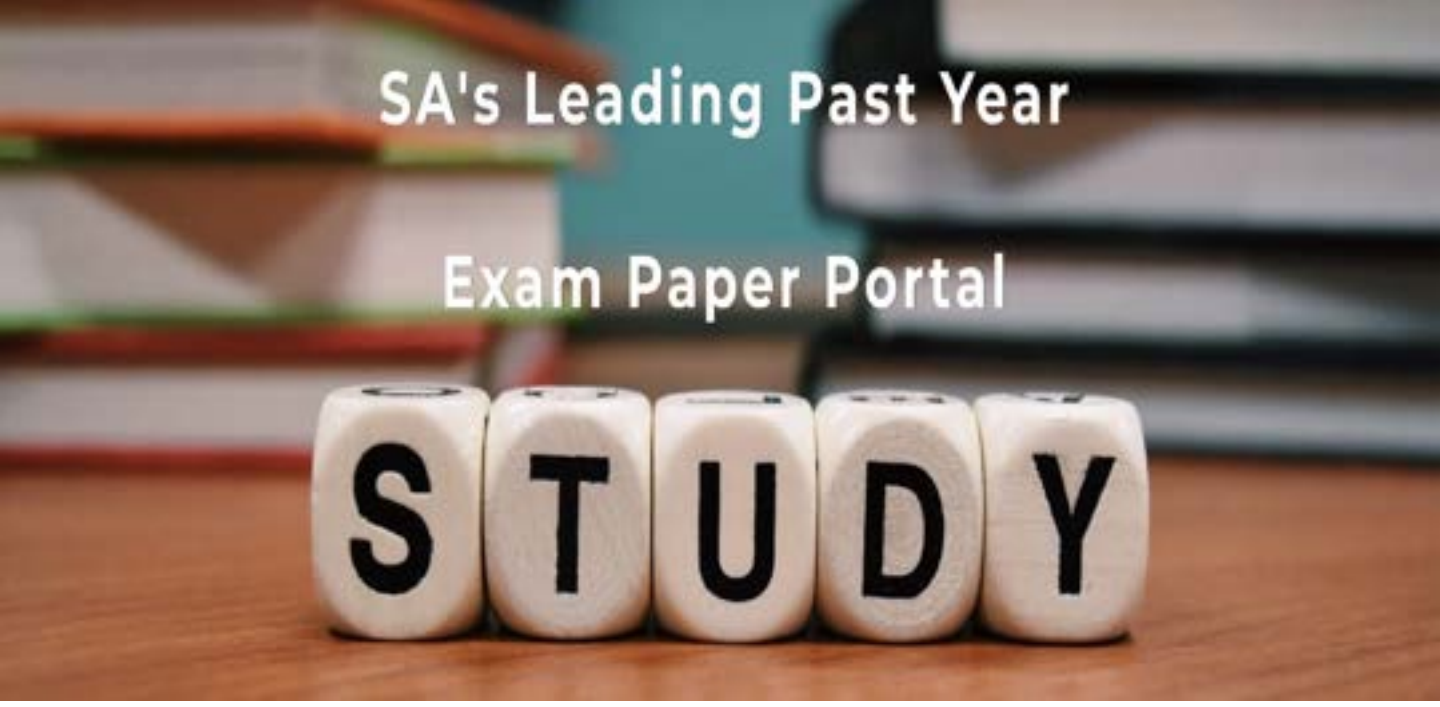

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GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2020

MARKS: 150

TIME: 3 hours

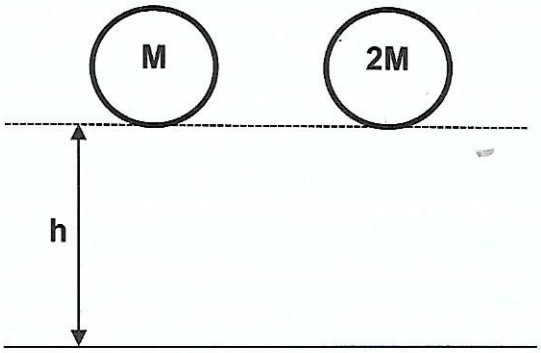
EPHSCP1

This question paper consists of 14 pages and 3 data sheets.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D. Each question has only ONE correct answer.

1.1 A metal ball with mass **M** and a second metal ball with mass **2M** has the same diameter. They are dropped from a height **h** as indicated in the diagram below.



