OCR
Oxford Cambridge and RSA

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Monday 15 June 2015 – Morning

GCSE ADDITIONAL APPLIED SCIENCE

A192/02   Science of Materials and Production (Higher Tier)

Duration: 1 hour

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. HB pencil may be used for graphs and diagrams only.
* Answer **all** the questions.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

* Your quality of written communication is assessed in questions marked with a pencil (✐).
* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* The total number of marks for this paper is **50**.
* This document consists of **16** pages. Any blank pages are indicated.

Turn over

2

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Answer **all** the questions.

1 Small amounts of magnesium carbonate may be added to table salt to help it flow more easily. Magnesium carbonate is an insoluble salt, which can be made by mixing solutions of magnesium sulfate and sodium carbonate.

(a) Complete this balanced equation for the reaction of magnesium sulfate and sodium carbonate.

$$MgSO_4 \ + \ Na_2CO_3 \ \rightarrow \ .... \ + \ ....$$

[2]

(b) Give a detailed description and explanation of a procedure for making a dry sample of pure **insoluble** magnesium carbonate crystals from solutions of magnesium sulfate and sodium carbonate.

The quality of written communication will be assessed in your answer to this question.

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.... **[6]**

[Total: 8]

Turn over

2 Jim is an Environmental Health Officer.

He investigates an outbreak of food poisoning in Smalltown.

Six people become very ill on the Saturday night and are rushed to hospital.

The doctor says that they all have food poisoning.

Jim asks the six people to list where they ate on Saturday.

Here are the results of his survey.

Where they ate on Saturday	Alice	Bert	Claudia	Dave	Elena	Fred
At home	✓	✓		✓	✓	
Fresh Fish Fryers			✓			
Best Pizza Parlour	✓	✓	✓		✓	✓
Hot Chilli Takeaway	✓			✓		✓
Quick Pasta Cafe				✓		

 (a) Why can't Jim be completely sure where the poisoned food was eaten?

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.... **[1]**

 (b) What might Jim conclude from his survey?

Use data from the survey to justify your answer.

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.... **[2]**

 (c) Jim suspects that the food was poisoned by bacteria in the food.

Explain how bacteria can poison food.

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.... **[2]**

(d) Microorganisms in food are not always harmful.

Describe **one** use of a microorganism to make a useful food product.

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.... **[2]**

[Total: 7]

Question 3 begins on page 6

Turn over

3 Jo works in a standards laboratory.

She tests a sample of climbing rope to check that it meets product standards.

Jo increases the weight hung from one end of the rope until it breaks.

(a) Name the type of loading that the rope has in this test.

.... **[1]**

(b) Here are Jo's results.

length of rope	5.5 m
diameter of rope	10 mm
maximum weight	40 000 N

Use these equations to show that the breaking strength of the rope material is about 500 N/mm^2.

$$\text{breaking strength (N/mm}^2\text{)} = \frac{\text{maximum weight (N)}}{\text{cross sectional area (mm}^2\text{)}}$$

$$\text{cross sectional area (mm}^2\text{)} = \frac{3.14}{4} \times (\text{diameter (mm)})^2$$

