Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

PHYSICS **5059/01**

Paper 1 Multiple Choice **15 September 2014**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, highlighters, glue or correction fluid.
Write your name, index number and class on this paper and on the Answer Sheet in the spaces provided.

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.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
The use of an approved scientific calculator is expected, where appropriate.
Any rough working should be done in this booklet.

For examiner's use only:

Total	/ 40

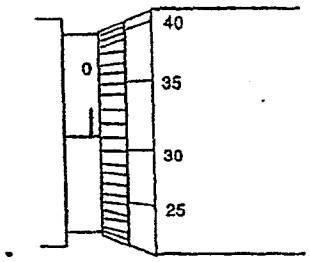
Overall weightings	Mark	%
Paper 1	40	
Paper 2A	50	
Paper 2B	30	

1 Which one of the following physical quantities is paired **wrongly**?

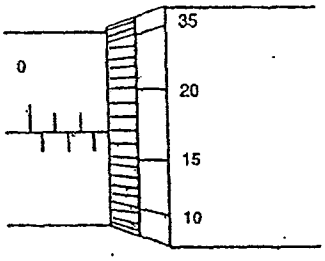
	Physical Quantity	Units
A	Pressure	$kg\ m^{-1}\ s^{-2}$
B	Energy	$kg\ m^{2}\ s^{-2}$
C	Charge	$A\ s^{-1}$
D	Resistivity	$\Omega\ m$

2 The diameter of a piece of wire is measured using a micrometer screw gauge.

A student takes an initial zero reading and then a reading of the diameter. The following figures show enlargements of the micrometer screw gauge readings.



Zero reading



Diameter reading

What is the diameter of the wire?

A 1.86 mm B 2.36 mm C 2.48 mm D 2.98 mm

3 A student dropped a metal sphere and a ping-pong ball from a thirty-storey building. The balls had the same volume and there was significant air resistance as the objects were falling.

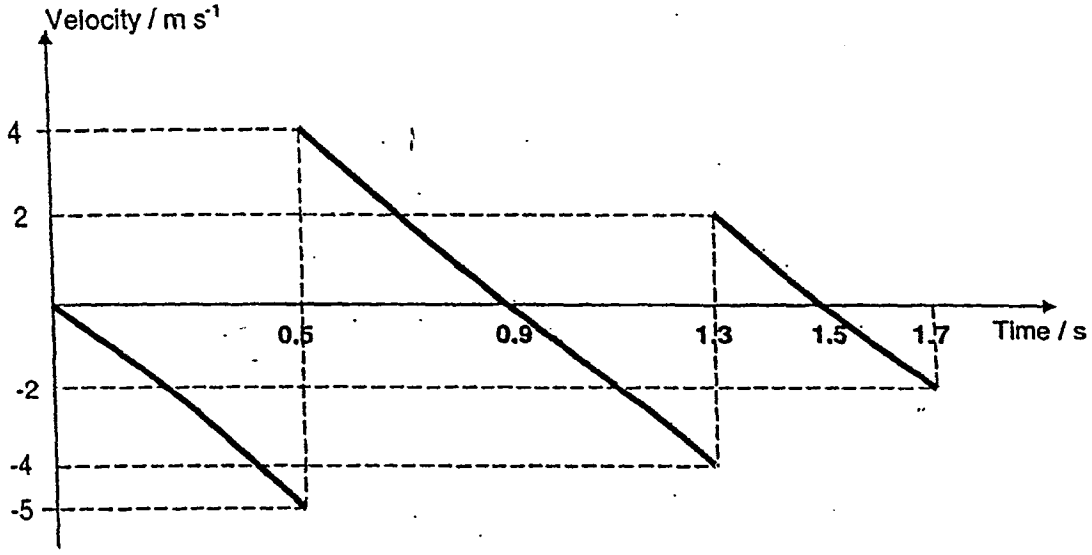
He made the following statements:

I The metal sphere will reach the ground first.
II Both objects will have the same initial acceleration.
III The ping-pong ball will have a greater final velocity than the metal sphere when it hits the ground.

Which of the statements are correct?

A I and II
B II and III
C I and III
D I, II and III

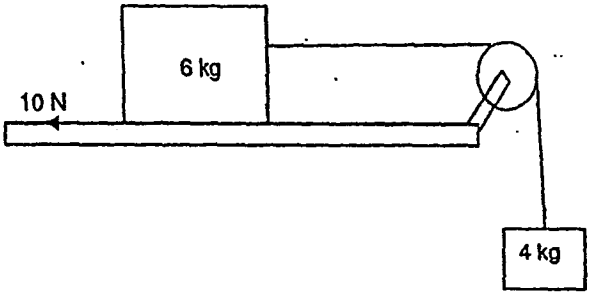
4 A ball is dropped from a height above a table. The ball hits the table and rebounds a few times before coming to rest. The velocity-time graph of the ball is shown below.



Calculate the initial height from the table from which the ball was released.

A 0.45 m B 0.80 m C 1.25 m D 2.05 m

5 The figure below shows a box of 6 kg sliding along a rough surface. A smaller box of 4 kg is pulling on the box of 6 kg. There is a friction of 10 N acting on the box.



Calculate the tension in the string.

A 8 N B 28 N C 30 N D 40 N

6 Which one of the following is **not** a vector quantity?

A Velocity
B Displacement
C Moment of a force
D Work done by a force

7 A ball falls vertically and bounces on the ground.

The following statements are about the forces acting while the ball is in contact with the ground.

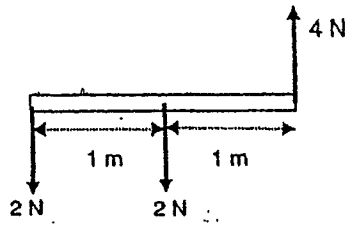
Which statement is correct?

A The force that the ball exerts on the ground is always equal to the weight of the ball.
B The force that the ball exerts on the ground is always equal in magnitude and opposite in direction to the force the ground exerts on the ball.
C The force that the ball exerts on the ground is always greater than the weight of the ball.
D The weight of the ball is always equal and opposite to the force that the ground exerts on the ball.

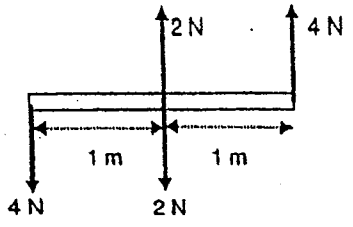
8 The figures below show forces acting on a beam with negligible weight.

Which of the beams is in equilibrium?

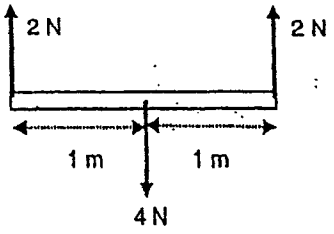
A



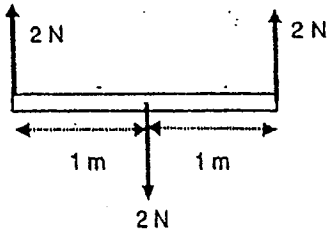
C



B



D



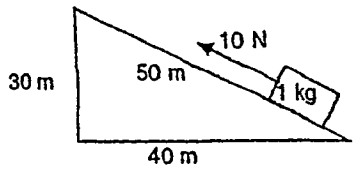
9 A student whose weight is 600 N runs up a flight of stairs 6 m high in 1 minute.

Calculate his useful output power.

A 60 W B 600 W C 3 600 W D 36 000 W

10 A 1 kg box is pulled up a slope at **constant speed** by a force of 10 N as shown in the figure.

Calculate the work done by the forces opposing the motion of the box.



