Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY FOUR EXPRESS

PHYSICS 6091/01 **12 SEPTEMBER 2018**

PAPER 1 **1 HOUR**

Additional Materials : Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

1. This paper consists of **40** Multiple Choice Questions.
2. Answer all questions on the Optical Answer Sheet (**OAS**).
3. Write your name, class and shade your register number in the spaces on the **OAS**
4. Do not fold nor use any correction fluid on the **OAS**. Read the instructions on the **OAS** carefully.
5. The total mark for this paper is 40 marks.

This paper consists of **16** printed pages, including this cover page.

Section A

Answer **ALL** the questions in this section.

1 The diameter of a cylindrical pencil is measured using a micrometer screw gauge. A student initially takes the zero error reading (Diagram A) of the micrometer followed by the reading of the diameter (Diagram B).

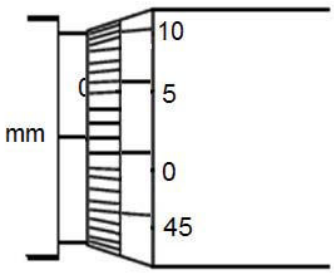


Diagram A

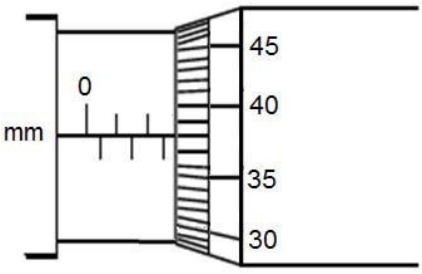


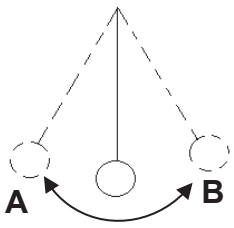
Diagram B

What is the actual diameter of the cylindrical pencil?

A 2.37 mm **B** 2.39 mm **C** 2.87 mm **D** 2.89 mm

2 The diagram shows a simple pendulum. It swings between **A** and **B**. The periods of oscillation for different lengths of pendulum are recorded in the table below.

length of pendulum / m	0.5	0.6	0.7	0.8
period of oscillation / s	1.429	1.565	1.689	1.805



If the length of the pendulum is 0.68 m, what is the approximate time taken for 20 oscillations?

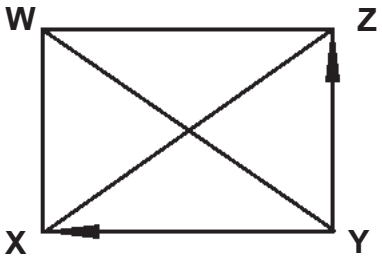
A 1.63 s

B 1.66 s

C 32.5 s

D 33.3 s

3 The figure below shows two forces acting at a point **Y** which are represented by **YX** and **YZ** respectively.



Which option represents a third force that is required to maintain equilibrium?

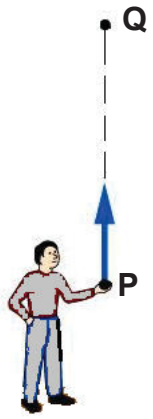
A **YW**

B **WY**

C **XZ**

D **ZX**

4 A ball is thrown vertically upwards from **P**. It reaches the greatest height at **Q** and then falls back to **P** where it is caught.



Neglecting air resistance, which of the following statements is **CORRECT**?

A Acceleration at **Q** is zero.

B The time of rise from **P** to **Q** is greater than the time of fall from **Q** to **P**.

C The total displacement of the ball is zero.

D The ball experiences a steady decreasing upward force when it rises from **P** to **Q**.

5 A car of a total mass of 800 kg is moving along a road at constant speed of 10 m/s. It suddenly brakes for 8 s before it comes to a stop in front of a traffic light.

Assuming that the braking force and the deceleration of the car are constants, what is the braking force exerted on the car?

A 80 N

B 100 N

C 640 N

D 1000 N

6 A 25 cm^3 molten copper of density 8.9 g/cm^3 is mixed thoroughly with 467 g of molten tin of density 7.3 g/cm^3 to form a bronze alloy.

What is the average density of the bronze alloy?

A 7.75 g/cm^3

B 7.92 g/cm^3

C 8.10 g/cm^3

D 8.33 g/cm^3

7 A 100 kg rock is being hung freely on the Moon. When an astronaut pushes the rock upwards, he will feel that _____.

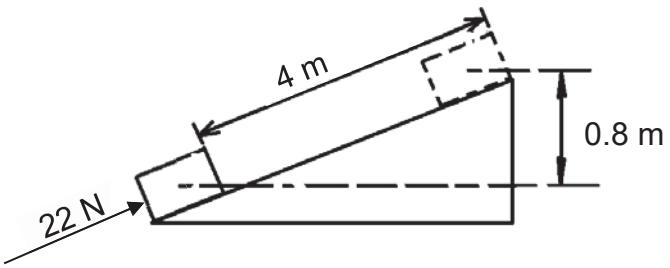
A the rock is easier to be pushed than on the Earth

B the rock is more difficult to be pushed than on the Earth

C the rock requires as much effort to be pushed as on the Earth

D the rock requires no effort to be pushed

8 A 22 N force is applied to push a 6 kg box along a 4 m ramp to reach a height of 0.8 m above its starting position. Assume gravitational field strength, g = 10 N/kg.



What is the work done against friction?

A 32 J

B 40 J

C 48 J

D 88 J

9 A 50 kg rectangular block of dimensions 2 m x 3 m x 5 m exerts pressure onto a hard ground. Assume gravitational field strength, g = 10 N/kg.

What is the **LEAST** pressure that the rectangular block can exert on the ground?

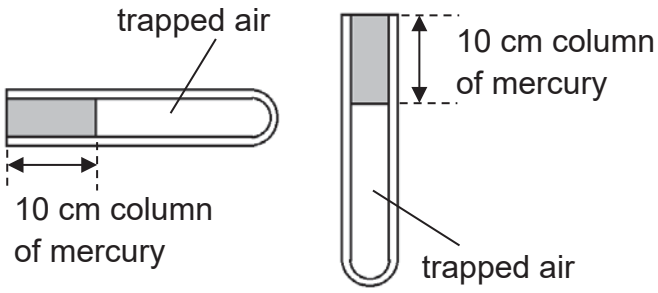
A 8.33 Pa

B 16.7 Pa

C 33.3 Pa

D 83.3 Pa

10 The diagrams below show air trapped in two capillary tubes **A** and **B** by a small column of mercury as shown. The length of the mercury column is 10 cm. The atmospheric pressure is 76 cm Hg.

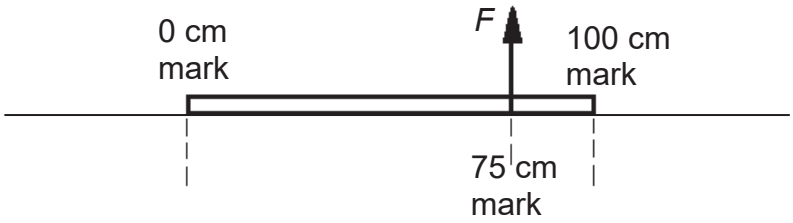


capillary tube **A** capillary tube **B**

What is the pressure of the trapped air in capillary tubes **A** and **B**?

	air pressure in capillary tube A	**air pressure in capillary tube B**
A	76 cm Hg	76 cm Hg
B	76 cm Hg	86 cm Hg
C	86 cm Hg	76 cm Hg
D	86 cm Hg	86 cm Hg

11 A 1 m uniform wooden rule weighing 20 N is being lifted vertically up by a force F at the 75 cm mark as shown.

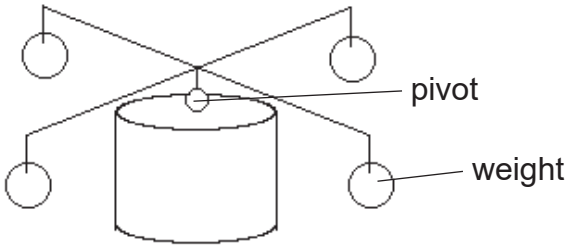


What is the **MINIMUM** force F required to lift the rule?

A 13.3 N **B** 26.6 N

C 40.0 N **D** 80.0 N

12 The diagram shows a balancing toy pivoted on a stand. If the toy is tilted slightly, it does not topple but returns to its original position.



Where is the position of the centre of gravity of the toy?

