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GRADE 11 EXAMINATION

JUNE 2021

PHYSICAL SCIENCES: PAPER I

Time: 2 hours

130 marks

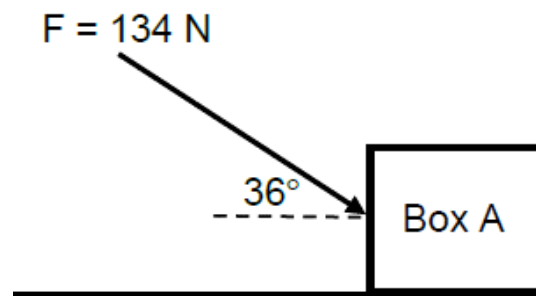
Examiner: K Mari

Moderator: C vd Venter

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 9 pages, and a Data Sheet of 2 pages. Please check that your question paper is complete.
 2. Read the questions carefully.
 3. Answer ALL the questions.
 4. Start each question on a new page.
 5. Number your answers as the questions are numbered.
 6. Use the data and formulae whenever necessary.
 7. Show your working in all calculations.
 8. Units need not be included in the working calculations, but appropriate units should be shown in the answer.
 9. Answers must be expressed in decimal format, not left as proper fractions.
 10. Where appropriate, express answers to TWO decimal places.
 11. It is in your own interest to write legibly and to present your work neatly.
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- 1.5 Joshua exerts a horizontal force $F = 134 \text{ N}$ at an angle of 36° to push a box along a rough horizontal surface as shown in the sketch below. The box is 3 kg . Which of the following statements is correct?

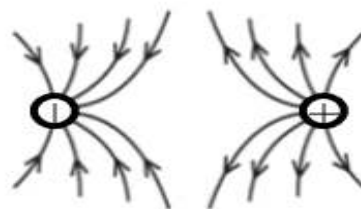


- A) The normal force equals the gravitational force of 134 N of Box A.
 B) The normal force of Box A has increased by a force of $134 \times \cos 54^\circ \text{ N}$.
 C) The weight of Box A is greater than force F .
 D) The frictional force equals the normal force.
- 1.6 Which diagram best represents the electric field pattern between two-point charges of equal magnitude and opposite sign?

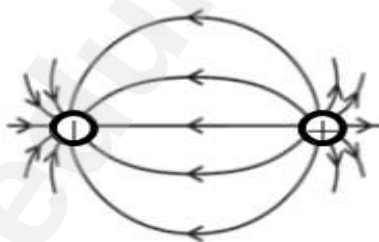
A)



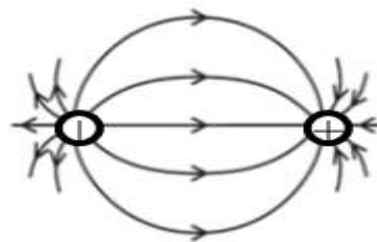
B)



C)



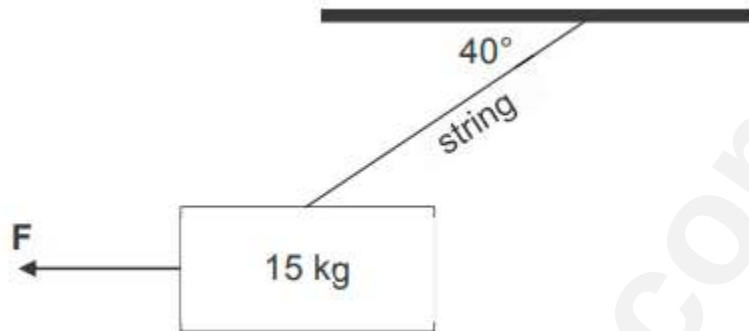
D)



- 1.7 A hair dryer that is rated 2000 W is used for 20 minutes . If a kWh from City Power costs 20 cents , how much did it cost her to dry her hair?
- A) $13,3 \text{ cents}$ B) $6,7 \text{ cents}$
 C) $\text{R } 13,33$ D) 10 cents

QUESTION 2 VECTORS

- 2.1 A billboard, of mass 15 kg, is suspended from a roof by means of a light inextensible string. Force F pulls the billboard sideways, as shown in the diagram below.