The time it takes for the two balls to hit the ground is …

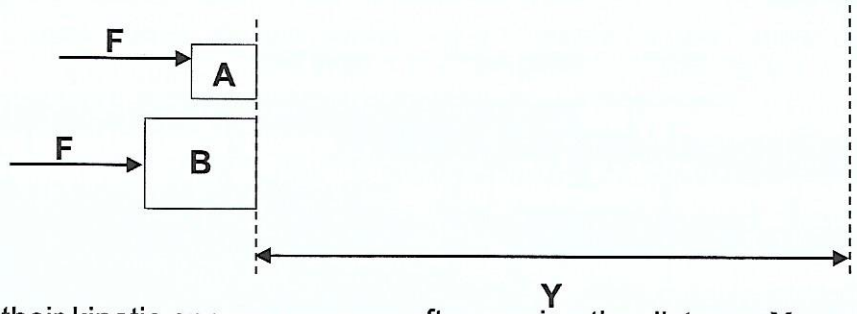
A ½ the time for **M** as for **2M**.

B the same time.

C slightly longer for ball **M** as for **2M**.

D slightly longer for ball **2M** as for **M**. (2)

1.2 Two metal blocks are at rest on a frictionless horizontal surface. Block **A** has a mass x kg and block **B** has a mass $4x$ kg. They are both pushed with a constant horizontal force **F** across the frictionless surface for distance **Y**.



How will their kinetic energy compare after moving the distance **Y**.

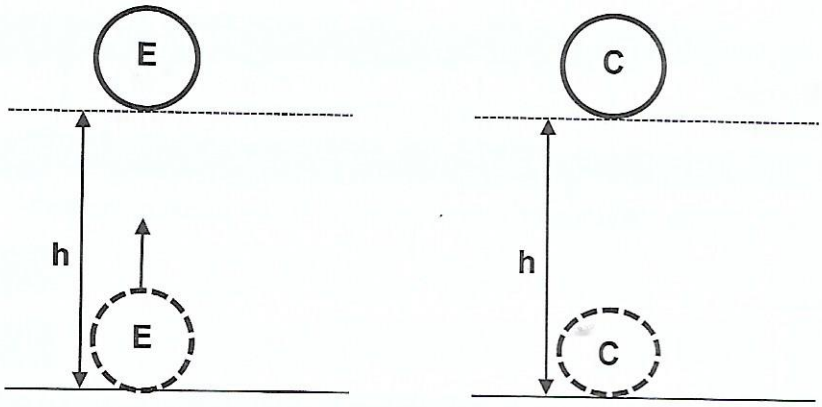
A The kinetic energy of **A** is four times smaller than **B**.

B The kinetic energy of **A** is four times larger than **B**.

C There kinetic energy will be the same.

D The kinetic energy of A slightly larger than **B**. (2)

1.3 Frank drops an elastic ball **E** and a clay ball **C** with the same mass from the same height **h**. The elastic ball bounce up after it strikes the floor. The clay ball do not bounce back up. Assume that the time of impact with the floor on both balls is the same. The force by the floor on the elastic ball is F_E and the force by the floor on the clay ball is F_C.



Choose the one statement that best describe the magnitude of the two forces F_E and F_C.

A $F_E = F_C$

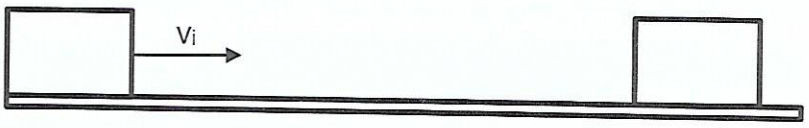
B $F_E < F_C$

C $F_E = 0$ N

D $F_E > F_C$

(2)

1.4 A metal block with a velocity of v_i is released and it comes to rest eventually. Which one of the following statements are correct?



The change in the kinetic energy of the block is equal to halve the change in the block multiplied by the …

A distance travelled until coming to rest.

B time elapsed until coming to rest

C deceleration of the block.

D change in velocity of the block.

(2)

1.5 A 4 kg bag with valuable camera equipment falls out of a helicopter at a height of 5000 m. A parachute instructor jumps after the bag in order to retrieve the bag. You are given four scenarios with explanations. Choose the most correct option.

The instructor stand a good chance ...

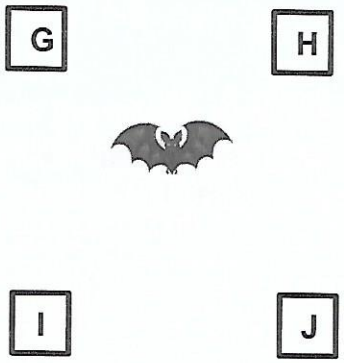
A not to retrieve the bag because their acceleration is the same.

