RADLEY

2017 Scholarship Examination Paper

PHYSICS

Time allowed – 30 minutes

Calculators are not to be used

Total marks available = 33

Most of the marks in these questions are for showing how well you think. Your final answers are less important than demonstrating a logical and systematic approach.

You must show your working out at all stages and state any assumptions that you make.

Where you can, use powers of ten to show very big or very small numbers. For example 1,000,000 can be written: 1.0×10^6

The Six Nations Rugby Union Championship

This exam is inspired by the 2017 Six Nations Championship, which takes place in February and March of this year. If Rugby is not your thing, do not worry! The questions will assume no prior knowledge…

The Pitch

1. A standard rugby pitch is 125 metres long by 70m wide. What is the area of a standard rugby pitch? **[2]**

2. It is normal for the turf of a rugby pitch to be laid onto a layer of sand 300mm deep. What volume of sand would be required for a standard rugby pitch? Express you answer in m^3. **[2]**

3. The density of dry sand is approximately 1 g/cm^3. Show that this is equivalent to 1000 kg/m^3. **[2]**

4. What mass of sand is required for a standard rugby pitch? Express your answer in kg and answer to two significant figures using powers of ten (eg 1.0×10^6). **[2]**

The Tournament

5. In the Six Nations, each of the six teams plays every other team once. How many matches are there in each tournament? **[3]**

6. The Six Nations is an annual competition. How many Six Nations matches were there between 2000 and 2016 (inclusive)? **[2]**

Blowing the Whistle

7. On the morning of a big match, the referee stands in the centre of the empty stadium and tests his whistle with a short, sharp burst of sound. The sound of the whistle echoes from the back of the stands. Approximately, how soon after he starts blowing the whistle will he start to hear the echo? State your assumptions and show your working. As you may know, the speed of sound is approximately 340m/s. **[3]**

8. Frequency, wavelength and speed are three important properties of a sound wave. They are related by the following equation:

Wave Speed (in metres per second) = Frequency (in Hertz) x Wavelength (in metres)

The frequency of a referee's whistle is approximately 1700 Hertz. What is the wavelength of this sound? **[3]**

Kicking the Ball

9. At various times during the game, a player will attempt to place kick the ball over the crossbar of the rugby posts. Describe the energy changes that take place during a successful place kick; from the moment the kicker starts his run-up to the moment the ball lands back on the ground. **[4]**

Scoring Points

10. In Rugby, points are scored as follows…

- Unconverted Try: 5 points
- Converted Try: 7 points
- Penalty: 3 points

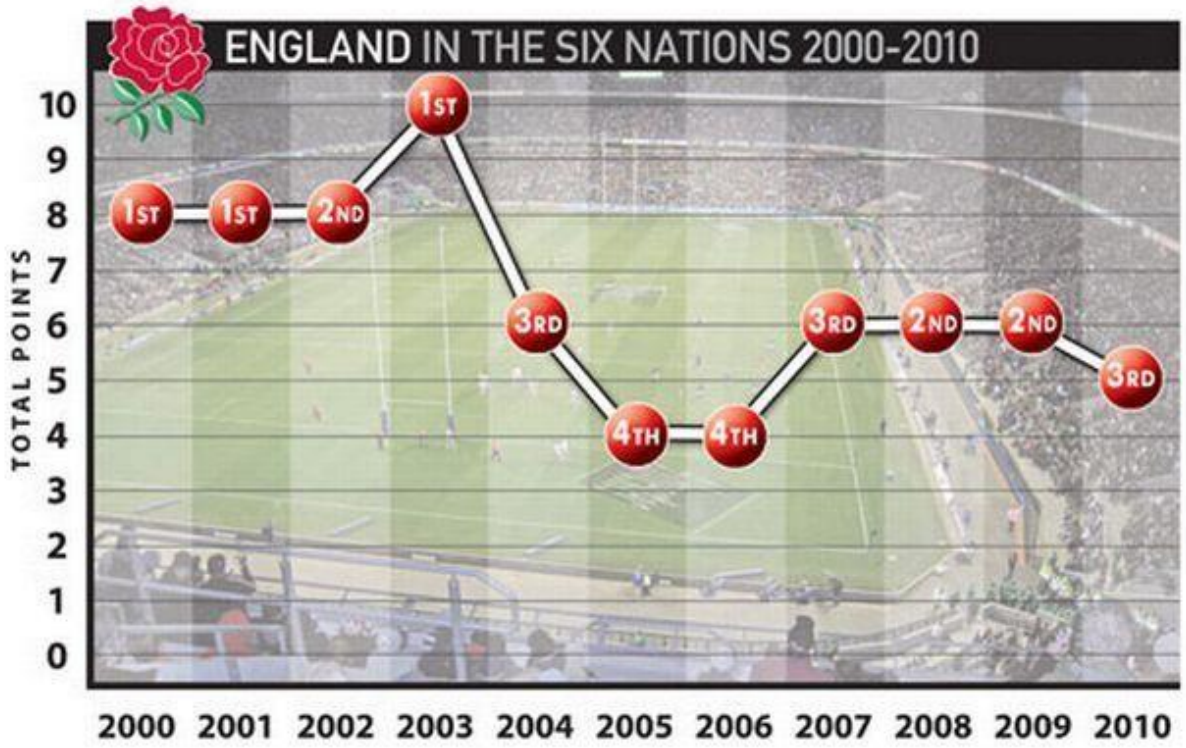
A team scores 17 points.

a) What is the maximum possible number of tries that the team scored? **[2]**

b) In your answer to (a), how many were converted? **[1]**

c) What is the maximum possible number of penalties the team scored? **[2]**

Some Statistics



The above graph describes England's performance in the Six Nations between 2000 and 2010 (inclusive). Use this graph to answer the next three questions.

11. How many times did England come 3rd in the competition? **[1]**

12. In which year did England complete a Grand Slam (win all of its matches)? **[2]**

13. In which year *must* another team have completed a Grand Slam? **[2]**