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NAME/INDEX NO. _____ () CLASS _____



BUKIT MERAH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
Secondary 4 Express

Physics
Paper 1 Multiple Choice

5059/01
18 Sept 2017
1 hour

Additional Materials: Multiple choice answer sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Do not use staples, paper clips, 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.

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.

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

Take $g = 10 \text{ m/s}^2$ or 10 N/kg unless stated otherwise.

This document consists of 17 printed pages.

1. Fig. 1.1 shows the zero error of a pair of Vernier calipers. Fig. 1.2 shows the same apparatus being used to measure the diameter of a metal disc.

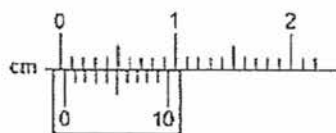


Fig 1.1

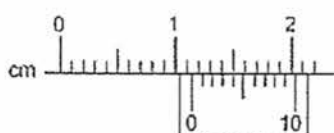
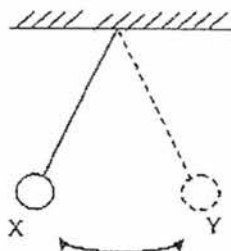


Fig 1.2

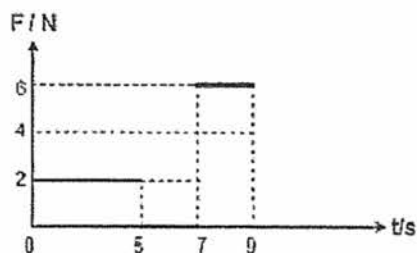
- What is the diameter of the metal disc?
- A 1.00 cm
B 1.10 cm
C 1.18 cm
D 1.20 cm
2. Which one of the following is correct?
- A The length of a field is about 1×10^2 m.
B The diameter of an atom is about 1×10^{-5} m.
C The diameter of the Earth is about 1×10^7 m.
D The thickness of a human's hair is about 1×10^{-3} m.
3. The bob of a simple pendulum is swinging between points X and Y.



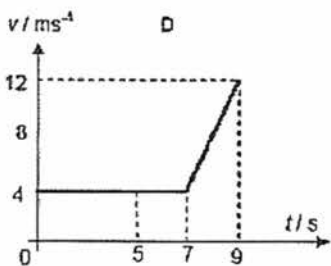
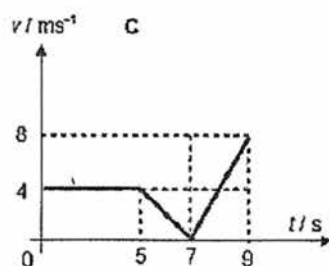
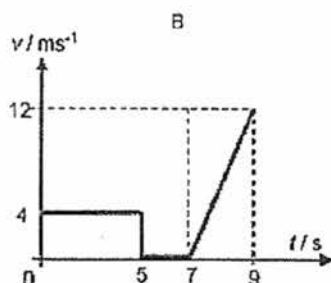
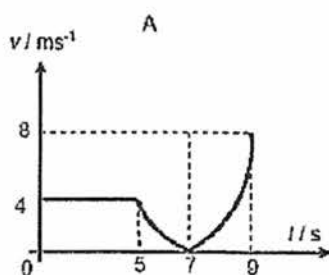
It swings from X to Y and back to X again ten times in 8.65 s.
What is the period of the pendulum?

- A 0.43 s
B 0.87 s
C 1.70 s
D 4.30 s

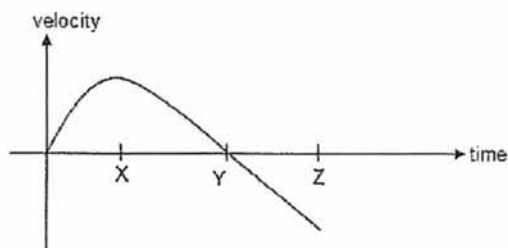
4. The graph below shows the applied force F acting on a 1 kg box which is moving at 4 ms^{-1} on a table for the first 5 seconds.



Which of the following velocity-time graph shows the motion of the box?



5. A water rocket is launched vertically upwards. The velocity-time graph below shows the relationship between the velocity of the rocket and time.

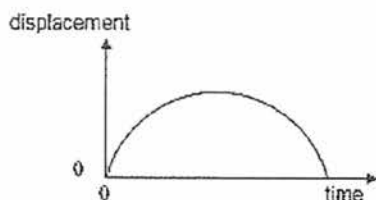


Which of the following statement(s) is/are correct?

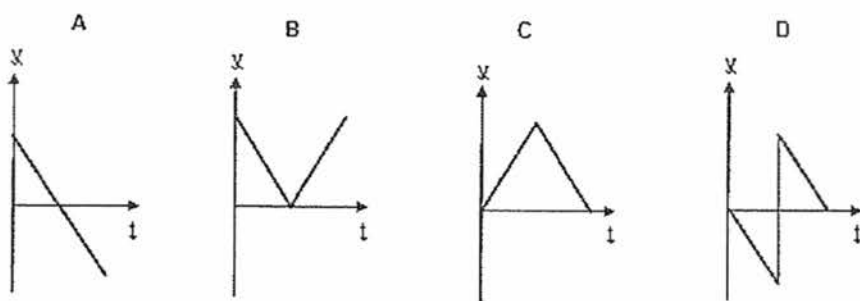
- (1) The rocket reaches the highest position at instant X.
- (2) The resultant force acting on the rocket is zero at instant Y.
- (3) The rocket is still in the air at instant Z.

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

6. The diagram shows the graph of displacement against time for a body moving in a straight line.



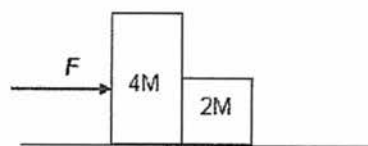
Which of the following velocity, v , against time, t , graphs describes the motion of the body over this period?



7. An object has a mass of 15 kg. It is pushed horizontally by a force of 40 N. The frictional force is 10 N. What is the acceleration of the object?

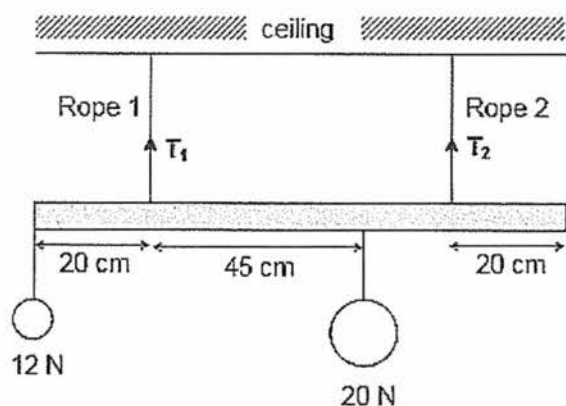
- A 0.50 ms^{-2}
 B 1.50 ms^{-2}
 C 2.00 ms^{-2}
 D 2.70 ms^{-2}

8. Two blocks with masses $4M$ and $2M$ are pushed along a horizontal frictionless surface by a horizontal applied force F as shown in the diagram. During the motion, both blocks exert equal and opposite forces against each other. What is the magnitude of this equal but opposite force?



