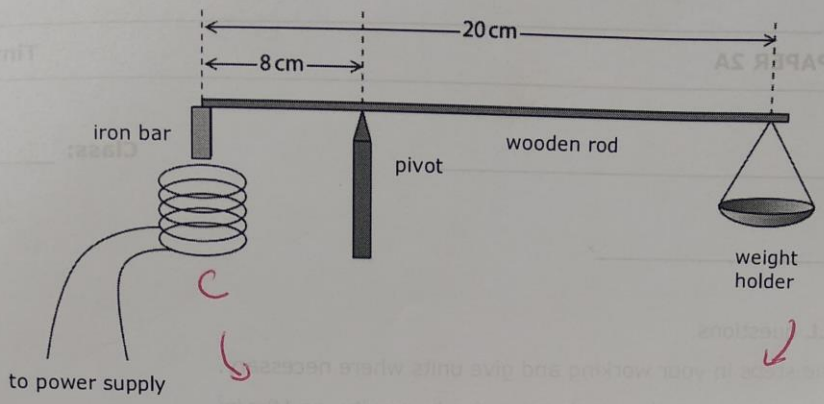
Paper 2A

1. A student uses this apparatus to investigate how the strength of the magnetic field in a current-carrying coil varies as the current changes.



a) A weight of 0.1 N is needed to balance the rod when the current in the coil is zero.

i) Label the coil, **C**, on the diagram. ✓ (1)

ii) Give the two conditions for equilibrium.

→ total ↻ moments = total ↺ moments ✓

→ total ↑ forces = total ↓ forces ✓ (2)

iii) Assuming that the weight of the rod and the weight of the weight holder are negligible, work out the **weight** of the iron bar.

+↻ Moment = +↺ moment | $0.1 \times 0.12 = 0.08F$

$(F \times s)_{weight} = (F \times s)_{bar}$ ✓ | $F = 0.15\,N$ ✓

$0.1 \times (0.20 - 0.08) = F \times 0.08$ ✓ (3)

iv) Hence, what is the **mass** of the iron bar?

$W = mg = 0.15 = m \times 10$

$m = 0.015\,kg$. (1)

b) The student increases the current in the solenoid.
What observation can be made? Explain.

stronger mag. field, ∴ more attraction
Rod no longer balanced (2)

c) Describe the method that the student would use, to study how the strength of the magnetic field in a current-carrying coil varies as the current changes.

- set up apparatus as shown
- set current, add weight to balance rod. again
- take reading of weights added and current from ammeter
- repeat with different values using a rheostat (4)
- plot a graph of weight added against current

d) Give one precaution the student should follow while carrying out the investigation.

No loose + rusted connections / take readings at eye level (1)

e) The readings noted while carrying out the investigation were plotted on the graph below.

Current in A	Total weight added in N
0.0	0.1
0.1	0.5
0.5	2.1
0.7	2.5
0.9	3.7
1.1	4.5

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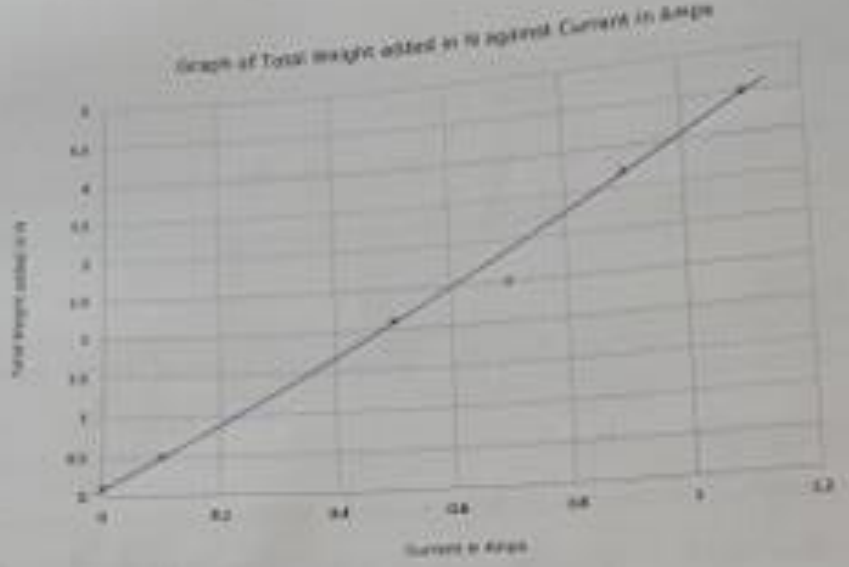


i) Draw a line of best fit for the points plotted. (1)

ii) What can you conclude about the relationship between the two quantities plotted on the axis? Explain.

