Solving Problems Using Time

From the National Curriculum:

Solve problems

- **Develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems.**
- **Develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics.**
- **Begin to model situations mathematically and express the results using a range of formal mathematical representations.**
- **Select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.**

Measures

Pupils should be taught to:
- **Use standard units of mass, length, time, money and other measures, including with decimal quantities.**

The UKMT Problem

12. The musical *Rent* contains a song that starts 'Five hundred and twenty five thousand six hundred minutes'.
Which of the following is closest to this length of time?

A a week   B a year   C a decade   D a century   E a millennium

JMC 2012 Q12

Starting points

Activity 1

These questions look at converting minutes to hours.

Question 1

Convert the following minutes to hours.

	Minutes	Hours
1	135	
2	1260	
3	865200	
4	9413880	
5	1440	
6	966	

Question 2

Convert the following hours to minutes.

	Hours	Minutes
1	550	
2	36	
3	1658	
4	4.5	
5	18.25	
6	1260	

Question 3

These questions look at how many minutes elapse between two times.

It has just turned 22:22. How many minutes are there until midnight?

A 178   B 138   C 128   D 108   E 98

JMC 2005 Q2

How many minutes will elapse between 20:12 today and 21:02 tomorrow?

A 50   B 770   C 1250   D 1490   E 2450

IMC 2012 Q5

On my clock's display, the time has just changed to 02:31. How many minutes will it be until all the digits 0, 1, 2, 3 next appear together again?

A 1   B 41   C 50   D 60   E 61

IMC 2010 Q8

The time shown on a digital clock is 5:55. How many minutes will pass before the clock next shows a time for which all the digits are the same?

A 255   B 316   C 377   D 436

IMC 2003 Q10

Activity 2

We can extend this to think about other time frames.

Question 1

How many minutes are there in a:	**Minutes**
Day	
Week	
Month with: • 28 days • 30 days • 31 days	
Year (not a leap year)	
Decade	
Century	

Question 2

Questions about different time conversions.

	Convert	**Answer**
1	How many weeks are there in 65 days?	
2	How many hours are there in two weeks?	
3	How many minutes are there in 7 hours?	
4	Hour many hours are there in 4 days 6 hours?	
5	How many hours are there in 6 days 10 hours?	
6	How many minutes are there in 16 minutes?	
7	How many years are there in 1000 days?	
8	How many hours are there in 9 weeks?	
9	How many seconds are there in 9 hours?	
10	How many hours are there in 1000 minutes?	

Question 3

A machine cracks open 180, 000 eggs per hour. How many eggs is that per second?

IMC 2013 Q1

How many hours are there in this week?

A 24   B 70   C 84   D 148   E 168

IMC 2008 Q1

A radio advertisement claimed that using a particular brand of artificial sweetener every day would 'save 7 000 calories in a year'. Approximately how many calories is this per day?

A 20   B 40   C 70   D 100   E 140

IMC 2010 Q4

Activity 3 - How old are you?

Question 1
How old are you in these units?

Minutes	
Days (remember that leap years occur every 4 years, and have 366 days)	
Weeks	
Months	
Years	
Decades	
Centuries	

Question 2
If I am 50,000 minutes old am I a baby, child, a teenager or an adult? Explain your answer.

Question 3
For these questions you can assume all years have 365 days.

If I am this old then… Questions converting mins, hours, seconds to age.	How old am I? In years, days, hours, minutes, and seconds. Assume 365 days in a year.
500,000 minutes	
500,000 hours	
1,000,000 seconds	
1,000,000 minutes	
178080 hours	
5,000,000 seconds	

Question 4
Which of these is longest 100,000 minutes, 10,000 hours or 1000 days?

Which of these is longest 500,000 minutes, 500 hours, or 50 days?

Which of these is longest 2,000 minutes, 200 hours, or 2 days?

Question 5 (JMC 2010 Q9)

Which of the following is the longest period of time?

