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ZHONGHUA SECONDARY SCHOOL

Preliminary Examination 2015

CANDIDATE
NAME

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CLASS

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SCIENCE (PHYSICS/CHEMISTRY)

5076/01

Paper 1 Multiple Choice

14 September, 2015

Secondary 4 Express/ 5 Normal (Academics)

1 hr

Set by: Mr Tan Jun Hong/ Ms Yong Ren Cui

Vetted by: Mr Lawrence Tang / Ms Ong Lay 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.

Data sheet for common hydroxide in page 17

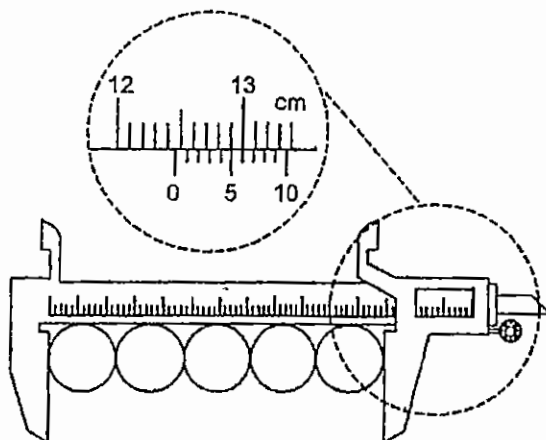
A copy of the Periodic Table is printed on page 18

Where necessary, take acceleration due to gravity, $g = 10 \text{ m/s}^2$

This document consists of 18 printed pages, including this cover page

[Turn over

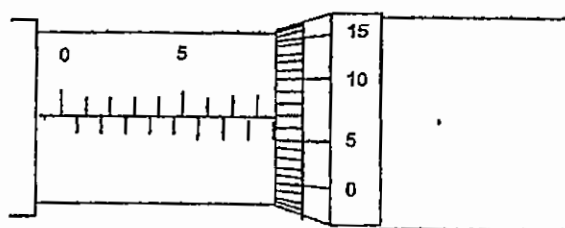
- 1 A pair of vernier calipers is used to measure the total length of 5 coins placed side by side



What is the diameter of one coin?

- | | | | |
|---|---------|---|---------|
| A | 2.45 cm | B | 2.49 cm |
| C | 2.59 cm | D | 2.95 cm |

- 2 The diagram shows a micrometer screw gauge used to measure the thickness of an eraser

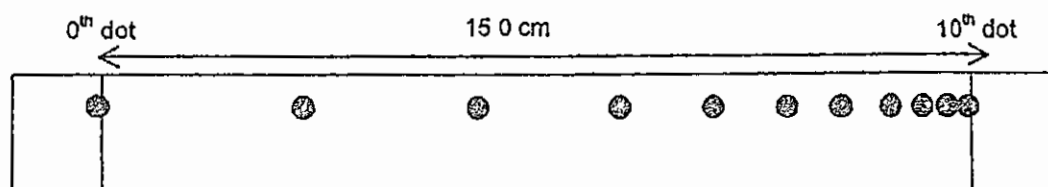


Given that the zero error of the instrument is +0.03 mm, what is the actual thickness of the eraser?

- | | |
|---|----------|
| A | 0.854 cm |
| B | 0.860 cm |
| C | 8.57 mm |
| D | 5.354 mm |

[Turn over

- 3 The diagram below shows a section of a ticker-tape that was attached to a toy car. The ticker-tape timer makes 50 dots per second.



What is the average speed and type of motion of the toy car?

- A 68.1 cm/s, increasing speed B 68.1 cm/s, decreasing speed
C 75.0 cm/s, increasing speed D 75.0 cm/s, decreasing speed
- 4 Which statement about a stationary body under the action of three unbalanced forces is correct?
- A The body remains stationary
B The body accelerates
C The body moves with constant velocity
D The resultant force on the body is zero
- 5 A 40 kg mass is moving across a horizontal surface at 5.0 m/s. What is the magnitude of the uniform net force required to bring the mass to a stop in 8.0 s?
- A 1.0 N B 5.0 N C 25 N D 40 N
- 6 A rock weighs 120 N on Earth. How much will it weigh on Mars where the acceleration of free fall is 4.0 m/s^2 ?
- A 30 kg B 30 N
C 48 kg D 48 N

[Turn over

mass = 50 kg

mass = 40 kg

mass = 50 kg

mass = 100 kg

Contact area per shoe = 0.20 m^2

Contact area per shoe = 0.06 m^2

Contact area per shoe = 0.08 m^2

Contact area per shoe = 0.25 m^2



A



B



C



D

density of a metal bar is 12.0 g/cm^3 . It has a mass of 36 g . When a hole of volume 2 cm^3 is drilled into the bar, what is its density?

6.0 g/cm^3

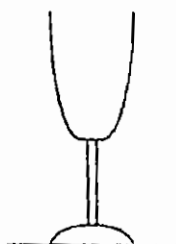
B

2.0 g/cm^3

12.5 g/cm^3

18.0 g/cm^3

- 8 The diagram shows an empty wine glass placed on a table



What is the effect on its stability and inertia when it is filled with water?

	stability	inertia
A	increases	increases
B	increases	decreases
C	decreases	decreases
D	decreases	increases

- 9 The diagram below shows a group of people attending a party. If the floor has a maximum loading capacity of 3 kN/m^2 , which person is not allowed? Assume all of them stand on both legs



[Turn over

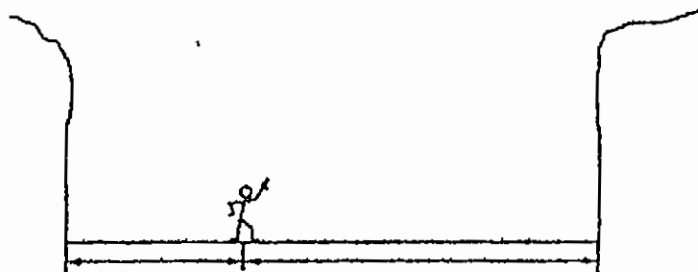
-

-

-
- A diagram illustrating the setup for the experiment. A vertical line on the left represents a wall. A horizontal line represents the distance from the wall to a mirror, which is 400 cm. The distance from the mirror to the person's eye is 70 cm.