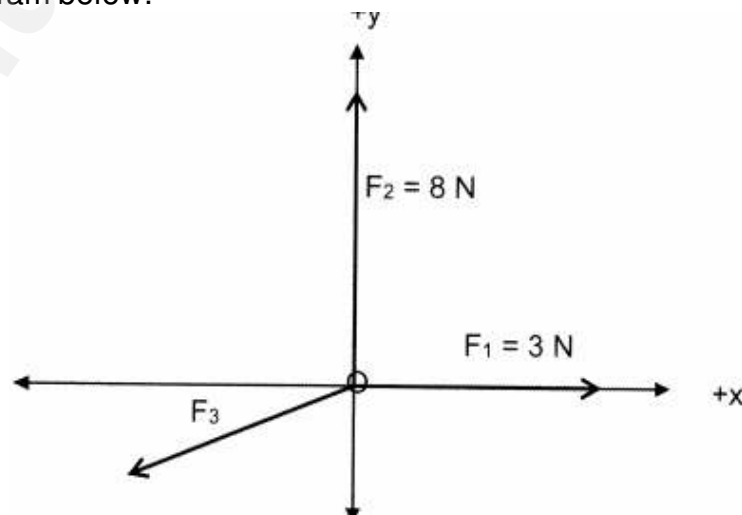


When the angle between the roof and the string is 40° , a closed vector diagram is obtained for all the forces acting on the billboard.

- 2.1.1 What deduction can be made when the forces acting on an object form a closed vector diagram? (2)
- 2.1.2 Calculate the weight of the billboard. (2)
- 2.1.3 Draw a labelled closed vector diagram of ALL the forces acting on the billboard. Indicate the value of ONE of the angles. (4)
- 2.1.4 Calculate the tension in the string. (3)
- 2.1.5 The magnitude of force F is equal to the magnitude of the horizontal component of the tension in the string.

Give a reason why these two forces are NOT considered to be an action-reaction pair according to Newton's Third Law. (2)

- 2.2 Three forces F_1 , F_2 and F_3 act simultaneously at a common point O as shown in the diagram below.



F_1 is a 3 N force, acting at 90° and F_2 is a 8 N force acting at 0° . F_3 has an x -component of -4 N and a y -component of -3 N.

2.2.1 Define the term *resultant vector*. (2)

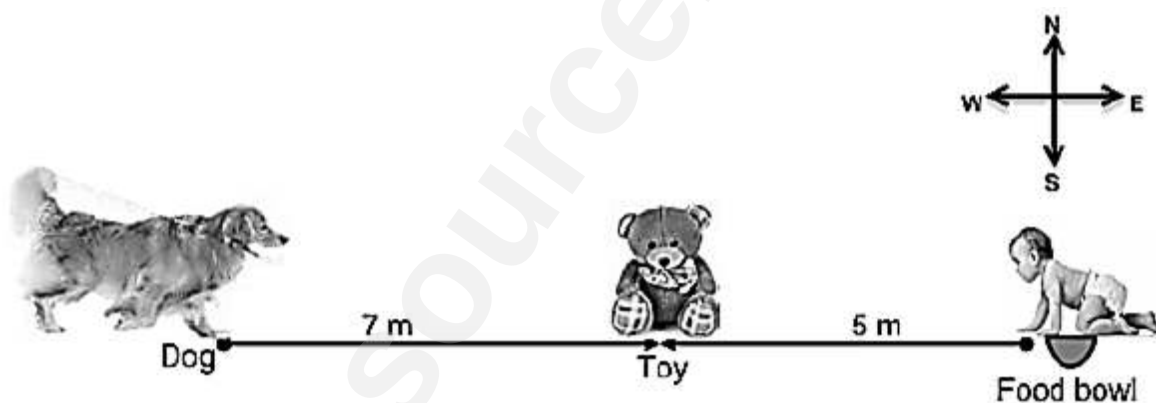
2.2.2 Calculate the magnitude of F_3 . (2)

2.2.3 Calculate the magnitude and direction of the resultant force acting at point O. (5)

[22]

QUESTION 3 KINEMATICS

- 3.1 A baby leaves a bowl of food on the floor and crawls westwards to fetch a toy placed 5 m away. At the same time a dog walks eastwards towards the baby. It takes the baby 30 s to reach the toy. The dog walks past the toy to eat the baby's food in the bowl.

