

FORMULAE

You may find the following formulae useful.

$$\text{average velocity} = \frac{\text{displacement}}{\text{time}}$$

$$v = \frac{s}{t}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$a = \frac{(v-u)}{t}$$

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$F = m \times a$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$p = m \times v$$

$$\text{change in potential energy} = \text{mass} \times \text{gravitational field strength} \times \text{change in height}$$

$$PE = m \times g \times h$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times (\text{velocity})^2$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$\text{electrical energy} = \text{voltage} \times \text{current} \times \text{time}$$

$$E = V \times I \times t$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

$$P = \frac{W}{t}$$

$$\text{work done} = \text{force} \times \text{distance moved in the direction of the force}$$

$$W = F \times s$$



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1.



The photograph shows Mposi using a flexible hose to refuel an aircraft. The hose is made of an insulator. The fuel is also an insulator.

- (a) After a while the hose becomes negatively charged. Explain how.

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(2)

- (b) Explain why this could be dangerous.

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(1)

- (c) Mposi overcomes this danger by connecting wires to the hose and the plane.

Explain what now happens to the charge.

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(2)

(Total 5 marks)

Q1



2. Fifty years ago, many shoe shops had X-ray machines. The photograph shows one of these.



- They were used to check how well shoes fitted.
- Customers stood with their feet in the bottom and viewed the fluoroscope screen at the top.
- The fluoroscope screen emitted light where it was hit by the X-rays.
- Customers could then see an image of their toes move inside the shoes.

(a) Many children would stay on the machine as long as they could. Suggest why parents allowed children to stay on the machine.

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(1)

(b) X-ray fluoroscopes are now banned from use in shoe shops. Suggest why.

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(1)

(c) Modern X-ray fluoroscopes are used by doctors to diagnose and treat some illnesses.

(i) Suggest why doctors are allowed to use X-ray fluoroscopes.

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(1)

(ii) Suggest an advantage of using an X-ray fluoroscope instead of a normal X-ray machine.

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(1)

(Total 4 marks)

