Mixed Exercise 2

1. When a nucleus of ${}^{90}_{38}X$ decays by beta radiation, it changes into a nucleus of an isotope of a different element Y.

   (a) Explain the changes taking place in the nucleus when a beta particle is emitted.

(3 marks)

   (b) Complete the nuclear equation given below for the beta decay of ${}^{90}_{38}X$.

$${}^{90}_{38}X \rightarrow {}^{\ }_{-}Y \quad + \quad \beta$$

(2 marks)

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2. A powder contains 400 mg of a radioactive material that emits α-particles.

The half-life of the material is 5 days.

What mass of that material remains after 10 days?

A 0 mg **B** 40 mg **C** 100 mg **D** 200 mg

[1]

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3. Which type of radiation has the greatest ionising effect?

A α-particles

B β-particles

C γ-rays

D all have the same ionising effect

[1]

4.

(a) In Fig. 6.1, a ray of red light is shown passing through a triangular glass prism and on to another prism that is identical but upside down.

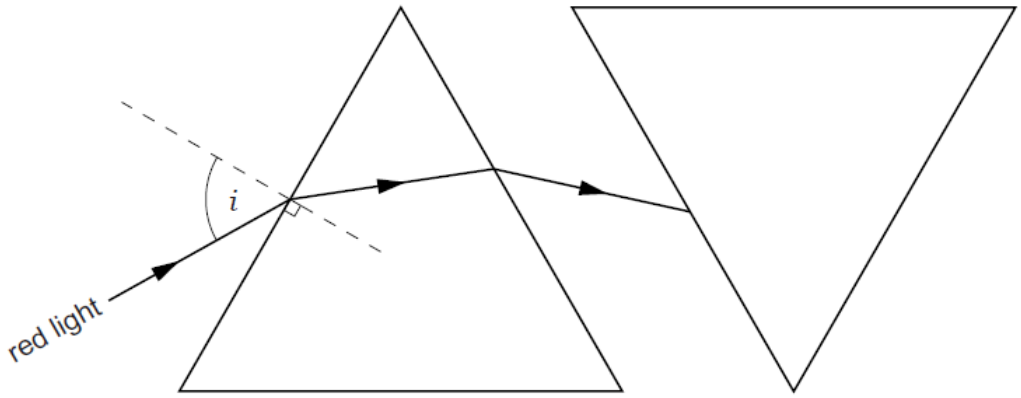


Fig. 6.1

(i) The angle of incidence of the red light at the first surface is shown on Fig. 6.1 as i.

On Fig. 6.1, use the letter r to mark clearly the angle of refraction at the first surface. [1]

(ii) On Fig. 6.1, complete the path of the ray through the right-hand prism and out into the air again. Label the emergent ray "line R". [3]

(iii) The beam of red light is moved so that it shines into the right-hand prism along line R.

Using the letter P, mark clearly the point where this ray will emerge from the left-hand prism. [1]

(b) On another occasion, a beam containing a mixture of red and blue light is shone into a prism, as shown in Fig. 6.2.

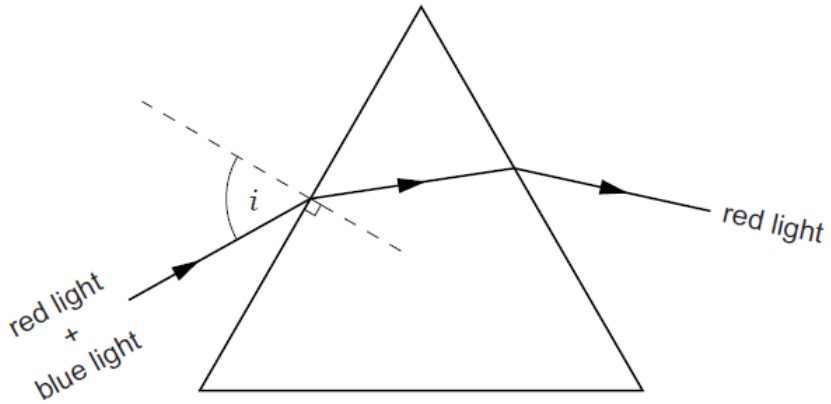


Fig. 6.2

(i) On Fig. 6.2, draw the path of the blue light through the prism and out into the air again. [3]

(ii) Refraction is occurring at the first surface.

