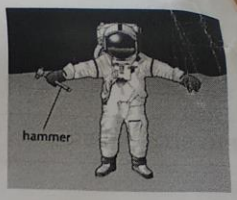
Paper 1

1. An astronaut drops a hammer during a mission on the moon.



a) The gravitational field strength on the moon is 1.6 N/kg. The mass of the hammer is 750 g. Calculate the height from which the hammer was dropped if the potential energy of the hammer before it drops was 2.2 J.

m = 750 g ÷ 1000 = 0.75 kg. (½)

g = 1.6 N/kg.

PE = 2.2 J.

PE = mgh (½) 2.2 = 1.6 × 0.75 × h (½)

h = 2.2 / 1.6 × 0.75 (½) = 1.83 m (1)

(3)

b) Find the speed with which the hammer hits the surface of the moon, assuming all the potential energy has been transferred to kinetic energy.

V = ?

PE lost = KE gained = 2.2 J.

2.2 = ½ mv² (½) (½)

2.2 = ½ (0.75) V²

V² = 2.2 × 2 / 0.75 (½)

V = √5.87 (½)

V = 2.42 m/s (1)

(3)

c) The astronaut lifts the hammer back to its original height. State the amount of work done in lifting the hammer.

2.2 J.

(1)

d) Explain why the astronaut would have to do more work to lift the same hammer through the same height on Earth.

g on Earth bigger, ∴ PE is greater

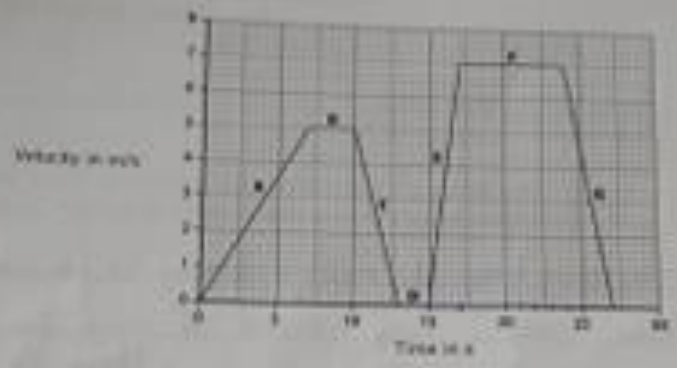
(1)

e) 'When the hammer fell on the moon, a sound was heard.' Explain why this statement is incorrect.

on moon, vacuum (1), ∴ sound does not travel (1)

(2)

2. A student cycles to school.



a) Describe and compare the motion of the student during stages B and D.

B: constant speed

D: at rest (2)

b) State how the graph shows that the acceleration for stage E is greater than the acceleration for stage A.

E is steeper (1), ∴ more acceleration (1) (1)

c) Use the graph to calculate the distance that the student travels in the last 10 s of the journey. (1) distance = area = (sum of parallel sides / 2) h

last seconds: Area = ((10 + 7)/2) 7 (1) | 46 → 54: Area = ((12 + 7)/2) ×7 (1)

= 54.5 m (1) | = 66.5 m (1) (3)

d) The total distance travelled during the whole journey is 106.5 m.
Work out the average speed for the whole journey.

av. speed = t.s. / t.t (1) = 106.5 / 27 (1) = 3.94 m/s (1)

(2)

3. Radon is a gas produced by some types of rocks.

a) Radon is a natural source of radioactivity. What is the name for this radioactivity?

background Radiation (1)

b) Radioactivity can take the form of alpha or beta particles. Give two properties of alpha particles which make them different from beta particles.

α particles are +vely charged + strong in ionisation.
β particles are -vely charged + ionise less than α. (2)

c) Radon-222 and radon-220 are both isotopes of radon.

i) A nucleus of radon-222 has 86 protons. How many protons are there in a nucleus of radon-220?

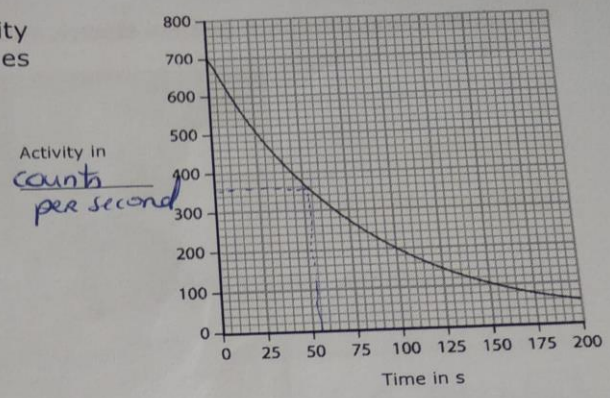
86 protons. (1)

ii) A nucleus of radon-222 has 136 neutrons. How many neutrons are there in a nucleus of radon-220?

