

X069/201

NATIONAL
QUALIFICATIONS
2004

FRIDAY, 28 MAY
1.00 PM – 3.00 PM

PHYSICS
INTERMEDIATE 2

Read Carefully

- 1 All questions should be attempted.

Section A (questions 1 to 20)

- 2 Check that the answer sheet is for Physics Intermediate 2 (Section A).
- 3 Answer the questions numbered 1 to 20 on the answer sheet provided.
- 4 Fill in the details required on the answer sheet.
- 5 Rough working, if required, should be done only on this question paper, or on the first two pages of the answer book provided—not on the answer sheet.
- 6 For each of the questions 1 to 20 there is only **one** correct answer and each is worth 1 mark.
- 7 Instructions as to how to record your answers to questions 1–20 are given on page two.

Section B (questions 21 to 31)

- 8 Answer the questions numbered 21 to 31 in the answer book provided.
- 9 Fill in the details on the front of the answer book.
- 10 Enter the question number clearly in the margin of the answer book beside each of your answers to questions 21 to 31.
- 11 Care should be taken to give an appropriate number of significant figures in the final answers to calculations.



SECTION A

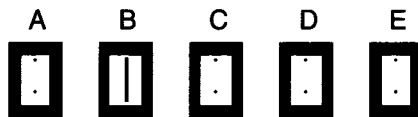
For questions 1 to 20 in this section of the paper, an answer is recorded on the answer sheet by indicating the choice A, B, C, D or E by a stroke made in ink in the appropriate box of the answer sheet—see the example below.

EXAMPLE

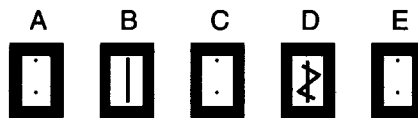
The energy unit measured by the electricity meter in your home is the

- A ampere
- B kilowatt-hour
- C watt
- D coulomb
- E volt.

The correct answer to the question is B—kilowatt-hour. Record your answer by drawing a heavy vertical line joining the two dots in the appropriate box on your answer sheet in the column of boxes headed B. The entry on your answer sheet would now look like this:



If after you have recorded your answer you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer D to an answer B, your answer sheet would look like this:



If you want to change back to an answer which has already been scored out, you should enter a tick (✓) to the RIGHT of the box of your choice, thus:



SECTION A

Answer questions 1–20 on the answer sheet.

1. Which of the following shows two physical quantities that have the same unit?

- A Potential energy and work done
- B Momentum and kinetic energy
- C Potential energy and momentum
- D Force and work done
- E Force and mass

2. Near the Earth a mass of 4 kg is falling with a constant velocity.

The air resistance force and the unbalanced force acting on the mass are

	<i>Air resistance force</i>	<i>Unbalanced force</i>
A	10 N upwards	10 N downwards
B	10 N downwards	50 N downwards
C	40 N upwards	0 N
D	40 N upwards	40 N downwards
E	10 N upwards	0 N

3. The table gives information about the velocities of three objects **X**, **Y** and **Z** for a time interval of 3 seconds. Each object is moving in a straight line.

<i>Time (s)</i>	0	1	2	3
<i>Velocity of X (m/s)</i>	2	4	6	8
<i>Velocity of Y (m/s)</i>	0	1	2	3
<i>Velocity of Z (m/s)</i>	0	2	5	9

Which of the following statements is/are correct?

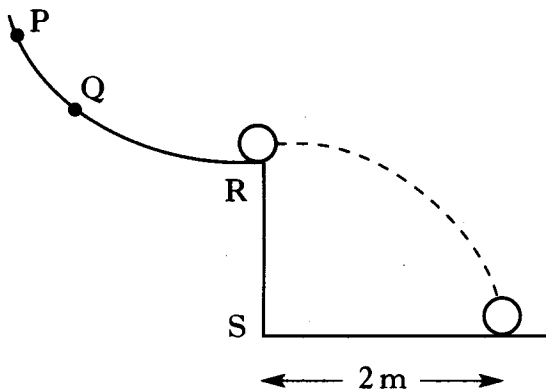
- I X moves with constant velocity.
 - II Y moves with constant acceleration.
 - III Z moves with constant acceleration.
- A I only
 - B II only
 - C I and II only
 - D I and III only
 - E II and III only

4. A mass of 1 kg is pulled along a level bench by a horizontal force of 10 N. The acceleration of the mass is 4 m/s^2 . The frictional force opposing the motion is

- A 0.25 N
- B 0.40 N
- C 2.5 N
- D 4 N
- E 6 N.