- A $\frac{F}{3}$
 B $\frac{F}{2}$
 C $\frac{2F}{3}$
 D F

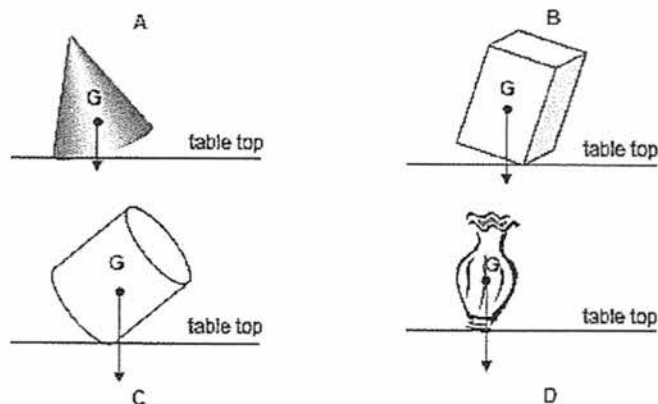
9. The weight of a rock on the earth is 20 N. If the gravitational field strength on the moon is approximately 1.7 N kg^{-1} , what is its weight on the moon?
- A 2.0 N
B 3.4 N
C 12 N
D 20 N
10. Because of inertia, a moving object tends to _____.
- A be at rest
B move at a constant speed
C accelerate in a straight line
D accelerate in a curved line
11. The initial density of a metal ball is 15.0 g cm^{-3} . When a hole of volume 1.0 cm^3 is drilled into the ball, what will its final density be?
- A 14.0 g cm^{-3}
B 15.0 g cm^{-3}
C 16.0 g cm^{-3}
D Not able to determine.
12. The figure below shows a metre rule hanging from the ceiling using two ropes. Two weights, 12 N and 20 N, are attached to the metre rule.



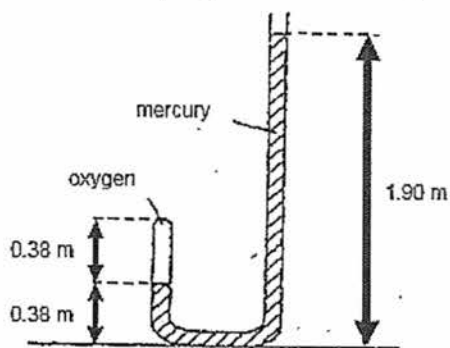
What is the tension T_2 ?

- A 11 N
B 12 N
C 21 N
D 32 N

13. The diagrams below show the positions of different objects when tilted. G is the centre of gravity of the objects. Which one of the following objects will topple when released from their respective positions?



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



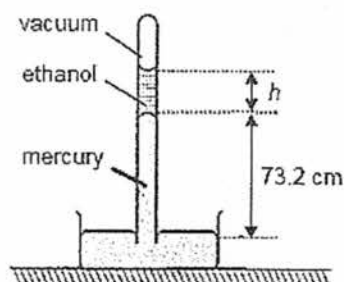
Given that atmospheric pressure is 0.76 mHg, what is the pressure of the oxygen gas in mHg?

- A 1.14 mHg
- B 1.52 mHg
- C 2.28 mHg
- D 2.66 mHg

15. A barometer contains mercury mixed with some ethanol as shown below.

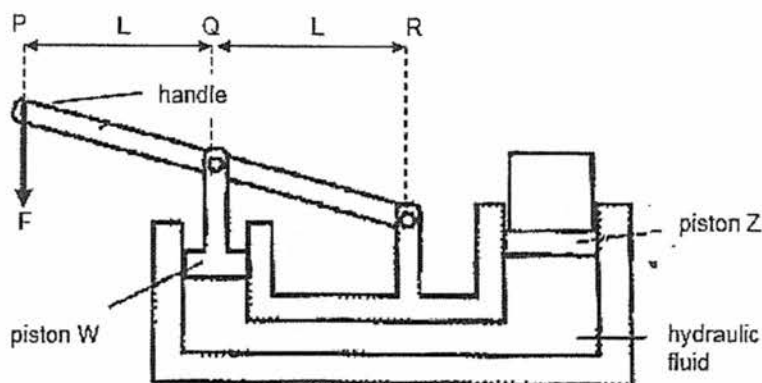
The following data is given:

Atmospheric pressure = 75.6 cm Hg
 Density of ethanol = 789 kg/m^3
 Density of mercury = $13\,600 \text{ kg/m}^3$
 Gravitational field strength = 10 N/kg



- What is the height of the ethanol above the mercury column, h ?
- A 17.2 cm
 - B 24.0 cm
 - C 30.4 cm
 - D 41.4 cm

16. The diagram below shows a lever connected to a piston W.



The surface area of Piston Z in contact with the hydraulic fluid is 10 times that of piston W. The horizontal distance PQ and QR is L .

What is the force, F , exerted at the handle if the load lifted at piston Z is $20\,000 \text{ N}$?

- A 500 N
- B 1000 N
- C 2000 N
- D 10 000 N

17. When a tennis ball drops onto a hard and smooth horizontal surface, it bounces up and down in the air. The height of each bounce gradually reduces until the ball stops moving.

Which of the following statements is true?

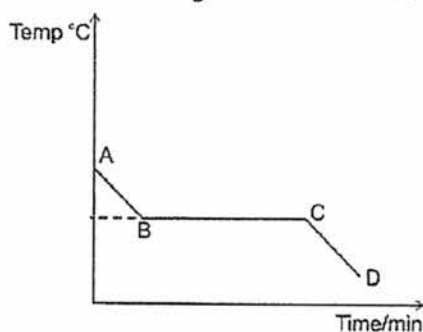
- A The kinetic energy of the ball is constant.
 - B The potential energy of the ball is constant.
 - C The sum of the kinetic energy and potential energy of the ball is constant
 - D The sum of the kinetic energy and potential energy of the ball is not constant.
18. A ball is released from a height h above a table. The air resistance is assumed to be negligible and 50% of its kinetic energy is lost at each bounce. What is the speed of the ball right before it touches the ground for the third bounce?

- A $\frac{gh}{\sqrt{4}}$
- B $\frac{gh}{\sqrt{2}}$
- C $\sqrt{\frac{gh}{4}}$
- D $\sqrt{\frac{gh}{2}}$

19. A smoke cell observed under a microscope gives evidence for Brownian motion. This evidence is _____.

- A looking at smoke particles colliding with air molecules
- B observing smoke particles moving in a random manner
- C realizing that smoke particles can be seen when light falls on them from the side
- D determining that smoke particles travel at different speeds

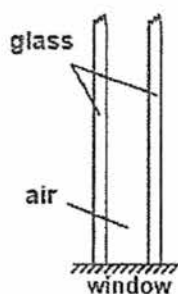
20. The diagram below shows a cooling curve of an unknown pure substance.



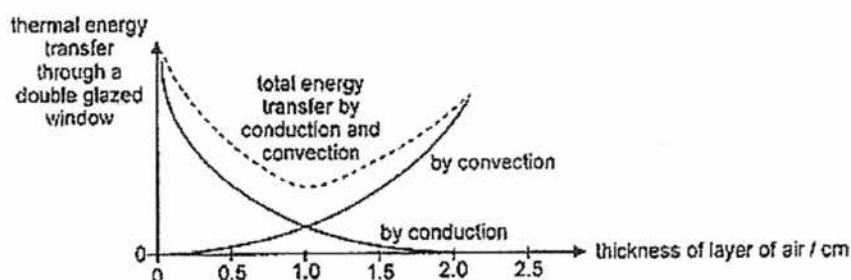
Which of the following statements are correct?

- A At BC, the kinetic energy increases and the potential energy remains constant.
- B At BC, the kinetic energy decreases and the potential energy remains constant.
- C At BC, the potential energy increases and the kinetic energy remains constant.
- D At BC, the potential energy decreases and the kinetic energy remains constant.

21. When calibrating a liquid-in glass thermometer, which of the following steps is **not** needed?
- A Choosing two fixed points.
 - B Choosing a thermometric property that varies constantly.
 - C Ensuring that the room temperature is kept constant.
 - D Ensuring that the thermometer is calibrated at one atmospheric pressure.
22. A double-glazed window has two sheets of glass separated by a layer of air.



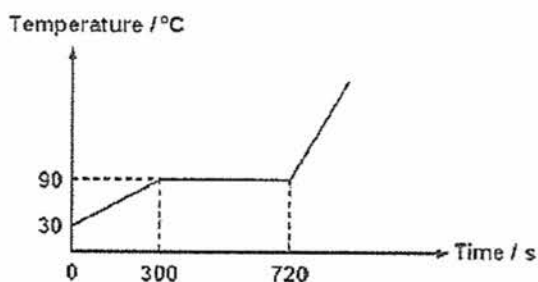
Thermal energy is transferred through the layer of air by conduction and convection. The amount of conduction and convection depends on the thickness layer of air as shown in the graph.



