SURNAME ..... FIRST NAME .....

JUNIOR SCHOOL ..... SENIOR SCHOOL .....

Independent Schools Examinations Board

COMMON ENTRANCE EXAMINATION AT 13+

SCIENCE

PHYSICS

Wednesday 25 January 2012

Please read this information before the examination starts.

- This examination is 40 minutes long.
- The answers should be written on the question paper.
- Answer **all** the questions.
- Calculators may be required.

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1. Underline the option which best completes each of the following:

(a) Light is given out by

the Hubble Space telescope **the Moon**

the Sun **Venus**

(b) An effect which light cannot undergo is

dispersion **reflection** **refraction** **repulsion**

(c) The best material to use as the core of a strong electromagnet is

aluminium **copper** **iron** **lead**

(d) A small rectangular block of metal must be a magnet if it

aligns itself east–west when hung up from the ceiling

is attracted towards a magnet

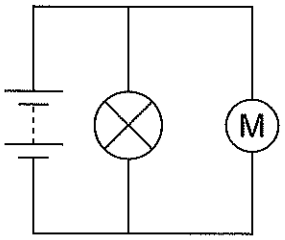
is made of steel

is repelled by a magnet

(e) A spring extends 9 cm when a weight of 3 N is hung from it.
A weight of 1 N will make it extend

1 cm **3 cm** **6 cm** **10 cm**

(f)



The energy transfer occurring in the circuit above is

from the battery and lamp to the motor

from the battery to the lamp and motor

from the lamp to the battery and motor

from the motor and battery to the lamp

(g) During an eclipse of the Sun the

Earth is between the Moon and the Sun

shadow of the Moon falls on the Earth

shadow of the Moon falls on the Sun

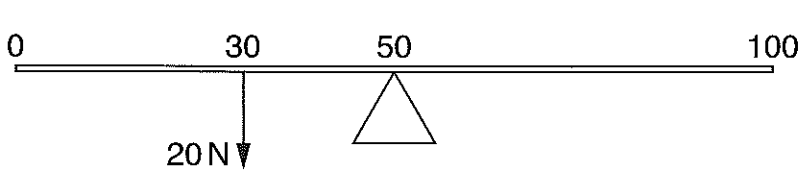
Sun is between the Moon and the Earth

(h) A car is going at a steady speed of 30 m/s.
In 1 minute it will go

0.5 m **300 m** **1 800 m** **108 000 m**

(8)

2. A metre ruler is balanced at its centre.



A force of 20 N pulls down at the 30 cm mark as shown.

(a) How far from the pivot is the 20 N force?

..... (1)

To balance the ruler, a downwards force of 16 N is applied on the other side of the pivot.

(b) (i) Find how far from the pivot this 16 N force should be applied.
Show your working.

.....

.....

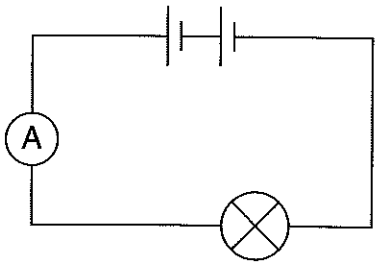
..... (2)

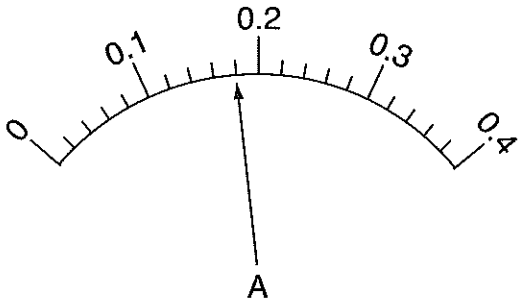
(ii) State at which mark on the ruler this force should be applied.

..... (1)

(c) Mark on the diagram the size and direction of the force which the pivot exerts on the ruler.
(You should ignore the weight of the ruler.) (2)

3. The circuit below is set up and the lamp glows brightly.
The diagram shows the reading on the ammeter.





(a) (i) Write down the reading on the ammeter.