breaking strength = ... N/mm^2 **[2]**
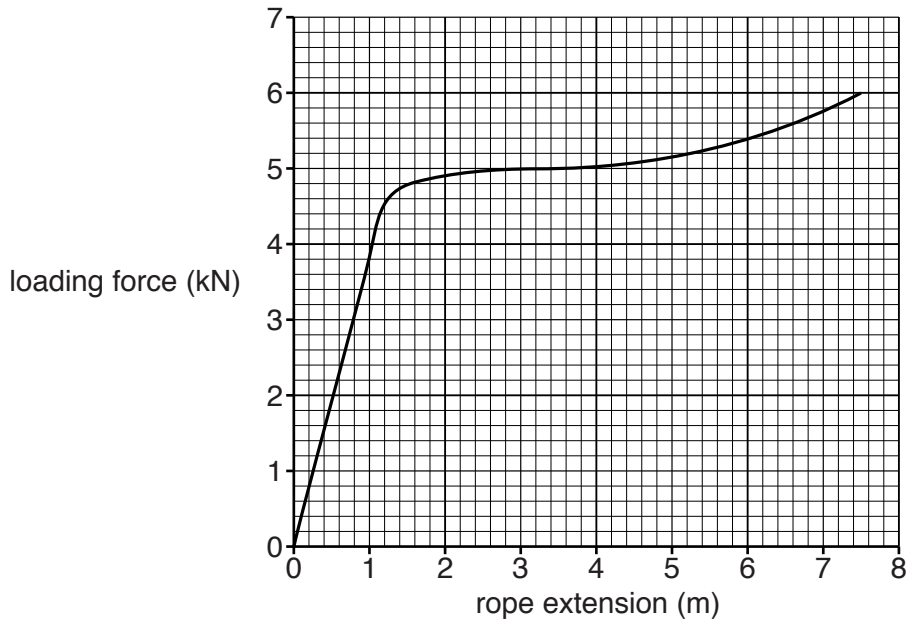
(c) The maximum loading that this type of climbing rope will have in use is only about 100 N/mm^2.

Explain why the product standard requires a breaking strength of at least 400 N/mm^2.

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.... **[2]**

(d) Here is a force-extension graph for another rope as it is stretched to breaking point.

loading force (kN)

rope extension (m)

   (i) State the minimum loading force required to give the rope **plastic** behaviour.

loading force = ... kN **[1]**

   (ii) What is the difference between elastic and plastic behaviour of a material?

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.... **[2]**

[Total: 8]

4 Greg tests his new skis.

Greg's new skis are made of a **composite material** called carbon fibre, with a suitable combination of properties.

Describe the structure of **another** composite material and state how it combines the useful properties of the materials it is made from and avoids their drawbacks.

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[Total: 4]

5 Nina is designing a new theatre.

She knows that her choice of materials for the walls, ceiling and floor will affect the way that sound carries from the stage and is heard in the hall.

Suggest suitable materials and explain the effect of these materials on the sound heard by the audience.

The quality of written communication will be assessed in your answer to this question.

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[Total: 6]

6 Julie and Mike go to an open-air music festival.

(a) Julie can't see the stage because of the people in front of her.

She uses this arrangement of mirrors (a periscope) to see over their heads.

top mirror

light from
the stage

tube

bottom mirror
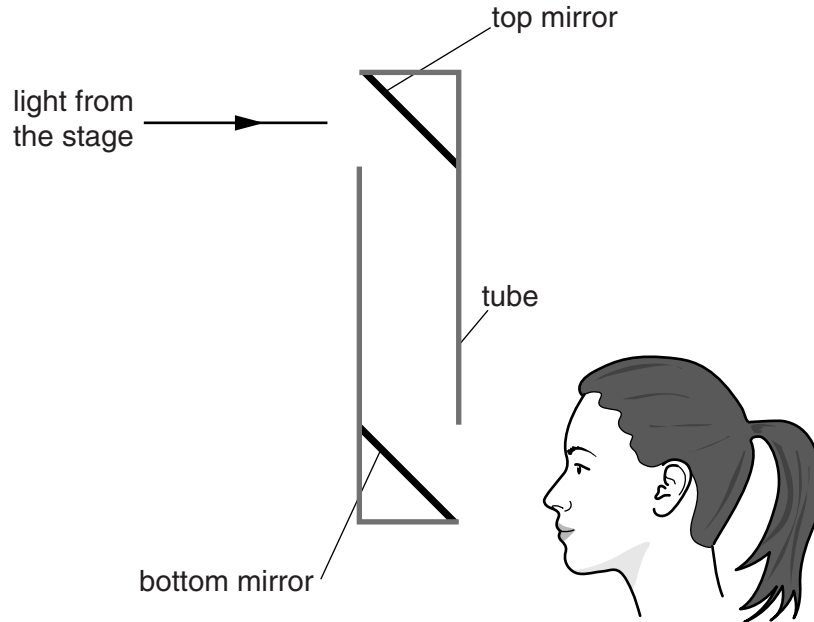
Draw lines to continue the ray of light from the stage through the periscope to Julie's eyes.

