This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 03

26JAN2024

Do NOT write in this box. Your MARK will be placed here.

Subject :	Physics
Class :	9A
Teacher :	Dr. Ruth Brett
Duration :	1 hour

Write your answers in the spaces provided on this question paper. There is a formula on the first page, along with the value of g.

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

FORMULA AND INFORMATION

You may find the following formula useful:

$$(\text{final speed})^2 = (\text{initial speed})^2 + (2 \times \text{acceleration} \times \text{distance moved})$$

$$v^2 = u^2 + (2 \times a \times s)$$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$

Questions 1-5 are multiple choice. Circle the letter of the correct answer. (1 mark each)

Q1.

A car takes 15 minutes to travel along a road that is 20 km long.

What is the average speed of the car?

A 0.75 km/h **B** 5.0 km/h **C** 80 km/h **D** 300 km/h

Q2.

A student rubs a plastic rod with a cloth.

The rod becomes positively charged.

What has happened to the rod?

A It has gained electrons.

B It has gained protons.

C It has lost electrons.

D It has lost protons.

Q3.

An astronaut in an orbiting spacecraft experiences a force due to gravity. This force is less than when she is on the Earth's surface.

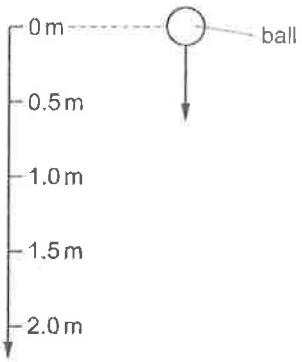
Compared with being on the Earth's surface, how do her mass and her weight change when she goes into orbit?

	mass in orbit	weight in orbit
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

Q4.

On Earth, a ball is dropped and falls 2.0 m in a vacuum.

The acceleration of the ball at 1.0 m is 10 m/s^2.



What is the acceleration of the ball at 0.5 m?

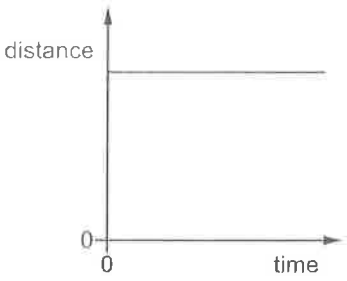
A 5.0 m/s^2 **B** 10 m/s^2 **C** 15 m/s^2 **D** 20 m/s^2

Q5.

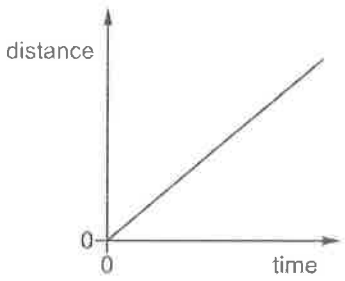
A car is moving along a straight, level road, with a constant acceleration.

Which graph shows the motion of the car?

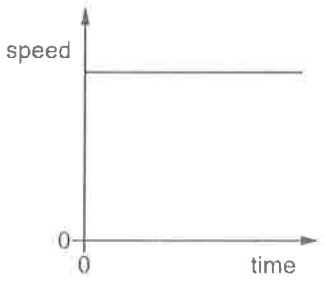
A



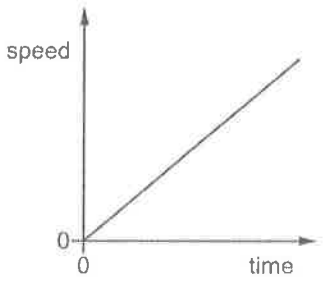
B



C



D



Q6. Plastic is an insulator. A student rubs a piece of plastic with a cloth. This gives the plastic a negative charge.

(a) Explain how the plastic is charged by the rubbing.

(2)

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(b) The cloth is also charged when it rubs against the plastic. Describe the charge on the cloth.

