United We Soar

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics 5059 / 1

Paper 1

Date: 25 August 2016

Time 0900 – 1000 hr **Duration**: 1 hour

Additional Materials: OTAS

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in
Write in soft pencil.
Do not staples, paper clips, highlighters, glue or correction fluid.

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 (OTAS)

The use of approved scientific calculator is expected, where appropriate.

At the end of the examination, hand in the OTAS and question paper separately

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.

Name of Student _____ ( )

Class: Secondary 4-8

Setter: Mrs Jennifer Peng

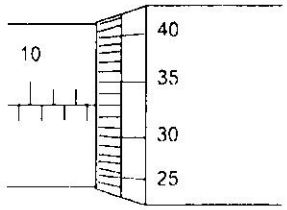
This question paper consists of **12** printed pages, including cover page.

SECTION A (40 Marks)
Multiple Choice Questions
Answer all questions on the OTAS sheet provided.

1. A metre rule is used to measure a length. Which of the following is a possible reading obtained?

   (A) 0.6 m (C) 0.643 m
   (B) 0.64 m (D) 0.6431 m

2. A student used a micrometer screw gauge to measure the thickness of a metal sheet. The diagram below shows part of the micrometer.



   What is the thickness of the metal sheet?

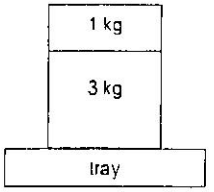
   (A) 10.33 mm (C) 12.83 mm
   (B) 12.33 mm (D) 15.33 mm

3. Which car, moving from rest, has an average acceleration of 2.0 m/s^2?
   (A) a car reaching a speed of 10 m/s in 2 s.
   (B) a car reaching a speed of 20 m/s in 5 s.
   (C) a car reaching a speed of 30 m/s in 10 s.
   (D) a car reaching a speed of 40 m/s in 20 s.

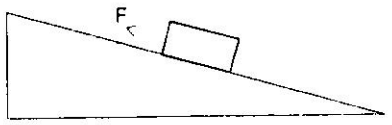
4. Two objects have the same size and shape but one is heavier than the other. They are each dropped from rest. Comparing the two objects, the heavier object has
   (A) the higher initial acceleration and the higher terminal velocity
   (B) the higher initial acceleration and the same terminal velocity.
   (C) the same initial acceleration and the higher terminal velocity.
   (D) the same initial acceleration and the same terminal velocity.

5 A tray supports a 1 kg mass and a 3 kg mass as shown below. What is the force acting on the 1 kg mass by the 3 kg mass? (g = 10 N / kg)

   (A) 10 N
   (B) 20 N
   (C) 30 N
   (D) 40 N

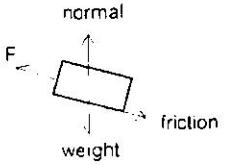


6 The diagram below shows a box being moved up by a force, F, on a rough inclined plane. F is parallel to the inclined plane.

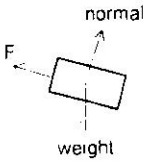


Which of the following diagrams correctly shows all the forces acting on the block?

(A)



(C)



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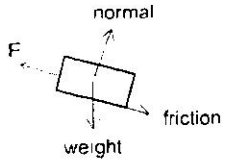
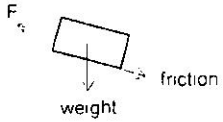
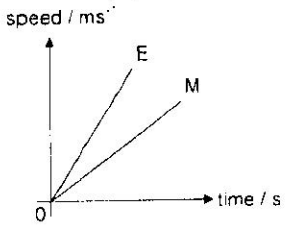


(D)

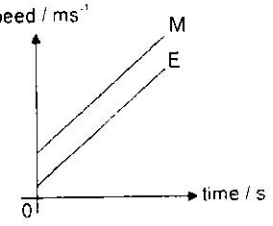


7 The acceleration due to the gravity of the Moon is one-sixth of that of the Earth. If a stone is thrown upwards, which graph shows the variation of the speed of the stone with time as it goes up on the Moon (**M**) and on the Earth (**E**)?

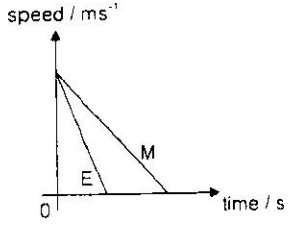
(A)



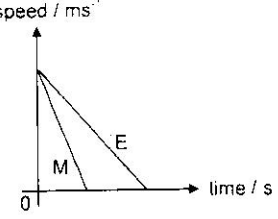
(C)



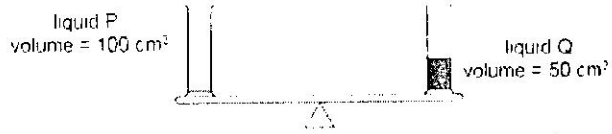
(B)



(D)



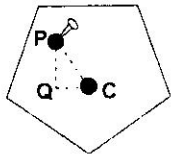
8. Two identical measuring cylinders containing different liquids are placed on a simple balance. They balance as shown.



How does the density of P compare with the density of Q?

(A) Density of P is half the density of Q.
(B) Density of P is equal to the density of Q.
(C) Density of P is twice the density of Q.
(D) Density of P is four times the density of Q.

9 A plane lamina is freely suspended from point **P**. The mass of the lamina is 0.3 kg and the centre of gravity is at **C**. The lamina is displaced to the position shown. What is the moment that will cause the lamina to swing?

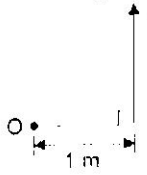


QC = 0.30 m
PC = 0.50 m
PQ = 0.40 m

(A) 0.09 Nm clockwise
(B) 0.10 Nm clockwise
(C) 0.12 Nm clockwise
(D) 0.90 Nm clockwise

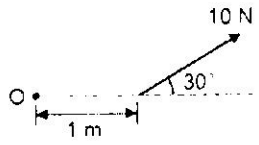
10. Which of the following force produces the greatest moment about O?

(A)

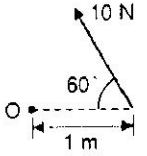


(C)

(B)



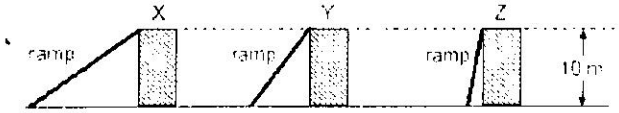
(D)



11. During the flag raising assembly, a pupil pulls the rope with a force of 15 N and the flag rises at a uniform speed of 0.5 m/min. Calculate the power supplied by the pupil.

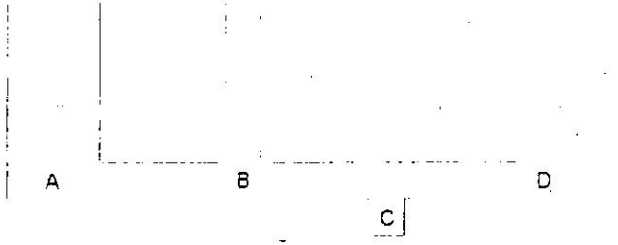
(A) 0.125 W
(B) 7.5 W
(C) 40 W
(D) 450 W

12 A load is to be lifted on three different lengths of ramps from ground level to a height 10 m above the ground. All the ramps are of the same material, but placed at different angles from the ground. Which path will require the most amount of work done in lifting the load? Assume that the surface is frictionless and the load moves at constant speed



(A) Path X
(B) Path Z
(C) Path Y
(D) Equal amount of work is done for every path

13. At which position will the pressure be the greatest?



14. Which of the following physical properties can be used to measure temperature?

1. Expansion of gas
2. Change in resistance
3. Change in mass

(A) 1 only
(B) 1 and 2 only
(C) 1 and 3 only
(D) 2 and 3 only

15 A piece of wire has an electrical resistance of 2.0 Ω in melting ice and 2.5 Ω in boiling water. What is the resistance at 20 °C assuming that resistance changes uniformly with temperature?

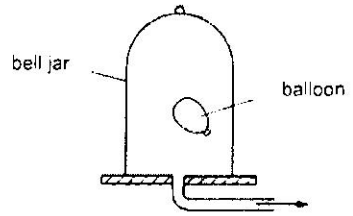
(A) 2.1 Ω
(B) 2.2 Ω
(C) 2.3 Ω
(D) 2.4 Ω

16. Which of the following statements about the movement of smoke particles in a Brownian motion experiment using smoke particles are correct?

I. It is due to the bombardment of air molecules.
II. It is faster if the particles are larger.
III. It is faster if the temperature of the air is higher.
IV. It is at random.

(A) I and II only
(B) I, II and IV only
(C) I, III and IV only
(D) I, II, III and IV

17. A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.



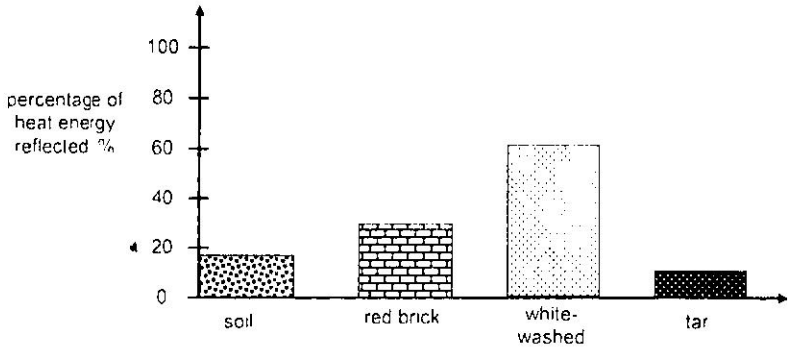
Air is then pumped out of the bell jar. What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
(A)	decreases	decreases
(B)	decreases	increases
(C)	increases	decreases
(D)	Increases	increases

18. A copper rod is heated at one end. Which statement describes how heat transfer occurs in the copper?

(A) Energetic copper molecules move from the cooler end to the hotter end.
(B) Energetic copper molecules move from the hotter end to the cooler end.
(C) Energetic free electrons move from the cooler end to the hotter end.
(D) Energetic free electrons move from the hotter end to the cooler end.

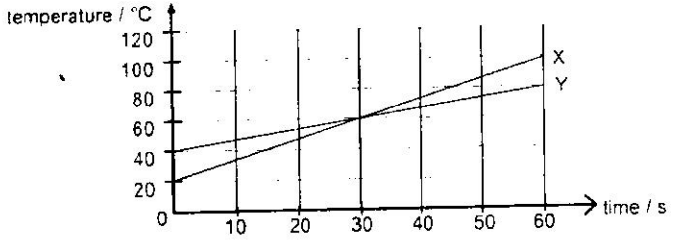
19. Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?

(A) cover it with a layer of red brick dust
(B) cover it with a layer of soil
(C) paint it with tar
(D) paint it white-washed

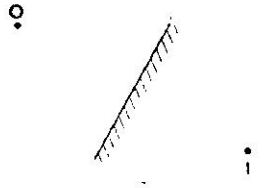
20. Two blocks X and Y, which are made of the same metal, are heated by heaters at the same power rating. The variations of temperature with time are given below.



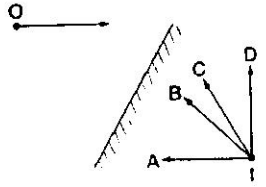
What is the ratio of masses X to Y?

(A) 1 : 2
(B) 1 : 4
(C) 2 : 1
(D) 4 : 1

21 An object placed in front of a plane mirror at O produces an image I.

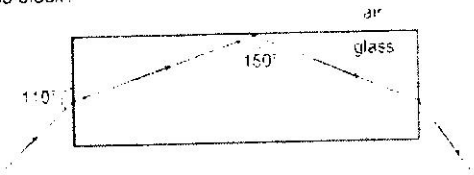


If the object moves towards the mirror in the direction shown by the arrow.
In which direction does the image move?



22. A ray of red light enters a glass block as shown and is reflected off one of its side. The diagram is not drawn to scale.
What is the refractive index of the glass block?

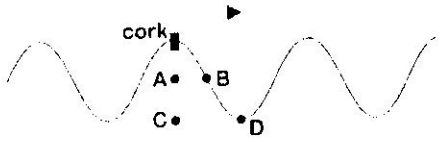
(A) 0.97
(B) 1.32
(C) 1.88
(D) 3.63



23. When water wave flows from shallow water into deep water, how do the frequency, wavelength and speed change?

	frequency	wavelength	speed
(A)	no change	decreases	decreases
(B)	no change	no change	decreases
(C)	no change	increases	Increases
(D)	increases	no change	increases

24. A water surface wave (ripple) is travelling to the right on the surface of a lake.
The wave has period T. The diagram shows the surface of the lake at a particular instant of time. A piece of cork is floating in the water in the position shown.
Which is the correct position of the cork a time $\frac{T}{4}$ later?



25. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

(A)	Gamma ray	→	Ultra-violet	→	Radio wave
(B)	Gamma ray	→	Visible light	→	Ultra-violet
(C)	Microwave	→	Ultra-violet	→	X-ray
(D)	Visible light	→	Infra-red	→	X-ray

26. Below are four statements about the uses of electromagnetic radiation.
1. Gamma rays are used in medical treatment.
2. Infra-red waves are used in sunbeds.
3 Microwaves are used in satellite television
4 X-rays are used in intruder alarms.

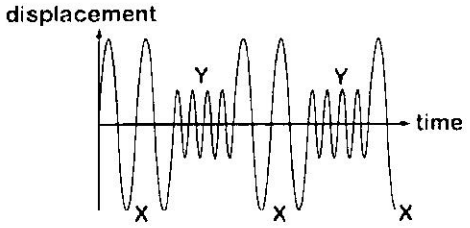
How many of these statements are correct?

(A) 1
(B) 2
(C) 3
(D) 4

27. A student stands between two vertical walls. One wall is 300 m away and the other is 600 m away. After making a loud clap, he hears two echoes at an interval of time t. What is the time interval, t? Take the speed of sound in air to be 300 m/s.

(A) 1.0 s
(B) 1.5 s
(C) 2.0 s
(D) 4.0 s

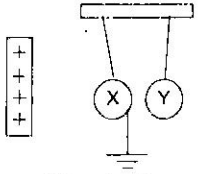
28. An ambulance siren emits two different sounds X and Y. These are produced alternately. The diagram represents the sounds emitted.



Which sound is louder and which has lower pitch?

	louder	lower pitch
(A)	X	X
(B)	X	Y
(C)	Y	X
(D)	Y	Y

29 Two isolated metal spheres X and Y are initially uncharged. The diagram shows a positively charged strip being placed near metal spheres X and Y. X is then earthed momentarily. During the whole process, X and Y do not touch.

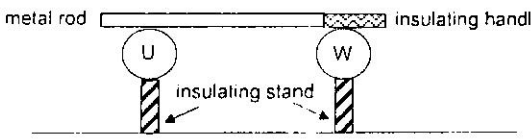


With the strip still in position, what would be the charges on X and Y?

	X	Y
(A)	negative	neutral
(B)	negative	negative
(C)	positive	neutral
(D)	neutral	negative

30. Two spheres U and W are mounted on insulating stands. Sphere U is initially uncharged and made of brass and sphere W is initially weakly positively charged and made of polythene.

A metal rod, held by an insulating handle, is placed in contact with U and W as shown.



What are the charges on U and W after the rod is placed in contact with them?

	charge on U	charge on W
(A)	positive	positive
(B)	positive	uncharged
(C)	uncharged	positive
(D)	uncharged	uncharged

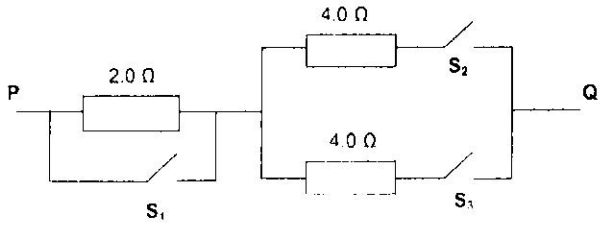
31. The potential difference across two identical resistors in series is 8.0 V. How much energy is dissipated in one of the resistors when 5.0 C of charge flows through it?

(A) 0.8 J (C) 20 J
(B) 1.6 J (D) 40 J

32. A 1.0 m length of wire, having a cross-sectional area of 0.40 mm^2, has a resistance of 2.0 Ω. What is the resistance of a 0.50 m length of wire (made of the same material), with a cross-sectional area of 0.80 mm^2?

(A) 0.5 Ω (C) 2.0 Ω
(B) 1.0 Ω (D) 8.0 Ω

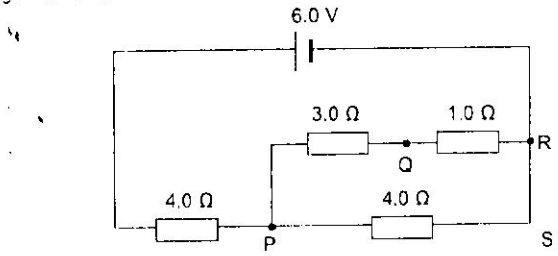
33. The diagram shows part of a circuit in which all the switches are open.



Which of the following combinations will result in a resistance of 2.0 Ω between P and Q?

	S_1	S_2	S_3
(A)	Closed	Closed	Closed
(B)	Closed	Opened	Closed
(C)	Opened	Closed	Closed
(D)	Opened	Opened	Closed

34. The diagram shows an electric circuit.



What is the potential difference between P and Q?

