



COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2026
SECONDARY 4 EXPRESS PHYSICS

Name: _____ () Class: _____

Physics

6091/02

Paper 2 Theory

Monday 31 August 2026

1130 – 1315

Candidates answer on the Question Paper.

1 hour 45 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

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

Section A

Answer **all** questions.

Section B

Answer **one** question.

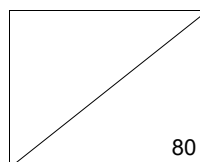
Candidates are reminded that **all** quantitative answers should include appropriate units.

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

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, ensure that you have submitted all your work.

The number of marks is given in brackets [] at the end of each question or part question.



Name of setter: Mdm Quek Lay Hong

This booklet consists of **20** printed pages and **2** blank pages.

SECTION A

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

- 1 (a) State the *principle of moments*.

.....

[2]

- (b) Fig. 1.1 shows a metal sheet suspended from a hole in one corner at A. The weight of the metal is 0.50 N and the centre of gravity is at B. The diagram is drawn to full scale.

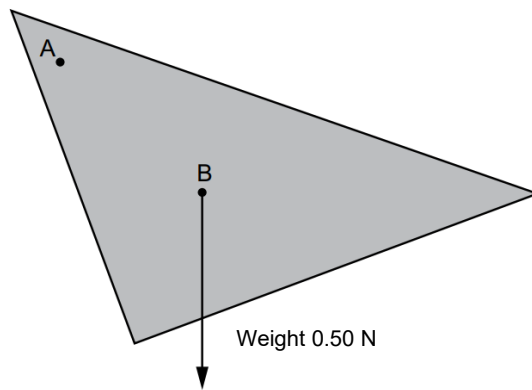


Fig. 1.1 (to scale)

- (i) State what is meant by the *centre of gravity* is at B.

.....
[1]

- (ii) Using a measurement taken from Fig. 1.1, calculate the moment of the weight about point A.

On Fig. 1.1, indicate the measurement that you make.

moment = [3]

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- (iii) The metal sheet in Fig. 1.1 swings freely and eventually comes to rest.

Describe the final position of B and explain why the sheet remains at rest in this position.

.....

.....

.....[2]

[Total: 8]

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- 2 (a) A car of mass 970 kg is travelling at 27 m/s when the brakes are applied. The speed of the car decreases to 15 m/s in 40 m.
- (i) Calculate the amount of energy that is transferred out of the kinetic store of the car when the brakes are applied.

energy transferred out = [2]

- (ii) Hence, calculate the magnitude of the average braking force on the car.

average braking force = [2]

- (b) One type of renewable energy source is shown in Fig. 2.1.

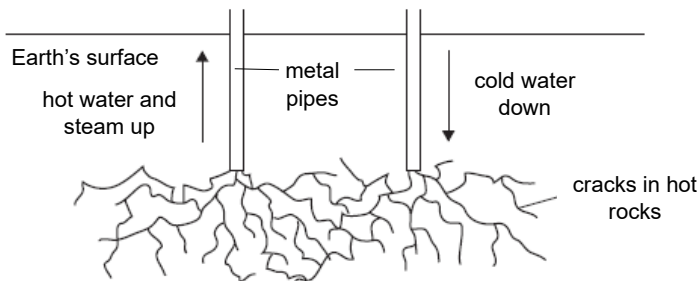


Fig 2.1

- (i) State the name of the renewable energy source shown in Fig. 2.1.
..... [1]
- (ii) State what is meant by a *renewable energy source*.
.....
.....[1]

[Total: 6]

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- 3 A man uses a steam wallpaper stripper, shown in Fig. 3.1, to help him prepare his living room for re-decoration.