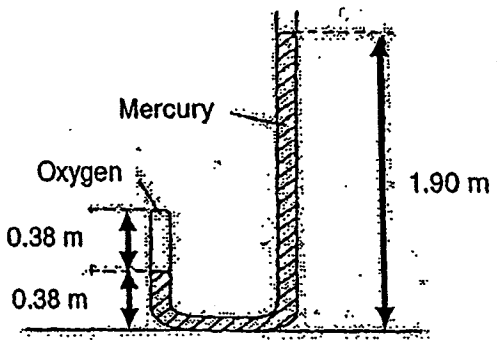
A 200 J B 300 J C 500 J D 800 J

11 The diagrams show to the same scale, the vertical sections of a set of circular vessels. Each vessel contains the same depth of water.

Which of the following statements is correct?

A The water exerts the greatest force on the bases of vessel P and Q.
B The water exerts the greatest force on the bases of vessel R and S.
C The water exerts the greatest pressure on the base of vessel S.
D The water exerts the same force on the base of each vessel.

12 The figure below shows oxygen compressed in the sealed end of a long U-tube by means of a column of mercury exposed to the atmosphere.



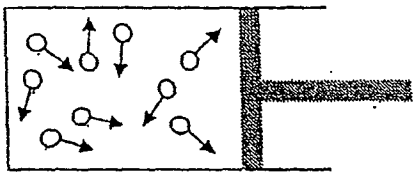
Given that atmospheric pressure is 0.76 m Hg, what is the pressure of the oxygen gas in m Hg?

A 1.14 m Hg B 1.52 m Hg C 2.28 m Hg D 2.66 m Hg

13 Which law or principle does Brownian Motion provide evidence for?

A Conservation of Energy
B Kinetic Theory
C Newton's Second Law of Motion
D Newton's Third Law of Motion

14 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the gas cylinder **remains constant** as the piston pushes outwards.



How do the speed of the gas molecules and the rate of collision with the piston compare with their initial values at the lower temperature?

	Speed of molecules	Rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

15 Which of the following processes of heat transfer involve a change in density?

A Conduction only
B Convection only
C Radiation only
D Conduction and convection

16 Which one of the following is **not** suitable for use as a temperature scale?

A the resistance of a metal wire
B the volume of a column of water
C the pressure of a fixed mass of gas at constant volume
D e.m.f. produced by junctions formed with wires of two different metals

17 When calibrating a liquid-in glass-thermometer, which of the following steps is **not** needed?

A Choosing two fixed points.
B Choosing a thermometric property that varies constantly.
C Ensuring that the room temperature is kept constant.
D Ensuring that the thermometer is calibrated at one atmospheric pressure.

18 In an experiment to determine the heat capacity of a liquid by an electrical method, a student obtained the following results:

Mass of liquid heated	1.5 kg
Initial temperature of liquid	300 K
Final Temperature of liquid	357 K
Power of heater	1,000 W
Time of heating	3 min

What is the heat capacity of the liquid?

A $35\ J\ kg^{-1}\ K^{-1}$
B $53\ J\ K^{-1}$
C $2\,100\ J\ kg^{-1}\ K^{-1}$
D $3\,200\ J\ K^{-1}$

19 5 g of steam at 100 °C is passed into a beaker of 500 g of water at 10 °C.

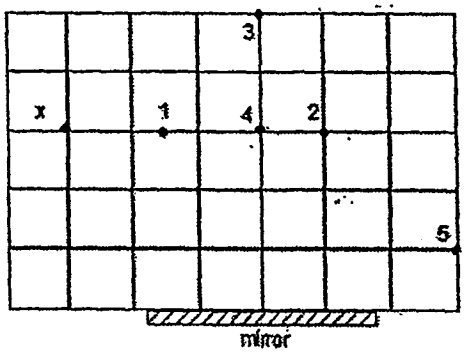
Ignoring the heat capacity of the beaker, calculate the **rise in temperature** of the beaker of water.

(Specific heat capacity of water = $4.2\ J\ g^{-1}\ K^{-1}$; specific latent heat of vaporisation of water = $2260\ J\ g^{-1}$)

A 6.2 °C B 16.2 °C C 22.6 °C D 77.4 °C

20 A person stands at point X as shown in the figure below.

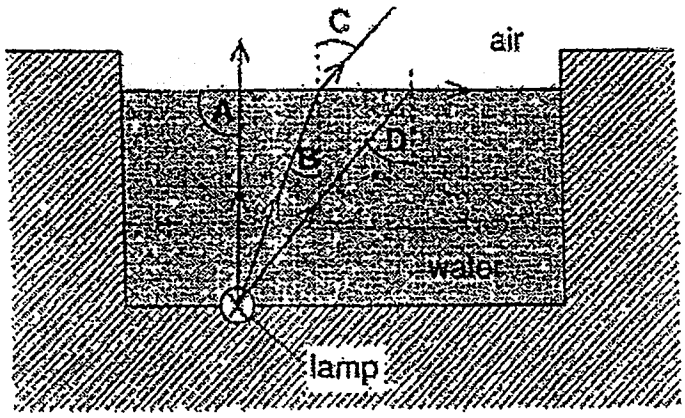
Which of the pins 1, 2, 3, 4 or 5, will the person be able to see in the mirror?



A Pins 1 and 3
B Pins 2 and 4
C Pins 2, 3 and 5
D Pins 2, 4 and 5

21 A swimming pool is lit by a lamp at the bottom of the pool. The directions of three rays of light from the lamp are shown.

Which of the marked angles is the critical angle for the light ray in water?



22 An object of height 5 cm is placed 20 cm behind a thin converging lens of focal length 10 cm. A real image is captured on the screen.

What is the change observed in the image formed as the object is moved further away from the lens?

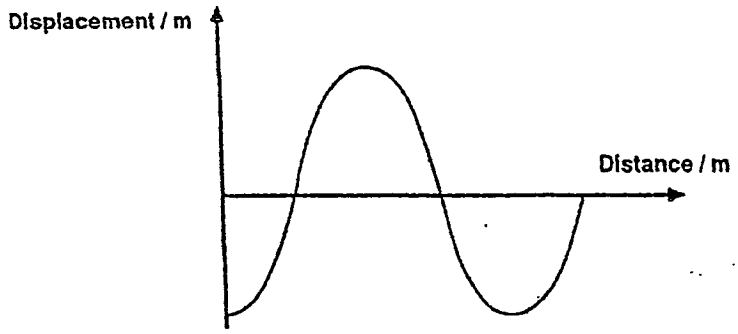
A The image size increases.
B The image size decreases.
C The image becomes brighter.
D The image becomes a virtual image.

23 A sound wave is traveling from air to glass.

How will the speed, frequency and wavelength change as it enters glass?

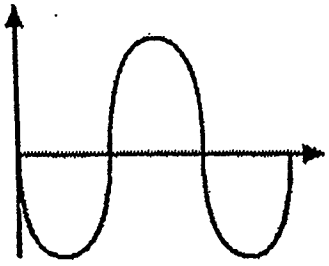
	Speed of wave	Frequency	Wavelength
A	increase	no change	increase
B	decrease	no change	decrease
C	no change	increase	decrease
D	no change	decrease	increase

24 A student generates a transverse wave in a long rope. The direction of propagation of the wave is to the right. The period of the wave produced is 4 s.

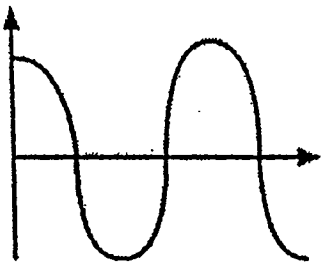


Which of the following diagrams correctly represents the shape of the rope **3 s** later?