[Turn over

5. A ball is released from point Q on a curved rail, leaves the rail horizontally at R and lands 1 s later.



The ball is now released from point P.

Which row describes the motion of the ball after leaving the rail?

	<i>Time to land after leaving rail</i>	<i>Distance from S to landing point</i>
A	1 s	less than 2 m
B	less than 1 s	more than 2 m
C	1 s	more than 2 m
D	less than 1 s	2 m
E	more than 1 s	more than 2 m

6. A student makes the following three statements.

I Momentum is lost in all collisions.

II Momentum is mass times velocity.

III Momentum is a vector quantity.

Which of these statements is/are correct?

- A I only
 B I and II only
 C I and III only
 D II and III only
 E I, II and III

7. Information about water is shown below.

Specific latent heat of fusion
 $= 3.34 \times 10^5 \text{ J/kg}$

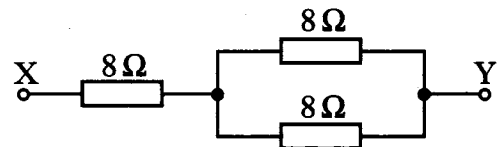
Specific heat capacity
 $= 4.18 \times 10^3 \text{ J/kg}^\circ\text{C}$

Specific latent heat of vaporisation
 $= 2.26 \times 10^6 \text{ J/kg}$

The heat energy required to turn 0.25 kg of water at 100°C into steam at 100°C is

- A $0.25 \times 3.34 \times 10^5 \text{ J}$
 B $0.25 \times 4.18 \times 10^3 \text{ J}$
 C $4.18 \times 10^3 \times 0.25 \times 100 \text{ J}$
 D $2.26 \times 10^6 \times 0.25 \times 100 \text{ J}$
 E $0.25 \times 2.26 \times 10^6 \text{ J}$.

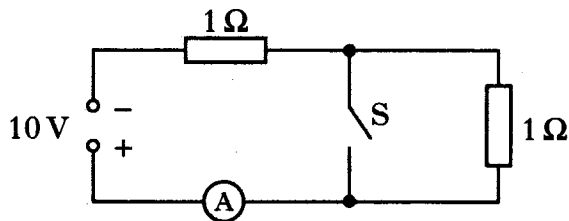
8. Three resistors are connected as shown.



The total resistance between X and Y is

- A 4Ω
 B 8Ω
 C 12Ω
 D 16Ω
 E 24Ω .

9. In the circuit shown, switch S is initially open.

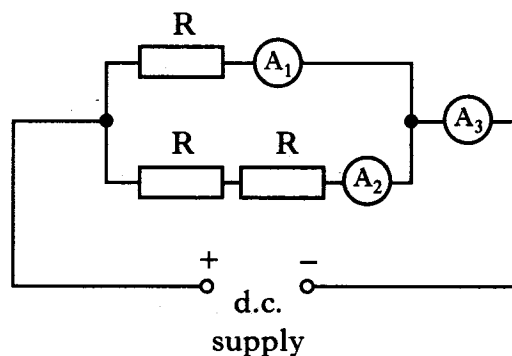


Switch S is now closed.

Which row in the table shows the current with S open and the current with S closed?

	<i>Current with S open</i>	<i>Current with S closed</i>
A	0.1 A	0.2 A
B	0.2 A	0.1 A
C	5 A	2.5 A
D	5 A	10 A
E	10 A	5 A

10. Three identical resistors are connected with three ammeters to a d.c. supply as shown.

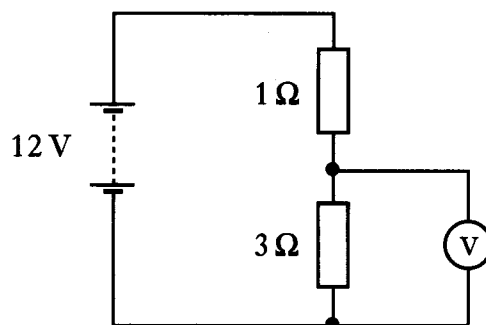


The reading on A_3 is 0.6 A.

Which row shows the readings on A_1 and A_2 ?