(2)

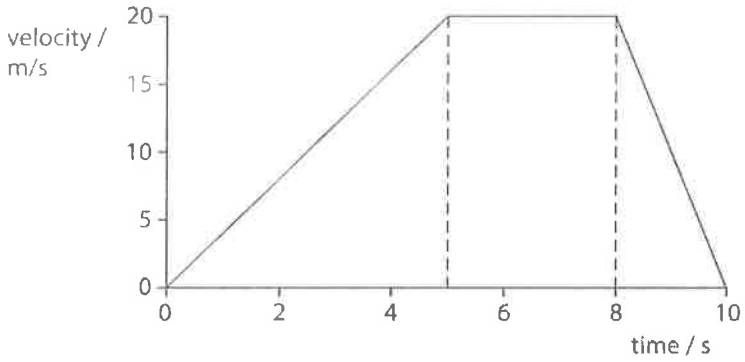
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(Total for question = 4 marks)

Q7. The graph shows how the velocity of a small car changes with time.



(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The resultant force on the car will be zero when the car is

(1)

☐ **A** accelerating

☐ **B** decelerating

☐ **C** changing velocity

☐ **D** moving at a constant velocity

(Continued on the next page)

(b) (i) Use the graph to estimate the velocity of the car at three seconds.

(1)

velocity ..... m/s

(ii) Calculate the acceleration of the car when it is speeding up.

(2)

acceleration = ... m/s^2

(iii) Explain why the units of acceleration are m/s^2.

(2)

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(iv) Show that the car travels further at a constant velocity than it does when it is slowing down.

(3)

Total for Question = 9 marks

Q8. Callisto is a moon of the planet Jupiter. Callisto has a gravitational field strength of 1.2 N/kg at its surface.
The Earth's moon has a gravitational field strength of 1.6 N/kg at its surface.
An object has a weight of 59 N on the surface of the Earth's moon.

Calculate the weight of the same object if it were on the surface of Callisto.

(3)

weight = ... N

(Total for question = 3 marks)

Q9. Schiaparelli is a spacecraft that was sent to Mars in 2016. A parachute was used to slow it down as it descended through the atmosphere.
The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars, and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.
The acceleration of free-fall on Mars is 3.4 m/s^2.

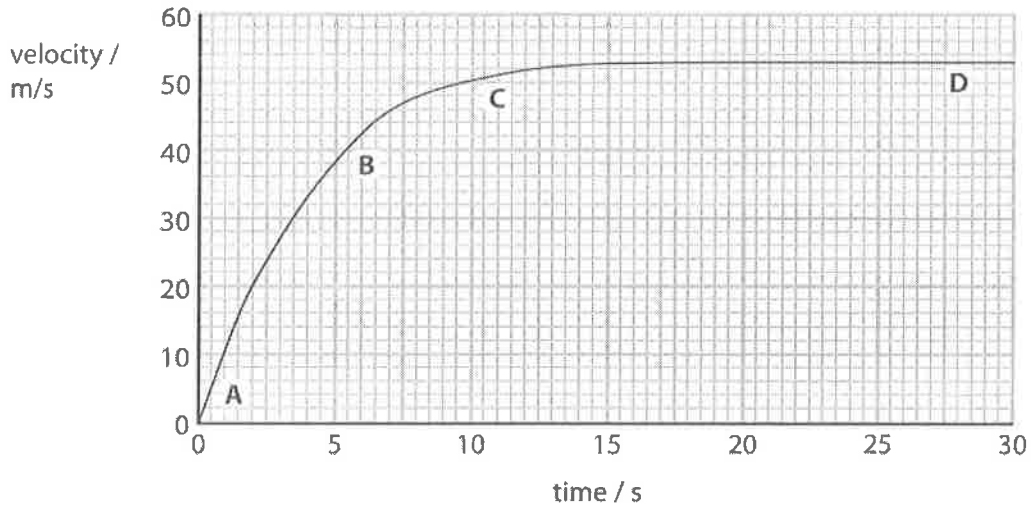
(4)

speed = ... N

(Total for question = 4 marks)

Q10. Christine is a free-fall parachutist.

This is a velocity-time graph for the first 30 second of her jump.



(a) Complete the sentence by putting a cross (☒) in a box next to your answer.

On the graph, the greatest acceleration is at

(1)

☒ **A**

☐ **B**

☐ **C**

☒ **D**

(b) Estimate how far Christine falls in the first 2 s.

