



GRADE 10 EXEMPLAR EXAMINATION  
2006

PHYSICAL SCIENCE: PAPER II  
(PHYSICS FOCUS)

100 marks

Time: 1½ hours

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**INSTRUCTIONS:**

1. Answer all the questions.
  2. Write legibly.
  3. Make neat diagrams when necessary.
  4. Show the formulas and equations you use.
  5. Show all calculations.
  6. All answers should have the correct units.
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**Section A      Motion of cars**

The price of petrol is an increasing problem in South Africa. In addition, crude oil and coal from which we manufacture petrol, are non-renewable fossil fuels. Burning these fuels also produces

- so-called greenhouse gases like carbon dioxide, as well as pollutants like
  - sulphur dioxide (burning coal) and
  - oxides of nitrogen (burning petrol in car engines)

Many are suggesting that the use of electric or hybrid cars can help solve these problems. An electric car is powered by batteries and has an electric motor. It makes no use of petrol at all. The hybrid car makes use of petrol as well as batteries. In fact, in the hybrid car there are batteries, an electric motor (and an electric generator) as well as a petrol engine. In a hybrid car the electric motor and petrol engine can be used singly or together.

The "Car Magazine" has published a report in which the authors compare a hybrid car with a car with a normal petrol engine.

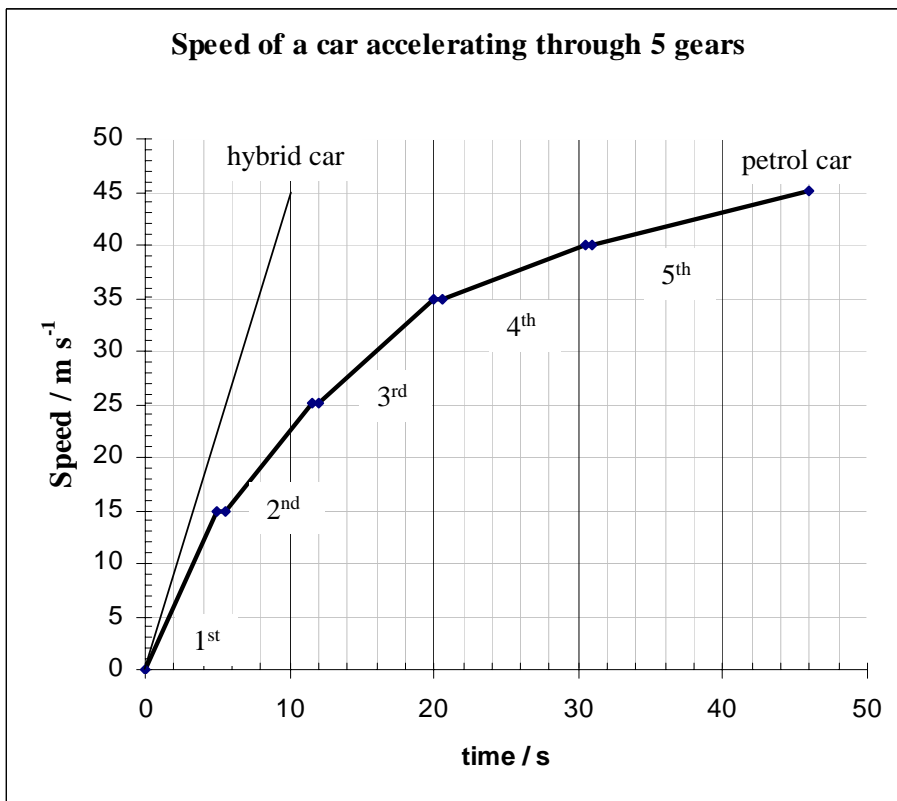
The report covers various aspects of the performance of these cars.

**Question 1      Acceleration tests: 0 – 144 km.h<sup>-1</sup>**

Study the graph giving the acceleration of the hybrid car and a petrol car. Both cars start at zero displacement at time zero.