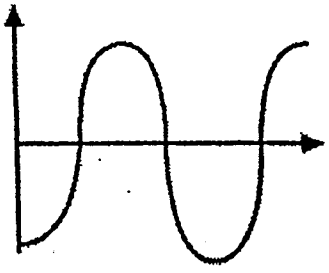
A



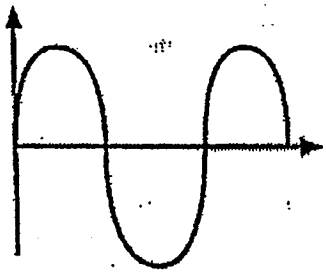
C



B



D



25 Below are four statements about the use of electromagnetic radiation.

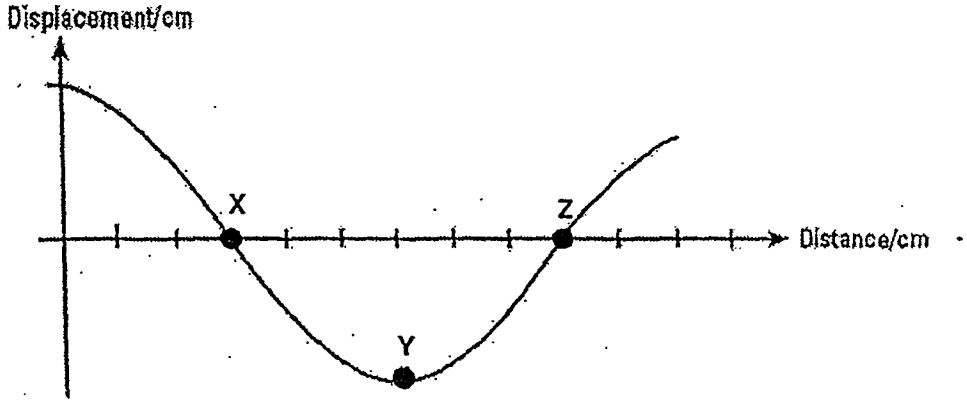
I Gamma rays are used in medical treatment.
II Ultra-violet waves are used in sunbeds.
III Microwaves are used in satellite TV.
IV X-rays are used in intruder alarms.

How many of the four statements are correct?

A 1 B 2 C 3 D 4

26 The figure below shows the displacement-distance graph of a sound wave. The sound wave is travelling to the right.

Three of the particles X, Y and Z in the sound wave are marked below.



Which particle(s) in the graph above is/are **centre(s) of rarefaction**?

(You may assume a displacement to the right as positive displacement and a displacement to the left as negative displacement.)

A Particle X
B Particle Y
C Particle Z
D Particles X and Z

27 Two notes of different loudness but the same pitch are played on a musical instrument.

The two sound waves produced will have

A the same amplitude and the same speed.
B the same frequency and different speeds.
C different amplitudes and the same speed.
D different amplitudes and different speeds.

28 Ships use sound waves to find the vertical distance to the seabed. A pulse of sound waves is sent out and the echoes are detected.

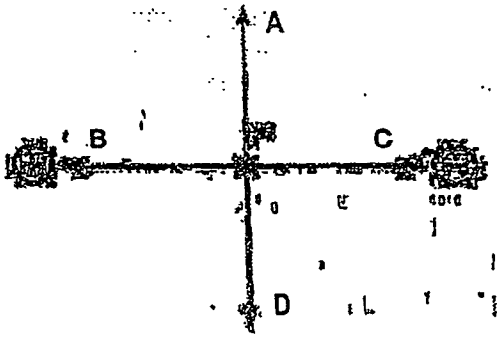
A ship emits a pulse of waves lasting 0.50 s. The waves have a frequency of 3600 Hz.

How many complete wavelengths does the pulse contain?

A 1800 B 3600 C 7200 D 18 000

29 An electric field acts between two charges as shown.

In which direction does the electric field act at the point P?



30 A light metal sphere is attracted by a negatively-charged rod. What can be concluded about the light metal sphere?

A It is negatively charged.
B It is positively charged.
C It is electrically neutral.
D It is not possible to determine the charge of the sphere.

31 A circular wire with length *l* and diameter D has resistance of 10 Ω.

What is the resistance of another circular wire made of the same material but with length 4*l* and diameter 2D?

A 5.0 Ω B 10 Ω C 20 Ω D 40 Ω

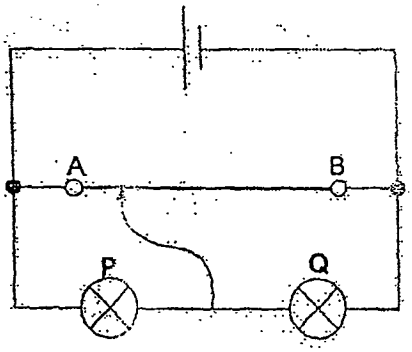
32 Voltage-current readings were obtained for different electrical components.

Which readings are for a 3 V, 0.06 A torch bulb?

A	voltage / V	0	1	2	3
	current / mA	0	6	12	18
B	voltage / V	0	1	2	3
	current / mA	0	25	45	60
C	voltage / V	0	1	2	3
	current / mA	0	20	40	60
D	voltage / V	0	1	2	3
	current / mA	0	10	20	30

33 A resistance wire AB is connected in a circuit as shown.

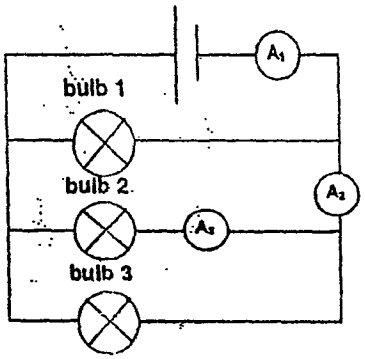
What happens to the brightness of the lamps, P and Q, as the jockey slides along the resistance wire from point A to point B?



A Lamp P gets brighter while lamp Q gets dimmer.
B Lamp Q gets brighter while lamp P gets dimmer.
C There is no change in the brightness of lamp P or Q.
D Both lamp P or Q do not light up.

34 A circuit with three identical light bulbs is shown below.

The light bulbs are all working initially. What happens to the readings on the ammeters A_1, A_2 and A_3 when **bulb 3** suddenly blows?



	Ammeter A_1	Ammeter A_2	Ammeter A_3
A	increase	increase	increase
B	decrease	decrease	increase
C	decrease	decrease	no change
D	increase	increase	no change

35 The fuse in a particular circuit 'blows' regularly.

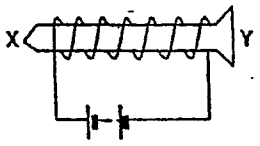
This could be because there is a direct connection between

I live and neutral.
II live and earth.
III earth and body of the appliance being used.

Which of the following statements are correct?

A Only III B I and II C I and III D I, II and III

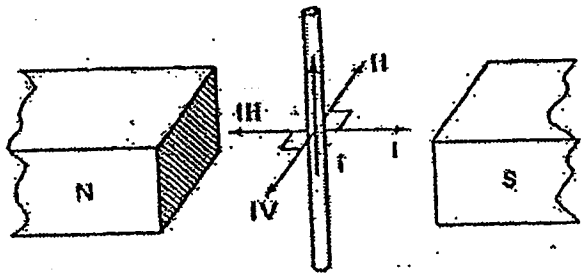
36 A soft iron nail, XY, is placed within a current carrying solenoid for a short while as shown below.



When the nail is removed from the solenoid, which of the following is true?

A End X will be able to repel a similar copper nail.
B End X will be attracted to the north-seeking pole of a bar magnet.
C End Y will be repelled by the south-seeking pole of a bar magnet.
D End Y will point to the North Pole of the earth when freely suspended.