A specially designed room is to be installed with these double-glazed windows. The temperature of this room is kept constant with fluctuations in temperature to be kept to a minimal. What thickness of layer of air of the installed double-glazed windows will best maintain the temperature of the room and why?

- A 0.5 cm because there is little convection.
- B 1.0 cm because the total thermal energy transfer is minimal.
- C 1.5 cm because the total thermal energy transfer is small and conduction is low.
- D 2.0 cm because there is little conduction.

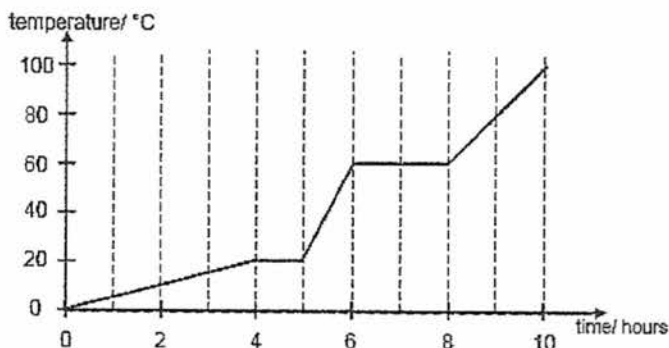
23. The diagram shows a graph of temperature against time when 0.5 kg of salt is being heated.



If heat energy is supplied to the salt at a rate of 100 W. What is the specific latent heat of fusion of the salt?

- A $1.4 \times 10^3 \text{ J/kg}$
- B $2.1 \times 10^4 \text{ J/kg}$
- C $8.4 \times 10^4 \text{ J/kg}$
- D $1.4 \times 10^5 \text{ J/kg}$

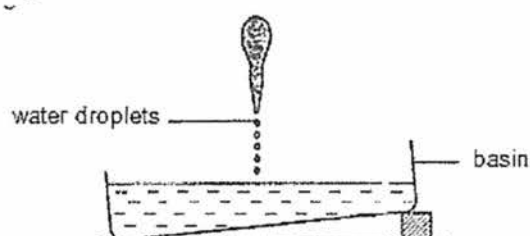
24. A sample of a material is heated at a constant rate from solid state until it reaches the gaseous state and a graph of temperature against time is shown below.



Which of the following can be deduced from the graph?

- A The heat capacity of the material increases with temperature in gaseous state.
- B The specific heat capacity of the material is smallest when in the solid state.
- C The specific latent heat of fusion is the same as the specific latent heat of vaporisation.
- D The specific latent heat of fusion is half the specific latent heat of vaporisation.

25. A tilted basin contains water. Water is dripped at a constant rate into the basin as shown in the diagram below.

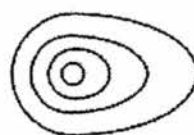


Which of the following pattern of the wavefronts will be observed in the basin as viewed from the top?

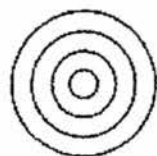
A



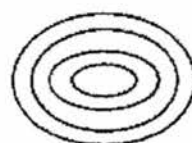
B



C



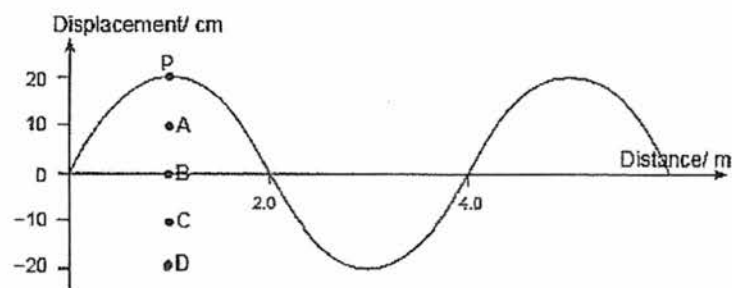
D



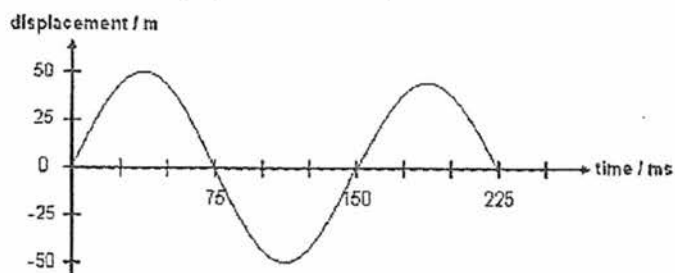
26. The graph below shows the relationship between the displacement and the distance travelled by a transverse wave.

Point P represents the position of a wave particle at time $t = 0$ s.

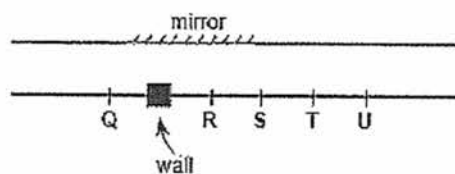
If the period of the wave is 0.50 s, what is the new position of P at $t = 3.25$ s?



27. The displacement-time graph of a wave's particles is shown below.

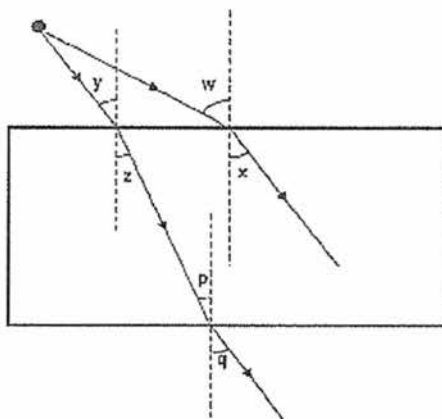


- What is the wavelength of the wave if its speed is found to be 60 ms^{-1} ?
- A 0.9 m
 B 5.0 m
 C 9.0 m
 D 10.0 m
28. Mary stands at point Q. A wall separates her from four other classmates standing at points R, S, T and U. The wall blocks her direct line of sight to them.
- If a mirror is placed as shown below, how many persons can she see reflected in the mirror?



- A Four
 B Three
 C Two
 D One

29. The figure below shows two rays of light entering a glass block.

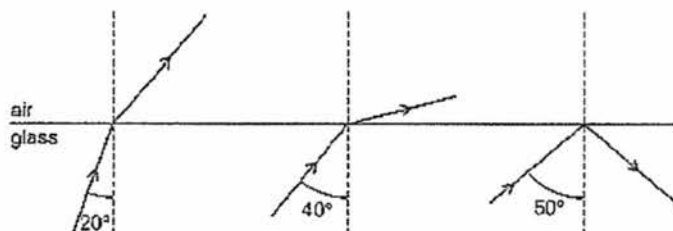


Which of the equations are **correct**?

I $\frac{w}{x} = \frac{y}{z}$ II $\frac{\sin y}{\sin z} = \frac{\sin p}{\sin q}$ III $\frac{\sin w}{\sin x} = \frac{\sin q}{\sin p}$ IV $\frac{\sin y}{\sin z} = \frac{\sin w}{\sin x}$

- A I and II
B II and III
C II and IV
D III and IV

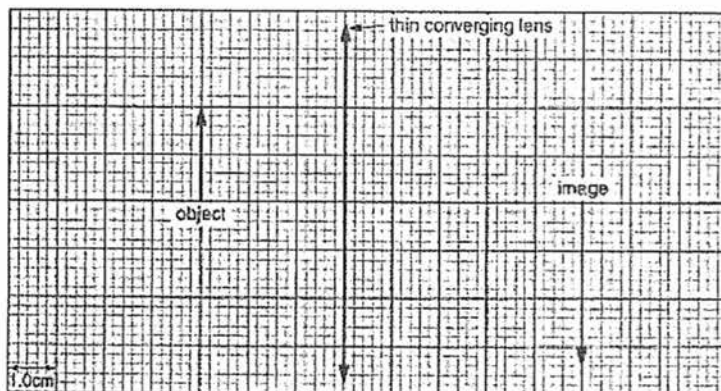
30. Three rays of light are incident on the boundary between a glass block and air. The angles of incidence are different as shown below.