- 1.1      What is the speed of the hybrid car after 10 s? (1)
- 1.2      After what period of time does the petrol car have a speed of 35 m s<sup>-1</sup>? (1)
- 1.3      During the period 5 to 5,5s, was the speed of the petrol car increasing, decreasing or staying the same? (1)
- 1.4      To what do the labels 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup>, on the graph, refer? (1)
- 1.5      If you were in the petrol car when it was moving as shown in the graph, what would you have observed at 5 s, 11,5 s, 20 s and 30,5 s? (1)

1.6 Copy and complete: 1 kilometer = ..... meters and 1 hour = .... seconds.



(2)

1.7 In the information provided in "Car Magazine" speeds are give in  $m.s^{-1}$  rather  $km h^{-1}$ .  
 $108 km.h^{-1}$  can be written as  $\frac{108 km}{1 h}$ . Convert  $40 m s^{-1}$  to  $km h^{-1}$ .

(3)

1.8 John is asked to calculate the average acceleration of the hybrid car from 0 to  $40 m.s^{-1}$  (in  $m.s^{-2}$ ). Here is his attempt:

$$\begin{aligned}
 &\text{Hybrid car} \\
 v &= u + at \\
 0 &= 40 + a(9) \\
 -9a &= 40 \\
 a &= \frac{9}{40} \\
 a &= 0.225 m/s^{-1}
 \end{aligned}$$

List the mistakes John has made in his calculation for the **hybrid** car.

(4)

1.9 Copy and complete the following table by calculating the hybrid's position after 10 s. Now, using the values on your table, draw a position-time graph to scale, on graph paper, for the hybrid car. The position must be given relative to the car's starting point.

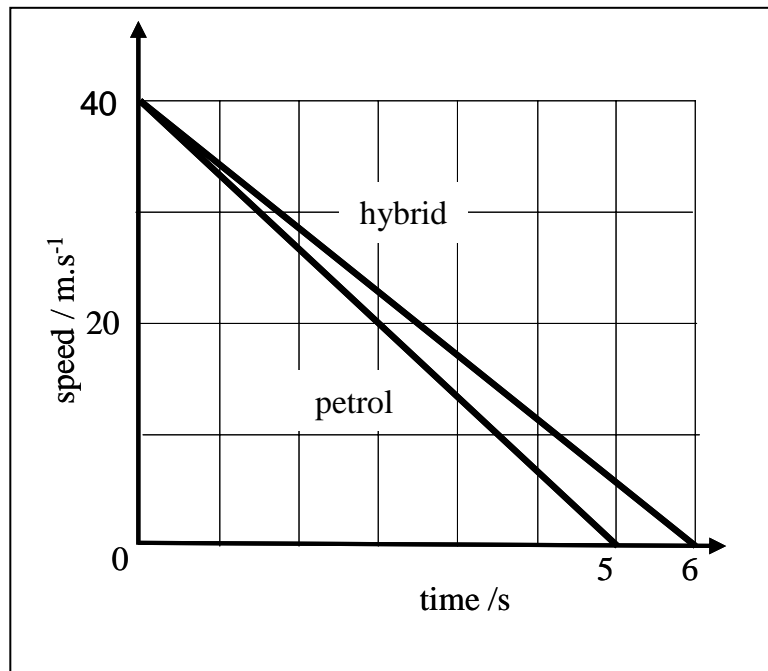
<b>Time /s</b>	0	2	4	6	8	10
<b>Position /m</b>	0	9	36	81	144	

(8)

[22]

**Question 2      Braking tests**

The braking tests were shown on one set of axes:



2.1 Which car has more effective brakes? Explain (2)

2.2 How much further did it take the hybrid-car to stop? (3)

The hybrid-car stops by using the car's kinetic energy for braking. It does this by changing the motor into a generator which charges the batteries.

