Q16. (a) The diagram shows a gardener using a steel bar to lever a tree stump out of the ground.



When the gardener pushes with a force of 300 N the tree stump just begins to move.

Calculate the moment produced by the gardener on the steel bar.

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

.....

.....

.....

.....

.....

.....

Moment = ...

(4)

(b) Using a longer steel bar would have made it easier for the gardener to lever the tree stump out of the ground.

Explain why.

.....

.....

.....

.....

.....

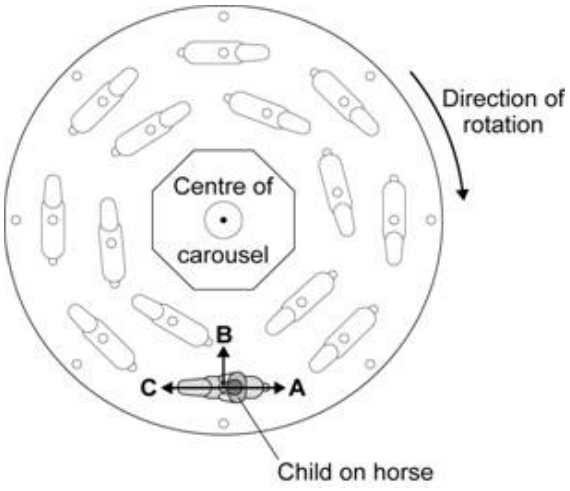
(3)
(Total 7 marks)

Q17. The picture shows a fairground carousel.

The diagram shows the position of one child, at one point in the ride, viewed from above.

Picture

Diagram



Draw a ring around the correct answer to complete the following sentences.

(a) The resultant force needed to keep the child moving in a circular path is

called the | centripetal / circular / gravitational | force.

(1)

(b) The resultant force on the child acts in the direction | **A.** / **B.** / **C.** |

(1)

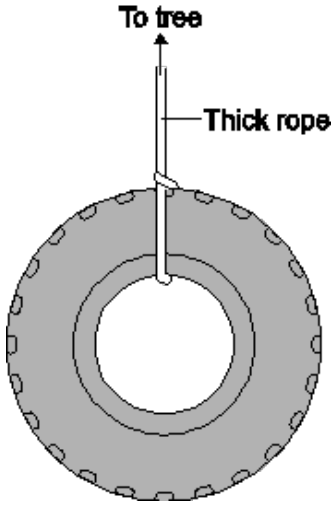
(c) At the end of the ride, as the carousel slows down, the resultant force on

the child | decreases. / stays the same. / increases. |

(1)

(Total 3 marks)

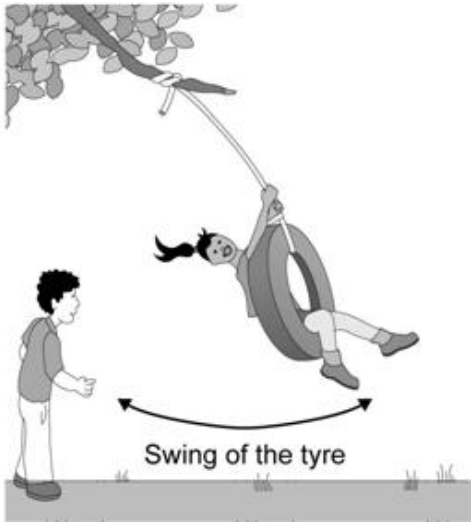
Q18. The drawing shows a car tyre which is hanging from the branch of a tall tree.



(a) Draw an **X** on the diagram to mark the centre of mass of the tyre.

(1)

(b) Some children use the tyre as a swing. Pulling the tyre to one side and letting it go makes the tyre swing backwards and forwards like a pendulum.



The time it takes the tyre to swing from one side to the other and back again is called the time period.

(i) What is the unit for time period?

.....

