WELLINGTON COLLEGE

16+ ENTRANCE EXAMINATION

PHYSICS

Time allowed: 40 minutes

Total: 40 marks. Marks for each question are in brackets (x)

Special Instructions:

- Answer all questions in the spaces provided.
- Calculators may be used.

Name: _____

Current School: _____

1.   This question is about atoms of gold.

Here are some data about the precious metal gold:

The mass of 1 mole of gold is 197g
There are 6.02×10^{23} atoms in 1 mole
The density of gold is 1.92×10^4 kg/m^3.

a)   Use the data given above to show that the number of atoms of gold in 1 m^3 of gold is about 5.9×10^{28}

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(3)

b)   If we now assume that an atom of gold is cubic in shape, calculate the length of one gold atom.

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(2)

c)   If all of the atoms from 1 m³ of gold were to be lined up, side by side, calculate how long the line of gold atoms would be.

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(1)

d)   Compare, and comment on, your answer to part c) with any distances you may know.

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(2)

2. This question is about some words used in Physics.

Explain what the following words mean in Physics:
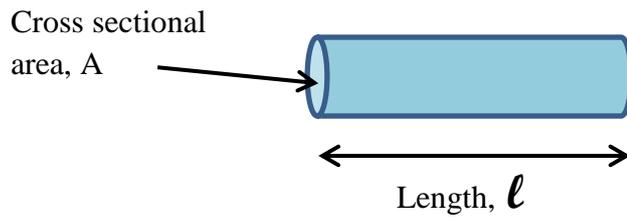
a) Temperature

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b) Pressure

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c) Power

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d) Efficiency

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(4)

3.   This question is about an electrical resistor.

Cross sectional
area, A

Length, ℓ

The diagram above shows an electrical resistor. The resistor has length, l, and cross sectional area, A.

a) The resistance, R, of the resistor is proportional to l and inversely proportional to A.
Using the axes below, sketch graphs of how the resistance of the resistor varies with l and with A.

Resistance, R

length, ℓ

Resistance, R

Cross sectional area, A

(2)
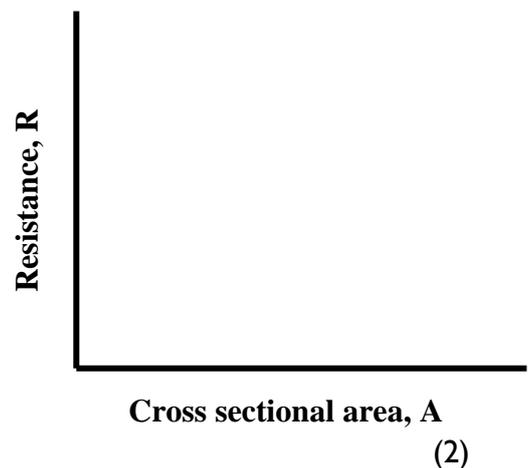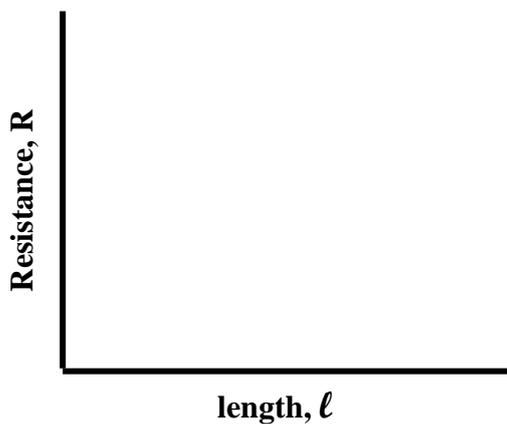
b) A Physics student wants to measure the resistance of the resistor using an electrical circuit containing an ammeter and a voltmeter.
Draw in the space below a circuit that the student could use to find the resistance of the resistor.

(3)

c) The student measures that the potential difference across the resistor is 3.5 V and the current flowing through the resistor is 13.6 mA. Calculate the resistance of the resistor.

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(2)

d) The student has several friends who live in different countries and asks the friends if they would repeat the experiment. The student reminds the friends that they must make sure that the experiment is a fair test and that they must all keep the temperature of the resistor constant at 20 °C.
Suggest:

i) Why the student thinks it is necessary to repeat the experiment

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ii) Why the temperature needs to be kept constant

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iii)   **Three other** factors that must be controlled in the experiment if it
         is to be a fair test.

