1 The picture shows a weight lifter.

(a) In one lift, he does 5040 J of work against gravity.

(i) One lift takes 4 seconds.

Complete the sentence by putting a cross (☒) in a box next to your answer.

The power used to lift the weight is

(1)

☒ **A** 1260 W

☒ **B** 2016 W

☒ **C** 12600 W

☒ **D** 20160 W

(ii) The weight he lifts has a mass of 240 kg.
Gravitational Field Strength = 10 N/Kg
The energy gained by the mass is equal to the work done when lifting it.

Calculate the height he lifts this mass.

(3)

height = ... m

(b) After lifting the mass, he must hold it steady for 3 seconds.
During this time, he does no work on the mass.

State why he does no work on the mass in this time.

(1)

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(c) After the 3 seconds, the weight lifter drops the mass.
The velocity of the mass just before it hits the floor is 6.4 m/s.

Calculate the momentum of the mass just before it hits the floor.
State the unit.

(3)

momentum = ... unit = ...

(Total for Question 1 = 8 marks)

Going downhill

2 Andrew skis down a hill.

(a) Andrew starts from the top of the hill and his speed increases as he goes downhill.

He controls his speed and direction by using his skis.

He brings himself to a stop at the bottom of the hill.

Describe the energy changes that happen between starting and stopping.

(3)

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(b) Andrew returns

(i) His mass is 67 kg.

Show that his momentum is about 2000 kg m/s when his velocity is 31 m/s.

(2)

(ii) He falls over when his momentum is 2000 kg m/s.

After he falls over, he slows down by sliding across the snow.

It takes 2.3 s for his momentum to reduce to zero.

Calculate the average force on Andrew as he slows down.

(2)

force = ... N

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

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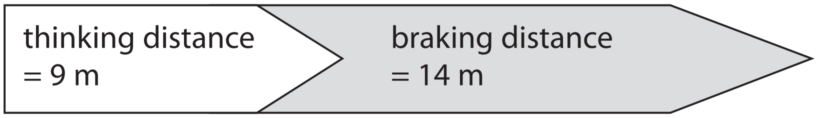
(Total for Question 2 = 9 marks)

Speed and safety

3 The Highway Code gives this information about the stopping distance of a car.

speed = 30 miles per hour



(a) (i) What is the stopping distance?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** 5 m

☐ **B** 9 m

☐ **C** 14 m

☐ **D** 23 m

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The driver's **thinking** distance is most likely to increase when

(1)

☐ **A** the driver is tired

☐ **B** there is ice on the road

☐ **C** the car is heavier

☐ **D** the car moves at a slower speed

(b) A car has a mass of 800 kg.
It has a velocity of 3.0 m/s.

Calculate the momentum of the car.

(2)

momentum of car = ... kg m/s

(c) (i) The braking force on another car is 600 N.
The force acts for a distance of 15 m.

Calculate the work done by the braking force.

(2)

work done by braking force = ... J

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The work done by the brakes during braking is equal to

(1)

☒ **A** the energy transferred

☒ **B** the stopping distance

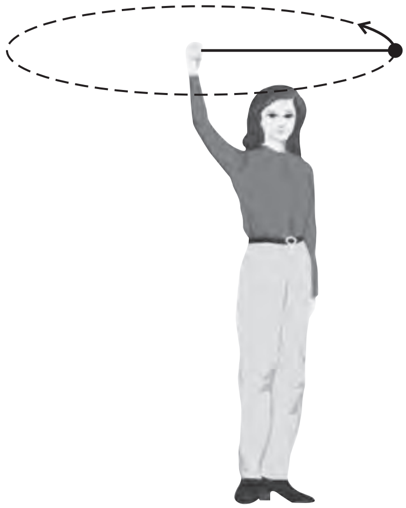
☒ **C** the acceleration

☒ **D** the thinking distance plus braking distance

(Total for Question 1 = 7 marks)

Circular motion

4 (a) The diagram shows a girl swinging a rubber ball in a horizontal circle above her head.



(i) In which direction does the resultant force act on the ball?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** away from the centre of the circle

☒ **B** in the direction of the arrow on the diagram

☒ **C** in the opposite direction to the arrow on the diagram

☒ **D** towards the centre of the circle

(ii) State the name of the resultant force acting on the ball.

(1)

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(iii) Suggest what would happen to the ball as the girl gets tired.

(2)

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(iv) The girl lets go of the string and the ball hits a wall.

The collision is not elastic.

Explain what happens to both momentum and kinetic energy when the ball hits the wall.

(2)

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*(b) Describe a cyclotron and how charged particles move inside it.

You may draw a labelled diagram to help with your answer.

(6)

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(Total for Question 5 = 12 marks)

Cyclotrons and Collisions

5 (a) A cyclotron accelerates charged particles.

(i) Describe the shape of the path a charged particle takes in the cyclotron.

(1)

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(ii) Explain how radioactive isotopes can be produced using cyclotrons.

(3)

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(b) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

In an **inelastic** collision there is conservation of

(1)

☒ **A** kinetic energy

☒ **B** momentum

☒ **C** kinetic energy and momentum

☒ **D** velocity

(ii) State why momentum has the unit kg.m/s.

(1)

....

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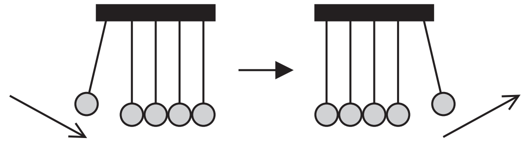
*(iii) Different types of collision are shown in the diagrams.

Analyse both collisions in terms of momentum and kinetic energy.

collision 1



collision 2

(6)

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(Total for Question 6 = 12 marks)