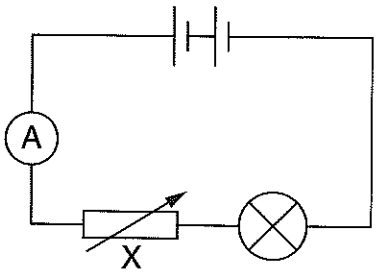
..... (1)

(ii) From the list in the box below, underline the quantity which an ammeter measures.

current	electricity	power	voltage

(1)

Another component, X, is now connected into the circuit as shown below.



(b) Name component X.

..... (1)

Component X is adjusted to make the lamp dimmer.

(c) (i) State what happens to the reading on the ammeter.

..... (1)

(ii) Explain what has been done to component X to make this happen.

..... (1)

When the reading on the ammeter falls to 0.1 A, the lamp stops glowing.

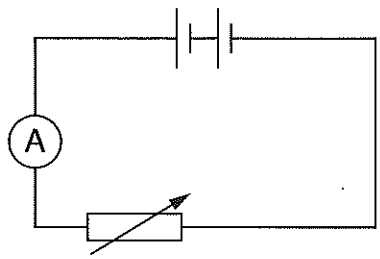
(d) Explain why the lamp stops glowing even though current is still flowing through it.

.....

..... (1)

The lamp is now removed and replaced with an LED.

(e) To the diagram below, add the symbol for an LED connected correctly.



(2)

The LED glows brightly even when the ammeter is reading 0.02 A.

(f) Suggest why LEDs, rather than lamps, are now used in torches.

.....

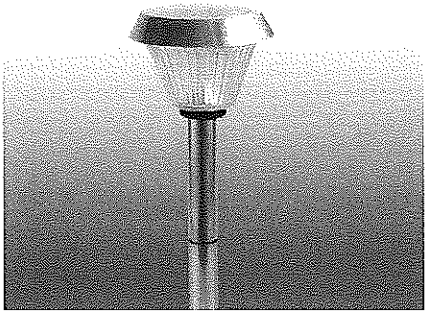
..... (2)

The connections to the LED are now reversed.

(g) State the reading on the ammeter.

..... (1)

4. The picture below shows a garden light.



These lights contain a device called a *photovoltaic cell.*

When the Sun shines on the photovoltaic cell during the day, it converts the solar energy and stores energy in a battery.

(a) Complete the box below to show the energy transformation which occurs in the photovoltaic cell during the day.

(1)

(b) In which form is the energy stored in the battery?

..... (1)

When it gets dark, the circuit switches on automatically and the garden light shines.

(c) Name the component in the light's circuit which enables it to sense when it gets dark.

..... (1)

The garden light does not shine for as long in September as it does in June.

(d) Give two reasons for this.

1: .....

.....

2: .....

..... (2)

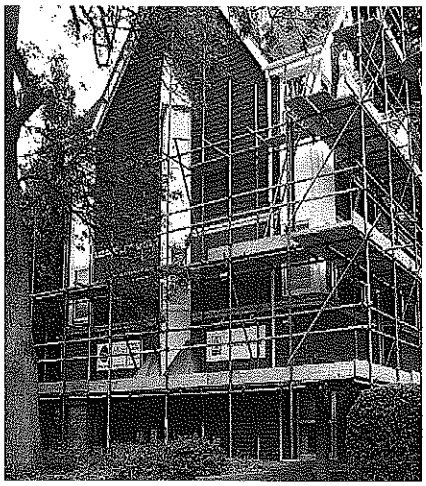
(e) Suggest why you think these lights are described as being 'environmentally friendly'.

.....

.....

..... (2)

5. The picture below shows some scaffolding round a building.

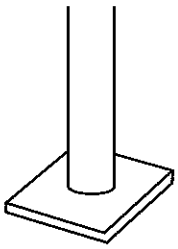


(a) Suggest why some of the poles are placed diagonally.

.....

(1)

The bottom of each vertical pole is placed on a square sheet of wood, as shown below.



(b) Explain why this is sensible.

.....

.....

.....

.....

(3)

A builder on the top level hauls a bucket of cement up to where he is working.

The cement in the bucket has a volume of 5000 cm^3; wet cement has a density of 2.8 g/cm^3.

(c) (i) State the equation which relates density, mass and volume.

.....

..... (1)

(ii) Show that the bucket full of wet cement has a mass of about 14 kg.

.....

.....

