# GRADE 12

# PHYSICAL SCIENCES: CONTROL TEST (P1)

## MARCH 2018

**MARKS: 50**

**TIME: 1 hour**

**This question paper consists of 7 pages and 1 data sheet**

## INSTRUCTIONS AND INFORMATION

1. This question paper consists of FOUR questions. Answer ALL the questions in the ANSWER SHEET.

2. Start EACH question on a NEW page in the ANSWER SHEET

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. You are advised to use the attached DATA SHEETS.

8. Show ALL formulae and substitutions in ALL calculations.

9. Round off your final numerical answers to a minimum of TWO decimal places.

10. Give brief motivations, discussions, et cetera where required.

11. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.3) in the ANSWER SHEET, for example 1.4 E.

1.1 The front of a modern car is designed to crumble in case of a head-on collision. The chance of serious injuries to the passenger is reduced because the.....

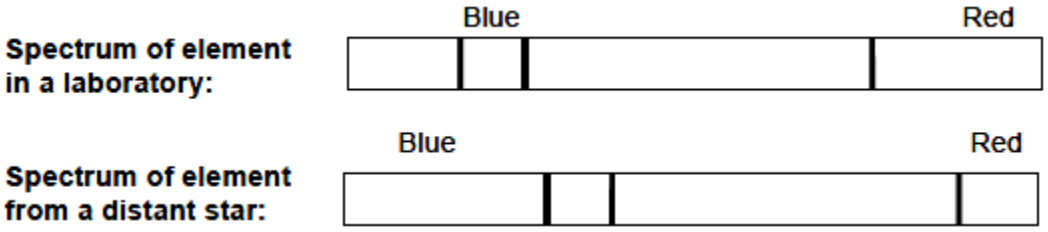
A Net force acting on the passenger is reduced since the contact time for the car to stop increases

B Net force acting on the passenger is reduced, since the rate of change in momentum increases

C Net force acting on the passenger is reduced, since the change in momentum is reduced

D Net force acting on the passenger is reduced, since the change in momentum is increased (2)

1.2 Astronomers obtained the following spectral lines of an element:




A star is moving closer towards earth.

B earth is moving towards the star.

C temperature of earth is increasing.

D universe is expanding. (2)

1.3 When an excited electron moves from a higher energy level to a lower energy level a specific.....

A emission line in an emission spectrum is observed

B absorption line in an emission spectrum is observed

C emission line in an absorption spectrum is observed

D absorption line in an absorption spectrum is observed (2)

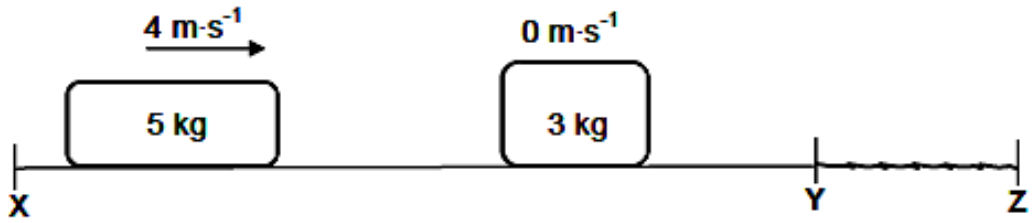
**[6]**

**QUESTION 2 (Start on a new page.)**

The diagram below shows two sections, **XY** and **YZ**, of a horizontal, flat surface. Section **XY** is smooth, while section **YZ** is rough.

A 5 kg block, moving with a velocity of 4 $m \cdot s^{-1}$ to the right, collides head-on with a stationary 3 kg block. After the collision, the two blocks stick together and move to the right, past point **Y**.

The combined blocks travel for 0,3 s from point **Y** before coming to a **STOP** at point **Z**.




2.1 State the *principle of conservation of linear momentum* in words. (2)

2.2 Differentiate between elastic and inelastic collision (2)

2.3 Calculate the **magnitude** of the:

2.3.1 Velocity of the combined blocks at point Y (4)

2.3.2 Net force acting on the combined blocks when they move through section **YZ** (4)

**[12]**

## QUESTION 3 (Start on a new page.)

The siren of a police car produces a sound of frequency 420 Hz. A man sitting next to the road notices that the pitch of the sound changes as the car moves towards and then away from him.