A above the pivot

B below the pivot

C exactly at the pivot

D inside the weight

13 A gas of the same volume as a liquid expands faster when heated?

Which of the following reasons is **CORRECT**?

A The gas molecules are bigger.

B The gas molecules expand faster.

C The forces between gas molecules are weaker than those between the liquid molecules.

D The gas molecules collide more frequently with each other.

14 In the Brownian motion experiment involving smoke particles, heavy particles settle quickly but very small particles remain suspended for long periods of time.

Which of the following reasons is **CORRECT**?

A The air pressure has a greater effect on very small particles.

B Very small particles have low inertia and are easily affected by the bombardments of the air particles.

C The Earth's gravitational field does not act on the very small particles.

D The very small smoke particles has the same density as the air.

15 A liquid-in-glass thermometer has a mercury level of 3.0 cm at – 5 °C and a mercury level of 11.0 cm at 115 °C.

What is the mercury level when the temperature is 105 °C.

A 8.3 cm **B** 9.8 cm

C 10.1 cm **D** 10.3 cm

16 The thermocouple is able to measure a temperature as high as 2500 °C.

Which of the following reason(s) is/are **CORRECT**?

(1) high specific heat capacity

(2) low heat capacity

(3) high melting point

A 1 only

B 3 only

C 1 and 2 only

D 1 and 3 only

17 Which of the following statements about the vacuum flask is **INCORRECT**?

A Heat loss by radiation is minimised by keeping the hot water in a double-walled container.

B Heat loss is minimised by placing a cork or plastic stopper to close up the neck of the container.

C The vacuum in the doubled-wall container effectively prevents conduction and convection.

D The walls of the container are silvered to reduce radiation.

18 Which of the following statement(s) is / are **CORRECT**?

(1) Electrical conductors are usually good conductors of heat.

(2) Conductors of heat have free electrons to transmit heat quickly.

(3) Electromagnetic waves need electrons to transmit energy.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

19 The specific heat capacity for ice and water is given as 2.1 kJ/kg °C and 4.2 kJ/kg °C respectively. The specific latent heat of fusion of water is given to be 340 kJ/kg.

What is the total amount of energy needed to raise 1.5 kg of ice from −15 °C to 40 °C?

A 173 kJ

B 346 kJ

C 809 kJ

D 28600 kJ

20 Evaporation is always accompanied by cooling.

Which of the following reasons is **CORRECT**?

A The air molecules cool the liquid surface.

B The more energetic molecules leave the liquid.

C There are fewer molecules left in the liquid.

D The escaped molecules returned to the liquid.

21 X-rays, visible light and ultraviolet radiation are all part of the electromagnetic spectrum.

Which of the following describes the **CORRECT** order in increasing wavelength?

A X-rays, visible light and ultraviolet radiation

B X-rays, ultraviolet radiation and visible light

C visible light, X-rays and ultraviolet radiation

D ultraviolet radiation, X-rays and visible light

22 What are the **CORRECT** changes to the frequency, wavelength and speed of the water waves when they move from shallow waters to deep waters?

	frequency	**wavelength**	**speed**
A	increases	remains the same	increases
B	remains the same	decreases	decreases
C	remains the same	increases	increases
D	decreases	remains the same	decreases

23 An insect makes a sound that is higher than the maximum audible frequency of a normal person.

Given that the speed of the sound in air is 300 m/s, which of these wavelengths of the sound is made by the insect?

A 0.012 m

B 0.068 m

C 15 m

D 68 m

24 In an experiment to measure the speed of sound in air, a girl stands 60 m away from a wall and claps her hands together to produce a sound. At the instant when she hears an echo, she claps her hands again. She does this for 50 claps. The total time taken for 50 claps is 15 s.

Which of these calculations gives the speed of sound in air?

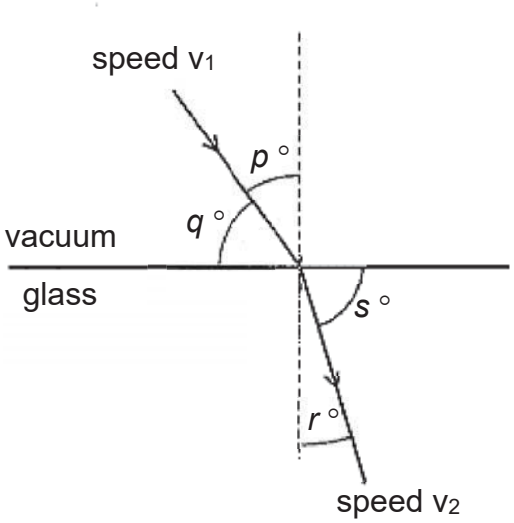
A $\frac{15}{60\times50}$

B $\frac{60\times50}{15}$

C $\frac{60\times2\times50}{15}$

D $\frac{60\times2\times15}{50}$

25 A ray of light travels from vacuum into glass.



What is the refractive index of the glass?

A sin(p °)/sin(s °)

B sin(q °)/sin(r °)

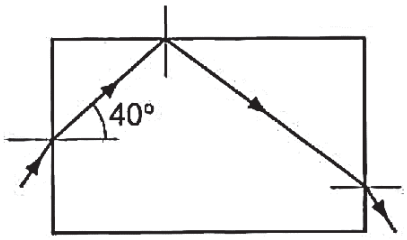
C v_1/ v_2

D v_2/ v_1

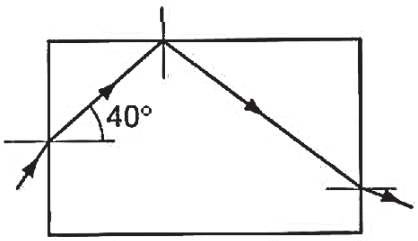
26 A ray of light is incident on one side of a rectangle glass block. The angle of refraction is 40 º in the glass. The critical angle for light in glass is 42 º.

Which diagram shows the path of this ray?

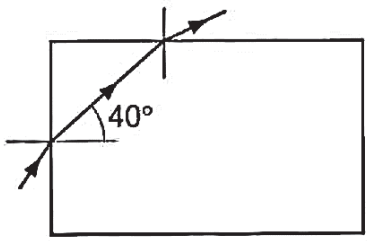
A



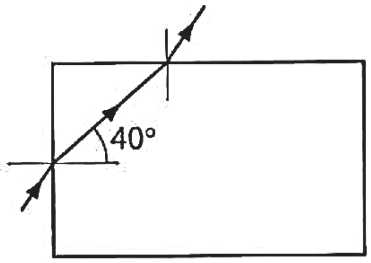
B



C



D



27 When the object is placed at 19 cm from the optical centre of a converging lens, the image formed is real, inverted and magnified. When the object is placed at 21 cm from the optical centre of the same converging lens, the image formed is real, inverted and diminished.

What is the focal length of the converging lens?

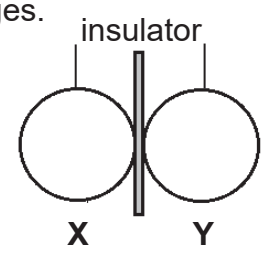
A 10 cm

B 20 cm

C 40 cm

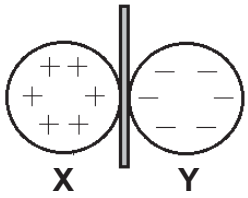
D cannot be determined

28 Two neutral conducting balls **X** and **Y** are suspended by insulating threads from the ceiling as shown. They are separated by a sheet of insulator. **X** is touched by a rod which carries positive charges.

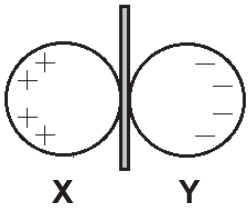


Which of the following diagrams best represents the charge distribution on them?

