Questions

Q1.

This question is about magnetic fields.

(a) Describe an experiment to investigate the magnetic field pattern around a permanent bar magnet.

You may draw a diagram to help your answer.

(3)

....

....

....

....

....

....

....

....

....

(b) The diagram shows two bar magnets.

Complete the diagram to show the magnetic field pattern.

(3)

(Total for question = 6 marks)

Q2.

A student investigates a transformer.

This is the student's method.

- use a primary coil with 10 turns
- connect the primary coil to a constant maximum input voltage
- measure the output voltage across the secondary coil
- repeat using an increasing number of turns on the primary coil

The table shows the student's results.

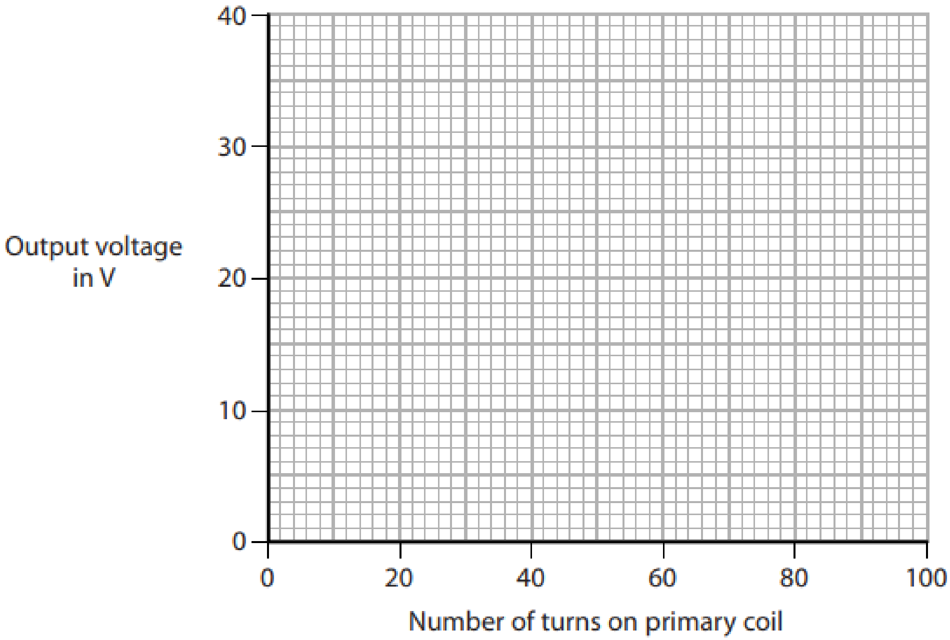
Number of turns on primary coil	Output voltage in V
10	39.6
20	19.7
40	9.9
60	6.6
80	5.0
100	4.0

(a) (i) Plot a graph of the student's results on the grid.

(1)

(ii) Draw a curve of best fit.

(1)



(iii) Describe the relationship between the output voltage and the number of turns on the primary coil.

(2)

....

....

....

....

(b) (i) State the formula linking input and output voltages and the turns ratio for the transformer.

(1)

(ii) The input voltage of the transformer is 6.8 V.

Calculate the number of turns on the secondary coil.

(2)

number of turns = ...

(Total for question = 7 marks)

Q3.

Photograph 1 shows a child's toy.

The toy has two magnets on a vertical shaft.

Photograph 1

(a) Magnet A rests on a support near the bottom of the vertical shaft.

A student places magnet B at the top of the vertical shaft and releases it from rest.

Magnet B is repelled by magnet A causing it to come to rest again at the position shown.