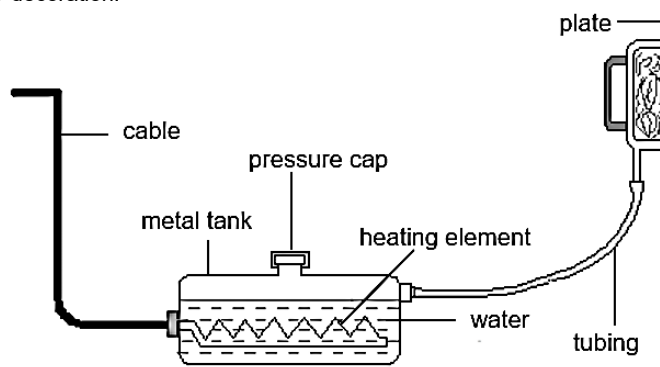


Fig. 3.1

When the appliance is in use, water is heated until it boils and produces steam. The plate is then held against the wall and the steam released from the pipe slackens the wallpaper, releasing it from the wall.

The following information is shown on the appliance:

IMPORTANT:	
Ensure that the metal tank is fully filled before switching current on.	
Power rating	2.5 kW
Voltage	240 V
Capacity	20 litres

Tap water at 20 °C is used to fill the tank. One litre of water has a mass of one kilogram. The stripper is used until 50% of the water has been turned into steam.

The specific heat capacity of water is 4200 J/(kg °C) and the specific latent heat of vaporisation of water is 2.26×10^6 J/kg.

- (a) Define *specific heat capacity*.

.....

 [2]

- (b) Calculate the energy transferred to heat the water to 100 °C.

energy transferred = [1]

- (c) Define *specific latent heat of vaporisation*.

.....

 [2]

- (d) Calculate the energy transferred to turn 50% of water at 100 °C into steam.

energy transferred = [1]

- (e) Determine the time for which the stripper was switched on.

time taken = [2]

- (f) Explain why the time determined in (e) is shorter than the actual time for which the stripper was switched on.

.....
 [1]

[Total: 9]

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- 4 Fig. 4.1 shows 11 toy boats floating on water. The boats are stationary and spaced 5.0 cm apart from each other.

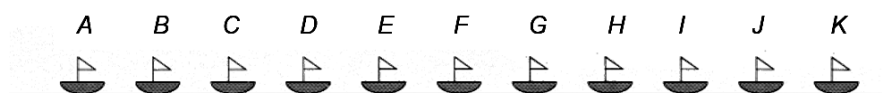


Fig. 4.1

Fig. 4.2 shows a dipper P connected to a motor that vibrates with a frequency of 10 Hz.

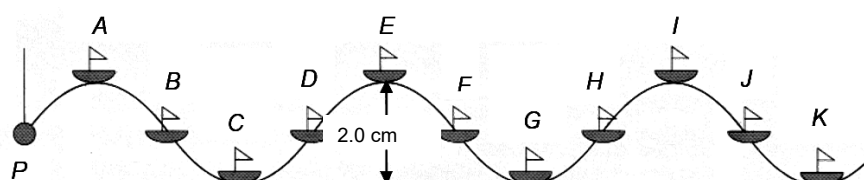


Fig. 4.2

The positions of the boats are shown at an instant in Fig. 4.2.

- (a) Determine the

(i) wavelength

wavelength = [1]

(ii) speed

speed = [2]

(iii) amplitude of the wave.

amplitude = [1]

- (b) State the direction of motion of A , D and G in the next instant of time.

A : D : G :

[2]

[Total: 6]

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- 5 (a) Fig. 5.1 shows an eye of an observer and an object in front of a plane mirror. The object is marked with x.

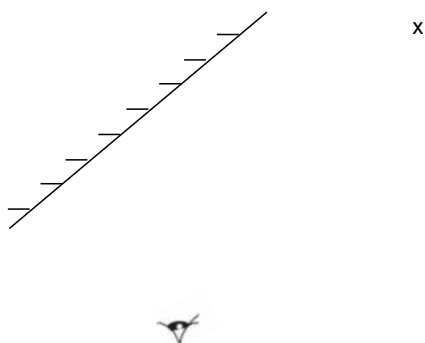


Fig. 5.1

Draw a ray on Fig. 5.1 to show how the eye sees the object in the mirror. Label the image I. Show all essential construction work clearly. [2]

- (b) Fig. 5.2 shows a ray of light travelling from air into a transparent block made from substance X.