	<i>Ammeter A_1</i>	<i>Ammeter A_2</i>
A	0.2 A	0.4 A
B	0.3 A	0.3 A
C	0.4 A	0.2 A
D	0.6 A	0.3 A
E	0.6 A	0.6 A

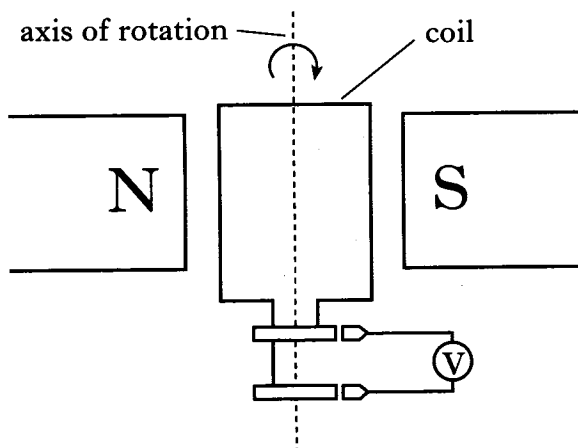
11. Consider the following circuit.



The reading on the voltmeter is

- A 3 V
- B 4 V
- C 8 V
- D 9 V
- E 12 V.

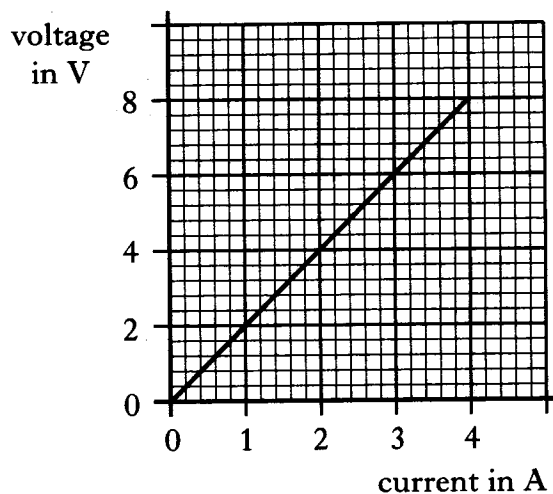
12. A voltage is induced in a coil when it is rotated in a magnetic field.



Which of the following combinations of changes produces the greatest increase in the induced voltage?

	<i>Strength of magnetic field</i>	<i>Number of turns in the coil</i>	<i>Speed of rotation of the coil</i>
A	decrease	increase	increase
B	increase	decrease	increase
C	increase	increase	decrease
D	decrease	decrease	decrease
E	increase	increase	increase

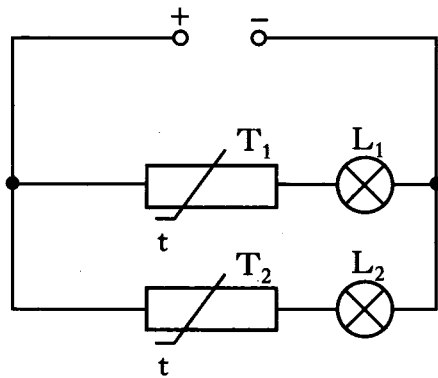
13. The graph shows the relationship between the voltage across a resistor and the current in the resistor.



The resistance of the resistor is

- A 0.5Ω
- B 2Ω
- C 4Ω
- D 12Ω
- E 32Ω .

14. Identical thermistors T_1 and T_2 are connected with lamps L_1 and L_2 as shown.



The resistance of these thermistors falls when their temperature rises.

T_1 is heated, T_2 is not heated.

What happens to the brightness of the lamps?

	<i>Brightness of L_1</i>	<i>Brightness of L_2</i>
A	gets dimmer	stays the same
B	stays the same	stays the same
C	gets brighter	gets brighter
D	gets dimmer	gets brighter
E	gets brighter	stays the same

15. The diagram shows part of the electromagnetic spectrum.

P	Visible light	Q	X-rays
---	---------------	---	--------

The radiations in regions P and Q are

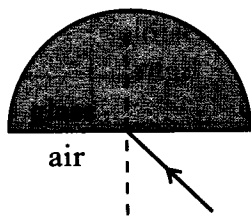
	<i>Region P</i>	<i>Region Q</i>
A	infrared	ultraviolet
B	ultraviolet	microwaves
C	ultraviolet	infrared
D	infrared	microwaves
E	microwaves	ultraviolet