A 470 cm B 800 cm C 870 cm D 940 cm

249

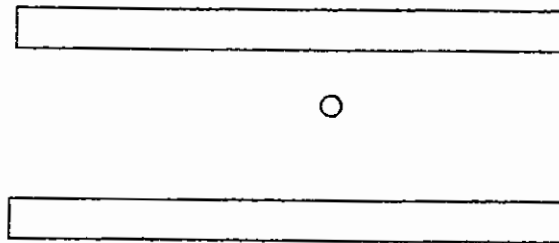


P

Oil drop

7

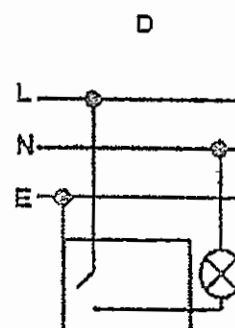
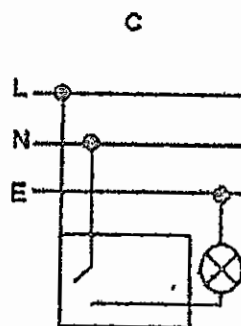
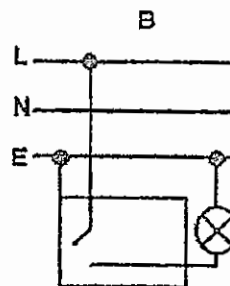
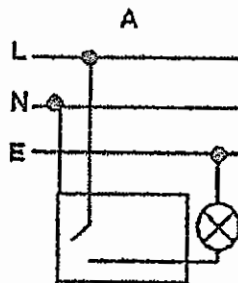
- Q 17 A positively charged oil drop stays stationary between two charged metal plates P and Q as shown in the diagram below. If the positive charge in the oil drop is reduced, the oil drop



- A remains stationary
 B moves downwards
 C moves upwards
 D moves horizontally
- 18 Which diagram shows the correct connections for a switch and lamp in a lighting circuit?

Key L live
 N neutral

E earth
 metal case



[Turn over

B C
current

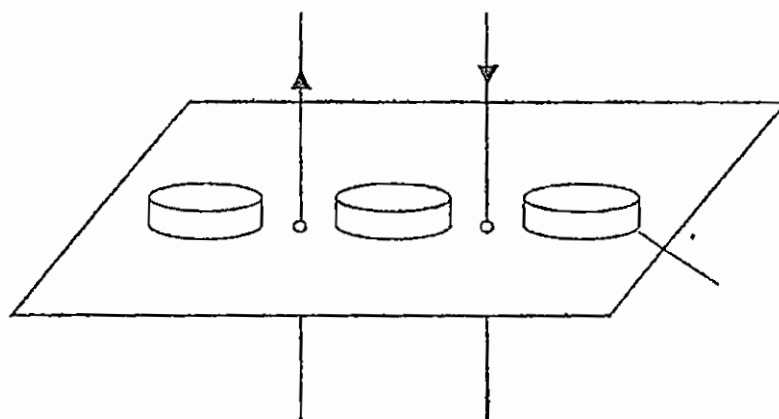
8

- P Q R
19 The cost of running a 2 kW heater and a 100 W bulb in a small room for 4 hours at 26 cents per kWh is

A \$2 18 B \$21 84 C \$5 46 D \$54 60

A D

- 20 Two parallel wires AB and CD carry currents in opposite directions. The currents create a strong magnetic field around the wires. The plotting compasses, P, Q and R are equally spaced from one another with Q mid-way between the wires.



Which of the following correctly identifies the motion of the wires and the compasses that point in the same direction?

	motion of wires	compasses that point in the same direction
A	move towards each other	P and Q only
B	move away from each other	Q and R only
C	move away from each other	P and R only
D	move towards each other	P, Q and R

[Turn over

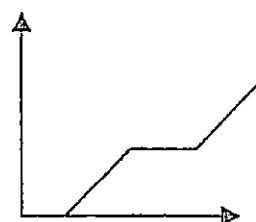
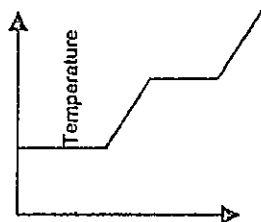
Temperature

Temperature

- 21 A piece of solid is steadily heated until it completely becomes gas. Which graph of temperature against time represents this change most correctly?

A Time

B Time

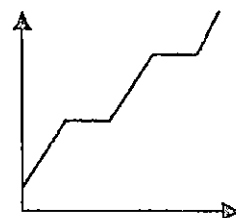
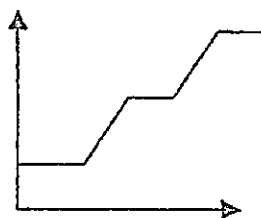


Time

Time

C

D



- 22 An ion Y^{3+} has a nucleon number 27 and 10 electrons.

What will the nucleus of the ion Y^{3+} contain?

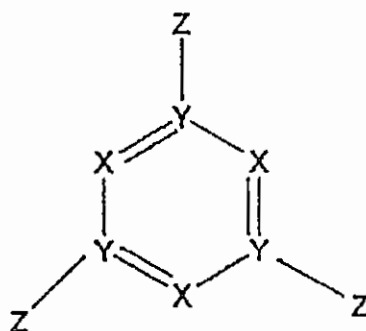
	number of protons	number of neutrons
A	13	14
B	14	13
C	10	17
D	17	10

[Turn over

- 23 The melting points and electrical conductivities of four substances are shown below. Which of the substances could be carbon tetrachloride?

	melting point/ °C	electrical conductivity in solid state
A	-23	poor
B	64	good
C	772	poor
D	1538	good

- 24 A stable molecule containing atoms of the elements X, Y and Z has the following structure

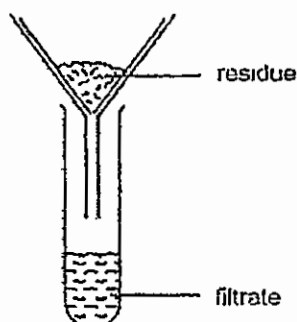


Which of the following is a possible combination of the elements?

	X	Y	Z
A	C	O	H
B	N	Si	H
C	S	Ge	Cl
D	N	S	O

[Turn over

- 25 Which of the following equations would indicate that the salt prepared is collected as the residue?



