Exam Index Number	

Anglo-Chinese School (Barker Road)

PRELIMINARY EXAMINATION 2017

SECONDARY FOUR EXPRESS

PHYSICS 5059/01
(PAPER 1 Multiple Choice)

TIME: 1 HOUR

READ THESE INSTRUCTIONS FIRST

Write your Exam Index Number in the box provided at the top of this page and any separate answers paper provided.
Write in soft pencil.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

This question paper consists of **21** printed pages

1 A vernier caliper is used to measure the diameter of a ball-bearing.
Diagram 1 shows the reading when the vernier caliper is closed.
Diagram 2 shows the reading when the ball-bearing is placed between the jaws.

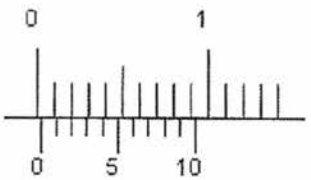


Diagram 1

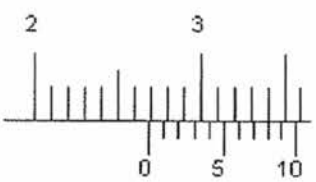


Diagram 2

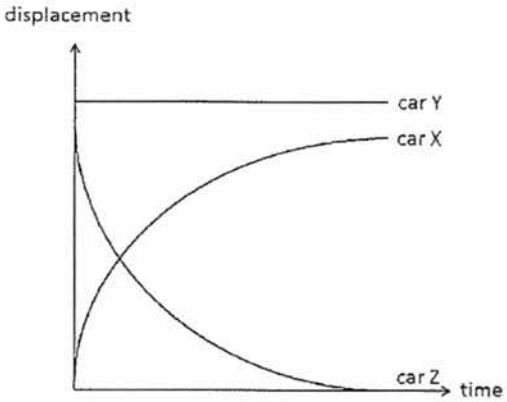
What is the diameter of the ball bearing?

A 2.48 cm
B 2.66 cm
C 2.68 cm
D 2.88 cm

2 Which has two vector quantities?

A acceleration and weight
B density and kinetic energy
C force and power
D pressure and volume

3 The graph shows how displacement varies with time for three cars X, Y and Z.



Which row describes cars X, Y and Z correctly?

	car X	car Y	car Z
A	decreasing speed	constant speed	moving in the same direction as car X
B	decreasing speed	not moving	moving in the opposite direction to car X
C	increasing speed	constant speed	moving in the opposite direction to car X
D	increasing speed	not moving	moving in the same direction as car X

4 An athlete participates in a 200 m race. In the first 10 seconds, he increases his speed from rest with a uniform acceleration of 1.0 m/s^2. Thereafter, he maintains his speed and completes the remaining distance.

What is the time he took for the entire race?

A 15 s

B 25 s

C 30 s

D 35 s

5 An object released from the top of building falls through the air with terminal velocity.

How many statement(s) is/are correct as the book continues to fall?

- The air resistance acting on the book will increase.
- The book will undergo uniform acceleration.
- The book will increase in velocity.
- The forces acting on the book are balanced.

A 1

B 2

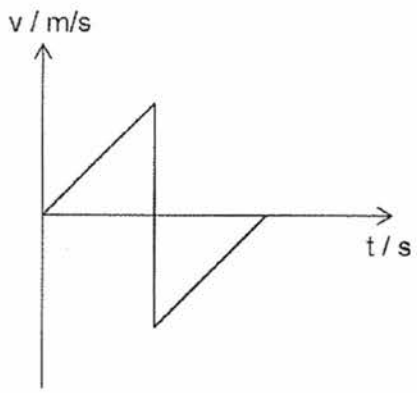
C 3

D 4

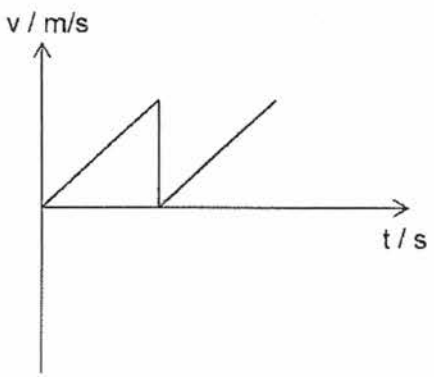
6 A ball rebounds after being dropped from a height.

Assuming that no energy is lost during its impact with the ground and air resistance is negligible, which graph best describes the motion of the ball from the time it rebounds?

A



B



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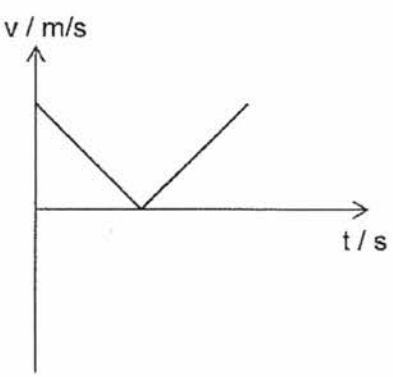
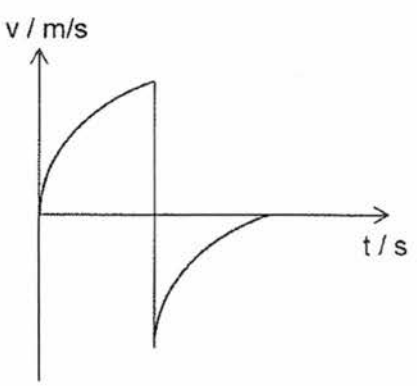


D



7 Which statement is correct?

A 1 kg of iron is heavier than 1 kg of air.

B Mass and weight for matter can both be zero.

C Gravitational field is a region in which a mass experiences a force due to gravitational attraction or repulsion.

D Gravitational field strength is the gravitational force acting per unit mass.

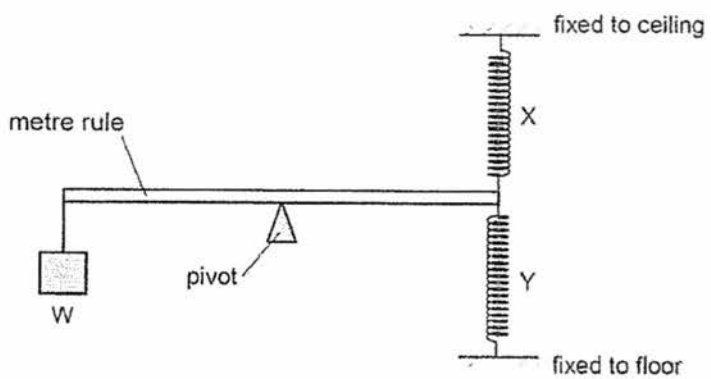
8 An alloy is made from two metals A and B.

The mass of metals A and B are 14 g and 23.5 g respectively.
The volume of metal A is 1.1 cm^3 and the alloy has a density of 15 g/cm^3.

What is the volume of metal B?

A 0.8 cm^3
B 1.4 cm^3
C 2.2 cm^3
D 2.5 cm^3

9 The diagram shows two stretched springs X and Y being attached to one end of a metre rule. A weight W is hung from the other end.



The weight W is now moved gradually towards the pivot.

How does the extension of each spring change?

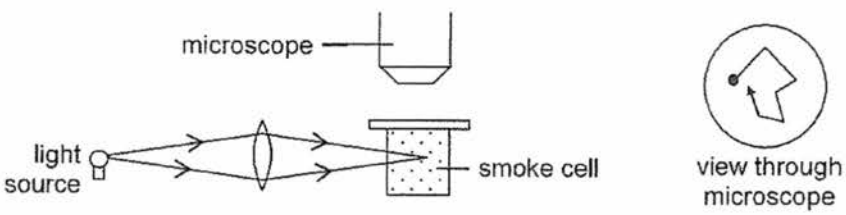
	X	Y
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

10 Four persons climbed up four different staircases. Their weights, vertical heights of the staircases and times are recorded in the table.

Which person develops the least power?

	weight / N	height / m	time / s
A	590	13	7
B	720	9	6
C	850	11	8
D	940	6	5

11 The diagram shows a light source illuminating smoke particles in air. When observed with a microscope, moving points of light are seen.



What are these moving points of light?

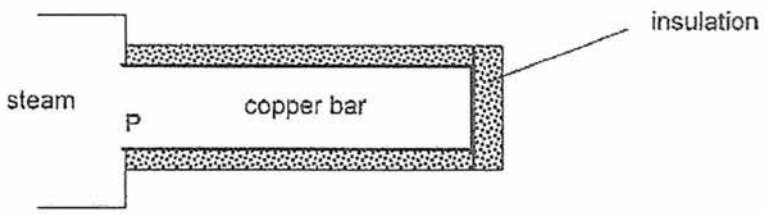
A Reflected light from smoke particles that move due to convection.

B Reflected light from smoke and air particles that move randomly.

C Reflected light from air molecules, colliding with smoke particles.

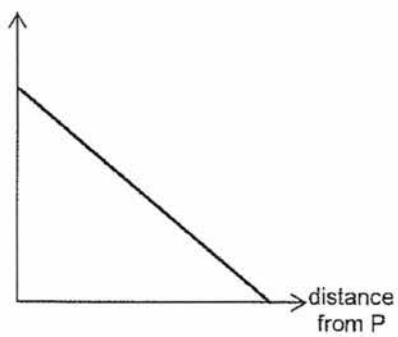
D Reflected light from smoke particles, colliding with air molecules.

12 The diagram shows a cylindrical copper bar with one end, **P**, in contact with a continuous supply of steam. The sides and the other end of the bar are well-insulated as shown in the diagram.