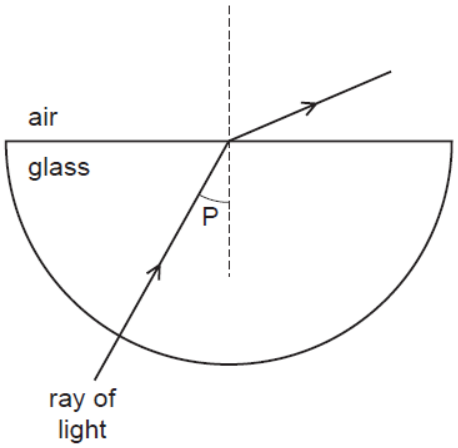
Which of the following is also occurring? Tick one box.

diffraction	☐
dispersion	☐
focusing	☐
total internal reflection	☐

[1]

5.

The diagram shows a ray of light passing through a semicircular glass block into air.

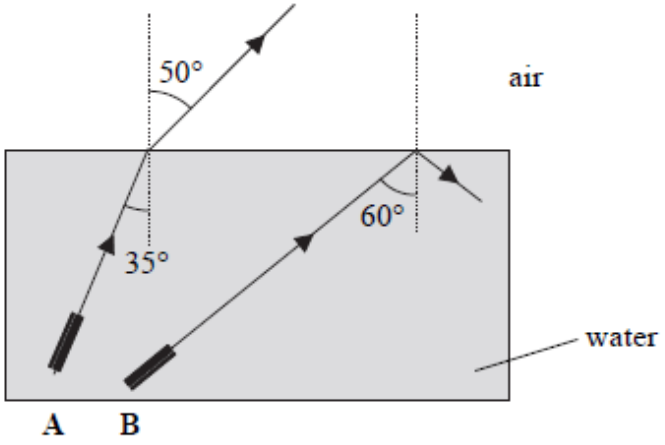


Which row gives the correct name for angle P and states how angle P compares with the critical angle?

	name of angle P	angle P compared with the critical angle
A	angle of incidence	larger than the critical angle
B	angle of incidence	smaller than the critical angle
C	angle of refraction	larger than the critical angle
D	angle of refraction	smaller than the critical angle

6.

The diagram shows a torch emitting a beam of light from two different positions **A** and **B** under water.



(a) What is the name of the two dotted lines on the diagram?

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(1)

(b)

Explain the paths followed by the two beams of light.
Refer to the critical angle in your answers.

(i) Path from position **A**.

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.....

.....

(2)

(ii) Path from position **B**.

.....

.....

.....

(2)

7.

Ignore air resistance in this question.

A helicoptor hovering in air at a height of 300 m drops a parcel of mass 5kg.

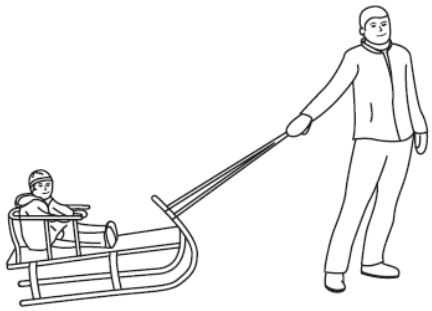
(a) At what speed will the parcel hit the ground?

(b) How long will it take for the parcel to hit the ground?

(c) Next the helicoptor, hoverung at the same height, drops a parcel of mass 20kg. How does the time taken for the second parcel to hit the ground compares to the time taken by the first parcel?

8.

The diagram shows a man pulling a child on a sledge.



(a) The acceleration of the sledge is 1.5 m/s^2.

The mass of the child and sledge is 38 kg.

(i) State the equation linking force, mass and acceleration.

(1)

(ii) Calculate the force needed to produce this acceleration.

(2)

force = ... N

(iii) Suggest a reason why the force exerted on the sledge by the man must be greater than the force calculated.

(1)

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(b) The sledge starts from rest and accelerates at 1.5 m/s^2 until its velocity is 2.8 m/s.