(3)

Christine falls = ... m

(c) Explain the difference between velocity and speed.

(2)

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*(d) The graph shows how Christine's velocity changes from the time she leaves the plane until she reaches terminal velocity.

Explain, in terms of forces, why her velocity changes as shown in the graph.

(6)

(Total for question = 12 marks)

Q11. The **overall stopping distance** of a car is divided into two parts, **thinking distance** and **braking distance.** Some of the factors which affect the **overall stopping distance** are shown in the table below.

Column A	Column B	Column C
speed of the vehicle	condition of the brakes **or** road surface conditions	alcohol **or** tiredness

Choose **one** factor from **each column** of the table and describe fully how the chosen factors affect the distances described above.

In your answer, include the following:

- the **three** factors you have chosen;
- for **each** factor, refer to the thinking distance, braking distance and overall stopping distance;
- describe clearly whether these distances are increased, decreased or unaffected by the factor.

(6)

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(Total for question = 6 marks)

Q12. A light polystyrene ball is coated with a thin layer of metal. Diagram 1 shows the ball on a metal plate. In diagram 2, the plate has been charged and the ball is rising to hit the earthed lid.

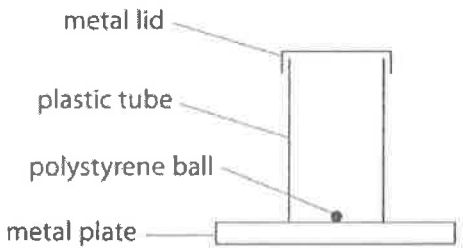


diagram 1

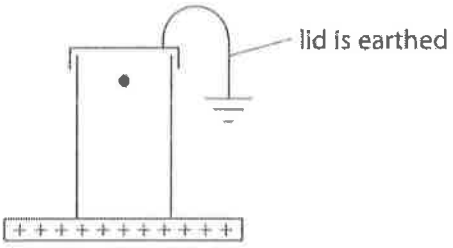


diagram 2

(a) (i) State the sign of the charge on the ball as it moves upwards.

(1)

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(ii) Explain why the ball moves upwards.

(2)

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(b) The ball discharges when it hits the earthed lid. Explain **how** the ball loses its charge.

(2)

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(c) The ball continues to move up and down between the charged plate and the earthed lid. Explain **why** the ball continues to move up and down.

(2)

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(Total for question = 7 marks)

FORMULA AND INFORMATION

You may find the following formula useful:

(final speed)² = (initial speed)² + (2 × acceleration × distance moved)

$$v^2 = u^2 + (2 \times a \times s)$$

Where necessary, assume the acceleration of free fall, $g = 10\ m/s^2$

Questions 1-5 are multiple choice. Circle the letter of the correct answer. (1 mark each)

Q1.

A car takes 15 minutes to travel along a road that is 20 km long. 15 minutes = 0·25h

What is the average speed of the car? Speed = 20/0·25 = 80 km/h

A 0.75 km/h **B** 5.0 km/h (1) **C** 80 km/h **D** 300 km/h

Q2.

A student rubs a plastic rod with a cloth.

The rod becomes positively charged.

What has happened to the rod?

A It has gained electrons.

B It has gained protons.

(1) **C** It has lost electrons.

D It has lost protons.

Q3.

An astronaut in an orbiting spacecraft experiences a force due to gravity. This force is less than when she is on the Earth's surface.

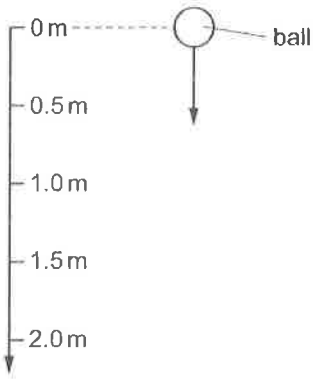
Compared with being on the Earth's surface, how do her mass and her weight change when she goes into orbit?

	mass in orbit	weight in orbit
A	decreases	decreases
B	decreases	unchanged
(1) **C**	unchanged	decreases
D	unchanged	unchanged

Q4.