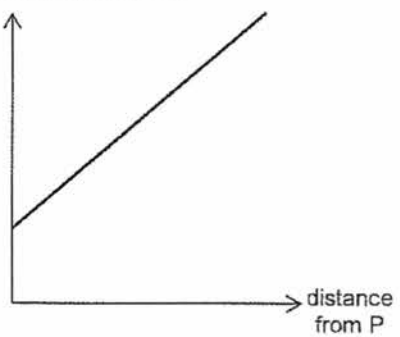


How does the temperature of the bar vary with the distance from point **P** after several hours?

A



B



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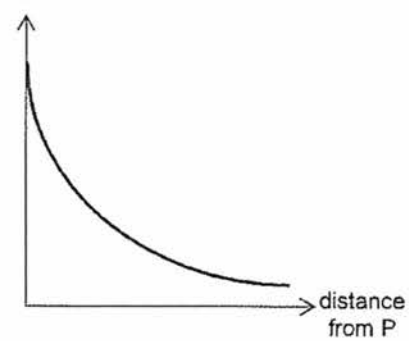
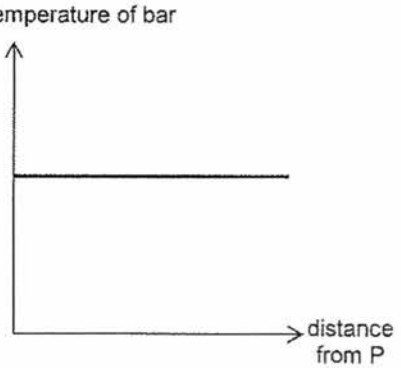


D

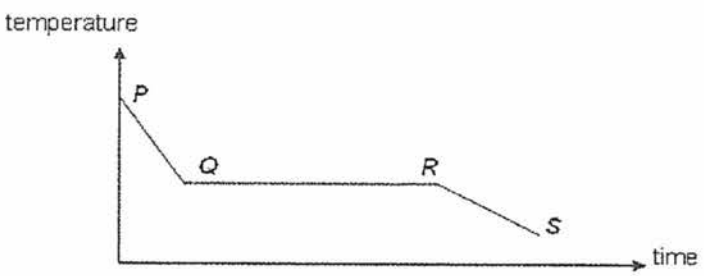


13 The resistance of a wire is 1.00 Ω at ice point and 1.40 Ω at steam point.

What is the resistance of the wire at 200 °C?

A 1.80 Ω
B 1.96 Ω
C 2.00 Ω
D 2.80 Ω

14 The graph shows how the temperature of a sample of molten wax changes as it cools.



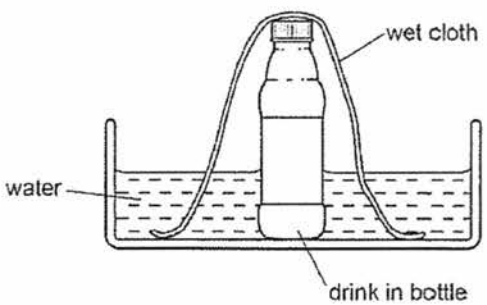
Which statement is correct?

A From P to Q, the molecules lose internal energy and molecules move more slowly.
B From Q to R, latent heat is given out to the surroundings and intermolecular forces of attraction decrease.
C From Q to R, the molecules come closer together and internal energy increases.
D From R to S, latent heat is given out to the surroundings and intermolecular forces of attraction increases.

15 Which of the following correctly shows the changes to the potential energy and the kinetic energy of the molecules of a liquid as it boils?

	potential energy	kinetic energy
A	decreases	increases
B	increases	stays the same
C	stays the same	decreases
D	stays the same	increases

16 The diagram shows a drink in a bottle placed in a bowl of water on a hot day.



The drink is kept cool by placing a wet cloth over it.

Which statement correctly explains why the drink is kept cool?

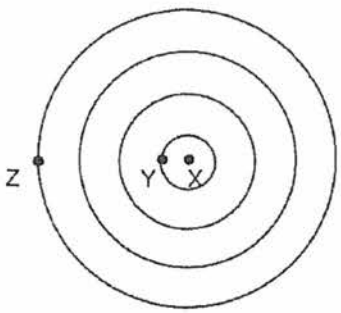
A Hot air cannot escape from the bottle.

B The cloth conducts heat from the bottle into the water.

C The drink cannot evaporate from the bottle.

D Water evaporating from the cloth cools the drink.

17 The diagram shows circular wavefronts moving from X to Z.



(diagram not drawn to scale)

The distance between Y and Z is 1.2 m and the frequency of the dipper at X is set at 15 Hz.

What is the speed of the wave?

A 4.5 m/s

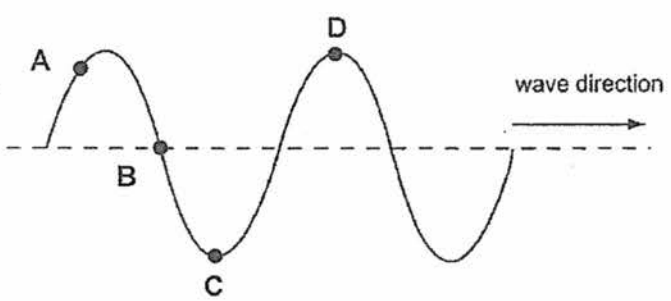
B 6.0 m/s

C 12.5 m/s

D 18.0 m/s

18 The diagram shows a water wave moving in the direction shown.

At which point is the water moving upwards with maximum speed?



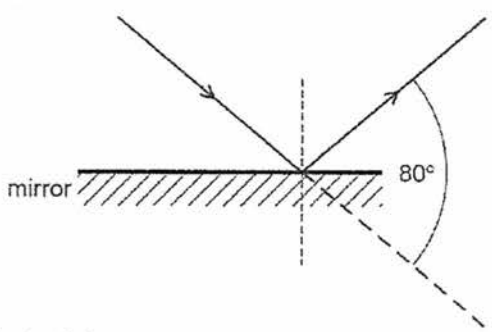
19 A student makes five statements.

- All electromagnetic waves can travel in a vacuum.
- All waves obey the laws of reflection but some waves do not obey the laws of refraction.
- Sound is a longitudinal wave which travels in a direction parallel to the direction of vibrations.
- The distance between 3 consecutive crests of a transverse wave is equal to 3 wavelengths.
- Transverse waves transfer energy by transferring matter but longitudinal waves transfer energy without transferring matter.

How many statements is/are **not** correct?

A 1
B 2
C 3
D 4

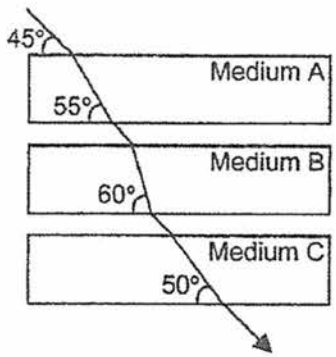
20 The diagram shows a ray of light reflecting off a mirror.



What is the angle the light ray turns through?

A 40°
B 50°
C 80°
D 130°

21 The diagram shows a ray of light passing through three transparent media, A, B and C.



(diagram not to scale)

Which statement is correct?

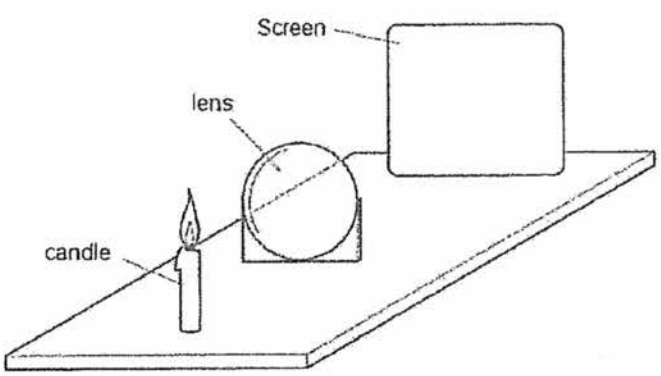
A Medium B has a lower refractive index than medium C.

B Medium B has the smallest refractive index.

C Light travels slower in medium A than in medium C.

D Light travels the fastest in medium A.

22 The diagram shows a thin converging lens placed in between a candle and a screen.



Various focussed images of the candle are produced on the screen by moving the lens and the screen backwards and forwards.

Which statement is correct?

A The image is bigger than the object.

B The image is closer to the lens than the object is.

C The image is formed at the focal point of the lens.

D The image is inverted.

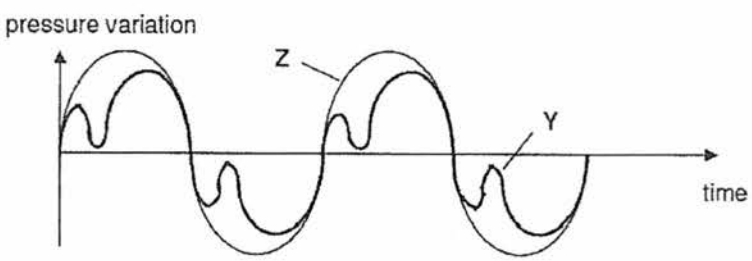
23 Which of the following is arranged in order of decreasing wavelength?

A microwaves, X-rays, visible light
B radio waves, ultraviolet rays, infra-red radiation
C radio waves, visible light, gamma rays
D ultraviolet rays, visible light, infra-red radiation

24 Which electromagnetic wave can cause structural damage to living cells and tissue?

A infra-red radiation
B microwaves
C radiowaves
D ultra-violet radiation

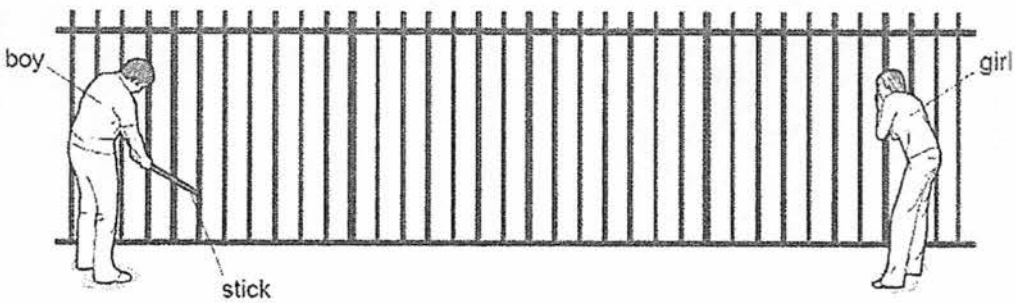
25 The diagram shows waveforms produced by a flute (Y) and turning fork (Z) played by two students.