A 3002 hours   B 125 days   C $17\frac{1}{2}$ weeks   D 4 months   E $\frac{1}{3}$ of a year

Activity 4

The original problem.

Convert the number of minutes to hours, and the hours to days. What length of time is this?

12. The musical *Rent* contains a song that starts 'Five hundred and twenty five thousand six hundred minutes'.

Which of the following is closest to this length of time?

A a week   B a year   C a decade   D a century   E a millennium

JMC 2012 Q16

Challenge Activity 1: Talent Show!

TV talent shows are increasingly popular. People audition in front of a group of three or four judges in the hope of becoming a star.

Question 1

If 250,000 people audition for a show, and each audition takes 5 minutes, how long will it take the judges to view all the auditions?

Question 2

This may be an overestimate. Apparently, there are 'tens of thousands' of people applying. If 50,000 people audition, how long will this take the judges to view all the auditions?

Question 3

Obviously this is impossible, and most auditions are heard by researchers first. Suppose there are 5,000 people auditioning in a venue over two days, how many researchers would be needed to see everyone? Assume each researcher works only 5 hours per day.

Question 4

How many people do you think actually get to audition in front of the judges? Explain your answer.

Challenge Activity 2: Calendars

Question 1

Explain why the 1st of March is always on the same day of the week as the 1st of November

Make a deduction about the day of the week that 31st May falls on compared to the 1st August.

Question 2

30 days has September,
April, June and November.
All the rest have 31,
Except February alone,
Which has 28 days clear,
And 29 in each leap year.

If March 29th is a Wednesday, what day is the April 6th in the same year?

Challenge Activity 3: Father Christmas

Father Christmas delivers presents to every child on Christmas Eve.

Question 1
The population of the world is 7.6 billion. How many do you think are children?

Question 2
The actual time during which children are asleep varies across the world due to the different time zones. Let's assume Father Christmas has 24 hours to deliver all the presents. How long does he have in which to deliver each present?

Question 3
So Father Christmas must have some magic powers to deliver the presents that fast! Assuming he did it without the aid of magic, and needed 10 minutes per child, how long would it actually take him?

Question 4
Each household had 2.7 children on average. How many households does he have to visit?

Question 5
The average distance between households is 2.5 km. How far does Father Christmas need to travel?

Question 6
Assuming he had 24 hours in which to deliver all the presents how fast is Father Christmas traveling?

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Further UKMT questions to use:
UKMT IMC 1999 Q3
UKMT IMC 2007 Q1
UKMT IMC 2008 Q1
UKMT IMC 2010 Q4
UKMT IMC 2010 Q7
UKMT IMC 2012 Q5
UKMT IMC 2013 Q2
UKMT IMC 2014 Q5

Answers

Activity 1

Question 1

	Minutes	Hours
1	135	2.25 = 2 hrs 15 min
2	1260	21
3	865200	14420
4	9413880	156898
5	1440	24
6	966	16.1 = 16 hrs 6 min

Question 2

	Hours	Minutes
1	550	33,000
2	36	2160
3	1658	99480
4	4.5	270
5	18.25	1095
6	1260	75600

Question 3

It has just turned 22:22. How many minutes are there until midnight?

A 178   B 138   C 128   D 108   E 98

JMC 2005 Q2

E: At 22:22 there are 60 – 22 = 38 minutes until 23:00. There are a further 60 minutes to midnight. So the number of minutes which remain until midnight is 38 + 60 = 98.

How many minutes will elapse between 20:12 today and 21:02 tomorrow?

A 50   B 770   C 1250   D 1490   E 2450

IMC 2012 Q5

D: The difference between the two given times is 24 hours and 50 minutes. So the number of minutes that elapse are 24 x 60 + 50 = 1440 + 50 = 1490.

On my clock's display, the time has just changed to 02:31. How many minutes will it be until all the digits 0, 1, 2, 3 next appear together again?

A 1   B 41   C 50   D 60   E 61

IMC 2010 Q8

B: The next such display will be 03:12, that is in 41 minutes' time.

