Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 2

Monday 15 May 2017 (afternoon)

Candidate session number

1 hour 15 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

2217 – 6511

13 pages

© International Baccalaureate Organization 2017

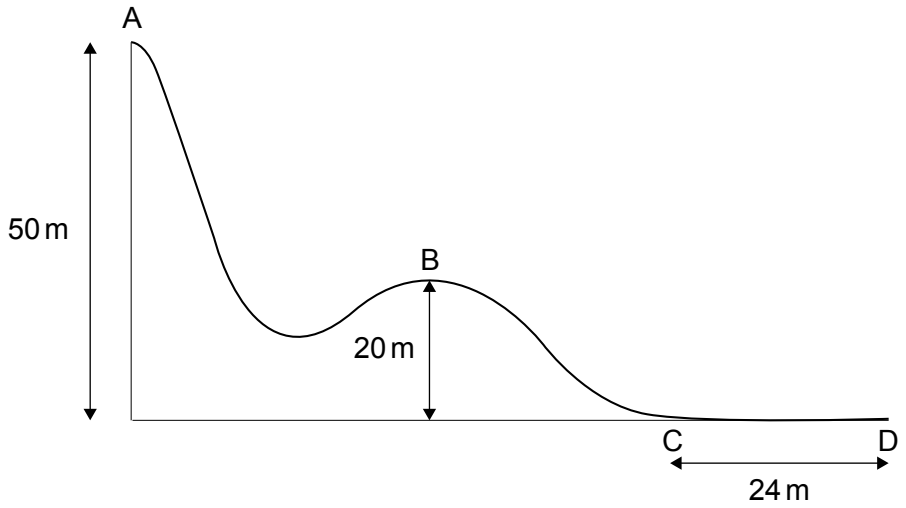
International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Please **do not** write on this page.

Answers written on this page
will not be marked.

Answer **all** questions. Answers must be written within the answer boxes provided.

1. The diagram below shows part of a downhill ski course which starts at point A, 50 m above level ground. Point B is 20 m above level ground.



(a) A skier of mass 65 kg starts from rest at point A and during the ski course some of the gravitational potential energy transferred to kinetic energy.

(i) From A to B, 24 % of the gravitational potential energy transferred to kinetic energy. Show that the velocity at B is 12 m s^{-1}. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) Some of the gravitational potential energy transferred into internal energy of the skis, slightly increasing their temperature. Distinguish between internal energy and temperature. [2]

. . . . . .

. . . . . .

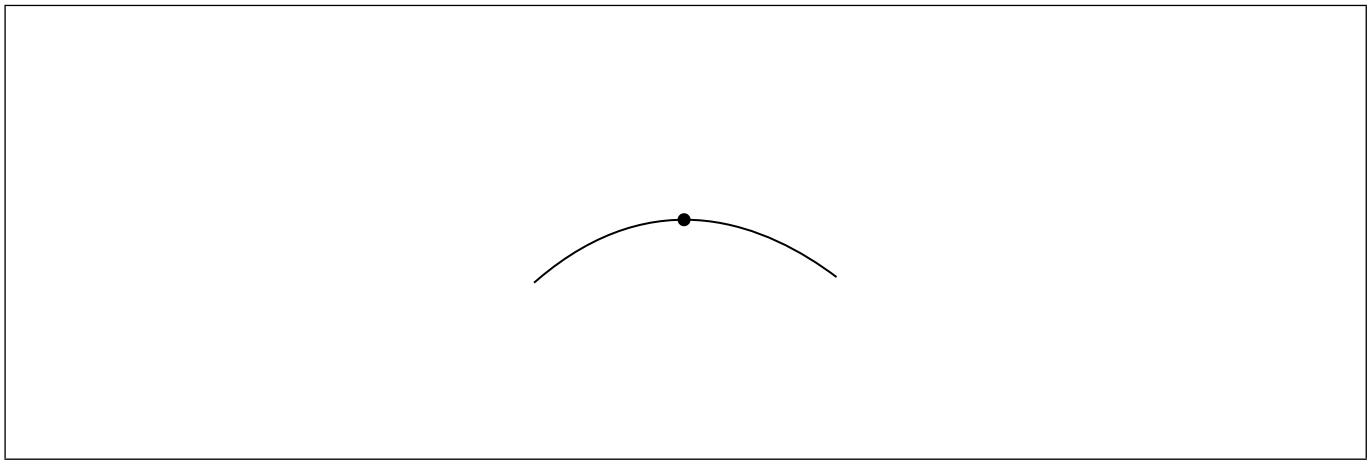
. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(b) (i) The dot on the following diagram represents the skier as she passes point B. Draw and label the vertical forces acting on the skier. [2]



(ii) The hill at point B has a circular shape with a radius of 20 m. Determine whether the skier will lose contact with the ground at point B. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) The skier reaches point C with a speed of $8.2\,m\,s^{-1}$. She stops after a distance of 24 m at point D.

Determine the coefficient of dynamic friction between the base of the skis and the snow. Assume that the frictional force is constant and that air resistance can be neglected. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(d) At the side of the course flexible safety nets are used. Another skier of mass 76 kg falls normally into the safety net with speed $9.6\,m\,s^{-1}$.