How does the loudness and pitch of the sound from the turning fork Z compare to flute Y?

A The loudness of Y is lower but has the same pitch as compared to Z.
B Both Y and Z have the same pitch and loudness.
C The loudness of Y is higher and the pitch is lower as compared to Z.
D The loudness of Y is the same and the pitch is higher as compared to Z.

26 A boy strikes a rigid metal fence with a stick. A girl listens with her ear against the fence. One second after the fence is struck, the girl hears a sound through the air.



How long will it take for the girl to hear a sound through the fence?

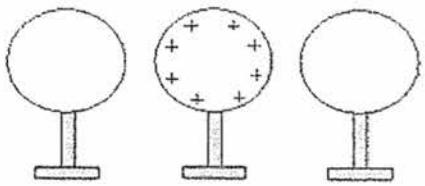
A less than 1 second

B 1 second

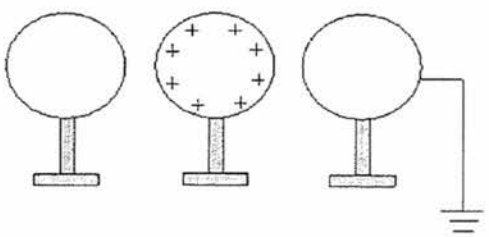
C more than 1 second

D sound cannot travel through the fence

27 The diagram shows a positively charged metal sphere placed between two uncharged metal spheres.

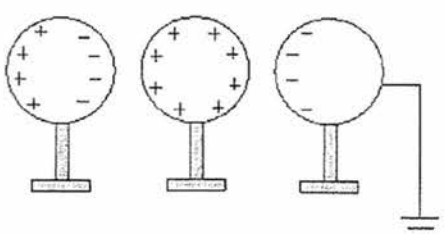


The sphere on the right is now earthed.

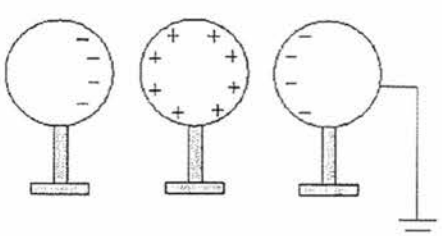


Which diagram correctly shows how the charges are distributed on the spheres?

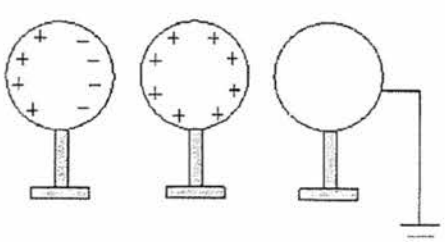
A



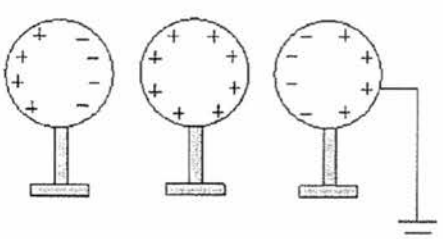
B



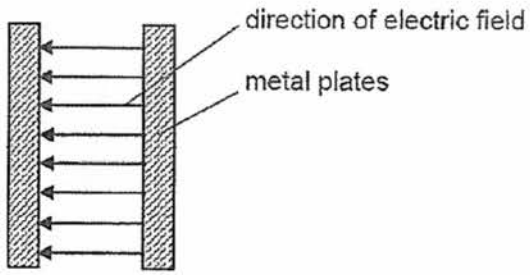
C



D



28 The diagram shows the electric field produced by two metal plates which are connected to an electrical supply.

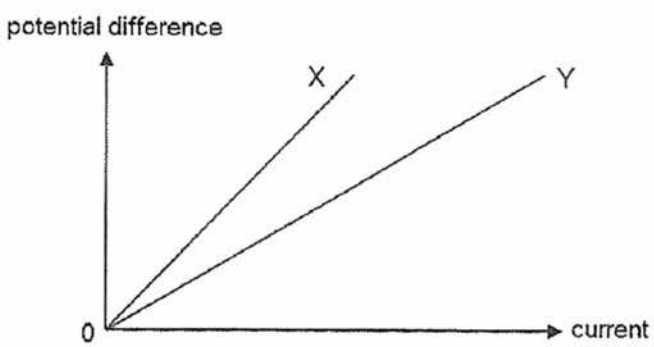


A small negative charge is placed in the gap between the two plates.

What is the direction of the force exerted by the electric field on the negative charge?

A down
B left
C right
D up

29 The diagram shows how the potential difference varies with current for two wires X and Y.

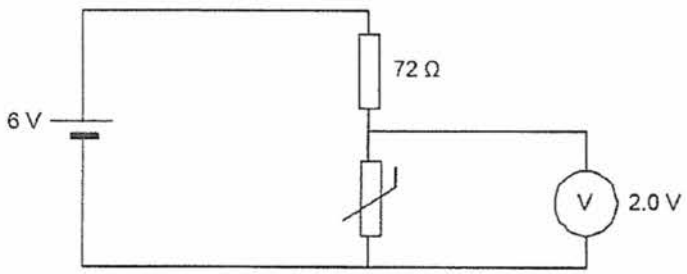


Both wires have the same length and cross-sectional area.

Which statement is correct?

A A higher current flows through X than Y, if the same p.d is applied across them.
B Both X and Y do not obey Ohm's Law.
C The resistivity of X is greater than Y.
D Y has a greater resistance than X.

30 The diagram shows a thermistor connected in series with a 72 Ω resistor connected across a 6 V power supply. When the temperature of the thermistor is 20°C, the potential difference across it is 2.0 V.



What is the resistance of the thermistor when the temperature is 20°C?

A 36 Ω

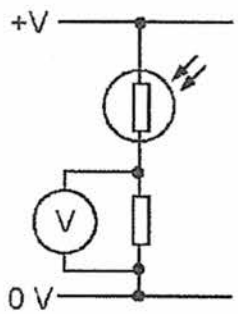
B 48 Ω

C 108 Ω

D 144 Ω

31 In which circuit does the voltmeter reading decrease when light shines on the light dependent resistor?

A



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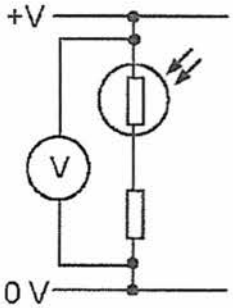

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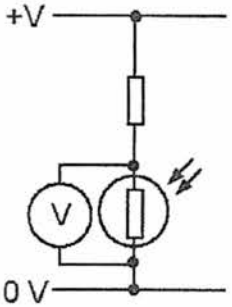

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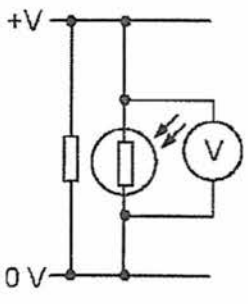


32 Four electric heaters are connected in parallel to the same power supply source. The resistances of the four heaters and the amount of time it was used are shown in the table.

Which heater consumed the most electrical energy?

	resistance / Ω	time / s
A	17.6	221
B	18.8	242
C	19.4	230
D	20.3	253

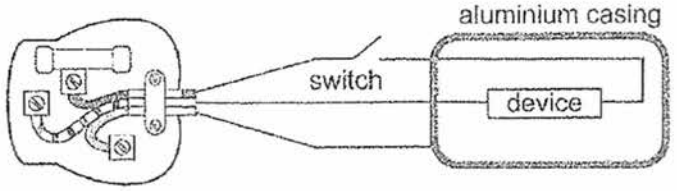
33 A 1.9 kW vacuum cleaner and a 200 W television is connected in parallel to a 240 V mains.

Which will be a suitable fuse rating for the mains?

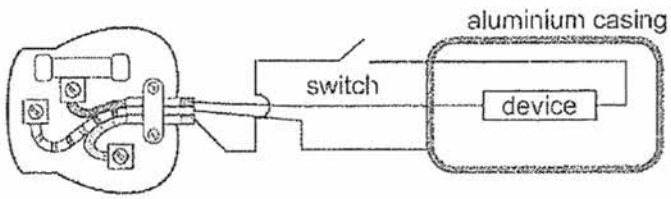
A 7 A
B 8 A
C 9 A
D 10 A

34 Which device is correctly wired to a three-pin plug?

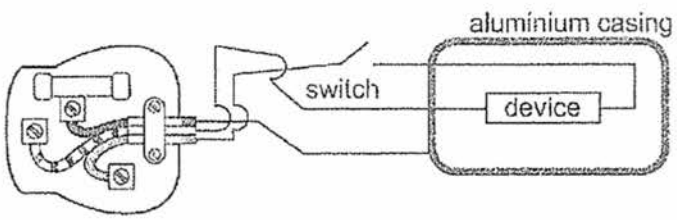
A



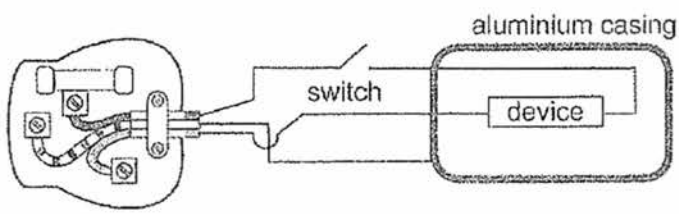
B



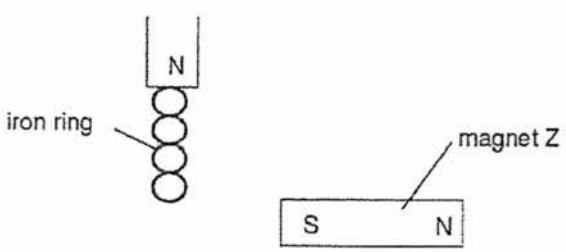
C



D



35 The diagram shows a strong magnet with four small iron rings attracted to it.



A weak magnet, Z, is brought near to the end of the lowest ring.