16. Which of the following is a longitudinal wave?

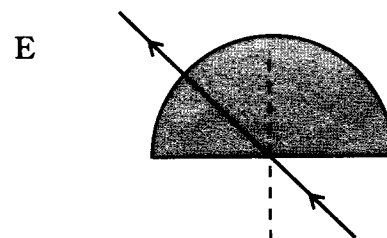
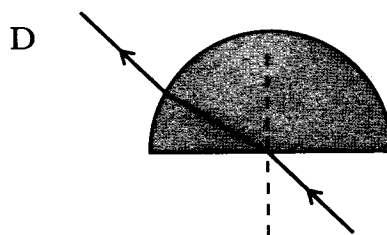
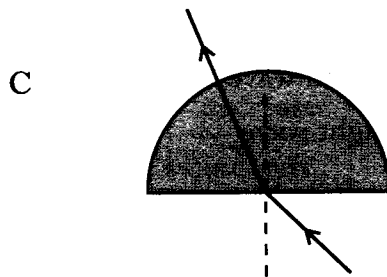
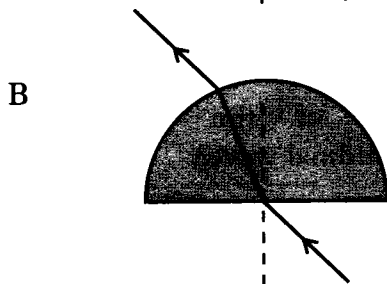
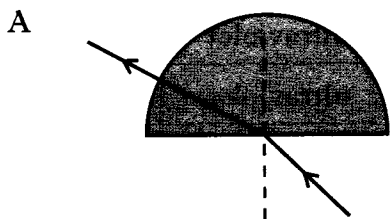
- A Water wave
- B Radio wave
- C Gamma ray
- D Sound wave
- E Light wave

[Turn over

17. The diagram shows a ray of light incident on the centre of the straight edge of a semicircular glass block.



Which diagram shows the path of the ray through the block?



18. An alpha particle has
- A the same mass as a helium nucleus, positive charge and is strongly ionising
 - B the same mass as an electron, negative charge and is weakly ionising
 - C the same mass as a helium nucleus, negative charge and is weakly ionising
 - D the same mass as an electron, negative charge and is strongly ionising
 - E the same mass as a helium nucleus, positive charge and is weakly ionising.

19. A patient's thyroid gland is exposed to radiation. Information about the radiation and the dose received by the gland is shown.

$$\text{Absorbed dose} = 500 \mu\text{Gy}$$

$$\text{Energy absorbed} = 15 \mu\text{J}$$

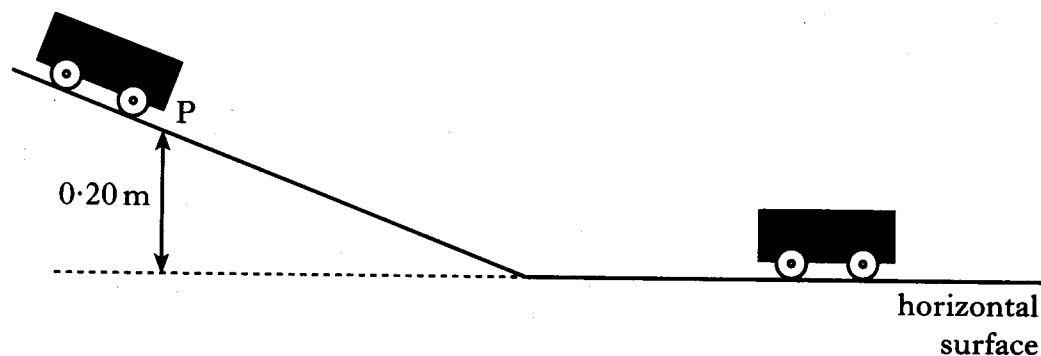
$$\text{Quality factor} = 20$$

The mass of the thyroid gland is

- A 0.01 kg
 - B 0.03 kg
 - C 0.04 kg
 - D 0.33 kg
 - E 0.75 kg.
20. The activity of a sample of a radioactive substance is 80 Bq. The half-life of the substance is 4 hours. The time for the activity to fall to 10 Bq is
- A 4 hours
 - B 6 hours
 - C 8 hours
 - D 12 hours
 - E 20 hours.

Write your answers to questions 21–31 in the answer book.

21. A cart A of mass 1.2 kg is held at point P on a slope. P is 0.20 m above a horizontal surface. A second cart B of mass 2.8 kg is placed close to the bottom of the slope as shown.



Cart A is released, runs down the slope and collides with cart B. The carts stick together and move off along the horizontal surface.

