ALEXANDER ROAD HIGH SCHOOL

JUNE 2013 2.5 HOURS

PHYSICAL SCIENCE

PE, CO TOTAL = 125

GRADE 12

Instructions

- The question paper consists of 11 questions
- Answer all the questions
- Answer section A on the answer sheet provided
- Answer section B on the folio sheets provided
- A non-programmable calculator may be used
- Number the answers correctly according to the numbering system used on this question paper
- A data sheet will be provided for your use.
- Round off to two (2) decimal place unless otherwise stated

SECTION A

- Answer on the answer sheet -

QUESTION 1:

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

1.1 The product of mass and velocity. (1)

1.2 The general term used to describe a system on which no external forces act. (1)

1.3 A space where a unit positive charge will experience an electric force. (1)

1.4 One coulomb per volt (1)

1.5 The type of electrical motor that contains permanent magnets. (1)

[5]

QUESTION 2: Multiple choice:

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (2.1 – 2.5) on the attached ANSWER SHEET.

2.1 Power is defined as the rate…

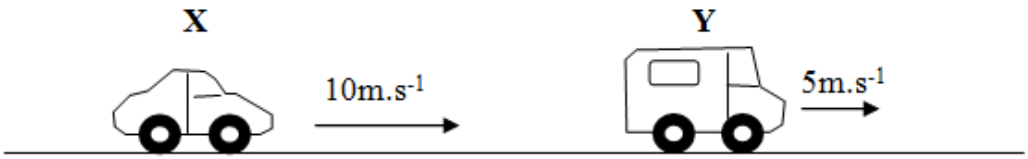
A. of change of velocity.

B. at which work is done.

C. of the change of momentum.

D. of change in displacement.

2.2 Two cars **X** and **Y**, are traveling in an easterly direction along a straight road as shown in the diagram. The velocity of car **X** is 10 $m.s^{-1}$ relative to the ground and the velocity of car **Y** is 5 $m.s^{-1}$ relative to the ground.



The velocity of car **Y** relative to car **X** is…

A. 5 $m.s^{-1}$ east.

B. 5 $m.s^{-1}$ west.

C. 15 $m.s^{-1}$ east.

D. 15 $m.s^{-1}$ west.

2.3 Which one of the following is an example of a contact force?

A. Frictional force.

B. Magnetic force.

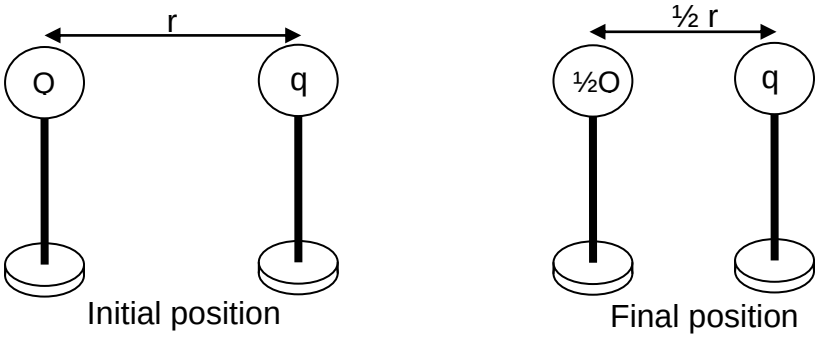
C. Electrostatic force.

D. Gravitational force.

2.4 The equivalent unit of $N.C^{-1}$

A. $J.C^{-1}$ B. V.C C. $V.m^{-1}$ D. $C.J^{-1}$

2.5 Two identical metal spheres on insulated stands carry charges of Q and q respectively, as indicated in the diagram. When they are at a distance **r** from each other, they experience a force F.



The charge on Q is halved and the two charges are moved closer to each other so that the final distance between them is half the original distance, as illustrated. Which ONE of the following correctly describes the new magnitude of the force that the charges experience?