What will happen to the chain of iron rings?

A It will bend away from Z.

B It will bend towards Z.

C It will fall to the ground.

D It will remain still.

36 A student makes three statements on magnetism.

(i) A freely suspended magnet always points in a North-South direction.
(ii) A compass is a temporary magnet.
(iii) Electrical method of magnetisation will always produce permanent magnets

Which statement(s) is/are correct?

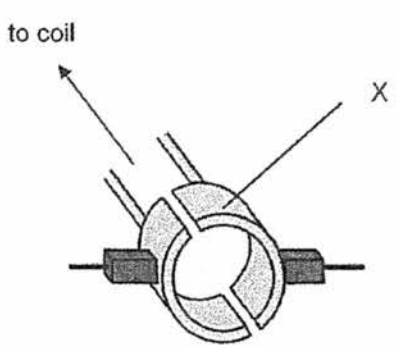
A (i) only
B (i) and (iii) only
C (ii) only
D (i), (ii) and (iii)

37 The diagram shows a beam of electrons moving in the direction shown.

What will happen to the beam of electrons as they enter into a magnetic field that goes into the plane of the paper?

A continue moving in the same direction and accelerates
B continue moving in the same direction and decelerates
C deflect downwards
D deflect upwards

38 The diagram shows part of a d.c. motor.

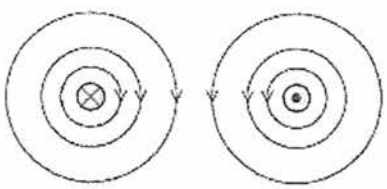


What is the function of X?

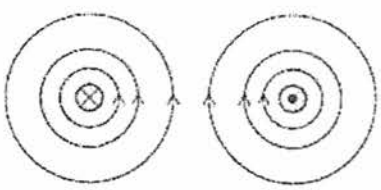
A to control the speed of rotation
B to provide a magnetic field
C to reverse the direction of current in the coil every half a revolution
D all of the above

39 Which diagram shows the correct magnetic field around two parallel wires carrying a current?

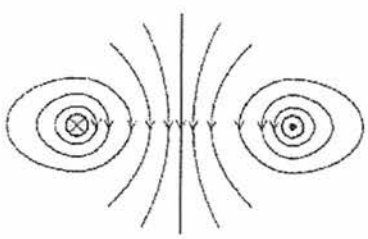
A



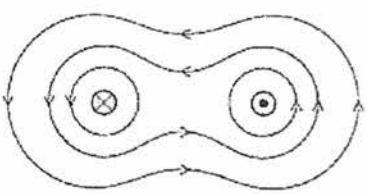
B



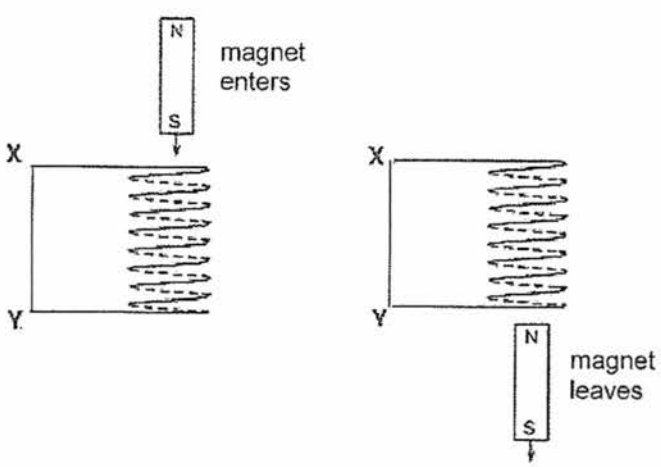
C



D



40 The diagrams below show the set-up for which a short bar magnet is dropped through a coil of wire.



Which of the following correctly indicates the direction of the induced current between X and Y?

	as magnet enters the coil	as magnet leaves the coil
A	X to Y	X to Y
B	X to Y	Y to X
C	Y to X	X to Y
D	Y to X	Y to X

Exam Index Number	

Anglo-Chinese School (Barker Road)

PRELIMINARY EXAMINATION 2017

SECONDARY FOUR EXPRESS

PHYSICS 5059
(PAPER 2 Theory)

TIME: 1 HOUR 45 MINUTES

READ THESE INSTRUCTIONS FIRST

Write your Exam Index Number in the box provided at the top of this page and any separate answer paper provided.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.

Section A
Answer **all** questions.

Section B
Answer **all** questions.
Question 11 has a choice of parts to answer.

Candidates are reminded that all qualitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
PAPER 1	/40
PAPER 2	
Section A	/50
Section B	/30
Total	/80

This question paper consists of 23 printed pages

Section A
Answer **all** the questions in this section.

1 Fig. 1.1 shows an acrobat walking a tight rope.

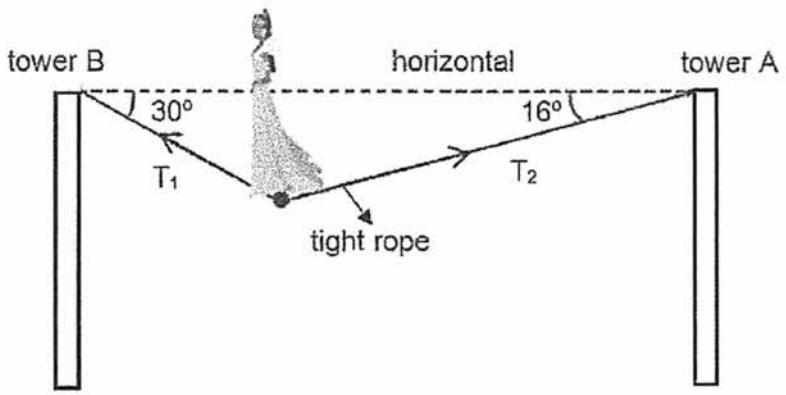


Fig. 1.1

The acrobat is at rest at the position shown in Fig. 1.1.
The tensions T_1 and T_2 in the rope are 600 N and 540 N respectively.

(a) (i) In the space below, draw a labelled diagram to show the resultant of the two tensions.

Determine the size of the resultant force and the direction between the resultant force and the horizontal.

resultant force = ...

direction : .....[3]

(ii) Determine the weight of the acrobat.

weight = ...[1]

(b) A second acrobat of mass 65 kg stationed at tower B jumps vertically upwards with a force of 2000 N.

The gravitational field strength is 10 N/kg.

(i) Calculate the initial acceleration of the second acrobat.

acceleration = ...[2]

(ii) On Fig. 1.2, sketch a velocity-time graph of the second acrobat from the instant she jumped upwards to the instant she lands back on tower B.

Neglect air resistance in your sketch.

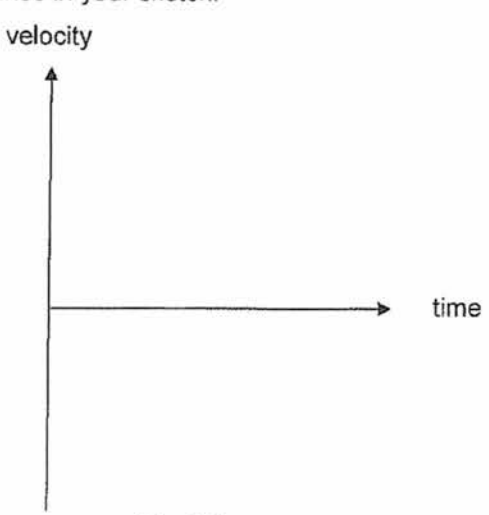


Fig 1.2

[1]

2 Fig. 2.1 shows a uniform oval disc freely pivoted at **P**. The bottom of the disc is pulled to the right by the tension in the thread **ST**.

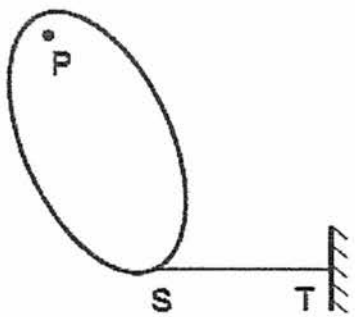


Fig. 2.1

(a) On Fig. 2.1, draw an arrow to represent

(i) the weight of the disc, marking out the position of the centre of gravity of the disc with a cross, X, [1]

(ii) the force exerted by the thread on the disc and label it as F_1, [1]

(iii) the force exerted by the pivot on the disc and label it as F_2. [1]

(b) Describe and explain what happens to the disc when the string **ST** is cut.

.....

.....

.....[2]

3 **Fig. 3.1** shows a simplified structure of a tidal generator used to generate electricity.

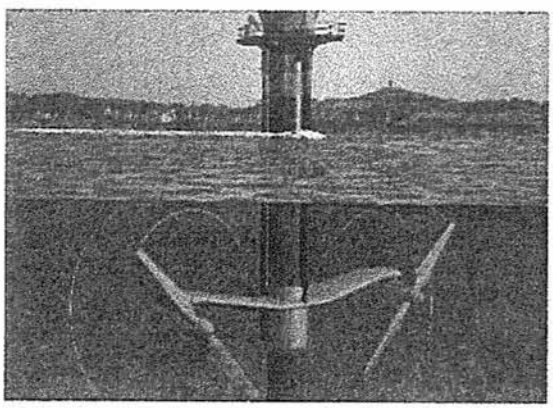


Fig. 3.1

(a) **(i)** State the Principle of Conservation of Energy.

