NCHS
P2

4

Name: Register Number: Class:

南僑中學

NAN CHIAU HIGH SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY FOUR EXPRESS

PHYSICS **6091/02**

Paper 2 Theory 27 August 2020, Thursday
1 hour 45 mins

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided on the question paper.
You may use an HB pencil for any diagrams, graphs tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A: [50 marks]
Answer **all** questions.

Section B: [30 marks] parent's signature
Answer **all** questions. Question 12 has a choice of parts to answer.

The total marks for this paper is 80.
Take gravitational field strength of Earth to be 10 N/kg and gravitational acceleration = 10 ms^{-2}.

	For Examiner
Section A	/ 50
Section B	/ 30
TOTAL	/ 80

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

Section A (50 marks)
Answer **all** the questions in the section.

1 **Fig. 1.1** shows a sealed long cylinder that demonstrates how two similar objects **A** and **B** falls under gravity on Earth.

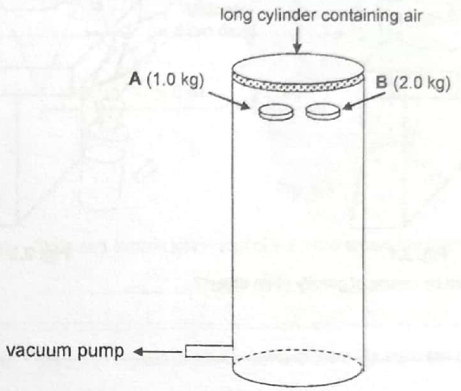

Fig. 1.1

(a) **(i)** Objects **A** and **B** are released from rest simultaneously from the top of the cylinder.
State which object will first reach the bottom of the cylinder. [1]

(ii) Explain using forces why the object reaches first the bottom of the cylinder. [2]

(b) A vacuum pump is connected to cylinder and the air is removed. The experiment is first repeated on Earth and then on the moon where **A** and **B** are released from the top of the cylinder.
State two differences in the two experiments. [2]

2 A bottle of water has a light rope tied around its neck. It is suspended over a tooth pick which is placed on the surface of a table. A 10-kg mass is placed over part of the tooth pick. The entire setup is shown in **Fig. 2.1**.

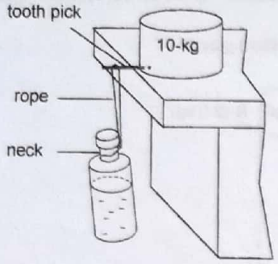

Fig. 2.1

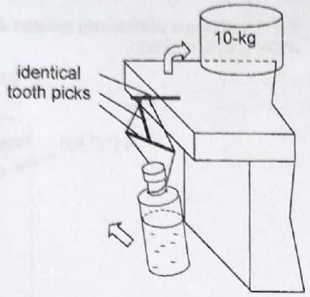

Fig. 2.2

(a) What is meant by *centre of gravity* of an object? [1]

(b) Indicate the centre of gravity of the water-filled bottle with a **cross** on **Fig. 2.1**. [1]

(c) State and explain what happens to the bottle if the 10-kg mass is removed in **Fig. 2.1**. [2]

(d) Two more tooth-picks were added to the light rope in the setup and the 10-kg mass was removed as shown in **Fig. 2.2**. The new setup of light rope, tooth picks, and bottle was moved backwards as indicated by the arrow in **Fig. 2.2**. The new setup oscillates and comes to rest again in **Fig. 2.2**.

(i) State the type of equilibrium of the new setup in **Fig. 2.2**. [1]

(ii) Draw and label the forces on **Fig. 2.2** responsible for the equilibrium in **(d)(i)**. [1]

(iii) State why the new setup is in equilibrium. [1]

3 **Fig. 3.1** shows a hydraulic jack in a car service centre.

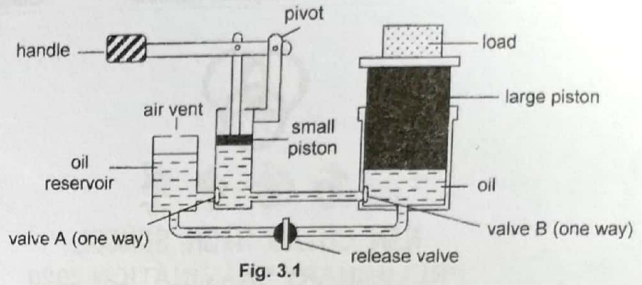

Fig. 3.1

A force of 50 N is exerted on the small piston when the handle is pushed down. The cross-sectional areas of the small piston and the large piston are 0.040 m^2 and 0.80 m^2 respectively.