(1)

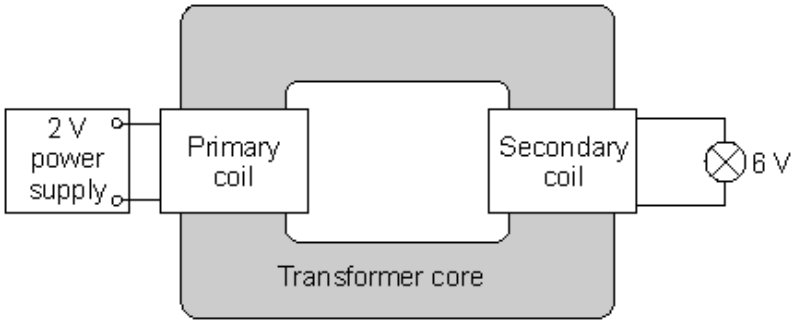
(ii) How would using a shorter rope change the time period of the swing?

.....

.....

(1)
(Total 3 marks)

Q19. The diagram shows a transformer made by a student. The student has designed the transformer to make a 6 V light bulb work using a 2 V power supply.



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

(i) For the transformer to work, the student

must use an a.c.
can use either an a.c or a d.c.
must use a d.c.

power supply.

(1)

(ii) On the primary coil there are 30 turns of wire. For the lamp to work brightly

there must be

less than 30
exactly 30
more than 30

turns of wire on the secondary coil.

(1)

(b) What is the transformer core made from?

Give a reason for your answer.

.....

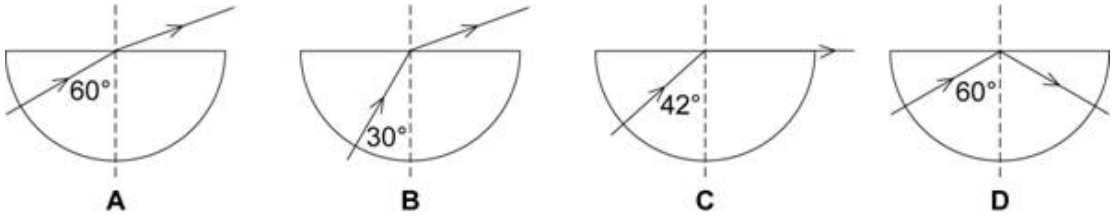
.....

.....

.....

(2)
(Total 4 marks)

Q20. (a) Each diagram shows a light ray incident on a glass-air boundary.
The critical angle for glass is 42°.



Which **one** of the diagrams, **A**, **B**, **C** or **D**, shows total internal reflection?

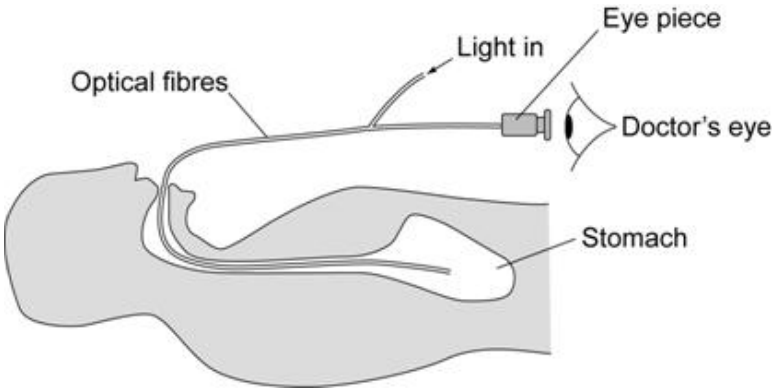
Write the correct letter in the box. ☐

(1)

(b) (i) Complete the diagram to show the path taken by the light ray as it travels through the optical fibre.

(2)

(ii) The diagram shows an endoscope being used by a doctor to look inside a patient's stomach. Light travels into the stomach through a bundle of optical fibres.



The following sentences describe how the endoscope allows the doctor to see inside the patient's stomach. The sentences are in the wrong order.

Q Light passes through a bundle of optical fibres into the patient's stomach.

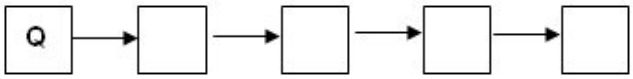
R The inside of the stomach reflects some of the light.

S The optical fibres take the light to an eyepiece.