- A $\text{Cl}_2 + 2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{Cl}^-$
 B $2\text{Na}^+ + \text{CO}_3^{2-} \rightarrow \text{Na}_2\text{CO}_3$
 C $\text{Mg}^{2+} + \text{SO}_4^{2-} \rightarrow \text{MgSO}_4$
 D $\text{Zn}^{2+} + 2\text{OH}^- \rightarrow \text{Zn}(\text{OH})_2$
- 26 A series of tests were conducted on solution P. The observations are shown in the table below.

reagent added	observation
aqueous sodium hydroxide	white precipitate, insoluble in excess
aqueous ammonia	no precipitate
dilute nitric acid, followed by aqueous silver nitrate	white precipitate

What are the ions present in solution P?

- A zinc and chloride
 B zinc and sulfate
 C calcium and chloride
 D calcium and sulfate

[Turn over

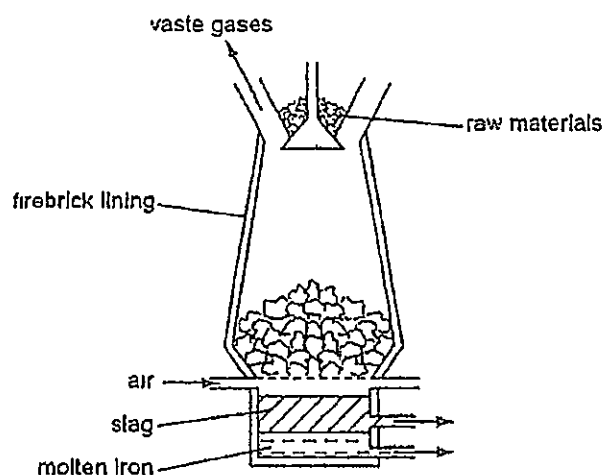
- 27 A beaker contains 15 cm^3 of 0.3 mol/dm^3 sulfuric acid

Which volume of sodium hydroxide of 0.3 mol/dm^3 is required to completely neutralise the sulfuric acid?

- | | | | |
|---|--------------------|---|-------------------|
| A | 7.5 cm^3 | B | 15 cm^3 |
| C | 30 cm^3 | D | 45 cm^3 |
- 28 The following substances produce carbon dioxide on complete combustion. Which of the following will produce 24 dm^3 of carbon dioxide?
- A 0.5 mol of ethanol
B 1.5 mol of ethane
C 1.5 mol of propane
D 2 mol of carbon
- 29 Metal Y is placed between zinc and iron in the reactivity series. Which statement is true about metal Y?
- A The oxide of metal Y decomposes on heating to form metal Y
B Metal Y reacts with cold water to form the hydroxide of metal Y
C Metal Y can be extracted by electrolysis and reduction using carbon
D Metal Y displaced aluminium from an aqueous solution of aluminium salt
- 30 When a piece of chromium is dropped into a solution of dilute hydrochloric acid, hydrogen gas is liberated, but it does not react with cold water.
- When a piece of chromium is dropped into a solution of lead (II) nitrate, crystals of lead appear.
- What is the order of decreasing reactivity of the metals lead, sodium and chromium?
- A sodium, chromium, lead
B sodium, lead, chromium
C chromium, sodium, lead
D chromium, lead, sodium

[Turn over

- 31 Iron is extracted in the blast furnace using the raw materials haematite, coke and limestone



Which substance undergoes thermal decomposition?

- A limestone
 - B haematite
 - C coke
 - D slag
- 32 Which deduction about iodine can be made from its position in Group VII?
- A It is more reactive than astatine
 - B It is a liquid at room temperature
 - C It forms a covalent compound with sodium
 - D It can be displaced by astatine from its potassium iodide solution
- 33 The formation of hydrogen iodide from hydrogen and iodine is an endothermic reaction



Which of the following statements is true for this reaction?

- A Heat is given off to the surroundings
- B The enthalpy change of this reaction is negative
- C Energy level of the products is lower than the energy level of the reactants
- D Energy given off in bond forming is less than the energy taken in for bond breaking

[Turn over

34 Which of the following processes are exothermic?

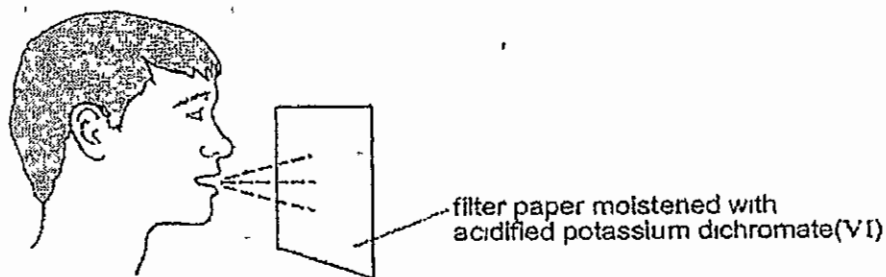
- 1 condensation of ethanol vapour
- 2 melting of sodium chloride
- 3 reacting aqueous sodium hydroxide and dilute hydrochloric acid
- 4 $\text{Cl}_2 \rightarrow \text{Cl} + \text{Cl}$

- A 1 and 3
- B 1 and 4
- C 2 and 3
- D 2 and 4

35 Which underlined substance in the following reactions acts as a reducing agent?

- A $\text{H}_2 + \underline{\text{PbO}} \rightarrow \text{H}_2\text{O} + \text{Pb}$
- B $2 \text{Fe}^{2+} + \underline{\text{Cl}_2} \rightarrow 2 \text{Fe}^{3+} + 2 \text{Cl}^-$
- C $\underline{\text{ZnO}} + \text{CO} \rightarrow \text{Zn} + \text{CO}_2$
- D $\underline{\text{Mg}} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2$

36 Acidified potassium dichromate (VI) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed an alcoholic drink

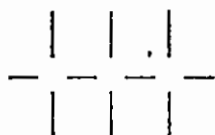


A colour change from orange to green is observed if ethanol is present. This shows that ethanol is _____.