B to retrieve the bag because the parachutist will have a greater mass than the bag. By reducing the surface area he has the greater ability to overcome air friction and will have a greater terminal velocity.

C not to retrieve the bag because the bag is lighter and will accelerate much faster to the ground.

D to retrieve the bag because it always happen like that in the movies. (2)

1.6 Four sound sensors are placed to detect the sound of a bat. A bat makes a sound with a frequency of 4 kHz. Sensor **G**, **H**, **I** and **J** are placed as shown in the diagram. The bat is flying during the night as indicated in the diagram.



The frequencies picked up by the sensors are given in the following table:

Sensors	**G**	**H**	**I**	**J**
Frequency	4,2 kHz	4 kHz	4 kHz	3,8 kHz

The bat is flying towards sensor ...

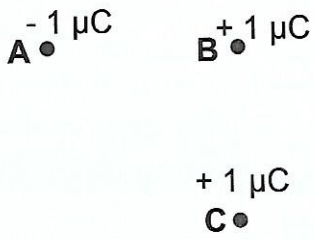
A **G**

B **H**

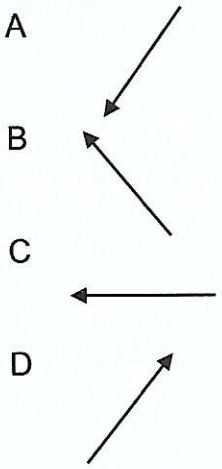
C **J**

D **I** (2)

1.7 Three point charges A -1 µC, B +1 µC and C +1 µC are placed as shown in the diagram.



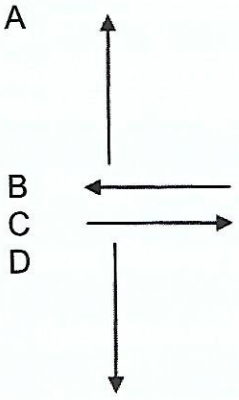
Which one of the following direction arrows is pointing in the direction of the net force on charge B?



(2)

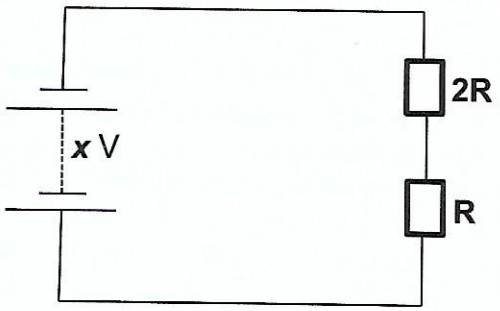
1.8 Wire 1 has a current (I_1) flowing out of the page (●), as shown in the diagram. Wire 2 near wire 1 has a current (I_2) flowing into the page (✖).

Which arrow indicate the direction of the magnetic field at point **P**?



(2)

1.9 Consider the circuit diagram below and answer the following question. The figure shows a circuit with two resistors **R** and **2R** in series. The battery has an EMF of ***x*** V and no internal resistance.



What is the voltmeter reading across **2R**?

A $\mathbf{x}$ V

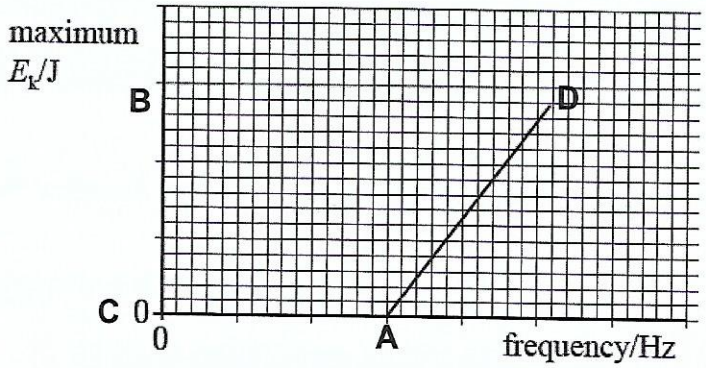
B $2\mathbf{x}$ V

C $\frac{\mathbf{x}}{3}$ V

D $\frac{2\mathbf{x}}{3}$ V

(2)

1.10 The graph below shows how the maximum kinetic energy of the photo electrons varies with the frequency of the light shining on the metal surface.



The threshold frequency is indicated on the graph by point ...