(A) 1.5 V (C) 2.5 V
(B) 2.0 V (D) 3.0 V

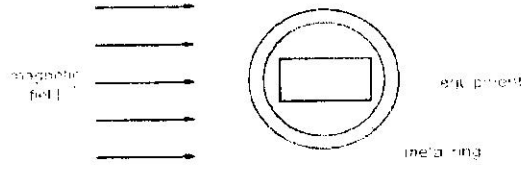
35. Which of the following best gives the reason why the earth wire is a necessity for many household appliances?

(A) To protect the fuse in the electric plug.
(B) To complete the circuit in order for the device to work.
(C) To protect the user against electrocution if the appliance becomes faulty.
(D) To protect the device against damage by preventing the excess current from flowing through the device

36. Which of the following observations confirms that an object is a magnet?

(A) The object is attracted by a strong bar magnet.
(B) The object causes a compass needle to move.
(C) The object rotates before being attracted to a bar magnet.
(D) The object is attracted to both poles of a horseshoe magnet.

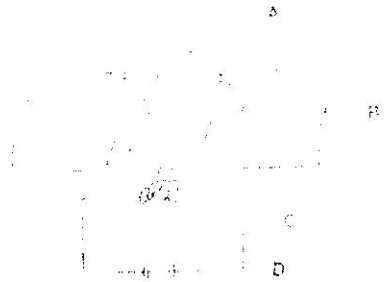
37 A metal ring shields a piece of equipment from a magnetic field.



Which metal should be used for the ring, and why?

	metal	reason
(A)	copper	The metal carries the field lines around the equipment.
(B)	copper	The metal is non-magnetic.
(C)	iron	The metal carries the field lines around the equipment.
(D)	iron	The metal is non-magnetic.

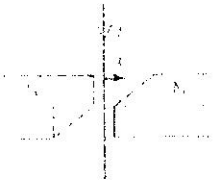
38 The diagram shows a simple d.c. motor. Which part needs to be made of soft iron to increase the efficiency of the motor?



39 Which diagram shows the direction of the force F that is produced by a current I in a magnetic field?

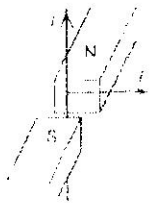
(A)

(C)



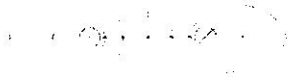
(B)

(D)



40. Two parallel wires each carry a current into the plane of the paper. Which diagram shows the magnetic field pattern due to the currents in the two wires?

(A)



(C)

(B)

(D)

*** END OF PAPER 1 ***

HILLGROVE

United We Soar

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics **5059 / 2**

Paper 2

Date 25 August 2016

Time: 1100 – 1245 hr Duration: 1 hour 45 minutes

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in.
Write in the dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working
Do not staples, paper clips, highlighters, glue or correction fluid.

SECTION A (Short Structured Questions)
Answer all questions.
Write your answers in the spaced provided on the question paper.

SECTION B (Long Structured Questions)
Answer all questions.
Question **12** has a choice of parts to answer

Candidates are reminded that all quantitative answers should include appropriate units
The use of 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 the sound use of Physics than for correct answer.

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.

Name of Student: _____ ( )

Class: Secondary 4-8

Parent's Signature: _____

Setter: Mrs Jennifer Peng

Section	Marks
A	/ 50
B	/ 30
Total	**/ 80**

This question paper consists of 18 printed pages, including cover page.

SECTION A [50 Marks]
SHORT STRUCTURED QUESTIONS
Answer all questions in the spaces provided on the question paper.

1. A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The velocity-time graph for the stone is shown in Fig. 1.2.

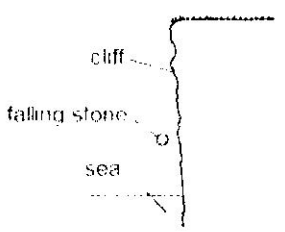


Fig. 1.1

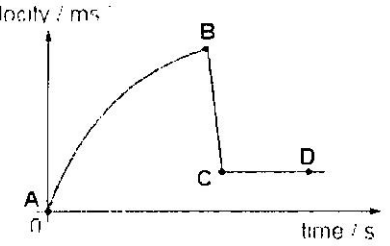


Fig. 1.2

(a) Describe the changes in motion of the stone between point A and D. [3]

(b) Explain, in terms of the forces acting, for your answer in (a). [3]

2 A uniform rod AB of length 3 m weighs 10 N. It is suspended by two identical strings at points X and Y as shown in Fig. 2.1. T_1 and T_2 are the tension in the strings.

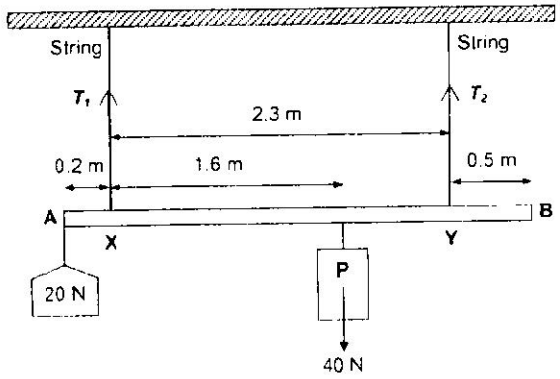


Fig. 2.1

Two weights, 20 N and P, are hung from the rod at point **A** and 1.6 m from **X** respectively.

(a) Draw the weight of the rod in Fig. 2.1 and label it **W**.
Indicate clearly its distance from point A. [1]

(b) Determine T_2, the tension of the string at **Y**.

T_2 = [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X**

T_1 = [1]

3 In an Olympic game, a man of mass 58 kg is trying to swing on a high bar as shown in Fig 3. He is momentarily at rest at the top of the swing. At this position, his centre of mass is at a height of 0.9 m above the bar as shown in the diagram.

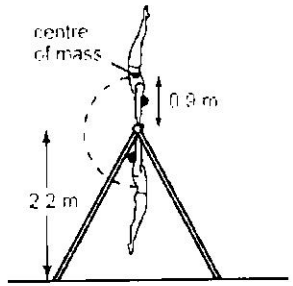


Fig 3

(a) Calculate his gravitational potential energy at the top of the swing.

gravitational potential energy = [2]

(b) Calculate his speed at the bottom of his swing.

speed = [2]

(c) State two assumptions that are made in (b) [2]

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4. Fig. 4 shows two identical pots containing the same soup at different temperature, 90 °C and 75 °C. The mass of soup in both pots are the same and they are both left to cool under the same surrounding conditions.

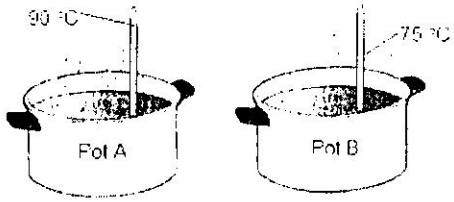

Fig. 4

(a) Explain why the following features of a pot are advantageous to cooking:

(i) The pot is made of metal. [1]

(ii) The pot has low heat capacity. [1]

(b) State and explain which pot will see a larger drop in temperature at the end of ten minutes. [2]

(c) State and explain if your answer in (b) would differ if both pot A and pot B are painted black. [2]

5. A 2 kW heater is used to melt 1.5 kg of solid lead from a room temperature of 27 °C.

(a) The heater takes 29.25 s to heat the lead to its melting point of 327 °C. Calculate the specific heat capacity of lead.

specific heat capacity of lead = [2]

(b) Given that the specific latent heat of fusion of lead is 22.4 kJ/kg. Calculate the amount of time to further heat the lead until it is completely melted

time = [2]

(c) Describe clearly the changes in kinetic energy and potential energy of the solid lead throughout the entire process. [4]

6 Fig. 6.1 below shows a thin converging lens being used to produce an image X' of an object X. Show on Fig. 6.1 how the given light ray will travel after passing through the converging lens.

(a) Complete Fig. 6.1 with suitable light rays to locate the position of the principal focus F. [3]

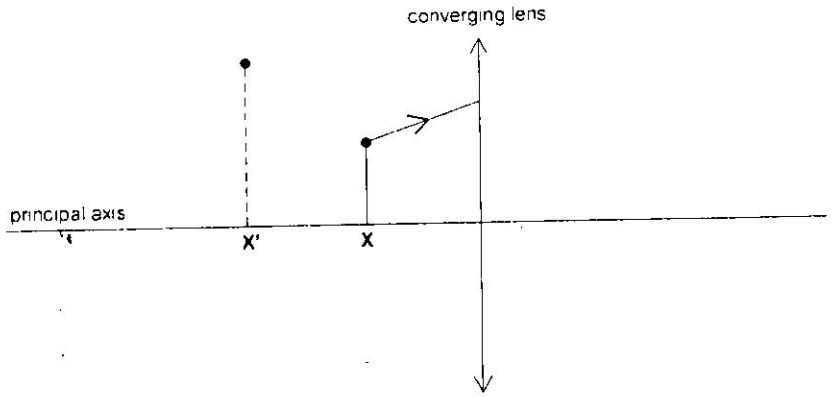

Fig. 6.1

(b) Give one common application for the lens set-up in Fig. 6.1. [1]

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7 Two metal conductors **P** and **Q** are mounted on insulating stands. Conductor **P** is given a negative charge, which is initially spread uniformly over the surface of the conductor. Conductor **Q**, initially uncharged, is brought close to **P** as shown in Fig. 7. There is now more negative charge on the right-hand side of **P** than its left-hand side.

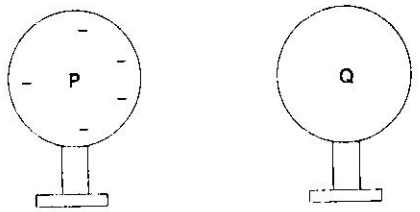

Fig 7

(a) On the diagram above, draw the induced charges on **Q**. [1]

(b) Explain how these charges are induced in **Q**. [2]

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(c) The conductors **P** and **Q** are brought closer and are in physical contact. State what happens to the charges on **P** and **Q**. [2]

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8. In the circuit shown in Fig. 8.1, a 4 700 Ω resistor is connected in series with a light-dependent resistor (LDR), which has a resistance of 3300 Ω, and with a 12 V power supply.

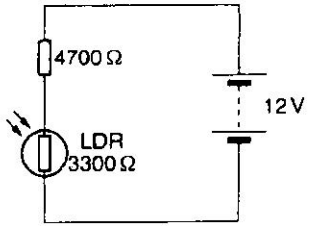

Figure 8.1

(a) Calculate the current through the LDR.

current = [2]

(b) Calculate the voltage across the LDR.

voltage = [1]

(c) Describe how the resistance of the LDR changes as brighter light falls on it. [1]

(d) A student claims that in theory if the resistor is replaced by a buzzer, it can function as a burglar alarm. Describe and explain how the student's setup will work when a burglar shines a very bright light on the LDR. [2]

9. Fig. 9 below shows a science exhibit consisting of three vertical hollow tubes, T_1, T_2 and T_3, each about 2 m long. The tubes are identical in size. With the tubes are three identical small cylinders, one to each tube.

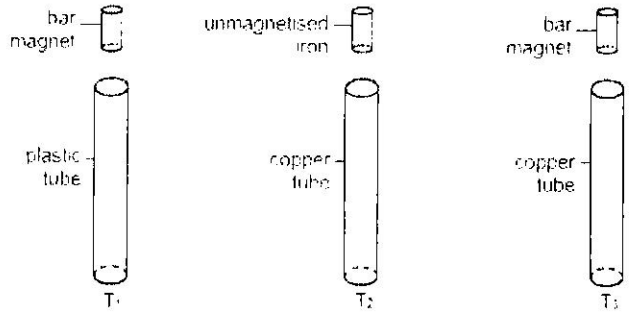

Fig. 9

The three cylinders are released from rest and dropped into the hollow tubes at the same time. When the cylinders are dropped down the hollow tubes, those in T_1 and T_2 reach the bottom in less than 1 second, while that in T_3 takes a few seconds.

(a) Explain why the cylinder in T_3 takes longer to reach the bottom of the tube than the cylinder in T_1. [2]

(b) Explain why the cylinder in T_1 and the cylinder in T_2 take the same time to reach the bottom. [3]

SECTION B [30 Marks]

Answer Question 10 and 11 in the spaces provided.

Answer only one of the two alternative questions in Question 12

10. Many electrical devices, such as television and computers, have stand-by mode.

Fig 10.1 shows the 230 V mains supply connected to a television.

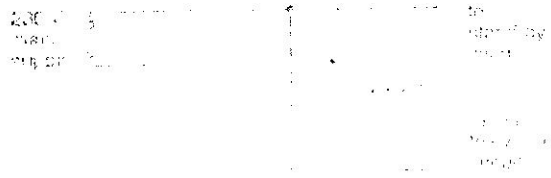

Fig. 10.1

When switch S is open, the television is in stand-by mode. No energy is supplied to the main television circuit. Some energy is supplied to the stand-by circuit.

When the television is in full use, switch S is closed and energy is supplied to both circuits. In the house of a student, the television is never unplugged. In one week, the television is in full use for 30 hours and in stand-by mode for 138 hours.

Fig 10.2 shows the current in the two circuits when in full use and in stand-by mode.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main television circuit / mA	450	0
current in stand-by circuit / mA	34	34

Fig 10.2

(a) Calculate the total power supplied to the two circuits by the 230 V mains supply when the television is in full use.

power = [3]

(b) (i) Calculate the amount of energy supplied in one week by the mains supply to the television when in stand-by mode. Give your answers in joules.

energy = [2]

(ii) The cost of 1 kWh of electrical energy is 25 cents. Calculate the cost of the energy in (b) (i)

cost = [3]

(c) In the same house, there is a computer which is also never unplugged. This computer has a stand-by circuit and a switch similar to those in the television.

In one week, the computer is in full use for 50 hours and in stand-by mode for 118 hours.

Fig 10.3 gives data for the computer similar to the data in Fig 10.2.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main computer circuit / mA	270	0
current in stand-by circuit / mA	34	34

Fig 10.3

(i) To save energy, the student decides to unplug either the television or the computer when not in use.

Explain, in words, why unplugging the television saves more energy. [1]

(ii) Suggest one disadvantage in completely unplugging a computer when not in use. [1]

11 Fig. 11.2 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.

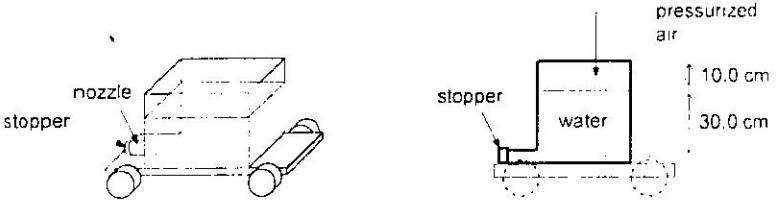

Fig. 11.2

The following information is provided.

Initial height of the water in the tank	30.0 cm
Initial height of the air in the tank	10.0 cm
Initial air pressure in the tank	2.50×10^5 Pa
Cross-sectional area of the nozzle	4.00×10^{-4} m^2
Atmospheric pressure	1.00×10^5 Pa
Density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

total pressure = [2]

(b) The calculated pressure in part (a) is larger than the atmospheric pressure. Explain why the stopper is not forced out of the nozzle. [2]

(c) When the stopper is removed, the water will be pushed out of the nozzle, causing a forward force which propels the trolley to move forward. Calculate the maximum forward force due to this propulsion.

maximum forward force = [2]

(d) After a short period of time, the height of the water drops to 15.0 cm. Calculate the air pressure inside the tank.

air pressure = [2]

(e) The cross-sectional area of the nozzle is enlarged. State two changes that will occur with reference to the trolley. [2]

12. EITHER

In an experiment to study sound waves, a tuning fork is struck and placed near a microphone.

(a) Explain how the sound waves are transmitted from the tuning fork to the microphone. [2]

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(b) The microphone converts the sound into electrical signal which is input into a cathode ray oscilloscope. Fig. 12.1 shows the trace obtained on the screen of the CRO when the input signal is applied to it. The time-base of the CRO is set at 2 ms/div

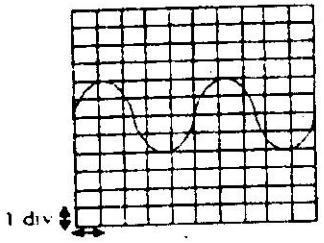

Fig. 12.1

(i) Calculate the frequency of the sound waves produced by the tuning fork.

frequency = [2]

(ii) Calculate the wavelength of the sound waves, given that the speed of sound in air is 340 ms^{-1}.

wavelength = [1]

(c) State and explain the effect on the trace on the screen when the tuning fork is moved further away from the microphone. [2]

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(d) In a second experiment, the tuning fork is replaced by a device which emits an ultrasound.