2.3 What is the advantage of this braking method? (1)

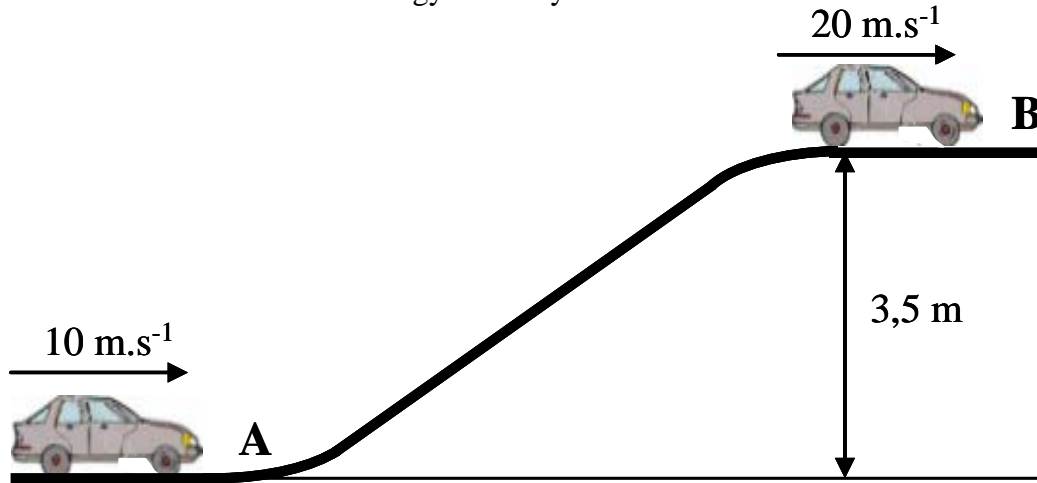
2.4 Calculate the energy transferred to the battery of the 1500 kg hybrid-car. (4)

[10]

**Question 3      Going uphill**

The hybrid-car is now tested for its performance while going uphill. The car reaches the foot of an incline at a speed of  $10 \text{ m}\cdot\text{s}^{-1}$  and reaches the top (3,5 m higher up), 5 seconds later, at a speed of  $20 \text{ m}\cdot\text{s}^{-1}$ . The mass of the car is 1500 kg.

3.1 Calculate the mechanical energy of the hybrid at A



3.2 Calculate the mechanical energy of the hybrid at B. (3)

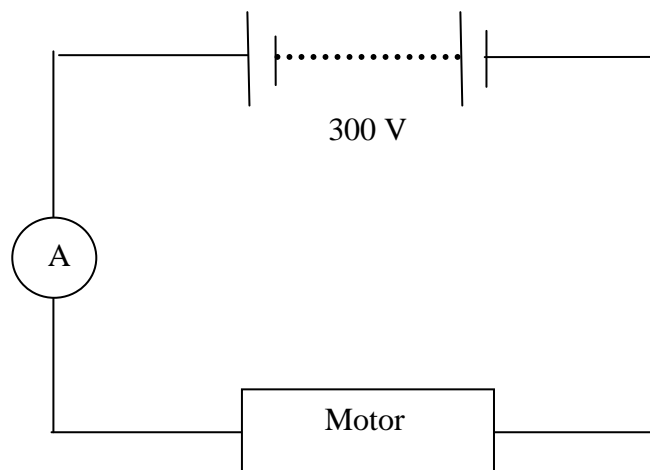
3.3 What was the increase in mechanical energy? (5)

(2)  
[10]

**Question 4      The electric circuit**

The maximum current used by the motor of the hybrid car is 100 A. The supply voltage from the batteries is 300 V.

Here is a simplified circuit for the electric motor.



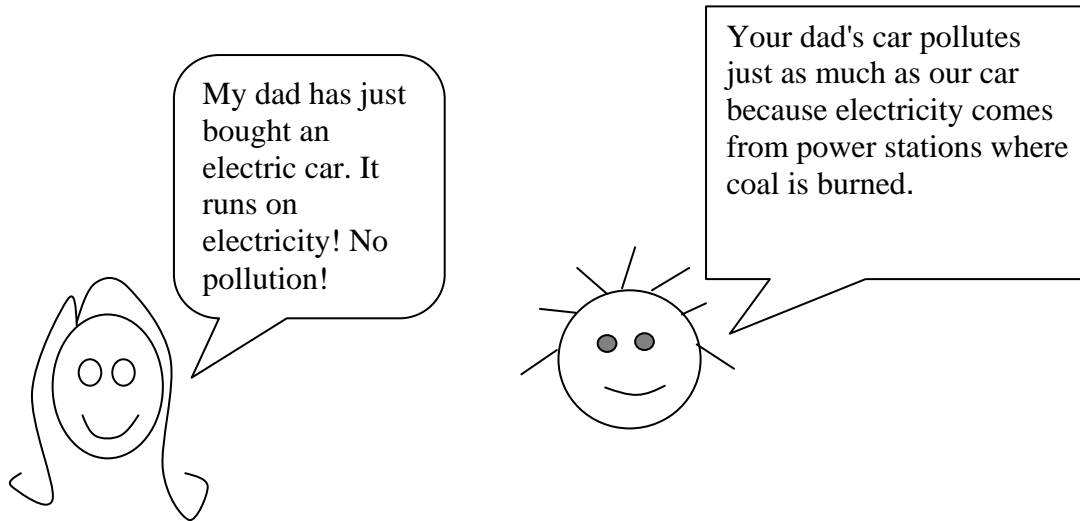
4.1 Calculate the resistance of the motor. (3)