.....

.....[1]

(ii) The total kinetic energy provided by tidal currents acting in a second is 111 240 J.

The efficiency of the tidal generator is 77%.

Calculate the energy output of the tidal generator in 10 min.

output = ...[2]

(iii) Give a reason why the efficiency of the tidal generator is not 100%.

.....

.....[1]

(b) Both wind turbines and tidal turbines are potentially eco-friendly and inexpensive sources of renewable energy.

State one advantage of tidal turbines as compared to wind turbines.

.....

.....[1]

4 Fig. 4.1 shows a solar heating system.

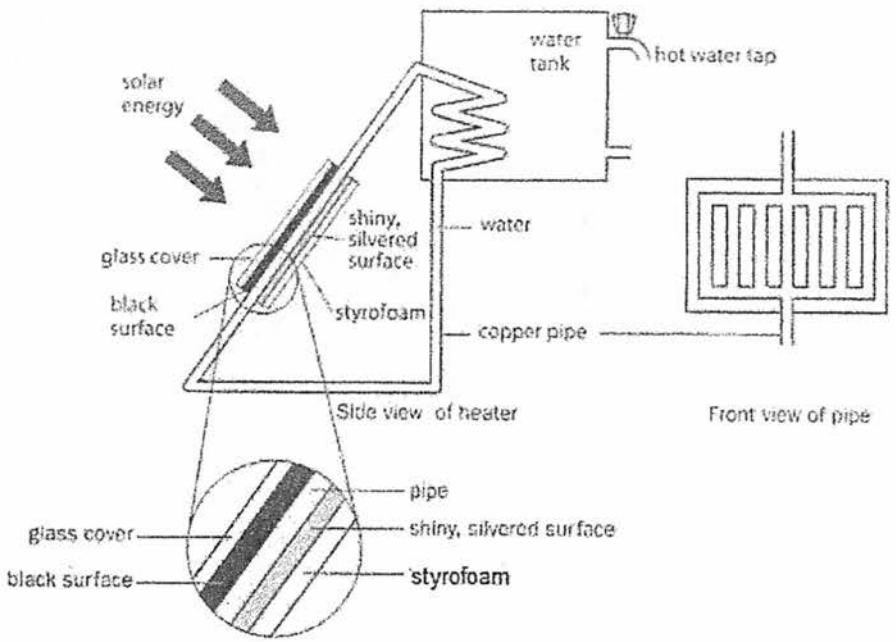


Fig. 4.1

(a) Explain how the sun causes the water in the tank to heat up.

.....

.....

.....

.....

.....

.....[4]

(b) Explain the purpose of the styrofoam.

.....

.....[1]

(c) Suggest one modification that can heat up the water at a greater rate and explain why.

.....

.....[2]

5. Fig. 5.1 shows a setup using ultrasound to detect flaws in welding. A pulse sent by the transmitter reflects from the other end of the metal into the receiver. Fig. 5.2 shows one normal C.R.O. signal display and two abnormal displays. The speed of ultrasound through the piece of metal is 3200 m/s.

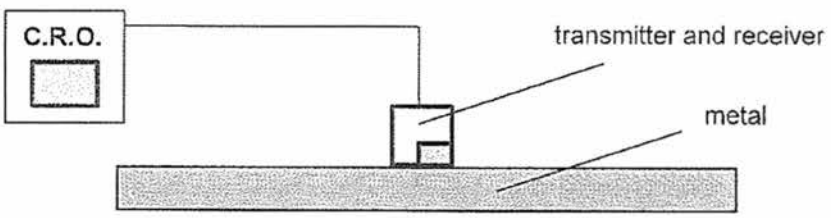


Fig. 5.1

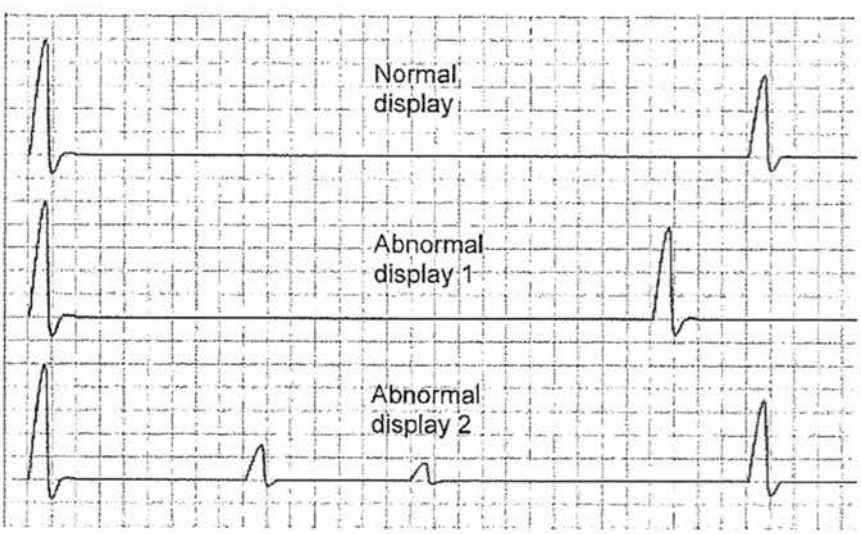


Fig. 5.2

(a) For the normal display, the time interval between the transmitted and received pulse is 30×10^{-6} s.

Calculate the thickness of the piece of metal.

thickness = ...[1]

(b) Suggest a possible reason for the abnormalities in

display 1,

.....

.....[1]

display 2.

.....

.....[1]

(c) Explain why a received pulse will have a lower amplitude than the transmitted pulse.

.....[1]

(d) Electromagnetic waves can also be used to detect flaws in welding.

(i) State one electromagnetic wave that is used.

..... [1]

(ii) Explain how the use of electromagnetic waves is different from ultrasound waves in detecting flaws.

.....

.....[1]

6 Fig. 6.1 shows the print head for an inkjet printer. The inkjet from the ink gun is charged before it is ejected downwards.

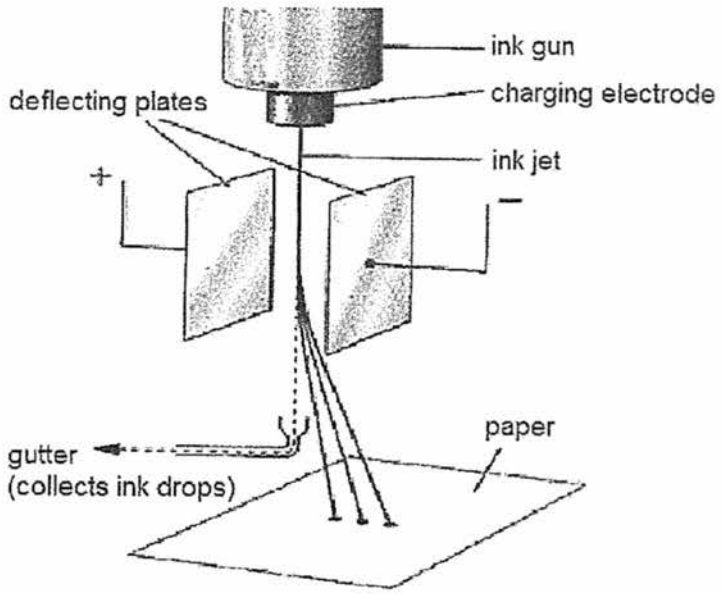


Fig. 6.1

(a) State the type of charge on the inkjet and explain your answer.

.....

.....[1]

(b) Explain why the ink particles form an even layer of coating on the paper.

.....

.....[1]

(c) Predict if an even layer of coating on the paper is more likely to be achieved by a printer in an air-conditioned room compared to a non air-conditioned room.

.....

.....

.....[2]

(d) The deflecting plates are maintained at a potential difference of 20 V. A charge of 1.5 μC is passed between the plates every second.

(i) State what is meant by potential difference.

.....

.....[1]

(ii) State the electric current passing through the plates.

current = ...[1]

(iii) Calculate the energy consumed by the plates in one minute.

energy =.....[2]

7 A magnetic relay uses a small circuit to control a larger circuit. Fig. 7.1 shows a simple magnetic relay, together with three contacts X, Y and Z, used to control the operation of two lamps L_1 and L_2.

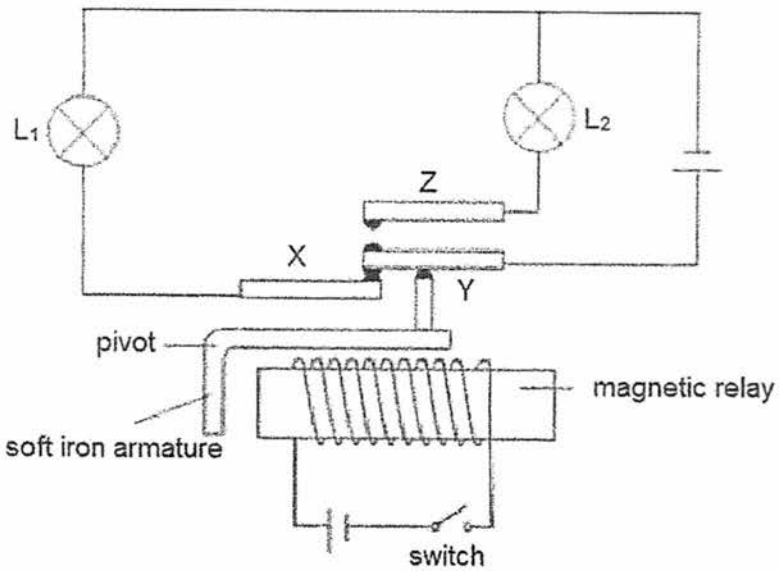


Fig 7.1

The switch is closed.