(i) Explain the term *ultrasound*. [1]

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(ii) State the effect on the trace on the screen when the ultrasound is input into the CRO [1]

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(e) State one practical application of ultrasound. [1]

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OR

The table contains data about a transformer. The turns ratio of primary coil to the secondary coil is 0.5. This is not an ideal transformer as seen from the data. The load resistance, connected to the secondary coil has been varied.

input voltage / V	output voltage / V	load resistance / Ω	input power / W
6.00	0.57	1.0	6.86
6.00	4.00	10.0	4.80
6.00	6.00	20.0	3.60
6.00	7.20	30.0	2.88
6.00	7.64	35.0	2.62

(a) State what is meant by an ideal transformer. [1]

(b) Explain why the transformer under study is NOT ideal [1]

(c) Use the table to calculate

(i) the current in the primary coil when the input power is 2.62 W.

current = [2]

(ii) the corresponding current in the secondary coil.

current = [2]

(d) Determine the output power when the input power is 2.62 W.

power = [2]

(e) Sketch a graph of the output voltage against the input voltage if this transformer is ideal. [2]

*** END OF PAPER 2 ***

HILLGROVE SECONDARY SCHOOL
Pure Physics Preliminary Examination 2016
Secondary 4 Express

Question	Answer	Remarks / Explanation
1	C	Accuracy of metre rule is 3 dp when measured in metres
2	C	12.5 + 0.33 = 12.83 mm
3	D	a = 10/2 = 5 a = 20/5 = 4 a = 30/10 = 3 a = 40/20 = 2
4	C	Both objects fall with an initial acceleration of 10 m/s^2. However as the heavier object has a larger weight, as a result the downward force is larger. By the time the air resistance manages to balance the downward force (*i.e. resultant force is zero*), the downward velocity is greater than that of the lighter man.
5	A	Look at only the 1 kg mass. There are only two forces acting on the 1 kg mass. The gravitational force acts on the 1 kg mass by the Earth and the reaction forces acts on the 1 kg mass by the 3 kg mass. For the system to be in equilibrium, action = reaction force and the two forces must be equal and opposite.
6	B	Weight acts vertically downwards. Normal force is perpendicular to the plane. Friction acts in a direction opposite to motion.
7	B	Acceleration = gradient of speed-time graph. E has a steeper gradient as acceleration due to gravity is higher. If the stone is thrown upwards, acceleration due to gravity is negative as it is downwards (acting in the opposite direction)
8	A	Mass of P and mass of Q is equal. As volume of P is double volume of Q, then density (mass/volume) of P will be half that of Q
9	D	Weight = mg = 0.3 x 10 = 3 N Moment = Fd = 3 x 0.30 = 0.90 Nm clockwise
10	A	Greatest perpendicular distance between pivot and line of action of force
11	A	Power = (15 x 0.5) / 60 = 0.125 W
12	D	Vertical height is the same
13	C	Lowest point
14	B	
15	A	20 = [(R – 2) / (2.5 – 2)] x 100 0.2 = (R – 2) / 0.5 R = 2.1 Ω
16	C	
17	B	
18	D	
19	D	
20	A	Q = mcθ $m_1c(80) = m_2c(40)$ $m_1 / m_2 = 40 / 80 = 1 / 2$
21	C	
22	B	n = sin (20) / sin (15) n = 1.32
23	C	
24	A	
25	A	Gamma, X-ray, Ultra-violet, Light, Infrared, Microwave, Radio
26	B	
27	C	The interval is the time take for the sound to travel the extra distance made by the longer sound path. Extra distance travelled by the longer sound path = 2 x 600 – 2 x 300 = 600 m Distance = speed x time 600 = 300 t t = 2 s
28	A	
29	A	
30	C	
31	C	V = 4 V, Q = 5 C, E = ? V = E / Q 4 = E / 5 E = 20 J
32	A	When length + 2, R = 2 / 2 = 1 ΩWhen A x 2, R = 1 / 2 = 0.5 Ω
33	A	1/R = ¼ + ¼ = ½ R = 2 Ω
34	A	$R_T = (¼ + ¼)^{-1} + 4 = 6\ Ω$ $V_{PQ} = 2/6 \times 6 = 2$ V $V_{1/2} = ¼ \times 2 = 1.5$ V
35	C	
36	C	
37	C	
38	A	
39	D	
40	B	

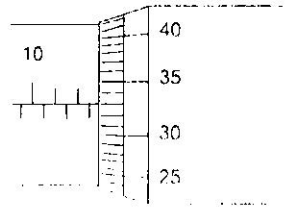
SECTION A (40 Marks)
Multiple Choice Questions
Answer all questions on the OTAS sheet provided

1 A metre rule is used to measure a length. Which of the following is a possible reading obtained?

(A) 0.6 m (C) 0.643 m
(B) 0.64 m (D) 0.6431 m

Accuracy of metre rule is 3 dp when measured in metres

2. A student used a micrometer screw gauge to measure the thickness of a metal sheet. The diagram below shows part of the micrometer.



What is the thickness of the metal sheet?

(A) 10.33 mm (C) 12.83 mm
(B) 12.33 mm (D) 15.33 mm

12.5 + 0.33 = 12.83

3. Which car, moving from rest, has an average acceleration of 2.0 m/s^2?

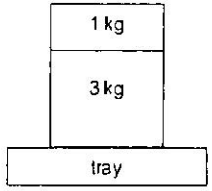
(A) a car reaching a speed of 10 m/s in 2 s. a = 10/2 = 5
(B) a car reaching a speed of 20 m/s in 5 s. a = 20/5 = 4
(C) a car reaching a speed of 30 m/s in 10 s. a = 30/10 = 3
(D) a car reaching a speed of 40 m/s in 20 s. a = 40/20 = 2

4. Two objects have the same size and shape but one is heavier than the other. They are each dropped from rest. Comparing the two objects, the heavier object has

(A) the higher initial acceleration and the higher terminal velocity.
(B) the higher initial acceleration and the same terminal velocity.
(C) the same initial acceleration and the higher terminal velocity.
(D) the same initial acceleration and the same terminal velocity.

Both objects fall with an initial acceleration of 10 m/s^2. However as the heavier object has a larger weight, as a result the downward force is larger. By the time the air resistance manages to balance the downward force (*i.e. resultant force is zero*), the downward velocity is greater than that of the lighter man.

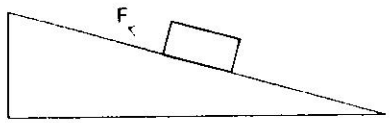
5. A tray supports a 1 kg mass and a 3 kg mass as shown below. What is the force acting on the 1 kg mass by the 3 kg mass? (g = 10 N / kg)



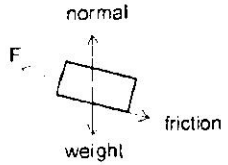
(A) 10 N
(B) 20 N
(C) 30 N
(D) 40 N

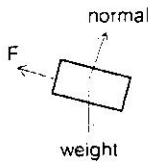
Look at only the 1 kg mass. There are only two forces acting on the 1 kg mass. The gravitational force acts on the 1 kg mass by the Earth and the reaction forces acts on the 1 kg mass by the 3 kg mass. For the system to be in equilibrium, action = reaction force and the two forces must be equal and opposite

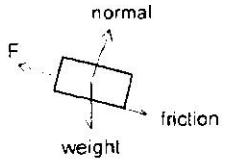
6 The diagram below shows a box being moved up by a force, F, on a rough inclined plane. F is parallel to the inclined plane.

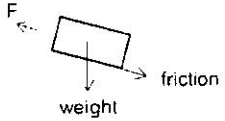


Which of the following diagrams correctly shows all the forces acting on the block?

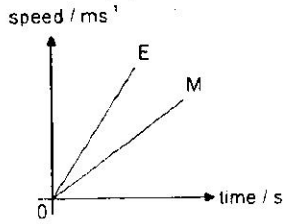
(A)


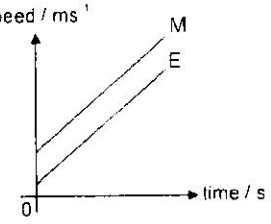
(C)


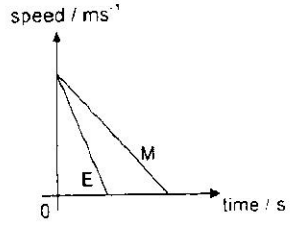
(B)


(D)


7 The acceleration due to the gravity of the Moon is one-sixth of that of the Earth. If a stone is thrown upwards, which graph shows the variation of the speed of the stone with time as it goes up on the Moon (**M**) and on the Earth (**E**)?

(A)


(C)


(B)


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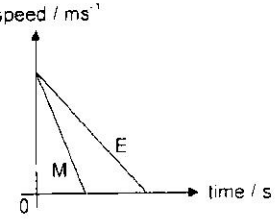
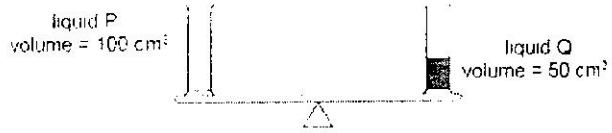


8 Two identical measuring cylinders containing different liquids are placed on a simple balance. They balance as shown.

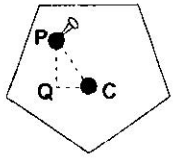


How does the density of P compare with the density of Q?

(A) Density of P is half the density of Q.
(B) Density of P is equal to the density of Q.
(C) Density of P is twice the density of Q.
(D) Density of P is four times the density of Q.

Mass of P and mass of Q is equal. As volume of P is double volume of Q, then density (mass/volume) of P will be half that of Q.

9 A planelamina is freely suspended from point **P**. The mass of the lamina is 0.3 kg and the centre of gravity is at **C**. The lamina is displaced to the position shown. What is the moment that willcause the lamina to swing?

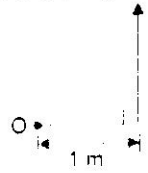


QC = 0.30 m
PC = 0.50 m
PQ = 0.40 m

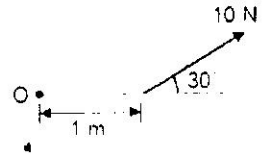
(A) 0.09 Nm clockwise
(B) 0.10 Nm clockwise
(C) 0.12 Nm clockwise
(D) 0.90 Nm clockwise

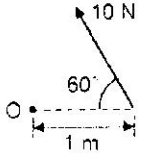
Weight = mg = 0.3 x 10 = 3 N
Moment = Fd = 3 x 0.30 = 0.90 Nm clockwise

10 Which of the following force produces the greatest moment about O?

(A)


(C)


(B)


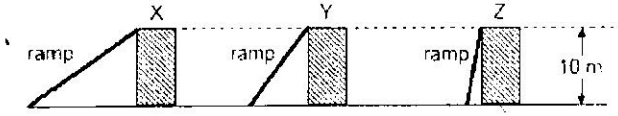
(D)


11 During the flag raising assembly, a pupil pulls the rope with a force of 15 N and the flag rises at a uniform speed of 0.5 m/min. Calculate the power supplied by the pupil.

(A) 0.125 W
(B) 7.5 W
(C) 40 W
(D) 450 W

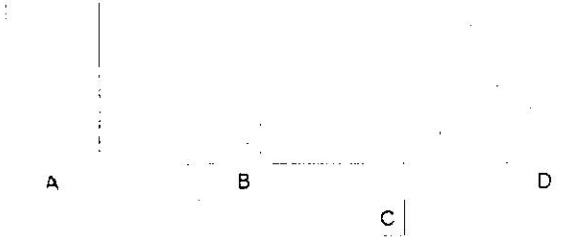
Power = (15 x 0.5) / 60 = 0.125 W

12. A load is to be lifted on three different lengths of ramps from ground level to a height 10 m above the ground. All the ramps are of the same material, but placed at different angles from the ground. Which path will require the most amount of work done in lifting the load? Assume that the surface is frictionless and the load moves at constant speed.



(A) Path X
(B) Path Z
(C) Path Y
(D) Equal amount of work is done for every path

13 At which position will the pressure be the greatest? C (lowest point)



14. Which of the following physical properties can be used to measure temperature?
1. Expansion of gas
2. Change in resistance
3. Change in mass

(A) 1 only (C) 1 and 3 only
(B) 1 and 2 only (D) 2 and 3 only

15 A piece of wire has an electrical resistance of 2.0 Ω in melting ice and 2.5 Ω in boiling water. What is the resistance at 20 °C assuming that resistance changes uniformly with temperature?

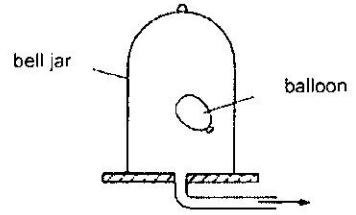
(A) 2.1 Ω (C) 2.3 Ω
(B) 2.2 Ω (D) 2.4 Ω

$20 = [(R - 2) / (2.5 - 2)] \times 100$ $0.2 = (R - 2) / 0.5$ $R = 2.1\ \Omega$

16. Which of the following statements about the movement of smoke particles in a Brownian motion experiment using smoke particles are correct?
I. It is due to the bombardment of air molecules
II. It is faster if the particles are larger.
III. It is faster if the temperature of the air is higher.
IV. It is at random.

(A) I and II only (C) I, III and IV only
(B) I, II and IV only (D) I, II, III and IV

17. A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.

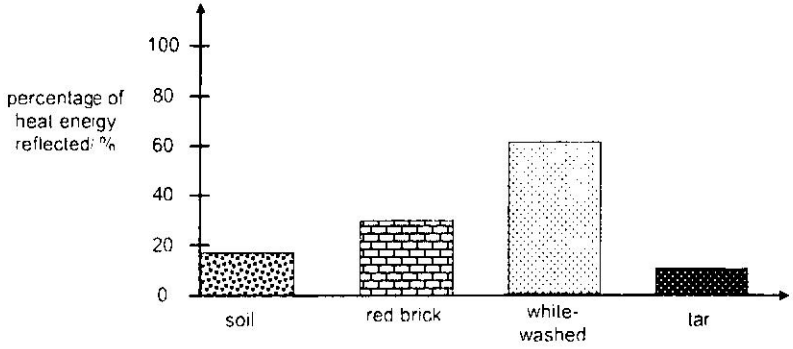


Air is then pumped out of the bell jar. What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
(A)	decreases	decreases
(B)	decreases	increases
(C)	increases	decreases
(D)	Increases	increases

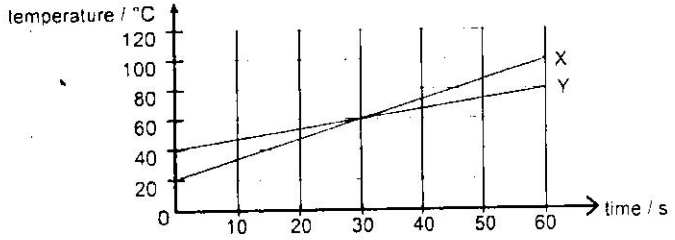
18. A copper rod is heated at one end. Which statement describes how heat transfer occurs in the copper?
(A) Energetic copper molecules move from the cooler end to the hotter end.
(B) Energetic copper molecules move from the hotter end to the cooler end.
(C) Energetic free electrons move from the cooler end to the hotter end.
(D) Energetic free electrons move from the hotter end to the cooler end.

19 Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?
(A) cover it with a layer of red brick dust
(B) cover it with a layer of soil
(C) paint it with tar
(D) paint it white-washed

20. Two blocks X and Y, which are made of the same metal, are heated by heaters at the same power rating. The variations of temperature with time are given below.



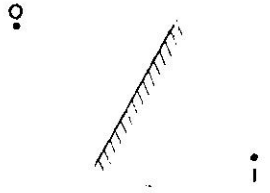
What is the ratio of masses X to Y?

(A) 1 : 2 (C) 2 : 1

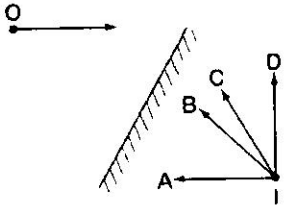
(B) 1 : 4 (D) 4 : 1

$Q = mc\theta$ $m_X c(80) = m_Y c(40)$ $m_X / m_Y = 40 / 80 = 1 / 2$

21 An object placed in front of a plane mirror at O produces an image I.



If the object moves towards the mirror in the direction shown by the arrow,
In which direction does the image move? **C**



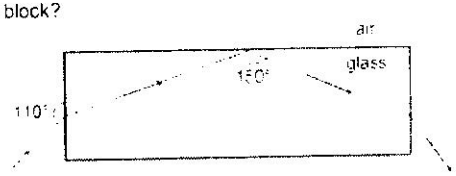
22. A ray of red light enters a glass block as shown and is reflected off one of its side. The diagram is not drawn to scale.
What is the refractive index of the glass block?

(A) 0.97

(B) 1.32

(C) 1.88

(D) 3.63



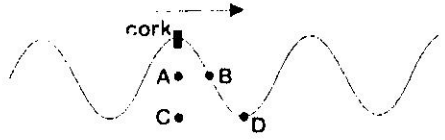
$n = \sin(20) / \sin(15)$

$n = 1.32$

23. When water wave flows from shallow water into deep water, how do the frequency, wavelength and speed change?

	frequency	wavelength	speed
(A)	no change	decreases	decreases
(B)	no change	no change	decreases
(C)	no change	increases	Increases
(D)	increases	no change	increases

24. A water surface wave (ripple) is travelling to the right on the surface of a lake.
The wave has period T. The diagram shows the surface of the lake at a particular instant of time. A piece of cork is floating in the water in the position shown.
Which is the correct position of the cork a time $\frac{T}{4}$ later? A



25. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

(A)	Gamma ray	→	Ultra-violet	→	Radio wave
(B)	Gamma ray	→	Visible light	→	Ultra-violet
(C)	Microwave	→	Ultra-violet	→	X-ray
(D)	Visible light	→	Infra-red	→	X-ray

Gamma, X-ray, Ultra-violet, Light, Infrared, Microwave, Radio

26. Below are four statements about the uses of electromagnetic radiation.
1. Gamma rays are used in medical treatment.
2. Infra-red waves are used in sunbeds.
3. Microwaves are used in satellite television
4. X-rays are used in intruder alarms.