T The doctor looks through the eyepiece to see inside the patient's stomach.

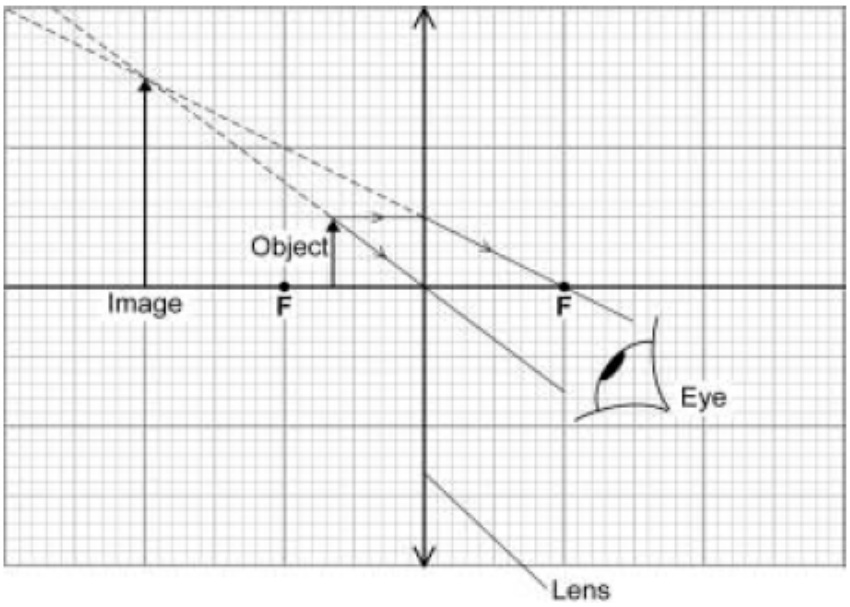
U The reflected light passes through a second bundle of optical fibres.

Arrange these sentences in the correct order. Start with letter **Q**.



(3)
(Total 6 marks)

Q21. The ray diagram shows a converging lens being used as a magnifying glass. The diagram has been drawn to scale.



(a) What name is given to the type of lens used as a magnifying glass?

.....

(1)

(b) Calculate the magnification produced by the lens.

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

.....

.....

.....

.....

.....

.....

Magnification = ...

(2)

(c) Describe the image produced by a magnifying glass.

.....

.....

.....

(3)

(Total 6 marks)

M1. (a) **A** – lens

1

B – retina

1

C – pupil

1

(b) **L**

1

it diverges the light (before entering the eye)
or
it will make the light focus on the retina

accept spreads for diverges

1

[5]

M2. (a) (from present/recent) data/evidence/observations of (the rate of change in) Phobos'/the moon's orbit (1)

or appropriate example of data (1)
and its correct use (1)

(and) continued/extended/extrapolated (the pattern/trend for the next 100 million years) (1)

example (present) distance from Phobos to Mars (1)
÷ (average) rate of approach (1)

2

(b) (it is) increasing (1)

Phobos/the moon will be nearer (to Mars) (1)

or the radius/circumference/diameter of the orbit of Phobos/the moon will decrease/be less
only credit 2nd mark if the first mark is correct

2

(c) it will increase/be more (1)

(because) Phobos/the moon will get/be closer to Mars/the planet (1)

only credit 2nd mark if the first mark is correct
note part(s) of this response may be included as the answer to part (b)
read both before marks are awarded

2

[6]

M3. (a) centre of **X** at the centre of the concentric circles

judge by eye that the intention is correct

1

(b) drawn from any corner to the diagonally opposite corner

judge by eye that the intention is correct

or from the mid-point of any side to the mid-point of the opposite side

if more than one axis of symmetry has been drawn, accept only if both / all are correct

1

(c) a turning

accept any unambiguous indication

1

[3]

M4. (a) any **two** from:

- inversely proportional
- as the load gets biggerthe (maximum safe) distance gets less

allow 'as the mass increases the distance decreases'
accept an unspecified response e.g. 'big load at a short distance' for (1)

- load × distance = 60 (kNm)