(a) On Fig. 7.1, draw the magnetic field around the magnetic relay. [2]

(b) Describe the changes that occur in L_1 and L_2.

.....

.....

.....

.....[3]

8 Fig. 8.1 shows an a.c. generator.

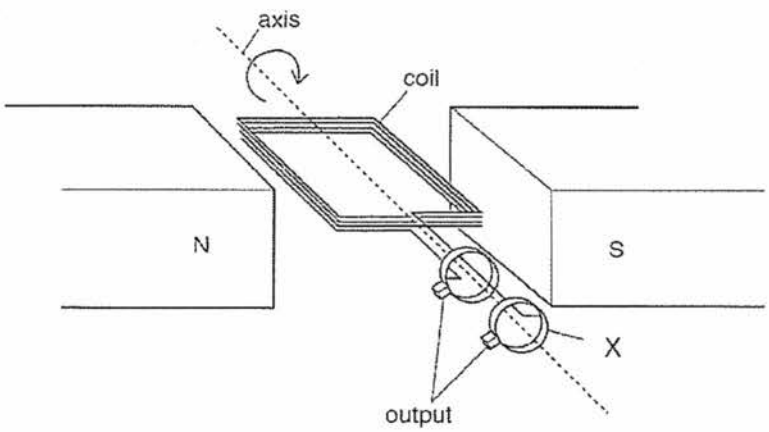


Fig 8.1

(a) The coil starts to rotate from the position shown in Fig. 8.1.

(i) Explain why the e.m.f. induced is a maximum at this instant.

.....

.....

.....[2]

(ii) The coil rotates 180° every 10 s and the maximum e.m.f. induced is 110 V.

On Fig. 8.2, sketch the voltage against time graph for the first 20 s, indicating your values clearly.

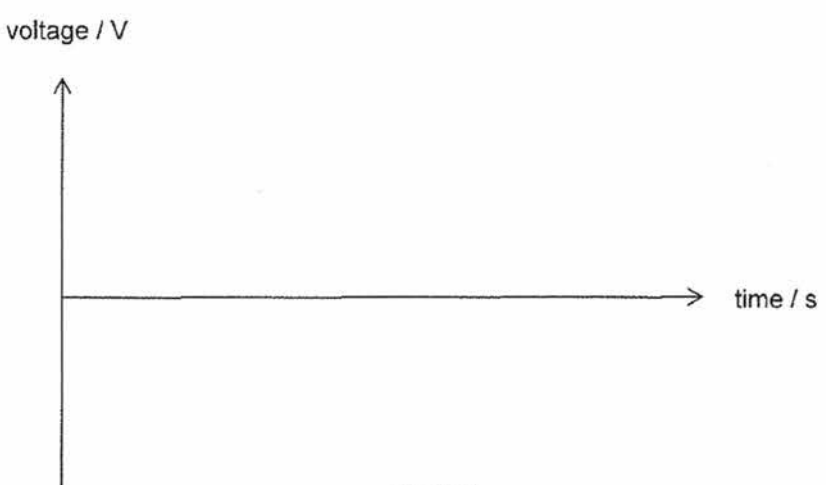


Fig 8.2

[2]

(b) State one way to increase the magnitude of the induced e.m.f.

.....[1]

(c) State component X and its function.

.....

.....[2]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in Question **11**.

9 Induction cookers work on the principle of electromagnetic induction. Fig 9.1 shows an induction cooker which consists of a copper coil connected to an alternating current (a.c.) supply and a ceramic plate. When a pot made of soft magnetic material is placed on top of the cooker and the a.c. supply is turned on, electromagnetic induction leads to the pot being heated. The ceramic plate remains relatively cool.

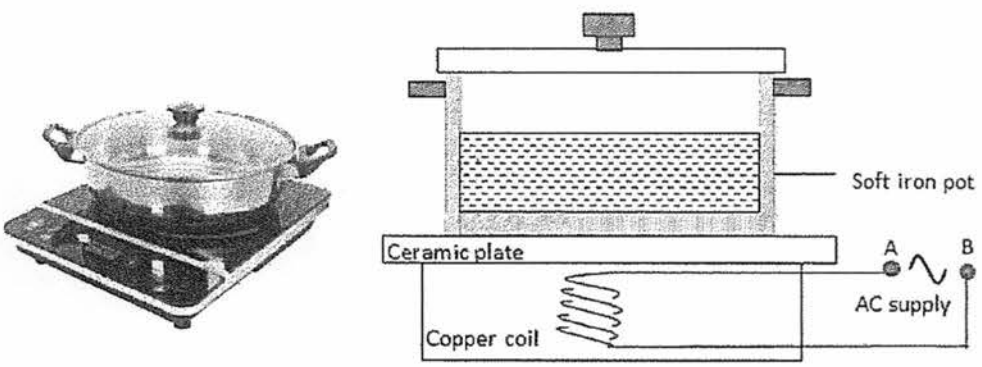


Fig. 9.1

(a) Explain how an alternating current causes a heating effect in the pot but not in the ceramic plate.

.....

.....

.....

.....

.....[3]

(b) The manufacturer is exploring alternative materials for the pot. Fig. 9.2 shows how the resistivities of two alloys **A** and **B** change with temperature.

temperature / °C	resistivity of **A** (Ωm)	resistivity of **B** (Ωm)
20	1.5×10^{-7}	7.0×10^{-7}
70	2.3×10^{-7}	8.1×10^{-7}
120	3.1×10^{-7}	9.2×10^{-7}
170	3.9×10^{-7}	10.3×10^{-7}
220	5.3×10^{-7}	13.4×10^{-7}
270	8.7×10^{-7}	18.7×10^{-7}
320	12.7×10^{-7}	26.8×10^{-7}
370	18.9×10^{-7}	37.6×10^{-7}
420	26.2×10^{-7}	58.4×10^{-7}
470	35.4×10^{-7}	80.7×10^{-7}

Fig. 9.2

(i) Using data from Fig. 9.2, describe the relationship between temperature and resistivity of **A**

1. At low temperature, ...

.....[1]

2. At high temperature, ...

.....[1]

(ii) Fig 9.3 shows the chemical composition of alloys **A** and **B**.

Alloy	A	B
carbon (%)	2	3
iron (%)	88	78
chromium (%)	10	19

Fig. 9.3

The data in Fig. 9.2 and Fig. 9.3 provides some evidence of a relationship between chromium content and resistivity. State this possible relationship.

.....

.....[1]

(c) The induction cooker has a power rating of 1800 W and contains 0.2 kg of water at a temperature of 23 °C. The pot was left on the induction cooker until all the water boiled off.

The specific heat capacity of water = 4200 J/(kg °C)
The specific latent heat of vaporization of water = 2 260 000 J/kg

Calculate the minimum time the pot was left on the induction cooker.

time =.....[3]

(d) Fig. 9.4 shows a gas stove used to heat up a pot.

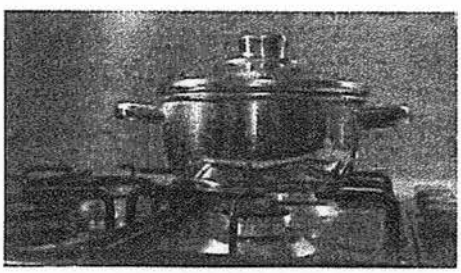


Fig. 9.4

Suggest why an induction cooker is more efficient than the gas stove using the same pot with the same energy input.

.....

.....[1]

10 Fig. 10.1 shows an air pump, which is 1.0 m in length, connected to a manometer. It initially contains 2000 cm^3 of air at atmospheric pressure of 1.03×10^5 Pa. The volume of air in the narrow tube is negligible. The right side of the manometer is exposed to atmospheric pressure.

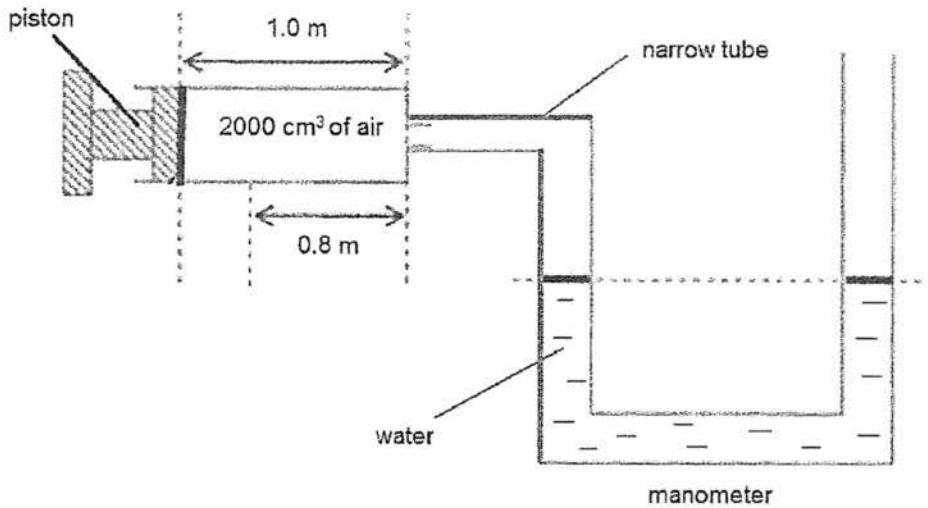


Fig. 10.1

The piston is partially pushed to the right and held steady at a distance of 0.8 m as indicated in Fig. 10.1. The temperature of the air inside the air pump remains constant.

(a) Describe the difference in the motion of the air molecules in the air pump and the water molecules in the manometer.

.....

.....

.....[2]

(b) The cross-sectional area of the piston is 2×10^{-3} m^2.

Calculate the force of air acting on the piston before it was pushed.

force = ...[2]

(c) Using ideas about molecules, explain why the pressure of the air inside the air pump increases when the piston is pushed.