- A an alkali
- B an indicator
- C an oxidising agent
- D a reducing agent

[Turn over

- 37 Copper (II) oxide can catalyze the decomposition of aqueous hydrogen peroxide to produce oxygen and water. Which of the following statements is true of the copper (II) oxide?
- A Copper(II) oxide will be used up in the reaction
 - B An alternative reaction pathway with lower activation energy was provided by copper(II) oxide
 - C The surface area of copper(II) oxide decreases as the decomposition progressed
 - D The volume of oxygen produced increases when more copper(II) oxide is used
- 38 The structure of dibromopropane is as given below



Three statements are being made about dibromopropane

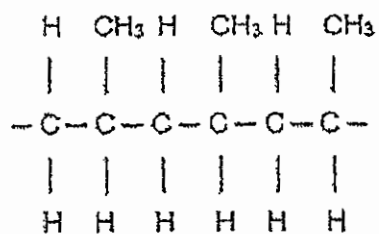
- 1 It is a saturated compound
- 2 It is formed by addition reaction of propane with aqueous bromine
- 3 It is formed by substitution of propane with bromine in UV light

Which of the above statement(s) about dibromopropane is correct?

- A 2 only
 - B 3 only
 - C 1 and 2 only
 - D 1 and 3 only
- 39 An organic compound, X, reacts with sodium hydroxide to give a compound with formula C_2H_5COONa . What is compound X?
- A ethanol
 - B propanol
 - C ethanoic acid
 - D propanoic acid

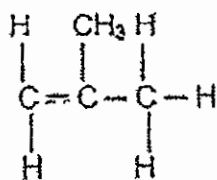
{Turn over

- 40 The structural formula of a polymer is shown below

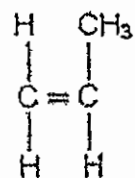


What is the structural formula of the monomer that is used to manufacture this polymer?

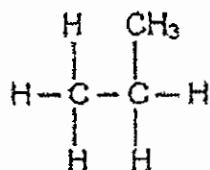
A



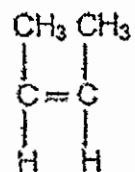
B



C



D



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

[Turn over

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

[Turn over

10

†90-103 Actinoid series

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)



ZHONGHUA SECONDARY SCHOOL

Preliminary Examination 2015

CANDIDATE
NAME

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CLASS

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SCIENCE (PHYSICS)

5076/02

Paper 2 Theory

2 September, 2015

Secondary 4 Express / 5 Normal(Academic)

1 hour 15 minutes

Set by: Mr Tan Jun Hong

Vetted by: Mr Lawrence Tang

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 soft 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 any two questions

Write your answers on the question paper provided, and if necessary, continue on separate answer paper

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 on Earth, $g = 10 \text{ m/s}^2$

For Examiner's Use	
Section A	/ 45
Section B	
Q	/ 10
Q	/ 10
Total	/65

This document consists of 19 printed pages, including this cover page.

[Turn over

Section A

Write your answers in the spaces provided on the question paper

- A1 Fig 1.1 shows three strings attached to a ring. The ring and the strings lie in a horizontal plane and are at rest.

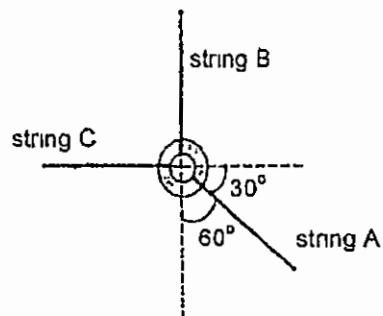


Fig. 1.1

The tension in string A is 200 N

By means of a scaled diagram, determine the tension in string B and the tension in string C

tension in string B = _____ N

tension in string C = _____ N [3]

Total marks:	
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[Turn over

- A2 The Bugatti Veyron EB 16.4 is a mid-engined sports car, designed and developed by the Volkswagen Group and manufactured in Molsheim, France by Bugatti Automobiles S A S. Fig 2.1 shows the super sport version of the Bugatti Veyron.

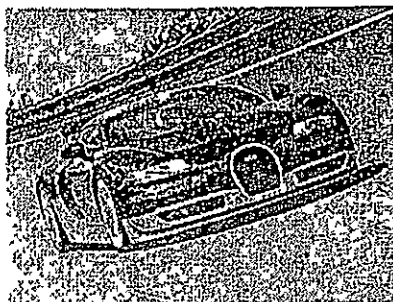


Fig 2.1

Fig 2.2 shows the specifications of the super sport version of the Bugatti Veyron.

<u>Performance</u>		
Top speed	=	431.072 km/h
Time for acceleration from 0 to 100 km/h	=	2.46 seconds
Braking distance	=	31.4 m

Fig 2.2

Source: http://en.wikipedia.org/wiki/Bugatti_Veyron

- (a) (i) Express 100 km/h in m/s

$$100 \text{ km/h} = \underline{\hspace{2cm}} \text{ m/s} \quad [1]$$

- (ii) Hence, using the information given, calculate the acceleration of the sports car in m/s^2

$$\text{acceleration} = \underline{\hspace{2cm}} \text{ m/s}^2 \quad [1]$$

Total marks:	
--------------	--

[Turn over]