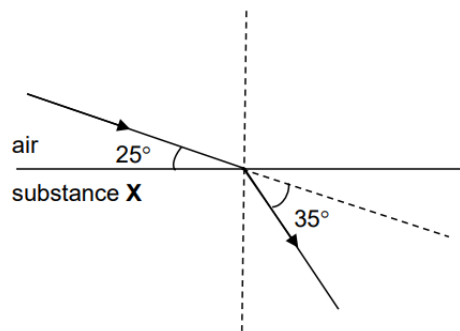


Fig. 5.2

- (i) Define *refractive index*.

.....

 [1]

- (ii) Determine the angle through which the ray deviated from its original direction.

angle of deviation = [1]

- (iii) Calculate the refractive index of the substance **X**.

refractive index = [2]

- (c) Fig. 5.3 shows a thin converging lens with a real image **I**. The horizontal line represents the principal axis. The focal length of the lens is 2 cm.

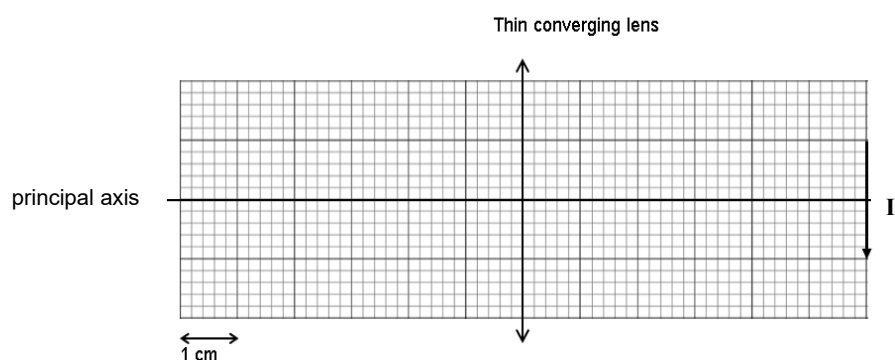


Fig. 5.3 (To scale)

- (i) On Fig. 5.3:

- draw **two** rays from the tip of the image to show the formation of the object
- draw the whole of the object and label it **O**.

[3]

- (ii) Name a practical use of such an arrangement of the converging lens.

..... [1]

[Total: 10]

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- 6 (a) Fig. 6.1 shows the I - V characteristics of a filament lamp.

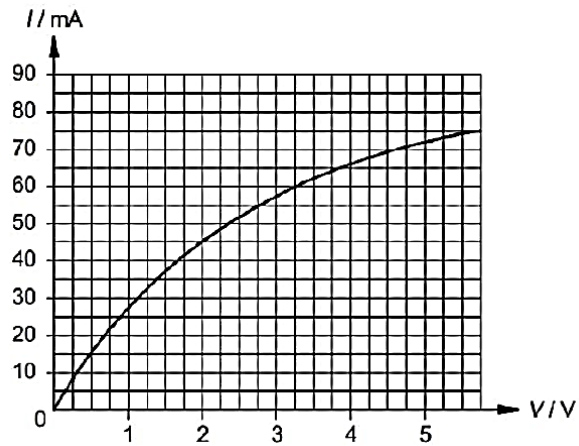


Fig. 6.1

- (i) Explain why the filament lamp is a non-ohmic conductor.

.....

 [1]

- (ii) Calculate the resistance of the lamp when $V = 4.50$ V.

resistance = [2]

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- (b) A thermistor is an input transducer that has a resistance which changes with temperature.

Fig. 6.2 shows the filament lamp in (a) connected in series with a thermistor and a 12.0 V source. The thermistor is an NTC (Negative Temperature Coefficient) type.

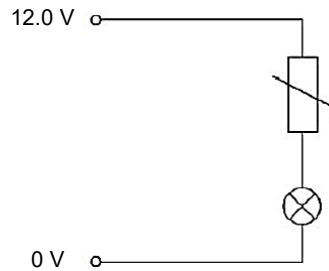


Fig. 6.2

If the surrounding temperature decreases, state and explain whether the resistance of the filament lamp will increase or decrease.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

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- 7 Electronic components can be damaged by overheating. One method of overcoming this problem is to mount the component on a heat sink as shown in Fig. 7.1.