.....

.....

.....

.....

.....[3]

(d) After the piston was pushed, the pressure in the air pump increases to 1.29×10^5 Pa.

The density of water is 1000 kg/m^3 and gravitational field strength is 10 N/kg.

Calculate the height difference between the water columns in the manometer.

height difference = ...[2]

(e) Explain why there is no change to the height difference between the water columns in the manometer in **(d)** if the diameter of the manometer tubing is increased.

.....[1]

11 EITHER

(a) Fig. 11.1 shows an electric motor where a coil PQRS is connected to a battery and is placed between two solenoids AB and CD which are connected to a separate d.c. power supply.

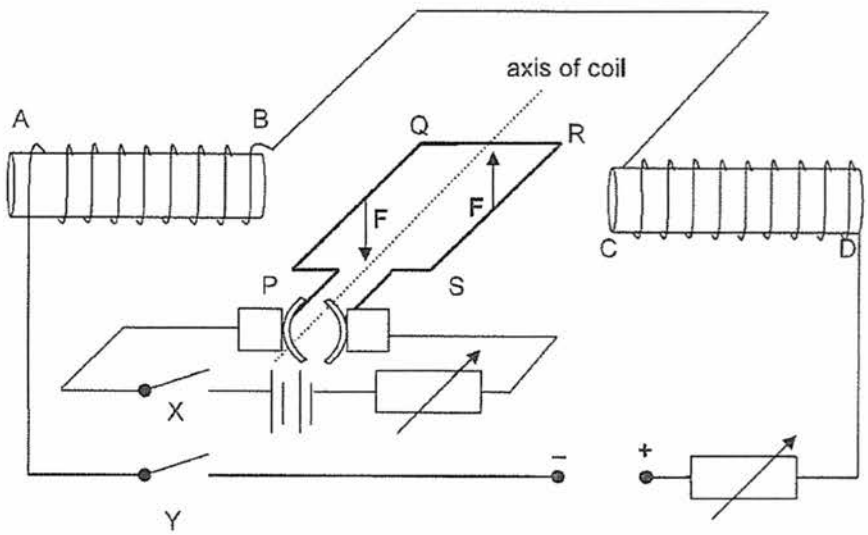


Fig 11.1

(i) On Fig. 11.1, **F** represents the force experienced by sides PQ and RS of the coil when both switches X and Y are closed.

Explain why a force is experienced by sides PQ and RS of the coil.

.....

.....[1]

(ii) The force experienced on each side of the coil is 8 N. The lengths of PQ and QR are 0.8 m and 0.5 m respectively.

Calculate the moment produced by the motor and state its direction of rotation.

moment =.....[2]

direction of rotation : .....[1]

(iii) Describe and explain the effect on the movement of coil PQRS when the d.c. power supply connected to solenoids AB and CD is replaced by an a.c. power supply.

.....

.....

.....[2]

(b) Fig. 11.2 shows a cathode-ray oscilloscope (c.r.o.) being used to measure the period and voltage of an a.c. supply.

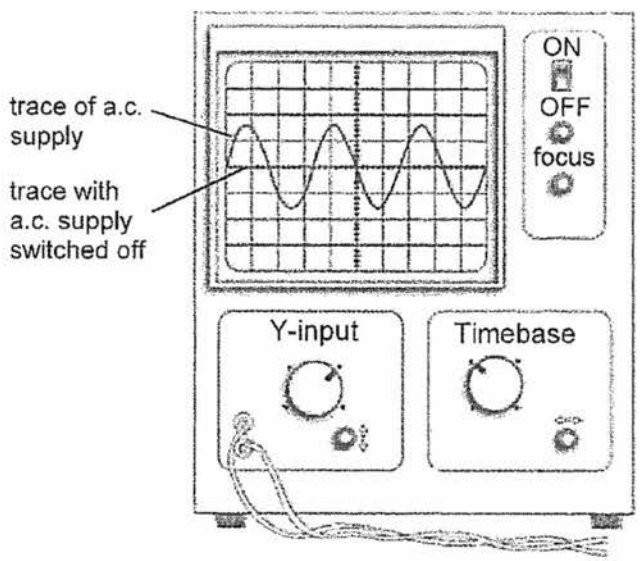


Fig 11.2

(i) The Y gain is 5 V / division and the timebase is 2 ms / division.

Using Fig. 11.2, determine the peak voltage and period of the a.c. supply.

peak voltage = ... [1]

period = ... [1]

(ii) Calculate the frequency of the a.c. supply.

frequency = ...[2]

11 OR

(a) Figure 11.3 shows a lamp and two resistors connected to a battery of e.m.f. 6.0 V.

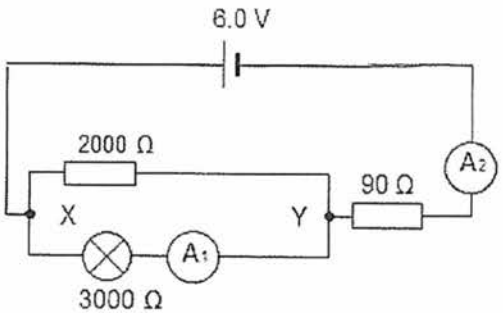


Fig. 11.3

(i) Calculate the total resistance of the circuit.

resistance = ... [2]

(ii) Calculate the ammeter reading A_2.

ammeter reading = ...[1]

(iii) Calculate the potential difference across XY.

potential difference = ...[1]

(iv) A 100 Ω resistor was connected in parallel across the 90 Ω resistor. The ammeter reading A_1 increased. Explain why.

.....

.....[1]

(b) An a.c. source is used to light up another lamp as shown in Fig. 11.4. A transformer with 500 turns in the primary coil is attached to a 240 V, 50 Hz a.c supply. The secondary coil is connected to a 20 V, 50 W lamp that is operating under normal working condition.

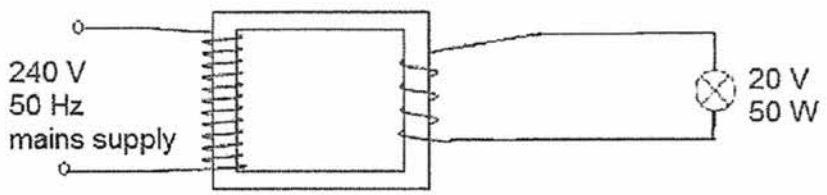


Fig. 11.4

(i) Calculate the number of turns in the secondary coil.

number of turns = ...[2]

(ii) Calculate the current flowing through the primary coil.

current = ...[1]

(iii) A thicker wire is used at the secondary coil instead of the primary coil.

Suggest a reason.

.....

.....

.....[1]

(iv) The core linking the two transformers is made of thin laminated sheets.

Explain how this improves the efficiency of the transformer.

.....

.....[1]

End of Paper

2017 Preliminary Exam - Sec 4 Express
Physics (SPA) 5059 Suggested Answers & Feedback

Paper 1 (40 marks)

Qn	Ans
1	B
2	A
3	B
4	B
5	A
6	C
7	D
8	B
9	C
10	B

Qn	Ans
11	D
12	D
13	A
14	A
15	B
16	D
17	B
18	B
19	C
20	C

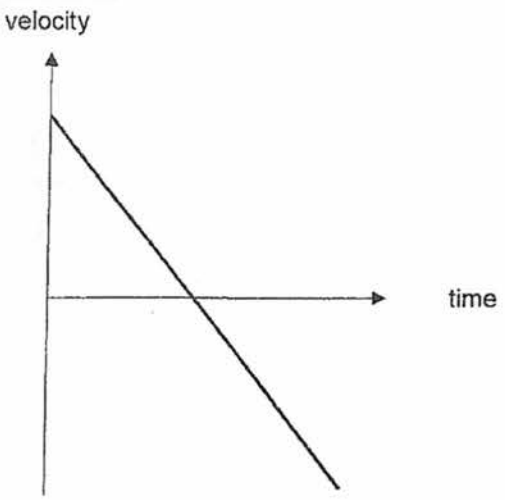
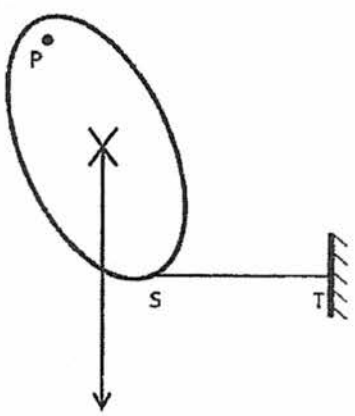
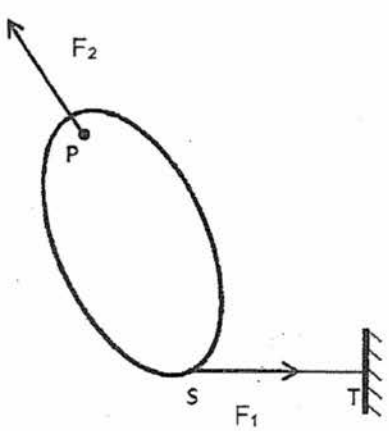
Qn	Ans
21	C
22	D
23	C
24	D
25	A
26	A
27	A
28	C
29	C
30	A

