Mark schemes

1. (a) hold thumb first finger and second finger (of left hand) at right angles to each other
allow first two fingers/index and middle for first and second finger throughout

1

second finger represents the current pointing out of the paper

1

first finger represents the field pointing downwards

1

thumb points in the direction of the force / thrust / acceleration

1

(therefore) the rod moves left to right
allow correct description (eg away from the magnet)
dependent on scoring marking point 3 or 4

1

(b) decrease the resistance of the variable resistor
allow increase the current/pd

1

use a stronger magnet
allow use a magnet with a greater flux density

1

(c) F = 0.30 × 1.7 × 0.050

1

F = 0.0255 (N)

1

m = 0.004(0 kg)

1

0.0255 = 0.0040 × a

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

1

a = 0.0255 / 0.0040
or
a = 6.375

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

1

Δv = 6.375 × 0.15 = 0.95625 (m/s)

allow a correct calculation using an incorrectly / not converted m and / or an incorrectly calculated F

allow 0.96 ***or*** *0.956 (m/s)*

1

alternative method

F = 0.30 × 1.7 × 0.050 (1)

F = 0.0255 (N) (1)

m = 0.004(0 kg) (1)

$$0.0255 = \frac{0.0040 \times \Delta v}{0.15} \quad (1)$$

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

$$\Delta v = \frac{0.0255 \times 0.15}{0.0040} \quad (1)$$

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

Δv = 0.95625 (m/s) (1)

allow a correct calculation using an incorrectly / not converted m and / or an incorrectly calculated F

allow 0.96 ***or*** *0.956 (m/s)*

[13]

2. (a) motor (effect)

1

(b) current creates a magnetic field (around the coil)

1

(which) interacts with the permanent magnet field

1

producing a (resultant) force causing the coil/cone to move

1

(when the) direction of the current reverses, the direction of the (resultant) force reverses (producing a sound wave)

allow coil/cone for force allow backwards for reverses

1

(c) the student changed two variables at the same time

allow only one variable should be changed at a time

1

(so) it is not possible to know the effect of each variable

1

[7]

3. (a) any **two** correct lines drawn from the top of the visitor and passing through the lens

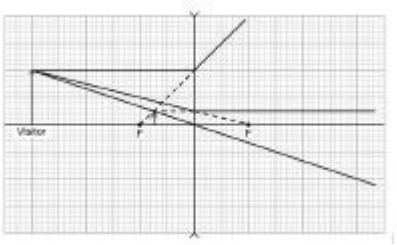
allow construction lines that are not dashed

2

image drawn at the correct position and with the correct orientation

mark only scores if first two marks scored.

*a convex lens diagram scores **0** marks*



1

(b) Decreases

1

(c) Iron

1

(d) there is a current in the solenoid / circuit

allow a charge flows through the solenoid / circuit

1

creating a magnetic field

allow the solenoid / coil is magnetised

1

attracting the bolt

1

(e) 1.50 cm = 0.015 m

1

2.88 = k × 0.015

this mark may be awarded if distance is incorrectly/not converted

1

k = 2.88 / 0.015

this mark may be awarded if distance is incorrectly/not converted

1

k = 192 (N/m)

allow a correctly calculated answer using an incorrectly/not converted distance

1

(f) Any **two** from:

- increase the current (in the solenoid / circuit)
  *allow any sensible suggestion for increasing the current such as increasing the p.d. / power of the battery **OR** using lower resistance wire in the solenoid*
- add more turns to the solenoid
  *do **not** allow increase the number of coils*
- use a spring with a lower spring constant
  allow use a weaker spring

2

[14]

4. (a) to vary the (output) potential difference

allow different devices require different potential differences

1

so that you don't need a different generator for each type of device

allow so that it is compatible with different devices

*do **not** allow answers in terms of power*

1

(b)

$$\frac{1.5}{5.0} = \frac{150}{N_s}$$

1

$$Ns = \frac{150}{0.3}$$

1

Ns = 500

1

(c) the coil moves through the magnetic field

or

the coil cuts magnetic field lines

1

a potential difference is induced (across the coil)

1

there is a complete circuit, so a current is induced (in the coil)