What is a possible **critical angle** for light in the glass?

- A 15°
B 30°
C 45°
D 60°

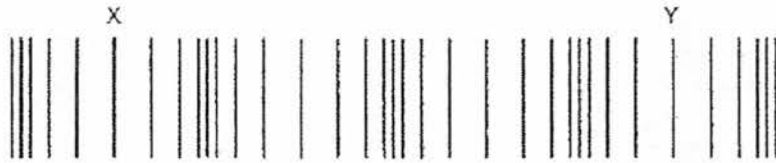
31. The diagram below shows an image of an object formed by a thin converging lens.



The object is now moved towards the left and its distance from the lens doubles. What are the properties of the new image?

- A real, inverted, enlarged
 - B real, inverted, diminished
 - C virtual, inverted, enlarged
 - D virtual, inverted, enlarged
32. Which of the following statements are correct?
- I Radio waves are used to detect flaws in metal pipes.
 - II Infra-red rays are used in treating muscle aches.
 - III Microwaves are used in satellite TV.
 - IV X-rays are used in intruder alarms.
- A I and II only
 - B I and III only
 - C II and III only
 - D II and IV only
33. Which of the following components of the electromagnetic spectrum are placed in ascending order of their frequency?
- A gamma rays, ultra-violet rays, visible light
 - B gamma rays, visible light, ultra-violet rays
 - C ultra-violet rays, visible light, gamma rays
 - D visible light, ultra-violet rays, gamma rays

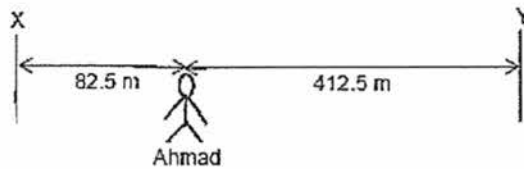
34. A series of compressions and rarefactions of a sound wave is shown below. The sound wave has a frequency of 1600 Hz and a speed of 320 m/s.



What is the distance between X and Y?

- A 0.20 m
- B 0.40 m
- C 0.60 m
- D 1.20 m

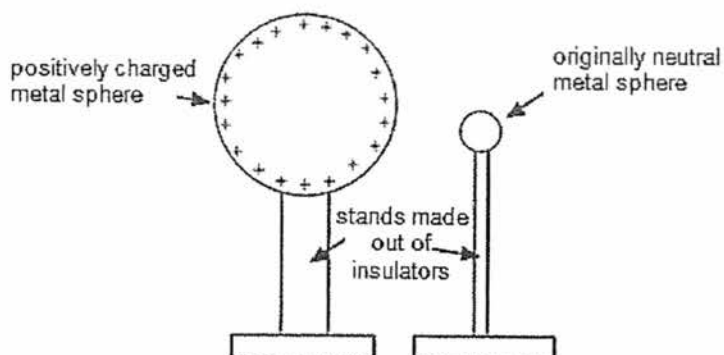
35. The figure below shows Ahmad standing between two cliffs X and Y. He fires a pistol.



If the speed of sound in air is 330 ms^{-1} , what is the time interval between the first two echoes heard by Ahmad?

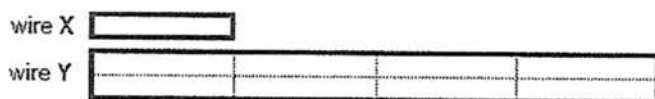
- A 0.75 s
- B 1.25 s
- C 1.75 s
- D 2.00 s

36. A small metal sphere, which is electrically neutral, is brought close to but not touching a positively charged metal sphere as shown in the diagram below.



Which of the following is correct?

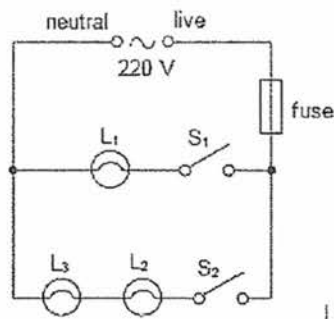
- A Current will flow from the large sphere to the small sphere.
 - B Some of the positive charges on the larger sphere is neutralised.
 - C The smaller sphere becomes negatively charged.
 - D There is a potential difference between the two spheres.
37. Wire X and Y are two wires made of the same material such that wire Y is twice as thick and four times longer than wire X.



What is the ratio of wire X's resistance to wire Y's resistance?

- A 1 : 1
- B 1 : 2
- C 1 : 4
- D 1 : 8

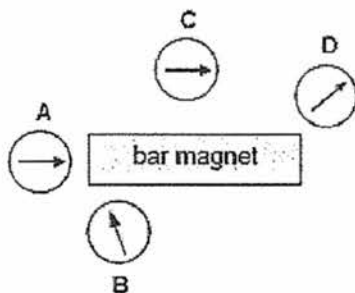
38. The figure below shows a part of the lighting circuit of a house.



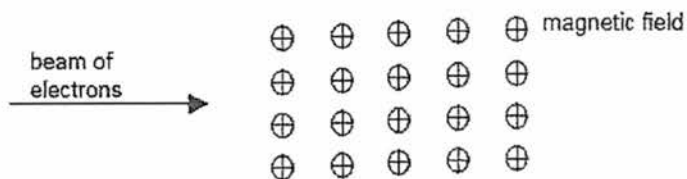
If all the bulbs are identical and they are rated at 200 W, 220 V, what is the suitable rating of the fuse when both S_1 and S_2 are closed?

- A 1 A
- B 2 A
- C 5 A
- D 10 A

39. Four magnetic compasses are placed near a bar magnet as shown in the figure below. Which compass is faulty?



40. The following figure shows a beam of electrons entering a magnetic field going into the paper.



How will the beam of electrons be deflected?

- A Downwards
- B Into the paper
- C Upwards
- D Out of the paper

END OF PAPER

NAME/INDEX NO. _____ () CLASS _____



BUKIT MERAH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
Secondary 4 Express

Physics
Paper 2

5059/02
13 Sept 2017
1 hour 45 minutes

Candidates answer on the Question Paper.
No additional materials

READ THESE INSTRUCTIONS FIRST

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

Section A

Answer **all** questions in the spaces provided.

Section B

Answer **all** questions. **Question 11 has a choice of parts to answer.**
Write your answers to **all** questions in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

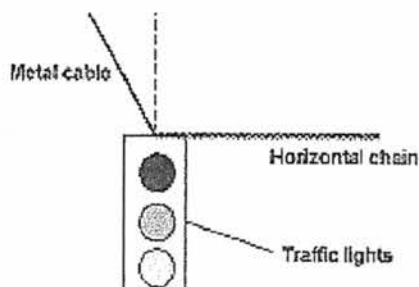
The number of marks is given in brackets [] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the value of g to be 10 ms^{-2} or 10 Nkg^{-1} .

FOR EXAMINER'S USE	
Section A	/ 50
Section B	/ 30
TOTAL	/ 80

Section A: Answer all questions in the spaces provided. [50m]

1. A set of traffic lights hangs from the end of a metal cable. A horizontal chain pulls the traffic lights to the right so that they are above the middle of the road. The diagram below shows the metal cable inclined to the vertical. The weight of the traffic light is 300 N.



- a) Two of the forces on the traffic lights are the tension in the horizontal chain and the weight of the traffic lights. [1]

On the diagram, draw

(i) an arrow that represents the tension in the horizontal chain,

(ii) an arrow that represents the weight of the traffic lights

- b) The tension in the horizontal chain is 200 N. Use a scale diagram to determine the tension in the metal cable. State the scale used for the diagram. [2]

Scale:

Tension:.....

2.
a) **Fig. 2.1** shows a child's toy. It is made of wood, in the shape of a bird. The toy includes a metal weight stuck to the tail. When placed on a metal rod, the toy balances in equilibrium.