A. ¼F B. ½F C. 2F D. 4F

[2 X 5 = 10]

SUB – TOTAL: 15

SECTION B

- Answer all questions on the folio pages provided -

QUESTION 3:

A ball of mass 0,2kg is dropped from a height of 0,8m onto a hard floor. It bounces to a maximum height of 0,6m. The floor exerts a force of 50N on the ball. Ignore the effects of friction.

3.1 Give the magnitude and direction of the force exerted by the ball on the floor. (2)

3.2 Calculate:

3.2.1 The velocity of the ball when it strikes the floor. (4)

3.2.2 The time that the ball is in contact with the floor if it bounces off the floor at a speed of 3,43 $m.s^{-1}$. (4)

3.3 The ball takes 0,404 s from the moment it is dropped to strike the floor.

Sketch a graph (not to scale) of position versus time representing the entire motion of the ball. USE THE GROUND AS ZERO REFERENCE.

Indicate the following on the graph:

- Height from which the ball is dropped
- Height reached by the ball after the bounce
- Time at which the ball bounces off the floor. (5)

[15]

QUESTION 4

4.1 State Newton's 2nd law in terms of momentum. (3)

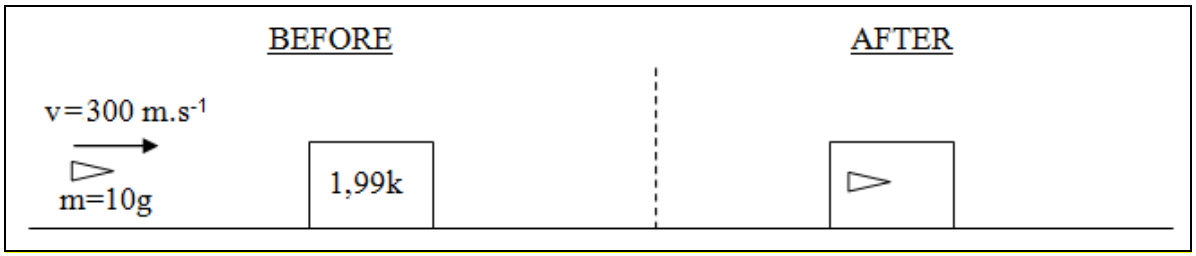
4.2 A body of mass 20kg moves across a frictionless horizontal surface at $10 m.s^{-1}$. What will be the magnitude of the velocity (in $m.s^{-1}$) of the body after a force of 10N has acted on it for 5s in the direction of its motion?

(5)

[8]

QUESTION 5:

A bullet of mass 10g, moving at a velocity of $300\ m.s^{-1}$, strikes a wooden block of mass 1,99kg resting on a flat horizontal surface as shown it the diagram below. The bullet becomes imbedded in a wooden block. Ignore the effects of air friction



5.1 Write down in words the *principle of conservation of linear momentum.* (2)

5.2 Calculate the speed of the block and bullet immediately after the collision (4)

5.3 Is the collision elastic or inelastic? Give a reason for your answer. (2)

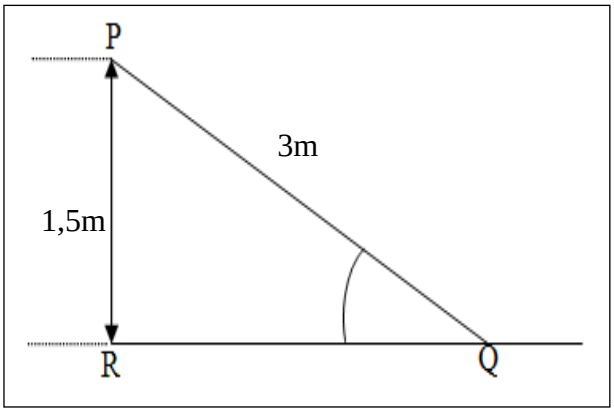
The floor exerts a constant 8N frictional force on the block-bullet system as it comes to rest.

5.4 Calculate the distance that the block-bullet system moves after the collision. (5)

[13]

QUESTION 6:

The simplified diagram shows a slide (PQ) at a playground. The slide is 3m long and 1,5m high. A boy of mass 40kg and a girl of mass 22kg stand at the top of the slide at P.