I directly ∝ Weight added ✓

straight line graph ✓ (2)

iii) What conclusion can be drawn about the relationship between the strength of the magnetic field and the current in the current-carrying coil?

directly proportional (1)

iv) Suggest why the student should repeat the readings for a current of 0.7 A.

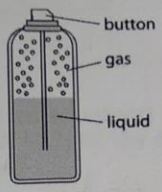
½ out of line ∴ inaccurate ½ (1)

f) Besides increasing the current, what other change could have been made to change the strength of the magnetic field around the current-carrying coil.

increasing the no. of turns (1)

2. This question is about Pressure and the gas laws.

a) A spray-can contains gas particles that are constantly moving.



i) How do the gas particles produce a pressure on the walls of the spray-can?

✓ particles moving around at very high speeds / haphazardly
✓ colliding on the walls (exerting a pressure) (2)

ii) A student presses the button and liquid leaves the can. How does this affect the pressure in the spray-can? Explain.

mass ↓ ½ ∴ more ½ space for the particles to move in, ∴ pressure ↓ ✓ (2)

iii) What happens to the average speed of the gas particles when the spray-can is warmed by the sun on a hot day? Explain

particles' temperature ↑, KE ↑ in particles ∴ speed ↑ ✓ (2)

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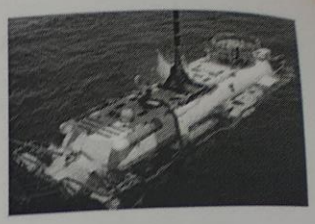
b) The LR5 is a specialist submarine for underwater rescues.



The average density of sea water is 1028 kg/m^3.

i) Calculate the increase in pressure as the LR5 descends from the surface to a depth of 700 m.

h = 700 m $P = hfg = 700 \times 1028 \times 10$

$f = 1028$ kg/m^3 $P = 7,196,000$ Pa

(3)

ii) What is atmospheric pressure at the sea-level?

100,000 Pa (1)

iii) Work out the total pressure acting on the LR5 when it is at a depth of 700 m below sea level.

7196,000 + 100,000 = 7,296,000 Pa (1)

c) On another descent, the LR5 experiences a total pressure of 4.1×10^6 Pa. The entrance to the LR5 is through an access door which has an area of 3.1 m^2.

i) State the equation which relates pressure, area and force.

$P = F/A$ (1)

ii) Calculate the force on the outside of the door.

$P = F/A$, $4.1 \times 10^6 = F/3.1$, $F = 4.1 \times 10^6 \times 3.1$

$F = 12710000$ N (2)

QUESTION CONTINUED ON THE NEXT PAGE.

d) The LR5 is tested in fresh water. The density of fresh water is 1000 kg/m^3. Explain why the pressure on the submarine in fresh water is less than the pressure in sea at the same depth.

ρ of fresh water < ρ of sea water
but $P \propto \rho$, ∴ P in fresh water is less (2)

e) Describe a simple experiment to find the density of a sample of liquid.

1 - Use top-pan balance to find mass of empty container, m_1
1 - Fill container with 50 cm^3 of water, and find mass, m_2
1 - mass of liquid = $m_2 - m_1$
1 - Find $\rho = m/V$. (4)

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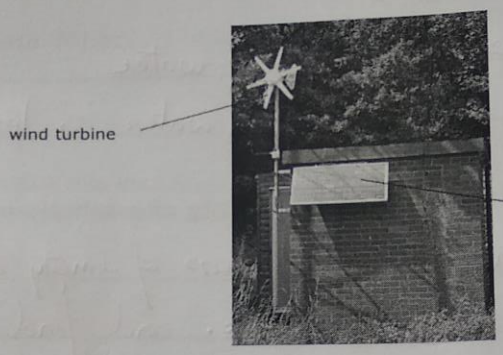
3. The photograph shows equipment used for generating electricity from renewable sources.



a) Define the term 'renewable sources'.

energy sources which can be used over + over again (1)

b) Give one advantage and one disadvantage of using renewable energy over non-renewable energy.

Advantage: generate no atmospheric pollution', cheap to maint

Disadvantage: expensive to install, not reliable enough (2)

c) Fill in the blanks.