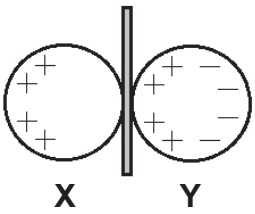
A



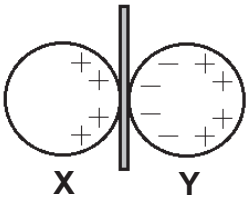
B



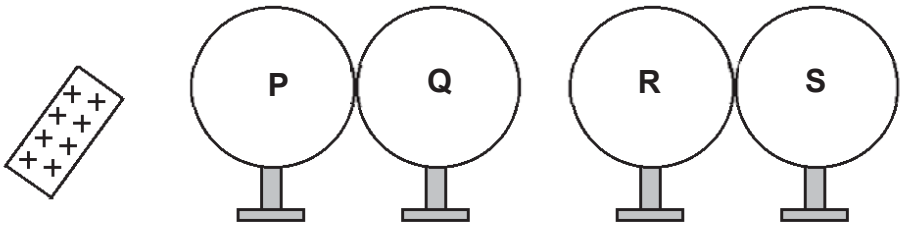
C



D



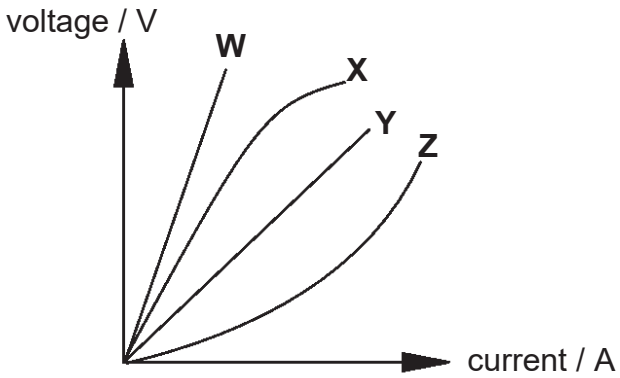
29 **P**, **Q**, **R** and **S** are four identical insulated metal spheres. They are arranged as shown below. A positively charged rod is brought near to **P**. Sphere **S** is earthed momentarily.



If the rod is removed, what would be the charge on spheres **R** and **S**?

	R	**S**
A	positive	positive
B	positive	negative
C	negative	positive
D	negative	negative

30 The graph below shows the relationships between the potential difference and the current of four different conductors, **W**, **X**, **Y** and **Z**.



Which conductor has the highest resistance??

A **W**

B **X**

C **Y**

D **Z**

31 What is the e.m.f. of the cell in an electrical circuit if it uses 1kJ of energy to send 3A of current around the circuit for 2 minutes?

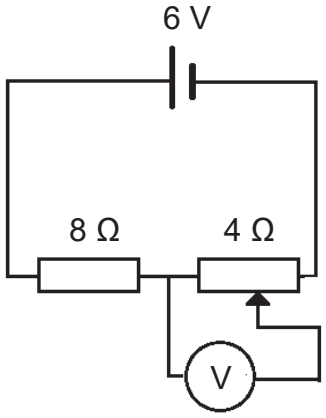
A 2.78 V

B 6.00 V

C 167 V

D 360 V

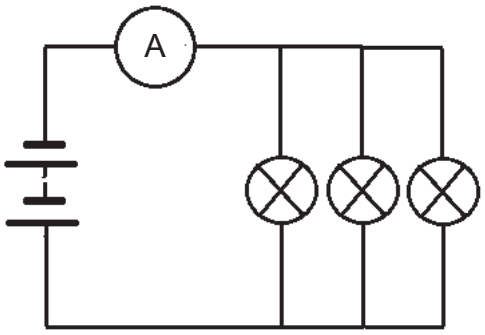
32 The diagram shows a circuit with a potential divider joined in series with a fixed resistor.



What are the minimum and maximum readings which can be obtained on the voltmeter?

	minimum voltage/ V	**maximum voltage/ V**
A	0	2
B	0	4
C	2	4
D	2	6

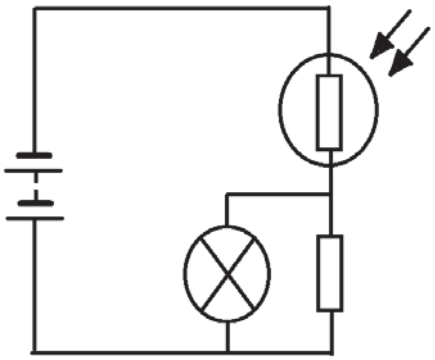
33 Three identical filament bulbs are connected to a d.c. supply as shown in the figure below. Each bulb operates at normal brightness and the ammeter registers a steady current. Filament in one of the bulbs in the circuit breaks.



What happens to the ammeter reading and the brightness of the remaining bulbs?

	ammeter reading / A	**brightness/ V**
A	increases	increases
B	increases	unchanged
C	decreases	increases
D	decreases	unchanged

34 Some electronic components are connected as shown in the circuit.



Which of these circumstances will light up the lamp in the circuit?

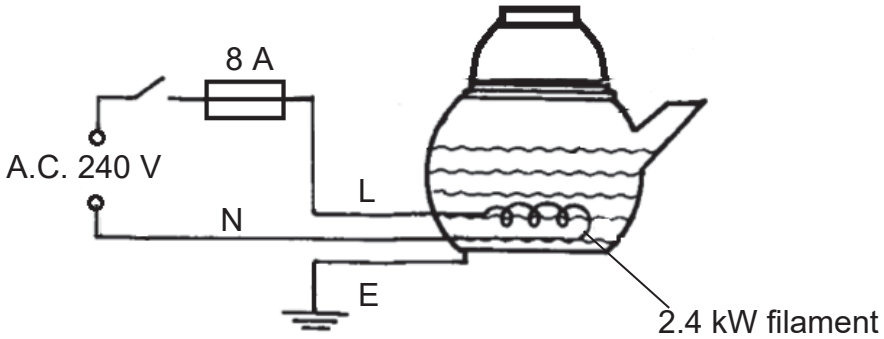
A Circuit placed under a bright light

B Circuit placed in a dark room

C On a cold day

D On a hot day

35 The figure below shows the connection of a metal-cased electric kettle to the a.c. mains.



Which of the following statements about the arrangement is **TRUE**?

A The switch should be placed along the neutral wire.

B The rating of the fuse is too small.

C The fuse should be placed along the neutral wire.

D The Earth wire should not be connected to the casing.

36 End **X** of a metal rod attracts the N-pole of a compass needle. What does this show about the rod?

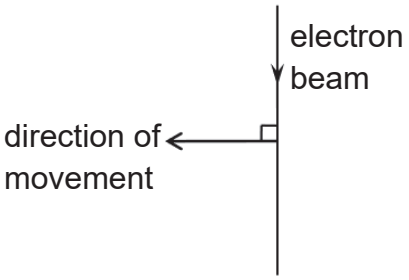
A It could be made of copper but is not permanently magnetised.

B It could be made of copper with a S-pole at **X**.

C It could be made of steel but is not magnetised.

D It could be made of steel with a N-pole at **X**.

37 A beam of electrons travels between the poles of a magnet. The beam starts to move in the direction shown.



Which is the most likely direction of the magnetic field?

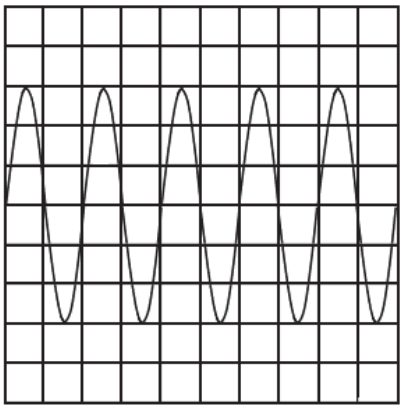
A into the paper

B out of paper

C to the right

D to the left

38 A 20 Hz signal is displayed on a C.R.O. screen as shown.



What is the setting of the time base of the C.R.O.?

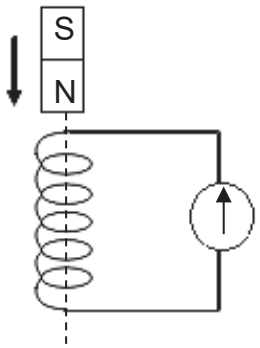
A 20 ms / div

B 25 ms / div

C 200 ms / div

D 250 ms / div

39 A small coil is connected to a sensitive galvanometer. When the magnet is allowed to fall towards the coil, the galvanometer needle moves quickly to the right of the zero position. The magnet moves through the coil.



How does the galvanometer needle move as the magnet falls away from the coil?