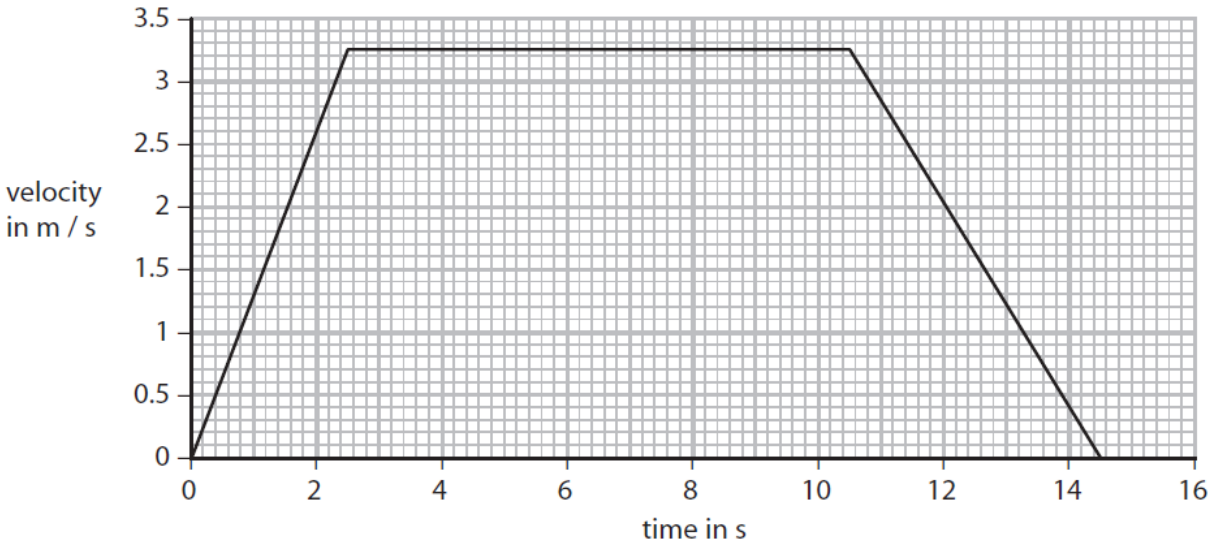
(i) State the relationship between acceleration, velocity and time.

(1)

(ii) Show that the time taken to reach 2.8 m/s is about 2 s.

(2)

(c) This velocity-time graph shows the motion of the sledge as it travels down a hill.



(i) Calculate the distance travelled by the sledge.

(3)

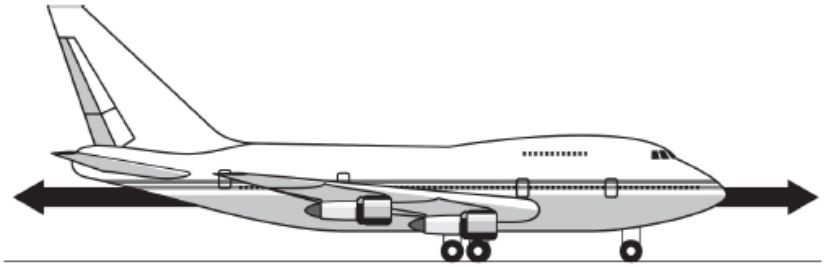
distance travelled = ... m

(ii) State the equation linking average speed, distance moved and time taken.

(1)

9.

(a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

.....

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(1 mark)

(ii) Describe the movement of the aircraft when the resultant force is zero.

.....

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(1 mark)

(b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Calculate the maximum acceleration of the aircraft.

Show clearly how you work out your answer and give the unit.

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.....

.....

Acceleration = ...

(3 marks)

(c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

Explain why.

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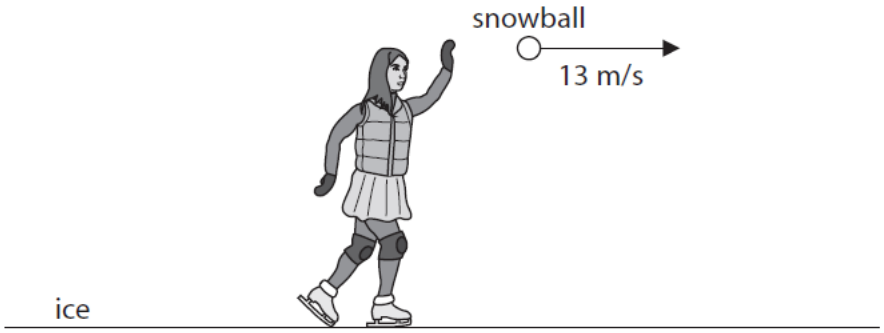
(2 marks)

10.

An ice skater throws a 0.23 kg snowball with a velocity of 13 m/s.



(a) (i) State the equation linking momentum, mass and velocity.

(1)

(ii) Calculate the initial momentum of the snowball.

(2)

initial momentum = ... kg m/s

(b) When the skater throws the snowball forwards, she slides backwards on the ice.

Explain why she moves in this direction.

(3)