IMC 2003 Q10   The time shown on a digital clock is 5:55. How many minutes will pass before the clock next shows a time for which all the digits are the same?

A 255   B 316   C 377   D 436

B The next time the digits are all the same is 11.11, so 316 minutes will pass.

Activity 2

Question 1

How many minutes are there in a:	Minutes
Day	1440
Week	10080
Month • 28 days • 30 days • 31 days	• 40320 • 43200 • 44640
Year	525600
Decade	5256000
Century	52560000

Question 2

	Convert	Answer
1	How many weeks are there in 65 days?	9 weeks 2 days
2	How many hours are there in two weeks?	336 hours
3	How many minutes are there in 7 hours?	420 minutes
4	Hour many hours are there in 4 days 6 hours?	102 hours
5	How many hours are there in 6 days 10 hours?	154 hours
6	How many minutes are there in 16 minutes?	960 minutes
7	How many years are there in 1000 days?	2.74 = 2 years 270 days, assuming no leap year
8	How many hours are there in 9 weeks?	1512 hours
9	How many seconds are there in 9 hours?	32400 seconds
10	How many hours are there in 1000 minutes?	$16\frac{2}{3}$ hours = 16 hours 40 minutes.

Question 3

A machine cracks open 180, 000 eggs per hour. How many eggs is that per second?

IMC 2013 Q1

The machine cracks open 180,000 /(60x60) = 50 eggs per second.

How many hours are there in this week?

A 24   B 70   C 84   D 148   E 168

IMC 2008 Q1

E: The clocks do not go forward or back this week, so there are seven 24-hour days, that is 168 hours.

A radio advertisement claimed that using a particular brand of artificial sweetener every day would 'save 7 000 calories in a year'. Approximately how many calories is this per day?

A 20   B 40   C 70   D 100   E 140

IMC 2010 Q4

A: The number of calories saved per day is $\frac{7000}{365} \approx \frac{7000}{350} \approx 20$.

Activity 3

Question 1

Can you work out how old you are in:	Assuming a 14 year old student:
Minutes	5113x24x60 = 7,362,720
Days	If you are 14 you will have lived through 3 or 4 leap years. 10x 365 = 3650 4 x 366 = 1464 Total 5114
Weeks	728 weeks
Months	168 months
Years	14
Decades	1 decade 4 years
Century's	0.14 century's

Question 2

If I am 50,000 minutes old, Am I a baby, child, teenager or adult?
34.7 days =34 days 17 hours 20 mins. So still a baby!

Question 3

Questions converting mins, hours, seconds to age	How old am I?
500,000 minutes	347 days, 5 hours , 20 mins
500,000 hours	57 years 28 days 8 hours assuming 365 days in a year
1,000,000 seconds	11 days 13 hours 46 min 40 seconds
1,000,000 minutes	1 year 329 days 10 hours 40 minutes
178080 hours	7420 days= 20 years 120 days
5,000,000 seconds	3472 days 13 hours 20 min = 9 years 187 days 13 hours 20 min

Question 4

Which of these is longest 100000 minutes, 10000 hours or 1000 days?
1000 days is 24,000 hours and 1,440,000 minutes, so longest.
Which of these is longest 500000 minutes, 500 hours, or 50 days?
50 days is 1200 hours and 72,000 minutes, so 500,000 minutes is longest.
Which of these is longest 2000 minutes, 200 hours, or 2 days?
200 hours is 12,000 seconds so longest.

Question 5 (JMC 2010 Q9)

Which of the following is the longest period of time?				
A 3002 hours	B 125 days	C $17\frac{1}{2}$ weeks	D 4 months	E $\frac{1}{3}$ of a year

A	One year is, at most, 366 days, so one-third of a year is less than 125 days. No month is longer than 31 days so 4 months is also less than 125 days;17.5 weeks equal 122.5 days However, 3002 hours equals 125 days and 2 hours, so this is the longest of the five periods of time.