On Earth, a ball is dropped and falls 2.0 m in a vacuum.

The acceleration of the ball at 1.0 m is 10 m/s^2.



What is the acceleration of the ball at 0.5 m?

A 5.0 m/s^2 **B** 10 m/s^2 **C** 15 m/s^2 **D** 20 m/s^2

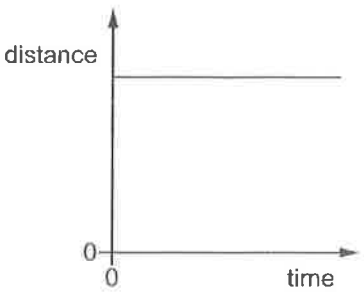
(B) (i)

Q5.

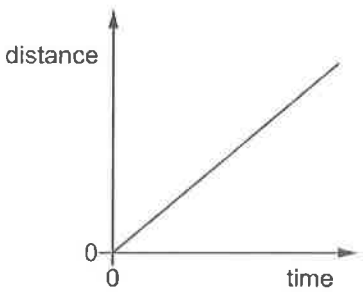
A car is moving along a straight, level road, with a constant acceleration.

Which graph shows the motion of the car?

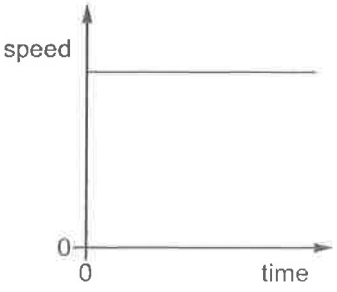
A



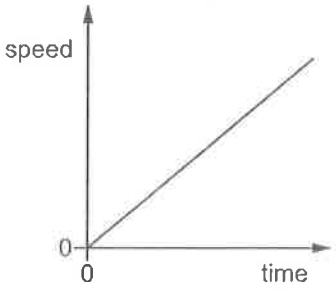
B



C



(D) (i)



Q6. Plastic is an insulator. A student rubs a piece of plastic with a cloth. This gives the plastic a negative charge.

(a) Explain how the plastic is charged by the rubbing.

(2)

Electrons (1) are transferred (1) to the plastic.

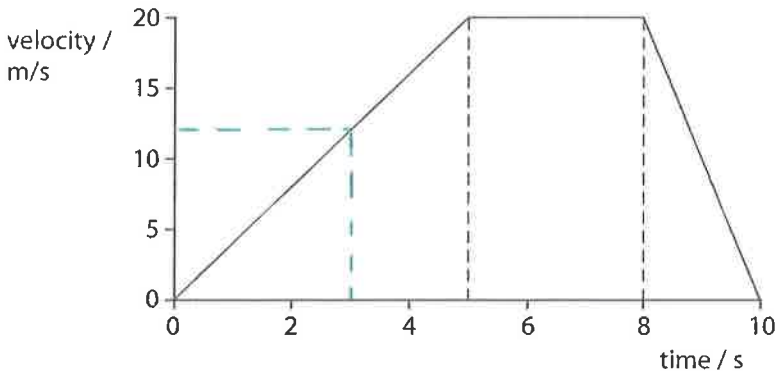
(b) The cloth is also charged when it rubs against the plastic. Describe the charge on the cloth.

(2)

The charge on the cloth is positive (1) but equal in size (1) to the charge on the plastic

(Total for question = 4 marks)

Q7. The graph shows how the velocity of a small car changes with time.



(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The resultant force on the car will be zero when the car is

(1)

- ☐ **A** accelerating
- ☐ **B** decelerating
- ☐ **C** changing velocity
- ☒ **D** moving at a constant velocity (1)

(Continued on the next page)

(b) (i) Use the graph to estimate the velocity of the car at three seconds.

(1)

velocity 12 (1) m/s

(ii) Calculate the acceleration of the car when it is speeding up.

(2)

acceleration = gradient

$a = \frac{(20 - 0)}{(5 - 0)} = 4 m/s^2$ (1)

acceleration = 4 (1) m/s²

(iii) Explain why the units of acceleration are m/s².