How many of these statements are correct?

(A) 1 (C) 3

(B) 2 (D) 4

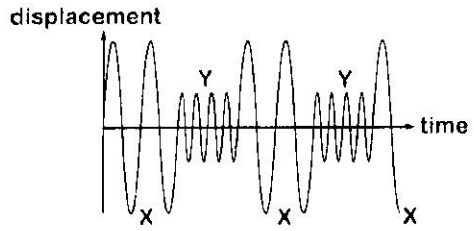
27. A student stands between two vertical walls. One wall is 300 m away and the other is 600 m away. After making a loud clap, he hears two echoes at an interval of time t. What is the time interval, t? Take the speed of sound in air to be 300 m/s.

(A) 1.0 s (C) 2.0 s

(B) 1.5 s (D) 4.0 s

The interval is the time take for the sound to travel the extra distance made by the longer sound path. Extra distance travelled by the longer sound path = 2 x 600 – 2 x 300 = 600 m
Distance = speed x time $600 = 300\ t$ $t = 2$ s

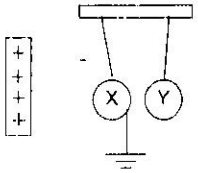
28. An ambulance siren emits two different sounds X and Y. These are produced alternately. The diagram represents the sounds emitted.



Which sound is louder and which has lower pitch?

	louder	lower pitch
(A)	X	X
(B)	X	Y
(C)	Y	X
(D)	Y	Y

29 Two isolated metal spheres X and Y are initially uncharged. The diagram shows a positively charged strip being placed near metal spheres X and Y. X is then earthed momentarily. During the whole process, X and Y do not touch.

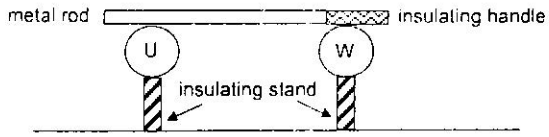


With the strip still in position, what would be the charges on X and Y?

	X	Y
(A)	negative	neutral
(B)	negative	negative
(C)	positive	neutral
(D)	neutral	negative

30 Two spheres U and W are mounted on insulating stands. Sphere U is initially uncharged and made of brass and sphere W is initially weakly positively charged and made of polythene.

A metal rod, held by an insulating handle, is placed in contact with U and W as shown.



What are the charges on U and W after the rod is placed in contact with them?

	charge on U	charge on W
(A)	positive	positive
(B)	positive	uncharged
(C)	uncharged	positive
(D)	uncharged	uncharged

31. The potential difference across two identical resistors in series is 8.0 V. How much energy is dissipated in one of the resistors when 5.0 C of charge flows through it?

(A) 0.8 J (C) 20 J
(B) 1.6 J (D) 40 J

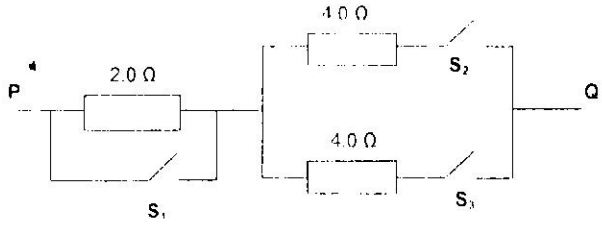
V = 4 V, Q = 5 C, E = ? V = E / Q 4 = E / 5 E = 20 J

32. A 1.0 m length of wire, having a cross-sectional area of 0.40 mm^2, has a resistance of 2.0 Ω. What is the resistance of a 0.50 m length of wire (made of the same material), with a cross-sectional area of 0.80 mm^2?

(A) 0.5 Ω (C) 2.0 Ω
(B) 1.0 Ω (D) 8.0 Ω

When length ÷ 2, R = 2 / 2 = 1 Ω When A x 2, R = 1 / 2 = 0.5 Ω

33 The diagram shows part of a circuit in which all the switches are open

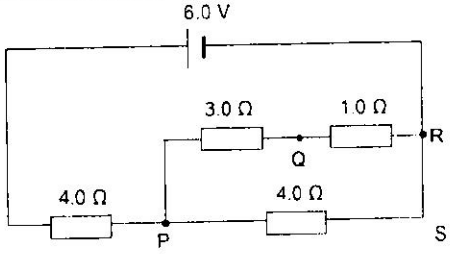


Which of the following combinations will result in a resistance of 2.0 Ω between P and Q?

	S_1	S_2	S_3
(A)	Closed	Closed	Closed
(B)	Closed	Opened	Closed
(C)	Opened	Closed	Closed
(D)	Opened	Opened	Closed

1/R = ¼ + ¼ = ½ R = 2 Ω

34. The diagram shows an electric circuit.



What is the potential difference between P and Q?

(A) 1.5 V (C) 2.5 V

(B) 2.0 V (D) 3.0 V

$R_{PQ} = (\frac{1}{4} + \frac{1}{4})^{-1} + 4 = 6\ \Omega$ $V_{PQ} = 2/6 \times 6 = 2$ V $V_{PQ} = \frac{1}{4} \times 2 = 1.5$ V

35 Which of the following best gives the reason why the earth wire is a necessity for many household appliances?

(A) To protect the fuse in the electric plug.

(B) To complete the circuit in order for the device to work.

(C) To protect the user against electrocution if the appliance becomes faulty.

(D) To protect the device against damage by preventing the excess current from flowing through the device

36 Which of the following observations confirms that an object is a magnet?

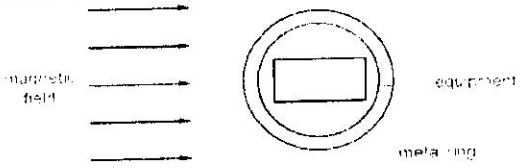
(A) The object is attracted by a strong bar magnet.

(B) The object causes a compass needle to move.

(C) The object rotates before being attracted to a bar magnet.

(D) The object is attracted to both poles of a horseshoe magnet.

37. A metal ring shields a piece of equipment from a magnetic field.



Which metal should be used for the ring, and why?

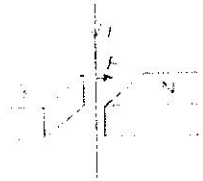
	metal	reason
(A)	copper	The metal carries the field lines around the equipment
(B)	copper	The metal is non-magnetic.
(C)	iron	The metal carries the field lines around the equipment.
(D)	iron	The metal is non-magnetic.

38. The diagram shows a simple d.c. motor. Which part needs to be made of soft iron to increase the efficiency of the motor? A

39. Which diagram shows the direction of the force F that is produced by a current I in a magnetic field?

(A)

(C)

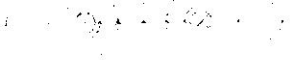


(B)

(D)

40. Two parallel wires each carry a current into the plane of the paper. Which diagram shows the magnetic field pattern due to the currents in the two wires?

(A)



(C)

(B)

(D)

*** END OF PAPER 1 ***

HELLOPOM

United We Soar

ANSWERS

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics **5059 / 2**

Paper 2

Date: 25 August 2016

Time: 1100 – 1245 hr Duration: 1 hour 45 minutes

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in.
Write in the dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not staples, paper clips, highlighters, glue or correction fluid.

SECTION A (Short Structured Questions)
Answer all questions.
Write your answers in the spaced provided on the question paper.

SECTION B (Long Structured Questions)
Answer all questions.
Question **12** has a choice of parts to answer

Candidates are reminded that all quantitative answers should include appropriate units.
The use of 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 the sound use of Physics than for correct answer.

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.

Name of Student: _____ ( )

Class: Secondary 4-8

Parent's Signature: _____

Setter: Mrs Jennifer Peng

Section	Marks
A	/ 50
B	/ 30
Total	**/ 80**

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

SECTION A [50 Marks]
SHORT STRUCTURED QUESTIONS
Answer all questions in the spaces provided on the question paper.

1. A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The velocity-time graph for the stone is shown in Fig. 1.2.

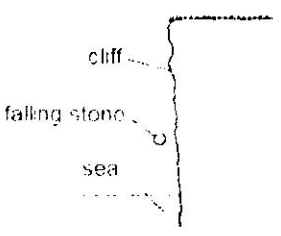


Fig. 1.1

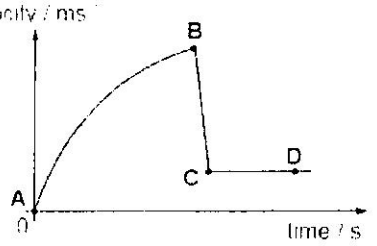


Fig. 1.2

(a) Describe the changes in motion of the stone between point A and D. [3]

A to B: speed increases at a decreasing rate / **decreasing acceleration** [B1]

B to C: speed decreases at a constant rate / **constant deceleration** [B1]

C to D: speed is constant / **acceleration is zero.** [B1]

(b) Explain, in terms of the forces acting, for your answer in (a). [3]

A to B: As the stone moves faster, **air resistance increases.** [a] Since resultant force = weight – air resistance, with weight remains constant thus **resultant force decreases**. [b] [B1: both a and b to get 1 mark]

B to C: **water resistance is greater than its weight** [c] and **resultant force is opposite to its motion**, thus the object slows down. [d] [B1: both c and d]

C to D: **water resistance is equal to its weight** [e] and **resultant force is zero** [f], thus acceleration is zero [B1: both e and f]

2. A uniform rod AB of length 3 m weighs 10 N. It is suspended by two identical strings at points X and Y as shown in Fig. 2.1. T_1 and T_2 are the tension in the strings.

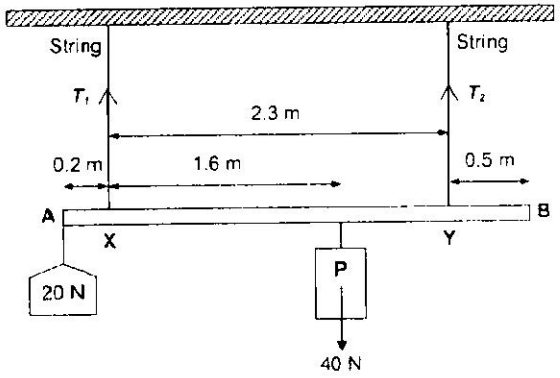


Fig. 2.1

Two weights, 20 N and **P**, are hung from the rod at point **A** and 1.6 m from **X** respectively

(a) Draw the weight of the rod in Fig. 2.1 and label it **W**. [1]
Indicate clearly its distance from point A.
Downward arrow drawn in the middle of the rod. W indicated for weight. Must indicate distance (e.g. 1.5 m from point A)

(b) Determine T_2, the tension of the string at **Y**.
Taking moments about X, at equilibrium
$(T_2 \times 2.3) + (20 \times 0.2) = (10 \times 1.3) + (40 \times 1.6)$
[M1: award 1 mark if there is 2 correct calculation of moments]
$T_2 = 31.739 =$ **31.7 N** (3 sf) [A1: minus 1 mark for wrong or missing unit]

$T_2 =$ [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X**.
Total Upwards Force = Total Downwards Force
$T_1 = 70\ N - 31.7\ N$
$= 38.3\ N$ [A1: minus 1 mark for wrong or missing unit]

$T_1 =$ [1]

3. In an Olympic game, a man of mass 58 kg is trying to swing on a high bar as shown in Fig 3. He is momentarily at rest at the top of the swing. At this position, his centre of mass is at a height of 0.9 m above the bar as shown in the diagram.

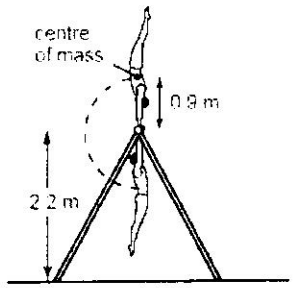


Fig 3

(a) Calculate his gravitational potential energy at the top of the swing.
GPE = mgh
$= 58 \times 10 \times (2.2 + 0.9)$ [M1: correct distance of 3.1 m]
$= 1798$ J
$=$ **1800 J** (3 sf or 2 sf) [A1: minus 1 mark for wrong or missing units]

gravitational potential energy = [2]

(b) Calculate his speed at the bottom of his swing.
Using conservation of energy,

Lost in GPE	=	Gain in KE	
$58\ (10)\ (0.9 + 0.9)$	=	$\frac{1}{2} \times 58 \times v^2$	[M1: difference in GPE]
v	=	**6 m/s**	[A1: minus 1 mark for units]

speed = [2]

(c) State two assumptions that are made in (b). [2]

No work is done against friction between his hand and the bar [B1]

No energy is given to the surrounding to do work (sound and heat energy) against air resistance. [B1]

4. Fig. 4 shows two identical pots containing the same soup at different temperature, 90 °C and 75 °C. The mass of soup in both pots are the same and they are both left to cool under the same surrounding conditions.

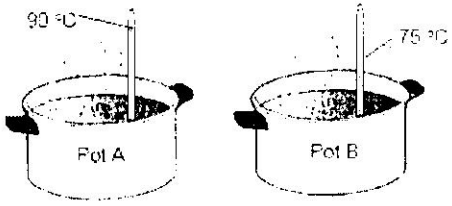


Fig 4

(a) Explain why the following features of a pot are advantageous to cooking.

(i) The pot is made of metal. [1]

Metal is a **good conductor of heat** and **heat** from the stove **can be quickly transferred** through the pot to the food. [B1]

(ii) The pot has low heat capacity. [1]

With low heat capacity, a **smaller amount of heat is required to raise the temperature of the pot by 1°C**. Hence, the **pot can heat up faster**. [B1]

(b) State and explain which pot will see a larger drop in temperature at the end of ten minutes. [2]

Pot A [B1] will see a larger drop in temperature as there is **greater difference in temperature** [a] **with the surroundings**. **More heat will be lost by radiation**. [b]

[B1: both a and b to be present to gain 1 mark]

(c) State and explain if your answer in (b) would differ if both pot A and pot B are painted black [2]

No [B1 awarded only is explanation is correct.]

Both pots will lose more heat as black is a good radiator of heat.

However, pot A will still have a larger drop in temperature compared to pot B. [B1]

5. A 2 kW heater is used to melt 1.5 kg of solid lead from a room temperature of 27 °C.

(a) The heater takes 29.25 s to heat the lead to its melting point of 327 °C. Calculate the specific heat capacity of lead.

Heat supplied by heater	= Heat gained by lead	
Pt	= mcΔθ	
2000 × 29.25	= 1.5 × c × (327 – 27)	[M1: 58500 J obtained]
58 500	= 1.5 × c × (300)	
c	= 58500 / (1.5 × 300)	
	= **130 J/(kg K)**	[A1: minus 1 mark for units]

specific heat capacity of lead = [2]

(b) Given that the specific latent heat of fusion of lead is 22.4 kJ/kg. Calculate the amount of time to further heat the lead until it is completely melted

Heat supplied by heater	= Heat gained by lead	
Pt	= ml_f	
2000 t	= 1.5 x 22400	[M1: correct substitution of ml_f]
t	= **16.8 s**	[A1: minus 1 mark for units]

time = [2]

(c) Describe clearly the changes in kinetic energy and potential energy of the solid lead throughout the entire process. [4]

When the solid lead is heated from **27 °C to 327 °C**, the atoms vibrates [move is NOT accepted] much more vigorously and hence its **kinetic energy increases** [B1] **potential energy of the lead remains constant**. [B1]

At **melting point**, the temperature remains constant and hence the **kinetic energy remains constant** [B1]. However, the **energy supplied is used to overcome the intermolecular forces between the atoms and hence its potential energy increase** [B1], thus its internal energy increases.

6. Fig. 6.1 below shows a thin converging lens being used to produce an image X' of an object X. Show on Fig. 6.1 how the given light ray will travel after passing through the converging lens.

(a) Complete Fig. 6.1 with suitable light rays to locate the position of the principal focus F. [3]

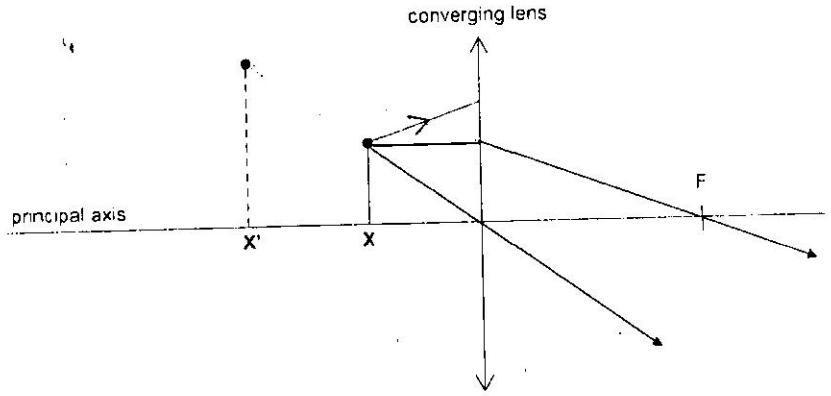


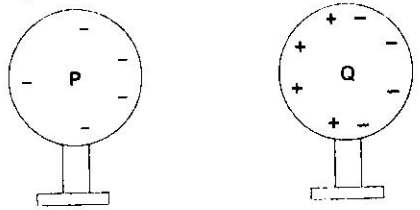
Fig. 6.1

	Completing the existing ray with correct dotted and solid portions and direction.
	Principal Focus F correctly positioned using two light rays with correct dotted and solid portions and directions, and labelled.