Activity 4 (JMC 2012 Q16)

12.	The musical *Rent* contains a song that starts 'Five hundred and twenty five thousand six hundred minutes'. Which of the following is closest to this length of time? A a week B a year C a decade D a century E a millennium

B	Five hundred and twenty five thousand six hundred minutes is equal to: $\frac{525\ 600}{60}$ hours = 8760 hours = $\frac{8760}{24}$ days = 365 days. So the length of time in the song is the number of minutes in a year, unless it is a leap year.

Challenge Activity 1: Talent Show!

Question 1
If 250,000 people audition for a show, and each audition takes 5 minutes, how long will it take the judges to view all the auditions?
250,000 x 5 = 1,250,000 minutes
1250000 = 20833 hours
= 868 days
= 2.4 years.

Question 2
This may be an overestimate. Apparently there are 'tens of thousands' of people applying. If 50, 000 people audition, how long will this take?
2.4 year /5 = 0.47 years
0.47 x 365 = 174 days

Question 3
Obviously this is impossible, and most auditions are heard by researchers first. Suppose there are 5,000 people auditioning in a venue over two days, how many researchers would be needed to see everyone?
Assuming 5 min auditions and researchers working for 10 hours over the two days,
5000 x 5 min = 25, 000 mins = 416 hrs.
416/10 hours per researchers = 42 researchers.

Question 4
How many people do you think actually get to audition in front of the judges? Explain your answer.
Assuming each audition takes 10 mins, and the judges work 5 hours a day, and maybe do 15 days of auditions.
This would mean
15x10 = 150 hours, or 9000 minutes.
9000/10 = 900 auditions.

Challenge Activity 2: Calendars

Question 1

1. Let's look at the cycle of days through the week.

   Take any start date. We know that 7 days later, it will be the same day of the week as the start date. In addition, 14 days, 21 days, 28 days etc. later will also be the same day of the week.

2. So let's count the number of days between 1st March and 1st November in each year. We add up 31 days for March, 30 for April, 31 for May, 30 for June, 31 for July, 31 for August, 30 for September, and 31 for October. This gives 245 in total.

3. Now let's look at 31st May and 1st August.
   There are 1 + 30 + 31 = 62 days between these dates, which is not a multiple of 7.

   However, 62 is equal to 8 lots of 7 with a remainder of 6. So we can say for sure that if 1st August will be the day of the week previous to whatever day of the week the 31st May was.

   For example, in 2011, 31st May was a Tuesday, and 1st August was the day of the week before Tuesday – a Monday!

Question 2
If March 29th is a Wednesday, what day is the April 6th in the same year?
Thursday.

Challenge Activity 3: Father Christmas

Question 1
The population of the world is 7.6 billion. How many do you think are children?
Apparently 25% of the world population are under 15, 1.9 Billion.

Question 2
The actual time during which children are asleep varies across the world due to the different time zones. Let's assume Father Christmas has 24 hours to deliver all the presents. How long does he have to deliver each present?
FC has 24x60x60 = 86, 400 seconds to deliver all the presents.
86,400 / 1,900,000,000 = 0.00004547 seconds.

Question 3
So Father Christmas must have some magic powers to deliver the presents that fast! Assuming he did it without the aid of magic, and needed 10 minutes per child, how long would it actually take him?
1,900,000, 000 x 10 minutes = 19,000,000,000 minutes,
19,000,000,000 minutes = 316,666,666 hours = 13,194,444 days = 36,149 years!

Question 4
Each household had 2.7 children on average. How many household does he have to visit?
1,900,000,000/2.7 = 703,000,000 households.

Question 5
The average distance between households is 2.5 km. How far does Father Christmas need to travel?
703,000,000 x 2.5 = 1,760,000,000 km.

Question 6
So how fast is he travelling?
Speed = distance/time.
Speed = 1,760,000,000 km /86,400 seconds = 20,370 Km per second.