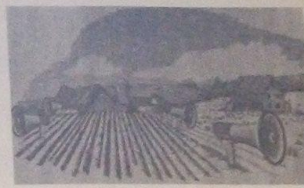
1. ***This question is about the properties of an LDR.***



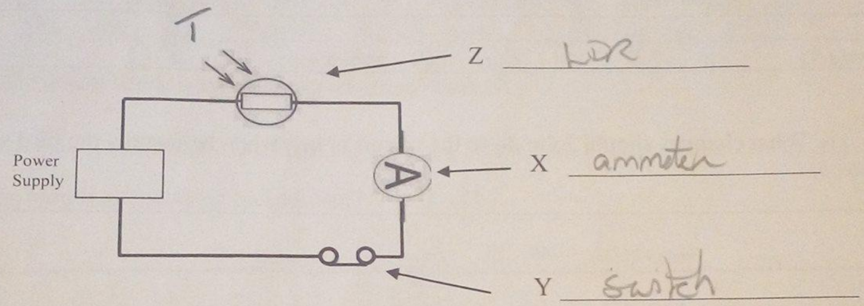
John is a farmer. He is having a problem with birds since they are eating away his crops during the day. He has bought a bird scaring device which he needs to activate from sunrise till sunset. The supplier gave John an LDR. He needs your help in installing the apparatus.

a. What does LDR stand for?

Light dependent Resistor

(1 mark)

b. The diagram below shows one way of connecting an LDR.



i. Label components X, Y and Z (3 marks)

ii. Indicate on the diagram with the letter **'T'** the position you would place a torch in order to test the LDR. The torch can provide different levels of brightness.

(1 mark)

iii. Put the following steps in order so that John can follow and understand the function of the LDR in the circuit. The torch has three levels of brightness. The first one has been done for you. (4 marks)

4	The torch is then switched on higher levels of brightness; the reading on component X is checked again.
3	The torch is switched on the first level of brightness; reading on component X is checked.
1	All the components are connected as above and the connections checked.
2	The torch is off and the reading on component X is noted.
5	The torch is switched off .

iv. Mention one precaution that should be taken.

Pp A 1 c iii

(1 mark)

v. What quantity will component X measure? State in full the unit of this quantity.

X will measure current in Amperes

(2 marks)

vi. Will the reading on device X be a maximum or a minimum when the torch is switched on the lowest level of brightness? Explain your answer.

lowest level of brightness, minimum reading on X since in on LDR ↑ light, ↓ resistance, ∴ ↑ I

(2 marks)

vii. What changes should John do to the circuit in b(i) when he installs the bird scaring device?

Pp A

(2 marks)

c. When the farmer went to install the bird scaring device he got confused. So, he went to the nearest ironmonger and bought a timer so that the device switches on and off automatically. He plugged the device in the timer and made the following settings:

ON	**7.00 am**
OFF	**7.00 pm**

i. The above setting is not suitable for the whole year. Explain.

Pp. A 1 d i

(1 mark)

ii. How would the LDR set up be more effective?

Pp A 1 d ii

(2 marks)

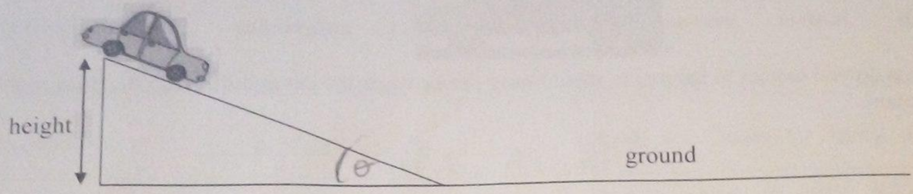
d. Give one other situation where the LDR might be useful.

Pp A 1 e

(1 mark)

2. ***This question is about forces and motion.***

a Julie and Edward investigate how the height of the ramp determines the stopping distance of the toy car on horizontal ground.



i. Explain the meaning of 'stopping distance'.

how far the car travels for its speed to become 0 (1 mark)

ii. Name an instrument used to measure the stopping distance.

measuring tape (1 mark)

iii How can the height of the ramp be changed?