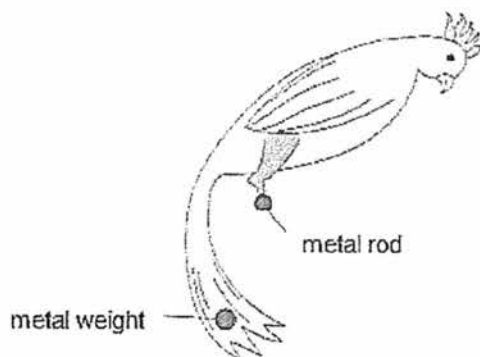


Fig 2.1

- (i) Mark and label the possible position of the centre of gravity of the bird **only** on **Fig. 2.1** with a cross 'x'. [1]
- (ii) State and explain what happens to the toy immediately after the metal weight falls off. [1]

.....

.....

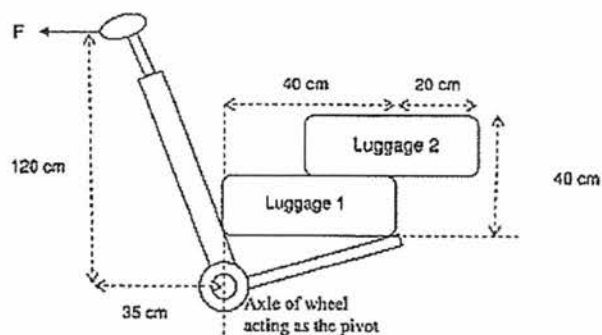
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- b) An airplane passenger places two identical luggages, each of mass 15 kg, onto a trolley as shown in the diagram. The centre of gravity of each luggage is in the middle of each luggage. He applies a force F at the handle to raise the luggages to the horizontal position shown.



- (i) Calculate the force F applied at the handle to keep the luggage horizontal. [2]

Force $F = \dots\dots\dots$

- (ii) The airplane passenger wheels the trolley as shown in the diagram for a distance of 150 m. The frictional force on the trolley is 25 N. What is the useful work done by passenger? [2]

Useful work done = $\dots\dots\dots$

- (iii) If the airplane passenger let go of the handle, the trolley will become upright. [3]
What will happen to **luggage 1** and **2**? Explain your answer.

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3. Fig. 3.1 shows a water pipe that is laid at the bottom of the sea. Along the pipe, there are horizontal hatches, each with a surface area of 0.80 m^2 .

Take gravitational field strength to be 10 N/kg . The density of sea water is 1030 kg/m^3 and the atmospheric pressure is $1.03 \times 10^5 \text{ Pa}$.

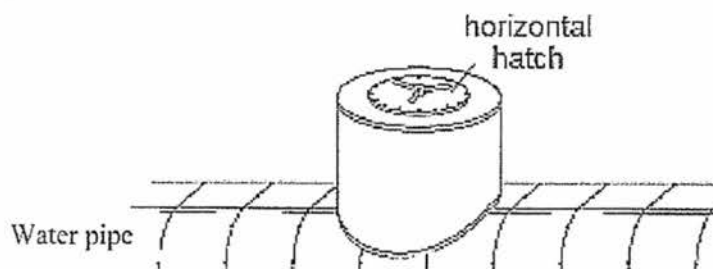


Fig 3.1

- a) Calculate the total pressure acting on the hatch if the hatch is located 150 m below the sea surface. [2]

Pressure =

- b) An air bubble escapes from the hatch and rises to the surface. Assume that the temperature of the sea water at the bottom of the sea is the same as that on the surface.

- (i) State how the volume and pressure of the air bubble change as it rises to the surface of the sea. [1]

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- (ii) Using the kinetic theory of molecules, explain why there is a change in the pressure of the air bubble when the volume changes. [2]

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- c) The actual temperature of the sea water is found to be much cooler at the bottom of the sea than at the surface.

Suggest and explain how the volume of the air bubble at the bottom of the sea might differ when the temperature difference is taken into consideration. [3]

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4.

- a) The resistance of a metal wire is a physical property that can be used to measure temperature. [1]

State another suitable physical property of a different material that can be used.

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- b) **Table 4.1** shows how the resistance of a wire changes with temperature.

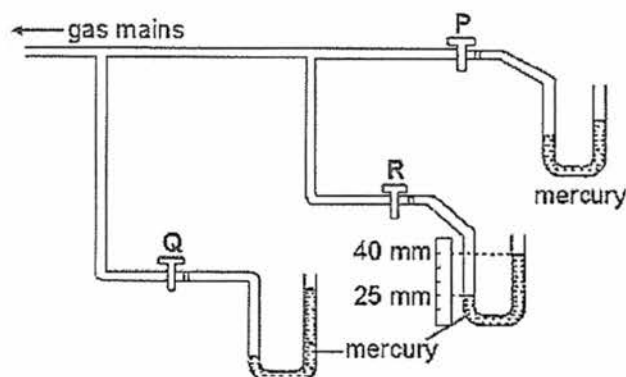
Find the unknown temperature Θ . Express your answer in Kelvin. [2]

Temperature / $^{\circ}\text{C}$	Resistance / Ω
55	30
100	80
Θ	56

Table 4.1

$\Theta =$

5. The diagram shows three identical mercury manometers connected to three gas taps for a particular experiment. [2]



At which gas taps P, Q or R is the gas pressure highest? Explain your answer.

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6.
a) Fig. 6.1 shows a 100 W coffee-making machine.



Fig 6.1

- (i) In the coffee-making machine, steam at 100°C is passed into the mixture of cold milk and coffee of mass 0.20 kg in each cup at 8°C until its temperature rises to 96°C . [3]

Specific heat capacity of the coffee and milk mixture is 4000 J/kgK

Specific heat capacity of water is 4200 J/kgK

Specific latent heat of vaporisation of water is 2300000 J/kg

Find the mass of hot coffee finally produced in each cup.

Mass of hot coffee =

- (ii) The unit cost of electrical consumption is \$0.25. Calculate the total cost of electrical consumption if the coffee machine is used for 2 hours daily for a month of 30 days. [2]

- b) Fig. 6.2 shows a baby's milk bottle containing some milk being heated in a bottle warmer. The bottle warmer has a foam-filled plastic wall and a smooth shiny casing. Total cost = [3]

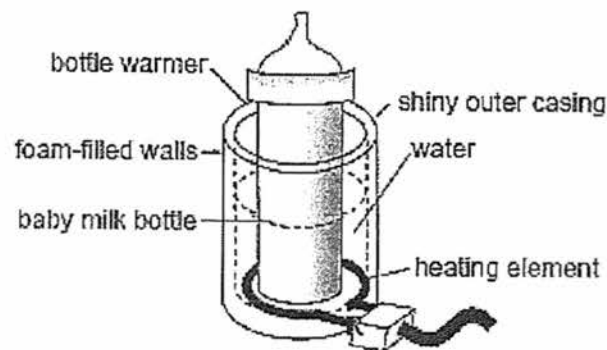


Fig 6.2

- (i) State which features of the bottle warmer help to keep the milk warm for as long as possible and how these features reduce heat loss. [3]

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- (ii) During heating, the student notices that some of the water evaporates from the warmer. Describe and explain, using ideas about molecules of water, what happens during evaporation. [2]

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(iii) The student finds that the rate of evaporation increases when the temperature of the water is higher. [2]

State and explain one other change that **increases** the rate of evaporation.

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(iv) The student turns off the power supply and the water cools down. [2]

Describe and explain how convection in the air causes the water to cool.

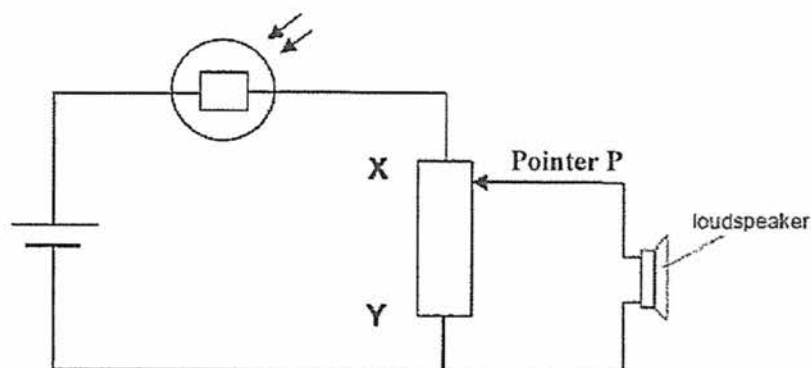
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7. The diagram shows a circuit consists of a light dependent resistor (LDR), a potentiometer XY and a loudspeaker.