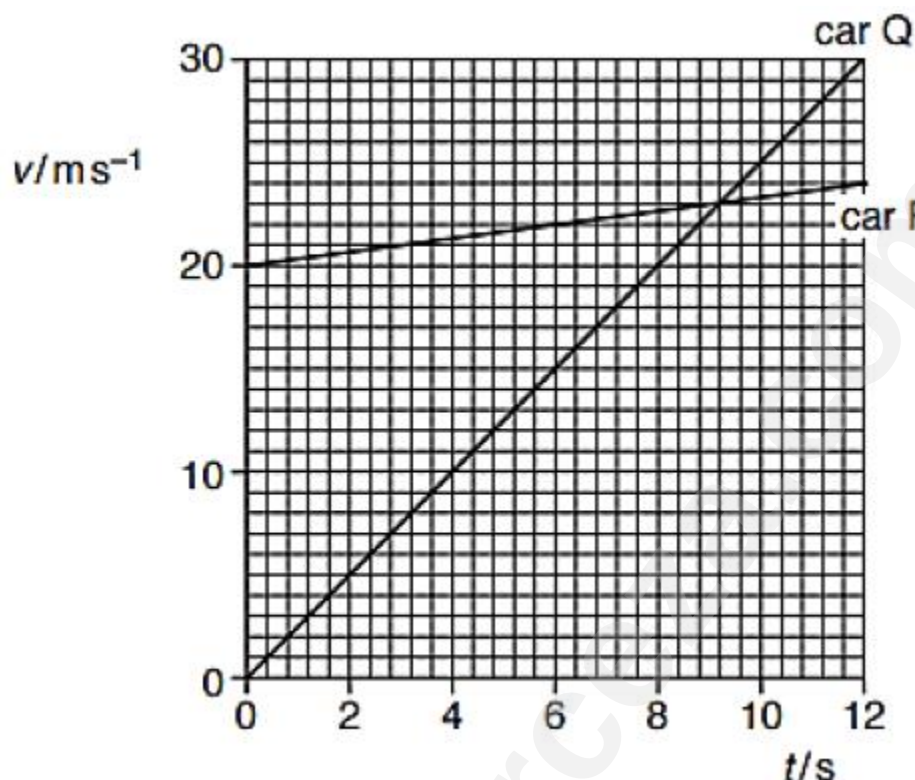


3.1.1 Define the term displacement. (2)

3.1.2 Determine the position of the dog relative to the baby before they both moved. (2)

3.1.3 Calculate the average velocity of the baby. (3)

- 3.2 The variation with time t of the velocity v of two cars P and Q is shown in the graph below:



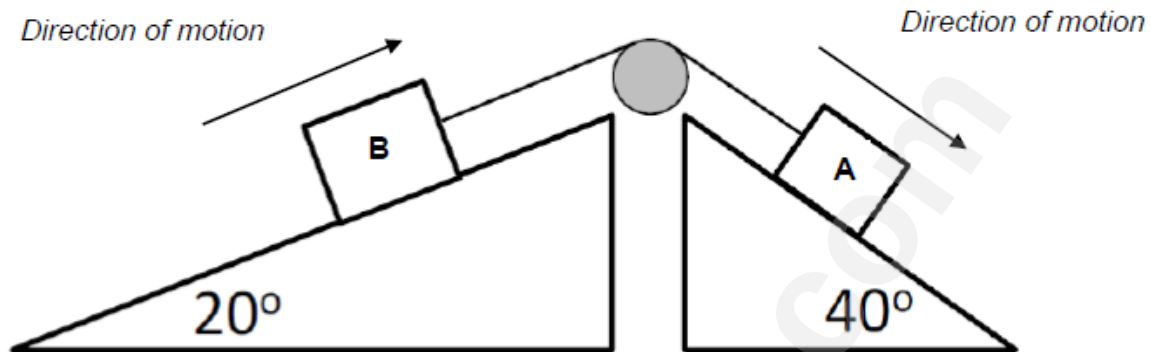
The cars travel in the same direction (SOUTH) along a straight road. Car P passes car Q at time $t = 0$. The speed limit for cars on the road is $100 \text{ km}\cdot\text{h}^{-1}$.