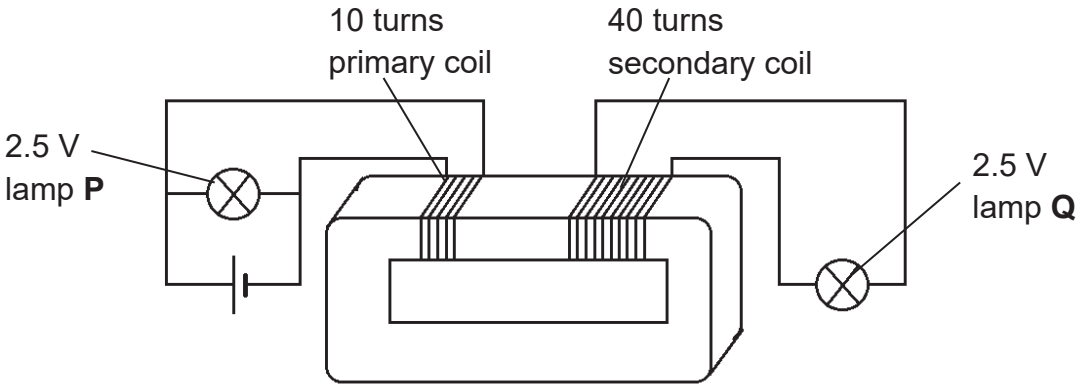
A It does not move.

B It gives a steady reading to the right.

C It moves quickly to the left of the zero position and then returns to zero

D It moves quickly to the right of the zero position and then returns to zero.

40 A pupil sets up a model transformer as shown. It is connected to a 2.5 V d.c. supply. Both lamps have a voltage of 2.5 V.



What does the pupil notice about the lamps?

	lamp P	**lamp Q**
A	normal brightness	not lit
B	very bright	dim
C	dim	very bright
D	decreases	unchanged

*****END OF PAPER*****

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY FOUR EXPRESS

PHYSICS 6091/02 **12 SEPTEMBER 2018**

PAPER 2 **1 HOUR 45 MINUTES**

Additional Materials : NIL

READ THESE INSTRUCTIONS FIRST

1. Answer **ALL** questions in Section **A** on the question paper.
2. In **Section B**, answer Questions **9** and **10**, and ***either part*** of Question **11**. Write your answers in the spaces provided on the question paper.
3. All workings and constructions must be shown clearly. **Omission of essential working will result in loss of marks**
4. The number of marks is given in brackets [ ] at the end of each question or part question.
5. You are expected to use an electronic calculator to evaluate explicit numerical expression.
6. The total mark for this paper is 80 marks.

This paper consists of **17** printed pages, including this cover page.

Section A [50 Marks]

Answer **ALL** the questions in this section. Write your answers in the spaces provided on the question paper.

1 In a Singapore F1 night race, a race car driver approaches a S-shaped bend carefully at the beginning of the race as follows:

(i) The race car approaches the first bend at 100 km/h at t = 0 s.

(ii) The race car slows down with decreasing deceleration to 40 km/h to navigate the first bend from t = 0 s till t = 4 s.

(iii) The race car continues at 40 km/h to navigate the second bend from t = 4 s till t = 8 s.

(iv) The race car speeds up along a straight road with increasing acceleration to 200 km/h after the bend from t = 8 s till t = 16 s.

(a) State what is meant by uniform acceleration.

……..……..……...

……..... [1]

(b) Using the information from **(i)** to **(iv)**, sketch the speed-time graph of the race car from t= 0 s till t =16 s. Label your graph. [4]

2 Fig. 2.1 below represents a force-time graph of the force applied to a stationary 2 kg box to push it over a rough surface. The box accelerates uniformly at 0.25 m/s^2 during t = 0 s to t = 3 s. Assume the frictional force is constant throughout the motion of the box.

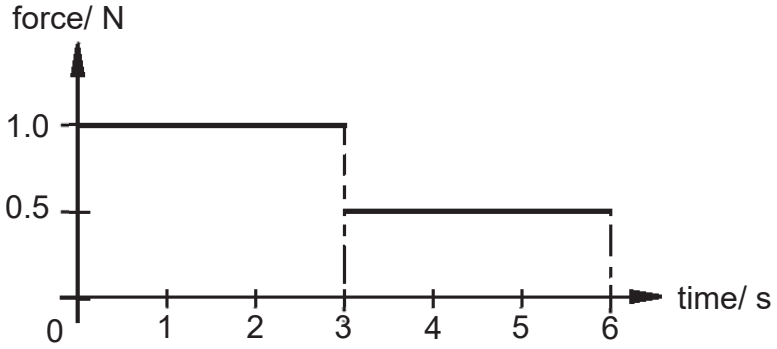


Fig. 2.1

(a) Calculate the frictional force acting on the 2 kg box.

frictional force = ... [2]

(b) Determine the acceleration from t = 3 s to t = 6 s.

acceleration = ... [1]

(c) After 6 seconds, a braking force is being applied to the box to slow it down.
Determine the average braking force applied from t = 6 s to stop it at t = 8 s.

average braking force = ... [3]

3 A uniform rod **PQ** of length 100.0 cm and weight 5.0 N is hung as shown in the Fig. 3.1. Two spring balances, **A** and **B** are attached to points **P** and **Q** of the rod respectively. A load of 15.0 N is placed 20.0 cm from the spring balance **A**.

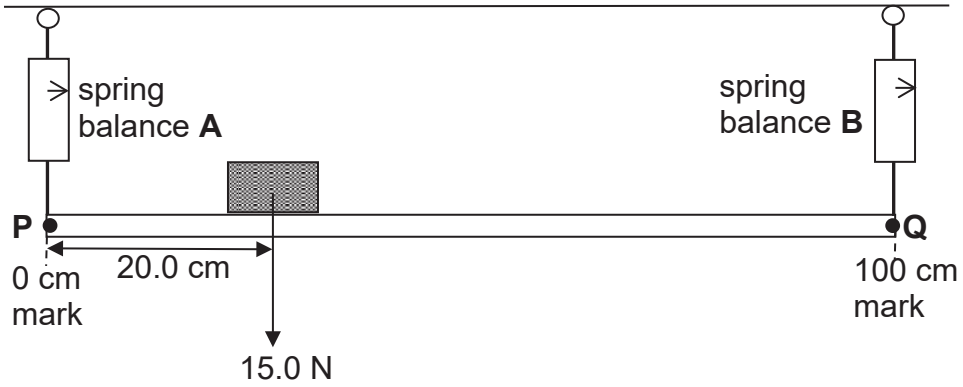


Fig. 3.1

(a) On Fig. 3.1, mark and label the position of the weight of the rod. [1]

(b) Taking moments about point **Q**, calculate the reading on the spring balance **A** in order for the rod to balance horizontally.

reading = ... [2]

(c) Hence or otherwise, determine the reading on the spring balance **B** in order for the rod to balance horizontally.

reading = ... [2]

(d) If the 15.0 N weight is gradually moved along the rod towards point **P**, while the rod is being kept in equilibrium.

State and explain the change in the reading of the spring balance **B**.

……..

……..

……..[2]

4 Fig. 4.1 shows a type of manometer used to measure the pressure difference between the pressure exerted by the force of 60 N on a platform area of 0.5 m^2 and a gas within a gas vessel. The volume of gas is 0.0122 m^3. Given that the density of water is 1000 kg/m^3 and the gravitational constant is g = 10 N/kg.

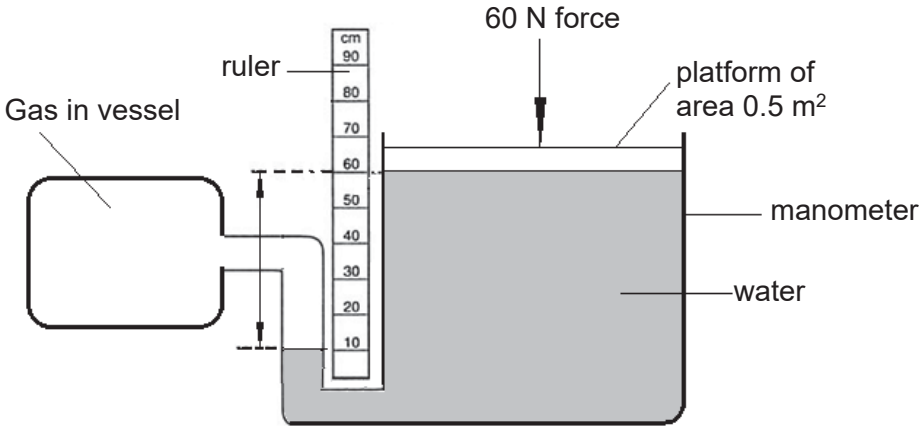


Fig. 4.1

(a) Label in Fig. 4.1 with '**A**' the location with the highest pressure. [1]

(b) Determine the pressure exerted by the force on the platform.

pressure = ... [1]

(c) Determine the gas pressure exerted by the gas in the vessel.

gas pressure = ... [2]

(d) After the removal of the 60 N force on the platform, the gas expands to a new volume of 0013 m^3.