3.1 Write down the NAME and STATE IN WORDS the phenomenon observed by the man (3)

3.2 Assume that the speed of sound in air is 340 $m \cdot s^{-1}$. Calculate the frequency of the sound of the siren observed by the man, when the car is moving towards him at a speed of 16 $m \cdot s^{-1}$ (4)

3.3 The police car moves away from the man at constant velocity. How will the observed frequency compare with the original frequency of the siren when the police car moves away from the man at constant velocity? Write only GREATER THAN, SMALLER THAN or REMAINS THE SAME. Explain your answer. (3)

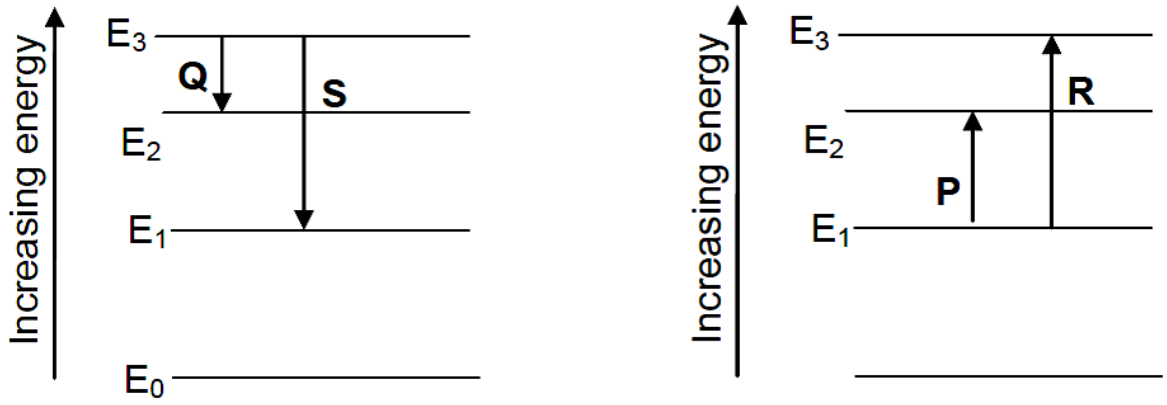
3.4 Name a medical device that makes use of the phenomenon stated in 3.1 (1)

3.5 Explain why astronomers suggest that the universe is expanding. Use an appropriate labelled diagram in your explanation (4)