- 3.2.1 State and explain whether car Q exceeds the speed limit. (2)
- 3.2.2 Define the term *acceleration*. (2)
- 3.2.3 Calculate the acceleration of car P. (3)
- 3.2.4 Determine the distance between the two cars at time $t = 12$ s. (4)
- 3.2.5 From time $t = 12$ s, the velocity of each car remains constant. Determine the time t at which car Q passes car P after 12 s. (4)

[22]

QUESTION 4 NEWTON'S LAWS

Two masses, A and B, each with mass of 3 kg, are arranged as indicated in the sketch. The 40° incline is frictionless, while the 20° incline has a coefficient of kinetic friction of 0,1.



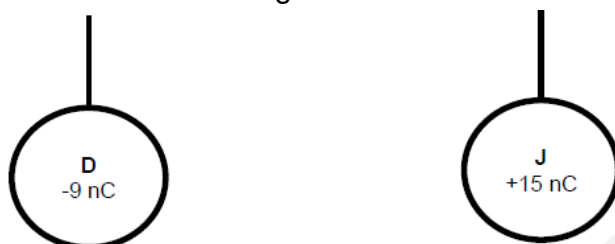
The objects accelerate in the direction indicated on the sketch.

- 4.1 State Newton's Second Law of Motion in words. (3)
- 4.2 Draw a free body diagram for the mass labelled B. (4)
- 4.3 Define the term *frictional force*. (2)
- 4.4 Calculate the frictional force acting on mass B. (3)
- 4.5 Calculate the tension in the cable. (7)
- 4.6 Calculate the magnitude of the acceleration of mass A. (2)
- 4.7 The angle of the incline of block A is decreased. What effect would this have on the magnitude of the acceleration of the system? Explain using physics principles. No calculations. (5)

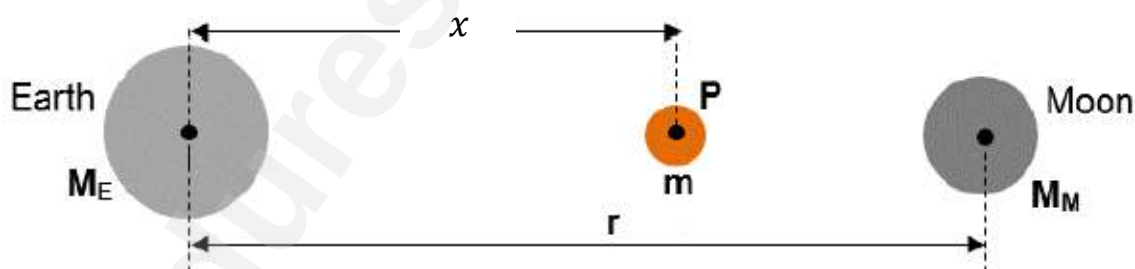
[26]

QUESTION 5 FIELDS

- 5.1 Two identical metal spheres are hanging 0,8 m apart on insulated threads as shown below. Sphere D has a charge of -9 nC and sphere J a charge of +15 nC as indicated on the diagram.



- 5.1.1 State *Coulomb's Law*. (2)
- 5.1.2 Calculate the magnitude of the force between the two spheres. (4)
- The two spheres are allowed to touch each other and are separated again.
- 5.1.3 State the direction of electron transfer between the spheres. Only state D to J or J to D. (2)
- 5.1.4 Calculate the new charge on each sphere. (2)
- 5.1.5 Calculate the number of electrons transferred while the spheres were touching. (2)
- 5.2 A learner wants to calculate the distance between the Earth (mass $M_E = 5,97 \times 10^{24}$ kg) and the Moon (mass $M_M = 7,35 \times 10^{22}$ kg). To achieve this, the learner placed a third mass 'm' at point 'P' where the net gravitational force is zero as shown in the diagram below. The distance between the centres of the Earth and the Moon is 'r'.