Assume that the temperature remains constant throughout the expansion of the gas, determine the new gas pressure exerted by the gas.

new gas pressure = ... [2]

5 A teacher demonstrates the sound produced by a loudspeaker by connecting a microphone to a cathode ray oscilloscope (C.R.O.). The teacher initially obtains the C.R.O. trace shown in Fig. 5.1.

Fig. 5.1

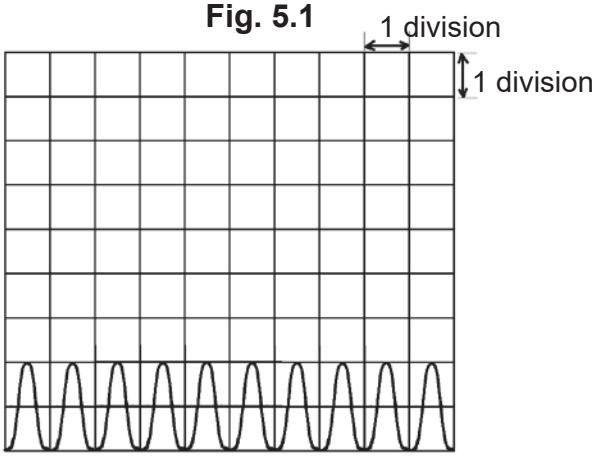
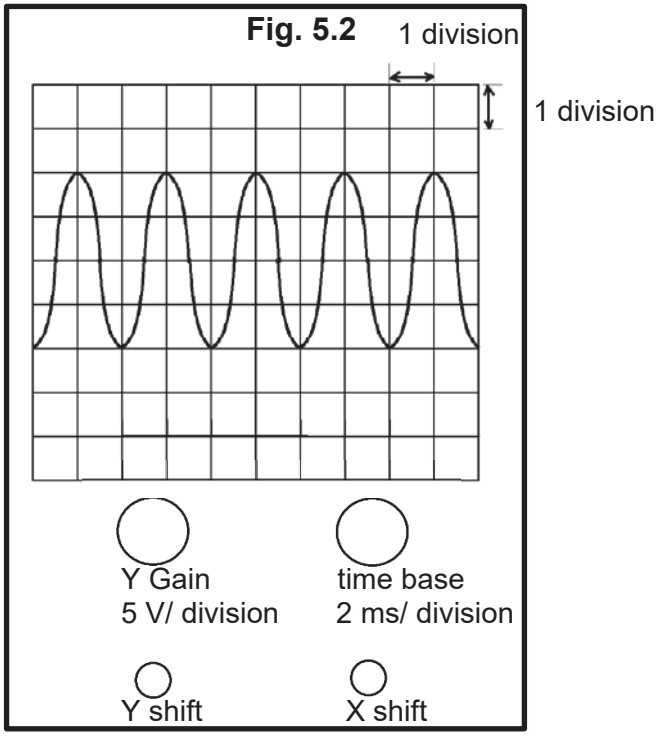


Fig. 5.2



The teacher then adjusts the controls to obtain the C.R.O. trace shown in Fig. 5.2.

(a) State and briefly explain the adjustments the teacher make to the controls to obtain trace on Fig. 5.2.

……

……

……

…… [3]

(b) The time base shown in Fig. 5.2 is set to 2 ms / division.

Determine the frequency emitted by the loudspeaker.

frequency = …… [2]

(c) The loudspeaker was adjusted to produce louder sound of a lower pitch.

Describe and explain what happens to the trace on the C.R.O. screen.

……

……

……

…… [2]

6 Fig. 6.1 shows a positively charged rod, an uncharged metal sphere on an insulated stand and a connection to earth.

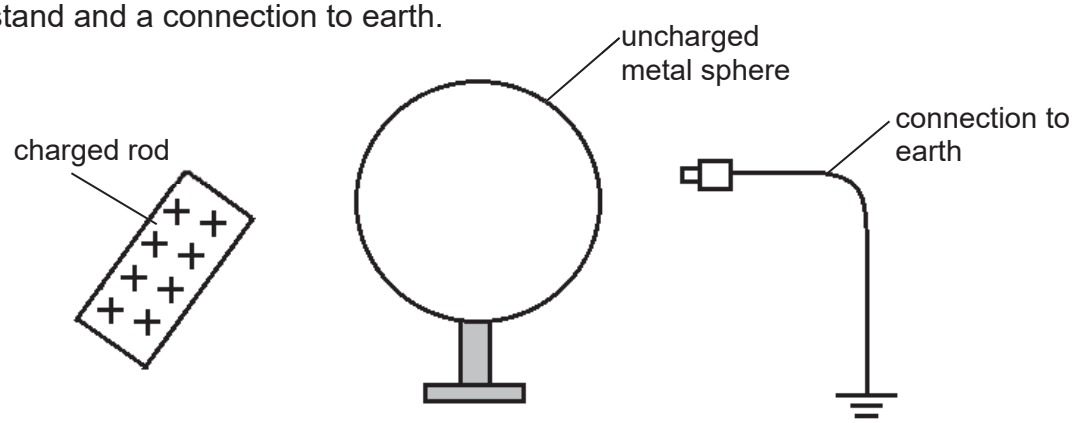


Fig. 6.1

(a) Describe how this apparatus is used to give the metal sphere a negative charge by induction.

……

……

……

……

…… [3]

(b) State and explain what happens to the free electrons in the metal sphere during the charging process.

……

……

……

…… [2]

(c) At the end of the charging process, the metal sphere has a negative charge of 1.2 nC. The charging process took 2.5 s.

Calculate the average current during this time.

current = …….. [1]

7 The Senoko power station generates electrical energy at 30 kV and 12 kA. The generator in the power station is connected to the primary coil of an ideal transformer. The transformer changes the voltage before the electrical energy is transmitted across the country through transmission cables at 450 kV.

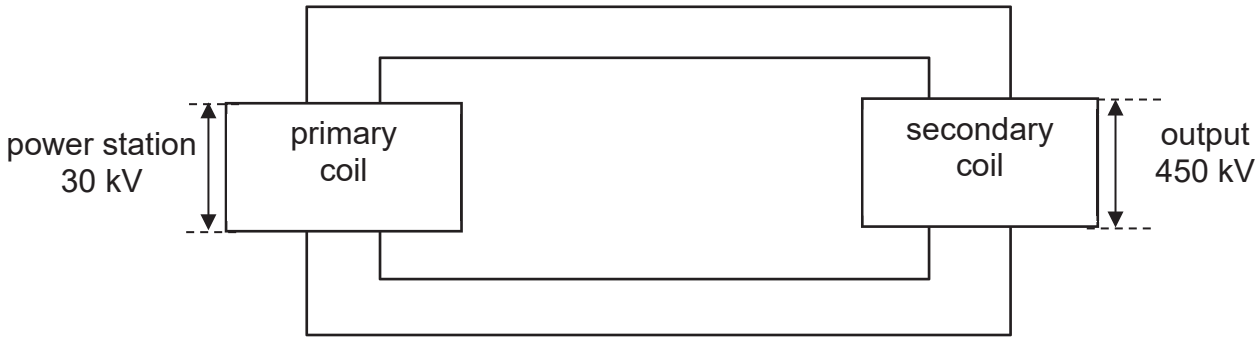


Fig. 7.1

(a) Explain how the current in the primary coil can produce an output voltage in the secondary coil.

.....

.....

.....

.....

..... [3]

(b) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil.

ratio = ... [2]

(c) The total resistance of the transmission cables is 1500 Ω and the electrical power transmitted through the transmission cables is 2.0×10^3 W.

Determine the power loss in the transmission cable.

power loss = ... [2]

8 Fig. 8.1 is drawn to full scale. An object **O** is placed in front of a converging lens **L**. The lens forms an image of the object **O**.