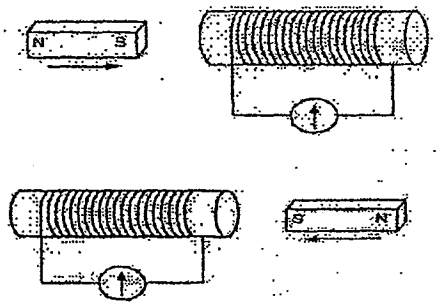
37 A current carrying conductor (carrying a current, i) is placed between two magnetic poles as shown.



The direction of the force acting on the wire is

A along direction I.
B along direction II.
C along direction III.
D along direction IV.

38 In the figure below, the galvanometer initially deflects to the right with a reading of 10 mA. The south pole of the same magnet is later pushed towards the coil from the other side **at a slower rate** as shown.



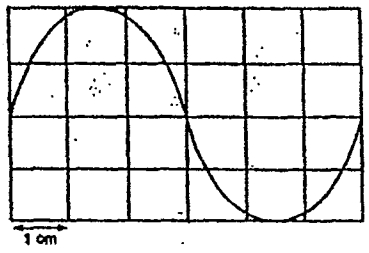
The direction of the galvanometer will be

A less than 10 mA to the right.
B less than 10 mA to the left.
C more than 10 mA to the left.
D more than 10 mA to the right.

39 In some countries, electricity is transmitted at a very high voltage over a distance using overhead cables. Why is this high voltage an advantage?

A Electricity can travel faster along the cables.
B It is safer for engineers to repair cables.
C It makes the cables stronger.
D There is less energy loss in the cables.

40 An a.c. voltage is seen on the screen of a c.r.o. shown in the figure below.



The time base is set at 15 ms cm^{-1}, and the Y-gain is set at 2.0 V cm^{-1}.

Calculate the frequency of the wave.

A 0.011 Hz B 0.031 Hz C 11 Hz D 22 Hz

CATHOLIC HIGH SCHOOL
Secondary 4 - Preliminary Examination 3 (2014)
PHYSICS 5059

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

Section 2A	/ 50

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

PHYSICS **5059/02**

Paper 2 Theory

15 September 2014
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Section A
Answer all questions.

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

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
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.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For examiner's use only:

Section 2A	/ 50
Section 2B	/ 30
Total	/ 80

Overall weightings	Mark	%
Paper 1	40	
Paper 2A	50	
Paper 2B	30	

Section A

For Examiner's Use

Answer all the questions in this section.

1 A swimming pool is filled with 450 m^3 of water at 12 °C.

The density of water is 1000 kg / m^3 and the specific heat capacity of water is 4.2 J / (g °C).

(a) Calculate the mass of water in the swimming pool.

mass = _____ [2]

(b) **(i)** Calculate the thermal energy (heat) needed to raise the temperature of the water to 27 °C.

thermal energy = _____ [2]

(ii) Suggest one reason why the thermal energy supplied to the water by the heating system, when raising the temperature of the water to 27 °C, differs from the value calculated in (i).

_____

_____ [1]

For Examiner's Use

2 (a) A girl of weight 550 N is playing on a see-saw with her brother. Fig. 2.1 shows her brother of weight *W* sitting 1.1 m to the right of the balance point.

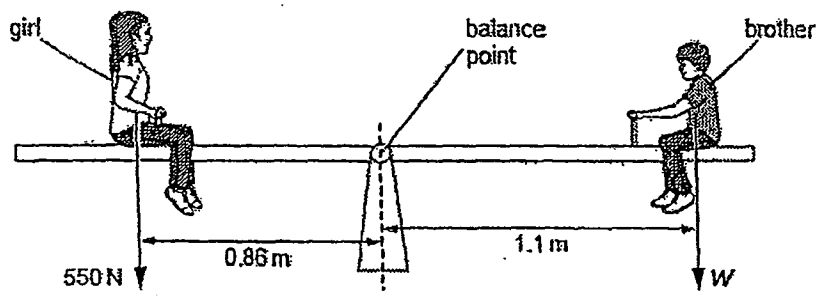


Fig. 2.1 (not to scale)

The see-saw is balanced when the girl sits 0.86 m to the left of the balance point. The gravitational field strength is 10 N / kg.

(i) State what is meant by *the gravitational field strength is 10 N / kg.*

_____

_____ [1]

(ii) Calculate the mass of the brother.

mass = _____ [2]

(iii) The girl and her brother slide equal distances along the see-saw away from each other.

Describe and explain what happens.

_____

_____

_____

_____ [3]

For Examiner's Use

(b) Fig. 2.2 and 2.3 below illustrate the rest position and the displaced position of a toy. G is its centre of gravity.

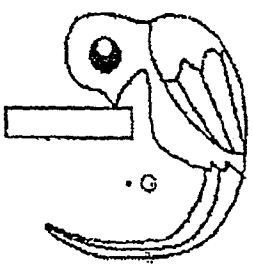


Fig. 2.2

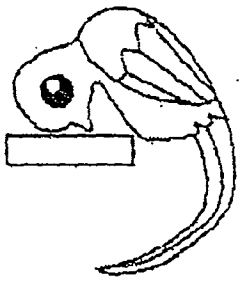


Fig. 2.3

(i) Explain briefly why the toy returns to its rest position when displaced and released.

_____

_____

_____ [2]

(ii) What type of equilibrium is the toy in?

_____ [1]

For Examiner's Use

3 Fig. 3.1 shows an elevator (lift) that is supported by a cable.

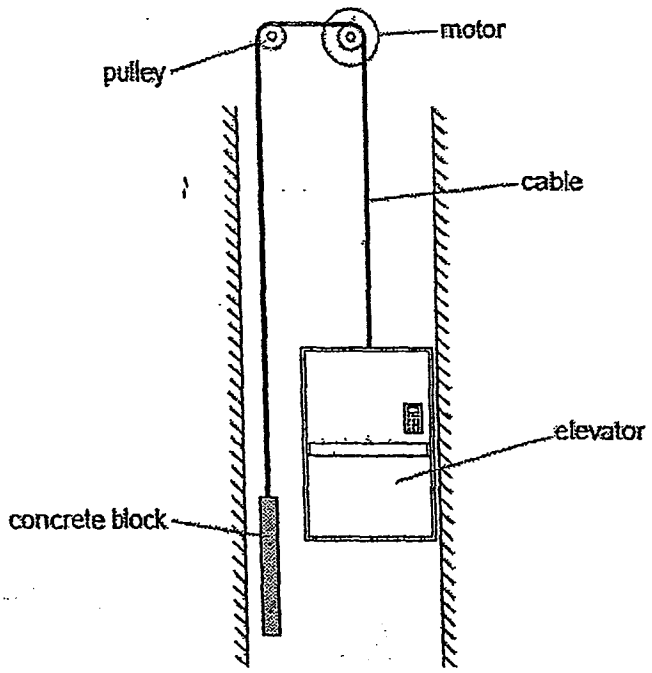


Fig. 3.1 (not to scale)

The cable passes around the axle of an electric motor and over a pulley. The cable is then attached to a concrete block that has the same mass as the empty elevator. As the elevator moves up, the concrete block moves down.

(a) Explain why very little work is done by the electric motor when lifting up the empty elevator.

_____

_____

_____ [2]

(b) Several people of total weight 4900 N are travelling upwards at constant speed in the elevator. They rise through a distance of 24 m in 28 s.

Calculate the minimum power output of the electric motor.

power = _____ [2]

For Examiner's Use

4 Fig. 4.1 shows a skydiver, of weight 700 N, falling towards the Earth at constant speed, a long time after jumping from an aeroplane.