?? ☺ increasing angle θ on diagram (1 mark)

iv. Can different cars be used during this investigation? Explain.

No, since in that case you would be changing 2 variables

∴ relationships vary (2 marks)

v. Explain why repeated readings should be taken.

so that errors are minimised

(2 marks)

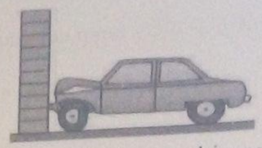
vi. Complete this prediction:

As the height of the car increases, the stopping distance increases. (1 mark)

vii. Name **one** precaution, besides repeated readings, that the students should take during the investigation.

PpA No. 2 a v (1 mark)

b. In an experiment at an accident research laboratory, a car is made to collide with a brick wall.



i. What do you expect to happen to the dummy driver when the car collides with the brick wall? Explain.

Pp. 2A 2bi

(2 marks)

ii. Complete the following:

Newton's 1st law of motion states that a body will remain at rest or continue to move at constant velocity, unless an external force makes it behave differently

(2 marks)

iii. A car decreases its speed from 7 m/s to 0 m/s as it hits the brick wall and stops in 1.4 s. Calculate the deceleration of the car during the collision.

v = 0 m/s $a = \frac{v-u}{t} = \frac{0-7}{1.4} = -5$ m/s²

u = 7 m/s

t = 1.4 ∴ dec = 5 m/s²

a = ?

(2 marks)

iv. The mass of the car is 800 kg. Calculate the change in momentum of the car during the collision.

Δ mom = mv − mu = m(v − u) = 800(0 − 7)

= − 5600 kg m/s.

(3 marks)

v. Calculate the impact force of the car on the wall.

Ft = mv − mu = Δmom

$F = \frac{\Delta mom}{t} = \frac{-5600}{1.4} = 4,000$ N

(2 marks)

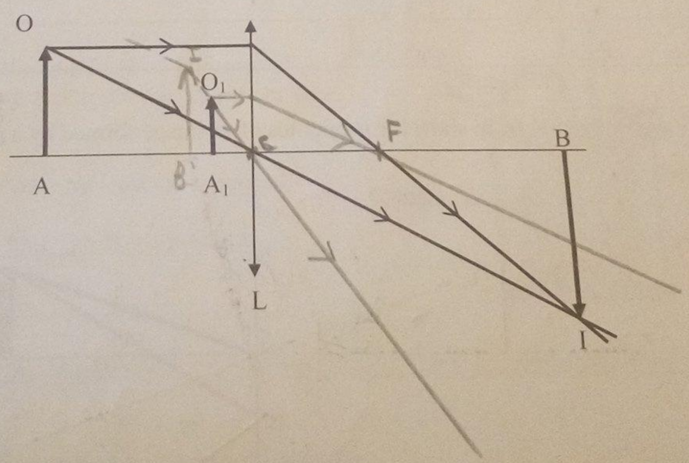
3. ***This question is about light and lenses.***

a. Choose appropriate words to fill in the gaps below. Each word may only be used once.

convex **glass** **converging** **refraction** **short** **concave** **virtual** **diverging**

There are two types of lenses -; convex and ___Concave___. Lenses work by the process of ___refraction___. Lenses are made by using a piece of ___glass___ or perspex. A convex lens is also known as a ___converging___ lens since it brings together the rays whilst ___concave___ lenses spread out the rays. (5 marks)

b. Maria is doing some experiments using lenses. She places an object in front of a convex lens and measures the image distance. She then draws a ray lens diagram. The figure shows two rays from the top of an object OA which pass through the lens L to the image IB.



i. Mark on the diagram the focal point of the lens with an F and measure the focal length.