(i) Calculate the impulse required from the net to stop the skier and state an appropriate unit for your answer. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) Explain, with reference to change in momentum, why a flexible safety net is less likely to harm the skier than a rigid barrier. [2]

. . . . . .

. . . . . .

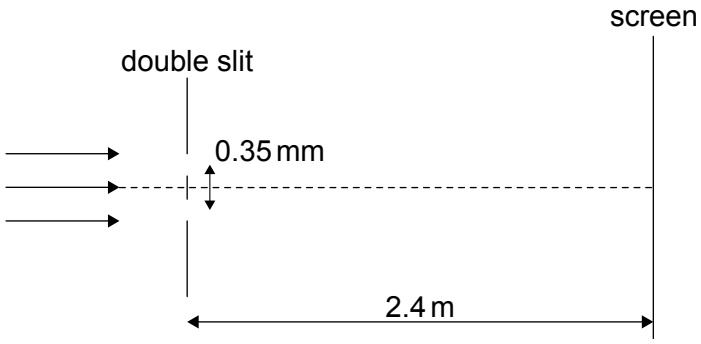
. . . . . .

. . . . . .

2. (a) Outline what is meant by the principle of superposition of waves. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Red laser light is incident on a double slit with a slit separation of 0.35 mm. A double-slit interference pattern is observed on a screen 2.4 m from the slits. The distance between successive maxima on the screen is 4.7 mm.



(not to scale)

Calculate the wavelength of the light. Give your answer to an appropriate number of significant figures. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 2 continued)

(c) Explain the change to the appearance of the interference pattern when the red-light laser is replaced by one that emits green light. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) One of the slits is now covered.

Describe the appearance of the pattern on the screen. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

3. Two renewable energy sources are solar and wind.

(a) Describe the difference between photovoltaic cells and solar heating panels. [1]

. . . . . .

. . . . . .

(b) A solar farm is made up of photovoltaic cells of area $25\,000\,m^2$. The average solar intensity falling on the farm is $240\,W\,m^{-2}$ and the average power output of the farm is 1.6 MW. Calculate the efficiency of the photovoltaic cells. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) An alternative generation method is the use of wind turbines.

The following data are available:

Length of turbine blade $= 17\,m$
Density of air $= 1.3\,kg\,m^{-3}$
Average wind speed $= 7.5\,m\,s^{-1}$

(i) Determine the minimum number of turbines needed to generate the same power as the solar farm. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 3 continued)

(ii) Explain **two** reasons why the number of turbines required is likely to be greater than your answer to (c)(i). [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

4. A heater in an electric shower has a power of 8.5 kW when connected to a 240 V electrical supply. It is connected to the electrical supply by a copper cable.

The following data are available:

Length of cable $= 10\,\text{m}$
Cross-sectional area of cable $= 6.0\,\text{mm}^2$
Resistivity of copper $= 1.7 \times 10^{-8}\,\Omega\,\text{m}$

(a) (i) Calculate the current in the copper cable. [1]

. . . . . .
. . . . . .

(ii) Calculate the resistance of the cable. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Explain, in terms of electrons, what happens to the resistance of the cable as the temperature of the cable increases. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 4 continued)

(c) The heater changes the temperature of the water by 35 K. The specific heat capacity of water is 4200 $J\,kg^{-1}\,K^{-1}$.

Determine the rate at which water flows through the shower. State an appropriate unit for your answer. [4]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

5. (a) State the quark structures of a meson and a baryon. [2]

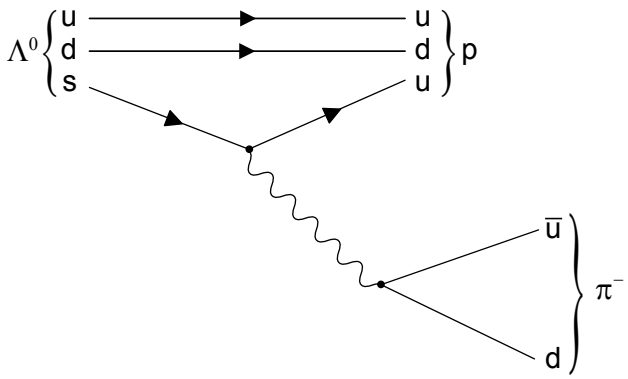
Meson: . . . . . .

. . . . . .

Baryon: . . . . . .

. . . . . .

(b) A possible decay of a lambda particle (Λ^0) is shown by the Feynman diagram.



(i) Explain which interaction is responsible for this decay. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) Draw arrow heads on the lines representing ū and d in the π^-. [1]

(This question continues on the following page)

(Question 5 continued)

(iii) Identify the exchange particle in this decay. [1]

. . . . . .
. . . . . .

(c) Outline **one** benefit of international cooperation in the construction or use of high-energy particle accelerators. [1]

. . . . . .
. . . . . .

Please **do not** write on this page.

Answers written on this page
will not be marked.

Please **do not** write on this page.

Answers written on this page
will not be marked.

Please **do not** write on this page.

Answers written on this page
will not be marked.