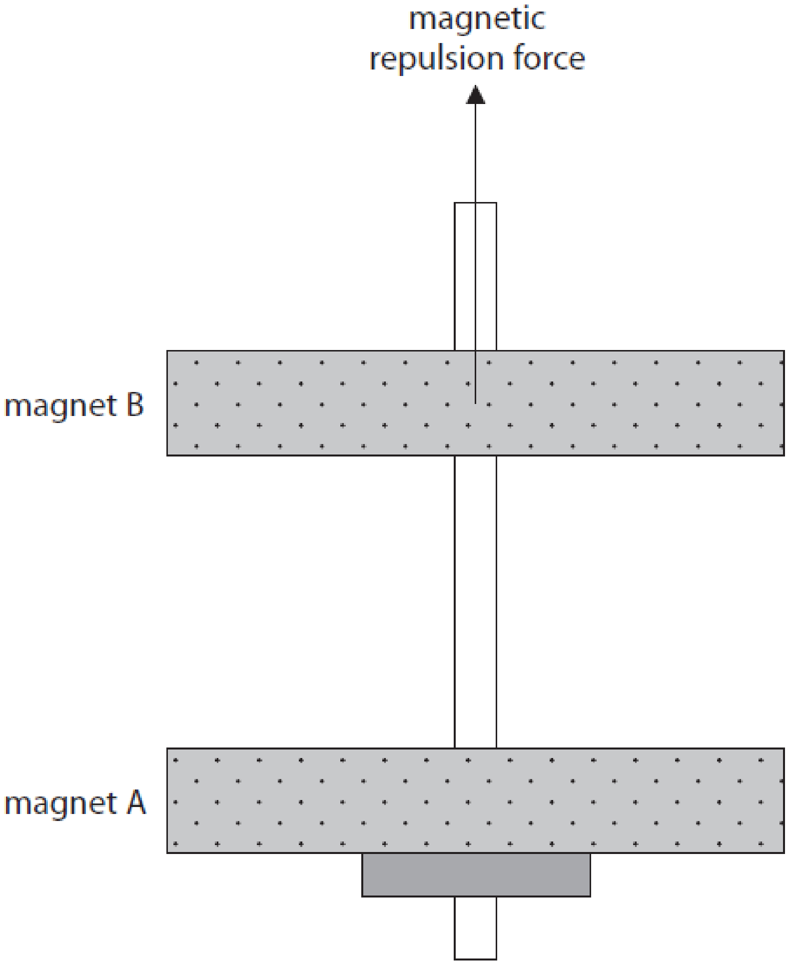
The table shows some energy stores in magnet B.

Put ticks (✓) in the correct boxes to show whether the amount of energy in each store of magnet B increases, decreases or stays the same when compared to its value at the top of the vertical shaft.

(3)

Energy store in magnet B	Increases	Decreases	Stays the same
gravitational			
magnetic			
kinetic			

(b) This is a diagram of the toy shown in photograph 1.



One of the forces acting on magnet B is shown.

Draw another labelled arrow on the diagram to show the other force acting on magnet B.

(2)

(c) The student adds a 10 g mass on top of magnet B when it is stationary above

magnet A and observes that the distance between the magnets decreases.

He carries out an investigation to see how the distance changes as more masses are added.

In your answer, you should refer to

- the measuring equipment required
- the independent and dependent variables
- a way to check the reliability of the data

You may draw a diagram to help your answer.

(5)

....

....

....

....

....

....

....

....

....

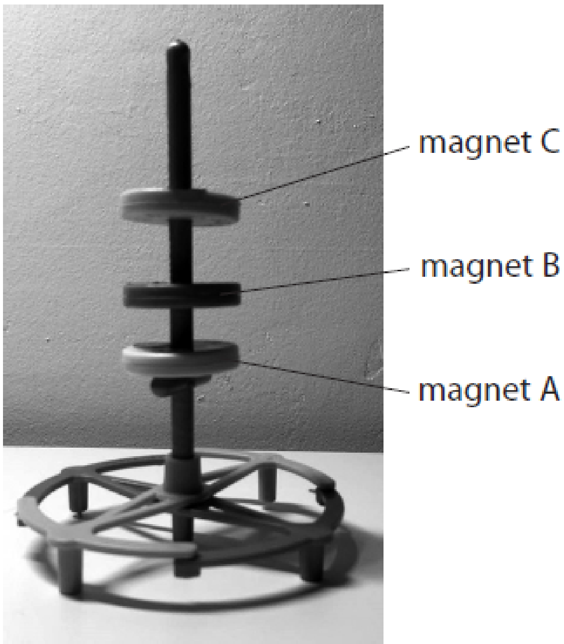
....

....

....

(d) The student removes the masses from magnet B.

He then adds magnet C on to the vertical shaft.



Photograph 2

Photograph 2 shows that when magnet C is added, magnet B moves further down the shaft until it is at rest again.

Explain why the distance between magnet A and magnet B has decreased.

(3)

....

....

....

....

....

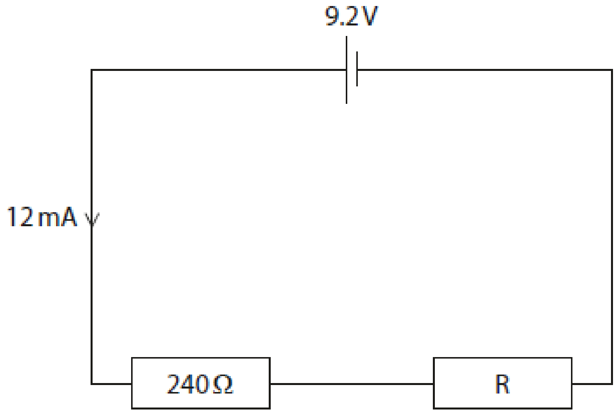
....