The girl accelerates uniformly from rest down the slide. She experiences a constant force of friction of 1,9N.

The boy falls vertically down from the top of the slide through a height PR of 1,5m.

Ignore the effects of air friction.

6.1 Write down the *principle of conservation of mechanical energy* in words. (2)

6.2 Draw a labeled free body diagram to show ALL the forces acting on the:

6.2.1 Boy while falling vertically (1)

6.2.2 Girl as she slides down the slide (3)

6.3 Use the principle of CONSERVATION OF MECHANICAL ENERGY to calculate the speed of the boy just before he reaches the ground at R (4)

6.4 Use the WORK-ENERGY THEOREM to calculate the speed of the girl when she reaches the end of the slide at Q. (5)

6.5 How would the velocity of the girl at Q compare to that of the boy at R if the slide exerts no friction on the girl? Write down only GREATER THAN, LESS THAN or EQUAL TO. (1)

[16]

QUESTION 7:

Consider the following situations: For each situation state whether MECHANICAL ENERGY is conserved on not. In each case give a reason for your answer:

7.1 A ball-bearing falling through oil. (2)

7.2 An electron moving freely in an electric field. (2)

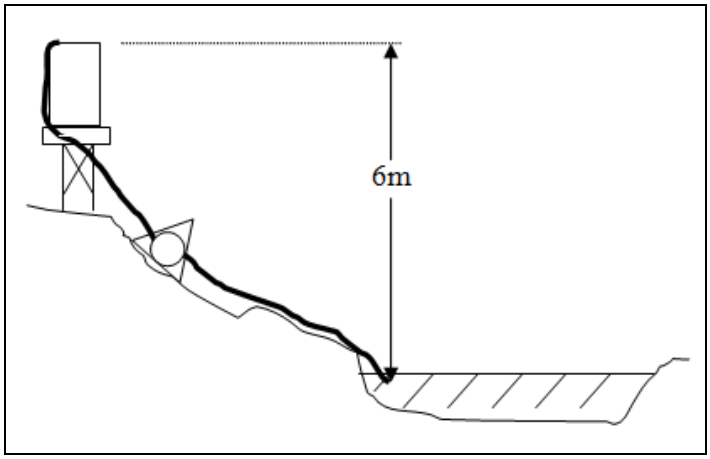
7.3 A feather falling in a vacuum. (2)

7.4 A rocket fired vertically upward from the moon. (2)

[8]

QUESTION 8

8. A 600 watt water pump, pumps 240 kg of water from a dam to a reservoir, positioned 6m above the water, in one minute. (see the sketch below)



8.1 Calculate the amount of work done by the pump. (3)

8.2 What power was generated in doing this work? (3)

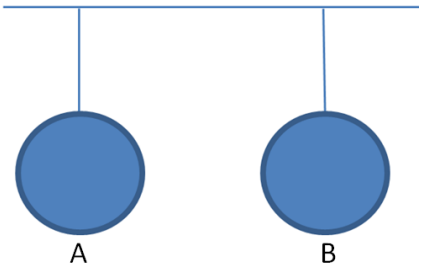
8.3 How does the answer in 8.2 above compare with the power rating of the pump? (1)

8.4 Give two possible reasons for this apparent 'loss' in power. (2)

[9]

QUESTION 9

Two metal spheres carry charges of 30nC and -14nC respectively and are suspended as shown. They touch and move back to their original positions. The magnitude of the electrostatic force between them is now $6{,}4 \times 10^{-4}$ N.