220 - 86 = 134 neutrons (1)
(½) (½) ∴ Mass =

QUESTION CONTINUED ON THE NEXT PAGE.

d) The graph shows how the activity of a sample of radon-220 changes with time.



i) Complete the graph by adding the missing unit for activity. (1)

ii) Explain what is meant by the term half-life.

the time (½) taken for the atoms of a (½) radioactive source to decay by (1) half

(2)

iii) Use the graph to find a value for the half-life of radon-220. Show any working here.

700 ÷ 2 = 350 (1) ∴ half life = 55 seconds

(2)

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4. A washing machine has an electric motor and an electric heater.

The resistance of the heater is 23 Ω. The mains voltage is 230 V.

a) Show that the current in the heater is about 10 A when it is working.

R = 22 Ω | V = IR (½) | I = 230 / 22 (½)

V = 230 V | 230 = I × 22 | I = 10 A (1) (2)

b) The washing machine is fitted with a fuse rated at 13 A.

i) Explain why the washing machine is fitted with a fuse.

will safeguard w. machine; when there is a fault and a greater current tries (1) to enter w.machine, the fuse melts (1) (2)

ii) When the motor is working, the current in it is 1.74 A. Explain why it would not be sensible to replace the 13 A fuse with a 2 A fuse.

if 2A fuse used, when heater needs (½) to work, the (1) fuse melts (½) and the w. machine does not operate (2)

QUESTION CONTINUED ON THE NEXT PAGE.

c) The washing machine takes 130 minutes to wash a load of dirty clothes.

i) Work out the power of the **motor**.

$I = 1.74A$ $P = IV = 1.74 \times 230$ (1)

$V = 230V$ $P = 400.2W$ (1) (2)

ii) Calculate the energy, in **kWh**, used by the washing machine.

$P = 400.2 \div 1000 = 0.4002kW$ (1) $E = 0.4002 \times 2.2$

$t = 130$ minutes $\div 60 = 2.2$ hr (1) $E = 0.88044kWh$ (1) (3)

iii) One unit of electricity is 17 c for every 1 kWh.
Find the cost of electricity for washing a load of clothes.

1 unit = 17c 17×0.88044 (1)

0.88044 units = ? $14.97c$ (1) (2)

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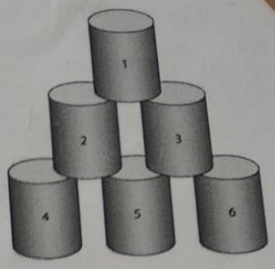
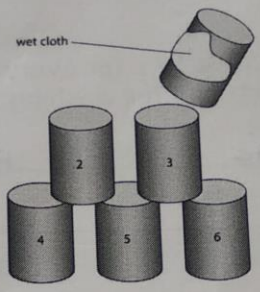
5. A student is playing a game with some empty tins.



a) He throws a wet cloth of mass 0.15 kg at the tins. The wet cloth moves at a velocity of 6.0 m/s.

$m_{cl} = 0.15\ kg$

$V_{cl} = 6\ m/s$



i) Calculate the momentum of the wet cloth.

momentum = mv = 0.15 × 6 = 0.9 kg m/s
(½) (½) (1)

(2)

ii) State the law of conservation of momentum.

total momentum before = total momentum after (1)

as long as no external forces are acting. (1)

(2)

QUESTION CONTINUED ON THE NEXT PAGE.

iii) The wet cloth sticks to tin 1. The mass of tin 1 is 0.050 kg. The cloth and tin 1 move away together. Calculate their velocity.

$m_t = 0.05\,kg$.

mom bef. = mom after (½)

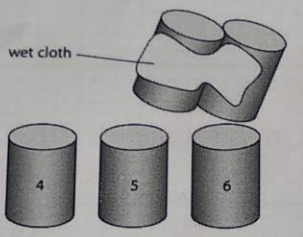
½ 0.9 = (0.05 + 0.15) V (1)

$\frac{0.9}{0.2} = V$ (1)

$V = 4.5\,m/s$. (1)

(3)

b) The student throws a bigger wet cloth at the remaining tins. This wet cloth sticks to tins 2 and 3 and they move away together.



The student concludes that since he threw the cloth the same way, then the velocity of tins 2 and 3 must be the same as the velocity of tin 1.