The panel of solar cells transforms light' energy into electrical energy while the wind turbine transforms kinetic' energy into electrical energy. (2)

QUESTION CONTINUED ON THE NEXT PAGE.

d) On a windy day, the wind turbine transfers 78 W of power.

i) Calculate the amount of energy the turbine transfers in 10 s.

78 W = P
t = 10 s
P = E / t = 78 / 10 = 7.8 W

(2)

ii) Give one **specific** advantage and one **specific** disadvantage of using wind turbines when generating electricity.

Advantage: land underneath can be used for farming

Disadvantage: noise + sound pollution

(2)

e) The solar cells generate a current of 2.3 A.

i) Calculate the charge transferred by the solar cells in 15 s.

Q = It = 2.3 × 15 = 34.5 C

(2)

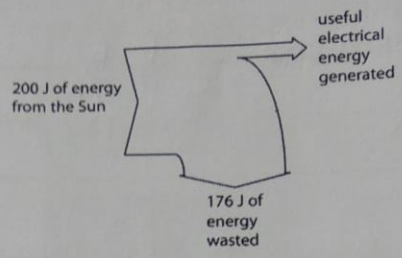
ii) Solar cells are wired in parallel. Suggest why the solar cells are not connected in series.

if one cell fails, the others will still operate.

(1)

QUESTION CONTINUED ON THE NEXT PAGE.

f) The Sankey diagram shows the energy transferred by the panel of solar cells.



i) Work out the useful energy for the panel of solar cell.

200 − 176 = 24 J. (1)

ii) Find the efficiency of the panel of solar cells.

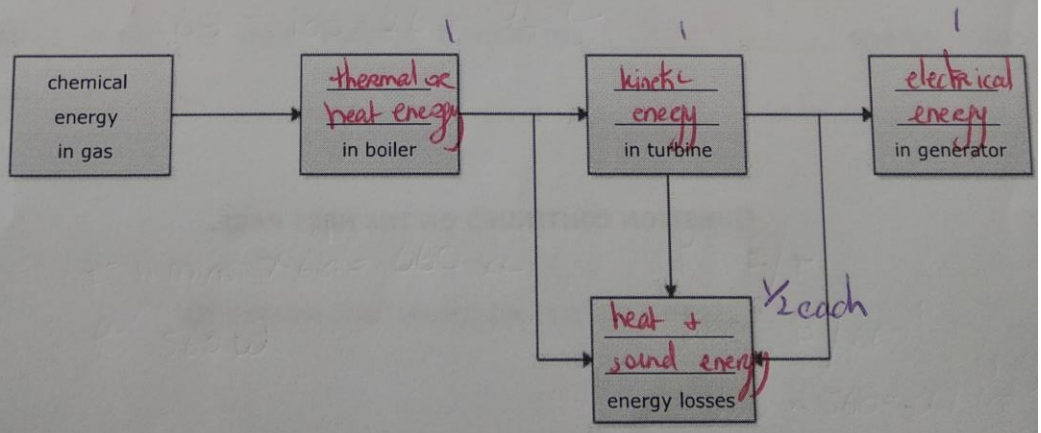
Eff = E. Out / E. In × 100% = 24 / 200 × 100 = 12% (2)

g) Gas can be used as a source for a power station.

i) Is gas a renewable or a non-renewable source of energy?

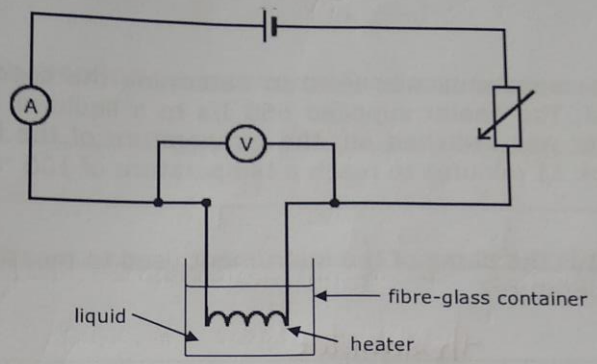
non-renewable (1)

ii) Complete the energy flow diagram below for a power station whose source is gas.