2

(b) yes, because 30 × 2 = 60 (2)

accept for (1) a correct but insufficiently explained response e.g. 'yes because it's safe'

accept for (2) a correct response which is sufficiently explained

e.g. 'yes, because 60 (kNm) at 1 metre is safe and 30 (kNm) is half the load at twice the distance

*do **not** accept 'no' and do not accept just 'yes'*

*do **not** accept 'yes, because 30 is between 24 and 40 and 2 is between 2.5 and 1.5'*

*do **not** accept 'the crane/ cable may break' or other dangers*

2

(c) the crane may/will topple over/fall <u>over/forward</u>

1

(d) results of experiments on this mobile crane

accept any unambiguous indication

1

[6]

M5. (a) either its direction or its speed

1

(b) (i) friction

1

(ii) centripetal

1

(iii) increase

1

(iv) increase

1

(c) examples

(yes) noisy (1)

disturbs people living nearby (1)

(yes) encourages people to drive fast (1) which makes (road) accidents more serious/likely (1)

(no) leads to improvements in safety features (1) such as better brakes (1)

(don't know) noisy (1) but new tyres have a better grip (1)

whichever box has been ticked, the mark(s) is/are for an appropriate response

note, accept responses which assume that the public may use the racetrack

2

[7]

M6. (a) 20000

accept any unambiguous indication

1

(b) kilohertz

credit misspellings

credit '1000 hertz' or '1000 Hz'

accept 1000 oscillations/beats/waves <u>per second</u>

1

(c) (i) cleaning (e.g. something delicate such as a watch)

***or** quality control/flaw detection*

credit any appropriate extra Specification response
e.g. sonar

1

(ii) pre-natal (scanning)

*do **not** credit just 'scanning'/medical scanning/ scanning a baby*

credit any appropriate extra Specification response
e.g. destruction of (kidney) stones or cleaning teeth

1

(d) 8 (μs)

1

(e) distance (1)

between the boundary and the detector (1)

accept 'between the boundary and the source'

accept any correct use of speed = distance/time

2

(f) examples

publish/tell doctors/the public (1) ... their evidence/results/research/data (1)

carry out more research/tests (1) ... to make sure/check reliability (1)

allow a wide variety of appropriate responses
valid point (1) appropriate example/qualification/expansion/etc. (1)
allow just 'stop using them/ultrasonic waves' (1)
allow using them (only) for industrial purposes (1)

2

[9]

M7. (a) electric drill, electric fan, electric food mixer and electric screwdriver

all four ticked and no others (2)
***either** all four of these ticked and only one other (1)*
***or** any three of these ticked and none/one/two of the others (1)*

2

(b) (i) reverse (the direction of the) current (1)

***or** reverse the connections (to the battery)*

reverse (the direction of the) magnetic field (1)

***or** reverse the (magnetic) poles /ends*
*do **not** credit 'swap the magnets (around)'*

2

(ii) any **two** from:

- increase the strength of the magnet(s)/(magnetic) field
  *do **not** credit 'use a bigger magnet'*
- increase the current
  allow 'increase the voltage/p.d.'
  allow add cells/batteries
  allow increase the (electrical) energy
  allow increase the power supply
  allow 'decrease the resistance'
  allow 'increase charge'
  allow ' increase the electricity'
  *do **not** credit 'use a bigger battery'*
- reduce the gap (between coil/armature and poles/magnets)
  allow increase the (number of) coils
- increase the turns (on the coil/armature)
  *do **not** credit 'use a bigger coil'*

2

[6]

M8. (a) the direction of the riders is constantly changing

1

therefore the velocity of the riders is changing

1

and because acceleration is the rate of change of velocity
the acceleration is changing

1

(b) to(wards) the centre (of the cylinder / rotor)

1

(b) centripetal

1

(b) it is reduced

1

[6]

M9. (a) 1.59

accept an answer that rounds to this
*allow **1** mark for correct substitution into correct equation*

ie refractive index = $\frac{\sin 16^\circ}{\sin 10^\circ}$

2

(b) 2 lines correctly drawn from the top of the pin through the lens

*allow **1** mark for each*

2

position of image correct

image must be upright

1

[5]