2.1cm (2 marks)

ii. Mark on the diagram the optical centre of the lens with an C. (1 mark)

iii. Describe the image IB.

inverted, real, magnified

(2 marks)

iv. Calculate the magnification of IB.

mag = hi/ho = 2.7/1.8 = 1.5 or di/do = 5.1/3.4 = 1.5

(1 mark)

v. Name a practical use of such an image.

projector

(1 mark)

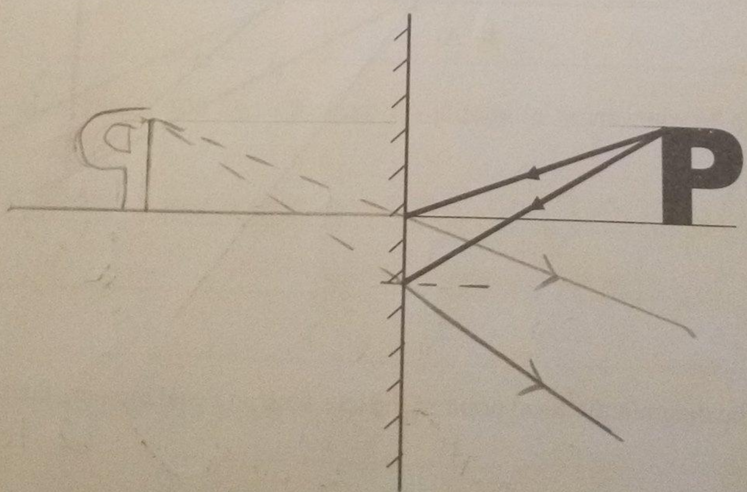
vi. Draw two rays from the top of the smaller object O_1A_1 which pass through the lens; hence find the image of O_1A_1 and label it I_1B_1. (2 marks)

vii. State two differences between the image IB and the image I_1B_1.

I_1B_1 : virtual, erect
IB : real, inverted

(2 marks)

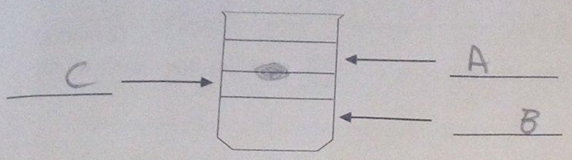
c. Complete the image below to show the properties of an image formed by a plane mirror.



(4 marks)

4. *This question is about specific heat capacity.*

a. Jeremy pours three liquids A, B and C in an empty beaker as shown in the diagram.



Liquid	Density
A	0.6 g/cm^3
B	1.8 g/cm^3
C	1.0 g/cm^3

i. With reference to the table above, mark with A, B and C, the position of the liquids in the beaker.

(2 marks)

ii. A solid plastic disk (⬬) has a density of 0.9 g/cm^3. Draw the position of this plastic disk in the beaker.

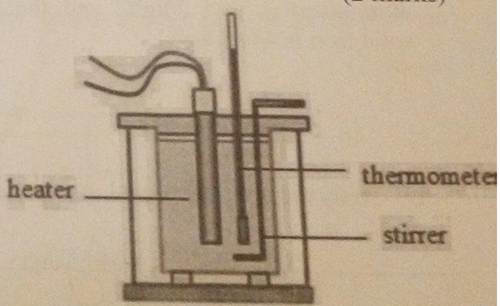
(1 mark)

iii. The mass of liquid A is 15 g. Calculate the volume of liquid A.

$\rho = m/V$ $\quad 0.6 = 15/V$ $\quad V = 15/0.6 = 25\ cm^3$

(2 marks)

b. Andrea investigates the specific heat capacity of an unknown liquid using the apparatus shown in the diagram.



i. Name **two** ways how heat losses are reduced.

- covering the top with a cover to stop convection
- lagging around container to stop radiation + conduction

(2 marks)

ii. State why heat losses should be kept to a minimum.

so that all energy supplied heats up the liquid. + not be wasted to surroundings.