..... (2)

(iii) On Earth, gravity exerts a force of 10 N on each kilogramme.
Calculate the weight of the cement in the bucket.

..... (2)

The builder accidentally drops the bucket and it falls to the ground.

(d) (i) Name the upwards force which acts on the bucket as it falls.

..... (1)

(ii) Explain whether or not the bucket falls at a constant speed.

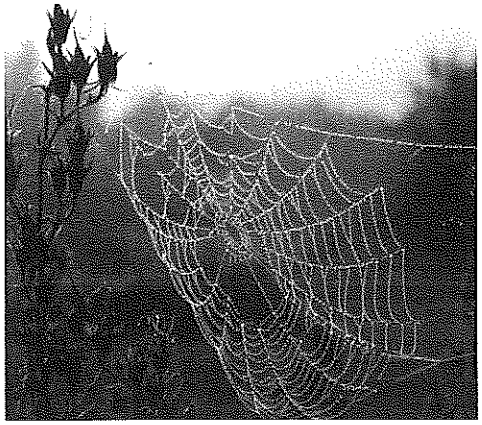
.....

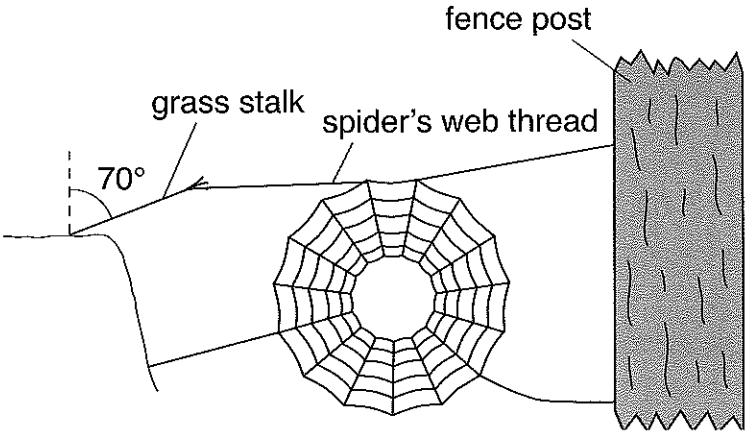
..... (2)

6. The picture below shows a spider's web.

Tim noticed a similar web spun across a roadside ditch.

One end of the top thread was attached to a fence post; the other was attached to a grass stalk, causing the stalk to be pulled over at an angle of 70° from the vertical, as shown in the diagram below.





(a) Name the force in the spider's thread pulling the grass stalk.

..... (1)

By attaching a thin cotton thread to another grass stalk, Tim tries to measure the size of the force, in millinewtons, needed to bend it over through different angles.

A millinewton (mN) is one thousandth of a newton.

His results are shown below.

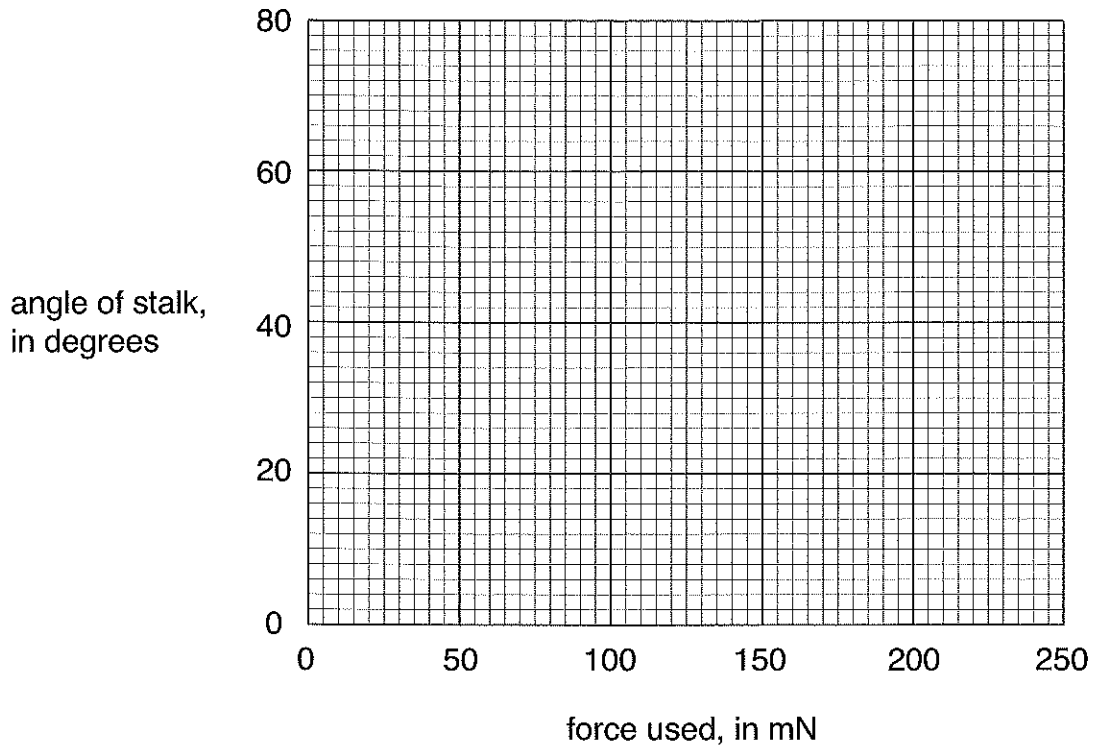
force used to pull grass stalk to this angle, in mN	angle of grass stalk from vertical, in degrees
0	0
25	20
50	36
75	48
100	57