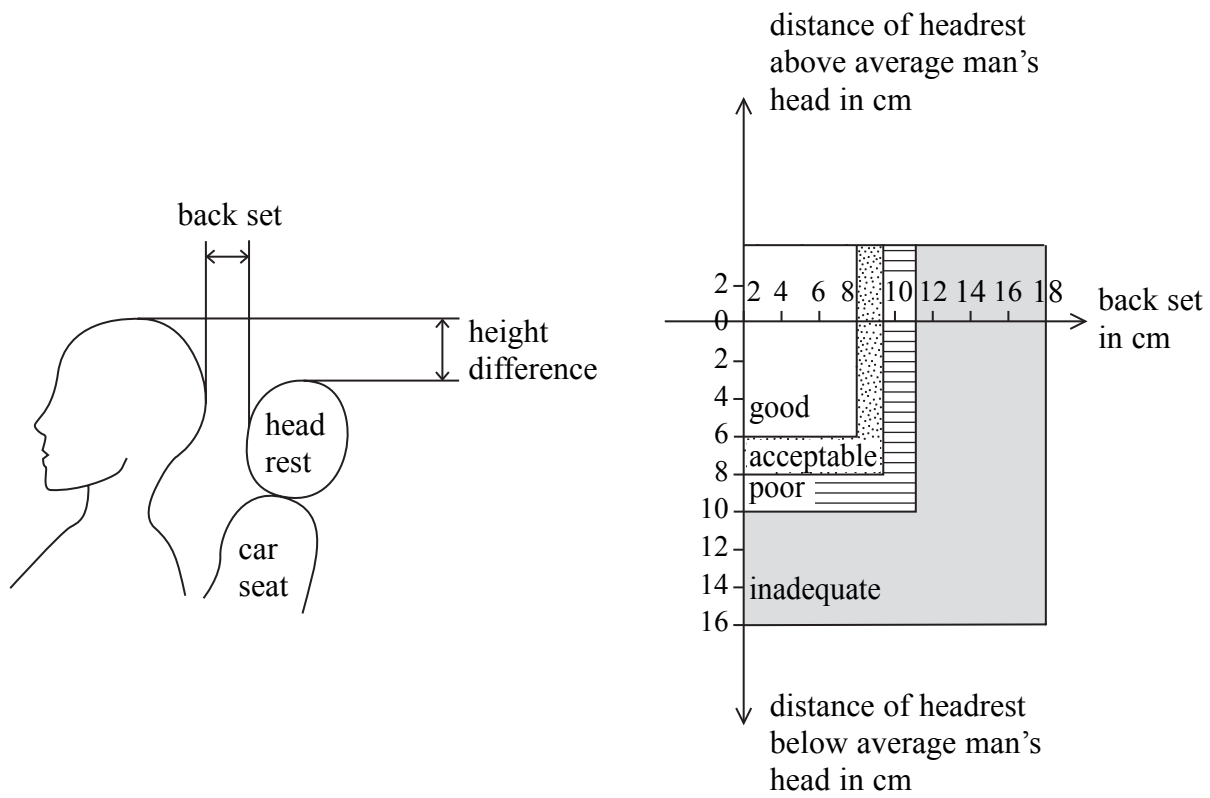
Q2



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3. Headrests are used in cars to prevent whiplash injuries. They are tested using crash dummies. The headrests can be moved vertically and horizontally. Here are some results.



(a) (i) State **two** ways which the headrest should be adjusted for a tall person.

1

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2

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(2)

(ii) Explain why.

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(1)



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- (b) Recent research suggests that when a driver gets a new safety feature such as ABS brakes he drives **less** carefully. Suggest a reason why.

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(1)

- (c) With reference to momentum, explain how the crumple zone in a car protects the driver in a crash.

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(2)

Q3

(Total 6 marks)



4. Tritium ${}^3_1\text{H}$ is an isotope of hydrogen (hydrogen-3).

(a) (i) Explain what is meant by an isotope.

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(1)

(ii) Tritium decays by emitting beta particles.
Explain why tritium cannot emit alpha particles.

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(1)

(b) The photograph shows a glow stick key ring.



- It consists of a sealed, thick glass tube containing tritium gas.
- The inside of the tube is coated with a phosphor.
- The phosphor emits light when beta particles hit it.

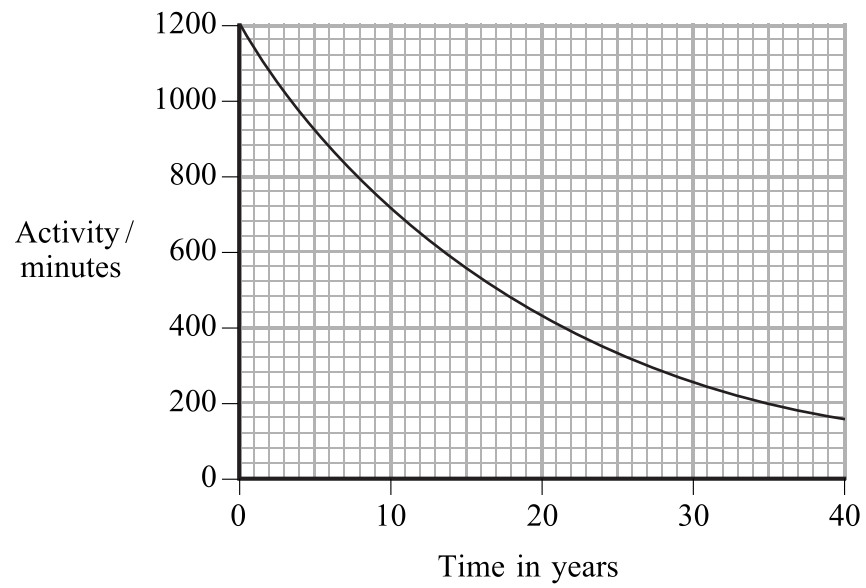
Explain why these key rings are safe to handle.