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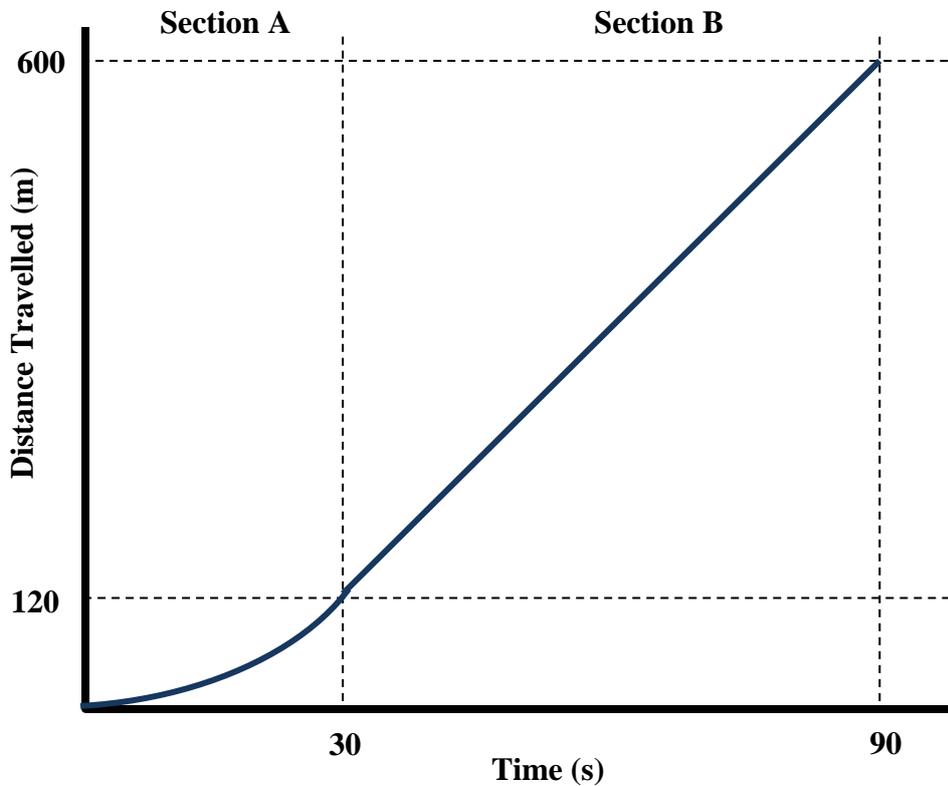   (5)

4. This question is about Forces and motion.

The graph below shows a journey made by a tractor in a muddy field.

a) Use the graph to calculate the average speed of the tractor during the whole journey.

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(1)

b) At the end of section A of the journey, the tractor was travelling at a constant speed, which it maintained throughout section B. If the mass of the tractor was 1,600 kg, calculate the average force supplied by the tractor's engine during section A of the journey.

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(4)

c) The two photographs below show the tyres of a tractor and the tyres of a family motor car of mass 1,200 kg.

Tractor Tyre

Car Tyre

Explain why the tractor will be able to drive along the muddy field, but the car will

not.

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(3)

5. This question is about Physics in movies.

   a) The 1979 science fiction film "Alien", was marketed with the tag line, "*In space no-one can hear you scream.*"
   Explain why the Physics of this statement is correct.

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   (2)

   b) The 1998 film "Armageddon" was a science fiction movie about an asteroid heading for the Earth. In the movie, some engineers were sent by space ship to land on the asteroid and to dig a deep hole into the asteroid, plant an atomic bomb and detonate the bomb so that the asteroid would be split into two parts, each of which would then veer off course, preventing the asteroid from colliding with, and destroying, the Earth.

   i)   In the movie, the asteroid is described as being a sphere as big as the US state of Texas. If the radius of the asteroid is taken to be 7.25×10^5 m and its density is
   3,000 kg /m^3, show that the mass of the asteroid is 4.8×10^{21} kg.

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The movie states that the detonation of the atomic bomb has to take place 4 hours before the asteroid collides with the Earth. The explosion will give kinetic energy to each of the two halves of the asteroid to make them move with a sideways velocity without altering their forward velocity. The diagram below shows the idea:

4 hour line
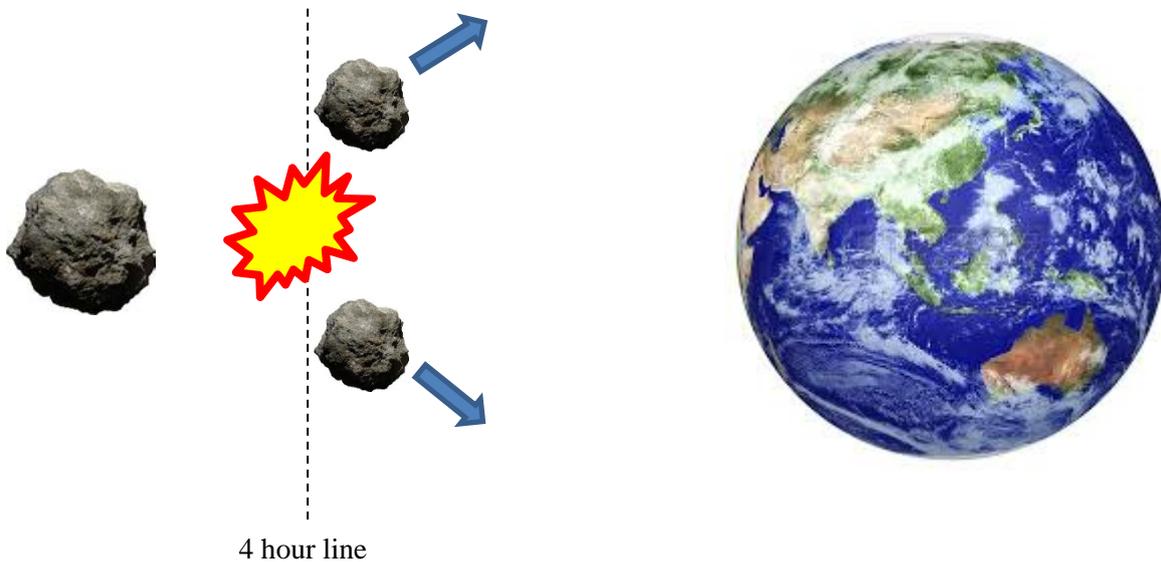
ii) According to the movie, the explosion of the atomic bomb provides 5 x 10^{18} J of energy, all of which is converted into sideways kinetic energy of the two asteroid halves. Given that the radius of the Earth is 6,400 km, is the Physics in this movie correct – i.e. will the Earth be saved?

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