Do you agree with this conclusion? Explain why.

(½) mass now increased, ∴ since mom = m × v and momentum before same, mom / v = m. (½) ∴ m ↑ & vel. (½)

No (½) ∴ vel decreases. (½)

(3)

increasing both mass.

To check

$m_c v_c + m_{t_1} v_{t_1} = (m_c + m_{t_1}) V$

$1(2) + 0 = (1 + 1) V$

$2 = 2V$

$\frac{2}{2} = V$

$V = 1$

$m_c v_c + m_{t_{12}} v_{t_{12}} = (m_c + m_{t_{12}} + m_2) V$

$2(2) + 0 = (2 + 1 + 1) V$

$4 = 5V$

$\frac{4}{5} = V$

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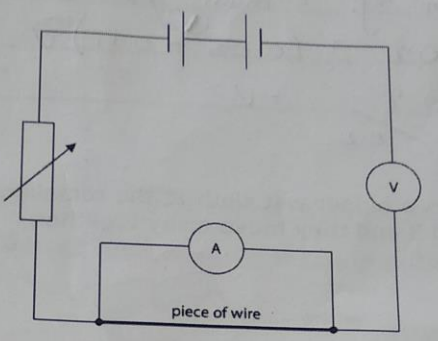
6. A student plans to measure the resistance of a piece of wire. He sets up this circuit and finds that it does not work.



a) Identify the three errors in the student's circuit.

(V) should be connected in parallel (1)

(A) should be connected in series (1)

'cello should be —|—|— (1)

(3)

b) The student uses a correct circuit to obtain these results.

Current in amps	Voltage in volts
0.00	0.0
0.24	1.5
0.71	4.5
0.89	6.0
1.00	7.5
1.10	9.0

i) Plot a graph to show the relationship between current and voltage for the wire. (5)

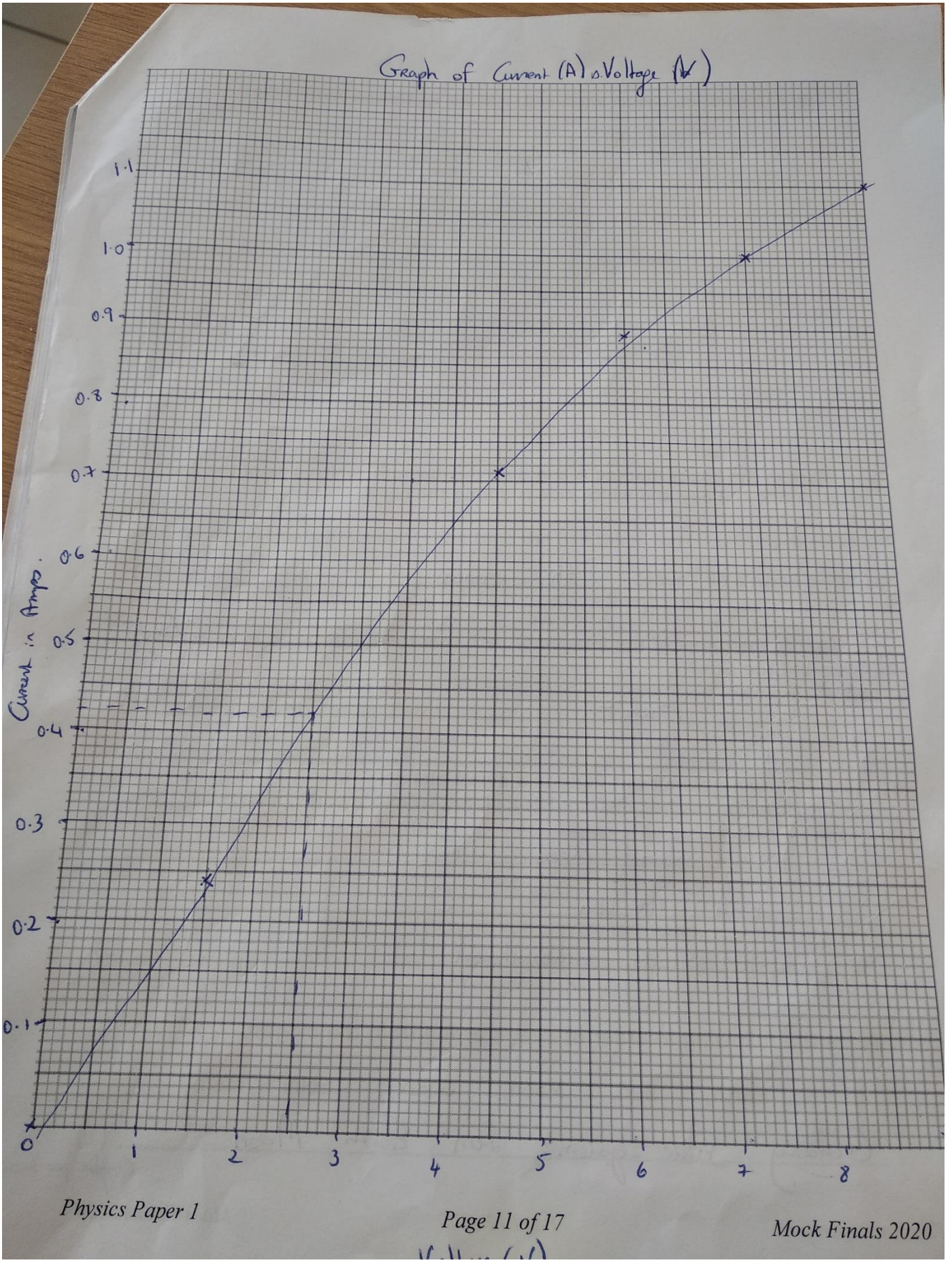
-1 title
-1 labelling axis
-½ readings
-½ area
-½ for each wrong coordinate
-½ if title + axis does not correspond
-½ no units