(4)

...gram illustrates an experiment in which the electrical energy used to produce a measured rise in temperature of a liquid can be determined.



i) The liquid will tend to be warmer at the top than at the bottom of the container. Explain why.

warm water has smaller ρ, ½ ∴ it floats on top of cold water, by convection ½ (2)

ii) What difference would be observed if the fibre-glass container is lagged? Explain.

lagging = good ~~set~~ insulator ½, ∴ heat losses by conduction ½ are reduced. ∴ temp of ½ water increases faster (2)

iii) The temperature will eventually stop rising even though the current is still passing through the heating coil. This is because the liquid would have reached its boiling point and starts turning into steam.

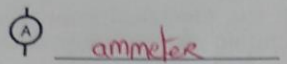
- What is this process called?

evaporation (1)

- Name one factor which would slow down this process.

- smaller surface area OR
- increased humidity (1)

b) Give the name of the symbols below.



ammeter

variable resistor or Rheostat (1)

c) The same apparatus was used to determine the specific heat capacity of the liquid. The heater supplied 560 J/s to a liquid of mass 0.5 kg. Before the heater was switched on, the temperature of the liquid was 26°C. The liquid took 11 minutes to reach a temperature of 100 °C.

i) What is the name of the instrument used to measure the rise in temperature?

thermometer (1)

ii) How can one take accurate readings when using this instrument?

take readings at eyelevel (1)

iii) What is the power of the heater?

560 W (1)

iv) Work out the change in temperature.

$\Delta\theta = 100 - 26 = 74°C$ (1)

v) Calculate the energy supplied by the heater to reach 100°C during the 11 minutes.

$t = 11 \text{ mins} \times 60 = 660 \text{ sec}$ $P = E/t$

$P = 560 \text{ W}$ $560 = E/660$

$E = 660 \times 560 = 369,600 \text{ J}$ (3)

vi) Define the term '**specific heat capacity**'.

the energy required to increase the temperature of 1kg of a material by 1°C. (2)

vii) Work out the specific heat capacity of the liquid being used.

c = ?
Q = 369600J
m = 0.5kg

E = mc(Δθ)
369600 = 0.5 × c × 74
c = 369600 / 0.5 × 74 = 9989 J/kg°C (3)

viii) The specific heat capacity of the liquid obtained in (vii) is slightly inaccurate. Give a reason for this inaccuracy.

due to energy losses (1)

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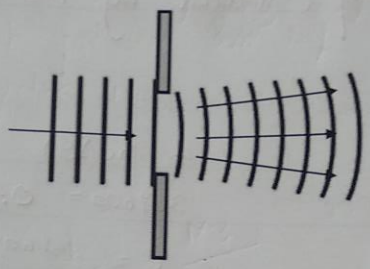
5. This question is about Water Waves and Optics.

a) Water waves passed through a gap as shown in the diagram below.



i) Water waves are 'transverse' waves because the vibrations of the particles are 'perpendicular' (right angle, 90°) to the direction of travel of the wave. They are made of crests and 'troughs'. (3)

ii) Define the term '**wavelength**'. Mark one wavelength on the diagram.

the distance between two consecutive crests or two consecutive troughs. (1)

iii) Name the effect which is happening after the waves pass through the gap.

diffraction (1)

iv) How can the waves be spread more?

('narrowing the gap') such that it is equal or less than λ. (1)

v) When the waves pass through the gap, what change, if any, occurs to:

- the wavelength 'same'
- the speed of the wave 'same' (2)

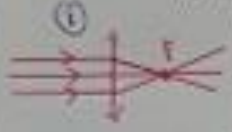
b) The diagram shows a section through a simple form of telescope.

i) Describe, by reference to the lens shapes, whether the eyepiece and objective lenses are converging or diverging lenses.

Eyepiece lens: diverging ✓

Objective lens: converging ✓ (2)

ii) With the help of a diagram, explain what is meant by the 'principal focus' of a converging lens.



the point through which all the rays pass after passing through the lens (2)

iii) Continue the ray diagram for an object which is placed between the F and 2F of a convex lens. with pencil (3)

-½ no arrows
-½ no labelling of I

To check for accuracy

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\frac{1}{25} = \frac{1}{33} + \frac{1}{v}$

$\frac{1}{v} = 0.1387$

$v = 7.3\,cm$ (most values)

iv) Describe the image formed and give one use for which this set-up is used.

Properties : inverted, magnified, beyond 2F, real
(1 each for the first 2 any)

Use : projector ✓ (3)

v) Work out the magnification of the convex lens used.

mag = $\frac{h_i}{h_o} = \frac{d_i}{d_o} = \frac{7.3}{3.8}$ ✓ ✓ = 1.9 ✓ (most accurate) (2)

END OF EXAM.