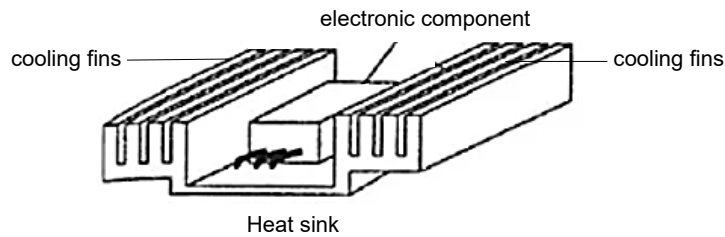


Fig. 7.1

The purpose of the heat sink is to 'soak up' surplus heat produced by the electric current in the component and transfer this heat to the surroundings. The heat sink is often in the form of a piece of aluminium of mass much greater than that of the component.

- (a) List the processes by which the heat sink could transfer heat to the surroundings.

..... [1]

- (b) Give a reason for

- (i) making the heat sink from metal,

..... [1]

- (ii) painting the heat sink black,

..... [1]

- (iii) having cooling fins on the heat sink.

..... [1]

- (c) The component produces heat continuously.

Explain why the temperature of the heat sink becomes constant after a short time.

..... [1]

[Total: 5]

Commented [VM1]: Typo for textbox

Commented [QL2R1]: done

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- 8 The pick-up on an electric guitar produces an electrical signal from the vibrations of the guitar strings. The pick-up consists of a small coil of insulated wire wound round a small cylindrical bar magnet as illustrated in Fig. 8.1 below.

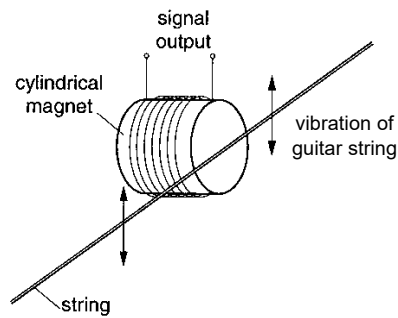


Fig. 8.1

The strings of the guitar are made of steel. When a string vibrates, an electrical signal is generated between the terminals of the coil.

- (a) Explain why an electrical signal is generated in the coil.

.....

.....

.....

.....

..... [3]

- (b) Suggest why the design of the pick-up would be inappropriate for use on a guitar with nylon strings.

.....

.....

..... [2]

[Total: 5]

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- 9 A scientist is working on a freshly prepared sample of a radioactive substance and using a computer he obtained Fig. 9.1 which shows how the count rate C varies with time t .

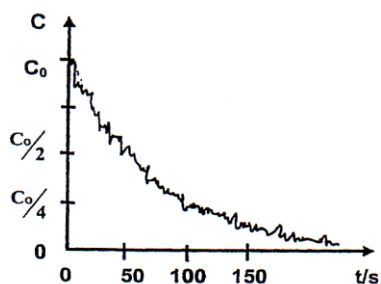


Fig. 9.1

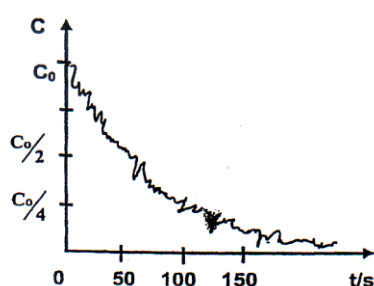


Fig. 9.2

The scientist repeats the experiment with a similar sample of the radioactive material at a higher temperature. The variation of the count rate for the second sample is shown in Fig. 9.2.

State the evidence that is provided by these two experiments for the

- (a) (i) random nature of radioactive decay,

.....
 [1]

- (ii) the spontaneous nature of radioactive decay.

.....
 [1]

- (b) (i) State what is meant by the *half-life of a radioactive nuclide*.