- (b) Fig 2.3 shows the distance-time graph of the sports car

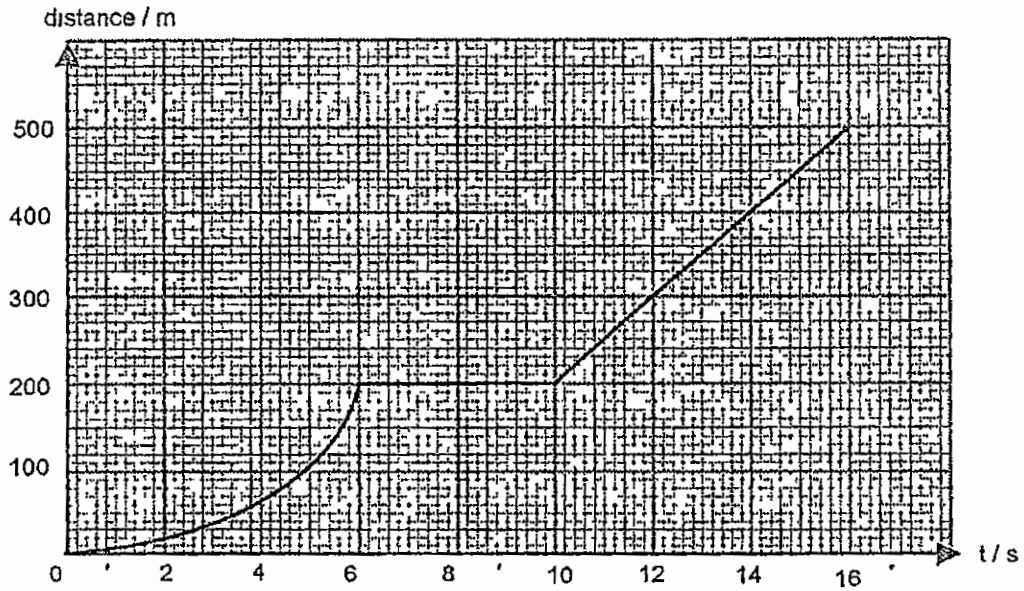


Fig 2.3

- (i) Describe the speed of the sports car for the first 10 seconds

from 0 – 6 s

from 6 – 10 s

_____ [2]

- (ii) Calculate the speed of the car at the instant when $t = 12$ s

speed = _____ [2]

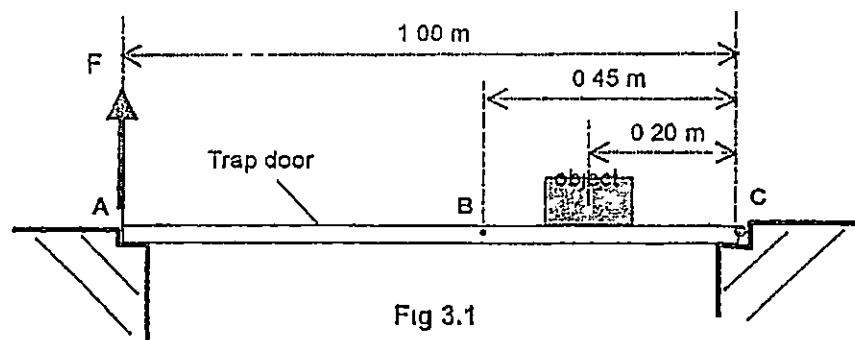
- (iii) Calculate the average speed of the sports car for the entire journey

average speed = _____ [2]

Total marks.	
--------------	--

[Turn over

- A3 Fig 3.1 shows a trap door AC of length 1.00 m. It is hinged at C. The weight of the trap door is 30 N and its centre of gravity is at B which is 0.45 m from C. An object of weight 40 N is placed on the trap door 0.20 m from C. A force F has to be applied at A to open the trap door.



- (a) State the Principle of Moments for a body in equilibrium

[1]

- (b) Calculate the total anti-clockwise moment about C due to the weight of the trap door and the weight of the object.

total anticlockwise moment = _____ Nm [2]

Total marks:	
--------------	--

[Turn over]

- (c) Hence, by applying the Principle of Moments, calculate the force F which is needed to just lift up the trap door

force $F =$ _____ N [2]

- (d) The object is gradually pushed towards A

Explain why the force F which is needed to just lift up the trap door increases

_____ [1]

Total marks.	
--------------	--

[Turn over

- A4 Fig 4.1 shows a small ball bearing rolling down a hemispherical bowl of radius 10.0 cm. The ball bearing has a mass of 0.045 kg.

The ball bearing was released from rest from X.

Assume that the surface of the bowl is smooth.

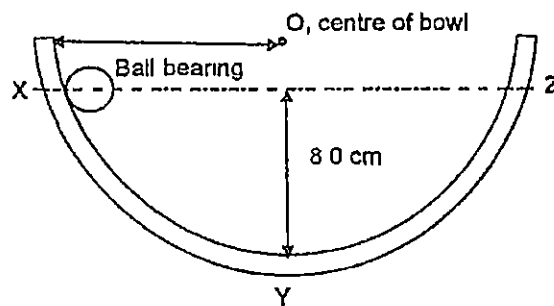


Fig 4.1

- (a) State the Principle of Conservation of Energy.

 _____ [1]

- (b) Describe the energy changes of the ball bearing as it rolls from X to Y.

 _____ [1]

- (c) Calculate the loss in gravitational potential energy as the ball bearing rolls from X to Y.

loss in gravitational potential energy = _____ J [2]

Total marks:	
--------------	--

[Turn over]

- (d) Calculate the speed of the ball bearing when it is at Y

speed = _____ m/s [2]

- (e) State and explain if the ball is able to reach point Z if the bowl is not smooth

[2]

Total marks	
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[Turn over

A5 Fig 5.1 shows the movement of a typical gas molecule

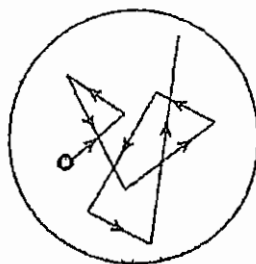


Fig. 5.1

- (a) Describe the difference between liquid and gas in terms of the movement of the molecules

[2]

- (b) Explain in terms of the forces of the molecules, why gases do not have fixed volume and shape

[2]

- (c) If the temperature of the gas increases, state and explain the effect on the movement of the gas molecules

[2]

Total marks*	
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Turn over

- A6 Fig 6 1 shows two bars attracted to a permanent magnet. Paper clips are attracted to these two bars.

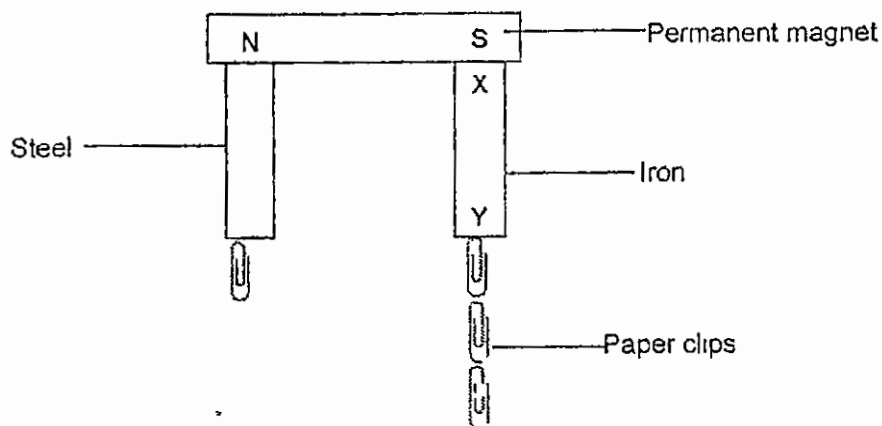


Fig 6 1

- (a) State the polarity at X and Y of the iron bar on Fig 6 1

X = _____ Y = _____ [1]

- (b) State and explain what happens to the paper clips at the two bars when the permanent magnet is removed

[2]

Total marks.	
--------------	--

[Turn over

- A7 A light ray is incident on a glass structure at an angle of 35° with the surface of the structure. The refractive index of glass is 1.62.