(b) Give one common application for the lens set-up in Fig. 6.1. [1]

Magnifying Glass

7. Two metal conductors **P** and **Q** are mounted on insulating stands. Conductor **P** is given a negative charge, which is initially spread uniformly over the surface of the conductor. Conductor **Q**, initially uncharged, is brought close to **P** as shown below. There is now more negative charge on the right-hand side of **P** than its left-hand side.



(a) On the diagram above, draw the induced charges on **Q**. [1]
A 1 - equal no. of positive charges and negative charges

(b) Explain how these charges are induced in **Q**. [2]

The negative charges in P **repel the negative charges in Q** to the **right-hand side of Q**, as **like charges repel**. [B1]

leaving behind positive charges in the **left-hand side of Q** [B1]

(c) The conductors **P** and **Q** are brought closer and are in physical contact. State what happens to the charges on **P** and **Q**. [2]

Some of the **negative charges in P will move into Q**. [B1]

Both P and Q will be negatively charged [B1]

8. In the circuit shown in Fig. 8.1, a 4 700 Ω resistor is connected in series with a light-dependent resistor (LDR), which has a resistance of 3300 Ω, and with a 12 V power supply.

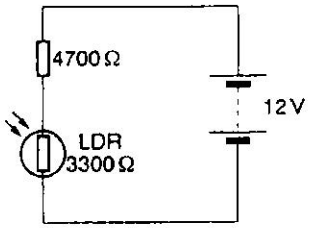


Figure 8.1

(a) Calculate the current through the LDR.

Current, I
= V / R
= 12 / (4700 + 3300) [C1: used total resistance]
= **0.0015 A** [A1: minus 1 mark for wrong or missing units]

current = [2]

(b) Calculate the voltage across the LDR.

Voltage, V
= IR
= 0.0015 x 3300
= **4.95 V** [A1: minus 1 mark for wrong or missing units]

OR

V = (R1 / RT) x E
= (3300 / 8000) x 12
= 4.95 V [A1]

voltage = [1]

(c) Describe how the resistance of the LDR changes as brighter light falls on it. [1]

Resistance of LDR drops [B1] when brighter light falls on it.

(d) A student claims that in theory if the resistor is replaced by a buzzer, it can function as a burglar alarm. Describe and explain how the student's setup will work when a burglar shines a very bright light on the LDR. [2]

When very bright light shines on the LDR, its voltage drops [B1] due to the drop in its resistance. **Voltage across the buzzer increases** OR **Current across the buzzer increases** [B1] and the buzzer will sound.

9. Fig. 9 below shows a science exhibit consisting of three vertical hollow tubes, T_1, T_2 and T_3, each about 2 m long. The tubes are identical in size. With the tubes are three identical small cylinders, one to each tube.

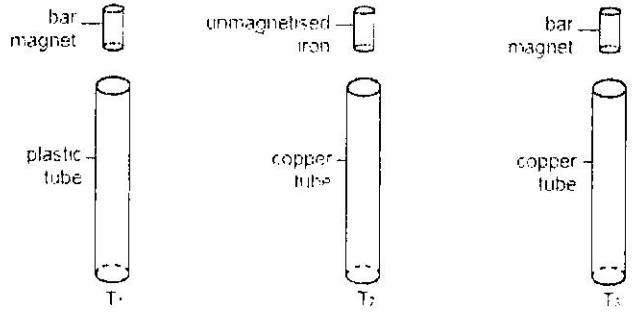


Fig. 9

The three cylinders are released from rest and dropped into the hollow tubes at the same time. When the cylinders are dropped down the hollow tubes, those in T_1 and T_2 reach the bottom in less than 1 second, while that in T_3 take a few seconds.

(a) Explain why the cylinder in T_3 takes longer to reach the bottom of the tube than the cylinder in T_2. [2]

As the bar magnet falls through the copper tube, there is a **change in magnetic flux cutting the copper conductor,inducing an e.m.f.** in the copper conductor. [B1]

By **Lenz's law** the **induced e.m.f. and hence the induced current flows to create magnetic field to oppose the change which produces it** [B1]

Hence the bar magnet in T_3 takes longer to reach the bottom of the tube.

(b) Explain why the cylinder in T_1 and the cylinder in T_2 takes the same time to reach the bottom. [3]

For T_2, since the unmagnetised iron does not have a magnetic field around it, **no e.m.f. is induced in the copper conductor** when the unmagnetised iron cylinder falls through the copper tube. [B1]

In T_1, the tube does not have any e.m.f. induced as it is made of plastic. [B1]

Hence, **no opposing magnetic field is set up to go against its motion** for both tubes thus they both fall with acceleration due to gravity. [B1]

SECTION B [30 Marks]

Answer Question 10 and 11 in the spaces provided.

Answer only one of the two alternative questions in Question 12

10 Many electrical devices, such as television and computers, have stand-by mode.

Fig 10.1 shows the 230 V mains supply connected to a television.

Fig. 10.1

When switch S is open, the television is in stand-by mode. No energy is supplied to the main television circuit. Some energy is supplied to the stand-by circuit.

When the television is in full use, switch S is closed and energy is supplied to both circuits. In the house of a student, the television is never unplugged. In one week, the television is in full use for 30 hours and in stand-by mode for 138 hours

Fig 10.2 shows the current in the two circuits when in full use and in stand-by mode.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main television circuit / mA	450	0
current in stand-by circuit / mA	34	34

Fig 10.2

(a) Calculate the total power supplied to the two circuits by the 230 V mains supply when the television is in full use.

P_{main} = VI_{main}
= 230 x 450 x 10^{-3}
= 103.5 W [M1]

$P_{stand-by}$ = $VI_{stand-by}$
= 230 x 34 x 10^{-3}
= 7.82 W [M1]

P_{total} = P_{main} + $P_{stand-by}$
= 103.5 + 7.82
= 111.32 W ≈ **111 W** (3 s.f.) [CAO1: correct answer with units]

power = [3]

(b) (i) Calculate the amount of energy supplied in one week by the mains supply to the television when in stand-by mode. Give your answers in joules.

Energy supplied,
E = VIt
= 230 x 34 x 10^{-3} x (60 x 60 x 138) [M1: convert time to seconds]
= 3 884 976 J ≈ **3 880 000 J** (3 sf) [CAO1: correct answer with units]

energy = [2]

(ii) The cost of 1 kWh of electrical energy is 25 cents. Calculate the cost of the energy in (b) (i)

E = VIt
= (230 x 34 x 10^{-3}) x 10^{3} x 138 [M1]
= 1.079 K Wh [M1]

Cost = 1.079 x 25
= 27 cents [CAO1: correct answer with units]

cost = [3]

(c) In the same house, there is a computer which is also never unplugged. This computer has a stand-by circuit and a switch similar to those in the television.

In one week, the computer is in full use for 50 hours and in stand-by mode for 118 hours.

Fig 10.3 gives data for the computer similar to the data in Fig 10.2.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main computer circuit / mA	270	0
current in stand-by circuit / mA	34	34

Fig 10.3

(i) To save energy, the student decides to unplug either the television or the computer when not in use.

Explain, in words, why unplugging the television saves more energy. [1]

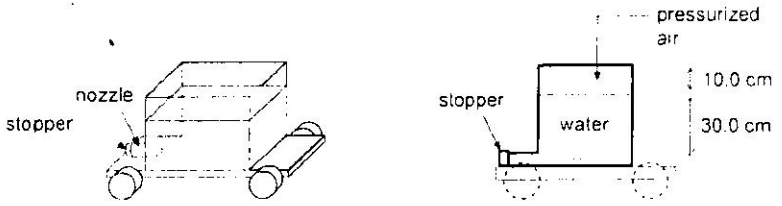
The television is in stand-by mode for 138 hours while the computer is in stand-by mode for 118 hours in a week. As the current in the stand-by circuit is the same for both, unplugging the television would save more energy as it is in the **stand-by mode for a longer duration**

(ii) Suggest one disadvantage in completely unplugging a computer when not in use. [1]

The computer needs more time to boot up if it is completely unplugged when not in use.

[Accept any reasonable answers]

11. Fig. 11.2 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.



Perspective View Side View

Fig. 11.2

The following information is provided.

Initial height of the water in the tank	30.0 cm
Initial height of the air in the tank	10.0 cm
Initial air pressure in the tank	2.50×10^5 Pa
Cross-sectional area of the nozzle	4.00×10^{-4} m^2
Atmospheric pressure	1.00×10^5 Pa
Density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

hpg = 0.30 x 1000 x 10 = **3000 Pa** [M1]

total pressure = 3 000 + 250 000 Pa
= **253 000 Pa (to 3 s.f.)** [CAO1: correct answer with units]

total pressure = [2]

(b) The calculated pressure in part (a) is larger than the atmospheric pressure. Explain why the stopper is not forced out of the nozzle. [2]

There is **no resultant force** acting on the stopper. [B1]

The **friction between the stopper and the nozzle** prevents the stopper from coming off. [B1]

(c) When the stopper is removed, the water will be pushed out of the nozzle, causing a forward force which propels the trolley to move forward. Calculate the maximum forward force due to this propulsion.

F = P A
= (253 000 − 100 000) x (4.00×10^{-4}) [M1]
= **61.2 N (to 3 s.f.)** [CAO1: correct answer with units]

maximum forward force = [2]

(d) After a short period of time, the height of the water drops to 15.0 cm. Calculate the air pressure inside the tank.

$P_1 V_1 = P_2 V_2$
(2.50×10^5 x (10.0 x A)) = (P_2 x (25.0 x A)) [M1]
P_2 = **1.00×10^5 Pa (to 3 s.f.)** [CAO1: correct answer with units]

air pressure = [2]

(e) The cross-sectional area of the nozzle is enlarged. State two changes that will occur with reference to the trolley. [2]

The **forward force** on the trolley is **increased**. [B1]

The trolley will be in **motion for a shorter duration** etc. [B1]

12 EITHER

In an experiment to study sound waves, a tuning fork is struck and placed near a microphone.

(a) Explain how the sound waves are transmitted from the tuning fork to the microphone [2]

The vibrating tuning fork causes a series of **compressions and rarefactions** of the air particles. [B1]

The **air particles** themselves just **vibrate** back and forth about their original positions. **transferring energy** to the neighbouring particles. [B1]

(b) The microphone converts the sound into electrical signal which is input into a cathode ray oscilloscope. Fig. 12.1 shows the trace obtained on the screen of the CRO when the input signal is applied to it. The time-base of the CRO is set at 2 ms/div.

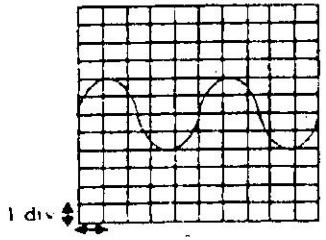


Fig. 12.1

(i) Calculate the frequency of the sound waves produced by the tuning fork.

$T = 5 \times 2 \times 10^{-3} = 10$ ms [M1]

$f = \frac{1}{T} = \frac{1}{10 \times 10^{-3}} = 100 Hz$ [CAO1: correct answer with units]

frequency = [2]

(ii) Calculate the wavelength of the sound waves, given that the speed of sound in air is 340 ms^{-1}

$v = f\lambda$

$340 = 100 \times \lambda$ [CAO1: correct answer with units]

$\lambda = 3.4m$

wavelength = [1]

(c) State and explain the effect on the trace on the screen when the tuning fork is moved further away from the microphone. [2]

The trace will have **smaller amplitude**. [B1]

As the sound waves travel through a longer distance, **energy is dispersed in all direction**. [B1]

(d) In a second experiment, the tuning fork is replaced by a device which emits an ultrasound.

(i) Explain the term *ultrasound*. [1]

Ultrasound are **sound waves that have a frequency of greater than 20 kHz** [B1]

(ii) State the effect on the trace on the screen when the ultrasound is input into the CRO [1]

The trace shown on the screen will have a **very small period of less than 0.05 ms**. [B1]

(e) State one practical application of ultrasound. [1]

- It can be used in ultrasound scanning to check the development of foetuses in pregnant women
- It can be used in ultrasound flow meter to measure the speed of blood flow in the body.
- It can be used in a technique known as shock wave lithotripsy to break kidney stones into small pieces.
- It can be used in sonar to locate underwater objects / determine the depth of the seabed.

[B1 accept any reasonable answer]

OR

The table contains data about a transformer. The turns ratio of primary coil to the secondary coil is 0.5. This is not an ideal transformer as seen from the data. The load resistance, connected to the secondary coil has been varied.

input voltage / V	output voltage / V	load resistance / Ω	input power / W
6.00	0.57	1.0	6.86
6.00	4.00	10.0	4.80
6.00	6.00	20.0	3.60
6.00	7.20	30.0	2.88
6.00	7.64	35.0	2.62

(a) State what is meant by an ideal transformer. [1]

An ideal transformer is one whose output power/energy is equal to the input power / energy

(b) Explain why the transformer under study is NOT ideal [1]

$\frac{N_s}{N_p} = 2$ but $\frac{I_p}{I_s} \neq 2$ [1] (OR $P_p \neq P_s$ using data from table)

(c) Use the table to calculate

(i) the current in the primary coil when the input power is 2.62 W.

P = IV
2.62 = I x 6.00 [C1]
I = 0.4367
= **0.437 A** [CAO1: correct answer with units]
current = [2]

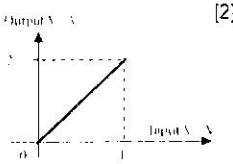
(ii) the corresponding current in the secondary coil.

V = IR
7.64 = I x 35.0 [C1]
I = 0.2183
= **0.218 A** [CAO1: correct answer with units]
current = [2]

(d) Determine the output power when the input power is 2.62 W.

P = IV
= 0.218 x 7.64 [C1]
= 1.668
= **1.67 W** [CAO1 correct answer with units]
power = [2]

(e) Sketch a graph of the output voltage against the input voltage if this transformer is ideal. [2]



Refer to diagram
Straight line [1]
Coordinates show that gradient equals 2. [1]
(Wrong graph, max 1m for straight line)

*** END OF PAPER 2 ***

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME ( )

CLASS

PHYSICS **5059/01**

Paper 1 Multiple Choice **19 September, 2016**

Secondary 4 Express **1 hr**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the OTAS 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 OTAS 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.

Any rough working should be done in this booklet.

Where necessary, take acceleration due to gravity, g = 10 m/s^2

1 Pendulum A makes 20 complete oscillations in 10 s. Pendulum B makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum B has a shorter period than pendulum A.

B The string of pendulum B is longer than that of pendulum A.

C The mass of the bob of pendulum B is smaller than that of pendulum A.

D The angle of swing of release for pendulum B is smaller than that of pendulum A.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.

diagram 1

diagram 2

What is the zero error and the actual thickness of the coin?

	zero error / cm	corrected reading / cm
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

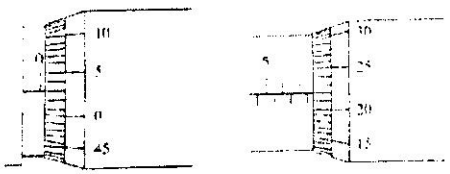


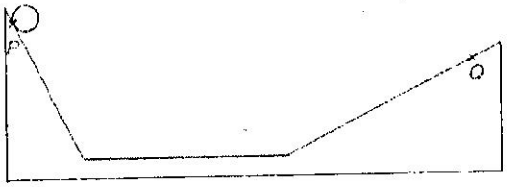
diagram 1

diagram 2

What is the true diameter of the ball bearing?

A 7.19 mm **B** 7.69 mm **C** 7.72 mm **D** 7.75 mm

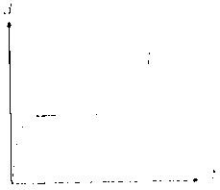
4 A sphere runs along a smooth rail from **P** to **Q** as shown



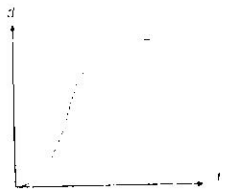
Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?

A

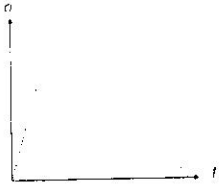
B



C



D



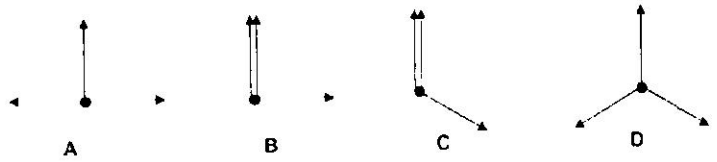
5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

What is its average speed during the journey?

A 4.0 m/s **B** 5.0 m/s
C 6.0 m/s **D** 7.0 m/s

6 Three forces of the same magnitude act simultaneously on a small object.

Which one of the following combination of these three forces will give the greatest resultant force?

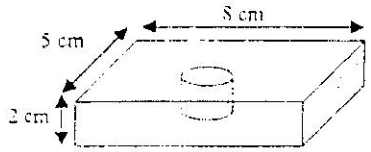


7 A 10.0 kg block of iron is brought from Earth to the surface of Planet Y.

Given that the gravitational field strength of Planet Y is 3.90 N/kg, how will the properties of the iron block change?

	inertia	density	weight
A	decreases	remains unchanged	increases
B	decreases	increases	increases
C	remains unchanged	decreases	decreases
D	remains unchanged	remains unchanged	decreases

8 A rectangular block of steel has a cylindrical hole bored through it as shown. The density of steel is 8.0 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 3.5 cm^2 **B** 5.0 cm^2

C 2200 cm^2 **D** 4400 cm^2

9 An object is in static equilibrium. Which of the following statements about the object is true?

A It is moving in a straight line at uniform speed.

