PHYSICS BRIDGING WORK

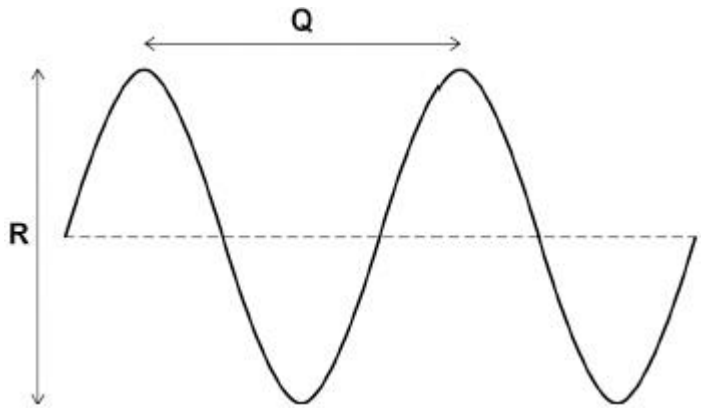
Summer 2024

90 MINUTES GCSE content

Q1.

Electromagnetic waves are transverse.

The figure below represents a transverse wave.



(a) Which of the following gives the wavelength of the transverse wave?

Tick (✓) **one** box.

wavelength = $\frac{Q}{2}$ ☐

wavelength = Q ☐

wavelength = 2 Q ☐

(1)

(b) Which of the following gives the amplitude of the transverse wave?

Tick (✓) **one** box.

amplitude = $\frac{R}{2}$ ☐

amplitude = R ☐

amplitude = 2 R ☐

(1)

(c) Microwaves are electromagnetic waves used for mobile phone communications.

Which other type of electromagnetic wave is also used for communications?

Tick (✓) **one** box.

Radio waves ☐

Ultraviolet ☐

X-rays ☐

(1)

(d) Microwaves from a mobile phone take 0.000 009 s to reach a mobile phone mast.

speed of microwaves = 300 000 000 m/s

Calculate the distance between the mobile phone and the mobile phone mast.

Use the equation:

distance = speed × time

_____

_____

_____

Distance = _____ m

(2)

(e) Mobile phone communications is only one of the uses for microwaves.

Give **one** other use of microwaves.

_____

_____

(1)

(Total 6 marks)

Q2.

Ultraviolet and visible light are both parts of the electromagnetic spectrum.

(a) How does the speed of ultraviolet in a vacuum compare to the speed of visible light in a vacuum?

Tick (✓) **one** box.

Ultraviolet travels at a faster speed than visible light. ☐

Ultraviolet travels at a slower speed than visible light. ☐

Ultraviolet travels at the same speed as visible light. ☐

(1)

(b) **Figure 1** shows parts of the electromagnetic spectrum.

Figure 1

Radio waves	A	B	C	D	X-rays	Gamma rays

Which letters represent the positions of ultraviolet and visible light in the electromagnetic spectrum?

Ultraviolet _____

Visible light _____

(2)

(c) **Table 1** shows the range of wavelengths for different types of ultraviolet.

Table 1

Type	Range of wavelength in nanometres
Ultraviolet **A** (UVA)	315–400
Ultraviolet **B** (UVB)	280–315
Ultraviolet **C** (UVC)	100–280

Determine which type of ultraviolet shown in **Table 1** has the largest range of wavelengths.

To gain full marks you must calculate the range of wavelengths for each type of ultraviolet.

_____

_____

_____

_____

Type of ultraviolet with the largest range of wavelengths _____

(3)

Figure 2 shows how different types of ultraviolet are absorbed by the ozone layer in the Earth's atmosphere.

Table 2 shows the relative ionising power from each type of ultraviolet.

Figure 2

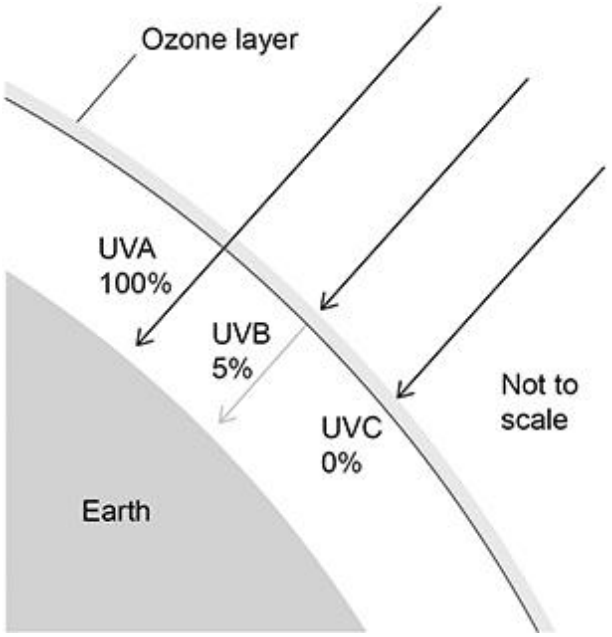


Table 2

Type	Relative ionising power
UVA	Low
UVB	Medium
UVC	High

(d) Explain the importance of the ozone layer in reducing the risk to people from all types of ultraviolet.