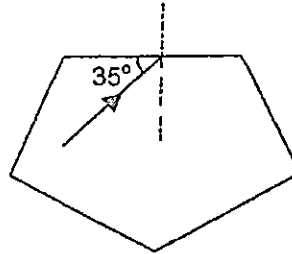


Fig 7.1

- (a) Calculate the angle of incidence of the light ray.

angle of incidence = _____ $^\circ$ [1]

- (b) Calculate the critical angle of the glass.

critical angle = _____ $^\circ$ [1]

- (c) State and explain whether total internal reflection will occur.

[3]

Total marks.	
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[Turn over]

A8 "Travelling at the speed of light, the ultraviolet and x-ray energies of the flare make the 93 million-mile trip to Earth in eight minutes. Some flares also hurl high-energy protons, which reach us in 15 minutes to an hour. A CME usually hits in one to three days, shortly before impact, its magnetic polarity is detected by the satellite called ACE."

- (a) Two electromagnetic waves are mentioned in the above excerpt. State another electromagnetic wave which has a frequency higher than any of the two mentioned

[1]

- (b) State one application of ultraviolet light.

[1]

- (c) One of the properties of electromagnetic waves is they travel at the speed of light of 3.0×10^8 m/s

- (i) State another two properties of electromagnetic waves

[2]

- (ii) Given that the x-ray used has a wavelength of 3.0 nm, calculate the frequency of the x-ray

frequency = _____ Hz [2]

Total marks:	
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[Turn over]

Section B

Answer any two questions

Write your answers on the question paper provided, and if necessary, continue on separate answer paper

- B9 Fig 9.1 shows the scaled diagram of an object O and its image, I formed by a thin converging lens

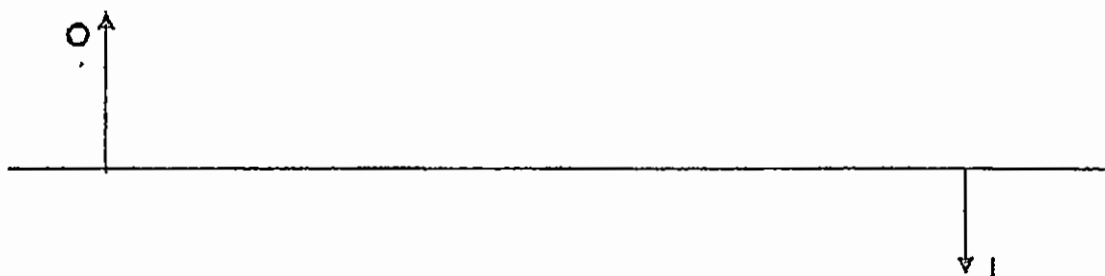


Fig 9.1

- (a) (i) Complete the ray diagram on Fig. 9.1 to show the position of the lens and principle focus [2]
- (ii) Label the optical centre, C, on Fig 9.1 [1]
- (iii) Indicate the position of the principle focus, F, on Fig 9.1 [1]
- (b) Object, O is now shifted towards the lens until it is 1.5 times of its focal length away from the lens ($u = 1.5f$), state one difference and one similarity to the image formed in Fig 9.1

[2]

Total marks:	
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[Turn over]

- (c) A converging lens can also be used by a watchmaker as a magnifying glass to observe a mechanical part of a watch as shown in Fig 9 2

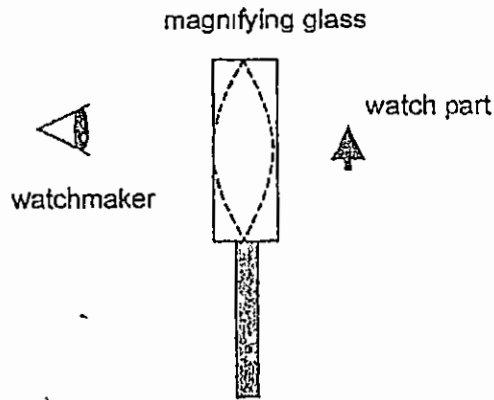


Fig. 9 2

Fig 9 3 shows an incomplete ray diagram of the magnifying glass

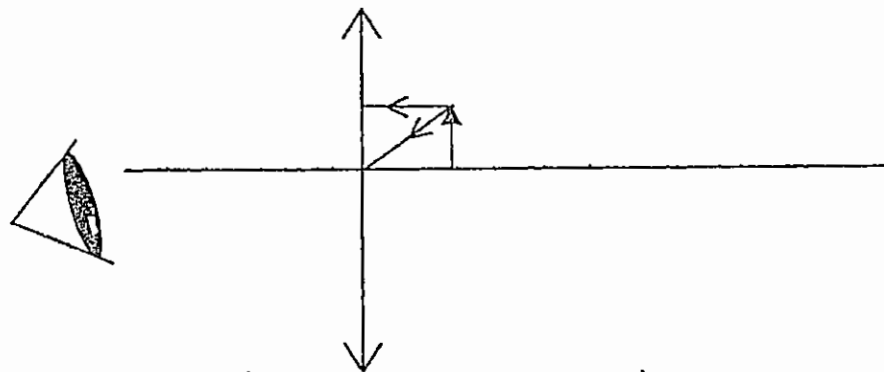


Fig. 9.3

- (i) Indicate on Fig 9 3 a possible focal point on each side of the lens. Label each point as F [1]
- (ii) Complete the ray diagram in Fig 9 3 to show how the magnified image of the watch part is seen by the watchmaker. Label the image as I [1]
- (iii) The image of the watch part is magnified. State two other characteristics of the image

[2]

Total marks.	
--------------	--

[Turn over]

B10 Fig 10 1 shows the structure of a solar water heating system that uses liquid as a heating fluid. The fluid is a mixture of water and propylene glycol.