When little light falls on the LDR, its resistance is $3000\ \Omega$. When the light of strong intensity falls on the LDR, its resistance is $500\ \Omega$.

- a) Describe and explain the conditions where the loudspeaker will be the loudest. [3]

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- b) Explain how sound is transmitted from the loudspeaker to the ears of a person. [2]

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- c) The Y-plates of a cathode-ray oscilloscope (CRO) are connected to the input voltage of the loudspeaker. The Y-gain of the CRO is set at 2.0 V/division and the time-base is set at 0.01 s/division .

Given that the amplitude of the input voltage is 4.0 V and its frequency is 25 Hz , draw the trace on the screen of the CRO in Fig. 7.1.

Draw **at least 2** complete waves.

[2]

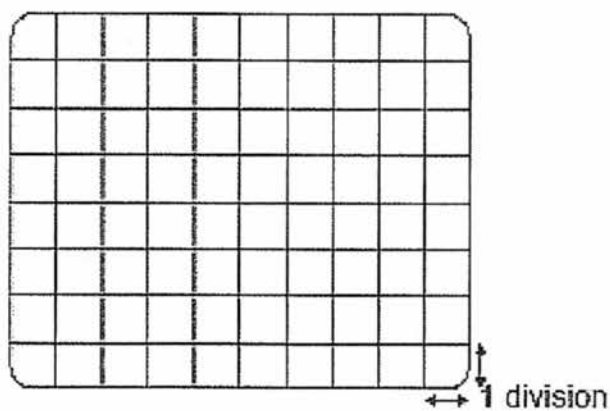


Fig 7.1

8. Fig. 8.1 shows an anemometer, a device for measuring wind speed. When the wind blows, the spindle rotates and there is a deflection on the a.c. voltmeter.

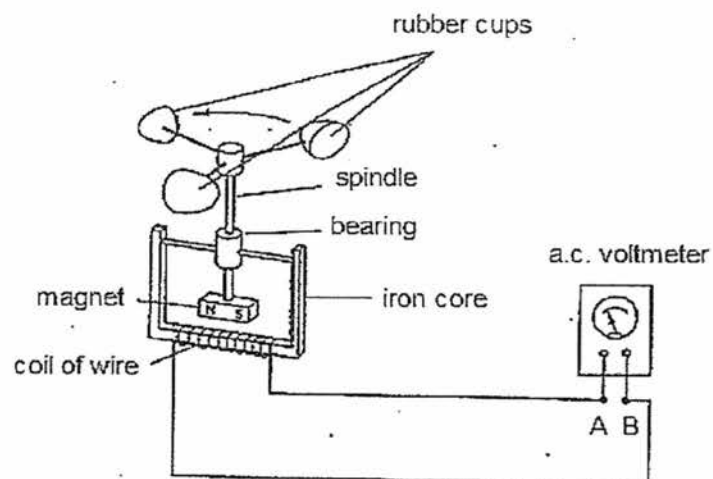


Fig 8.1

Explain how the rotating spindle causes an alternating deflection on the voltmeter.

[4]

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Section B: Answer all questions. Question 10 has a choice of parts to answer. [30m]

9. A wind turbine uses renewable energy source to generate electricity.

Fig 9.1 shows how the power output of a wind turbine varies with wind speed.

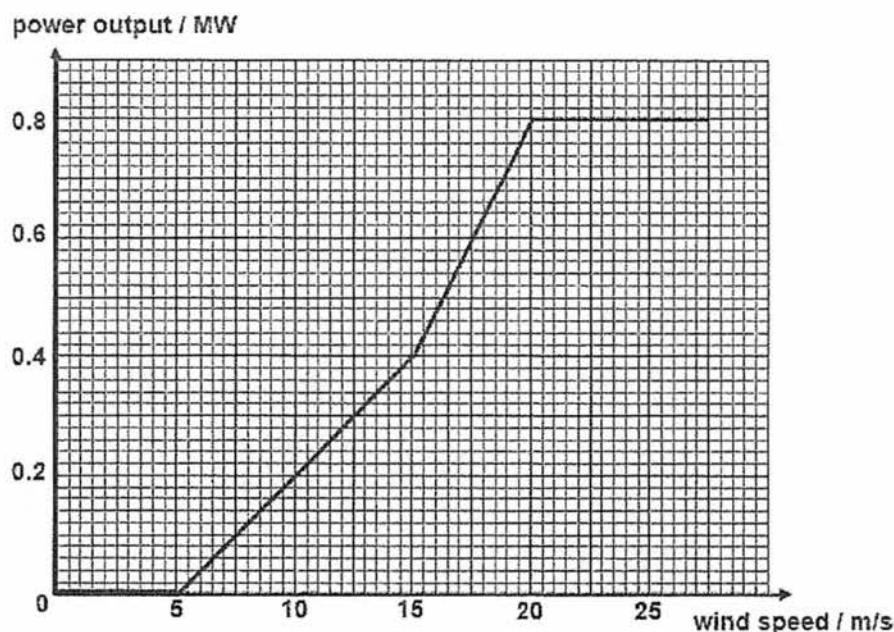


Fig 9.1

- a) Calculate the rate of power output (in MW / m/s) of the wind turbine for wind speed of 10 m/s. [1]

Rate of power output =

- b) Using Fig 9.1, describe how the power output varies with the wind speed of 5 m/s to 20 m/s. In your description, you are to include any numerical value(s) where necessary. [2]

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- c) The wind speed is recorded at two minute intervals as shown in Fig 9.2. [3]

Time / min	0	2	4	6	8	10	12	14	16	18
Wind speed / m/s	2	3	6	18	1	0	15	15	20	22

Fig 9.2

Using the data provided in Fig 9.1 and Fig 9.2, estimate the total energy produced in the 18 minute interval. Give your answer in joules

Total energy =

- d) (i) A wind turbine produces an alternating voltage of 600 V to the primary input of a transformer.

Explain how a transformer works.

[3]

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- (ii) Electric cables connect the secondary coil of the transformer to houses some distance away. Energy is wasted within the cable.

State and explain one method to reduce the amount of energy that is wasted.

[1]

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10 Fig. 10.1 shows a diagram of a simple d.c. motor.

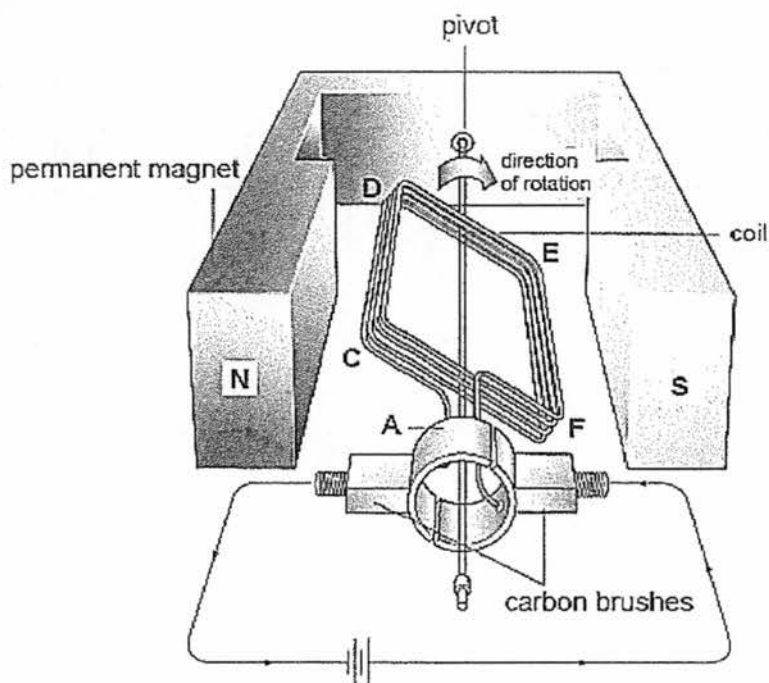


Fig 10.1

- a) The gap between two-halves of component A is so wide that only one carbon brush will only touch one half of component A at any point in time.