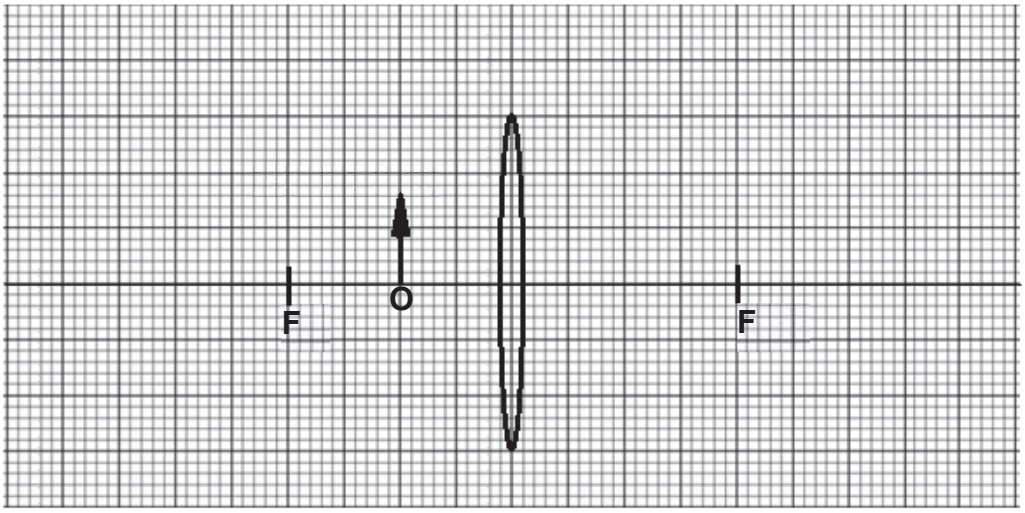


Fig. 8.1

(a) On Fig. 8.1,

(i) draw two rays from the top of the object to locate the top of image. [2]

(ii) draw and label the image **I**. [1]

(b) State how the rays show that the image is virtual.

……

……

…… [1]

(c) The object is move slightly away from the converging lens. State two changes that this will cause to the image.

1. ……

……

2. ……

……[2]

Section B [30 Marks]

Answer all questions in this section. Answer only one of the two alternative questions in **Question 11**. Write your answers in the spaces provided on the question paper.

9 In an experiment to find out the cooling effect of moving air, 2 kg of water was gently heated and left to cool. When the water reached a temperature of 40 °C, its temperature at each minute was measured and recorded for the next 5 min.

In the first run, there was no wind. In the second run, the water was placed in front of a fan which was switched to low speed. In the third and fourth runs, the fan was subsequently switched to medium and high speeds respectively. The results of the experiment are shown in the table below.

Wind speed	Water temperature/ °C				
	1 min	2 min	3 min	4 min	5 min
No wind	37	35	34	33	32
Low speed	36	34	33	32	31
Medium speed	35	32	30	28	27
High speed	34	30	28	26	25

(a) Explain why the temperatures need to be recorded when there is no wind.

.....

..... [1]

(b) It takes 4200 J of energy to increase or decrease the temperature of 1 kg of water by 1.0 °C.

Thus, calculate the drop in the temperature and the heat transferred from the 2 kg of water to the surrounding air over the period of 5 minutes. Record your answers in the table below. [4]

Wind speed	Temperature drop over 5 min/ °C	Heat transferred from water to air/ J
No wind		
Low speed		
Medium speed		
High speed		

(c) When the fan was switched to high speed, calculate how much more heat is lost over the 5 minutes period due to the moving air as compared to no wind for 2 kg of water.

heat lost = ... [1]

(d) Assume the speed of the moving air at high speed is 10 km/h.

Using the information from the experiment, estimate the total heat loss by the water in an hour if the wind speed is increased to 20 km/h.

heat lost = ... [2]

(e) State whether the heat loss calculated in **9(d)** is an overestimate or an underestimate and briefly explain the reason(s).

.....

.....

.....

.....

..... [2]

10 Fig. 10.1 shows a blower unit connected to a thermistor and a d.c. power source. The blower unit has a constant resistance of 480 Ω. The resistance of the thermistor is shown in the graph in Fig. 10.2.

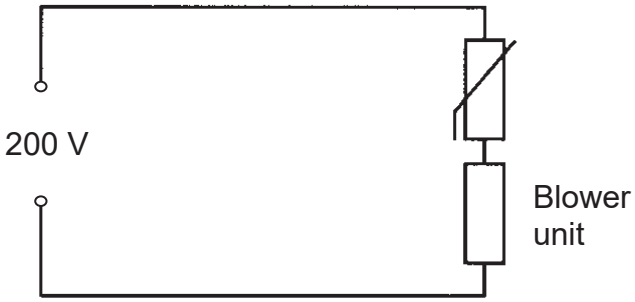


Fig. 10.1

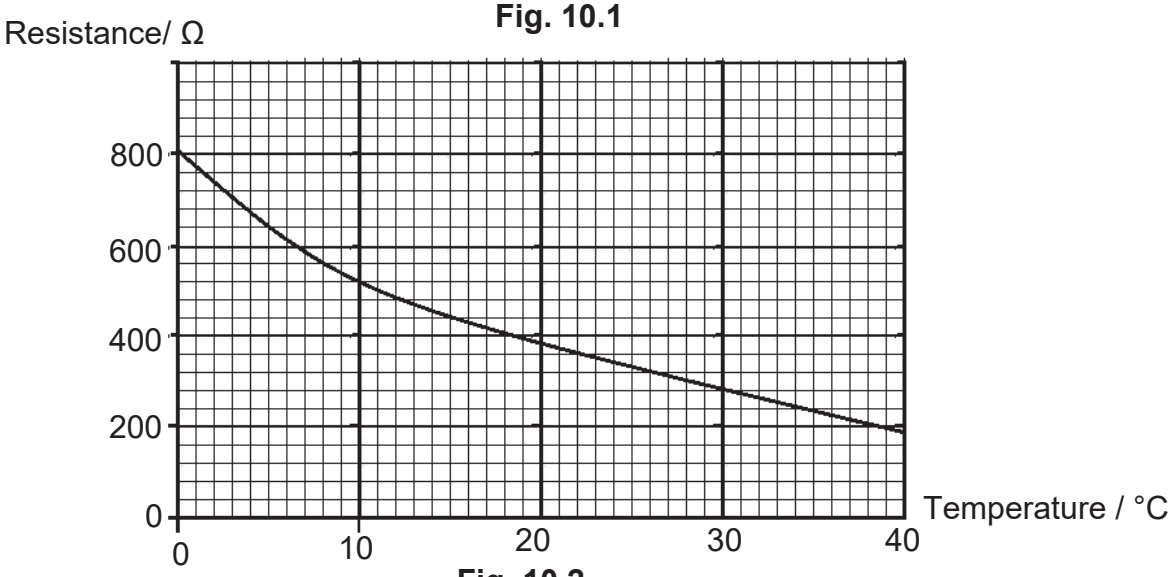


Fig. 10.2

(a) Use the graph to determine the resistance of the thermistor when the room temperature is at 20 °C.

..... [1]

(b) Calculate the current through the blower unit when the room temperature is at 30 °C.

current through the blower unit = ... [2]

(c) Explain how the speed of the blower unit changes when the room temperature increases.

……..……..

……..……..

……..……..

……..…….

……..…… [2]

(d) The blower unit needs a minimum of potential difference of 120 V to operate.

Determine the minimum room temperature that the blower unit will start to operate.

minimum temperature = ... [2]

(e) Explain how this circuit is suitable in operating an outdoor blower unit for both day and night operations.

……..……..

……..……..

……..……..

……..……..

……..……..

……..…… [3]

11 EITHER

Fig. 11.1 shows a coil in a magnetic field. The coil is able to rotate about the axis. The ends **X** and **Y** of the coil is connected directly to a d.c. power supply. The arrows on the sides of the coil shows the direction of the current in the coil.

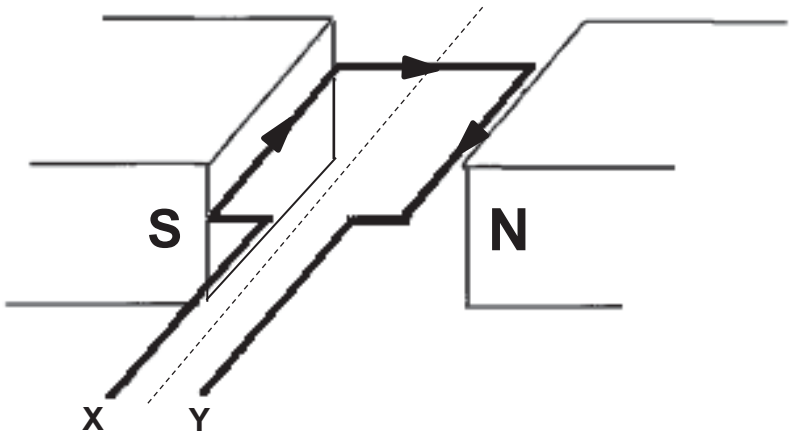


Fig. 11.1

(a) On Fig. 11.1, draw arrows to show the directions of the forces acting on both sides of the coil. [1]

(b) Describe the motion of the coil until it comes to rest.