1

every half turn the potential difference reverses direction

1

so (every half turn) the current changes direction

1

(d) provides a continuous / moveable contact / connection (between the coil and the transformer / contacts / brushes)

or

stops the wires from twisting together

1

(e) (after disconnection) there is no induced current

1

so no magnetic field (produced around / by the coil)

1

to oppose the movement of the coil

1

[14]

5. (a) chicken

allow a correct answer indicated in Table 3 provided the answer space in blank

1

(b) 2×10^{-6}

1

(c)

*an answer 0.025 (m) scores **4** marks*

time = 8μs = 8 × 10−6 (s)
or
4 × their answer to part (b)

subsequent marks may be scored if the number of squares is miscounted or t = 2μs is used

1

distance = ½ × 6300 × 8 × 10−6

allow 8 × 103 or 8 × 10^{-3} or 8 × 10^{-9} for 8 × 10^{-6}

1

distance = 0.0252 (m)

allow a correctly calculated answer using 8 × 103 or 8 × 10−3 or 8 × 10−9

1

distance = 0.025 (m)

allow a calculated value correctly rounded to 2 sig figs
*an answer 0.050 (m) scores **3** marks*
*an answer 0.05 or 0.0504 (m) scores **2** marks*

1

(d) to convert (the pressure variations in) sound (waves) into variations in current / p.d

allow electrical signal for variations in current / p.d.
*do **not** accept amplifies sound*

1

(e) sound (waves) cause the diaphragm to vibrate

diaphragm moves is insufficient

1

the diaphragm causes the coil / wire to vibrate

*do **not** accept moves the coil / wire up and down*
*if m.p.1 and m.p.2 do not score, allow sound (waves) cause the coil / wire to vibrate for **1** mark*

1

the coil / wire moves through the magnetic field
or
the coil / wire cuts magnetic field lines

1

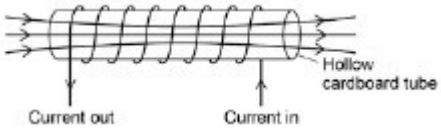
a potential difference is induced (across the ends of the coil / wire)

allow induced current for induced p.d.

1

[11]

6. (a) field lines going in, (through) and out of the solenoid



allow field lines only visible outside the cardboard tube

allow a bar magnet shaped field with lines above and below the solenoid

1

arrow(s) in correct direction

1

(b) the rods become (induced) magnets

allow the rods are (temporarily) magnetised
ignore rods repel
*do **not** accept rods become charged*

1

with the same polarity (at each end)

1

(c) changed two (independent) variables (at the same time)

allow need to keep current or number of turns constant

allow should only change one variable (at a time)

allow current and number of turns both changed
ignore fair test

1

so it is not possible to know the effect of one (independent) variable or the other

1

(d) (increasing the current) increases the strength until the strength reaches a maximum value

allow weight (held) for strength of electromagnet
ignore a given current value for when maximum strength happens

1

(e) increasing the number of turns from 10 to 20 increases the strength more than increasing from 20 to 30

a general trend is required

1

[8]

7. (a) P-waves are longitudinal and
S-waves are transverse

1

(b) 0.4

1

(c) wave speed = frequency × wavelength

allow $v = f\lambda$

1

(d) 7200 = 0.4 × wavelength

1

$$\text{wavelength} = \frac{7200}{0.4}$$

1

wavelength = 18 000 (m)

allow up to full marks for ecf using their answer to part ***(b)***

a method shown as
7200 × 2.5 = 18 000
scores ***0*** *marks*

1

an answer 18 000 scores ***3*** *marks*

(e) because S-waves cannot travel through a liquid

1

and S-waves do not travel through the (outer) core

allow some (seismic) waves cannot travel through a liquid and do not go through the core for ***1*** *mark*

1

(f) magnetic field around the coil changes
or
the magnetic field (lines) cut by the coil

allow the generator effect

1

(g) because the magnet changes direction

1

(h) stationary

1

(i) any **two** from:

- stronger magnetic field
  allow stronger magnet
  allow heavier magnet
  bigger magnet is insufficient

- more turns on the coil
  bigger coil is insufficient
  *do **not** accept more coils of wire*