.....
 [1]

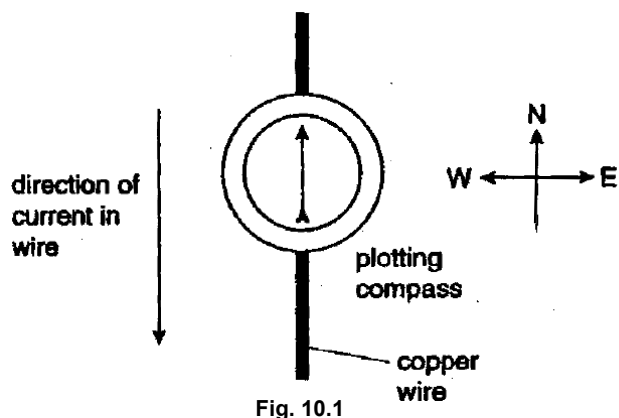
- (ii) Estimate the half-life of the radioactive sample in the experiment above. Show evidence on the graph indicating how you arrive at your answer.

half-life = [2]

[Total: 5]

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- 10 (a) Fig. 10.1 shows a small plotting compass placed above a copper wire. When there is no current in the wire, the plotting compass points towards the North.



A large current is switched on in the wire. The direction of the current is shown in Fig. 10.1.

- (i) State what happens to the compass needle.
 [1]
- (ii) State what happens if the compass is placed under the wire.
 [1]
- (iii) State and explain what is observed if there is a 50 Hz alternating current in the wire.

 [2]

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- (b) A student made a battery tester as shown in Fig. 10.2.

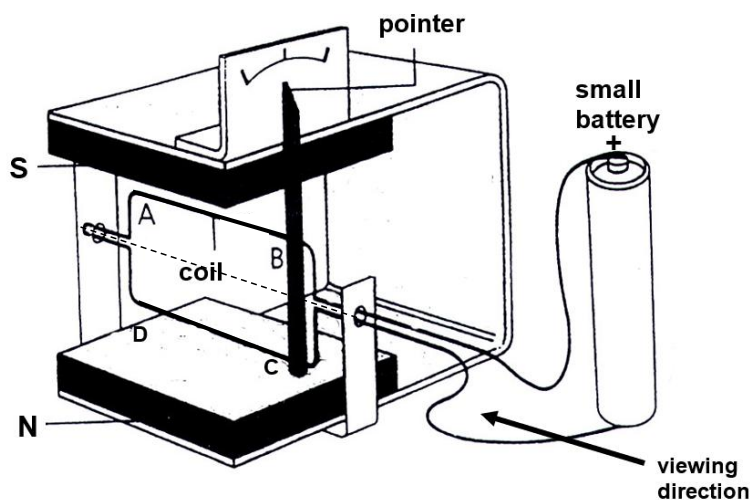


Fig. 10.2

The battery tester uses a pair of magnets, a coil **ABCD** and a pointer. The coil and the pointer are in contact. With the battery tester, the student can check whether a small battery is "live" or "dead".

- (i) State the direction of the current in **AB** and **CD**.

AB:

CD:

[2]

- (ii) State the direction of the forces acting on **AB** and **CD**.

AB:

CD:

[2]

- (iii) Explain why the coil turns and state the direction of the rotation.

.....

.....

..... [2]

[Total: 10]

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Section B (10 Marks)

Answer **one** question from this section.

Answer either **Question 11** or **Question 12**.

- 11 (a) In a car race called a "demolition derby", collisions between cars are common. Fig. 11.1 is a graph showing the motion of a car during the first few seconds of a race.

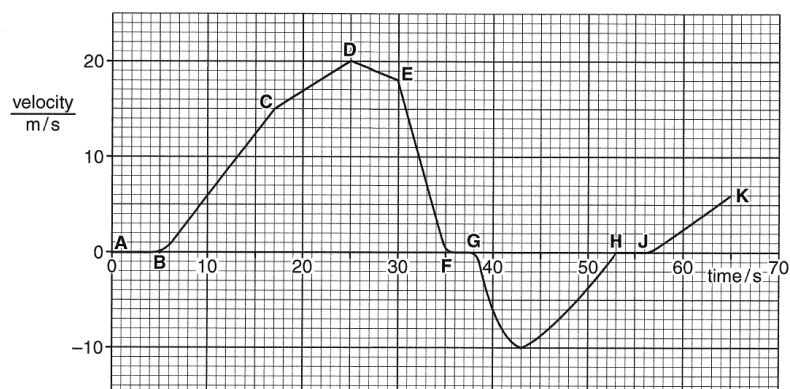


Fig. 11.1

From **A** to **F**, Fig. 11.1 shows the car

- braking
- colliding with another car and stopping
- increasing speed
- increasing speed at its greatest rate
- stationary

but not in this order.