……

……

……

…… [2]

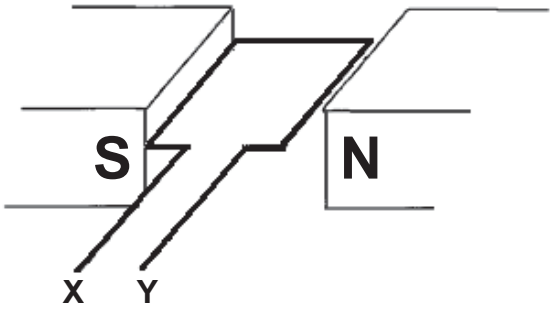


Fig. 11.2

(c) On Fig. 11.2, draw a split ring commutator and brushes connected to **X** and **Y**. Complete the diagram to show an electric circuit using symbols which include a direct current supply and a switch. [3]

(d) Explain why the coil rotates continuously when the split ring commutator is used.

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……[4]

11 OR

Fig. 11.3 shows a magnet, two compasses and two nails.

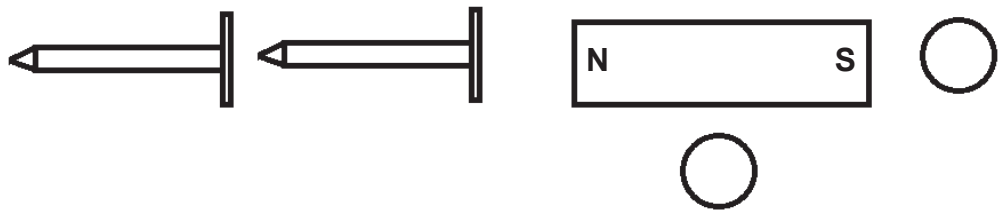

Fig. 11.3

(a) On Fig. 11.3, draw an arrow in each compass to show the direction of the magnetic field of the magnetic field in two positions. [2]

(b) The magnet causes the nails to become magnetised by induction. Both ends of each nail becomes magnetic poles.

On Fig. 11.3, mark **N** or **S** to both ends of each nail to show the magnetic poles. [2]

(c) When the magnet is removed, the nails are still magnetised.

Describe a method to test whether the nails are still magnetised when they are away from the magnet.

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……

……

…… [1]

Fig. 11.4 shows a solenoid carrying a current. The current in the solenoid create a magnetic field.

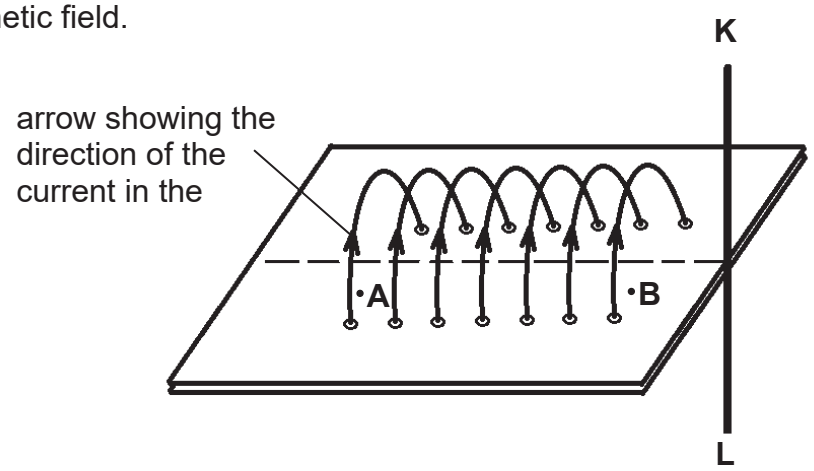


Fig. 11.4

(d) A magnetic field line passes through **A** and **B**.

On Fig. 11.4, draw this magnetic field line both inside and outside the solenoid. Draw an arrow on the line to show the direction of the magnetic field. [2]

(e) State how the pattern of the magnetic field lines inside the solenoid changes when the strength of the magnetic field increases.

……

……

……

…… [1]

(f) Fig. 11.4 shows a vertical wire **KL** next to the end of the solenoid. The wire is connected to a circuit and there is current downwards in the wire, from **K** to **L**. The current in the solenoid is shown in Fig. 11.4.

Describe how the direction of the force on wire **KL** can be determined.

……

……

……

……

……

……

……[2]

***** End of Paper *****

Sec 4E Express (Physics) Prelim Exam Marking Scheme 2018

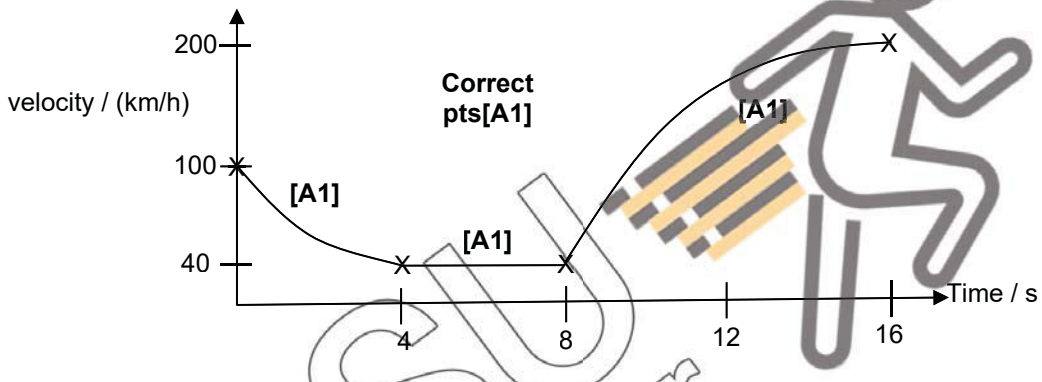
P1 MCQ:

Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans
1	**C**	6	**A**	11	**A**	16	**B**	21	**B**	26	**A**	31	**A**	36	**C**
2	**D**	7	**A**	12	**B**	17	**A**	22	**C**	27	**A**	32	**A**	37	**A**
3	**B**	8	**B**	13	**C**	18	**B**	23	**A**	28	**D**	33	**D**	38	**B**
4	**C**	9	**C**	14	**B**	19	**C**	24	**C**	29	**D**	34	**A**	39	**C**
5	**D**	10	**B**	15	**D**	20	**B**	25	**C**	30	**A**	35	**B**	40	**A**

P2 Section A:

1(a) constant rate of change of velocity or constant change of velocity per unit time **[A1]**

1(b)



2(a) F = ma = 2 x 0.25 = 0.5 N [A1]
Friction from 0-3 s = 1 - 0.5 = 0.5 N [A1]

2(b) F net = 0.5 – 0.5 = 0 N, no net force so no acceleration, 0 m/s^2 **[B1]**

2(c) speed of box at t = 3 s, = 3 x 0.25 = 0.75 m/s **[A1]**
Acceleration = (0 - 0.75)/2 = -0.375 m/s^2
Braking force + friction = 0.375 x 2 = 0.75 N **[A1]**
Braking force = 0.75 – 0.5 = 0.25 N **[A1]**

3(a) 5.0 N at 50 cm mark on figure**[A1]**

3(b) Using principle of moments about point Q,
Sum of anticlockwise moments = sum of clockwise moments
15.0 N x 0.8 m + 5.0 N x 0.5 m = F_A x1 m **[A1]**
F_A = 12+2.5 = 14.5 N**[A1]**

3(c) 20 – 14.5 = 5.5 N**[A1] ecf 3b**

3(d) The spring force at B will decrease.**[A1]** Clockwise moment about point P caused by the 15 N moving towards P decreases with a lesser moment arm. The anti-clockwise moment produced by the spring force to balance the rod will also decrease. **[A1]**

4(a) Point A is located any where along the base of the tank in figure**[A1]**

4(b) 60/0.5 = 120 Pa **[A1]**

4(c) hpg = 0.5 x 10 x 1000 = 5000 Pa **[A1]**
Total pressure = **120** + 5000 = 5120 Pa **[A1] ecf 4b**

4(d) $P_1 V_1 = P_2 V_2$
$(5120)(0.0122) = P_2 (0.013)$ **[A1]**
$P_2 = 4800$ Pa **[A1]**3sf

5(a) Teacher uses Y shift to move the trace 4 divisions from the bottom of screen to the middle of screen.**[A1]**
Teacher adjust the Y gain from 10 V/ div to 5 V/div to stretch the wave in the vertical direction.**[A1]**
Teacher adjust the time base 4 ms/ div to 2 ms/div to stretch the wave in horizontal direction. **[A1]**

5(b) period T = 2 division x 2 ms /div = 4 ms **[A1]**
f = 1/0.004 = 250 Hz **[A1]**

5(c) The amplitude of the sound on CRO screen will increase. **[A1]**
The frequency will decrease (less frequent) as pitch lower **[A1]**

6(a) Charge rod brought near to uncharged metal sphere but not touching it. **[A1]**
The connection to earth is connected to the opposite end of the metal sphere and it is then removed. **[A1]** The charged rod is now removed, the metal sphere becomes negatively charged. **[A1]**

6(b) The free electrons are initially attracted by the positively charged rod when it is brought near to the metal sphere. **[A1]** When the connection to earth is connected, the electrons will move from the earth to the metal sphere, resulting in excess electrons on the metal sphere. **[A1]** The metal sphere remains negatively charged after all connection and rod are sequentially removed.