4.2 Calculate the charge moving through the ammeter in 2 minutes. (4)

4.3 If the electric motor of the hybrid car produces less power than the power needed to go uphill, where does the extra energy come from? (1)

[8]

**Question 5 Which car to drive**

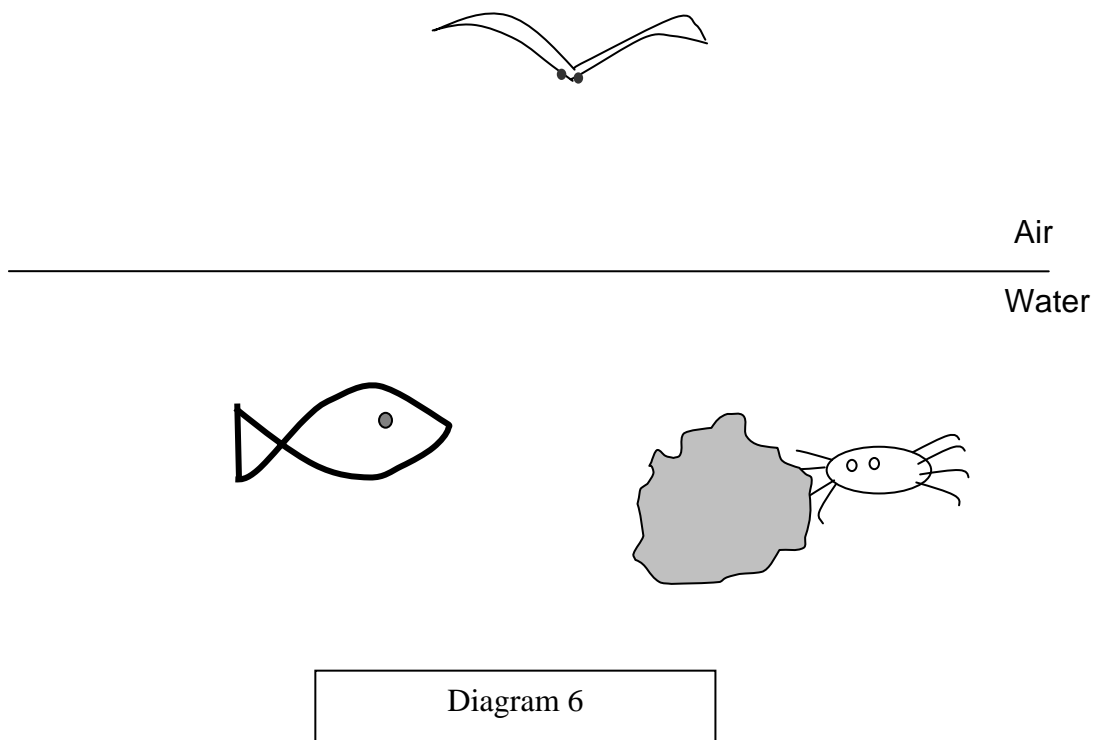


- 5.1.1 List the advantages and disadvantages of each car. (8)
- 5.2.1 Which car would you recommend for a person who works as a travelling salesman that travels 5 000 km per month? Justify your recommendation. (4)
- 5.2.2 Which car would you recommend for a business woman who works in the city. Justify your recommendation. (4)