(a) Calculate the pressure exerted on the oil in the hydraulic jack. [2]

(b) Calculate the force that the oil exerts on the large piston. [1]

(c) When the handle is pushed down, the load is lifted up by the large piston by 5.0 cm. State how the hydraulic jack is used to lift the load by 10.0 cm. [1]

(d) State and explain one modification to the large piston that enables the jack to lift a heavier load. [2]

(e) State the purpose of the air vent in the oil reservoir. [1]

4 (a) **Fig. 4.1** show one of the ways our body maintains the body temperature. Sweat is largely made up of water and it comes from sweat glands under the skin. When sweat *evaporates*, it takes heat energy away from our body.

Fig. 4.1

(i) What is meant by *evaporation* of water? [1]

(ii) Using kinetic theory of matter, explain how evaporation takes away heat energy from our body. [2]

(b) State **one** difference between the properties of liquids and gases and explain this difference in molecular terms. [2]

(c) While playing badminton, 0.050 kg of sweat was evaporated from Lin Dan's body. Calculate the quantity of heat energy lost from his body due to the evaporation.
[The specific *latent heat of vaporization* of sweat is 2.3×10^6 J kg^{-1}.] [2]

5 **Fig. 5.1** shows a trace of sound wave travelling in air.

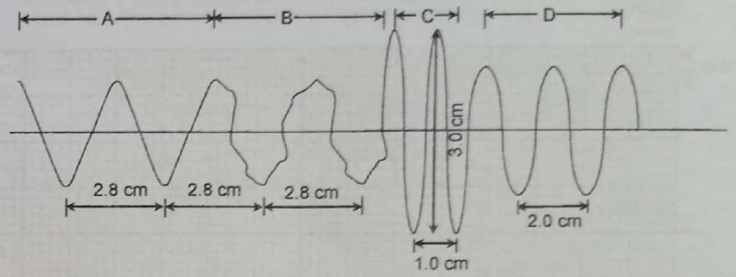

Fig. 5.1

(a) State and explain which part of the trace shows the sound is at its loudest. [1]

(b) State and explain which two parts of the trace have the same pitch. [1]

(c) Calculate the difference between the wavelength of the trace in parts **C** and **D**. [1]

(d) State one difference between a sound wave travelling in solid and in air. [1]

6 **Fig. 6.1** shows a converging lens and the image of an object formed on the screen. The image formed on the screen is twice the size of the object.

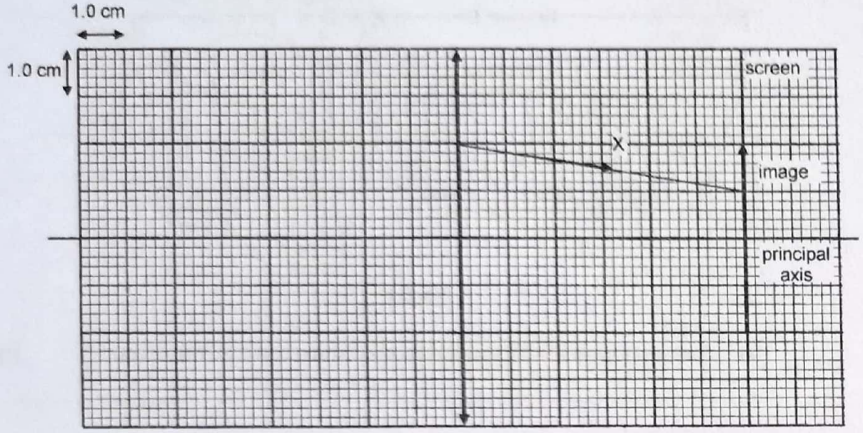

Fig. 6.1

(a) On **Fig. 6.1** draw,

(i) the object with the correct height and position, [1]

(ii) one ray from the object to locate the focal point and label it as F, [1]

(iii) the path of the incident ray from the object for ray X. [1]

(b) The object is now placed at infinity.
State the distance of the sharp image formed from the optical centre of the lens. [1]

_____

(c) The bottom half of the converging lens is covered up with a black cloth.
State and explain one change on the image that is formed earlier. [1]

_____

_____

_____

7 **Fig. 7.1** shows a lighting circuit of a house.

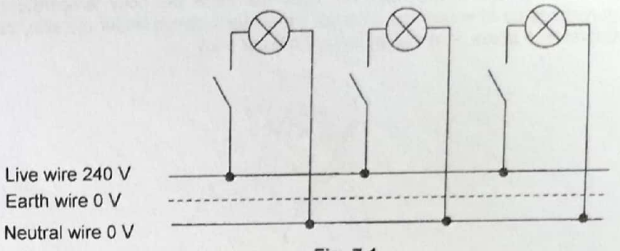

Fig. 7.1

(a) State and explain what happens to the other bulbs if one bulb blows? [1]

_____

_____

(b) All the bulbs in the circuit are labeled "240 V, 60 W".

