**1.** [Maximum mark: 14]

The following table shows the average body weight, $x$, and the average weight of the brain, $y$, of seven species of mammal. Both measured in kilograms (kg).

| Species | Average body weight, $x$ (kg) | Average weight of the brain, $y$ (kg) |
|---|---|---|
| Cat | 3 | 0.026 |
| Cow | 465 | 0.423 |
| Donkey | 187 | 0.419 |
| Giraffe | 529 | 0.680 |
| Goat | 28 | 0.115 |
| Jaguar | 100 | 0.157 |
| Sheep | 56 | 0.175 |

(a) Find the range of the average body weights for these seven species of mammal. [2]

(b) For the data from these seven species

    (i) calculate $r$, the Pearson's product–moment correlation coefficient;

    (ii) describe the correlation between the average body weight and the average weight of the brain. [4]

(c) Write down the equation of the regression line $y$ on $x$, in the form $y = mx + c$. [2]

The average body weight of grey wolves is $36\,\text{kg}$.

(d) Use your regression line to estimate the average weight of the brain of grey wolves. [2]

In fact, the average weight of the brain of grey wolves is $0.120\,\text{kg}$.

(e) Find the percentage error in your estimate in part (d). [2]

The average body weight of mice is $0.023\,\text{kg}$.

(f) State whether it is valid to use the regression line to estimate the average weight of the brain of mice. Give a reason for your answer. [2]

**4.** [Maximum mark: 16]

On her first day in a hospital, Kiri receives $u_1$ milligrams (mg) of a therapeutic drug. The amount of the drug Kiri receives increases by the same amount, $d$, each day. On the seventh day, she receives 21 mg of the drug, and on the eleventh day she receives 29 mg.

(a) Write down an equation, in terms of $u_1$ and $d$, for the amount of the drug that she receives

    (i) on the seventh day;

    (ii) on the eleventh day. [2]

(b) Write down the value of $d$ and the value of $u_1$. [2]

Kiri receives the drug for 30 days.

(c) Calculate the total amount of the drug, in mg, that she receives. [3]

Ted is also in a hospital and on his first day he receives a 20 mg antibiotic injection. The amount of the antibiotic Ted receives decreases by 50% each day. On the second day, Ted receives a 10 mg antibiotic injection, on the third day he receives 5 mg, and so on.

(d) (i) Find the amount of antibiotic, in mg, that Ted receives on the fifth day.

    (ii) The daily amount of antibiotic Ted receives will first be less than 0.06 mg on the $k$th day. Find the value of $k$.

    (iii) Hence find the total amount of antibiotic, in mg, that Ted receives during the first $k$ days. [9]
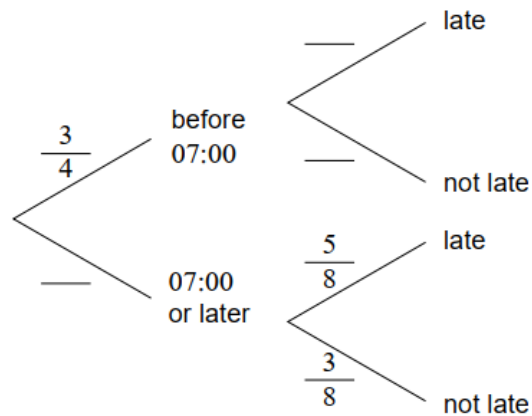
**8.** [Maximum mark: 14]

Pablo drives to work. The probability that he leaves home before 07:00 is $\frac{3}{4}$.

If he leaves home before 07:00 the probability he will be late for work is $\frac{1}{8}$.

If he leaves home at 07:00 or later the probability he will be late for work is $\frac{5}{8}$.

(a) **Copy** and complete the following tree diagram. [3]



(b) Find the probability that Pablo leaves home before 07:00 and is late for work. [2]

(c) Find the probability that Pablo is late for work. [3]

(d) Given that Pablo is late for work, find the probability that he left home before 07:00. [3]
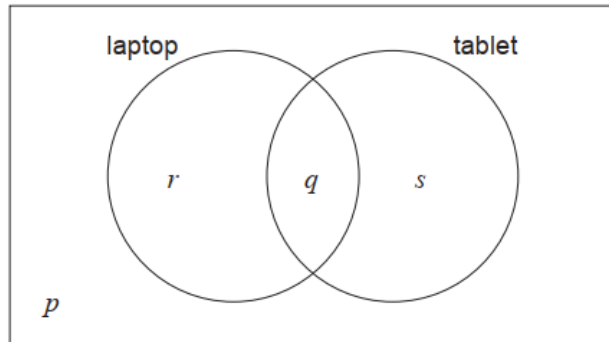
(e) Two days next week Pablo will drive to work. Find the probability that he will be late at least once. [3]

**8.** [Maximum mark: 13]

In a class of 21 students, 12 own a laptop, 10 own a tablet, and 3 own neither.
The following Venn diagram shows the events "own a laptop" and "own a tablet".
The values $p$, $q$, $r$ and $s$ represent numbers of students.
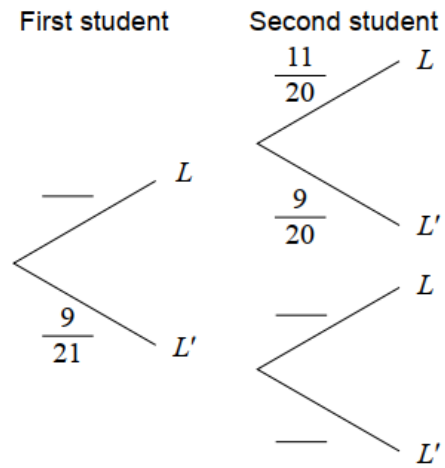


(a) (i) Write down the value of $p$.

 (ii) Find the value of $q$.

 (iii) Write down the value of $r$ and of $s$.                                           [5]

(b) A student is selected at random from the class.

 (i) Write down the probability that this student owns a laptop.

 (ii) Find the probability that this student owns a laptop or a tablet but not both.    [4]

**(This question continues on the following page)**

(c)   Two students are randomly selected from the class.  Let $L$ be the event a "student owns a laptop".

(i)   **Copy** and complete the following tree diagram.  (Do **not** write on this page.)

**First student**          **Second student**

$$\frac{11}{20} \qquad L$$

$L$

$$\frac{9}{20} \qquad L'$$

$L$

$$\frac{9}{21} \qquad L'$$

$$L'$$

(ii)   Write down the probability that the second student owns a laptop given that the first owns a laptop.                                                                                  [4]