B It is rotating at a constant rate at a fixed point.

C It is rotating anti-clockwise and then clockwise in cycles.

D It is at rest and not rotating.

10 A parachutist has opened his parachute and is falling to Earth at constant speed. What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy

C potential energy → kinetic energy

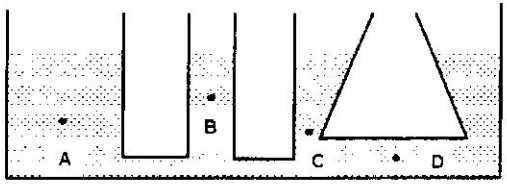
D potential energy → thermal energy

11 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power input by the motor? Take density of water to be 1000 kg m^{-3}.

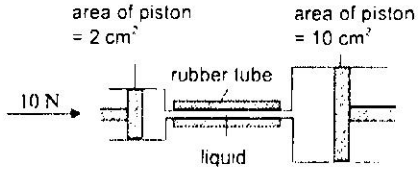
A 12.5 W **B** 22.2 W
C 556 W **D** 1330 W

12 The diagram shows a container with openings of different shapes filled with a liquid.

Which of the points **A** to **D** has the greatest pressure?



13 The diagram shows two syringes connected by a rubber tube. The space between the two pistons is filled with a liquid. The areas of the small piston and the large piston are 2 cm^2 and 10 cm^2 respectively. A force of 10 N is applied to the small piston.



What is the ratio of the pressure acting on the small piston to the pressure acting on the large piston?

A 1 : 1 **B** 1 : 2

C 1 : 5 **D** 5 : 1

14 A resistance thermometer shows a resistance of 1.0 Ω and 4.0 Ω when placed in melting ice shavings and in a liquid at 60 °C respectively.

What is the thermometer reading when it is placed in a liquid at 80 °C?

A 1.5 Ω **B** 2.3 Ω

C 4.0 Ω **D** 5.0 Ω

15 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.

How does the speed of the gas molecules and their 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

16 A heated smooth metallic body is allowed to cool in air. Which of the following statements about its heat loss is incorrect?

A Convection currents in the air aid the process of heat loss.

B Conduction is the main mode of heat loss as the body is a good conductor of heat.

C The rate of heat loss by thermal radiation is increased due to its smooth metallic surface.

D The rate of heat loss decreases as the temperature of the body nears room temperature.

17 A person places his two feet on two separate surfaces, a woollen carpet and a marble tile. Both surfaces are initially at the same temperature.

Which statement best describes how the person will feel?

A Both surfaces feel the same since both are at the same temperature initially.

B The foot on the carpet feels warmer because the carpet transfers heat to the foot.

C The foot on the tile feels cooler because the tile transfers coldness to the foot.

D The foot on the carpet feels warmer because the rate of heat transfer is slower through the wool.

18 A piece of ordinary kitchen aluminium foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside and why?

A The dull side should be on the outside because it is a better emitter of thermal radiation.

B The dull side should be on the outside because it absorbs thermal radiation better.

C The shiny side should be on the outside because it is a better thermal conductor

D The shiny side should be on the outside because it is a better absorber of thermal radiation.

19 Object A is 2 kg. It has a temperature of 40 ℃ and has an internal energy of 500 kJ. Object B is 2 kg. It has temperature of 50 ℃ and has an internal energy of 400 kJ. Which of the following statement is correct?

A Heat flows from object A to object B.

B Heat flows from object B to object A.

C No heat flow between object A and object B.

D There is not enough information to determine the direction of heat flow.

20 An ice tray contains 0.30 kg of water which has an initial temperature of 20°C. The ice tray and water are placed into a freezer that has a constant temperature of – 4.0°C. The specific heat capacity of water is 4180 J/(kg°C), the specific latent heat of fusion of water is 3.34×10^5 J/kg and the specific heat capacity of ice is 2100 J/(kg°C).

What is the energy that is needed to be removed in order to change the water into ice at – 4.0 °C?

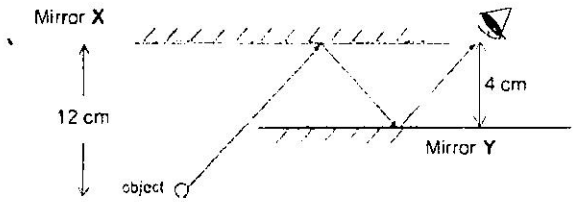
A 18 kJ

B 25 kJ

C 125 kJ

D 128 kJ

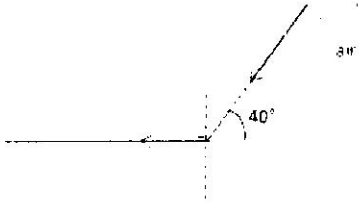
21 The figure below shows how a ray of light from an object enters the eye after being reflected twice.



What is the vertical distance (distance perpendicular to plane mirror) between the final virtual image of the object in mirror **Y** and the eye?

A 12 cm **B** 16 cm
C 20 cm **D** 32 cm

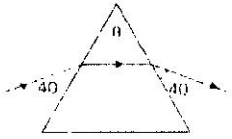
22 The following diagram shows a ray of light entering a transparent block from air



The speed of light in air is 3.0×10^8 m/s. Calculate the speed of light in the transparent block.

A 1.93×10^8 m/s **B** 2.30×10^8 m/s
C 1.14×10^8 m/s **D** 3.92×10^8 m/s

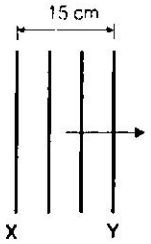
23 A light ray passes through a triangular glass prism of refractive index 1.5.



What is angle θ?

A 51° **B** 53° **C** 61° **D** 65°

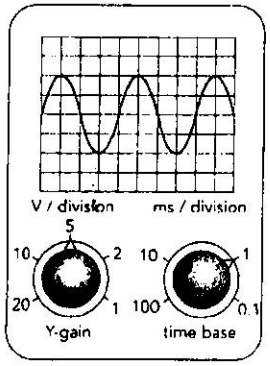
24 The figure below shows a water wave travelling in a ripple tank. The wavefront at **X** travels to **Y** in 5.0 s.



What is the frequency of the water wave?

A 0.60 Hz **B** 3.0 Hz **C** 15 Hz **D** 75 Hz

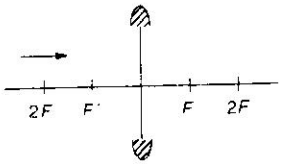
25 A wave is displayed on an oscilloscope with the settings as shown.



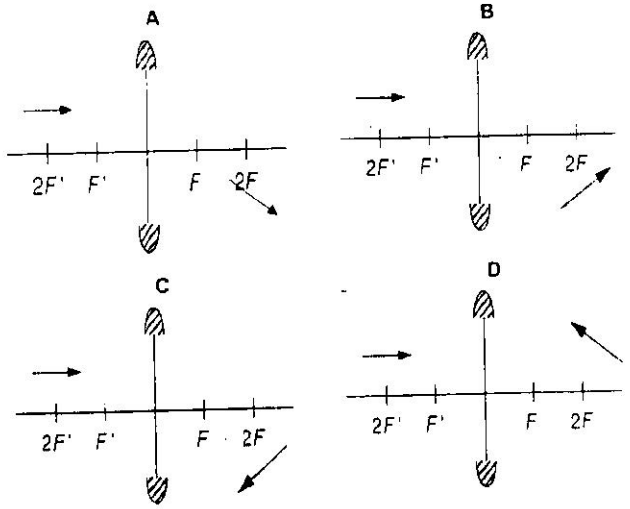
Which of the following shows the correct values for the peak voltage and frequency of the wave?

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

26 In the following diagram, F and F' are the focal points of a thin converging lens. An object represented by an arrow is placed in front of the lens.

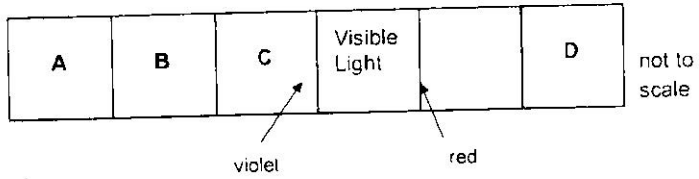


Which one of the following diagrams show the correct location and orientation of the image formed?



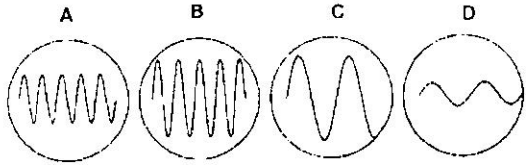
27 The following diagram shows an electromagnetic spectrum. The violet and red ends of the visible spectrum are marked. Which part of the spectrum can be used to detect counterfeit notes?

The Electromagnetic Spectrum



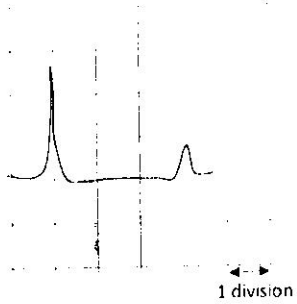
not to scale

28 The diagram shows the waveforms produced by different sounds. Which diagram corresponds to the loudest sound with the lowest pitch?



29 A man shouts on a mountain and detects the echo from the nearest neighbouring mountain after using a microphone attached to a cathode ray oscilloscope (CRO). The following CRO screen shows the original sound and echo trace. Sound travels at 330 m/s in air.

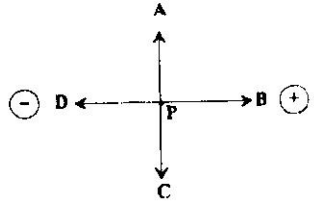
The time-based setting of the CRO is set to 10 s/div.



What is the distance between the man and the mountain?

A 30 m B 4950 m C 9900 m D 19800 m

30 The diagram below shows two electric charges. Which of the following shows the direction of the electric field at point P?

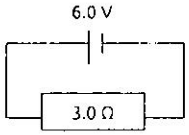


31 Wire X is 1.0 m long and has a diameter of 0.50 mm. It has a resistance of 5.0 Ω. Wire Y is made up of a material that has twice the resistivity of wire X's material. Wire Y is 2.0 m long but it has a diameter of 0.25 mm.

What is the resistance of Wire Y?

A 0.63 Ω **B** 5.0 Ω **C** 40 Ω **D** 80 Ω

32 A 3.0 Ω resistor is connected to a 6.0 V supply. How much charge flows through the resistor in 20 s?

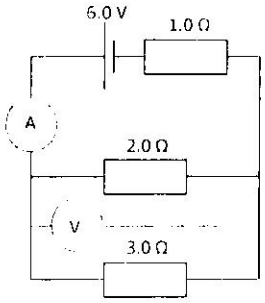


A 10 C **B** 40 C **C** 60 C **D** 120 C

33 Electromotive force is defined as the

A rate of flow of charge at a point
B the magnitude of force required to move a unit charge across the whole circuit
C the amount of energy required to move a unit mass of charge across the whole circuit
D the amount of energy converted per unit charge from non-electrical to electrical energy

34 The following diagram shows three fixed resistors connected to a 6.0 V supply



Which of the following show the voltmeter reading V and ammeter reading I?

	V/V	I/A
A	6.0	11
B	6.0	5.0
C	3.3	2.7
D	3.3	0.45

35 An electric iron is connected to the mains supply of 110 V by a cable. Which of the following shows a possible combination of the potential and current of the respective wires under normal operating conditions?

	live wire		neutral wire		earth wire	
	current/A	Potential	current/A	potential	current/A	potential
A	1.0	High	0.0	Low	0.0	Low
B	1.0	High	1.0	Low	0.0	Low
C	1.0	Low	1.0	High	1.0	High
D	0.0	Low	1.0	High	1.0	Low

36 An air-conditioner has a rating of 240 V, 1500 W. The cost of operating the air conditioner came up to $45 for a particular month. What is the duration of time that the air-conditioner was switched on for the month if one unit of electricity costs $0.20?

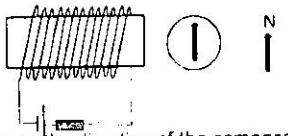
A 9 min **B** 150 hrs **C** 744 hrs **D** 938 hrs

37 The following diagram shows an electric bell.

Which materials would be suited for the parts labelled P, Q and R?

	P	Q	R
A	soft iron	brass	soft iron
B	soft iron	soft iron	spring steel
C	soft iron	brass	brass
D	spring steel	soft iron	spring steel

38 The following diagram shows a solenoid connected to a DC supply and the direction of a compass near it before the switch is closed.



Which of the following shows the direction of the compass after the switch is closed? Assume that a small current flows in the solenoid.

A

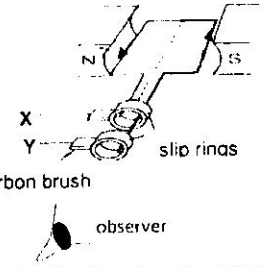
B

C

D

Refer to the following diagram for questions 39 and 40

The following diagram shows a representation of an AC generator connected to leads **X** and **Y**. At the instant shown, the current direction in the coil is as shown.



39 Which of the following shows the direction of rotation of the coil as seen by an observer and the rule used to obtain this direction of rotation?

	direction of rotation	rule used
A	clockwise	Fleming's Left Hand Rule
B	clockwise	Fleming's Right Hand Rule
C	anti-clockwise	Fleming's Left Hand Rule
D	anti- clockwise	Fleming's Right Hand Rule

40 Which of the following states the function of a slip ring in the AC generator?

A To prevent entanglement of the wire
B To ensure electrical contact between the coil and the external circuit
C To ensure the coil rotates continuously by changing the direction of the current in the coil every half a revolution
D To increase the magnetic field strength of the rotating coil

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

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME ( )

CLASS

PHYSICS **5059/2**

Paper 2 Theory **30 August, 2016**

Secondary 4 Express **1 hr 45 minutes**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions

Write your answers in the spaces provided on the question paper.

Section B

Answer all **three** questions, the last question is in the form either/or.

Write your answers on the separate answer papers provided.

You are advised to spend no longer than one hour on **Section A** and no longer than 45 minutes on **Section B**.

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.

All essential working must be shown clearly.

Where necessary, take acceleration due to gravity, g = 10 m/s^2.

For Examiner's Use	
Section A	
B 9	
B 10	
B 11	
Total	

This document consists of **24** printed pages, including this cover page.

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows a velocity-time graph for a ball bouncing vertically on a hard surface on an unknown planet. The ball was dropped at t = 0 s

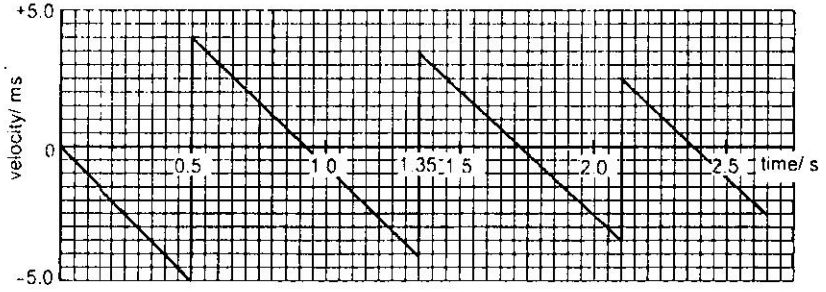


Fig. 1.1

(a) State the time at which the ball was just in contact with the ground for the first time.

[1]

(b) Calculate the height from which the ball was first dropped.

height = ... [2]

(c) State the acceleration of the ball at 0 s.

acceleration = ... [1]

Total marks: ____

(d) Sketch a displacement-time graph on Fig. 1.2 for the first 1.35 s of the motion.

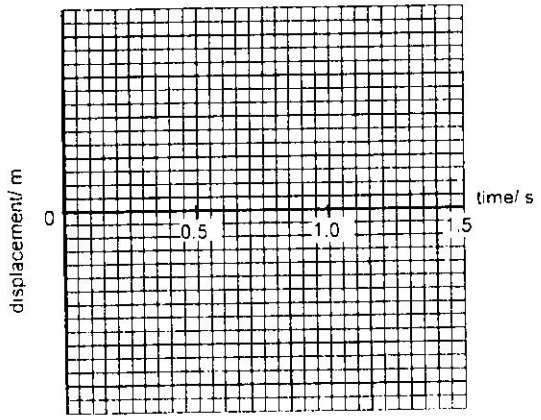


Fig. 1.2

[2]

2 Fig. 2.1 shows three cubes, **A**, **B** and **C**, of mass 35 kg, 5 kg and 20 kg respectively resting on a smooth horizontal surface initially. The cubes are in contact with each other as shown in Fig. 2.1. A horizontal force of 300 N is then exerted on cube **A**.

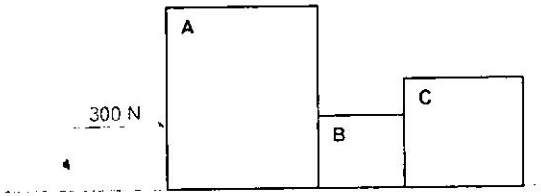


Fig. 2.1

(a) Calculate the acceleration of cube **B** and hence the resultant force acting on it.

acceleration = ...

force = ... [2]

(b) Calculate the force exerted on cube **A** by cube **B**.

force = [2]

(c) Draw all the pairs of action-reaction forces acting on cube **C** and label the forces clearly in Fig. 2.1. [2]

3 Fig. 3.1 shows an uniform gondola suspended in mid-air that is used to clean the window of buildings. A cleaner of mass 85 kg stands 2.0 m away from rope X inside the gondola. The mass of the gondola is 630 kg and the distance between the ropes is 6.0 m.