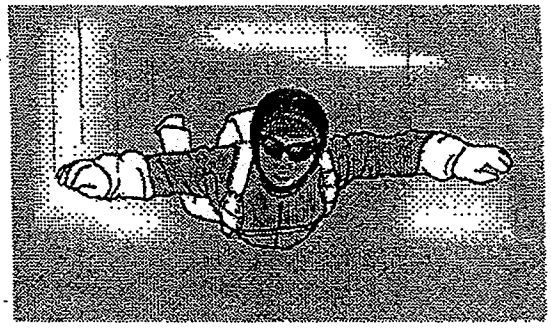


Fig. 4.1

At time $t = 0$, he receives a radio signal. He opens his parachute 12 s later. Fig. 4.2 is the speed-time graph for the skydiver.

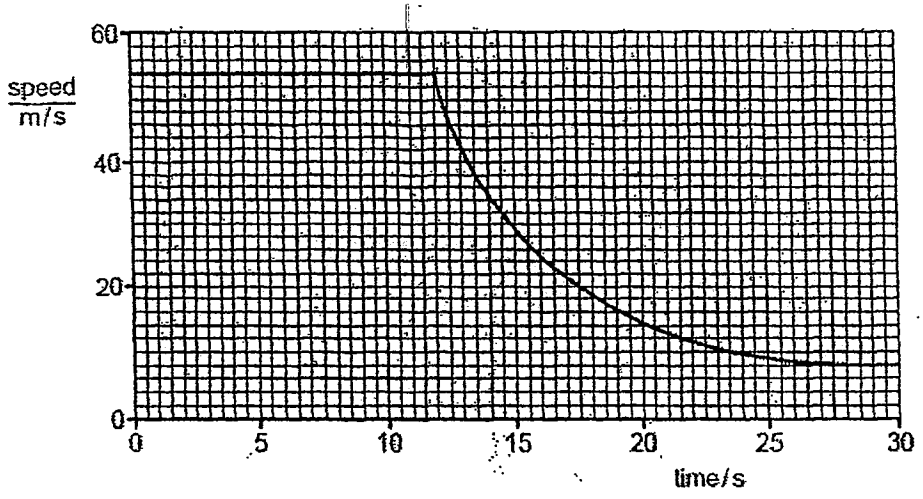


Fig. 4.2

(a) (i) As he jumps from the aeroplane initially, the skydiver is undergoing free-fall.

State what is meant by *the skydiver is undergoing free-fall.*

_____

_____ [1]

(ii) State the initial acceleration of the skydiver, as he initially jumps from the aeroplane.

_____ [1]

For Examiner's Use

(b) State the size of the air resistance acting on the skydiver between $t = 0$ and $t = 12$ s.

_____ [1]

(c) As he falls at constant speed, his gravitational potential energy changes into another form. State the name of this other form of energy.

_____ [1]

(d) (i) Using Newton's Laws of Motion, state and explain the effect on the motion of the skydiver of opening the parachute.

_____

_____

_____

_____ [3]

(ii) As the skydiver is undergoing the motion as stated in (i), according to Newton's Laws of Motion, the weight of the skydiver is one of the two forces that form an action-reaction pair of forces.

In the space below, illustrate these two forces by drawing a pair of free-body diagrams. [2]

For Examiner's Use

5 (a) Fig. 5.1 shows equipment placed on top of a house that uses solar energy to produce hot water.

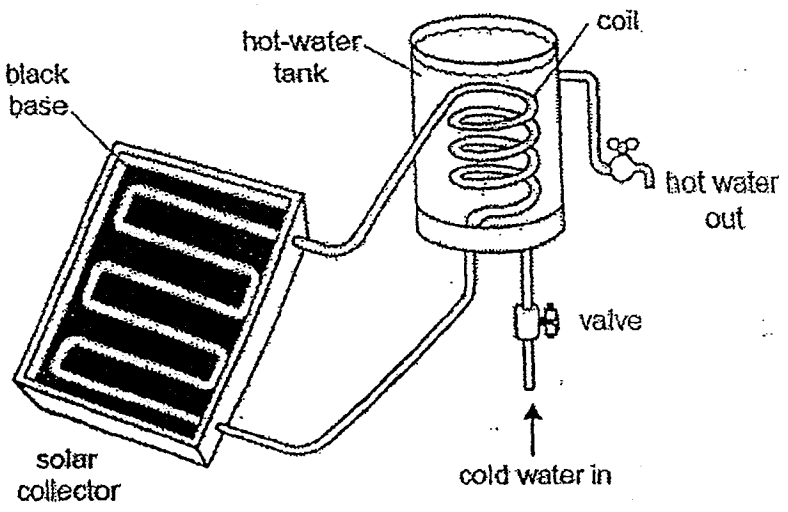


Fig. 5.1

(i) Explain why the solar collector has a black base.

_____

_____

_____ [2]

(ii) State and explain why the hot water in the solar collector travels to the hot-water tank.

_____

_____

_____ [2]

For Examiner's Use

(b) One type of renewable energy source is shown in Fig. 5.2.

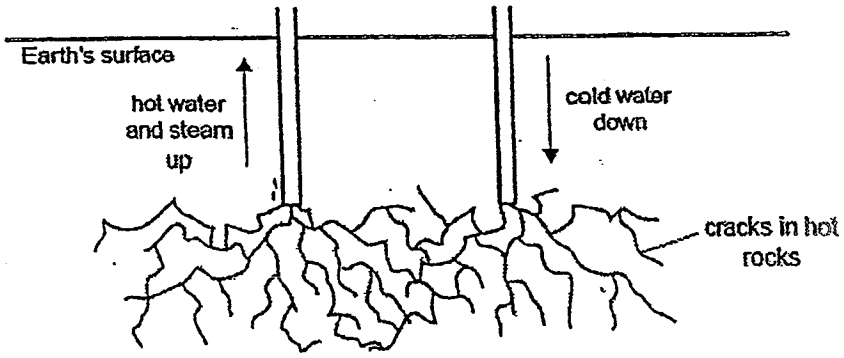


Fig. 5.2

(i) State the name of the renewable energy source shown in Fig. 5.2.

_____ [1]

(ii) State what is meant by a *renewable energy source*.

_____

_____ [1]

For Examiner's Use

6 Fig. 6.1 shows the arrangement of atoms in a solid block.

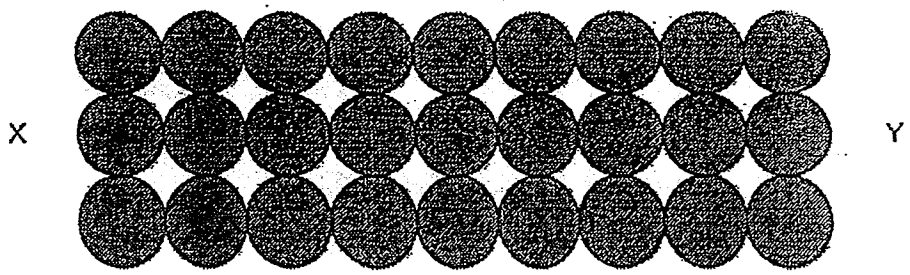


Fig. 6.1

(a) End X of the block is heated. Energy is conducted to end Y, which becomes warm.

(i) Explain how heat is conducted from X to Y by the atoms.

_____

_____

_____ [2]

(ii) Explain why the solid block expands when it is heated.

_____

_____ [1]

(b) The block is heated and becomes a liquid.

Describe the changes that occur to the arrangement and the motion of the atoms.