(i) What is meant by "240 V, 60 W"? [1]

_____

_____

_____

(ii) Calculate the current in the circuit when only one bulb is lit. [1]

(iii) State the rating of a suitable miniature circuit breaker for the above lighting circuit. [1]

_____

(c) Explain why it is not safe to connect the wiring of a water heater rated at 240 V 1.5 kW to the above lighting circuit even though the water heater used a 240 V supply. [1]

_____

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_____

_____

8 **Fig. 8.1** shows an air-purifier that claims to improve air quality by converting dirty dry air from the room into moist clean air. The air-purifier employs a device known as an ioniser that releases negative ions into the dirty dry air which passes through the layers of positively and negatively charged fine metal gauze and reaches the rotating discs which forces them to passes through the nano silver solution and finally out of the device.

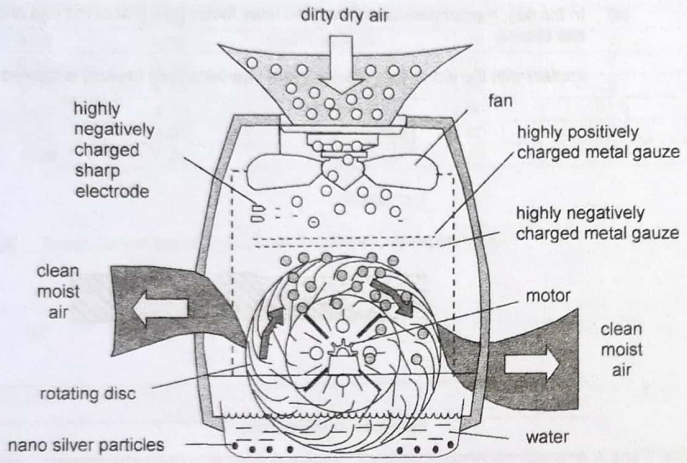


Fig. 8.1

(a) State the electrical charge(s) found at the dirty dry air. [1]

_____

(b) State the name of the electrostatic method of transferring electrons to the dirty dry air as it passes near the sharp electrode. [1]

_____

(c) Explain how the dirty dry air becomes clean air after passing through the charged metal gauze. [2]

_____

_____

_____

_____

(d) Name one electromagnetic wave which can kill any virus (e.g. COVID-19) found in the dirty dry air. [1]

_____

9 **Fig. 9.1** shows a mechanical door bell. The rod XY is made from two materials, soft iron and plastic. A spring is attached to one end of the rod and there is a solenoid around the plastic tube. The two metal plates are identical except plate A is **longer** than plate B.

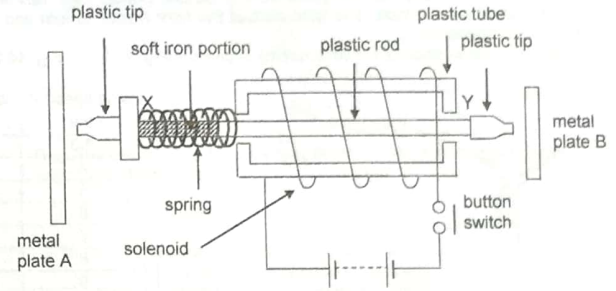


Fig. 9.1

(a) State the magnetic pole formed at the left hand side of the solenoid when the button switch is pressed. [1]

_____

(b) State and explain what is heard when the button switch in **Fig. 9.1** is pressed and released once. [3]

_____

_____

_____

_____

_____

_____

_____

(c) State why the bell in **Fig. 9.1** will not work if copper replaces the soft iron portion in the door bell. [1]

_____

_____

Section B [30 marks]

Answer **all** questions in this section.

Answer only one of the two alternative questions in **Question 12**.

10 Wind power can be used for the generation of electric power. **Fig. 10.1** illustrates one particular type of wind turbine. The wind causes the rotor blades to turn and these blades drive an electric generator.

Some technical information of the wind turbine is given in **Fig. 10.2** and **Fig. 10.3**.

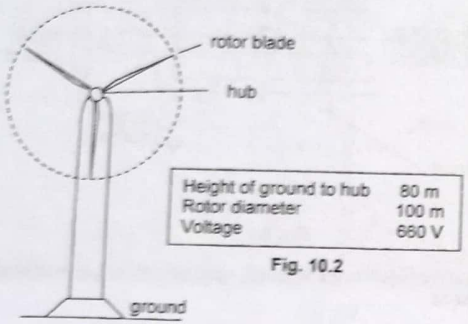


Fig. 10.1

Height of ground to hub	80 m
Rotor diameter	100 m
Voltage	660 V

Fig. 10.2

wind speed v / ms^{-1}	output power / kW
0-3	0
4	79
5	254
6	458
7	740
8	1117
9	1595
10	2103
11	2505
12	2870
13	3032
14	3034
15 to 20	3028
21 and more	0

Fig. 10.3

(a) Determine the minimum height of the tip of a rotor blade above ground level. [1]

(b) Suggest why the output power is zero when the speed is 21 ms^{-1} or more. [1]