(Total for question = 13 marks)

Q4.

This question is about voltage and current.

(a) The diagram shows two resistors connected to a battery.



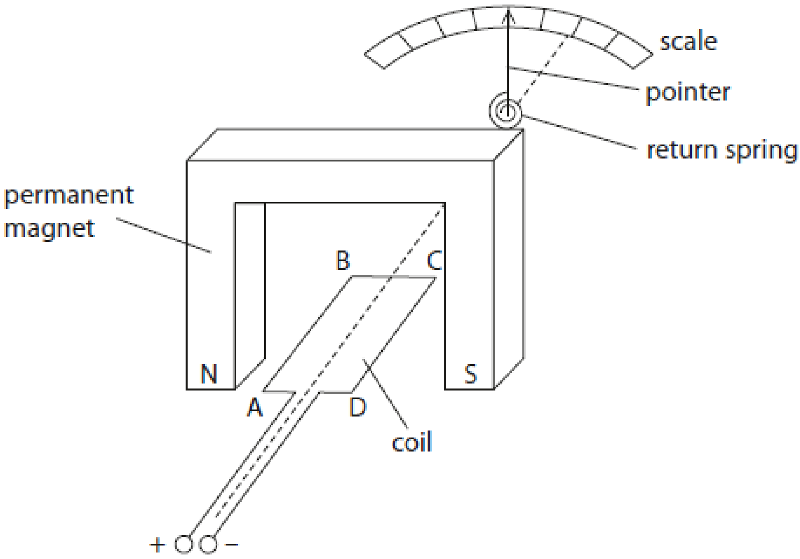
Calculate the voltage across resistor R.

(4)

voltage = ... V

(b) The diagram shows the parts of an ammeter.

The pointer is connected to the coil so they can move together.



(i) Explain what happens when there is a current in the coil.

(3)

....

....

....

....

....

....

(ii) Draw an arrow on the diagram to show the force acting on side CD of the coil when there is a current in the coil.

(1)

(iii) Explain how the ammeter could be changed so that it could measure smaller currents.

(3)

....

....

....

....

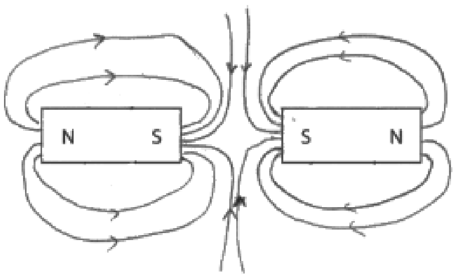
....

....

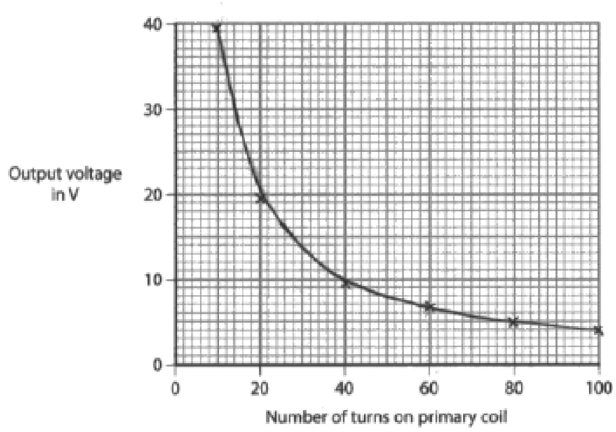
(Total for question = 11 marks)

Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	MP1. method to show shape; e.g. use compass(es) use of iron filings / powder MP2. use of plotting compass **to show direction**; MP3. a further method detail; e.g. move compass / multiple compasses in different positions idea of another line or lines added sprinkle iron filings (on to card) tap card (to distribute iron filings)	all marks may be given from diagram allow if compass seen in diagram pointing in a suitable direction allow equivalent materials to card e.g. paper, plastic etc.	3
(b)	correctly drawn field line patterns for both bar magnets; correctly drawn field line pattern for region between the magnets; at least three field line directions given from north to south;  	should show no lines linking south poles not every line needs to have an arrow reject mark if directions contradict 2 marks max. if any lines overlap condone lines touching	3

Q2.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>(a) (i)</td><td>Points plotted to within half a small square;
<table>
<tr><th>Number of turns on primary coil</th><th>Output voltage in V</th></tr>
<tr><td>10</td><td>39.6</td></tr>
<tr><td>20</td><td>19.7</td></tr>
<tr><td>40</td><td>9.9</td></tr>
<tr><td>60</td><td>6.6</td></tr>
<tr><td>80</td><td>5.0</td></tr>
<tr><td>100</td><td>4.0</td></tr>
</table>