A A

B B

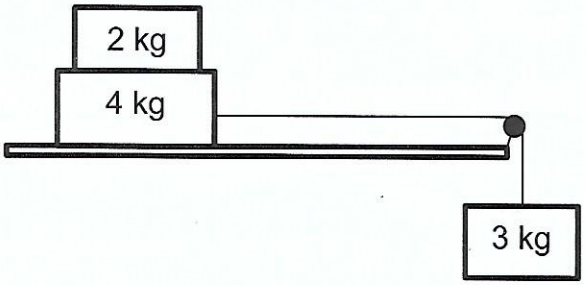
C C

D D

(2)
[20]

QUESTION 2 (Start on a new page.)

A 2 kg wooden block is placed on top of a 4 kg wooden block on top of a rough horizontal table. A light inextensible string is tied to the 4 kg block and extended across a frictionless pulley. The other side of the string is attach to a 3 kg wooden block as indicated in the diagram below.



2.1 Define Newton's Second Law of Motion in terms of momentum. (2)

2.2 Draw a labelled force diagram of all the forces acting on the 4 kg block. (5)

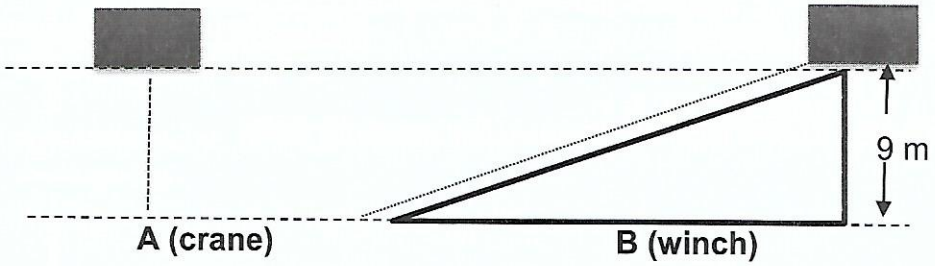
2.3 Calculate the normal force that the table exert on the 4 kg block. (3)

2.4 The friction coefficient μ is 0,3 between the table and the block. Calculate the kinetic friction force between the table and the block. (3)

2.5 Calculate the acceleration of the 4 kg block. (6)
[19]

QUESTION 3 (Start on a new page.)

An engineer wants to lift a 1250 kg transformer up to the roof of a three story apartment building. The building is 9 m high. His options are, **A** to use a **crane** to lift the transformer vertically upwards or **B** to use a **winch** to drag the transformer up a ramp. In both cases the transformer will be moving at a constant velocity. Ignore the effects of air resistance and friction.



3.1 Will the force exerted by the crane be the same as the force exerted by the winch? Explain your answer. (3)

3.2 If the ramp is 18 m long, calculate:

3.2.1 The work done by the winch to displace the transformer to the height of 9 m. (4)

3.2.2 The minimum power of the winch to move the transformer in 36 s up the ramp. (3)

3.3 State the law of conservation of mechanical energy. (2)

3.4 If the cable breaks at the top of the building in case B. Calculate the velocity of the transformer the moment it hits the ground. (3)
[15]

QUESTION 4 (Start on a new page.)

A fire breaks out on the top floor in an apartment building. A 90 kg man hangs on the side of the balcony. The fire fighters arrive and see the man hanging on for dear life. They get out an air mattress to save the man's life. The moment the mattress is inflated the man lose his hold and falls to the ground. The fire fighters runs with a constant velocity of 4,8 $m \cdot s^{-1}$ the 20 m to get the mattress in place just in time to break the man's fall and save his life.