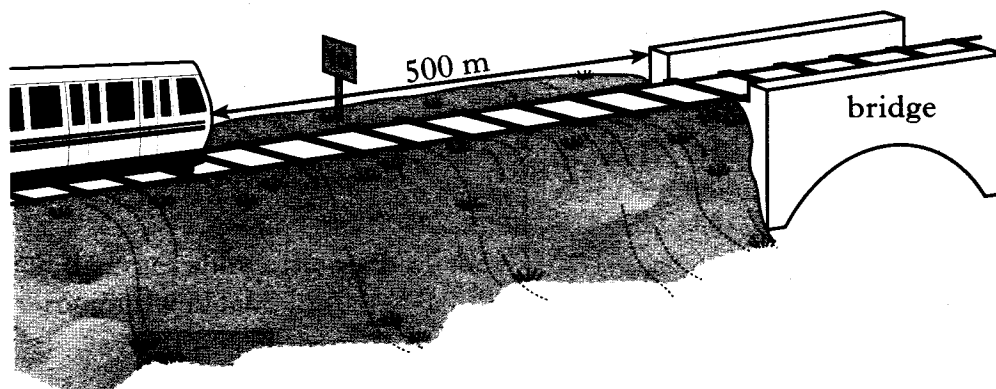
- (a) Calculate the change in gravitational potential energy of cart A from point P to the bottom of the slope. 2
- (b) Assuming no energy losses, show that the speed of cart A at the bottom of the slope is 2.0 m/s . 2
- (c) Calculate the speed of the carts just after the collision. 2
- (d) Describe how the instantaneous speed of the carts immediately after the collision can be measured.

List any apparatus required and state all the measurements that should be taken.

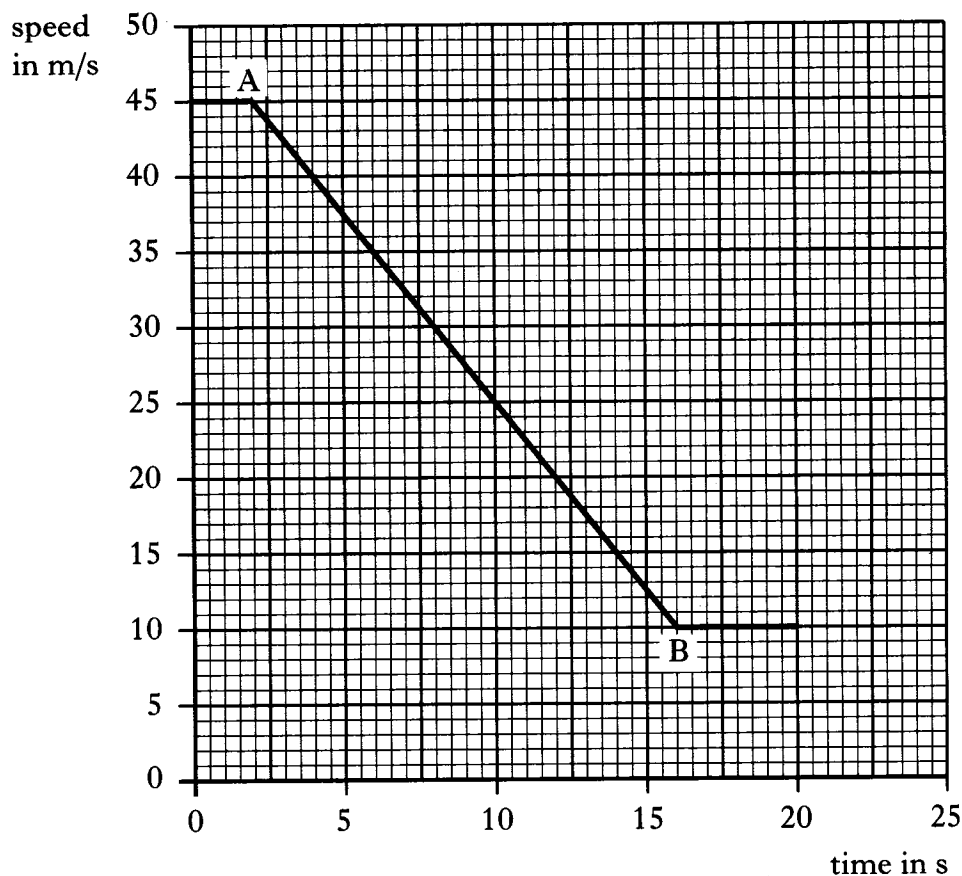
3
(9)

[Turn over

22. The driver of a train travelling at 45 m/s sees a sign indicating that there is a speed limit of 10 m/s on a bridge on the track ahead. At this point the distance from the train to the bridge is 500 m.