Qn	Ans
31	C
32	B
33	C
34	D
35	B
36	A
37	C
38	C
39	C
40	C

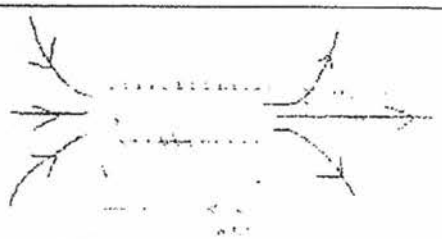
Paper 2

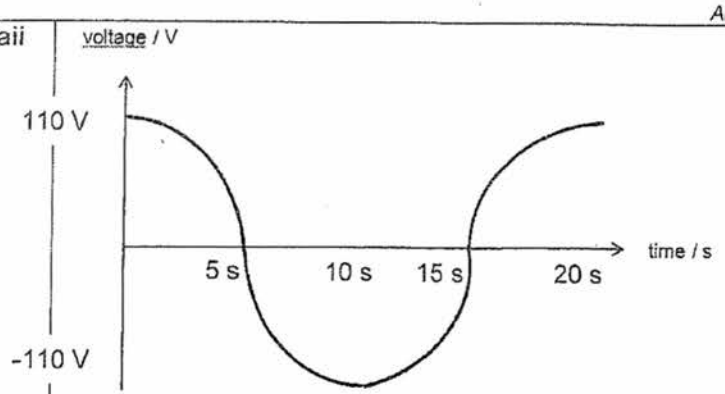
Section A (50 marks)

	SUGGESTED ANSWERS		FEEDBACK
1ai	Scale 1 cm rep 100 N or 1 cm rep 200 N 1 mark for correct scale, shape and arrows 1 mark for magnitude of resultant force resultant force = 450 N (accept 430 to 470 N) 1 mark for direction direction: 60° with T_1 (accept 59° to 61°) OR 74° with T_2 (accept 73° to 75°)	 B1 B1 B1	
1aii	weight = 405 N (accept 430 to 470 N)	B1	
1bi	F = ma 2000 – mg = ma 2000 – 65 x 10 = 65 a a = 20.8 m/s^2	 M1 A1	

1bii		B1	
2ai	 Correct position of X and arrow vertically down passing through X	B1	
2aii 2aiii		B1 B1	
2b	The weight of the disc will produce a moment (about the pivot) and disc will rotate clockwise OR disc will come to rest with centre of gravity directly below pivot.	B1 B1	

3ai	Energy cannot be created nor destroyed but can be converted from one form to another (total amount of energy in a closed system remains constant)	B1	
3aii	Efficiency = (Useful energy output / energy input) x 100% 77 = (Electrical energy output / KE energy input) x 100 77 = (Electrical energy output / (111 240 x 10 x 60)) x 100 Electrical energy output = 51 392 880 J	 M1 A1	
3aiii	Energy is used to overcome frictional forces / resistive forces. *Do not accept heat loss / converted to other forms of energy	B1	
3b	-There are constant tidal currents compared to wind speeds which fluctuate -Tidal turbines take up less space on land to construct compared to wind turbines *Any one	B1	
4a	Pipes are heated up through radiation from sun. The pipes conduct heat to the water flowing in pipe. Water expands, becomes less dense and rises, flowing to the top of the water tank. Cool water at the tank (is denser) and sinks, flowing down the pipe to get heated, repeating the process/forming a convection current.	B1 B1 B1 B1	
4b	Poor conductor / good insulator of heat to reduce heat loss to surroundings	B1	
4c	Increase bends of pipes / use longer pipe to increase surface area / allow more time for water to heat up	B1 B1	
5a	speed = total distance / total time 3200 = (2 x thickness) / (30 x 10^{-6}) Thickness = 0.048 m	 B1	
5b	display 1: metal is too thin display 2: two cracks/cavities in metal	B1 B1	
5c	-Energy is absorbed by the metal / energy is lost to surroundings Or any appropriate answer that shows waves reflect in different directions and not all return to receiver	B1	
5di	X rays or gamma rays	B1	
5dii	Ultrasound waves use the time taken for reflection as compared to electromagnetic waves that penetrates through the metal and measures the difference in radiation passing through.	B1	

6a	Positive. Like positive charge on inkjet is repelled by positive charge on deflecting plate OR gets attracted to negative charge on deflecting plate.	B1	
6b	Inkjet charges are alike and repel each other as like charges repel, thus spreading out with an even layer of coating. *Accept repel and not deflected	B1	
6c	Yes it will be more likely to achieve an even layer of coating in an air-conditioned room. There will be less water molecule charges in the air to discharge/neutralise the inkjet charges.	B1 B1	
6di	Potential difference is the work done to drive a unit charge across a component.	B1	
6dii	$I = Q / t$ $= 1.5 \times 10^{-6} / 1$ $= 1.5 \times 10^{-6}$ A	 B1	
6diii	$E = VQ$ $= 20 \times 1.5 \times 10^{-6} \times 60$ $= 0.018$ J *allow ecf from 6dii	M1 A1	
7a	 [1] – magnetic field arrows [1] – magnetic field shape/curvature	B1 B1	
7b	Magnetic relay is magnetised and attracts the soft iron armature. This breaks contact X with the battery and L1 switches off. Contact Y now touches contact Z and L2 lights up.	B1 B1 B1	
8ai	The magnetic field lines are being cut at the greatest rate / rate of change of magnetic flux is maximum. From Faraday's law, the magnitude of the induced current / e.m.f is directly proportional to the rate of change of magnetic flux and thus the e.m.f induced is maximum.	B1 B1	

8aii	 [1] – shape [1] - values	B1 B1	
8b	Increase speed of rotation / increase number of turns of coils / use stronger magnet / insert soft iron core (any one)	B1	
8c	Slip ring. To ensure the induced current in circuit / coil is transferred to the output.	B1 B1	

Section B

9a	An alternating current in the circuit creates a changing magnetic field/flux in the soft iron pot. This induces a current in the soft iron pot which heats up the pot. The ceramic plate does not heat up as it is an insulator of electricity (and no current flows through it). *Do not accept insulator of heat as question is not referring to transfer of heat between iron pot and ceramic plate	B1 B1 B1	
9bi	1. Low temperature: resistivity varies linearly with temperature / resistivity increases at a constant rate with temperature 2. High temperature: resistivity increases at an increasing rate with temperature	B1 B1	
9bii	As chromium content increases, the resistivity increases. *accept resistivity varies linearly with chromium content linearly with a positive gradient. **Do not accept resistivity is directly proportional to chromium content.	B1	
9c	Thermal energy required to change water from 23°C to 100 °C $Q = mc\Delta\theta$ = 0.2 x 4200 x (100 - 23) = 64 680 J Thermal energy required to change water from 100°C to steam at 100 °C $Q = ml_v$	M1	

	= 0.2 x 2 260 000 = 452 000 J Total energy needed = 64 680 + 452 000 = 516 680 J E = Pt 516 680 = 1800 x t t = 287 s *Accept 288 s (*minimum time)	M1 A1	
9d	For the same energy input, the gas stove loses more heat to the surroundings compared to the induction stove.	B1	
10a	Air molecules move freely and randomly at very high speeds. Water molecules move freely within liquid in random motion / sliding over one another.	B1 B1	
10b	p = F / A $1.03 \times 10^5 = F / (2 \times 10^{-3})$ F = 206 N	 M1 A1	
10c	When volume decreases, the number of air molecules per unit volume increases. The frequency of collision of air molecules with the walls increases, which increases the force of collision with the walls. *1 mark for every 2 correct sub-points This increases the force per unit area and the pressure.	B1 B1 B1	
10d	pressure difference = density x gravitational field strength x height difference $(1.29 - 1.03) \times 10^5 = 1000 \times 10 \times h$ h = 2.6 m	 M1 A1	
10e	The height difference depends on the pressure difference between the 2 water columns, (which does not depend on the cross sectional area of tubing).	B1	
11	EITHER		
11ai	The magnetic field of the current and magnetic field of the magnet interact to give a resultant magnetic field producing a force.	B1	
11aii	M = F x d = 8 x 0.25 x 2 = 4 Nm anticlockwise	 M1 A1 B1	

11aiii	The force acting on coils PQ and RS will change direction repeatedly. This will cause the coil to rotate anticlockwise and then clockwise repeatedly.	B1 B1	
11bi	Peak voltage = 5 V / div x 1.6 div = 8.0 V *accept 1.4 or 1.8 div (1.4 div x 5V / div = 7.0 V, 1.8 div x 5V / div = 9.0 V) 3 periods = 10 divisions 1 division = 2 ms 10 divisions = 20 ms 3 periods = 20 ms period = 20/3 = 6.67 ms *accept 3.2, 3.4 and 3.6 div (3.2 div x 2ms / div = 6.4 ms 3.4 div x 2 ms / div = 6.8 ms 3.6 div x 2 ms / div = 7.2 ms	B1 B1	
11bii	f = 1/T = 1 / 6.67 x 10^{-3} = 150 Hz *allow ecf from 11bi	M1 A1	
11	OR		
11ai	Parallel resistance = $(1/2000 + 1/3000)^{-1}$ = 1200 Ω Total resistance = 1200 + 90 = 1290 Ω	M1 A1	
11aii	I = V/R = 6 / 1290 = 4.65 x 10^{-3} A *allow ecf from 11ai	 B1	
11aiii	p.d. across XY + p.d. across 90 Ω = 6 V p.d. across XY + 4.65 x 10^{-3} x 90 = 6 p.d. across XY = 5.58 V OR R_{xy} = $(1/2000 + 1/3000)^{-1}$ = 1200 Ω V_{xy} = I R_{xy} = 4.65 x 10^{-3} x 1200 = 5.58 V OR V_{xy} = (1200/1290) x 6 = 5.58 V	 B1	
11aiv	Effective resistance will decrease. Main current in circuit will increase / A2 will Increase.	B1	

11bi	No. of turns in secondary/no. of turns in primary = voltage at secondary / voltage at primary No. of turns in secondary/500 = 20/240 No. of turns in secondary = 41.7	M1 A1	
11bii	power at primary = power at secondary VI (pri) = P(sec) 240 x I = 50 I = 0.208 A	B1	
11biii	Higher current at secondary which will leading to increased heating effect. Thicker wire is used as it has lower resistance which will reduce heating effect	B1	
11biv	The laminated sheets reduce eddy currents and reduce heating losses / energy lost as heat / joule heating effect	B1	