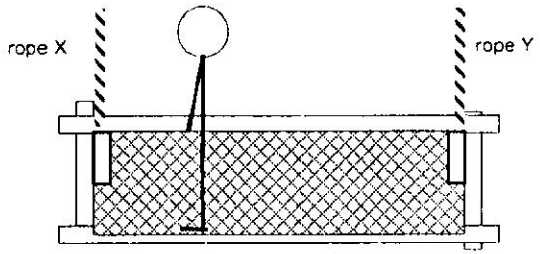


Fig. 3.1

(a) Draw and label all the vertical forces in Fig. 3.1 which are acting on the gondola.

[2]

(b) Calculate the force exerted by rope Y on the gondola.

force = [2]

(c) State and explain qualitatively how the force exerted by rope **Y** on the gondola will change as the cleaner moves towards rope **Y**.

[2]

Total marks:

[Turn over

4 Fig. 4.1 shows part of an experimental arrangement which is used to obtain a value for l_v, the specific latent heat of vaporisation of water.

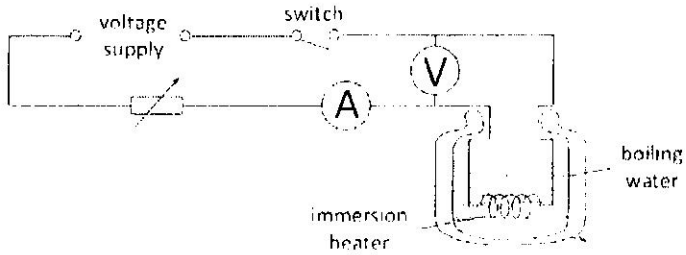


Fig. 4.1

(a) In a particular experiment using the apparatus in Fig 4.1, a student uses an immersion heater which supplies 300 J of energy per second. He closes the switch for 2 minutes, and 0.015 kg of boiling water is vaporised.

(i) Calculate a value for l_v.

l_v = [1]

(ii) State and explain whether you would expect the answer in **(a)(i)** to be larger or smaller than the true value of l_v.

[2]

Total marks:

[Turn over

(b) Another student doing the same experiment decides to insert a thermometer into the boiling water at the start of the experiment, as shown in Fig. 4.2, to ensure that the temperature remains at 100 °C throughout the experiment.

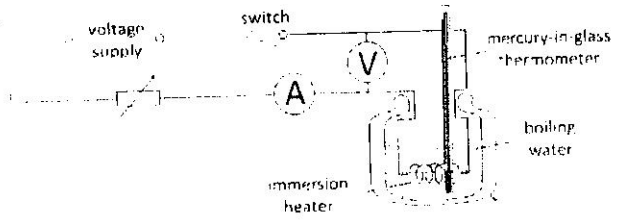


Fig. 4.2

(i) Suggest a reason why this student's concern may be invalid.

[1]

(ii) The student inserts the thermometer at 30 °C into the boiling water, right at the start of the experiment. Given that he uses the same immersion heater and keeps it on for the same 2 minutes, use your answer in **(a)(i)** to calculate the mass of boiling water that will be boiled off.

(You may take the average heat capacity of the mercury-in-glass thermometer to be 28.5 J K^{-1}, and assume that the thermometer reaches 100 °C before the end of the experiment.)

mass = [2]

(ii) Hence explain why thermometers cannot be made of thermometric substances with high heat capacities.

[1]

Total marks:

[Turn over

5 Fig 5.1 (an actual 1:1 scaled diagram) shows an object and its corresponding virtual image when the object is placed in front of a thin converging lens.

(a) Complete the diagram with two sets of rays to show how the image is formed. Mark the optical centre of the lens clearly with an X.

Fig 5.1

[2]

(b) State the magnification of this lens and its focal length.

magnification factor = ... [1]

focal length = ... [1]

6 Fig 6.1 shows a highly negatively-charged metallic ball on an insulated stand.

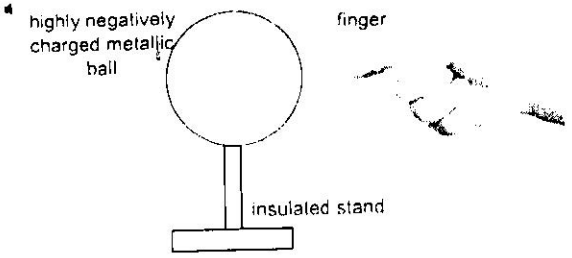


Fig 6.1

Describe and explain what happens to the charges in a person's finger when it approaches the ball without touching it. You may use the diagram to illustrate your answer. Include the idea of an electric field in your answer.

..... [2]

Total marks:

[Turn over

7 Seismic waves are generated by earthquakes. These waves start from the epicentre. Primary (P) waves travel in a direction parallel to the direction of the vibration of its particles. Secondary (S) waves travel in a direction perpendicular to the direction of vibration of its particles.

(a) State the type of wave that the P wave is.

.....[1]

(b) Fig 7.1 shows the time taken by the waves to travel different distances from the epi centre.

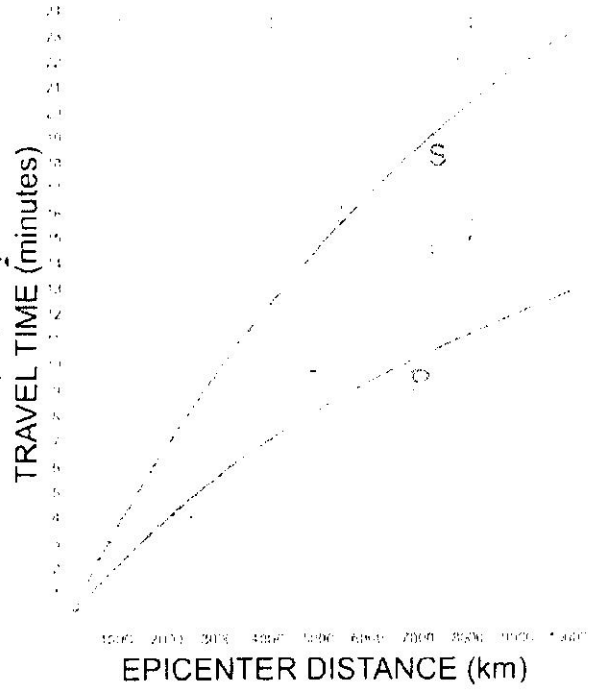


Fig 7.1

Calculate the average speed of the S wave that reached 10 000 km from the epi centre in m/s.

average speed = ... [2]

Total marks: [ ]

[Turn over

(c) A typical S wave has a frequency ranging from 0.50 to 1.0 Hz. Calculate the maximum possible wavelength of the S wave that reached 10 000 km from the epi centre.

wavelength = ... [2]

8 Fig 8.1 shows part of a circuit that is designed to switch on a LED when it is dark.

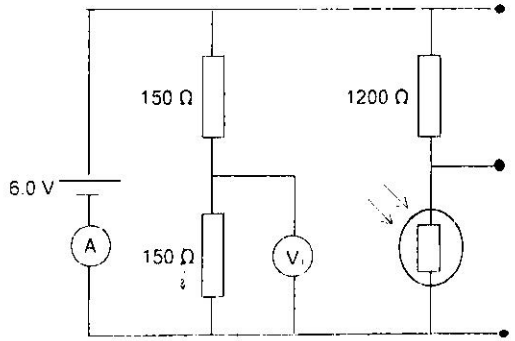


Fig 8.1

(a) Calculate voltmeter reading V_1.

V_1 = ... [1]

(b) State and explain if the LED should be placed across the 1200 Ω or LDR so that it can light up when the light intensity of the surroundings decreases.

.....

.....

.....

.....[2]

Total marks: [ ]

[Turn over

(c) Fig 8.2 shows how the current through a filament lamp changes as the potential difference (p.d) across it varies.

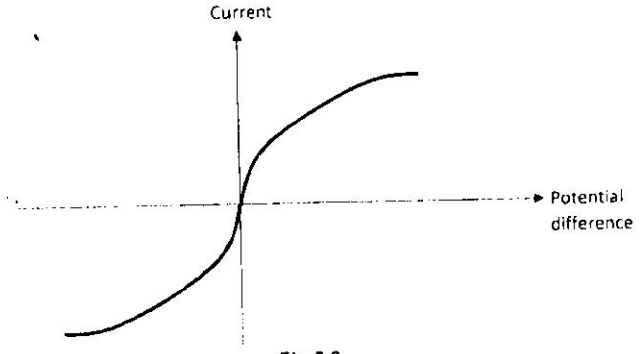


Fig 8.2

(i) Sketch on the same axis above how the current of an LED will change as the p.d across it changes. [2]

(ii) Hence or otherwise, explain the advantage of the LED over a filament lamp.

.....

..... [1]

9 Fig 9.1 shows part of a ring circuit in a phone shop. The ring circuit draws power from a 230 V supply.

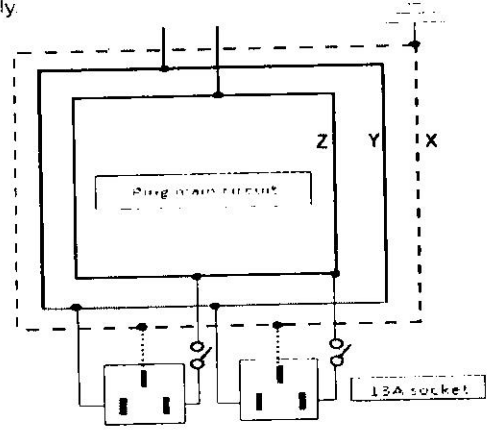


Fig 9.1

Total marks: [Turn over

(a) Wire X is the earth wire. Label wires Y and Z.

Y: ..... Z: ..... [1]

(b) Fig 9.2 shows a 6 point multi plug adaptor that is connected to one of the 3 pin sockets in Fig 9.1.

Fig 9.2

The shop owner plugs 6 phone chargers into the multi plug adaptor. Each of the phone charger has an input rating of 230 V, 50 W.

The wires in the 3 pin plug are thin and can only withstand a maximum of 1.0 A. State and explain, with clear working shown, if the 13 A fuse of the 3 pin plug of the adaptor inserted into the socket is able to protect the circuit.

.....

..... [2]

(c) Fig 9.3 shows part of a 3 pin plug with a fuse missing.

Fig 9.3

The shop owner claims that the missing fuse will not make any difference to the operation of the appliance. Explain if you agree with his statement.

.....

.....

..... [1]

Total marks: [Turn over

10 Fig 10.1 shows a simple hand-wound AC generator. The generator consists of a rotating single coil of wire. The emf generated lights up a lamp.

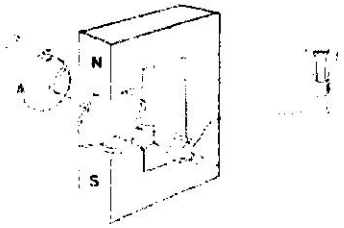


Fig 10.1

(a) Explain using Lenz's law, why the hand that is winding the generator coil experiences a resistive force when the lamp is lit.

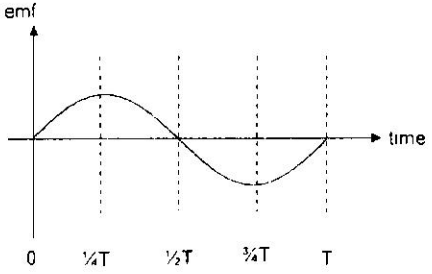
.....

.....

.....

..... [1]

(b) Fig 10.2 shows how the emf across the coil varies with time. Sketch on the same axis how the emf will change if the speed of rotation of the coil is doubled. A complete cycle of rotation of the coil takes a period T.



[2]

Fig 10.2

(c) Explain using Faraday's law, why increasing the number of turns of coil of wire increases the magnitude of the emf generated across the coil

.....

..... [1]

Total marks: [Turn over

Name: _____ ( )

Class: _____

Section B

Answer all **the** questions from this section.
Answer only one of the two alternative questions in **Question 13.**

11 Fig 11.1 shows a small water turbine that generates electricity from a reservoir of water located a height h above the turbine.

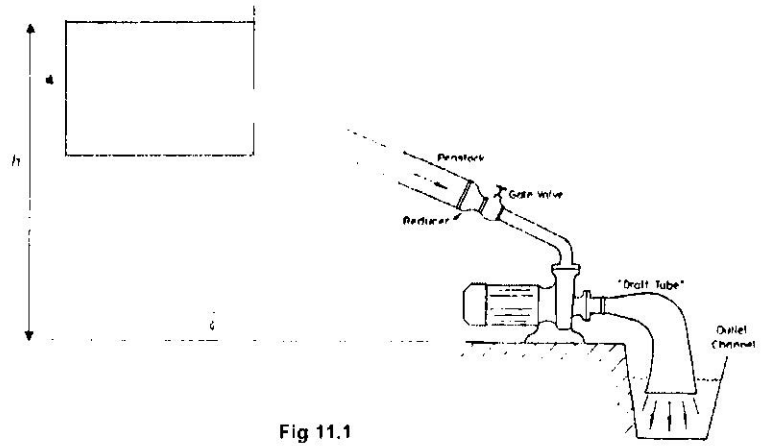


Fig 11.1

(a) Fig 11.2 shows the specifications of the water turbine.

power output (kW)	height h /m	flow rate (m^3/s)
5.0	20	0.035

Fig 11.2

Calculate the efficiency of the water turbine. Assume no frictional losses when the water flows from the reservoir to the water turbine. Take the density of water to be 1000 kg/m^3.

efficiency = ... [2]

Total marks: [Turn over

(b) Fig 11.3 shows the cross-section of the water turbine. The water flows into the turbine and turns the rotor blades.

Fig 11.4 shows the interior of the turbine. The rotor blade is wrapped by a coil of wire connected at a DC input. An e.m.f. is generated across the coils of wire wrapped around a stator (stator coils) when the water flows.

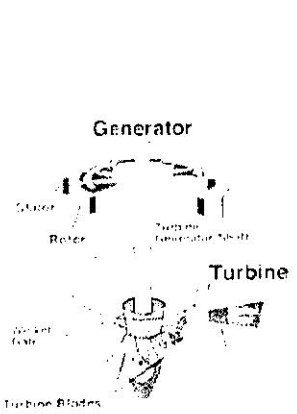


Fig 11.3

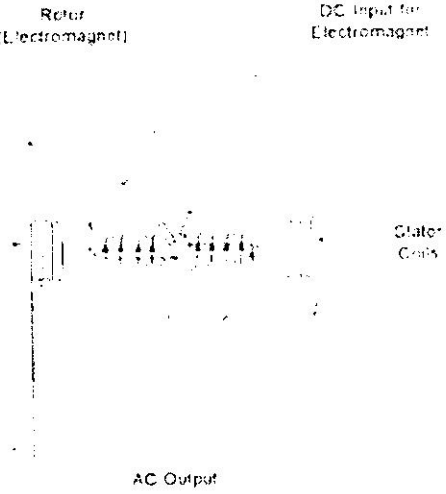


Fig 11.4

Explain how the flow of the water generates an e.m.f. across the stator coils

.....

.....

.....

.....

.....

..... [3]

Total marks:

(c) Fig 11.5 shows the representation of how power is generated and transmitted from a hydroelectric plant to homes. Assume both the transformers are 100% efficient.

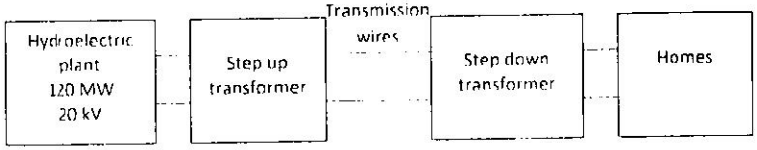


Fig 11.5

(i) Calculate the current generated by the hydroelectric plant.

current = ... [1]

(ii) The step-up transformer has a turns ratio of 40. Calculate the current output of the step-up transformer.

current = ... [1]

(iii) Assuming that each transmission wire has a resistance of 30 Ω, calculate the input voltage to the step-down transformer.

input voltage = ... [2]

(d) State an advantage and a disadvantage generating power using hydroelectric means instead of burning of fossil fuels.

advantage .....

.....

disadvantage .....

..... [1]

Total marks:

12 Fig 12.1 shows the DC motor of a fan. It consists of a single coil rotating in a clockwise manner about a pivot.

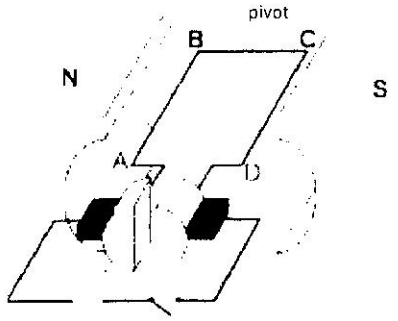


Fig 12.1

(a) (i) Draw the current direction in wire **AB** and **CD** so that the coil rotates in a clockwise manner. [1]

(ii) Complete Fig 12.1 to include a 12 V DC supply as well as a potentiometer that will allow the maximum potential difference across the motor to be 12 V [2]

(b) Fig 12.2 shows the front view of the wire **AB** between the two permanent magnets.