9.1 Calculate the magnitude of the charge on each sphere after contact. (2)

9.2 Determine the original distance between the spheres. (3)

9.3 Calculate the electric field strength that A experiences as a result of B, after they touched. (3)

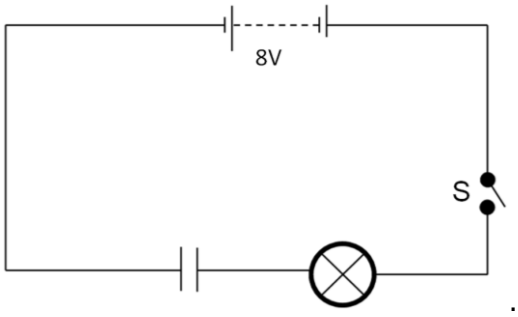
[8]

QUESTION 10

10.1.1 Write down the main function of a capacitor in a circuit. (1)

10.1.2 Draw a sketch that shows the electric field pattern between the plates of a capacitor. (3)

10.2 A high-resistance light bulb and an uncharged parallel plate capacitor are connected in series with a 8V battery and a switch S, as shown in the diagram. The internal resistance of the battery and the resistance of the connecting wires should be ignored.



Switch S is now closed and the capacitor charges.

10.2 Describe how the brightness of the light bulb changes during the charging process. (1)

The capacitor is now fully charged.

10.3 Write down the potential difference across the:

10.3.1 Light bulb (1)

10.3.2 Capacitor (1)

10.4 The distance between the plates of the capacitor is 4,8 mm.
For the fully charged capacitor, calculate the magnitude of the:

10.4.1 Electric field between the plates (3)

10.4.2 Show that the magnitude of the electrostatic force exerted on an electron between the plates is $2,67 \times 10^{-16}$N. (3)

10.5 An electron is positioned 3,8mm from the positive plate of the capacitor. Calculate the:

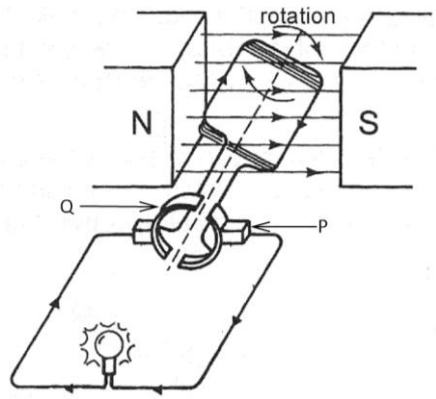
10.5.1 Distance (in mm) between the electron and the negative plate. (1)

10.5.2 Work that must be done to move the electron to the negative plate (Ignore the effects of gravitational force.) (4)

[18]

QUESTION 11

AC generators and DC generators differ in their construction and the type of current they deliver. The simplified sketch below represents a DC generator.

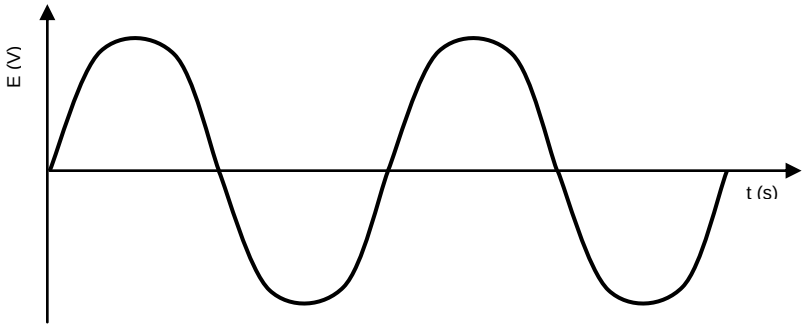


11.1 Which component (P or Q) enables this generator to produce DC? (1)

11.2 What structural change must be made to this generator to change it to an AC generator? (1)

11.3 Briefly explain why ESKOM prefers using AC instead of DC for the long distance transmission of electricity. (2)

11.4 The induced emf versus time graph for an AC generator is shown below.



Sketch a graph to show how the above waveform changes, if at all, after changing this generator into a DC generator. (2)

11.5 An AC generator delivers 220 V_{rms} to a light bulb. The peak current in the light bulb is 0,38A. Calculate the:

11.5.1 rms current in the bulb. (3)

11.5.2 resistance of the light bulb. (3)

11.5.3 power dissipated in the bulb. (3)

[15]

TOTAL: 125 MARKS