4.1 Define the term projectile. (2)

4.2 Calculate the height of the building? (4)

4.3 Define impulse. (2)

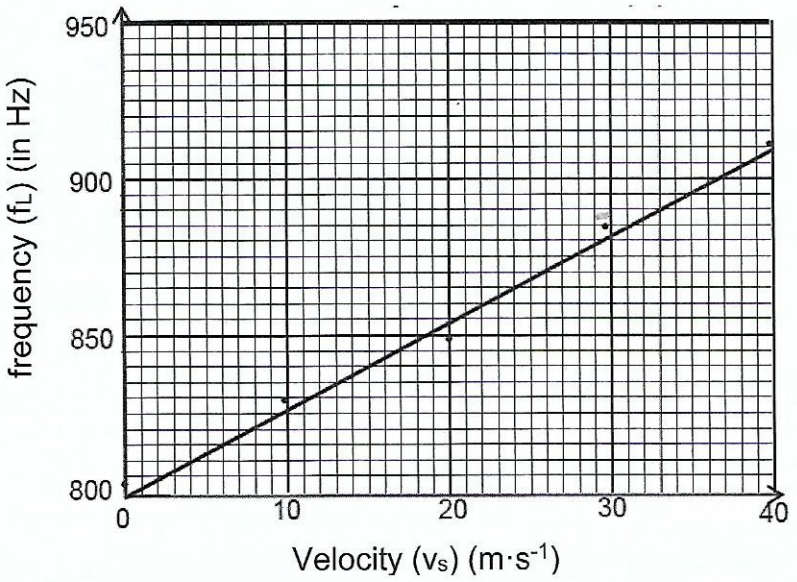
4.4 If it takes the man 1,2 s to come to rest after hitting the mattress, calculate the force that the mattress exert on the man. (6)

4.5 By using physics principals in conjunction with equations to explain why the mattress saves the man's life. (3)
[17]

QUESTION 5 (Start on a new page.)

The graph below shows the relationship between the observable frequency (f_L) of the sound heard by a STATIONARY listener and the velocity (v_s) of the source travelling TOWARDS the listener. Take the speed of sound in air as 340 $m.s^{-1}$.

Graph showing apparent frequency (f_L) versus velocity of sound source (v_s)



5.1 State the Doppler effect in words. (2)

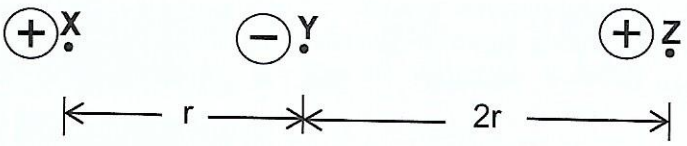
5.2 Write down the frequency produced by the sound source. (1)

5.3 Use the information in the graph to calculate the velocity of the source if the observed frequency is 950 Hz. (5)

5.4 Sketch a graph of the apparent frequency (f_L) versus velocity (v_s) of the sound source if the same source was moving AWAY from the listener. Show the frequency produced by the sound source. It is not necessary to show any other numerical values. (3)
[11]

QUESTION 6 (Start on a new page.)

Consider the charges **X**, **Y** and **Z** with the same magnetude in the following diagram.



Charge **X** exert a force of **F** on charge **Y**.

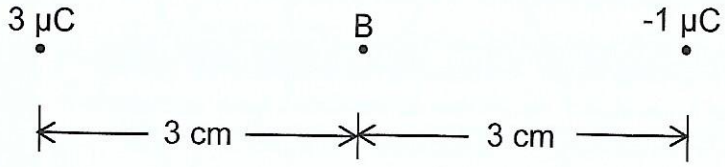
6.1. Define Coulomb's law. (2)

6.2. Calculate the magnetude and direction of the force that charge **Z** exert on charge **Y** in terms of **F**. (4)

6.3 Determine the magnetude and direction of the resultant force that **X** and **Z** exert on **Y** in terms of F. (3)
[9]

QUESTION 7 (Start on a new page.)

The diagram below shows two charges positioned relative to a point **B**. The diagram shows three charges that are placed a distance from each other in a straight line.



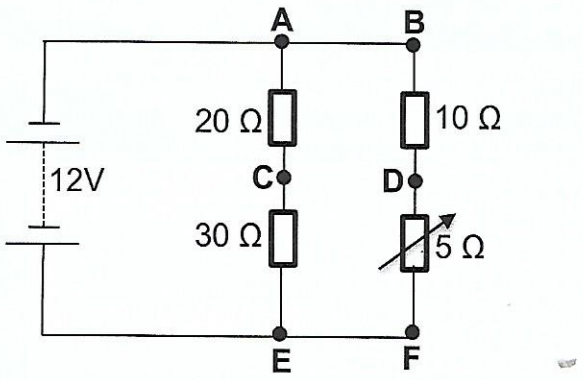
7.1. Define the direction of an electric charge at a point. (2)

7.2. Draw the electric field diagram caused by the the 3 μC and the -1 μC charge particles. (3)

7.3 Calculate the electric field strength at point **B.** (6)
[11]

QUESTION 8 (Start on a new page.)

The circuit below shows a 12 V battery of negligible internal resistance connected to a combination of three resistors and a rheostat (variable resistor).