- (i) Use each phrase once only to describe the motion of the car between points **A** and **F**.

A to B

B to C

C to D

D to E

E to F

[2]

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- (ii) By considering the forces on the car, explain why the speed of the car decreases between **D** and **E**.

.....
.....
.....
..... [2]

- (b) Describe the motion of the car between points **F** and **K**.

.....
.....
.....
.....
.....
.....
.....
..... [4]

- (c) Calculate the average acceleration of the car between points **C** and **D**.

acceleration = [2]

[Total: 10]

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- 12 (a) A positively charged metal sphere **P** is hung from an insulating string as shown in Fig. 12.1.

Fig. 12.2 shows the effect on **P** when a negatively charged metal sphere **Q** on an insulated rod is positioned close to it. The string makes an angle θ with the vertical.

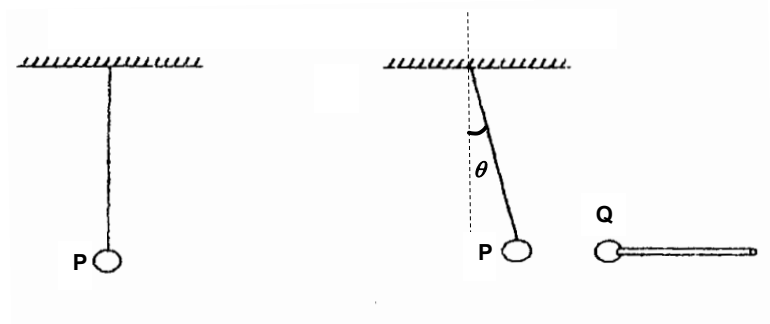


Fig. 12.1

Fig. 12.2

The weight of sphere **P** is 0.050 N and the electric force acting on **P** is 0.15 N.

Fig. 12.3 shows the weight and electric force acting on **P**, drawn to scale, where a length of 1.0 cm represents a force of 0.020 N.

On Fig. 12.3, draw and label, with a letter *R*, the resultant force of the weight and electric force.

Determine the size of the resultant force, the tension of the string and the angle θ made by the string with the vertical.

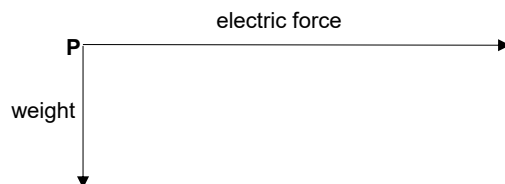


Fig. 12.3
(to scale)

resultant force =

tension of string =

angle θ =

[3]

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- (b) Fig. 12.4 shows two **horizontal** plates connected to a variable high potential difference (p.d.).

A **charged** oil drop **D** is introduced into the space between the horizontal plates.

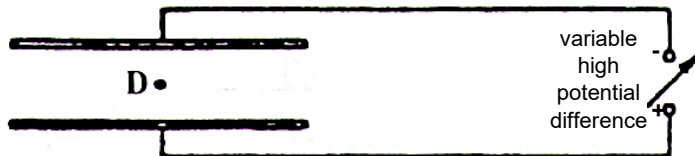


Fig. 12.4

The p.d. between the plates is adjusted until the oil drop **D** is stationary.

- (i) There is an electric field in the space between the two plates.

State what is meant by an *electric field*.

.....
 [1]

- (ii) On Fig. 12.4, draw the shape and the direction of the electric field produced by the horizontal plates. [2]

- (iii) Deduce the sign of the charge carried by the oil drop **D**.

..... [1]

- (iv) On Fig. 12.4, draw an arrow to represent the force on the oil drop **D** exerted by the electric field between the plates. [1]

- (v) Describe and explain what happens to the oil drop **D** when the p.d. between the plates is reduced.

.....

 [2]

[Total: 10]

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