The advantage is that this will protect the circuit. However, a drawback is that sometimes, the motor will not start rotating when switched on.

- (i) Explain how current that flows into the coil CDEF, causes it to rotate clockwise as shown in Fig. 10.1. [2]

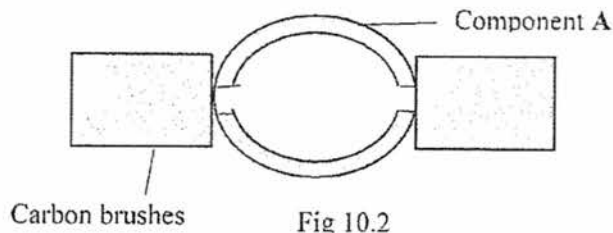
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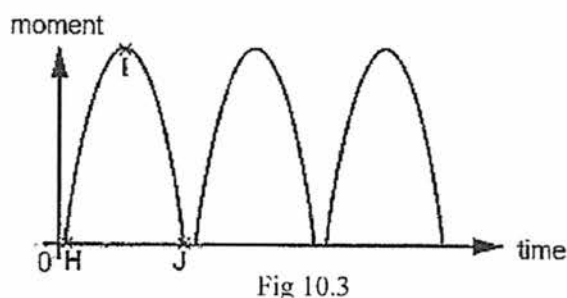
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- (ii) Fig 10.2 shows the side view the carbon brushes touching both halves of component A at the same time. Why is this not allowed? [2]



- (iii) Suggest and explain a possible situation when the motor does not start rotating when switched on, even if there is no friction. [2]

- b) Fig. 10.3 shows how the moment acting on the coil varies with time when the coil rotates at constant speed.



- (i) Which point(s) H, I or J, on Fig. 10.3, indicate(s) that the coil is in vertical position? [1]

- (ii) The frequency of the rotation is increased. Suggest a change that this causes to the graph in Fig. 10.3. [1]

- c) Instead of using permanent magnets in Fig 10.1, electromagnets can also be used. [2]

Complete the wiring from the battery Z to the iron bars so that the polarity on the left remains North and the polarity on the right remains South in Fig 10.4.

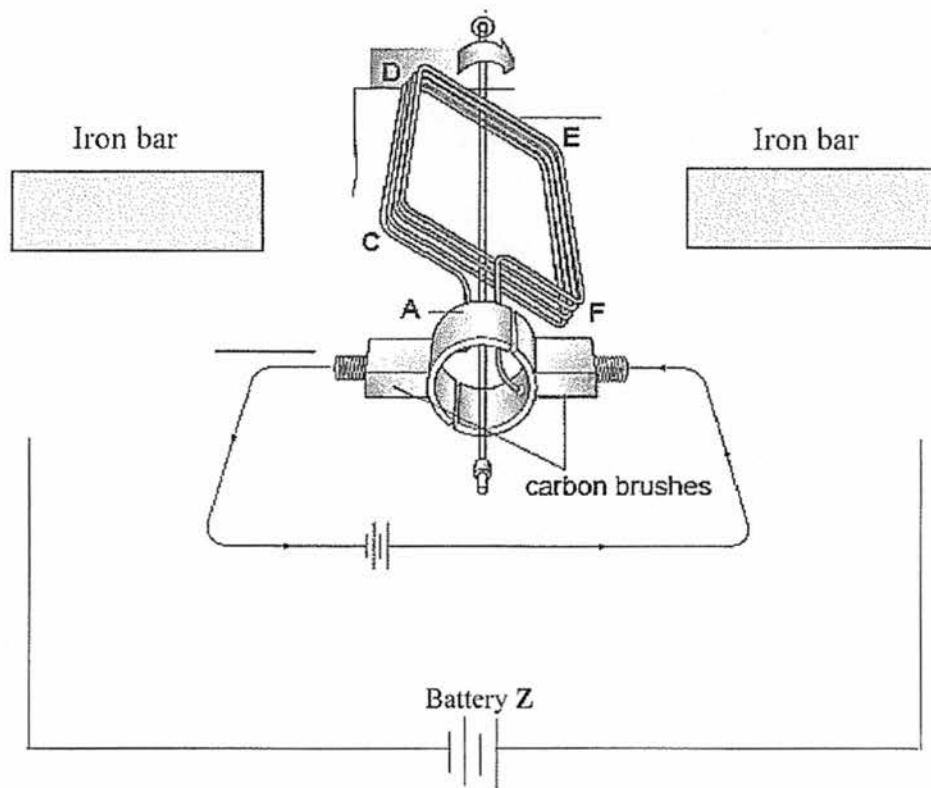


Fig 10.4

EITHER

11. In Fig. 11.1, a stunt man, initially at rest at position 1, has with one end of a thick elastic cord attached to him and the other end of the cord is firmly attached to a point on a high bridge.

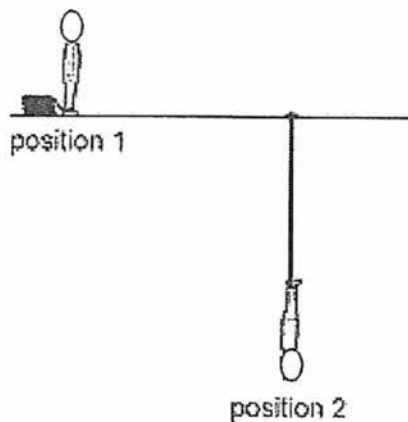


Fig 11.1

When the man jumps from the bridge, he falls freely under gravity for 2.5 s till he reaches position 2 in Fig. 11.1. Take acceleration of free fall to be 10 ms^{-2} .

- a) Calculate the vertical speed the man acquires at the end of his free fall. [2]

Speed =

- b) Sketch a velocity-time graph for the vertical motion of the man during his free fall. [2]
Indicate clearly the velocity and time on the axes.

- c) Calculate the vertical distance fallen during his free fall. [2]

- d) Suggest and explain whether the stunt man reaches terminal velocity before the cord stretches. [2]

Distance =

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- e) The stunt man is replaced with another person that has similar body surface area but a smaller mass. [2]

Taking into consideration air resistance and assuming both men reach terminal velocity, compare and explain the difference in the terminal velocity of the two men.

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OR

11.

- a) Fig 11.1 shows a method of producing sandpaper using static electricity.

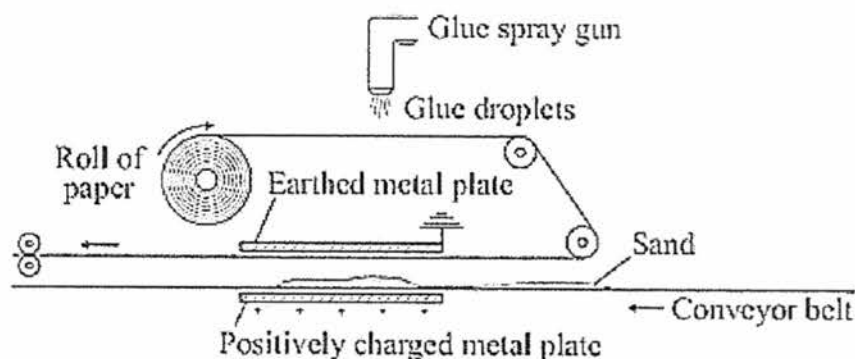


Fig 11.1

Glue is sprayed onto a moving strip of paper. As the glue leaves the spray gun, the glue breaks up into tiny negatively charged droplets which coat the paper. The sticky paper passes between two metal plates. Sand moving on a conveyor belt also passes between the metal plates.

- (i) What is the advantage of having all the glue droplets with the same (negative) charge? [2]

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- (ii) Explain why the sand moves towards the sticky paper. [2]

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- b) Thunderclouds contain charges. The buildup of charges on the clouds causes a large potential difference between the cloud and the ground.