Use **Figure 2** and **Table 2**.

(4)

(e) The Sun emits visible light.

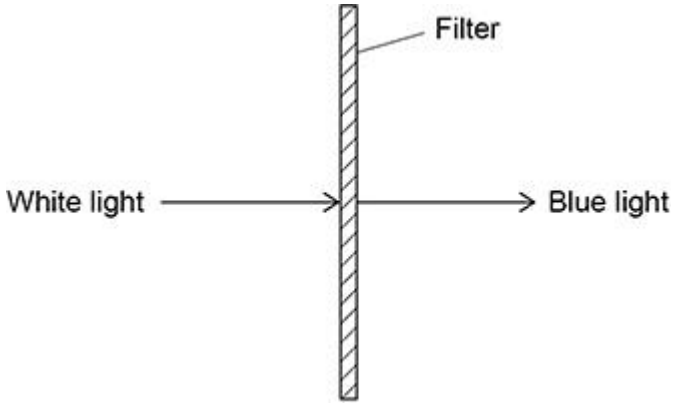
A student concludes that visible light is **not** absorbed by the ozone layer.

Give **one** piece of evidence that shows the student's conclusion is correct.

(1)

(f) **Figure 3** shows white light incident on a colour filter.

Figure 3



Complete the sentence.

Choose the answers from the box.

absorbed	**radiated**	**reflected**	**refracted**	**transmitted**

When white light is incident on the filter, only blue light is _____

and all other colours of light are _____.

(2)

(Total 13 marks)

Q3.

Radioactive waste from nuclear power stations is a man-made source of background radiation.

(a) Give **one** other man-made source of background radiation.

_____

(1)

Nuclear power stations use the energy released by nuclear fission to generate electricity.

(b) Give the name of **one** nuclear fuel.

_____

(1)

(c) Nuclear fission releases energy.

Describe the process of nuclear fission inside a nuclear reactor.

_____

_____

_____

_____

_____

(4)

(d) A new type of power station is being developed that will generate electricity using nuclear fusion.

Explain how the process of nuclear fusion leads to the release of energy.

(2)

(e) Nuclear fusion power stations will produce radioactive waste. This waste will have a much shorter half-life than the radioactive waste from a nuclear fission power station.

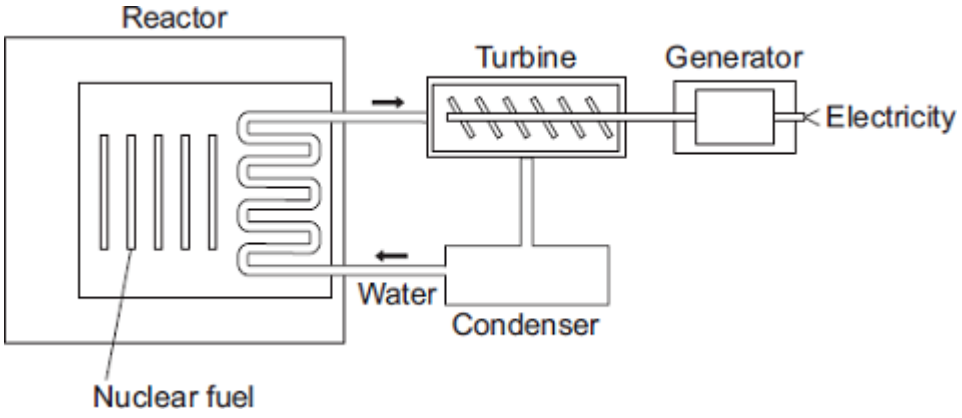
Explain the advantage of the radioactive waste having a shorter half-life.

(2)

(Total 10 marks)

Q4.

Nuclear power stations use the energy released from nuclear fuels to generate electricity.



(a) Which substance do the majority of nuclear reactors use as fuel?

Draw a ring around your answer.

plutonium-239 **thorium-232** **uranium-235**

(1)

(b) Energy is released from nuclear fuels by the process of nuclear fission.

Describe what happens to the nucleus of an atom during nuclear fission.

_____

_____

_____

_____

(2)

(c) Use words from the box to complete each sentence.

condenser	**gas**	**generator**	**reactor**	**steam**	**turbine**

The energy released from the nuclear fuel is used to heat water. The water turns into _____ and this is used to drive a _____ .

This turns a _____ to produce electricity.

(3)

(Total 6 marks)

Q5.

(a) Nuclear power stations generate about 14% of the world's electricity.

(i) Uranium-235 is used as a fuel in some nuclear reactors.

Name **one** other substance used as a fuel in some nuclear reactors.

_____

(1)

(ii) Energy is released from nuclear fuels by the process of nuclear fission.

This energy is used to generate electricity.

Describe how this energy is used to generate electricity.