- turns pushed closer together

- spring with a lower spring constant
  allow less stiff spring
  allow weaker spring
  *do **not** accept add an iron core*

2

[13]

8. (a) any **one** from:

- too few turns / coils on the secondary
  allow number of turns / coils on the primary was increased

- p.d. across the primary was reduced
  ignore human error

1

(b) the p.d. (across the secondary) goes above 2V
allow p.d. across secondary is higher than p.d. across primary after 20 turns

1

(c) it increases (until the nails reach a constant temperature)

1

(d) $\frac{640}{4} = \frac{V_p}{1.75}$ **1**

$V_p = \frac{640 \times 1.75}{4}$ **1**

Vp = 280 (V) **1**

280 × Ip = 336

allow their calculated
Vp × Ip = 336 **1**

Ip = 1.2 (A)

allow an answer that is consistent with their calculated value of Vp **1**

or

336 = Is × 1.75 (1)

$I_s = \frac{336}{1.75}$ (1)

Is = 192 (A) (1)

$I_p = 192 \times \frac{4}{640}$ (1)

allow

I_p = *their calculated* $I_s \times \frac{4}{640}$

Ip = 1.2 (A) (1)

allow an answer that is consistent with their calculated value of Is
*an answer of 1.2 (A) scores **5** marks*

[8]

9. (a) at least three circles drawn **1**

clockwise arrows on circles

*allow **1** mark for one or two circles with clockwise arrows* **1**

(b) 4×10^{-6} **1**

(c) the sides of the coil (parallel to the magnet) experience a force (in opposite directions)

allow the current creates a magnetic field
ignore Fleming's Left Hand Rule

1

the forces cause moments that act in the same (clockwise / anticlockwise) direction
or
the moments cause the coil to rotate (clockwise / anticlockwise)

allow the magnetic fields interact to create a pair of forces (acting in opposite directions)
or
allow the magnetic fields interact causing the coil to rotate

1

(each half-revolution) the two halves of the (rotating) commutator swap from one (carbon) brush to the other

1

(each half-revolution) the commutator reverses the current (in the coil)
or
keeping the forces in the same direction (keeping the coil rotating)

allow keeps the current in the same direction relative to the (permanent) magnetic field

1

[7]

10. (a) It is easily magnetised.

1

(b) p.d. across the secondary coil is smaller (than p.d. across the primary coil)

1

(c) ratio $\frac{Vp}{Vs} = \frac{6}{12}$

accept any other correct ratio taken from the graph

1

$\frac{6}{12} = \frac{50}{Np}$

use of the correct turns ratio and substitution or correct transformation and substitution

1

Np = 100

*allow 100 with no working shown for **3** marks*

1

[5]

11. (a) motor effect

1

(b) increase the strength of the magnet

or

increase the current

1

(c) $4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$

1

$F = 6 \times 10^{-3}$ (N)

1

$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$

1

$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$

1

B = 8 × 10−2 or 0.08

1

allow 8 × 10−2 ***or*** *0.08 with no working shown for* ***5*** *marks*

a correct method with correct calculation using an incorrect value of F gains ***3*** *marks*

Tesla

accept T

1

do not accept t

[8]

12. (a) in a longitudinal wave the oscillations / vibrations are parallel to the direction of energy transfer.

accept wave travel for energy transfer throughout

1

in a transverse wave the oscillations / vibrations are perpendicular to the direction of energy transfer.

1

(b) accept any sensible suggestion eg a vibrating drum skin does not move the air away to create a vacuum (around the drum)

1

(c) **Level 3 (5–6 marks):**
A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.

Level 2 (3–4 marks):
A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.

Level 1 (1–2 marks):
Some relevant points but fragmented with no logical structure.

0 marks:
No relevant content.

Indicative content

the current in the electrical circuit is varying

the current passes through the coil

the coil experiences a force (inwards or outwards)

reversing the current reverses the force

the size of the current affects the size of the force

the varying current causes the coil to vibrate

the (vibrating) coil causes the cone to vibrate

the vibrating cone causes the air molecules to move

the movement of the air molecules produces the pressure variations in the air needed for a sound wave
the air molecules bunch together forming compressions and spread apart forming rarefactions

6

[9]