**[15]**

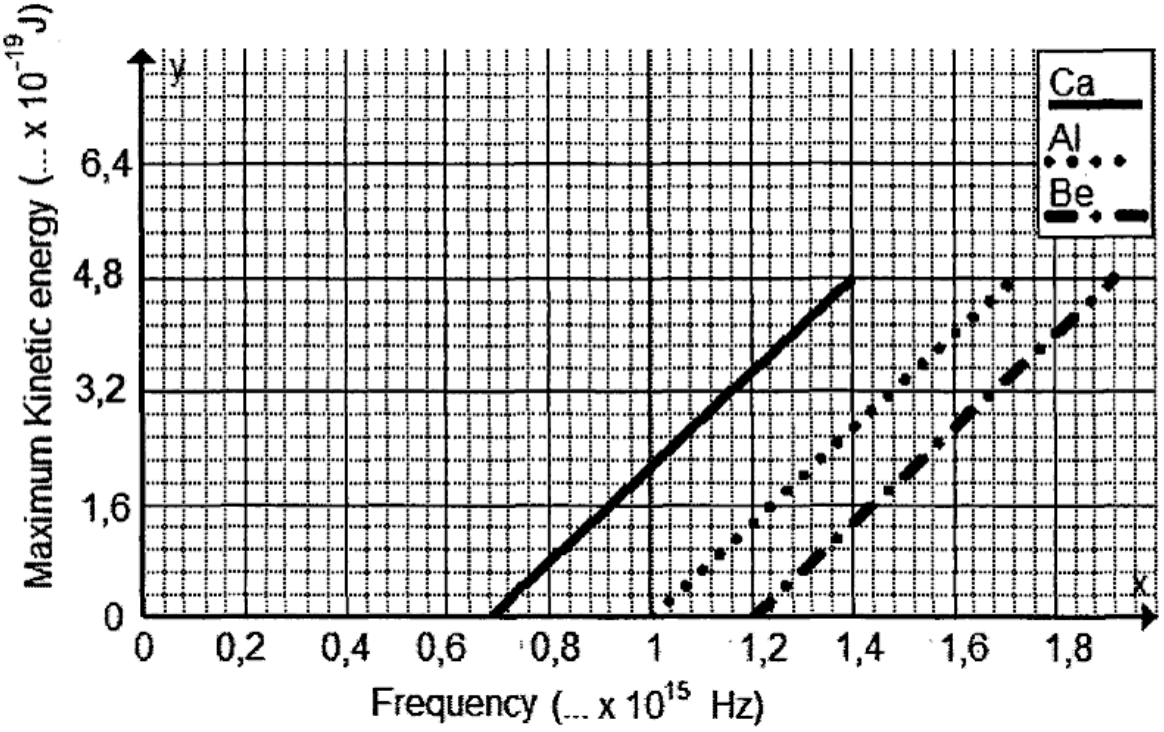
**QUESTION 4 (Start on a new page.)**

4.1 The simplified energy diagrams showing the possible electron transitions in an atom are shown below.




4.1.1 Using the letters **P**, **Q**, **R** and **S**, identify the lines that CORRECTLY show transitions that will result in the atom giving off an EMISSION SPECTRUM. (2)

4.2 When electromagnetic radiation shines on metals, electrons may be emitted. The maximum kinetic energy of emitted electrons is plotted against radiation frequency for three metals Calcium (Ca), Aluminium (Al) and Beryllium (Be) is as shown in the graph below



4.2.1 Name the phenomenon described above (1)

4.2.2 Define in words the term *cut-off frequency* (2)

4.2.3 Determine the cut-off frequency for the Beryllium (Be) metal (1)

4.2.4 What physical quantity does the gradient of these graphs represent? (1)

4.2.5 What is the minimum energy the incident light must have in order to emit electrons from the surface of the Calcium (Ca) metal? (3)

4.2.6 When electromagnetic radiation of wavelength 187 nm shines on one of the metals indicated on the graph, the maximum kinetic energy of the electrons is found to be $4\times10^{-19}$ J
Use the relevant calculations to identify the metal (7)
**[17]**

**GRAND TOTAL= 50 marks**

**"Most people say that it is the intellect which makes a great scientist. They are wrong: it is character" (Albert Einstein)**

**GOOD LUCK!!! GOOD LUCK!!! GOOD LUCK!!!**

## TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 m•s$^{-2}$ |
| Universal gravitational constant<br>*Universele gravitasiekonstant* | G | 6,67 x 10$^{-11}$ N•m$^2$•kg$^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | 3,0 x 10$^8$ m•s$^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | 6,63 x 10$^{-34}$ J•s |
| Coulomb's constant<br>*Coulomb se konstante* | k | 9,0 x 10$^9$ N•m$^2$•C$^{-2}$ |
| Charge on electron<br>*Lading op elektron* | e | -1,6 x 10$^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x 10$^{-31}$ kg |
| Mass of earth<br>*Massa op aarde* | M | 5,98 x 10$^{24}$ kg |
| Radius of earth<br>*Radius van aarde* | $R_E$ | 6,38 x 10$^3$ km |

## TABLE 2: FORMULAE/*TABEL 2: FORMULES*

### MOTION/*BEWEGING*

| | |
|---|---|
| $v_f = v_i + a\Delta t$ | $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ |
| $v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$ | $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ |

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $f_s^{\,max} = \mu_s N$ | $f_k = \mu_k N$ |
| $F_{net}\Delta t = \Delta p$<br>$\Delta p = mv_f - mv_i$ | $w = mg$ |
| $F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$ | $g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$ |

### WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $\quad f_L = \frac{v \pm v_L}{v \pm v_b} f_b$ | $E = hf$ or/*of* $E = \frac{hc}{\lambda}$ |
| $E = W_o + E_{k(max)}$ or/*of* $E = W_o + K_{max}$ where/*waar*<br>$E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$ | |