(2)

Acceleration is the change in speed in m/s (1) divided by the time in seconds (1)

$\frac{m/s}{s} = m/s^2$

(iv) Show that the car travels further at a constant velocity than it does when it is slowing down.

(3)

Distance = area under line

Distance travelled at constant speed = $3 \times 20 = 60m$ (1)

Distance travelled while slowing down = $\frac{1}{2} \times 20 \times 2 = 20m$ (1) (1)

so it travelled further at a constant velocity.

Total for Question = 9 marks

Q8. Callisto is a moon of the planet Jupiter. Callisto has a gravitational field strength of 1.2 N/kg at its surface.
The Earth's moon has a gravitational field strength of 1.6 N/kg at its surface.
An object has a weight of 59 N on the surface of the Earth's moon.

Calculate the weight of the same object if it were on the surface of Callisto.

(3)

Weight = mass x g

On Earth's moon $59 = m \times 1.6$ $m = \frac{59}{1.6} = 36.9\text{kg}$ (1)

on Callisto $W = 36.9 \times 1.2$ (1)

$W = 44.25\text{N}$

(1)

weight = 44.3 N

(Total for question = 3 marks)

Q9. Schiaparelli is a spacecraft that was sent to Mars in 2016. A parachute was used to slow it down as it descended through the atmosphere.
The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars, and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.
The acceleration of free-fall on Mars is 3.4 m/s^2.

(4)

$s = 2.0\text{m}$ $u = 0.45\text{ m/s}$ $v = ?$ $a = 3.4\text{ m/s}^2$

Use $v^2 = u^2 + (2 \times a \times s)$

$v^2 = 0.45^2 + (2 \times 3.4 \times 2)$ (1) substitution

$v^2 = 0.2025 + 13.6 = 13.8025$ (1)

$v = \sqrt{13.8025}$ (1)

$v = 3.72$

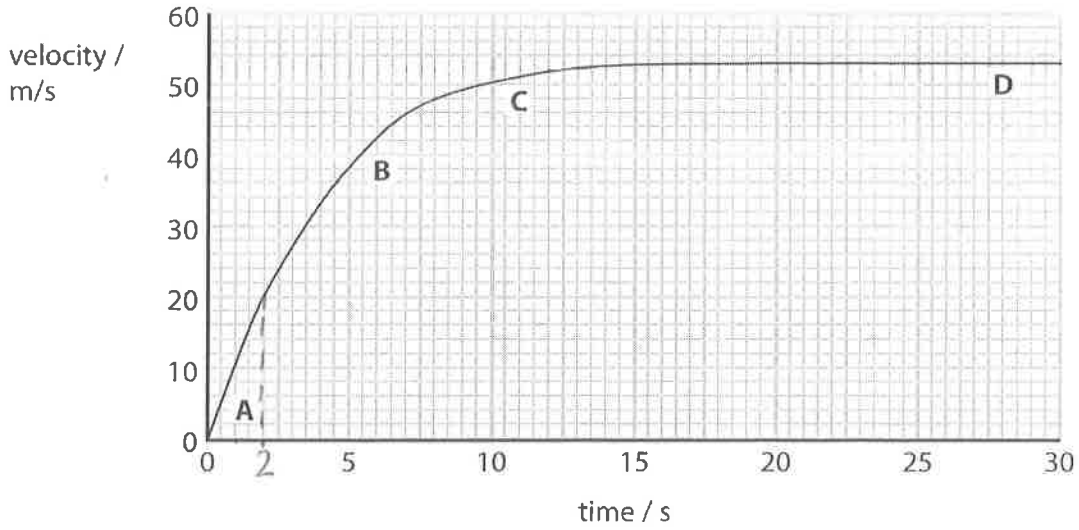
(1)

speed = 3.72 m/s

(Total for question = 4 marks)

Q10. Christine is a free-fall parachutist.

This is a velocity-time graph for the first 30 second of her jump.



(a) Complete the sentence by putting a cross (☒) in a box next to your answer.

On the graph, the greatest acceleration is at

(1)

(1) ☒ **A**

☐ **B**

☐ **C**

☐ **D**

(b) Estimate how far Christine falls in the first 2 s.