(c) Air of density ρ, 1.25 kgm^{-3} and speed v is incident normally on a rotor of radius r. The kinetic energy E of the air incident per unit time on the rotor is given by

$$E / t = 0.5 \pi r^2 v^3 \rho.$$

Calculate, for the wind turbine operating at **maximum output power**, the

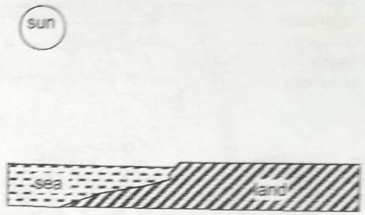
(i) kinetic energy of air incident per second on the rotor, [1]

(ii) overall efficiency of generation of electric power. [2]

(c) (iii) Suggest why the efficiency of a wind turbine is not 100%. [1]

(d) In the day, the temperature of the land rises faster than that of the sea and this causes sea breeze.

Explain with the aid of the given diagram how wind (sea breeze) is formed in the day. [2]



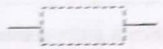
(e) State and explain one safety precaution that can protect the wind tower from lightning strike. [2]

11 Charlie went to the Physics Laboratory 1 and conducted an experiment on two unknown electrical components X and Y. For component Y, the external environment was modified in the experiment. **Table 11.1** shows the results of the experiment.

current / A	component X	Rx	component Y	RY
	p.d. / V		p.d. / V	
0.00	0.00	0	0.00	0
0.05	1.60	1.60/0.05 = 32	0.25	5
0.10	2.60	26	0.70	7
0.15	3.40	22.7	1.35	9
0.20	4.10	20.5	2.30	11.5
0.25	4.80	19.2	3.90	15.6
0.28	5.00	17.9	5.00	17.9

Table 11.1

(a) Complete the electric circuit used in the above experiment. [2]



component to be tested

(b) Describe the two relationships between the resistance of components X and Y with the current passing through. [2]

(c) In another experiment, both components X and Y are placed in series with a battery as shown in **Fig. 11.2**.

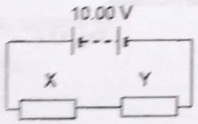


Fig. 11.2

(i) From the information given in **Table 11.1**, determine the resistance of component X. [2]

(ii) From **Table 11.1**, name the type of electrical component used in X and Y. [2]

(d) **Fig. 11.3** shows the connection of a resistor, a bulb and a light dependant resistor exposed to bright light condition.

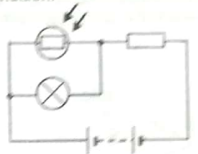


Fig. 11.3

Describe and explain how the brightness of the bulb changes when the environment brightness **decreases**. [2]

12 EITHER

Fig. 12.1 shows a simple DC motor. The ends of the single loop coil ABCD are soldered to copper pieces X and Y which make contact with springy metal strip P and Q. A cell is connected across P and Q

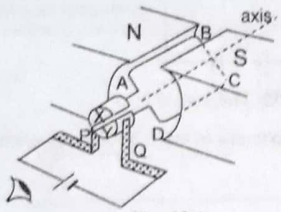


Fig. 12.1

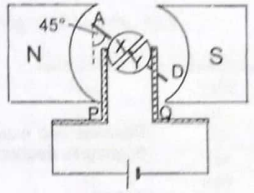


Fig. 12.2

Fig. 12.2 shows the front view of the arrangement as seen by the eye.

(a) Why does side AB in **Fig. 12.1** experience a force? [2]

(b) On **Fig. 12.2** draw and label the arrow on the side A to show the direction of the force mentioned in **(a)** when the coil is at 45° to the vertical line. [1]

(c) Explain why the coil still rotates in the same direction when the coil just passes the vertical position in **Fig. 12.2**. [2]

(d) In **Fig. 12.2**, the magnitude of the constant force acting on AB and CD is 3.0 N each. There is moment acting on the coil that varies with time as the coil turns.
Calculate the maximum moment produced by the coil if the distance AD is 0.065 m. [2]

(e) The motor in **Fig. 12.1** is replaced by **Fig. 12.3**.

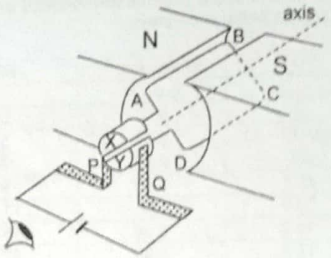


Fig. 12.1

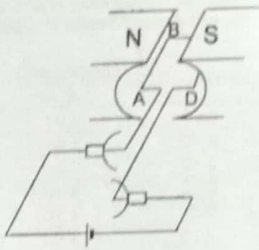


Fig. 12.3

(i) State and explain one difference in the motion of the new motor. [2]

(ii) On **Fig. 12.4**, sketch a graph to show how the moments of the force of the coil ABCD varis with angle of rotation starting from **Fig. 12.3**. [1]

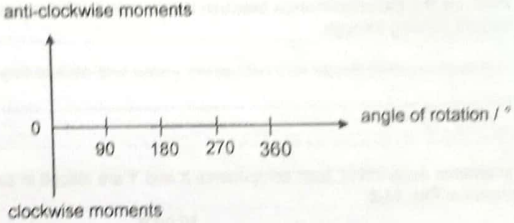


Fig. 12.4

12 OR

Fig. 12.5a shows the calibration of heater in water and **Fig. 12.5b** shows the data during the calibration process.