ii) Find the current when the voltage is 2.5 V.

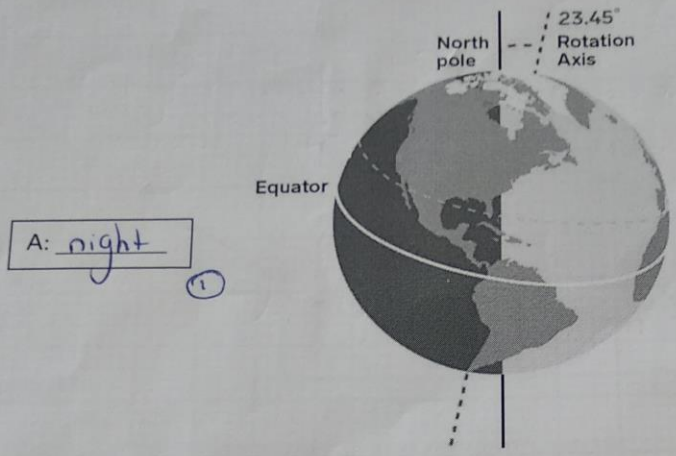
0.42 (1)

iii) Suggest why the line on the graph curves.

the piece of wire is not Ohmic.
or does not obey Ohm's Law


Graph of Current (A) vs Voltage (V)
Current in Amps.
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8

7. The Earth is tilted at an angle of 23.45° and rotates around the Sun.



a) Mark in the boxes marked A and B on the diagram, which side of the Earth is during the day and which side is during the night. (2)

b) The Earth's tilt causes the seasons. (1)

c) What is the name of the imaginary path that the Earth takes when rotating around the Sun?

orbit (1)

d) The Earth is a planet but Pluto is a dwarf planet.
What three properties distinguish a planet from a dwarf planet?

1. nearly round shape (1)
2. orbits the sun (1)
3. cleared its neighbourhood (1) (3)

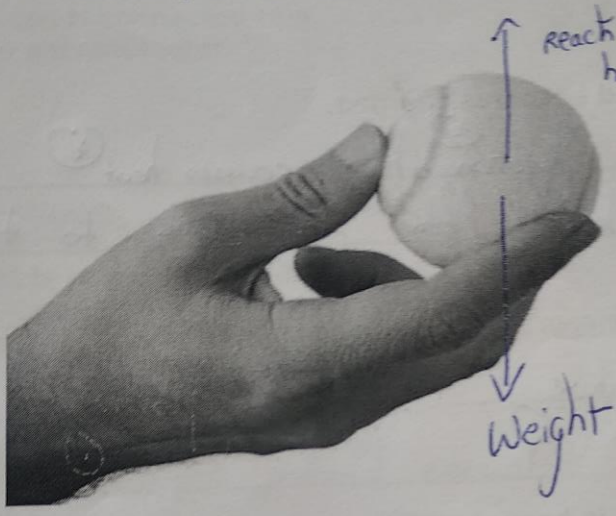
e) Place the following in order of size, starting from the biggest.