(3)

Distance = area under graph (1)

Distance = $\frac{1}{2} \times 2 \times 20 = 20\text{m}$ (1)

(1)

Christine falls = 20 m

(c) Explain the difference between velocity and speed.

(2)

Velocity is a vector so it has magnitude and direction. (1) Speed only has magnitude and no direction (1) because it is a scalar.

*(d) The graph shows how Christine's velocity changes from the time she leaves the plane until she reaches terminal velocity.

Explain, in terms of forces, why her velocity changes as shown in the graph.

(6)

At A, the only force acting on Christine is her weight acting downwards (1) so she accelerates downwards. (1) As she speeds up, the air resistance acting upwards increases. (1) This reduces the resultant force downwards so she continues to accelerate but at a lower rate. (1) We see this on the graph because it is steepest at A and less steep at B and less steep again at C. (1) Alternative to previous mark

Eventually the air resistance will be equal to her weight (1) so the resultant force will be zero. (1) Since $F = m \times a$, if the force is zero, the acceleration will be zero. (1) This is why her velocity becomes constant between C and D. (1) Alternative to previous mark She has reached her terminal velocity.

Maximum (6)

(Total for question = 12 marks)

Q11. The **overall stopping distance** of a car is divided into two parts, **thinking distance** and **braking distance.** Some of the factors which affect the **overall stopping distance** are shown in the table below.

Column A	Column B	Column C
speed of the vehicle	condition of the brakes **or** road surface conditions	alcohol **or** tiredness

Choose **one** factor from **each column** of the table and describe fully how the chosen factors affect the distances described above.

In your answer, include the following:

- the **three** factors you have chosen;
- for **each** factor, refer to the thinking distance, braking distance and overall stopping distance;
- describe clearly whether these distances are increased, decreased or unaffected by the factor.

(6)

Speed of the vehicle. The greater the speed, the greater the thinking distance (1), braking distance and overall stopping distance (1).

Condition of the brakes. The thinking distance is not affected (1). If the brakes are worn, the braking distance and overall stopping distance will increase. (1)

Tiredness. If the driver is tired, their reaction time will increase so the thinking distance will increase. (1) The braking distance will not be affected, but the overall stopping distance will increase. (1)

(Total for question = 6 marks)

Q12. A light polystyrene ball is coated with a thin layer of metal. Diagram 1 shows the ball on a metal plate. In diagram 2, the plate has been charged and the ball is rising to hit the earthed lid.

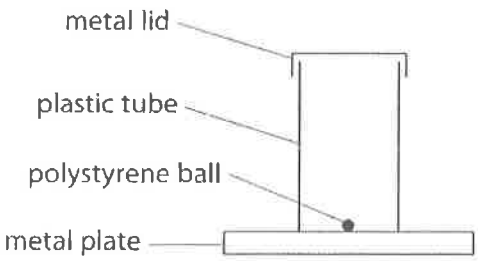


diagram 1

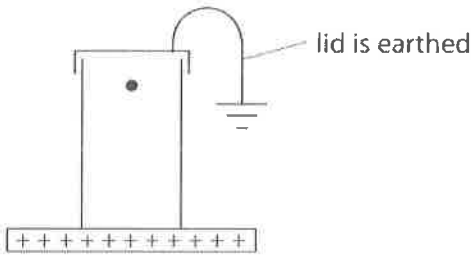


diagram 2

(a) (i) State the sign of the charge on the ball as it moves upwards.

(1)

Positive (1)

(ii) Explain why the ball moves upwards.

(2)

It has the same charge (1) as the metal plate, so the ball is repelled. (1)

(b) The ball discharges when it hits the earthed lid. Explain **how** the ball loses its charge.

(2)

Electrons (1) from the Earth move to the lid (1)

(c) The ball continues to move up and down between the charged plate and the earthed lid. Explain **why** the ball continues to move up and down.

(2)

When the ball is neutral it falls because of the gravitational force on it. (1) When it touches the plate it will become positive again so it will be repelled upwards. (1) This keeps repeating.

(Total for question = 7 marks)