**[16]**

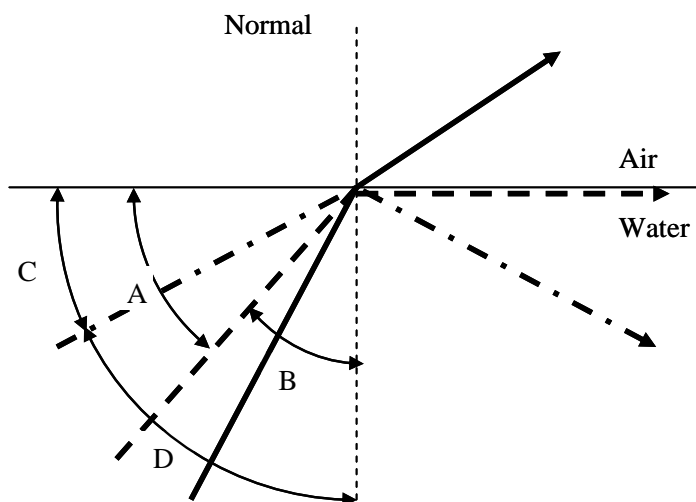
**Question 6      The fish, the crab and the bird**

A fish in a stream is threatened by a bird and a crab. The crab is behind a rock.



**The critical angle for water is  $48,6^\circ$ .**

- 6.1 State the relationship between the critical angle and the refractive index by using a formula. (1)
- 6.2 Calculate the refractive index for water. (2)
- 6.3 In the diagram below, three rays of light are shown, going from an optically more dense (water) medium to an optically less dense (air) medium. The angles of incidence, A, B, C and D are shown. Which one of these angles is the critical angle?



(2)

6.4 Use a drawing similar to the one in diagram 6 and draw the light rays relative to the normal on the water surface to show:

6.4.1 where the fish (in the water) actually sees the bird in the air. (3)

6.4.2 how it is possible for the fish to see the crab behind the rock. Use a "c" in your diagram to indicate the critical angle in your diagram). (3)

6.5 Supply the missing word/s:

6.5.1 The property of light that makes it possible for the fish to see the crab behind the rock, is \_\_\_\_\_ . (1)

6.5.2 The fish does not see the bird where it really is. The property of light that makes this possible, is the fact that light \_\_\_\_\_ when it changes medium. (1)

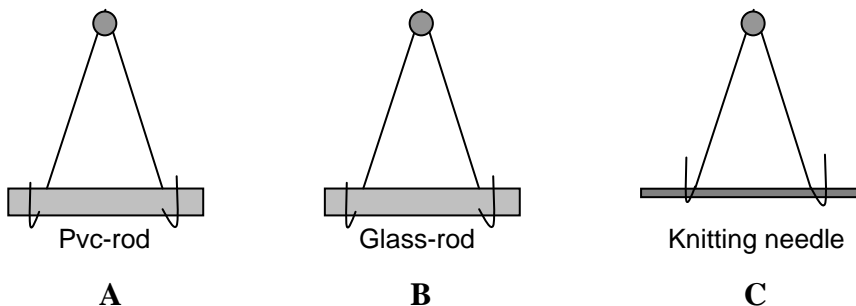
[13]

**Question 7 Static electricity practical**

John and Sarah investigate the direction of the forces between charged objects and the nature of the charges. They are given

- 2 pvc-rods
- 2 glass-rods
- 2 metal knitting needles
- a silk cloth

They rub one of the pvc-rods with a silk cloth and suspend it as shown in the diagram. They do the same with one of the glass rods and one of the knitting needles.



Step 1. John now rubs the other **pvc-rod**, suspends it in the same way as the others and brings it close to the first suspended pvc-rod A. The two rods repel each other.

Step 2. He repeats step1 bringing the suspended rubbed pvc-rod near to the first suspended glass-rod B and the suspended knitting needle C. He finds the pvc-rod and the glass-rod attracts one another and the pvc-rod and the knitting needle also attracts one another.

Step 3. Sarah rubs the other **glass rod** with the silk cloth and repeats what John has done. She finds that her glass rod and the suspended glass rod B repels one another, the glass rod and the suspended pvc-rod A attracts one another and that the glass rod and the suspended knitting needle C also attracts one another.



Step 4. She now rubs the other **knitting needle** with the silk cloth, suspends it in the same manner, and brings it close to the other suspended rods and knitting needle. The rods are attracted but nothing happens when the knitting needles are brought close together.

- 7.1 State the hypothesis John and Sarah test in step 1. (2)
- 7.2 Identify (in step 1) the
- 7.2.1 dependent variable
  - 7.2.2 independent variable (4)
- 7.3 Organize the above procedures, observations and an explanation of each of the observations in a suitable format that makes the information easily accessible. (12)
- 7.4 Write down three conclusions John and Sarah are able to draw from these results. (3)
- [21]**