Fig. 12.6a shows the same heater used to measure the specific heat capacity of liquid paraffin and the data collected during the experiment is shown in **Fig. 12.6b**.

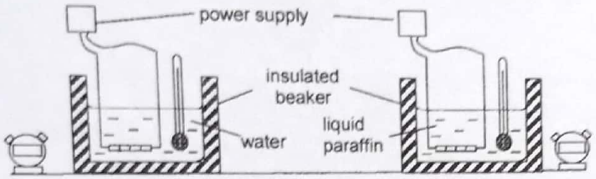


Fig. 12.5a

Fig. 12.6a

mass of water	= 0.25 kg
time of heating	= 3.5 min
initial temperature	= 15.0 °C
final temperature	= 35.0 °C

Fig. 12.5b

mass of paraffin	= 0.50 kg
time of heating	= 2.2 min
initial temperature	= 40.0 °C
final temperature	= 52.0 °C

Fig. 12.6b

The specific heat capacity of water is 4 200 J kg^{-1} $°C^{-1}$ and the beaker can be assumed to have negligible heat capacity.

(a) Calculate the heat energy given to the water during the time of heating. [1]

(b) Calculate the power rating of the heater. [1]

(c) From **Fig. 12.6a** and **Fig. 12.6b**, calculate the

(i) heat capacity of the paraffin; [2]

(ii) specific heat capacity of paraffin. [1]

(d) In a separate experiment, equal masses of water and paraffin are heated simultaneously by identical heaters. If the temperature of the water is observed to rise at 5.0 °C / min, calculate the rate of rise of temperature per minute for paraffin. [2]

(e) The experiment in **Fig. 12.6a** does **not** yield the specific heat capacity of paraffin which is equal to the standard value.

(i) State and explain one method that would reduce the difference. [2]

(ii) State the effect that the improvement in **(i)** would have on the final temperature after 2.2 minutes of heating. [1]

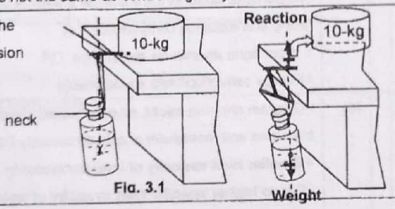
The End

NAN CHIAU HIGH SCHOOL
Sec 4 Express Physics Paper 1,2 Solution
2020 Prelim Examination

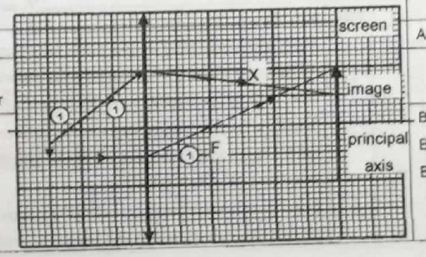
Paper 1 (40 marks)

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

Paper 2 Section A (50 marks)

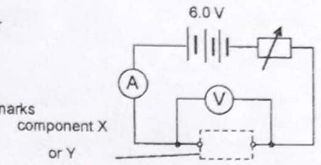
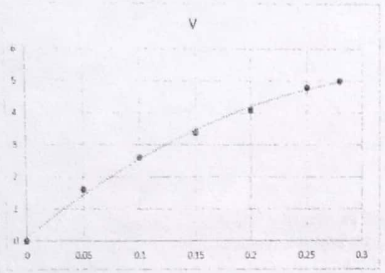
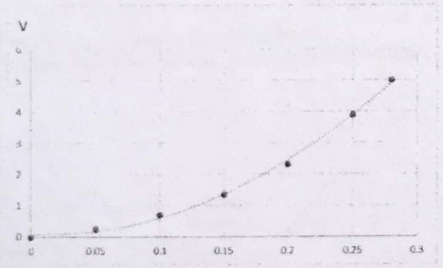
1	(ai)	>B	B1
	(aii)	> Weight of B is greater than weight of A and when A reaches terminal velocity where its air resistance = weight = 10 N, the air resistance of B is still smaller than Weight of B (20 N) >The net force on B causes B to increase its acceleration and velocity more than the terminal velocity of A.	B1 A1
	(b)	>On the moon, A and B takes more time to reach the ground (due to smaller gravitational field strength compared to earth, $g_{moon}=1/6(g_{earth})$). >On the moon, velocity of A and B on impact is smaller than that on Earth. >Acceleration on the moon is smaller than that on Earth. Note: There is no terminal velocity as air resistance is not present in vacuum and both reach ground together.	B1 B1
2	(a)	>C.G is a point where the entire weight or gravitational force acts through it irrespective of its orientation. Note: Centre of mass is not the same as centre of gravity	A1
	(b)	> C.G above 50% of water along the vertical line below point of suspension  Fig. 3.1	B1
	(c)	>Water bottle topples/rotate/experiences a turning effect >due to a net anti-clockwise moments of the weight OR line of action of the GF/Weight is to the left of the pivot point and the net force (Weight) causes the falling motion	B1 B1
	(di)	>stable equilibrium (because for neutral equilibrium when object swings to the front it stay put at the non-vertical position)	A1
	(dii)	>Correct 2 forces drawn vertically with the pivot point (not on edge of table) and labelled. Note. Tension in strings and tooth picks are internal forces and no friction in stationary system.	A1
	(dii)	>no net force and no net moment acting on the water-filled bottle OR because the line of action of the Weight is to the right of the edge of the table and vertically below the pivot point and the upward reaction Force is also aligned with the weight.	B1