_____

_____

_____ [2]

For Examiner's Use

7 Fig. 7.1 shows a glass lens in air and its two focal points F_1 and F_2.

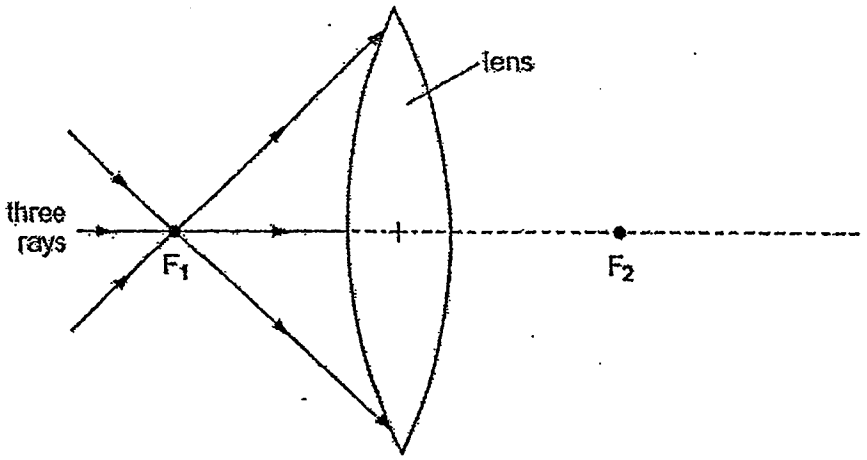


Fig. 7.1

Three rays of light pass through F_1 to the lens.

(a) On Fig. 7.1, continue the three rays through the lens and into air. [2]

(b) State what happens to the speed of light on

(i) entering the glass lens from air,

_____ [1]

(ii) leaving the lens and returning to the air.

_____ [1]

(c) Light having wavelength 0.060 nm travels in air at a speed of 3.0×10^8 m / s.

(i) Calculate the frequency of this light.

frequency = _____ [1]

(ii) Explain the effect, if any, on the frequency as the light enters the glass from air.

_____

_____ [1]

For Examiner's Use

8 A microwave oven is rated at 650 W and is connected to a 230 V mains supply.

(a) Calculate and suggest a rating of the fuse for use with this oven.

fuse rating = _____ [2]

(b) The insulation of the mains cable has worn away. The live wire touches the outer metal casing of the microwave oven.

(i) Explain the hazard that results if the outer metal casing is not earthed.

_____

_____

_____ [2]

(ii) Explain how connecting the earth wire to the outer casing and using a fuse of a suitable rating removes this hazard.

_____

_____

_____ [2]

Section 2B	/ 30

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

PHYSICS **5059/02**

Paper 2 Theory

15 September 2014
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

For Examiner's Use

Section B

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

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

9 Fig. 9.1 below contains data about a real transformer. The load resistor, connected to the secondary coil, is varied to obtain the readings.

	column 1	2	3	4	5	6	7	8
	primary turns	secondary turns	input voltage / V	output voltage / V	load resistance / Ω	input current / A	output current / A	output power / W
row 1	120	240	6.00	0.57	1.0	1.14	0.57	0.33
2	120	240	6.00	4.00	10.0	0.80	0.40	1.60
3	120	240	6.00	6.00	20.0	0.60	0.30	1.80
4	120	240	6.00	7.20	30.0	0.48	0.24	1.73
5	120	240	6.00	7.64	35.0	0.44	0.22	1.67
6	120	240	6.00	12.0	very large	0.00	0.00	0.00

Fig. 9.1

(a) (i) In the space on the following page, draw a labelled diagram of a transformer. Your diagram should show
- the structure of the transformer,
- the connection of a suitable power supply,
- the load resistor,
- meters that allow the measurements in columns 3, 4, 6 and 7 to be made. ***Label clearly*** each meter to show which measurement it makes.

[2]

For Examiner's Use

(ii) Explain briefly how a transformer works.

_____

_____

_____

_____ [2]

(b) (i) Explain the effect of increasing the load resistance on the **output current.**

_____

_____ [1]

(ii) State what effect increasing the load resistance has on

1. the **input current.**

_____ [1]

2. the **output power.**

_____ [1]

(c) When the load resistor is 10.0 Ω, calculate the fraction of the input power that is wasted in the transformer.

For Examiner's Use

fraction of input power wasted = _____ [1]

(d) Discuss briefly whether columns 1, 2, 3 and 4 suggest that the transformer is a step-up or a step-down transformer.

_____

_____

_____ [2]

For Examiner's Use

10 (a) Fig. 10.1 shows a design for a simple circuit breaker.

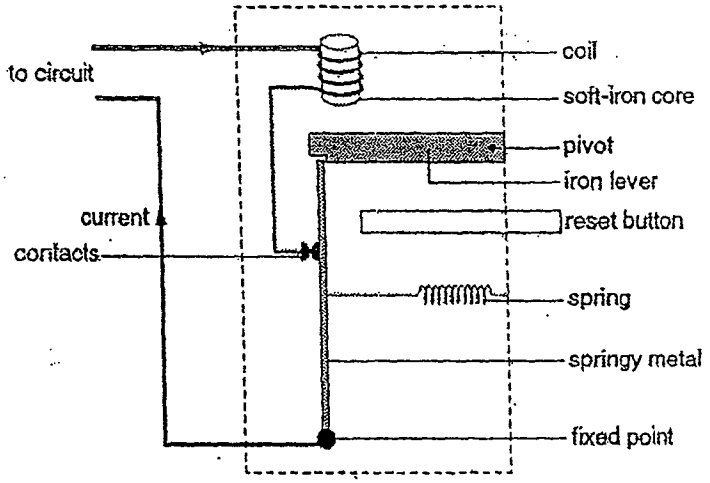


Fig. 10.1

(i) When there is a large current in the circuit, the circuit breaker operates.

Explain what happens to the soft-iron core, iron lever, spring and contacts.

[3]

(ii) The current now stops.

Explain what happens to the soft-iron core, iron lever, spring and contacts.

[2]

(iii) State how the current is switched on again after the circuit breaker has operated.

[1]

For Examiner's Use

(b) A teacher sticks a magnet to the top surface of a match-box cover. The bottom surface is placed in a small tray of iron paperclips. As the match-box cover is lifted up, a large number of paperclips are held on the bottom surface, as shown in Fig. 10.2.

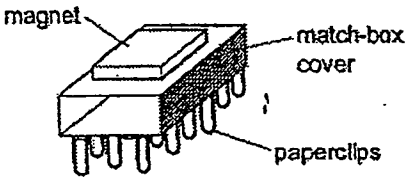


Fig. 10.2

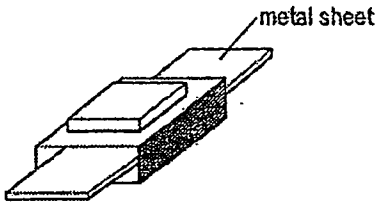


Fig. 10.3

Sheets of metal are placed inside the match-box cover, between the magnet and the paperclips, as shown in Fig. 10.3.

(i) When a particular sheet X is placed inside, the paperclips **stay attached**. Suggest what metal is the sheet X made from.

_____ [1]

(ii) When a particular sheet Y is placed inside, all the paperclips **fall off**.

1. Suggest what metal is the sheet Y made from.

_____ [1]

2. By drawing the magnetic field lines of forces below on Fig. 10.4 below, explain why the paperclips **fall off** when sheet Y is placed inside.

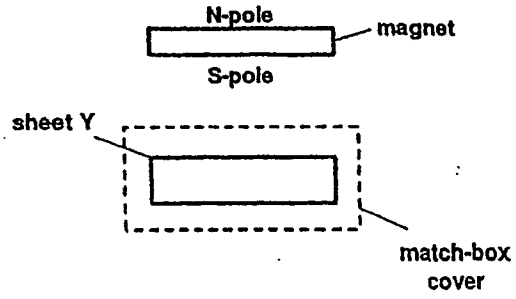


Fig. 10.4

_____

_____ [2]

For Examiner's Use

11 EITHER

(a) Describe how a simple hydraulic press works. In your account,

- give a labelled diagram of the setup,
- state the readings that are required,
- explain briefly the principle behind the simple hydraulic press.

