ALEXANDER ROAD HIGH SCHOOL

JUNE 2014 | 3 HOURS

PHYSICAL SCIENCE

IC, CO, KB | TOTAL = 150

GRADE 12

Instructions

- The question paper consists of 10 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 Multiple choice:

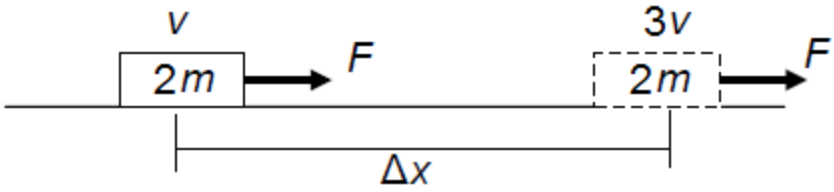
Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (1.1 – 1.10) on the attached ANSWER SHEET.

1.1 A constant net force acts on a body which can move freely in a straight line. Which physical quantity will remain constant?

A. Acceleration B. Velocity

C. Momentum D. Kinetic energy

1.2 An applied force accelerates an object of mass “2m” on a frictionless horizontal surface from a speed “*v*” to a speed “3*v*”.



The net work done on the object is equal to…

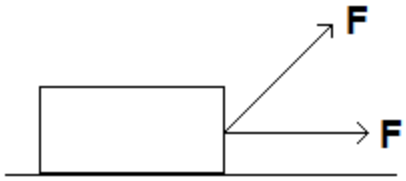
A. ½ mv^2

B. 2 mv^2

C. 4 mv^2

D. 8 mv^2

1.3 A crate is pulled along a frictionless surface by two forces, each with a magnitude of **F**, as shown in the diagram…



Which vector diagram correctly shows how the resultant force R on the crate can be determined?

A. B. C. D.

1.4 A girl of mass 50kg stands on a bathroom scale in a lift (the scale measures in newtons). If the lift accelerates downwards at 3m.s^{-2} what will the magnitude of the reading on the scale be?

A. 490N B. 340N

C. 640N D. 50N

1.5 Jonas throws a tennis ball, mass 50 g, in a westerly direction at a velocity of 7 $m.s^{-1}$ towards a wall. The ball bounces back from the wall at a velocity of 5 $m.s^{-1}$. The change in momentum is

A. 600 $kg.m.s^{-1}$ easterly

B. 600 $kg.m.s^{-1}$ westerly

C. 0,6 $kg.m.s^{-1}$ easterly

D. 0,6 $kg.m.s^{-1}$ westerly

1.6 Faraday's law is best described in which one of the following statements?

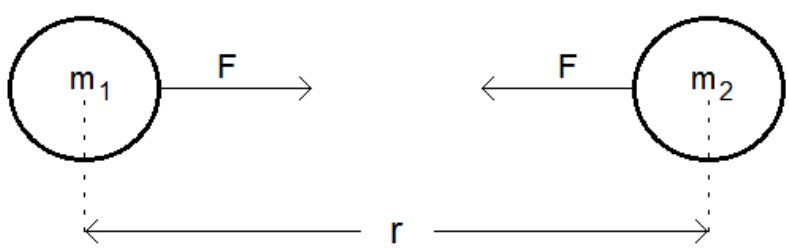
A. The induced current is directly proportional to the rate of change of magnetic field strength.

B. The induced *emf* is inversely proportional to the rate of change of magnetic flux.

C. The induced current is directly proportional to the rate of change of magnetic flux.

D. The induced *emf* is directly proportional to the rate of change of magnetic flux.

1.7 The diagram below shows two objects (mass m_1 and m_2) separated by a distance "r", exerting a gravitational force of "F" between them.