Earth, Sun, Moon, Galaxy, Solar System

Galaxy, Solar system, Sun, Earth, Moon (1)

(tajna jer has

8. Andrea, who is standing on a bridge 20 m high, holds a tennis ball in his hand.



a) Draw the forces acting on the ball and name them. (2)

b) He drops the ball. Calculate the time the ball takes to reach the ground.

$s = 20m$
$u = 0$.
$a_g = 10 m/s^2$ ①

$s = \frac{1}{2} a t^2$ ½
$20 = \frac{1}{2}(10) t^2$ ½

$t^2 = \frac{20 \times 2}{10}$
$t^2 = 4$
$t = \sqrt{4} = 2s$ ①

(3)

c) He then drops an iron ball of the same size. Comment on the time it takes to reach the ground.

Since there is ~~gravity~~ air resistance acting on Earth, then there will be opposing forces, ∴ it takes less time to fall ½ since mass of ball increases ½ (1)

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9. A duster is rubbed on a polythene rod. The rod becomes charged.

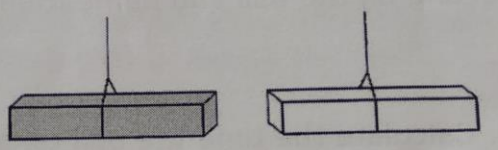
a) Explain how the rod becomes charged.

Rubbing causes friction which causes heat
∴ electrons flow from the cloth to the poly. (2)

b) What type of charge remains on the polythene rod and on the duster?

Polythene: negative Duster: positive (2)

a) Another charged rod is brought near the polythene rod as shown below. They move closer together.



What is the charge on the newly introduced rod? Explain.

positive since attraction occurs
between opposite charges (2)

b) Ann is wearing slippers with plastic soles. She walks on a carpet made from synthetic material. She touches the metal radiator and gets a small shock. Explain why she felt a shock.

moving along carpet charges, radiator = metal ∴ conductor
∴ when she touches conductor charge flows (2)

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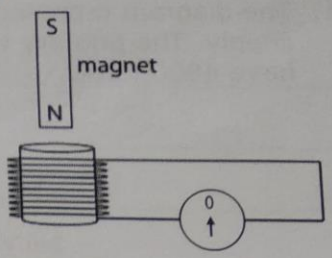
10. The diagram shows a magnet held above a coil. The coil is connected to a centre-zero galvanometer.



a) The magnet is released so that it falls into the coil.

i) Explain why the galvanometer shows a reading.

as magnet falls, magnetic lines of flux (1) are cut by coil, ∴ induced current (1) (2)

ii) The magnet is released from a greater height.
How does this affect the galvanometer? Explain your answer.

galvanometer gives a greater (1) reading, since the rate of cutting of flux is faster (1) (2)

b) State how the galvanometer reading changes when the same magnet:

i) moves more slowly in the coil: decreases

ii) moves into a coil with more turns: increases

iii) is reversed so the S-pole enters the coil first: opp. direction (3)

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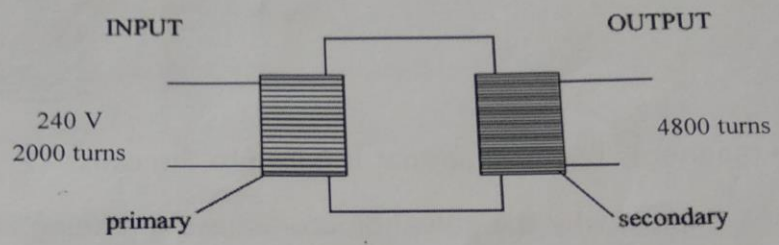
11. The diagram represents an ideal transformer connected to a 240-V, 50-Hz supply. The primary windings have 2000 turns and the secondary windings have 4800 turns.



a) Why is the core joining the primary and secondary windings made of iron?

stronger induced current in secondary coil. (1)

b) What does a.c. stand for?

alternating current (

c) Why is an a.c. supply used?

continuous cutting of magnetic flux. (1)
ac gives a
since continuous changing current (1)

d) What type of transformer is this: step-up or step-down?

step-up

e) Calculate the output voltage from the transformer.

$\frac{N_p}{N_s} = \frac{V_p}{V_s}$ (1) $\frac{240}{V_s} = \frac{2000}{4800}$ (1)

$V_s = 576\,V$ (1)

(3)

f) What assumption did you make to work out the output voltage?

no energy losses

(1)

g) State how this transformer could be used as a step-down transformer.

decreasing the no. of turns in secondary such that less than no. of turns in primary.

(1)

END OF EXAM.