(1 mark)

iii. Why is a stirrer used during the experiment?

so that temp. of liquid is constant through all liquid

(1 mark)

iv. The heater is rated at 250 W. Calculate the total energy provided to the liquid in 4 minutes.

$P = E/t$ | $250 = E/(4 \times 60)$ | $250 \times 240 = E$

$E = 60{,}000$ J

(2 marks)

v. The specific heat capacity is found using the equation $c = \frac{\Delta Q}{m \Delta \theta}$. What does each of the following represent?

- ΔQ energy supplied
- m mass
- $\Delta \theta$ change in temperature

(3 marks)

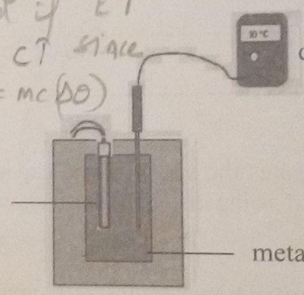
vi. The experimental value obtained for 'c' is higher than that given in data books. Explain why.

because the energy supplied to heat the liq. is greater to make up for energy losses

(1 mark)

c. John investigates the effect of equally heating 1 kg of aluminium and 1 kg of iron for the same amount of time. The specific heat capacity of solid aluminium is 904 J/kg°C and that of solid iron is 449 J/kg°C.

and if E↑ C↑ since $E = mc(\Delta\theta)$



i. Why did John use equal masses of each metal?

Fair investigation

(1 mark)

ii. Would you expect the digital thermometer to show the **same** temperature rise for aluminium and for iron? Explain.

no, since iron needs less energy for the temp. to rise by 1°C

(2 marks)

iii. The temperature of aluminium rises from 20 °C to 46 °C in 100 s. Calculate the change in temperature per second.

$46 - 20 = 26$ °C in 100s
? in 1s

$\frac{1 \times 26}{100} = 0.26$ s.

(2 marks)

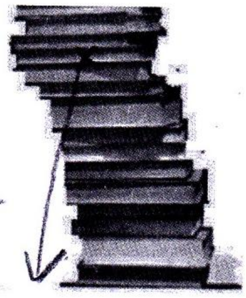
5. ***This question is about moments and centre of gravity.***

a. Define the term 'centre of gravity'.

the point where an object can be balanced or where the whole body weight is acting.

(2 marks)

b Monique is placing library books on top of each other. She decides to place them in the form of a staircase. With the aid of the diagram explain why the books will eventually topple over if more books are placed in this way.



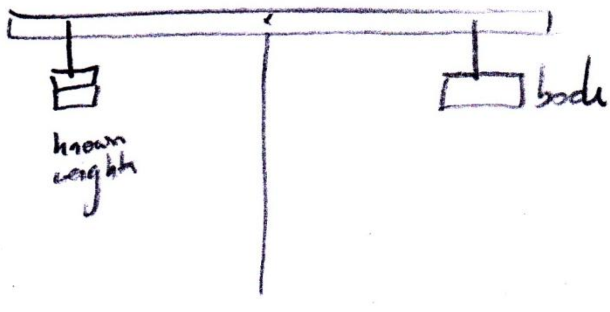
c. of gravity will be raised and ∴ it goes out of the base area ∴ topple over

(2 marks)

c. She then decides to find the mass of one of the books, using known weights she found in the physics lab and a suspended metre ruler. She suspends the book at one side of the metre ruler and the known weights on the other side of the ruler.

i. Draw a diagram to show how Monique can use this simple apparatus in order to find the unknown mass of the book.

(2 marks)



ii. Describe three steps Monique has to perform in order to find the unknown weight of the book.