If the distance between the objects and mass m_1 is halved, the new force will be…

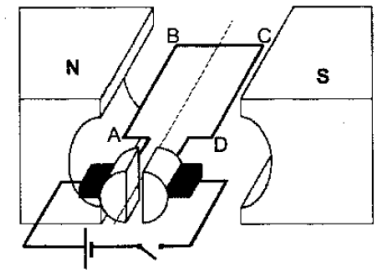
A. 2F

B. F

C. ½ F

D. ¼ F

1.8 A simplified diagram of an electrodynamic apparatus is given: Which statement is correct when the switch is closed?



A. A DC motor that will turn clockwise

B. A DC generator with current flowing from A to B

C. A DC motor that will turn anticlockwise

D. An AC generator that will produce current that flows from D to C and then C to D

1.9 Which of the following statements is correct with regards to red shift?

A. It is a shift in the light spectra of distant galaxies towards higher frequencies, towards the red end of the spectrum.

B. It is a shift in the light spectra of distant galaxies towards shorter wavelengths, towards the red end of the spectrum.

C. It is a shift in the light spectra of distant galaxies towards longer wavelengths, towards the red end of the spectrum.

D. It is a shift in the light spectra of distant galaxies towards longer wavelengths, away from the red end of the spectrum.

1.10 A certain metal is placed on an electroscope and the electroscope is charged negatively. The metal has a work function of 6.9×10^{-19}J. Green light is shone on the metal and there is no change to the electroscope. The intensity of the light is now increased. How will this affect the electroscope?

A. No effect

B. The leaf collapses slowly

C. The leaf collapses quickly

D. The leaf is repelled

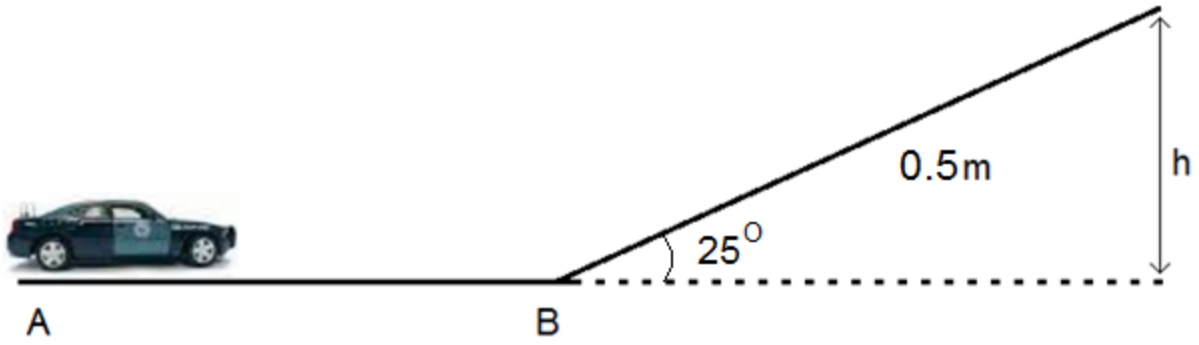
SUB – TOTAL: 20

SECTION B

- Answer all questions on the folio pages provided -

QUESTION 2:

The figure below shows a toy car of mass 0.5kg which is being pushed along a frictionless horizontal surface by a child. The car starts from rest (point A) and reaches a maximum speed of $4 m.s^{-1}$ when it gets to the bottom of a ramp (point B) inclined at 25^0 to the horizontal. The moment the car reaches the bottom of the ramp (point B) the child stops pushing the car and notices that the car moves up the ramp a distance of 0.5m, reaching a height "h" and then slides back down.



2.1 Write down the name of the non-conservative force acting on the toy car as it moves along the frictionless horizontal surface from A to B. (1)

2.2 Is this force path dependent or path independent? (1)

2.3 State the WORK-ENERGY THEOREM in words. (2)

2.4 If it takes 2 seconds to move the car from point A to point B, use the WORK-ENERGY THEOREM to calculate the power output of the child required to move the car between those two points. (6)

As the toy car moves up the ramp, it experiences a constant frictional force of 5N.