M10. (a) an alternating input / current to primary (coil)

1

which produces an alternating magnetic field

accept changing magnetic field for alternating magnetic field

if first mark point scores then 'alternating' not required here

1

in the (iron) core

this magnetic field links with the secondary coil

1

which induces an (alternating) voltage / p.d. across the secondary (coil)

1

(b) 0.21

accept 0.2 or any answer that rounds to 0.21

*allow **1** mark for correct equation*
ie power input = power output

or

*allow **1** mark for substitution into correct equation*
ie $230 \times I_p = 12 \times 4$

2

[7]

M11. (a) X-rays are ionising

or

X-rays kill / damage cells

accept cause cancer

1

any stray X-rays are absorbed by screen

1

which reduces the radiation dose to the radiographer

1

(b) medical records / X-ray records

1

of people with cancer

1

(c) a CT scan gives a 3D image

1

therefore the image can be observed from different directions

1

[7]

M12. (a) ciliary muscle

1

cornea

1

(b) (i) moved further (from his eyes)

1

(ii) rays between lens and eye converging

1

rays inside eye focus on the retina

1

(c) any **two** from:

- both use a converging lens
- image formed is real
- image is inverted
- image in eye formed on retina, image in camera formed on film / CCDs
- amount of light entering eye and camera can be controlled

2

[7]

M13. (a) so the results can be compared fairly

fair test is insufficient

1

(b) **J L M**

all 3 required and no other

1

(c) (i) for a given current the number of paper clips increases by the same factor as the number of turns

1

plus a mathematical explanation using the data
eg a current of 1 A with 10 turns picks up 3 clips, a current of 1 A with 20 turns picks up 6 clips

1

(ii) 30

*allow **1** mark for showing correct use of figures eg 20 turns × 5 = 100 turns*

2

(iii) check the new data / repeat the experiment

1

to identify any anomalous results

1

then reconsider prediction / hypothesis in the light of new evidence

1

[9]

M14. Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

No relevant content.

0 marks

There is a brief explanation of how a current is caused to flow in the starter motor circuit.

Level 1 (1–2 marks)

There is some explanation of how a current is caused to flow in the starter motor circuit.

Level 2 (3–4 marks)

There is a clear and detailed explanation of how a current is caused to flow in the starter motor circuit.

Level 3 (5–6 marks)

examples of the physics points made in the response

current flows through the coil / electromagnet

magnetic field produced

accept electromagnet switches on

(short side of) iron bar attracted to electromagnet

contacts pushed together (by iron bar)

starter motor circuit completed

current flows through starter motor

or

p.d. across starter motor

[6]

M15. (a) force

1

(b) 5

*allow **1** mark for substitution into correct equation ie* $\frac{50}{10}$

2

(c) the same as / equal to

accept =

1

[4]

M16. (a) (i) 360

*allow **1** mark for correct length used ie 1.2 m*

*allow **2** marks for substitution into correct equation - ie 300 × 1.2*

*allow **1** mark only for an answer 240*

3

(ii) Newton-metre or Nm

1

(b) the force is applied further from the pivot

1

which causes an increased moment to act on the steel bar

1

and therefore an increased force acts on the tree stump

1

[7]

M17. (a) centripetal

1

(b) **B**

1

(c) decreases

1

[3]

M18. (a) **X** drawn at the centre of the tyre

judge by eye

1

(b) (i) second

1

(ii) decreases it

1

[3]

M19. (a) (i) must use an a.c.

1

(ii) more than 30

1

(b) iron

reason can only score if iron is chosen

1

because it can be magnetised (and demagnetised) easily

1

[4]

M20. (a) **D**

1

(b) (i) total internal reflection shown

1

2 or 3 reflections only

1

(ii) **R U S T**

correct order
*allow **2** marks for two in correct place*
*allow **1** mark for one in correct place*

3

[6]

M21. (a) converging

accept convex

1

(b) 3

*allow **1** mark for substitution into the correct equation*
ie $\frac{3}{1}$ *or* $\frac{15}{5}$

2

(c) bigger

accept magnified

1

upright

1

virtual

1

[6]