Set up app. as shown with point below c. of gravity move book + weights back + forth until ruler is balanced. then work out Σ mom = G mom. + find the weight of the book

(2 marks)

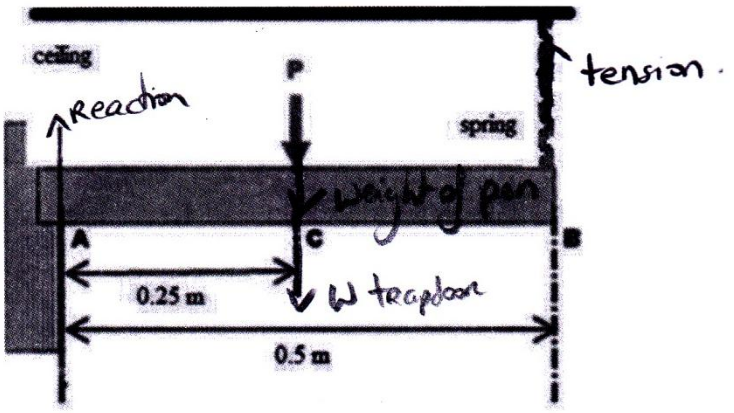
iii. What calculation needs to be done in order to find the mass of the book when the weight is found?

Σ mom = G moment. since balanced

(1 mark)

d. Jean Paul built a small uniform trapdoor which is 0.5 m long as shown below. It is held by hinges at A and has a mass of 0.4 kg. A spring is attached from the ceiling to point B. He places a pen of mass 0.1 kg at C 0.25 m away from A.

0.4 + 0.1 = 0.5 kg = 5N



i. Mark all the forces on the diagram. (4 marks)

ii. Calculate the size and state the direction of the moment created by the spring about point A.

Moment of spring = Moment of trap + Moment of pen
= (4 + 1 · 1) × 0.25 = 1.25 Nm

(2 marks)

iii. Hence calculate the Force exerted by the spring.

Mom = F × s   F = 1.25/0.5
0.125 = F × 0.5.   F = 2.5 N.

(2 marks)

iv. If the system is in equilibrium calculate the reaction Force at A.

↑F = ↓F ∴ R + 0.25 = 5N (4+1)
R = 5 − 2.5 = 2.5 N.

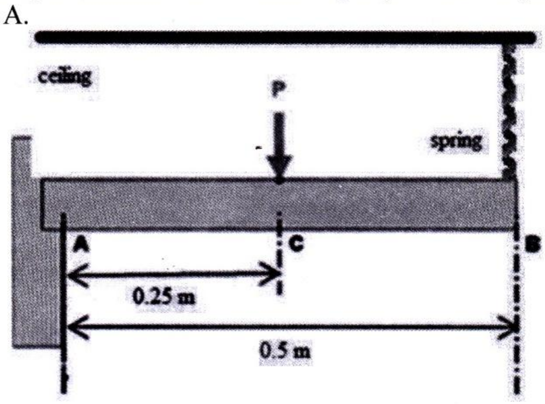
(1 mark)

v. A second identical pen is placed on the trapdoor 0.25 m from A. If the trapdoor is still in equilibrium, what happens to the force exerted by the spring and the Reaction Force at A? Explain.

F spring increases + R.F. decreases

(2 marks)

c. Jean Paul built a small uniform trapdoor which is 0.5 m long. It is held by hinges at A and has a mass of 0.4 kg. A spring is attached from the ceiling to point B. He places a pen of mass 0.1 kg at C, 0.25 m away from A.



i. Mark all the forces on the diagram. (3 marks)

ii. Calculate the force exerted by the spring.

Page B d ii + iii

(3 marks)

iii. Hence calculate the reaction force at A.

Page B d iv.

(1 mark)

iv. Would the reaction force at A and the force exerted by the spring be the same as the answers in (ii) and (iii), had the pen been placed closer to A? Explain.

pen closer to A, less moment ∴ F of spring is less and Reaction Force is greater.

(2 marks)

v. What happens to the spring when a force is exerted on it? Why?

it extends since it is an elastic material that obeys Hooke's law.

(2 marks)

vi. What could happen to the spring if a large mass is placed on top of the trapdoor? Explain.

becomes deformed since it exceeds elastic limit

(1 mark)