[4]

(b) A student goes for a walk in the mountains. During a storm, she sees lightning strike a hillside in the distance. Several seconds later, she hears the thunder caused by the lightning.

(i) Explain why she hears the thunder several seconds after she sees the lightning.

[1]

For Examiner's Use

(ii) The student knows the distance to the hillside. She waits for lightning to strike the hillside again. Describe how she can determine a value for the speed of sound in air.

_____

_____

_____ [2]

(iii) The student is unsure whether the thunder she heard can be considered as an echo or ultrasound.

Explain the difference between an *echo* and *ultrasound*.

_____

_____

_____ [2]

(iv) After the storm, the student sees a rainbow.

State the colours of the spectrum of the rainbow in order of **increasing wavelength**.

_____

_____ [1]

11 OR

For Examiner's Use

(a) Describe an experiment to show the difference between an electrical insulator and an electrical conductor. In your account,

- give a labelled diagram of the setup,
- explain what will be observed,
- name one example of each.

[4]

For Examiner's Use

(b) A 600 Ω resistor and a thermistor are connected in series with an ammeter and a 20 V d.c. (direct current) power supply. A voltmeter is in parallel with the resistor.

The resistance of the thermistor decreases with temperature.

Fig. 11.1 is the circuit diagram.

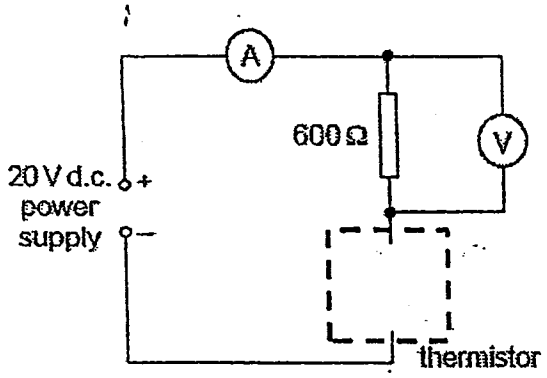


Fig. 11.1

The ammeter reads 0.025 A.

(i) On Fig. 11.1, draw the circuit symbol of a thermistor in the dotted box. [1]

(ii) Calculate

1. the reading on the voltmeter,

reading = _____ [1]

2. the resistance of the thermistor.

resistance = _____ [2]

(iii) The temperature of the thermistor increases.

Explain what, if anything, happens to the ammeter reading and to the voltmeter reading.

_____

_____

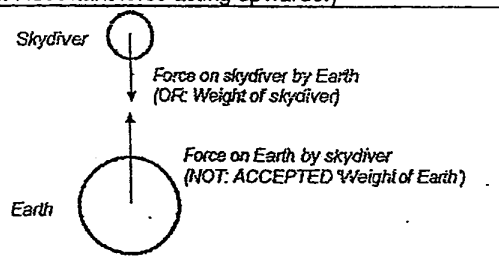
_____

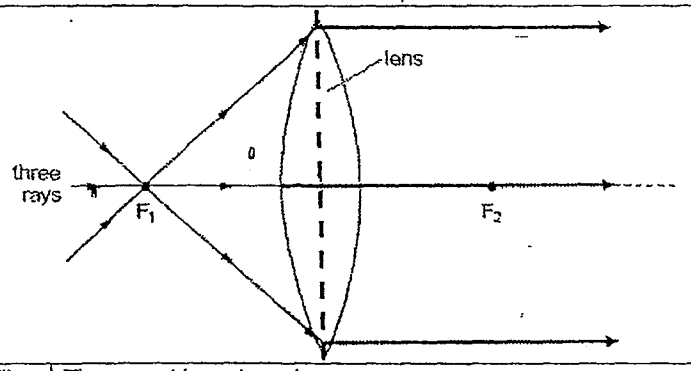
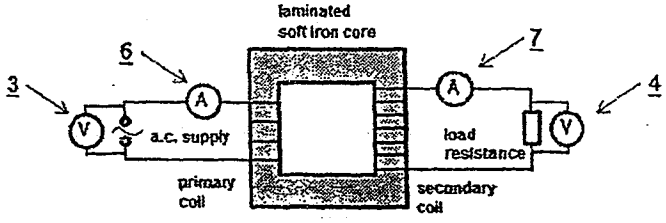
_____ [2]

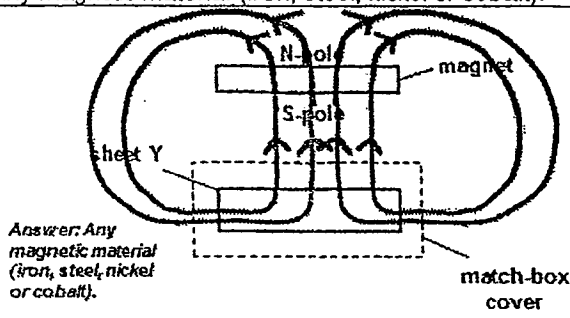
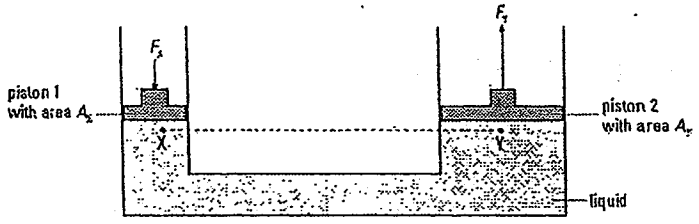
For Examiner's Use

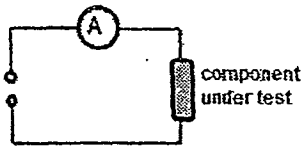
CATHOLIC HIGH SCHOOL
Secondary 4 - Preliminary Examination 3 (2014)
PHYSICS 5059

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

1	(a)		$\rho = m \div V \Rightarrow$ $m = \rho V = (1000)(450)$ $= 450\ 000 = \underline{4.5 \times 10^5\ kg}$ (2 s.f.)	[1] [1]
	(b)	(i)	$Q = mc\Delta\theta$ $= (4.5 \times 10^5 \times 1000)(4.2)(27 - 12)$ $= 2.835 \times 10^{10} = \underline{2.8 \times 10^{10}\ J}$ (2 s.f.)	[1] [1]
		(ii)	Thermal energy is lost to the surrounding air/ pool walls/ tiles etc. (OR: Thermal energy is lost to evaporation.)	[1]
2	(a)	(i)	The gravitational force acting per unit mass (OR: per kg) is 10 N.	[1]
		(ii)	$M = Fd$ Taking moments about the balance point, Sum of anticlockwise moments = Sum of clockwise moments $(550)(0.86) = W(1.1) \Rightarrow W = 430$ N $W = mg \Rightarrow 430 = m(10) \Rightarrow m = \underline{43\ kg}$ (2 s.f.)	[1] [1]
		(iii)	The see-saw rotates anticlockwise. Both moments due to weights of both persons increase. The girl's moment increases more.	[1] [1] or [2]
	(b)	(i)	When displaced, the line of action of the weight of the toy lies within the base area of the toy. (Or: When displaced, there is a perpendicular distance between the line of action of weight and the pivot.) The weight of the toy thus provides a (clockwise) restoring moment about the pivot.	[1] [1]
		(ii)	Stable equilibrium.	[1]
3	(a)		The falling block loses G.P.E. and is converted to the G.P.E. of the elevator to lift it. (OR: Work is done by the motor to lift up the empty elevator/ Weight of concrete block provides the force to pull elevator.) However the electric motor needs to do a little work to overcome air resistance and friction in the moving parts.	[1] [1]
	(b)		$P = E \div t = mgh \div t$ $(4900 \times 24) \div 28 = 117\ 600 \div 28$ $= \underline{4\ 200\ W}$ (2 s.f.)	[1] [1]
4	(a)	(i)	The skydiver is falling without air resistance initially. (OR: The skydiver is falling with constant (gravitational) acceleration (of 10 m/s^2) / Only force acting is weight.)	[1]
		(ii)	10 m/s^2	[1]
	(b)		700 N	[1]
	(c)		Thermal energy of skydiver/ air. (OR: K.E. of air)	[1]
	(d)	(i)	The skydiver decelerates/ slows down. The air resistance on the skydiver is larger than his weight. Hence by Newton's Second Law of Motion ($F_{net} = ma$), there is a negative resultant force acting downwards. (OR: Resultant force acting upwards.)	[1] [1] [1]
		(ii)		[2]

