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)

.....

.....

(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)

.....

.....

.....

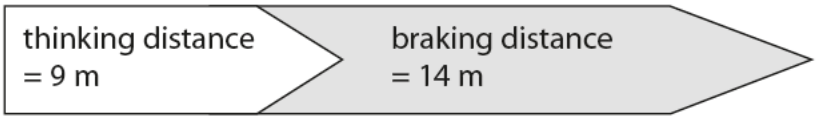
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(Total for Question 2 = 9 marks)

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

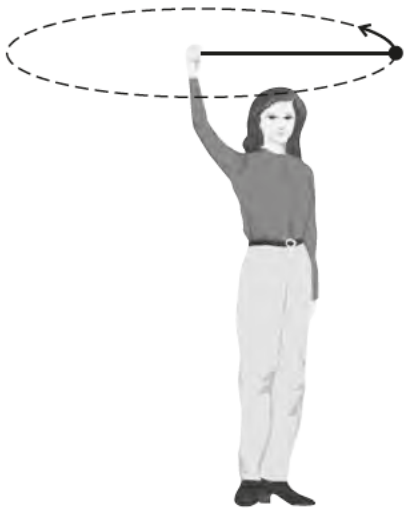
☐ **C** the acceleration

☐ **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)

.....

(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)

(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)

.....

.....

(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)

.....

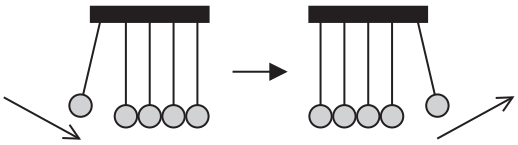
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*(iii) Different types of collision are shown in the diagrams.

Analyse both collisions in terms of momentum and kinetic energy.



collision 1



collision 2

(6)

(Total for Question 6 = 12 marks)