(b) Name the instrument which Tim could use to measure the force required.

..... (1)

(c) (i) Plot these data on the graph grid opposite. (2)

(ii) Draw a suitable best-fit line. (2)



(d) Use your graph to estimate the size of the force which would be needed to bend the grass stalk through 70°.

force exerted = ... (2)

(e) Suggest and explain why this is an unreliable way for Tim to find the force which the spider's thread exerts on the grass stalk which was being bent through 70°.

.....

.....

.....

..... (2)

When an insect lands in a spider's web, it causes the web to vibrate, but no sound can be heard coming from the web itself.

(f) Suggest two reasons why you think this might be.

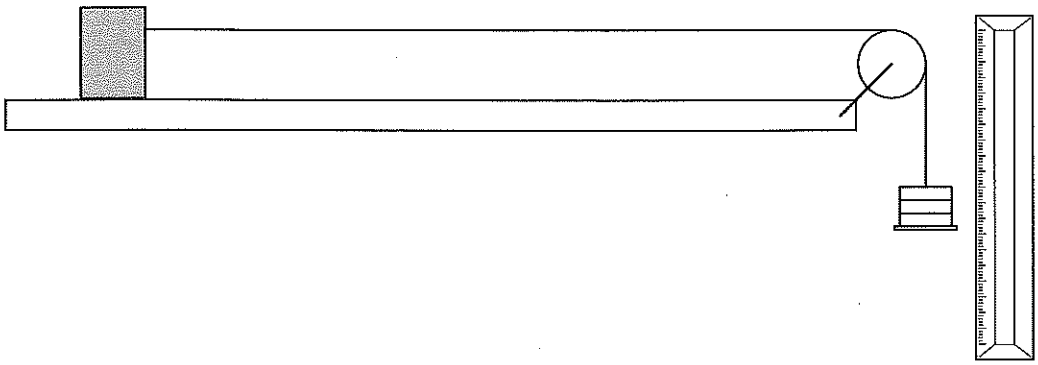
1: ..... (1)

2: ..... (1)

TURN OVER FOR QUESTION 7

7. Mary decides to compare the stiffness of different metals by stretching wires and measuring their extensions.

She decides to fix one end of a wire, pass the wire over a pulley and hang weights from the other end, as shown below.



She knows that she ought to design a 'fair test' and that she should choose a method which will make her measurements accurate.

She thinks that the five suggestions shown below are sensible.

suggestion	**effect**
take all the readings on the same day	improves the accuracy
use wires which are all the same thickness	
use the same set of weights	makes it a fair test
use wires which are 3 m long, not 1 m long	
repeat the readings with a new sample of wire and find the average extensions	makes no difference

Draw a line to link each of Mary's suggestions to the effect it will have.

(*The first suggestion has been linked for you.*) (4)

(Total marks: 60)