5	(a)	(i)	Black surfaces are good absorbers of infra-red radiation. [DO NOT ACCEPT: 'Good emitters...'] Hence the cold water in the solar collector is heated up faster by radiation.	[1] [1]
		(ii)	The hot water travels to the hot-water tank as convection currents occur due to density differences. When the cold water is heated, it expands, becomes less dense and rises to the hot-water tank. [Note: The colder water at the top is denser and sinks to replace the heated hot water.]	[1] [1]
	(b)	(i)	Geothermal.	[1]
		(ii)	It is an energy source that is infinite. (OR: It will not run out.) (OR: It is being replaced.) (NOT ACCEPTED: It can be used again/ recycled.)	[1]
6	(a)	(i)	When end X is heated, the atoms at X vibrate more. The atoms at X then collide more frequently and harder with surrounding atoms.	[1] [1]
		(ii)	The atoms move further apart.	[1]
	(b)	Arrangement: The atoms are in irregular arrangement. Motion: The atoms move randomly (instead of vibrating). (OR: The atoms slide over each other.)		[1] [1]
7	(a)			[2]
	(b)	(i)	The speed is reduced.	[1]
		(ii)	The speed returns to the original value (3.0×10^8 m/s). (Note: Stating 'the speed increases' is insufficient.)	[1]
	(c)	(i)	$v = f\lambda \Rightarrow f = v \div \lambda = (3.0 \times 10^8) \div (0.060 \times 10^{-9}) = 5.0 \times 10^{18}$ Hz (2 s.f.)	[1]
		(ii)	The frequency remains the same, as the frequency of the light depends on the source.	[1]
8	(a)	P = IV I = P ÷ V = 650 ÷ 230 = 2.83 = 2.8 A (2 s.f.) Suggested fuse rating = 3 A (whole no.) (Note: Accept 3 A OR 4 A.)		[1] [1]
	(b)	(i)	The casing becomes live/ at high voltage. When a person touches the outer metal casing, he will be electrocuted.	[1] [1]
		(ii)	The earth wire will allow any leakage current to flow to the earth. The fuse will melt and break the circuit.	[1] [1]
9	(a)	(i)		[2]
		(ii)	An alternating current flows in the primary coil and a changing magnetic field is produced in the iron core. The secondary coil experiences a change in magnetic flux linkages and an e.m.f. is induced in it.	[1] [1]
	(b)	(i)	Since V = IR, if the output voltage remains constant, increasing R will cause I to decrease.	[1]

		(ii)	1.	Input current will decrease. (Note: $\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$)	[1]
			2.	Output power will increase until R = 20.0 Ω, then output power starts to decrease.	[1]
	(c)	Input power, P = IV = (0.80)(6.00) = 4.8 W Output power = 1.60 W Fraction of input power wasted $= 1 - \frac{\text{Output Power}}{\text{Total Power}} = 1 - \frac{1.60}{4.80} = \frac{2}{3} = \underline{0.67}$ (2 s.f.)			[1]
	(d)	Columns 1 & 2 suggest it is a step-up transformer. Columns 3 & 4 suggest it is a step-up transformer only when load resistance is larger than 20.0 Ω.			[1] [1]
10	(a)	(i)		• Soft-iron core: Becomes a <u>stronger</u> electromagnet (OR: <u>more</u> magnetised). • Iron lever: Attracted towards the soft iron core (by rotating clockwise). • Spring: Pulls the springy metal away from the contacts. • <u>Contacts</u>: Becomes open.	[3] [-1 for any wrong]
		(ii)		• Soft-iron core: Becomes demagnetised. • Iron lever: Falls back. • Spring: Remains in position (pulls the springy metal away from the contacts) • Contacts: Remains open.	[2] [-1 for any wrong]
		(iii)		The reset button is pressed (towards the left).	[1]
	(b)	(i)		Any non-magnetic material (e.g. copper etc.)	[1]
		(ii)	1.	Any magnetic material (iron, steel, nickel or cobalt).	[1]
			2.	 The magnetic field lines of forces will be concentrated within/ flow sideways through the magnetic material (and be magnetically shielded from paper clips).	[1] [1]
11	EITHER				
	(a)	• <u>Setup</u>:  • <u>Readings that are required</u>: $P_x = F_X \div A_X$, where P_x: Pressure at point X in the liquid F_X: Force acting at piston 1 A_X: Area of piston 1 • <u>Principle</u>: Pressure is transmitted to every part of the liquid and pressure at Y is equal to pressure at X. Since $P_x = P_y$, hence $F_X \div A_X = F_y \div A_y$. Since $A_Y > A_X$, therefore $F_Y > F_X$ Thus a small force applied on a small piston is used to lift a larger load on a bigger piston.			[1] [1] [2]
	(b)	(i)		The speed of sound is (much) less than the speed of light.	[1]
		(ii)		Measure the time delay (between the lightning and thunder). Divide distance by the time delay.	[1] [1]

		(iii)	Echo: Sound reflected off hard, flat surfaces. Ultrasound: Sound with frequencies above the upper limit of the human range of audibility.	[1] [1]
		(iv)	Violet, indigo, blue, green, yellow, orange, red (NOTE: ROYGBIV – 'ROY Gave Birth In Vain' in reverse.)	[1]
11	OR			
	(a)		• Setup: Electrical circuit containing cell/ source, ammeter/ lamp/ bell and component under test, connected in series.  • Observation and explanation: E.g.: The ammeter will only show a reading when the electrical conductor is connected. This is because the resistance of electrical conductor is low enough for the electrical current to flow through. • One example of each: Electrical conductor - any metal/ carbon/ graphite. Electrical insulator - e.g. plastic, paper, wood etc.	[1] [2] [1]
	(b)	(i)		[1]
		(ii)	1. V = IR = (0.025)(600) = 15 V (2 s.f.)	[1]
			2. V across thermistor = 20 - 15 = 5 V Resistance of thermistor, R = V ÷ I = 5 ÷ 0.025 = 200 Ω (2 s.f.) [OR: Using potential divider, $V_1 \div V_2 = R_1 \div R_2$ $5 \div 15 = R_1 \div 600$ $R_1 = 200\ \Omega$]	[1] [1]
		(iii)	[Given $R_{thermistor}$ decreases with temp.] 1. I reading: Increases. & Overall resistance of circuit decreases (I = V ÷ R). 2. $V_{600\ \Omega}$ reading: Increases. & $R_{600\ \Omega}$ is constant and I increases (V = IR). [OR: As $R_{thermistor}$ decreases, $V_{thermistor}$ decreases in a potential divider circuit.]	[1] [1]