2.5 Calculate the work done by the frictional force during the toy car's motion up the ramp. (3)

2.6 Calculate the height "h" reached by the toy car. (5)

2.7 State Newton's second law of motion in words. (2)

2.8 Calculate the magnitude of the toy cars acceleration, parallel to the ramp, during its motion up the ramp. (6)

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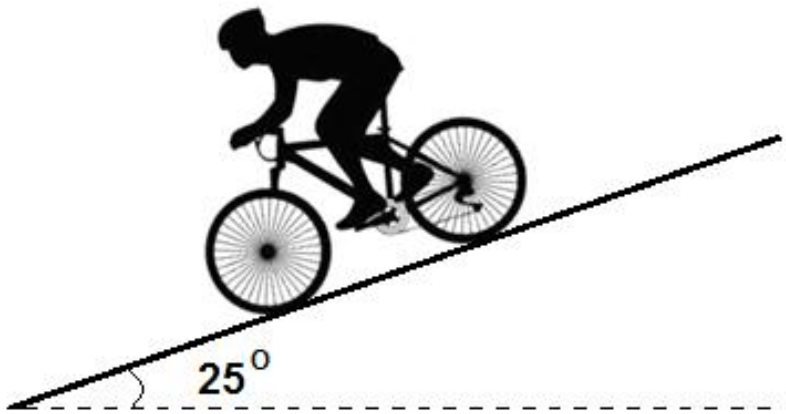
QUESTION 3

A cyclist free wheels (ie. moves without pedaling) down a straight stretch of road that makes an angle of 25^0 with the horizontal. The mass of the cyclist and his bike is 100kg. Throughout the motion, the cyclist experiences a frictional force of 120N. The cyclist and his bike are to be considered as a single object.



3.1 Draw a free-body diagram showing all the forces acting on the object. (3)

3.2 Determine the component of the objects weight acting perpendicular to the slope. (3)

3.3 If the kinetic frictional force is 120N, calculate:

3.3.1 The magnitude of the normal force. (1)

3.3.2 The coefficient of kinetic friction. (3)

3.4.1 If the angle that the road makes with the horizontal is decreased, will the frictional force INCREASE, DECREASE or STAY THE SAME? (1)

3.4.2 Provide an explanation for your answer in question 3.4.1. (2)

[13]

QUESTION 4

A passenger in a motor car notices that an air-freshener hanging from the rearview mirror of the car looks like it moves backwards when the car accelerates forward, away from a stop street.

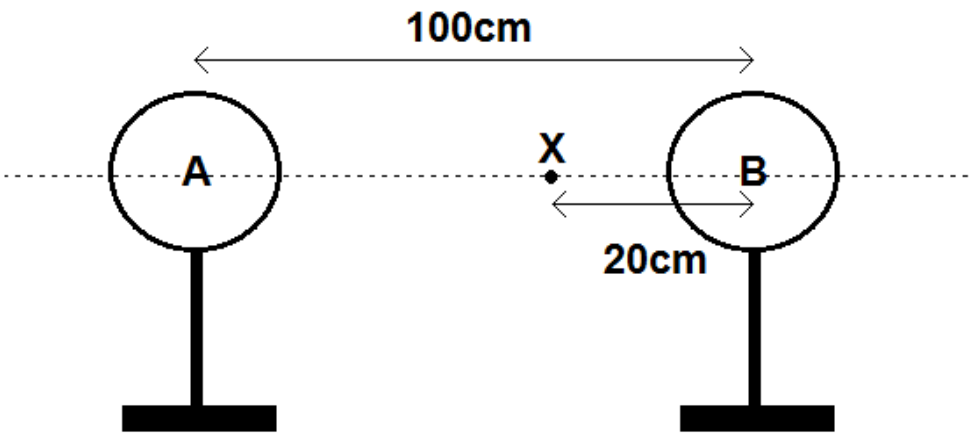
4.1 State Newton's first law of motion. (2)

4.2 Use it to explain this observation. (3)

[5]

QUESTION 5

Two insulated charged identical copper spheres, A and B, are placed with their centres 100cm apart (as indicated in the diagram below).