The resistance of the rheostat is 5 Ω

8.1 Explain the term Ohmic conductor. (1)

8.2 Calculate the total resistance of the circuit. (3)

8.3 Calculate the current through the battery. (3)

8.4 A high-resistance voltmeter is used to measure the potential difference between points **B** and **F** and **A** and **C** in turn.

8.4.1 Write down the voltmeter reading between points **B** and **F** (1)

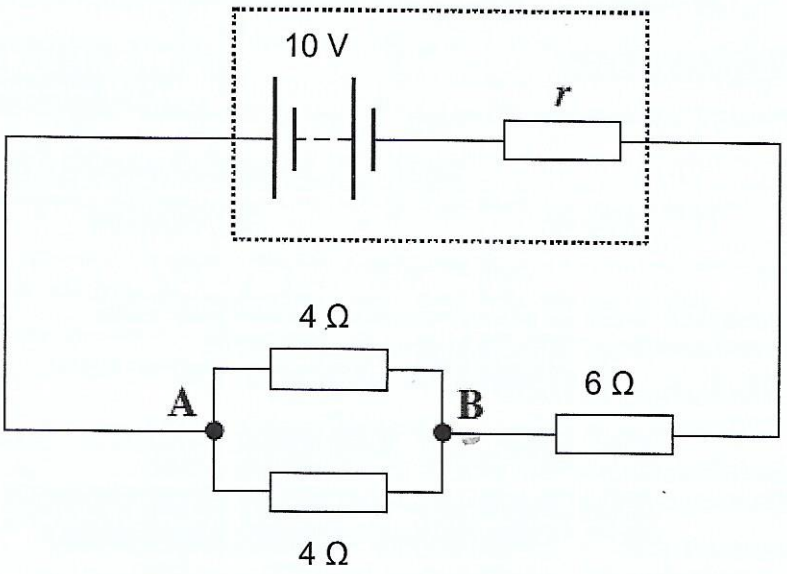
8.4.2 Calculate the potential difference between points **A** and **C** (3)

8.4.3 Calculate the potential difference between points **C** and **D** (4)

8.5 The rheostat is adjusted so that its resistance increases. How will this adjustment influence the voltmeter reading at position **A** to **E?** Choose from, STAY THE SAME, INCREASE or DECREASE.

Explain your answer. (3)

A battery with an emf of 10 V and internal resistance, *r*, is connected in the circuit shown in the diagram below. The current in the battery is 1,2 A.

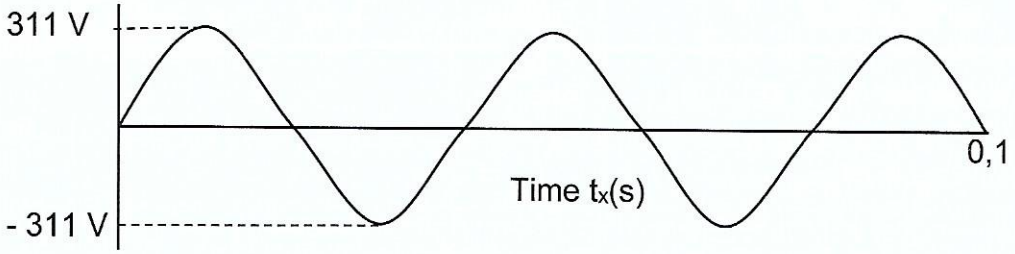


8.6 Calculate the internal resistance, *r*. (4)

[22]

QUESTION 9 (Start on a new page.)

The graph below shows a sinusoidal alternating voltage against time when connected across a resistor, R.



9.1 Explain what is meant with the term peak voltage. (2)

9.2 Calculate the V_{rms} value of the alternating voltage. (3)

9.3 Calculate the frequency of the alternating voltage. (2)

9.4 Calculate the average power dissipated in a 4 Ω resistor R. (3)

9.5 If the 4 Ω resistor is replaced by a 8 Ω resistor and the average power remains the same, calculate the I_{rms} through the 8 Ω resistor. (3)

9.6 What will happen to the emf when the frequency of the generator is increased. Choose from, STAY THE SAME, INCREASE or DECREASE.

Explain your answer. (3)

[16]

QUESTION 10 (Start on a new page.)

Photons of wavelength 1×10^{-12} m are required to remove electrons from the surface of a metal.

10.1 State what is meant by the wave-particle duality of light. (2)

10.2 Calculate the energy of the photon. (3)

10.3 Calculate the momentum of the photo electron just after it leaves the metal surface if the metal surface has a work function of $1,9 \times 10^{-13}$ J? (5)
[10]

TOTAL: 150