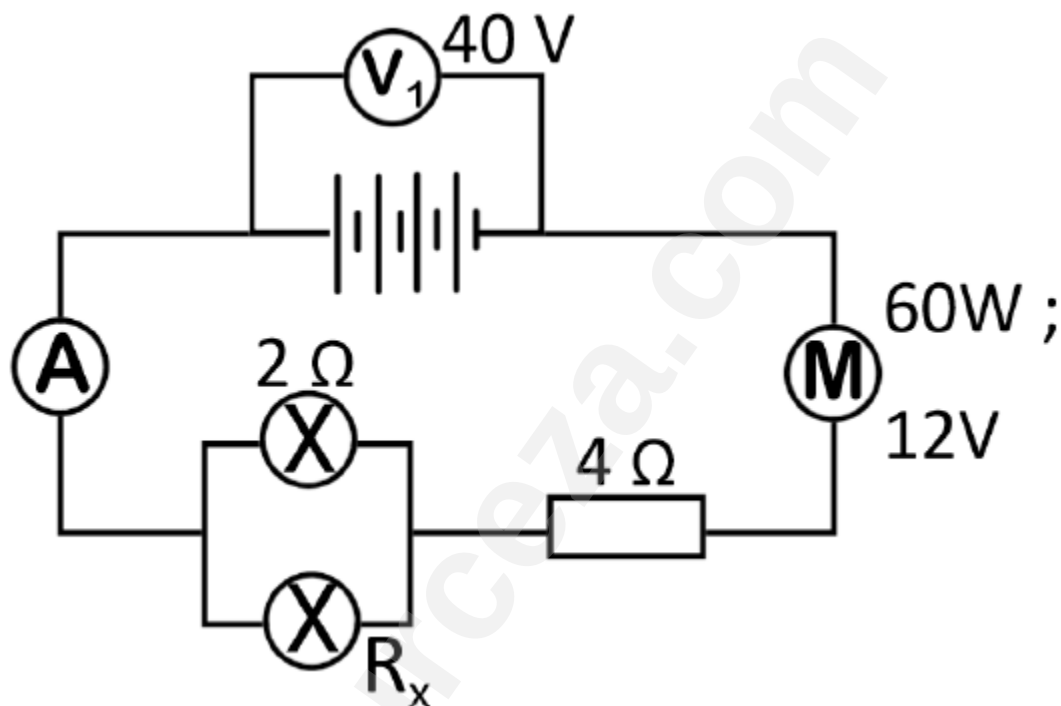
- 5.2.1 State Newton's Law of Universal Gravitation in words. (2)
- 5.2.2 Use the Law of Universal Gravitation to show that r and x are related by the following equation:

$$r^2 - 2rx + 0,988x^2 = 0 \quad (5)$$

[19]

QUESTION 6 ELECTRIC CIRCUITS

The circuit below shows a 12 V DC motor, M, connected in a circuit to a battery of emf 45 V and significant internal resistance. The motor is able to run on a lower voltage, but its rotation speed will decrease, however it will not function if 12 V is exceeded. One of the bulbs has unknown resistance, R_x .



- 6.1 Define the term *resistance*. (2)
- 6.2 Calculate the resistance of the motor. (3)
- 6.3 Calculate the reading on the ammeter. (3)
- 6.4 Define the term *potential difference*. (2)
- 6.5 Calculate the voltage across the 4 ohm resistor. (3)
- 6.6 Calculate the voltage across bulb R_x . (2)
- 6.7 Hence determine the resistance of R_x . (4)
- 6.8 Calculate the work done by the 2 Ω light bulb in a time of 2 minutes. (4)
- 6.9 Calculate the internal resistance of the battery. (4)

[27]**TOTAL : 130 MARKS**