- (i) Explain, in terms of energy, what is meant by *potential difference* in this context. [2]

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- (ii) There is a potential difference of 1000 MV between a cloud and earth. In a lightning discharge from the cloud to earth, a charge of 20 C passes. Calculate the energy involved in this discharge. [2]

Energy =

- (iii) A lightning conductor is placed at the top of a building to help to reduce the chance of a lightning discharge. Describe how this is achieved. [2]

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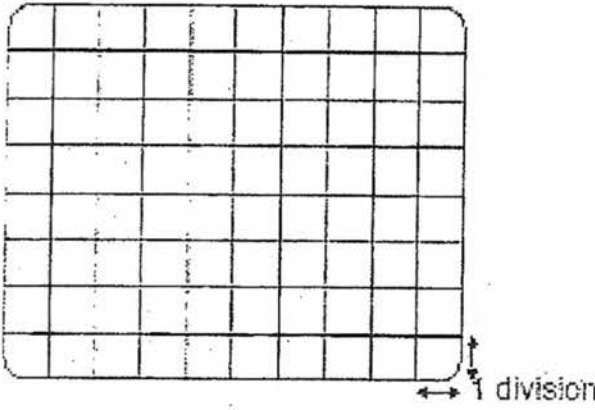
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END OF PAPER

4E Phy Prelim Answers 2017

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

	(ii) As the volume of the bubble increases, the <u>frequency of collision of the air particles against the walls of the bubbles decreases</u> . This <u>reduces the average force on the walls</u> . Since $P = F/a$, and contact area is constant, the <u>pressure of the air bubble decreases</u> .	A2
c)	The volume decreases further. At a lower temperature, the air molecules moves at a slower speed. This <u>reduces the frequency of collision of air particles against the walls of the bubbles</u> and therefore <u>reduces the force inside</u> . The <u>force exerted by the weight of the water is larger than the force inside</u> and therefore compresses the bubble.	A1 A1 A1
4a)	Volume of a liquid	A1
b)	$(80-30) / (100-55) = (56-30) / (\theta-55)$ $1.11 = 26 / (\theta-55)$ $\theta = 78.4^\circ\text{C} + 273\text{ K} = 351.4\text{ K}$	M1 A1
5.	At Q, the gas pressure highest The column of mercury at the right side is the highest above the mercury level on the left side.	A1 A1
6a)	(i) Heat lost by steam = Heat gained by coffee and milk mixture $mL + mc\theta = mc\theta$ $m(2300000) + m(4200)(100-96) = (0.20)(4000)(96-8)$ [M1] $2316800m = 70400$ $m = 0.030\text{ kg}$ [A1] Total mass = $0.030 + 0.20 = 0.23\text{ kg}$ [A1]	
(ii)	Total cost = $0.1\text{ kW} \times 2\text{ hr} \times 30\text{ days} \times \0.25 $= \$1.50$	M1 A1
b)	(i) The foam <u>traps air</u> , which is a <u>poor conductor of heat</u> and therefore reduce heat loss via conduction. The <u>shiny outer casing</u> is a <u>poor emitter</u> and therefore reduces heat loss via radiation.	A1 A1 A1
	(ii) The molecules <u>at the surface gain energy</u> and <u>overcomes forces of attraction</u> and <u>changes into vapour</u> . This <u>leaves behind the slower moving particles</u> in the water, which causes a decrease in its temperature.	A2

	(iii) <u>Increase the exposed surface area</u> (any other answers) This allows more molecules at the surface to gain energy, overcomes forces of attraction and changes into vapour.	A1 A1
	(iv) The air above the warmer water <u>heats up, expands, becomes less dense and rise, hence taking away the energy.</u> This <u>transfer of energy from the water to the air</u> helps the water to cool.	A1 A1
7a)	The LDR must be exposed to a <u>strong light</u> , this <u>reduces overall resistance, thus increasing current</u> [1] The pointer P must be placed <u>after X or at X</u> [1] This allows the <u>PD</u> across the loudspeaker to be the maximum[1]	
b)	The <u>vibration</u> from the loudspeaker <u>vibrates/disturbs the air particles</u> around it. This causes a transfer of energy is in the form of <u>longitudinal waves</u> where the <u>air particles undergo a series of compression and rarefactions</u> until the energy is transferred to the ears.	A2
c)		A1 – Y axis A1 – X axis
8	a) According to <u>Faraday's law</u> , an <u>emf is induced</u> and shown on the voltmeter when <u>the coil of wire experiences a rate of change of magnetic field lines</u> due to the <u>spinning of the magnet</u> above. According to <u>Lenz's law</u> , the <u>direction of induced EMF and current opposes the change causing it.</u> Hence, the <u>coil experiences alternating polarity as a polarity of the magnet approaches it or leaves, causing an alternating deflection on the voltmeter.</u>	A2 A2
9a)	Rate of power output $= 0.4 \div 10$ $= 0.040 \text{ MW / m/s}$	A1

b)	For wind speed from 5 m/s to 15 m/s, the power output increases at a constant rate of 0.040 MW / m/s [1]. For wind speed from 15 m/s to 20 m/s, there is a the power output increases of 0.080 MW / m/s [1].	
c)	Total energy produced = $[(0.04 + 0.64 + 0.4 + 0.4 + 0.8 + 0.8) / 6] \times 10^6 \times 18 \times 60$ [2] = 5.54×10^8 J [1]	
d)	(i) The <u>alternating voltage supply</u> produces an <u>alternating current</u> in the <u>primary coil</u> . This produces an <u>alternating magnetic field</u> around the iron core. This <u>alternating magnetic field</u> cuts the <u>secondary coil</u> and <u>induces an EMF</u> in the secondary coil.	A1 A1 A1
	(ii) By transmitting the power at <u>high voltages</u> [1] with the help of a step up transformer, the <u>current flowing in the cable</u> will be smaller [1] and thus the power loss due to the resistance of the cable will be reduced.	
10a)	(i) Current in coil CDEF produces a magnetic field, interacts with the magnetic field of the permanent magnet. By Fleming's left hand rule, an upward force will be exerted on CD, while a downward force will be exerted on EF	A1 A1
	(ii) To prevent short-circuit. Otherwise, coil will not turn OR Components of DC motor may get "burnt" and damage the motor.	A1 A1
	(iii) When the coil is in vertical position, no contact between a carbon brush and the split ring commutator. Hence, no current flows into the coil.	A1 A1
b)	(i) H and J	A1
	(ii) Choose one: ☐ Amplitude increases. ☐ Period decreases / Frequency increases	A1
c)	Correct wiring on both bars	A2

11a)	$10 = (v-0)/2.5$ $v = 25$ m/s	M1 A1
b)	Labelled axes with correct values Linear graph passing through the origin	A1 A1
c)	Distance = 0.5 (25) (2.5) Distance = $31.25 = 31.3$ m	M1 A1

d)	No. There is no air resistance in free fall. The only force acting on the body is the weight. The body will never reach terminal velocity.	A1 A1
e)	The man with the smaller mass has a lower terminal velocity. The man with smaller mass has a smaller weight, thus the amount of resistive force required to balance the weight is smaller.	A1 A1

OR

11a)	(i) The droplets will repel [1] each other, resulting in even coating [1] of glue/sand on the paper.	
	(ii) The sand becomes positively charged [1]. They are attracted to [1] the negatively charged paper as unlike charges attract.	
b)	(i) Potential difference is the energy [1] in carrying a unit charge from the ground at zero potential to the charged cloud [1].	
	(ii) $E = Q \times V$ $= 20 \times 1000 \times 10^6$ [1] $= 2 \times 10^{10} \text{ J}$ [1]	
	(iii) There is a great potential difference between the cloud and the lightning conductor and this causes the air between to ionize [1]. The oppositely charged ionized air will discharge the charges in the cloud preventing the charges in the cloud to accumulate [1]. This reduces the potential difference between the cloud and the lightning conductor. Thus, the chance of lightning striking is much reduced.	