Water in copper pipes is heated by solar radiation. The hot water in the copper pipes is then used to heat cold water in a tank.

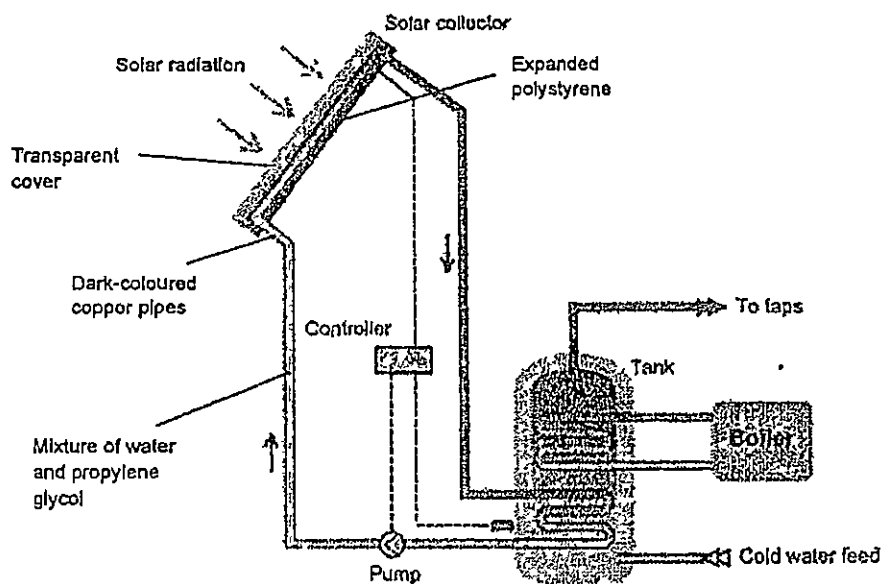


Fig 10 1

(a) Explain the purpose of the

(i) expanded polystyrene backing board

[1]

(ii) dark-coloured copper pipes

[2]

Total marks

[Turn over

- (b) Describe, in molecular level, how solar energy is transferred to the fluid through the copper pipes in the solar water heating system

[2]

- (c) Explain why the cold water feed is at the bottom of the water tank while the hot water tap is at the top of the water tank

[2]

- (d) The fluid used in the solar water heating system, which is a mixture of water and propylene glycol, has a lower freezing point than pure water

- (i) Suggest a reason why a fluid with low freezing point is important

[1]

- (ii) Given that the freezing point of the fluid is -10°C , sketch the cooling curve of the fluid in Fig 10 2.

Label clearly on your graph the freezing point of the fluid

Assume that the initial temperature is 20°C

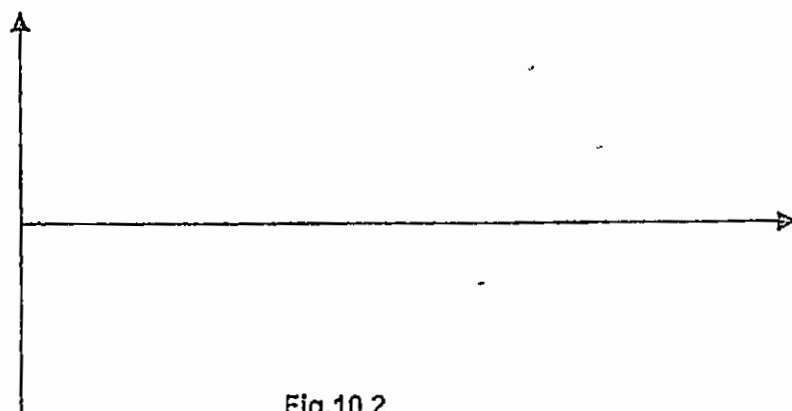


Fig.10 2

[2]

Total marks:	
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[Turn over]

X

300
Ω

5.0 V

R
17

- B11 Fig 11.1 shows four resistors connected to a battery with an electromotive force of 5.0 V in a circuit

A voltmeter and ammeter are connected to the circuit as shown

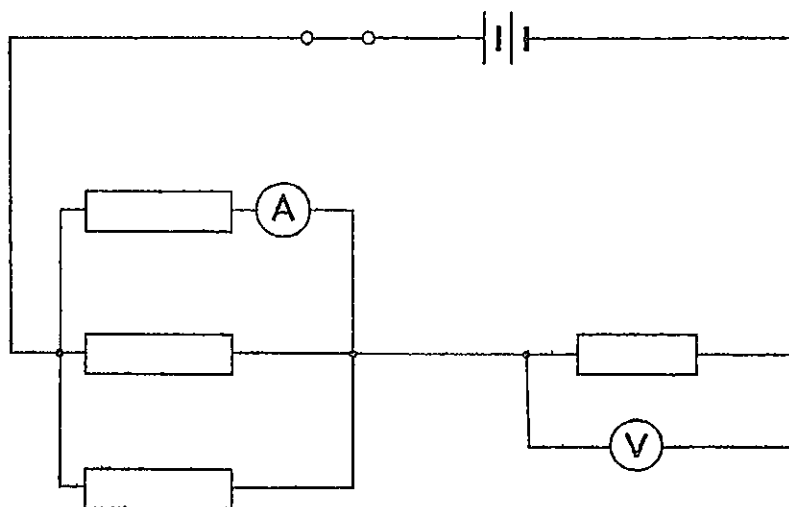


Fig 11.1

- (a) (i) Explain what is meant by "electromotive force of 5.0 V"

_____ [1]

- (ii) Calculate the effective resistance across XY

effective resistance = _____ Ω [1]

Total marks:	
--------------	--

[Turn over]

- (iii) Hence, given that the voltmeter reading is 3.0 V, calculate the resistance in the unknown resistor, R.

$$R = \text{_____} \Omega \quad [3]$$

- (b) The unknown resistor, R, is being replaced by a lightbulb rated at 3.0 V, 8.0 W

- (i) Explain what is meant by the lightbulb is "rated at 3.0 V, 8.0 W"

 _____ [1]

- (ii) Calculate the current flowing through the lightbulb when it is operating at normal brightness

$$\text{current} = \text{_____} \text{ A} \quad [2]$$

Total marks	
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[Turn over

- (iii) When the filament in the lightbulb heats up, its resistance increases

State and explain whether ammeter reading, A, increases, decreases or remains the same