Fig 12.2

Explain, by completing the diagram above, how the magnetic fields interact to produce a force on wire AB.

.....

.....

.....

..... [3]

Total marks:

(c) The magnetic field strength of the magnets is doubled.

(i) Explain why this would result in an increase in the rotation speed of the fan.

.....

.....

.....

..... [2]

(ii) Sketch in the axis below how the moments about the pivot would vary with time for both the original weaker magnets as well as the stronger magnets. Label the curve due to the weaker magnets as 'W' and the curve due to the stronger magnets as 'S'. The time taken for a complete revolution for the coil with the weaker magnets is T

Draw the two curves from time 0 to T. Assume both coils are horizontal initially.

[2]

Total marks:

13 EITHER

Fig. 13.1 shows the Griffon. It opened in August 2006 and is the world's tallest, floorless dive roller coaster. The ride features two nearly-vertical dives, one of which occurs at the start of the ride, subjecting the riders to large changes in speed and thrill of the ride.

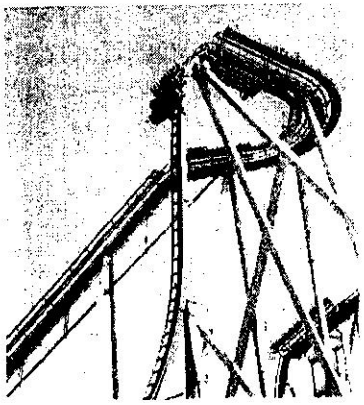


Fig. 13.1

Fig. 13.2 shows the simplified diagram of the first hill of the ride.

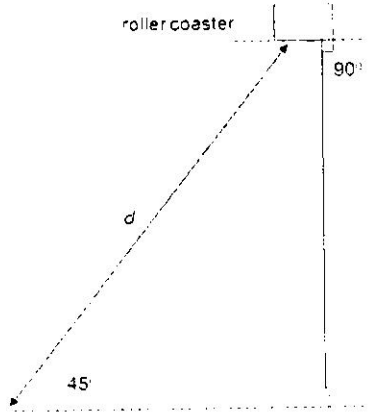


Fig. 13.2

At the start of the ride, the train of mass 3000 kg climbed a 45° lift hill at a constant

speed of 3.04 m/s. The train then pauses on a holding brake for five seconds before dropping 62.5m at 90° hitting a maximum speed of 31.7 m/s at the bottom of the hill.

(a) State the Principle of Conservation of Energy.

[2]

(b) In dropping from the top to the bottom of the first hill, determine the average friction between the tracks and the train.

mass = [3]

(c) Calculate the distance d and hence the time taken for the train to move up the first hill.

time taken = [2]

(d) The work done in pulling the train is converted to different forms of energy. Name these forms of energy

[1]

(e) Calculate the minimum power of the electric motor pulling the train up the first hill. Assume that friction is constant for the entire ride.

power = [2]

Total marks:

OR The Hare's apparatus is a device used for comparing the densities of two different liquids. As shown in Fig. 13.3, the equipment consists of a three-limbed E-shaped glass tube. The two longer limbs at the side are dipped into the beakers containing the liquids, **X** and **Y**.

One of the liquids is chloroform and the other is methyl isobutyl kelone. The central limb has a tap which allows air to be pumped out. When the tap is closed after air is pumped out, the densities of the liquids can be compared by measuring and comparing the column heights in the two long limbs.

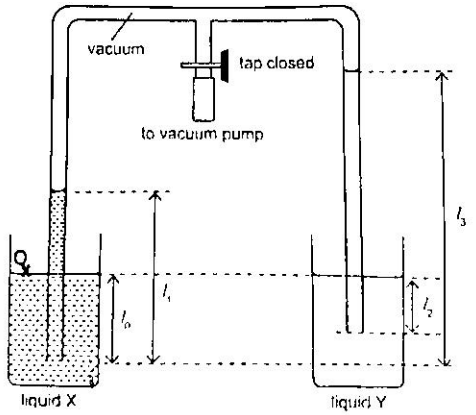


Fig. 13.3

The table below shows the densities of the two liquids.

liquid	density / kg m^{-3}
chloroform	1490
methyl isobutyl kelone	801

(a) Explain, in terms of the air molecules inside and outside the Hare's apparatus, why the liquid levels in the two limbs increase after the air is pumped out.

[3]

(b) On Fig. 13.4, sketch a graph to show the relationship between the pressure and

Total marks:

volume of gas in the Hare's apparatus.

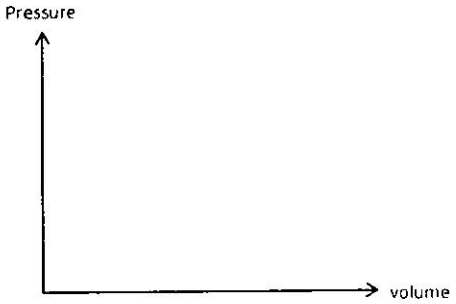


Fig. 13.4

[1]

(c) State which liquid (**X** or **Y**) is chloroform. Explain your answer.

[2]

(d) On Fig. 13.3, mark out a point **P** in liquid Y which has the same pressure as point **O**

[1]

(e) Given that l_0 = 5.0 cm, l_1 = 26.5 cm and l_2 = 3.0 cm, calculate l_3.

l_3 = [2]

Total marks:

(f) This experiment is repeated at a mountain top where the almospheric pressure is lower.

State and explain how your answer in **(e)** will be affected.

[1]

- End of Paper 2-

Total marks:

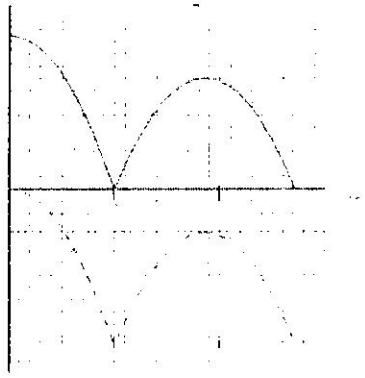
Zhonghua Secondary School

Preliminary Examinations 2016

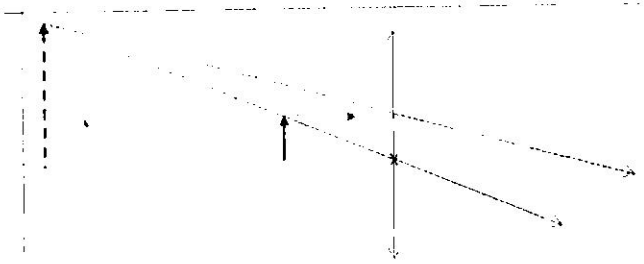
5059 Physics Answer Scheme

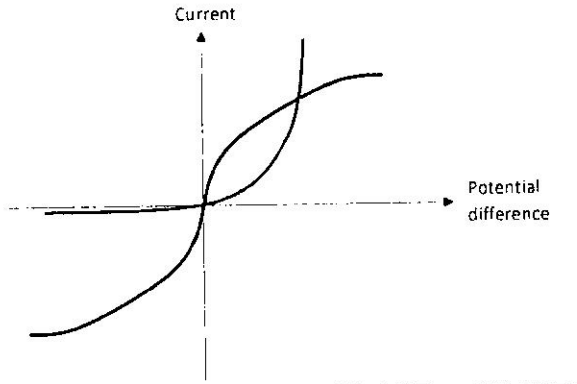
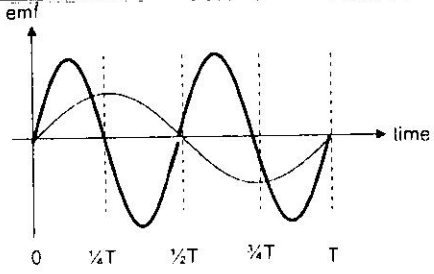
1	B	11	B	21	C	31	D
2	A	12	D	22	B	32	B
3	B	13	A	23	C	33	C
4	C	14	D	24	A	34	C
5	C	15	B	25	B	35	B
6	B	16	C	26	A	36	B
7	D	17	D	27	C	37	B
8	B	18	B	28	C	38	C
9	D	19	B	29	B	39	D
10	D	20	D	30	D	40	A

Paper 2

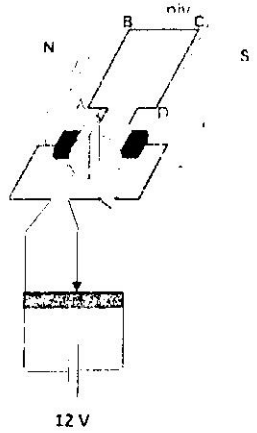
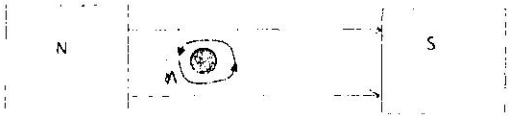
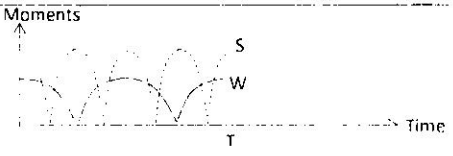
Qn		Mark
1a	0.50 s	1
1b	½ × 0.5 × 5 = 1.25 m	1 1
1c	10 or -10 m/s^2	1
1d		1 – shape from 0-0.5 s 2 m – 1.25 m and lower rebound height
2a	F_{net} on A, B and C = ma 300 = (35 + 5 + 20) a a = 5.0 m/s^2	1
	F_{net} = ma F_{net} on B = 5 × 5 F_{net} on B = 25 N	1
2b	F_{net} on A = 35 × 5 = 175 N 300 – $F_{(on\ A\ by\ B)}$ = 175 $F_{(on\ A\ by\ B)}$ = 125 N	1

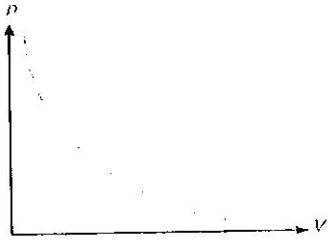
Question	Answer	Marks
2c	F on C by B and F on B by C F on C by surface and F on surface by C F on C by earth and F on earth by C	2
3a	Tension in X Tension in Y Force by cleaner on gondola (850 N) (W not accepted) Weight of gondola (6300 N)	2
3b	Taking X as the pivot: Y × 6 = (850 × 2) + (6300 × 3) Y = 3430 N (to 3sf)	 1 1
3c	Force exerted by rope Y will increase. As the cleaner moves from left to right, the perpendicular distance from the line of action of his weight and the pivot (X) increases. This increases the clockwise moment and hence the force exerted by Y has to increase to ensure the anticlockwise moment is equal to the clockwise moment.	1 1
4ai	$Pt = ml_v$ $(300\ W)(2 \times 60\ s) = (0.015\ kg)l_v$ $l_v = \frac{(300\ W)(2 \times 60\ s)}{0.015\ kg}$ $= 2.4 \times 10^6\ J\ kg^{-1}$	 1
4aii	The answer in (b)(i) is larger than the true value, because in reality energy is lost to the surrounding, and the mass of water *m* vaporised is less. Since l_v = Pt / *m*, a lower mass *m* leads to a higher l_v.	1 1
4bi	The boiling point of water is exactly 100 °C and so when the water is boiling the temperature will be constant at 100 °C.	1
4bii	$Q_{supplied} = Q_{thermometer} + Q_{water}$ $Pt = C_{thermometer}\Delta\theta + ml_v$ $(300\ W)(2 \times 60\ s) = (28.5\ J\ K^{-1})(20 - 0\ K) + m(2.4 \times 10^6\ J\ kg^{-1})$ $m = 0.0142\ kg$	 1 1
4biii	If the thermometer has a large heat capacity C, it will take up a significant amount of energy per unit rise in temperature from the heat source and affect the accuracy of the measurements OR a thermometer with a high C is less responsive.	1

5a		1 m – correct X 1 m – all rays
5b	m = 2.8/0.9 = 2.9 to 3.3 f = 3.2 to 3.6 cm	1 1
6	The negative charges in a ball sets up an electric field (an equivalent diagram) which causes electrons t be repelled from the negative charges in the ball as like charges repel (The electric field set up between the finger and the ball eventually causes the electrons to move from the ball to the fingertip. A spark may be seen)	1 1
7a	Longitudinal waves	1
b	Average speed = 10 000 x10^{3} / (23X 60) = 7246 m/s = 7200 m/s	1 1
c	Maximum wavelength = Speed / minimum frequency = 7246 / 0 50 m = 14500 m (or 15000 m) (or 14.5 or 15 km)	1 1
8a	V_1 = ½ 6.0 = 3.0 V	1
b	When light intensity decreases, R_{LDR} increases. Since $V_{LDR} = \frac{R_{LDR}}{R_{total}} \times emf$. LED should be placed across LDR	1 1

Question	Answer	Marks
8ci		1 m for curve, 1m for line
cii	If high p.d is high enough, the current of LED is higher than filament lamp for the same p.d, the LED will be brighter than lamp.	1
9a	Y: neutral wire Z: live wire	1
b	I = P/V = 50/230 = 0.217 A Total current flowing in fuse = 6(0.217) = 1.30 A	1
	There is no protection as 1.30 A > 1.0 A (or high current melt wire) and the 13 A will not blow to protect the fuse.	1
c	No, the appliance will not work as a missing fuse means the circuit is open and there will be no current.	1
10a	Lenz's Law states that the emf generated will produce a current which will flow in such a way to produce a magnetic field that opposes the motion of the coil.	1
b		1 – double amplitude 1 – double f
c	The rate of change of magnetic flux linking the coil and magnet increases. Since Faraday's Law depends on this rate of change, emf increases.	1

Question	Answer	Marks
11a)	Efficiency = (Po/Pi) X 100% = (5000/mgh) X 100% = (5000 / 0.035X1000X10X20) X 100% = (5/7) X 100% = 71%	1 1
b)	The current carrying coils around rotor generate a magnetic field. when the coil rotates, the flux linking the rotating coil and stator coil changes (or flux cuts stator coil) and induces an emf across the stator coil	Idea of magnetisation of rotor coil -1 Cause of flux change - 1 Flux change - 1
c)	$I = P/V = 120 \times 10^{6} / 20 \times 10^{3} = 6000$ A	1
ii)	Assuming no transformer power loss, $P_1 = P_2$ $V_1 I_1 = V_2 I_2$ $I_2 = (V_1/V_2) I_1$ But $(V_1/V_2) = 1/40$ Hence, $I_2 = (1/40)(6000) = 150$ A	1
iii)	Input V to step down transformer = Output V of step up transformer – V across 2 transmission wires = (Turns ratio)(Input V of step up transformer) – (Current)(R of 2 wires) Input V to step down transformer = = (40)(20 X 10^{3}) – 2(150)(30) =791,000 V	Either 2(150)(30) or (40)(20X10^{3}) - 1 m Ans-1 m
d)	Advantage : Energy is renewable Disadvantage : Have to clear forests to build dam	1

12a)i)	Using Fleming's Left Hand Rule: Current flows in direction BA Current flows in direction DC	1
ii)		1 m for terminal correct direction to achieve clockwise moment
b)	 Magnetic field of current and permanent magnet interact such that field is weakened above A and strengthened below A Force acts from region of high to low flux density (upwards)	Diagram-1 1 1
c)i)	The force on the coil is increased when the field strength increases This leads to a higher moment OR this is because there is a greater difference between the two interacting magnetic field densities	1 1
ii)		1 m only if cosine curve 1m for double f and amplitude No marks if sine curve

13Ea	Energy cannot be created nor destroyed. It can be converted from one form to another, or transferred from one body to another, but the total amount remains constant.	2
13Eb	Change in gravitational potential energy = (3000)(10)(62.5) = 1.875×10^6 J Increase in kinetic energy = ½·(3000)(31.7)^2 = 1.507×10^6 J Work done against friction = $1.875 \times 10^6 - 1.507 \times 10^6$ = 0.368×10^6 J Average friction = 0.368×10^6 ÷ 62.5 = 5880 N	3
13Ec	d = 62.5/sin 45 = 88.4 m t = 88.4 / 3.04 = 29.1 s	1 1
13Ed	Gravitational potential energy and thermal energy due to friction. (sound energy)	1
13Ee	Work done by motor against friction = 88.4 x 5880 = 5.23×10^5 J Total work done by motor = $5.23 \times 10^5 + 1.88 \times 10^6$ Power = $(5.23 \times 10^5 + 1.88 \times 10^6)/29.1$ = 8.26×10^4 W	 1 1
13Oa	As the air is pumped out, the number of air molecules per unit volume decreases and becomes lesser than outside. The frequency of collision of the air molecules with the liquid decreases. The pressure inside becomes lower than outside and hence the liquid level increases.	1 1 1
13Ob	 	1

13Oc	X is chloroform. Chloroform has a higher density from table. h= P/pg. Since pressure on liquids X and Y is the same, the higher density (ρ) of chloroform will lead to a lower liquid level (h) (liquid X)	1 1
13Od	Any point along the same level as point P in liquid Y	1
13Oe	$P_X = P_Y$ $\rho_x g h_x = \rho_y g h_y$ $(1490 \times 10 \times (l_x - l_h)) = (801 \times 10 \times (l_y - l_h))$ l_x = 45.0 cm (to 3sf)	 1 1
13Of	Answer will not be affected The ratio of the densities of X and Y is related only to the ratio of their column heights. Since there is no change in the ratio of the densities of X and Y, the column height of X will still be lower than Y	 1