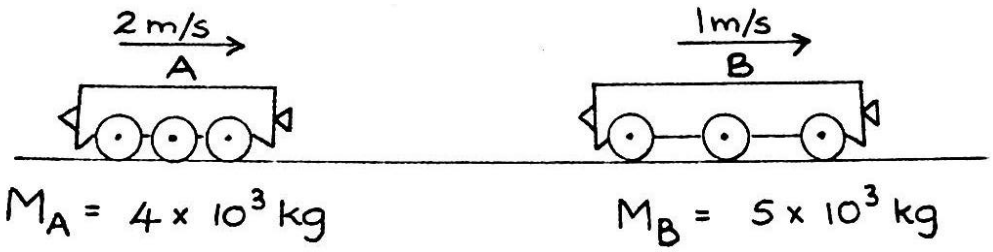
5.1 Calculate the magnitude of the electrostatic force, exerted between the two charges, if the charge on each sphere is 6μC. (4)

5.2 Calculate the net electric field at point "X" as shown in the diagram above. (6)

[10]

QUESTION 6:

In a shunting yard two railway trucks are moving in the same direction at different speeds. As shown in the sketch. The two trucks collide and link together.



6.1 Calculate the velocity of the two linked trucks after the collision. (6)

6.2 State, in words, the law that you used in answering the above question. (2)

6.3 Calculate the change in momentum of truck B. (3)

6.4 Was the collision between the trucks elastic or inelastic?
(Motivate your answer by a calculation) (3)

[14]

QUESTION 7

James and Karla do a vertical motion investigation in their spare time (LOL!). James is standing on a bridge 11,25 m above Karla who is standing on the ground. Karla throws an orange vertically upwards at 10 $m.s^{-1}$ and at the same time James drops a tomato.

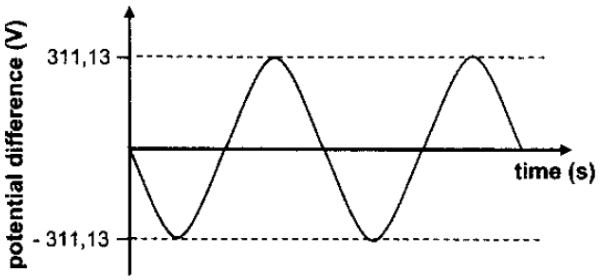
7.1 Calculate the maximum height obtained by the orange.
(State whether or not it reaches James) (5)

7.2 Calculate the vertical distance between the orange and the tomato 1 s after they were in motion. (4)

[9]

QUESTION 8

The output of an AC generator is shown in the graph below.



A light bulb with an average power rating of 110 W is connected to this generator.

8.1 Calculate the following:

8.1.1 The *rms* potential difference across the light bulb. (3)

8.1.2 The Peak current through the bulb. (5)

8.2.1 Draw a rough sketch graph (free hand) of one cycle of Potential difference versus time for the output of a DC generator. (no values needed on the graph) (1)

8.2.2 Draw a rough graph of one cycle of Power versus time for an AC generator (no values needed on the graph). (1)

8.2.3 Give one advantage of using AC. (2)

8.3.1 State two factors that will increase the power of an electric motor. (4)

8.3.2 State one structural difference between the DC motor and AC motor. (2)

8.3.3 What is the function of carbon brushes? (2)

8.3.4 What is the function of a split ring commutator? (2)

8.3.5 In which two electrodynamic devises do we find split ring commutators? (2)

8.3.6 The sketch below shows a side view of one loop/winding of the electric motor between the magnetic poles. Copy the incomplete sketch and add the magnetic field lines that will demonstrate the working of the electric motor. Indicate the force (F) on the conductor.