[2]

END OF PAPER

Total marks:	
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[Turn over]

Zhonghua Secondary School
Preliminary Examination 2015
5076/01 Sc(Physics) paper 1
Secondary 4E/5N

1	B	11	B
2	A	12	C
3	D	13	B
4	B	14	B
5	C	15	D
6	D	16	A
7	B	17	B
8	D	18	D
9	B	19	A
10	A	20	C

5076/02 Sc(Physics) paper 2
Secondary 4E/5N

Section A

B2 a)	$100 \text{ km/h} = \frac{100 \times 100}{60 \times 60}$ $= 27.778 \text{ m/s}$ $a = \frac{v - u}{t}$ $a = \frac{27.778 - 0}{2.46}$ $a = 11.3 \text{ ms}^{-2}$	1 1
c) (i)	From $t = 0$ to $t = 6 \text{ s}$, the speed of the car is increasing. From $t = 6$ to $t = 10 \text{ s}$, the speed of the car is zero.	1 1
(ii)	Instantaneous speed = $\frac{500 - 200}{16 - 10}$ $= 50 \text{ m/s}$	1 1
(iii)	Distance travelled = 500 m Average speed = $500/16$ $= 31.3 \text{ ms}^{-1}$	1 1
3a)	For an object in equilibrium, the sum of clockwise moments about a point is equals to the sum of anti-clockwise moments about the same point	1
b)	$\text{ACM} = (30 \times 0.45) + (40 \times 0.20)$ $= 13.5 + 8$ $= 21.5 \text{ Nm}$	1 1
c)	$F \times 1 = 21.5$ $F = 21.5 \text{ N}$	1
d)	The perpendicular distance from the weight of the object increases and therefore the clockwise moment increases. F must increase to increase the anticlockwise moment	1 1

B4a	Energy cannot be created nor destroyed. It can only be converted into another form or transferred from one body to another. Total energy is the same.	1
b	Gravitational potential energy to kinetic energy	1
c	GPE = mgh = 0.045 x 10 x (10/100) = 0.045 J	1 1
d	KE = $\frac{1}{2}mv^2$ 0.045 = $\frac{1}{2} \times 0.045 \times v^2$ $v^2 = 2.0$ $v = 1.41 \text{ m/s}$	1 1
e	No As energy is used to do work against friction, GPE at Z will be lower and therefore the height will be lower than X.	1 1
B5a	In liquid, the molecules are free to move about between clusters but are confined within the vessel.	1
	In gas, the molecules move randomly at high speeds.	1
5b	The intermolecular forces of attraction between each gas molecule are negligible or very weak. Therefore, the molecules are free to move about within the container and gases do not have a fixed shape.	1
	Since the intermolecular forces are weak, the molecules are far apart as well. This means that gases do not have fixed volume as they can be compressed easily since there is a lot of space between them.	1
5c	The gas molecules will move and change direction faster and more frequently.	1
	This is because thermal energy is converted into kinetic energy.	1
B6a	X N, Y S	1
b	The clips at the iron bar will fall while those at the steel bar will remain as iron loses its magnetism more easily compared to steel.	1 1
B7(a)	Angle of incidence = $90^\circ - 35^\circ$ = 55°	1
(b)	$\sin c = 1/1.62$ $c = 38^\circ$	1
(c)	For total internal reflection to occur, ray must be inside optically denser glass moving into optically less dense medium air and the angle of incidence in optically denser glass must be greater than the critical angle of glass.	1 1
	TIR will occur as the angle of incidence in optically denser medium glass is greater than the critical angle.	1
B8a	Gamma ray	1
b	Sun bed, Sterilisation (Any one reasonable application)	1
c (i)	EM waves are transverse waves EM waves do not need medium to travel through	2
(ii)	$3 \times 10^8 = f \times 3 \times 10^{-9}$ $f = 1.0 \times 10^{17} \text{ Hz}$	1 1

Section B

C9a(i),(ii)	See diagram	
b	Difference Image is now magnified instead of diminished Similarity Image is still real or inverted	1 1 (either)
c (i)	See diagram	
(ii)	Magnified, virtual	2
C10a (i)	To minimise heat loss by conduction, convection and radiation	1
(ii)	As dark-coloured is a good absorber of thermal radiation, thermal energy is absorbed by the copper pipes at a faster rate	1
	As copper is a good conductor of heat, thermal energy is transferred from the copper to the fluid more effectively	1
b	As the copper molecules gain thermal energy from the sun, it gains kinetic energy and vibrates faster about its fixed position. These molecules collide with their less energetic neighbouring molecules and some of their energy is transferred to them	1
	Copper also contains free electrons. When heated, free electrons gain energy and move faster. These free electrons are free to travel in the spaces between the molecules before colliding with other electrons and molecules and transferring some of their energy to them	1
	These processes continue until the transfer of energy reaches the opposite end of the copper and the energy is transferred to the fluid in the pipe	
c	As hot water is less dense than cold water, hot water rise and cold water sink. The position of the inlet and outlet is to ensure even distribution of the hot water in the water tank	1 1
d (i)	If the freezing point is too high, the fluid might freeze if the temperature of the surrounding drops and the system will not be able to function	1
(ii)	Correct shape before and after freezing point Correct shape and label at freezing point.	1 1
C11(a)(i)	Work done to drive a unit charge around a complete circuit is 5.0 J	1
(ii)	$R_{\text{eff}} = 1/(1/3+1/3+1/3)$ $= 1.0 \Omega$	1
(iii)	p.d across 3 resistors in parallel $= 5 - 3$ $= 2\text{V}$ current through R $= 2 / 1.0$ $= 2.0 \text{ A}$ Resistance $= V / I = 3 / 2.0$ $= 1.5 \Omega$	1 1 1
b (i)	The energy used by the lightbulb is 8.0 J per second if the voltage supply is 3.0 V	1
(ii)	$P = IV$ $8 = I \times 3$ $I = 8 / 3$ $I = 2.67 \text{ A}$	1 1

(iii)	Decrease When resistance of lightbulb increases, current across lightbulb will decrease ($I = V/R$)	1
	Current across either of the 3 branches will decrease as the total current decreases	1