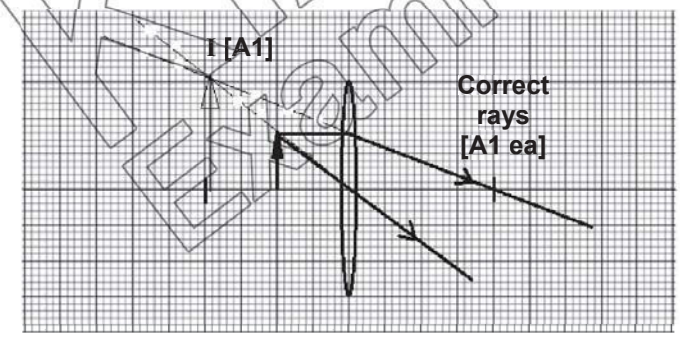
6(c) Charge = 1.2×10^{-9} C, time = 2.5 s
$Q = I t \Rightarrow I = 1.2 \times 10^{-9} / 2.5$ [A1] $= 4.8 \times 10^{-10}$ A **[A1]**

7(a) The alternating current generated by the power station at the primary coils.**[A1]**
This will induce an increasing magnetic field in the primary coil.[A1]
The increasing and changing magnetic field induces e.m.f. and a current in the secondary coils, giving 450000 V **[A1]**

7(b) ratio =Np/Ns = Vp/Vs = 30000: 450000 = 1:15**[A1]**

7(c) $I = P/V = 2 \times 10^3 / 450000 = 0.00444$ A **[A1]**
Power loss = $I^2R = (0.00444)^2 \times 1500 = 0.0296$ W **[A1]**

8(a)



8(b) The rays diverge and cannot converge to form an image. **[A1]**

8(c) The image will be larger **[A1]** The image will shift its position even further away from the object and the converging lens. **[A1]**

Section B

9(a) This is to determine the minimum amount of heat loss/ cooling effect/ change in temperature when there is no wind. **[A1]**

9(b)

Temp drop/ °C	Heat transferred/ J
8	67200
9	75600
13	109200
15	126000

[A1 per row]

9(c) 126000 – 67200 = 58800 J **[A1]**

9(d) Assuming the cooling effect is double for 20 km/h, the amount of heat lost in 5 min = 58800 x 2 = 117 600 due to wind and 117 600 x 12 = 1 411 200 J for 1 hour **[A1]** 67200 x 12 = 806 400 due to no wind. Total heat lost = 1 411 200 + 806 400 = 2 220 000 J **[A1]**

9(e) This is an overestimate as actual heat lost by water is less. **[A1]** The moving air might not be blowing over the water at an even manner and therefore it is not 100% efficient cooling system **[A1]** Can also say that the temperature difference between water and environment become less as more cooling takes place, thereby the rate of cooling is also greatly reduced.

10(a) 380 Ω**[A1]**

10(b) At 30 °C, thermistor R = 280 Ω.
Voltage across thermistor = 200 x (280)/(280+480) = 73.7 V **[A1]**
Current = 73.7 / 280 = 0.263 A **[A1]**

10(c) When the surrounding temperature increases, the resistance of the thermistor drops further. **[A1]** According to the potential divider rule, the blower unit will have a higher potential difference across it, resulting in a higher current and a higher speed. **[A1]**
Also accept overall resistance decreases thereby overall current increases.

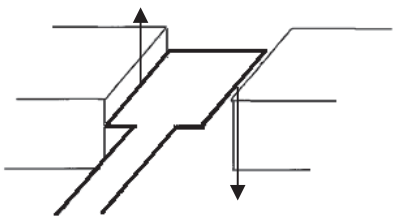
10(d) When blower is at 120 V, thermistor has a potential difference of 80 V across.
Resistance of thermistor:- R/(R+480) x 200 = 80
R = 0.4 R + 192
R = 320 Ω**[A1]**, According to graph, that occurs at <u>26 °C</u> **[A1]**

10(e) At day when temperature is higher, resistance of the thermistor is lower. The potential difference across blower unit is higher, thereby increasing blower speed.**[A1]**

At night, when temperature is lower and fall below 26°C, the resistance of the thermistor increases beyond 320 Ω and <u>potential difference across it rises above 80 V</u> **[A1]**. The potential difference across the blower unit <u>falls below operating voltage of 120 V</u> **[A1]**, blower is not operating.

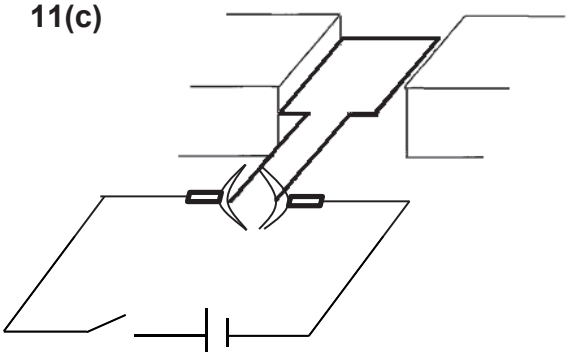
11 EITHER

11(a) [A1]



11(b) The coil rotates in a clockwise direction about its axis**[A1]** for about a maximum of 90 °. As the current is not reversed at this juncture, the coil continues to stay in the vertical position.**[A1]**

11(c)

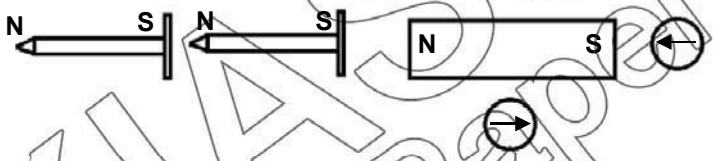


Correct shape of Commutator and brushes **[A1]**, circuit, battery and switch **[A1],** electrical connections (armature link correctly to commutator) **[A1]**

11(d) The split ring commutator changes the direction of the current every half a revolution **[A1]** A section of the coil rotates upwards due to an upward force caused by the magnetic field and the current. When the coil is at the vertical position, the current is instantaneously cut off as the split ring commutator is not in contact with the carbon brushes **[A1]**. The momentum carries the coil past the vertical position, the split ring commutator now contacts the carbon brushes on the other side and reverses the current direction. **[A1]** Using the Fleming's Left hand rule, there will be a downward force on the coil causing the coil to rotate about its axis continuously. **[A1]**

11 OR

(a & b)

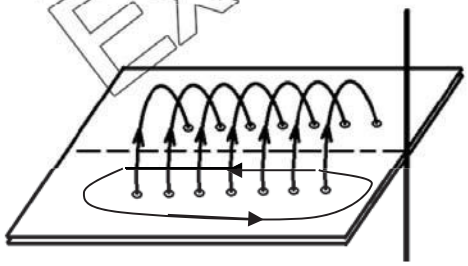


[A1 ea] 2 nail magnets and 2 compass directions

11(c) Place a non-magnetized iron filings/ iron paper clips near to the nail. When there is attraction, the nail is still magnetized **[A1]** or place a magnet near to the nail. And test both north and south poles towards the nail. If any of the poles is being repelled, the nail is magnetised.

Do not accept using nails themselves to test each other.

11(d)



[A1 ea an arrow and line inside and outside]

11(e) The number of magnetic field lines increases and the field lines becomes closer to one another **[A1]**

11(f) Using Fleming's Left hand rule, the direction of the magnetic field (represented by the index finger) is perpendicular to the current flow (represented by the middle finger) **[A1]**, the force generated as represented by the thumb is perpendicular to both the direction of the magnetic field and the current. **[A1]**