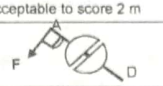
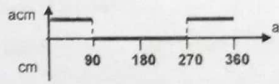
3	(a)	>P = F / A = 50 / 0.040 >P = 1 250 Pa = 1 300 Pa (2sf)	B1 A1
	(b)	>F = PA = 1250 x 0.80 = 1 000 N	B1
	(c)	>By exerting a vertical force on the ends of the handle to push the small piston to the lowest position and raising the handle up to its original position and repeat the pressing down and lifting up motion. OR force of 100 N to the small piston Or push the small piston to twice the depth of earlier case	A1
	(d)	>Increase area of large piston >Since P = F / A and P is constant a large area will exert a larger Force. Note: P is constant due to Pascal law of Transmission of Fluid-Pressure	B1 B1
	(e)	>Air vent is to allow action of the atmospheric pressure to push the oil from the reservoir (pass valve A to fill up the partial vacuum in the small cylinder when the small piston is lifted up). **OR when resetting the large piston which is in the lifted/raised-position to the original position the air vent prevents compression of the air when the released valve is open.**	A1
4	(ai)	>evaporation is the change of state from liquid to gaseous state at any temperature below boiling point of water. (100°C)	B1
	(aii)	>During evaporation fast moving surface molecules of water with greater KE are lost to the air. >The remaining water molecules have lower KE which causes a drop in temperature as KE is directly proportional to its temperature.	A1 A1
	(b)	**>Liquids are incompressible but gases are compressible.** >This is due to the stronger intermolecular forces in liquids and smaller intermolecular separation versus no intermolecular forces and much larger intermolecular separation in gases. OR **>Liquids have much higher density than gases.** >Due to higher number of particles per unit volume and the particles are slightly apart whereas in gases the opposite occurs. OR **>Liquids have fixed volume but no fixed shape versus gases having no fixed volume and shape.** >In liquid there are attractive forces between molecules and their restricted movement/lower speed within the liquid. In gases the molecules have no attractive forces among themselves and move unrestricted / randomly / very high speeds much faster within the gas.	B1 B1
	(c)	>E=ml = 0.050(2.3 x 10^6) >E = 1.15 x 10^5 = 1.2 x 10^5 J (2 sf)	B1 A1
5	(a)	>C is loudest because it has the largest amplitude	A1
	(b)	>A and B has the same pitch / frequency because both wavelengths and speed of sound is constant in air and f= v / λ	A1
	(c)	>2.0 – 1.0 = 1.0 cm	A1
	(d)	>Speed of sound in solid is 15X faster than speed of sound in air	
6	(ai) (aii) (aiii)	Correct position of object Correct ray to locate F Correct incident Ray for X (3/4 of object height, inverted)	B1 B1 B1