</td><td>Points should lie on a very good curved line.</td><td>1</td></tr>
<tr><td>(ii)</td><td>Best fit line is smooth curve;</td><td>ECF their data points.</td><td>1</td></tr>
</table>

<table>
<tr><td>(iii)</td><td>As number of (primary) turns increases, (secondary) voltage decreases;

At a decreasing rate/is non-linear;</td><td>Allow RA

Allow unqualified ‘inversely proportional’ for 2 marks.

Ignore: ‘negative exponential’</td><td>2</td></tr>
</table>

(b) (i)	$(N_P/N_S) = (V_P/V_S)$;	Allow any correct rearrangment. Allow "i(nput) and o(utput)" or "1 and 2"for "p(rimary) and s(econdary)". Allow correct word equation. Ignore 'P' for 'N' Condone 'T', 't' or 'n' for 'N' Condone 'coils' for 'turns'	1
(ii)	Substitution of values for N_p, V_P and V_s ; Evaluation of N_s ; e.g. $40 / N_s = (6.8/9.9) = 0.686....$; $N_s = 40 / 0.601.. = 58(.2....)$;	Allow any row of data from table or co-ordinates for a point on the line on the graph Accept answer in range 57-60. Accept non-integer number of turns.	2

Q3.

Question number	Answer	Notes	Marks
(a)	one mark for each correct row;;; Energy store in magnet B: gravitational – Decreases ✓; magnetic – Increases ✓; kinetic – Stays the same ✓		3
(b)	downward arrow labelled "weight"; arrow same length as upward force arrow;	ignore gravity allow gravitational force, gravitational pull ignore arrows associated with magnet A judge by eye	2
(c)	any five from: MP1. caliper (to measure distance); MP2. balance (to check mass is 10g); MP3. use of set square to ensure vertical distance; MP4. independent variable identified as the mass added; MP5. dependent variable identified as the distance; MP6. repeat readings and find mean (average); MP7. plot graph of results; MP8. (identify and) remove / ignore anomalies;	allow any marking point if clear from diagram allow ruler, measuring tape allow scales	5

Energy store in magnet B	Increases	Decreases	Stays the same
gravitational		✓	
magnetic	✓		
kinetic			✓

(d)	any three from: MP1. idea of magnet C providing a downward force on magnet B; MP2. idea that total downward force on magnet B is greater (than before); MP3. (creating) resultant downward force on magnet B; MP4. idea that (upward) force of magnet A on magnet B increases (when B moves down the shaft); MP5. (because) idea that decreased distance gives stronger magnetic field (between A and B);	ignore any references to magnets having different strengths allow "B is repelled by C" / eq allow idea that total downward force greater than upward force allow A repels B more strongly	3 Exp
		Total for question 4 = 13 marks	

Q4.

Question number	Answer	Notes	Marks
(a)	use of voltage = current × resistance; calculation of voltage across 240 ohm resistor (2.88 V); idea that voltages of two resistors in series adds up to supply voltage; evaluation of voltage across R; e.g. $V = I \times R$ V_{240} = (0.012 × 240 =) 2.88 (V) $V_R + V_{240} = 9.2$ (V_R =) 6.3 (V)	allow rearrangements and standard symbols calculate total resistance of circuit (767 Ω) evaluation of resistance of R (527 Ω) evaluation of voltage across R (using V = IR) allow 2.9 (V) allow 9.2 – 2.88 or V + 2.88 = 9.2 allow 6.32 (V) if mA not converted to A and 2880 seen then award 2 marks max.	4

(b) (i)	any three from: MP1. coil produces a magnetic field; MP2. (which) interacts with the magnetic field of the (permanent) magnet; MP3. producing a force acting on the coil; MP4. opposite forces on either side of coil; MP5. coil rotates / turns;	allow coil becomes an electromagnet allow one side is pushed up and the other is pushed down allow coil spins, pointer moves (to the left)	3
(ii)	vertical arrow UP (on wire CD);		1
(iii)	any three from: MP1. more turns on the coil; MP2. stronger (permanent) magnet; MP3. add an iron core; MP4. producing a larger force (for the same current); MP5. use of a longer pointer; MP6. use of a weaker return spring; MP7. producing a greater movement at the end of the pointer (for the same current);	allow "more coils" allow method to increase field strength e.g. moving magnets closer together allow producing the same force for a smaller current allow same movement for a smaller current	3