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(1)



(c) The graph shows how the activity of the tritium in the glow stick varies with time.



(i) Explain what is meant by half-life.

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(1)

(ii) Use the graph to estimate the half-life of tritium.
Show your working clearly.

half life =

(2)

(d) The manufacturers claim that the glow sticks will remain useful for more than 20 years.
The minimum activity required for the glow sticks to work is 400 counts per minute.
Evaluate the reliability of this claim.

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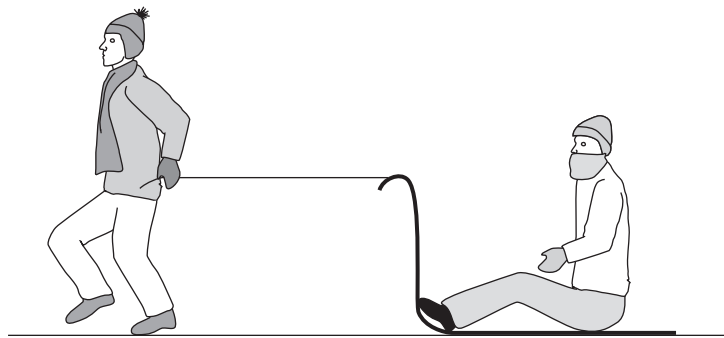
(1)

(Total 7 marks)

Q4



5. The diagram shows Frank and Simon playing with a flat sledge on an ice rink.



(a) At first, Simon pulls Frank at a constant speed of 1.2 m/s for 6 m with a horizontal force of 35 N.

(i) Calculate the momentum of Frank and the sledge if their combined mass is 38 kg.
State the unit.

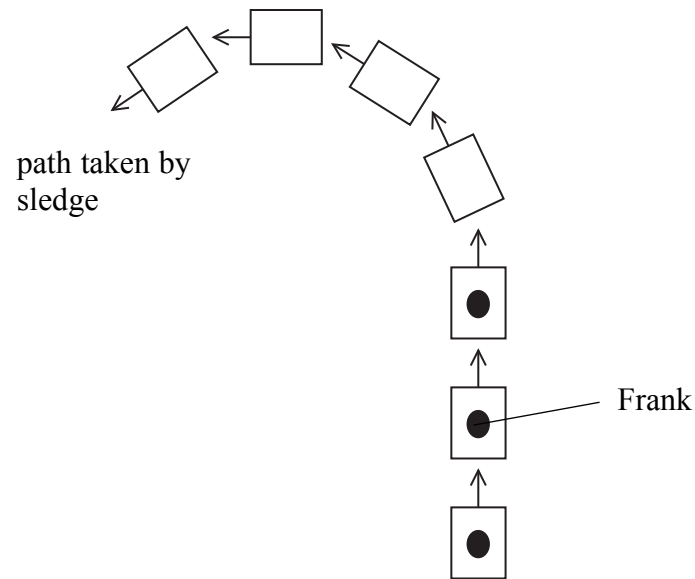
momentum =
(3)

(ii) Calculate how much useful work Simon has done.

work done = J
(2)



(b) Simon pulls Frank quickly round in a circle.
The diagram below shows 'bird's eye view' snapshots of the sledge as Simon pulls it round.



(i) State and explain what happens to Frank as the sledge moves quickly around in a circle.
You may add to the diagram if this makes your answer clearer.

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(2)

(ii) When it is Simon's turn, he sits inside a large empty cardboard box instead of on the flat sledge.
The box is pulled quickly around in a circle by Frank.
What happens to Simon?

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(1)

Q5

(Total 8 marks)

TOTAL FOR PAPER: 30 MARKS

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