	(b)	2.0 cm	B1
	(c)	>Dimmer as the amount of light reaching the screen is reduced Or image is blurrer as some light from the bottom part of the object is not focussed.	B1
7	(a)	> the two bulbs still have the same potential difference from the mains (240 V) across them; hence they continue to lit up when switches are closed OR The two bulbs will function normally as all the three bulbs are connected in parallel (and behave independently from each other);	A1
	(bi)	>The bulb will have normal brightness / or behave at factory's specification when the potential difference across the bulb is 240 V and the bulb will convert 60 J of electrical energy to other forms (heat and light) of energy in 1s.	A1
	(bii)	>I = P/V = 60 / 240 = 0.25 A	A1
	(biii)	>5 A or 6A MCB (this is the norm for HDB lighting circuit) (1 A MCB also accepted)	A1
	(c)	>The connecting cables will overheat and possibly catch fire as the current of 6.25 A flowing is larger than the cable rating of 2A or 5A. OR MCB will trip as the current require to operate the water heater normally exceeds the rating of the lighting MCB (I=P/V = 1 500 / 240 = 6.25 A >5.0 A)	B1
8	(a)	>positive, negative and uncharged charges	A1
	(b)	>Corona Discharge (note that this is not electrostatic induction as no earth cable is used to bring up electrons to the dust particles)	A1
	(c)	>When airborne particles such as dust or pollen flows between the collecting plates, the particles become charged negatively (through corona discharge, electrons are gained by air and dust particles), which causes the bigger size dust particles to attach to the oppositely charged collecting metal gauzes **as unlike charges attract**. OR Note that a few situation can occur at the highly charged wire gauzes >The positive charged and negatively dirty dry air are attracted to the negatively charged and positively charged metal gauze respectively as unlike charges attract and deposited at the metal gauze (electrostatic precipitation). Any negatively charged dust will be repelled by the negatively charged gauze as like charges repel back to the positively charged metal gauze. OR upon passing through the wire positively charged gauze, dust particles which are positively charged will be neutralised upon attraction to the positively charged gauze. Negatively charged air will be neutralised too and passed through, then become negatively charged air as it is released into the water. The **air** then flows **through**, leaving the **dust** particles attached to the meshes. The result in **cleaner**, purified **air**.	B1 B1 B1
	(d)	>UV-C UV-A causes wrinkling of skin, UV-B which can damage the DNA in our skin, leading to sunburn and eventually skin cancer (recently scientists have discovered that UVA can also do this). Both can be blocked out by most good sun creams. To use UVC safely, you need specialist equipment and training. The World Health Organization (WHO) has issued a stern warning **against people using UV light to sterilise their hands** or any other part of their skin. Note : gamma rays is used in hospital with proper shielding to sterilise medical equipment as the high energy gamma rays can pass through the entire consignment of medical equipment.	A1

		UV rays have sterilising effects on the surface only.	
			B1
9	(a)	>South Pole	A1
	(b)	>A ding and Dong sound or a high and then low frequency/pitch sound >When the button switch is pressed, current flows in the closed circuit and makes the solenoid into an electromagnet and **attracts the soft iron rod through magnetic induction** to slide through the plastic tube, compressing the spring to hit the metal plate B. A ding (higher frequency) is made. >When the button switch is released, no current flows and the solenoid is no longer energised thus the temporary magnet made from soft iron lose its magnetism. The compressed spring thus extends and pushes the plastic rod to the left and hit the metal plate A to produce the sound DONG.	B1 B1
	(c)	>Copper is not a magnetic material	B1
Section B			
10	(a)	>80 – 50 = 30 m	A1
	(b)	>To protect the wind turbine from damage due to its blades being ripped off or wear and tear or prevent turbulence or prevent the generator being burnt out or catastrophic failure or >Stop working during hurricane. >Current too high causing fuse to melt and open circuit so not working.	A1
	(ci)	>incident wind power = $0.5 \times \pi(100/2)^2 \times (14)^3 \times 1.25$ = 13 469 578.5 W = 13 MW (2 sf)	A1
	(cii)	>overall efficiency = Useful Power / Input Power x 100% = (3034 kW / 13 470 kW) x 100% >Eff = 22.5 % (correct to **2** s.f.)	M1 A1
	(ciii)	>Due to the limited number of blades mounted, not all the KE of the wind is converted to electrical energy. OR >In any mechanical system due to **friction** among moving parts or **resistance** in the electrical components, some of the electrical energy is wasted as **heating effect/thermal energy** on the wiring and electrical components. OR > Work done against **air resistance**. OR >Energy conversion into sound energy.	B1
	(d)	>Diagram showing **cyclic arrows in anti-clockwise direction** of movement of hot air rising from land and movement of cold air towards the land. OR > **Smaller heat capacity of land** compared to water. OR >Due to **higher specific heat capacity of water** compared to land. OR >The **warm air over the land** expands, becomes **less dense** and rises and creating a partial vacuum. OR >The heavier, **denser, cooler air over the water** flows in to take its place, creating sea breeze wind. OR > **Higher air pressure above sea** and **lower air pressure above land** causing air flow from sea to land. OR >Explanation of **conventional current** formed. [B1 each max 2m]	B1 A1
	(e)	>Lightning conductors mounted at the highest point, >and due to the point action of the sharp points which produces positively charged ions to a highly negatively charged cloud, the probability of lightning striking is reduced OR	B1 A1

		>Earth wire connected to the metallic part of the wind tower OR a network of strike termination devices (lightning rods); >A network of conductors to move lightning energy from the strike termination devices toward earth; a network for ground terminations (ground rods), direct excess charges to the ground/earth.	
11	(a)	>correct circuit connection for all >Correct symbol for ammeter and voltmeter and rheostat set up should at least be able to take 1 correct set of readings to be awarded any marks  	B1 B1
	(b)	>For X, Resistance R_X is not linearly related with I and graph has a decreasing positive ~~negative~~ gradient. OR Resistance **R_X decreases** when current in component X, **I_X increases** **(V-I graph, decreasing gradient→ R decreases)**  >For Y, Resistance R_Y is not linearly related with I and graph has an increasing positive gradient OR Resistance **R_Y increases** when current in component Y, **I_Y increases** **(V-I graph, increasing gradient→ R increases)**  	A1 A1
	(ci)	>R = V/I = 5.00 / 0.28 = 17.857 >R = 18 Ω (2sf)	B1 A1
	(cii)	>X = Thermistor (NTC) or LDR >Y = Filament bulb or Thermistor (PTC)	A1 A1
	(d)	> the resistance of a LDR increases	B1