[2]

(b) Mike uses this arrangement of lenses (a telescope) to view the stage.

filter

eyepiece lens

light from
the stage

light to
Mike's eyes
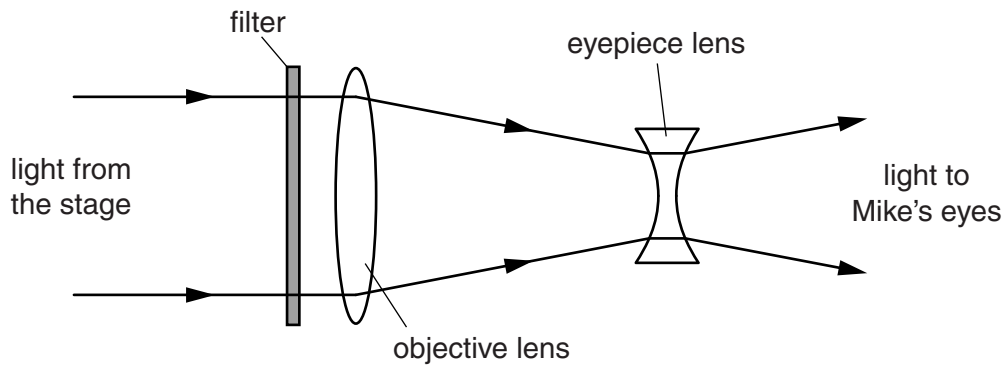
objective lens

(i) Complete these sentences to explain the action of the telescope.

Choose words from this list.

converging   diverging   image   object

opaque   reflects   refracts   transparent

The objective lens is a .... type.

It is made from .... glass which .... the light as it passes

through.

The eyepiece lens is a .... type, creating an .... which is

closer to Mike than the stage.

[3]

(ii) The telescope contains a filter with these characteristics.

Light colour	Percentage transmitted
red	90%
green	90%
blue	10%

What colour does the filter make the stage appear?

Give a reason for your answer.

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.... **[2]**

[Total: 7]

7 Shaun has some goats on his farm.

He decides to sell milk from his goats to a local shop.

Describe how and **explain** why he will **test** and **process** the milk from his goats.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

[Total: 6]

8 Sometimes farmers spray fruit trees with Bordeaux mixture. This stops fungal attack.
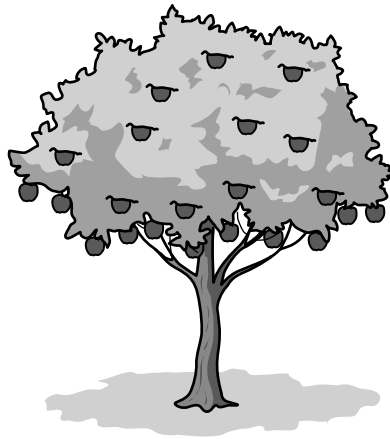
Here is a formulation for Bordeaux mixture:

* Dissolve 50 g of copper sulfate crystals in 3.0 litres of hot water.

* Dissolve 25 g of powdered lime in 2.0 litres of cold water.

* Mix the solutions together.

(a) Calculate the concentration of copper sulfate in Bordeaux mixture.

concentration of copper sulfate = ... g / litre **[2]**

(b) The recommended rate of application of Bordeaux mixture is 1.0 litre for 5 trees.

How many litres of mixture will be needed to spray 150 trees?

volume of mixture = ... litres **[1]**

Turn over

(c) There are three grades of copper sulfate crystal.

Which grade would be most suitable for making a fungicide?

Draw **one** straight line to join the most suitable **grade** with the **reason** for its use as a fungicide. Draw only **one** line.

grade	reason
technical	certified free from additives
analytical	do not need the highest purity
laboratory	only the best should be used

[1]

[Total: 4]

END OF QUESTION PAPER

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