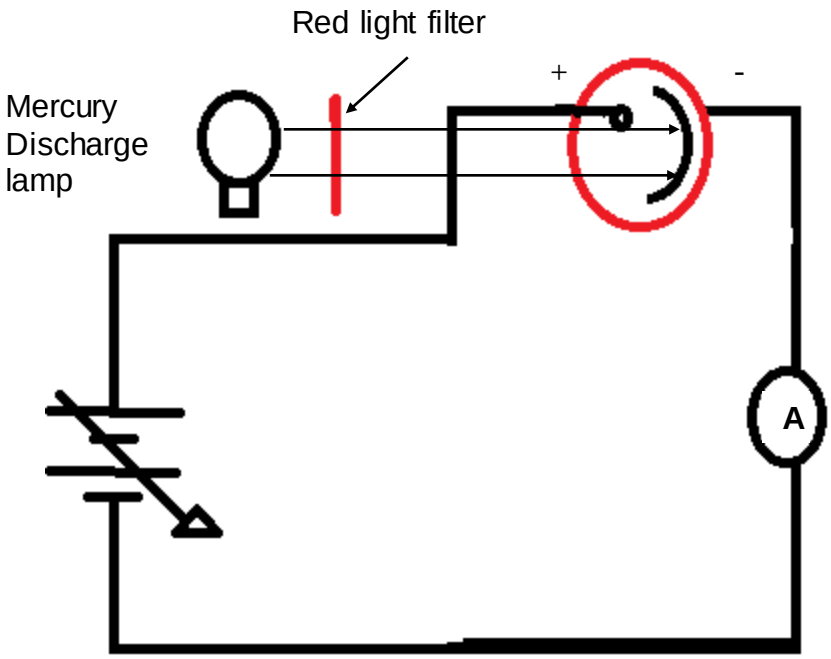
(3)

8.3.7 Name and state the *effect* that was demonstrated in question 8.3.6. (3)

[30]

QUESTION 9

A student sets up an experiment to demonstrate the photoelectric effect using a photosensitive vacuum tube. The experiment was set up as follows:



The negative terminal of the variable DC power supply is connected to the cathode. The mercury discharge lamp is connected to its power supply. The DC power supply was adjusted to supply a small voltage across the photocell.

A red filter is placed in front of the mercury discharge lamp and shines red light onto the metal cathode and ammeter readings were recorded. The intensity of the red light is increased by moving the mercury discharge lamp closer and ammeter readings were again recorded.

The red filter was replace by a blue filter and the same steps were followed.

9.1 When red light was shone on the metal cathode, the ammeter reading was zero. Explain. (2)

9.2 The intensity of the red light was increased but the ammeter reading was still zero. Explain. (2)

9.3 When blue light was shone on the metal cathode, there was in fact, a reading on the ammeter. Explain. (2)

9.4 The intensity of the blue light was then increased and the reading on the ammeter also increased. Explain. (2)

9.5 If the Work function of the metal cathode is $3{,}82 \times 10^{-19}$J, calculate the cut off (threshold) frequency of the metal cathode. (3)

[11]

QUESTION 10

A man is standing next to a railway line observing trains as they pass. The man hears the whistle of an approaching train. The sound produced by the whistle is 440Hz. The train is moving at a constant velocity of $40m.s^{-1}$. The speed of sound in air is $340m.s^{-1}$.

10.1 Calculate the frequency of the sound the man hears as the train approaches. (5)

10.2 Calculate the wavelength of the sound waves as the train approaches the man. (3)

10.3 At which moment during the motion of the train would the man be able to hear the actual frequency produced by the whistle? (1)

10.4.1 If the train was moving at a faster speed, would the frequency heard by the man, when the train is moving away, be HIGHER, LOWER or THE SAME as it was when it was moving at $40m.s^{-1}$? (1)

10.4.2 Provide an explanation for your answer in question 10.4.1 (2)

[12]

TOTAL: 150 MARKS