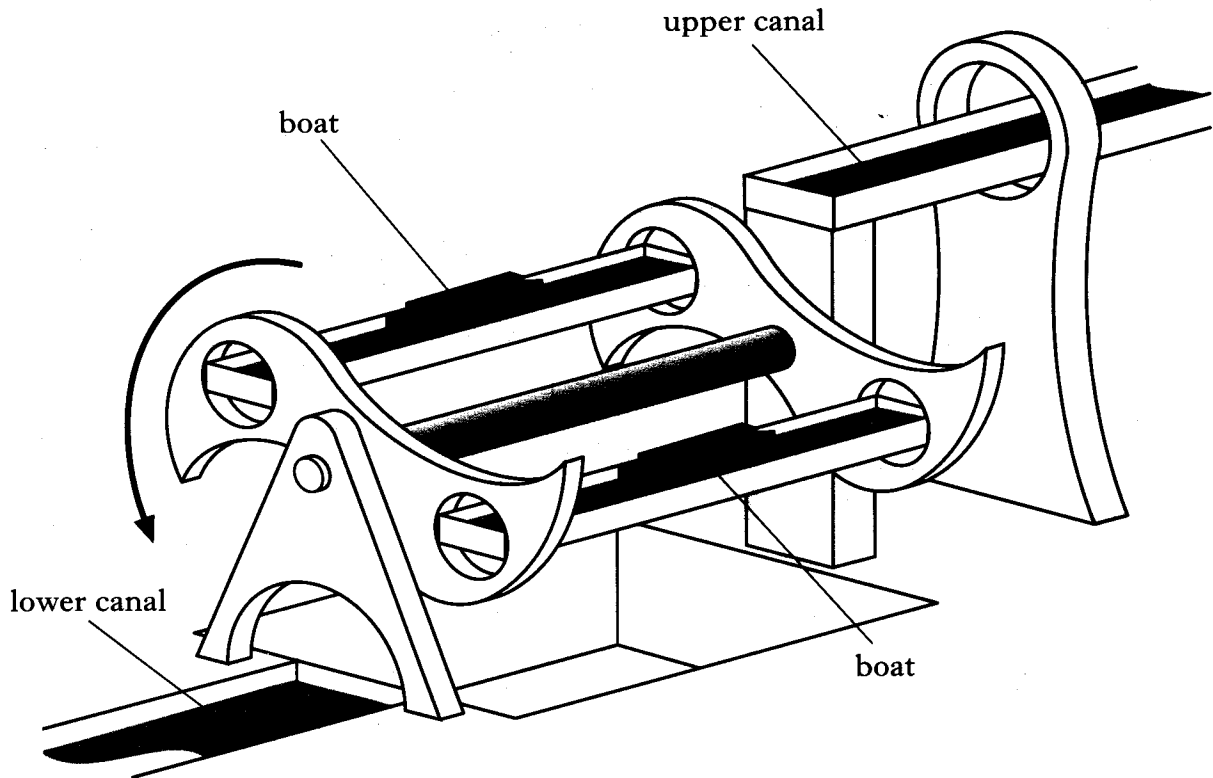


The speed-time graph of the train's motion, from the moment the driver sees the sign, is shown below.



- (a) (i) State the time at which the driver starts to apply the brakes. 1
- (ii) Explain your answer. 1
- (b) Calculate the acceleration of the train between A and B. 2
- (c) Is the train travelling at 10 m/s when it reaches the bridge? 3
 You **must** justify your answer by calculation. (7)

23. A boat lift is used to move boats between two canals at different heights as shown.



The lift rotates, lowering a boat on one side while raising a boat on the other side.

The system is balanced. The motor rotating the lift has to overcome only frictional forces. Information about the lifting process is shown below.

Frictional force	= 84 000 N
Distance through which force acts	= 12 m
Time for lifting process to be completed	= 4 minutes

- (a) Show that the power required to operate the lift is 4.2 kW. 3
- (b) The motor operates at 400 V and draws a current of 16 A.
Calculate the input electrical power. 2
- (c) Calculate the efficiency of the motor. 2
- (d) State whether the power required to start the lift moving is greater than, less than or equal to 4.2 kW. You must explain your answer. 2

(9)

[Turn over