		>Under dim lighting, the resistance of a LDR increases and since it is connected in parallel to a fixed resistor, the total resistance will increase. From potential divider concept, the pd across the combined setup or LDR will increase which also increases its power in $P=V^2/R$. Hence the Brightness of the bulb must increase. * students must get resistance of LDR to be correct before awarding the 2nd mark.	A1
12E	(a)	>Current flowing in AB produces a concentric magnetic field which will interact with the radial field of the C-shaped permanent magnet to produce a catapult-shaped field where there is a stronger magnetic field on one side. >AB moves from region of strong field to weak magnetic field. Note: Explanation by using FLHR scores no mark as the question does not ask for direction of force. OR Idea of Lateral Tension and Longitudinal Tension model is acceptable to score 2 m	B1 B1
	(b)	>F drawn acting at right angles to AD  	B1
	(c)	>**Copper pieces X, Y** (=split rings) **changes electrical contacts with metal strips Q and P** (= carbon brushes) resulting in a **reversal of current flow in the coil** which is now in the direction ABCD. [Earlier before passing the vertical position current was flowing in the direction DCBA as coper piece Y was in electrical contact with P. After coil just passes the vertical position, copper piece X is in electrical contact with metal strip P and now the current flowing in the coil reverses to ABCD. >There was a change of electrical contact with the other metal strip, P, by copper piece (split ring) which was in contact with metal strip Q after passing the vertical position] >**The reversal in the direction of the couple** acting on the sides AB and CD causes continuous rotation [Earlier Force acting on side DC is downwards and now changed to upward. Similarly Force acting on side AB is upwards and now change to downwards OR force on side of coil nearer to N-pole of magnet always acts downwards and nearer to S-pole always acts upwards.]	B1 B1
	(d)	>M = Fd = 3.0 x 0.065 >M = 0.195 = 0.20 Nm (2sf) 1 mark for M = 0.098 Nm.	M1 A1
	(ei)	>Motor in Fig. 1.3 rotates with maximum torque for ¼ cycle of rotation versus maximum torque for almost the entire rotation for motor in Fig. 12.1. >The difference is due to current supply to the coil for ¼ cycle of rotation versus current supplied to the entire cycle of rotation in Fig. 12.1	B1 B1
	(e)	>Correct shape No ecf for this part.  	B1
12 OR	(a)	>E=mc(Δθ) = 0.25(4200)(35-15) = .25(4200(20) >E=21 000 J	M1 A1
	(b)	>P=E/t = 21 000 / (3.5 x 60) = 21 000 / 210 = 100 W	A1
	(ci)	>E = Pt = 100(2.2 x 60) = 13 200 >E = C(Δθ), C = E / (Δθ) = 13 200 / 12 = 1 100 J/°C	B1 B1
	(cii)	>C = mc, c = C/m = 1 100 / 0.50 = 2 200 J / (kg°C)	B1

	(d)	> From $E/t = mc\Delta\theta/t$ E /1min =m(4 200)(5.0 °C/1min) ---Equation 1 for water E/1min = m(2 200)(Δθ /1 min) --- Equation for paraffin >Eqn 1 / Eqn 2 1 = (4 200 / 2 200)(5.0 °C/1min / Δθ /1 min) Δθ /1 min = 9.545= 9.5 °C/min (2sf)	M1 B1
	(ei)	>Use a plastic cover with 2 holes (one for thermometer and the other for heater) over the beaker in Fig. 12.5 to prevent loss of mass of paraffin through evaporating during the 2.2 minutes of heating. OR > Use a plastic cover with 2 holes (one for thermometer and the other for heater) over the beaker in Fig. 12.5 to reduce loss of heat from paraffin to surrounding through convection during the 2.2 minutes of heating. OR > paint the outside of the beaker white/silver to reduce heat loss from beaker through radiation.	B1 B1
	(eii)	Lower final temperature (as the same amount of energy is used to heat a larger mass of paraffin) OR Higher final temperature a less heat is lost from the paraffin to the surrounding. Mark only awarded for correct, logical consequence of the part (ei), no mark for this part if part (ei) is wrong. Note: Theoretical value of shc of paraffin is 2130 J/kg°C. For $E=mc(\Delta\theta)$ = 0.50(2130)(32-10) = 12 780 J Amount Energy lost to environment = 13 200 -12 780 = 420 J $E = ml_{vap}$ m = 420/152 = 2.76 g vaporize	B1

The END