Do **not** explain the nuclear fission process.

_____

_____

_____

_____

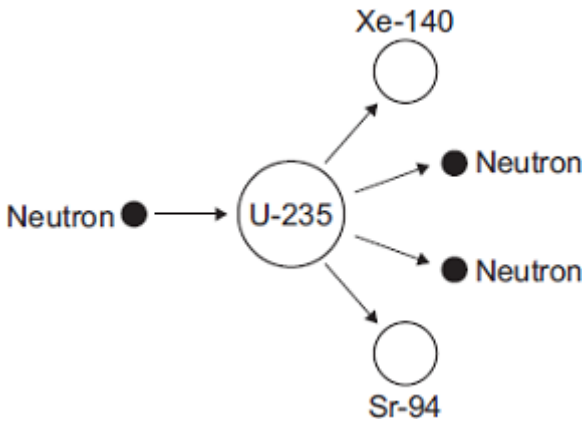
_____

_____

(3)

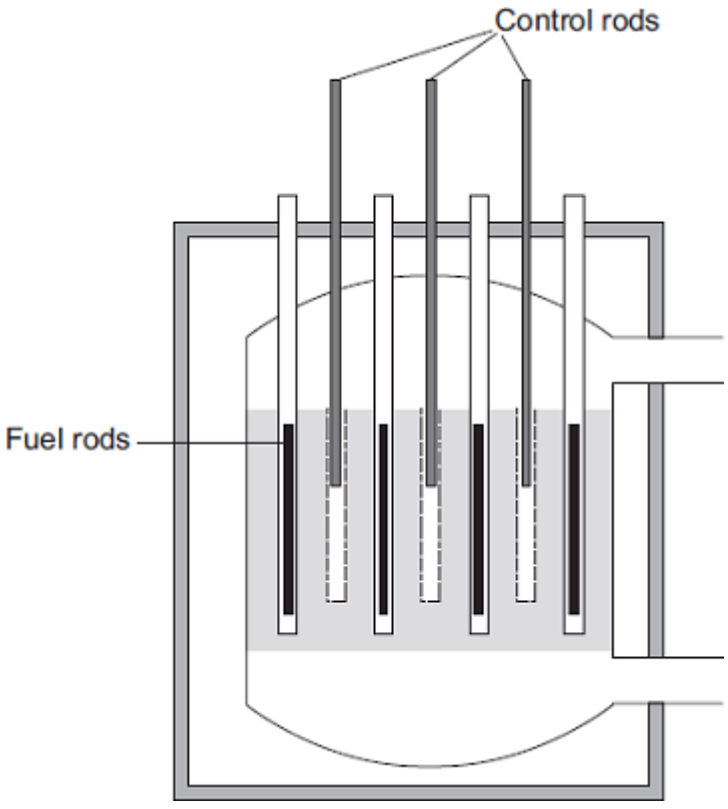
(b) The diagram shows the nuclear fission process for an atom of uranium-235.

Complete the diagram to show how the fission process starts a chain reaction.



(2)

(c) The diagram shows the cross-section through a nuclear reactor.



The control rods, made from boron, are used to control the chain reaction. Boron atoms absorb neutrons without undergoing nuclear fission.

Why does lowering the control rods reduce the amount of energy released each second from the nuclear fuel?

_____

_____

_____

_____

(2)

(Total 8 marks)

Q6.

(a) Brown dwarf stars are thought to have been formed in the same way as other stars. They are too small for nuclear fusion reactions to take place in them.
Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

(i) Describe how a star is formed.

_____

_____

_____

_____

(2)

(ii) Describe the process of nuclear fusion.

_____

_____

_____

(1)

(iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

_____

_____

_____

(1)

(b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

(i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

_____

_____

(1)

(ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

_____

_____

(1)

(c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

_____

_____

(1)

(Total 7 marks)

Q7.

Stars go through a life cycle.

Some stars will finish their life cycle as a black dwarf and other stars as a black hole.

(a) The table below gives the mass, relative to the Sun, of three stars, **J**, **K** and **L**.

Star	Mass of the star relative to the Sun
J	0.5
K	14.5
L	20.0

Which **one** of the stars, **J**, **K** or **L**, will become a black dwarf? _____

Give a reason for your answer.

_____

_____

(2)

(b) Scientists can take the measurements needed to calculate the mass of many stars.

Scientists cannot calculate the mass of the star Betelgeuse.

They estimate that the star has a mass between 8 and 20 times the mass of the Sun.

(i) Betelgeuse is in the red super giant stage of its life cycle.

What will happen to Betelgeuse at the end of the red super giant stage?

_____

_____

(1)

(ii) Suggest **one** reason why scientists can only estimate and **not** calculate the mass of Betelgeuse.

_____

_____

_____

(1)

(iii) In the future, it may become possible for scientists to calculate the mass of Betelgeuse.

Suggest **one** reason why.

_____

_____

_____

(1)

(c) Describe what happens to a star, after the main sequence period, for the star to eventually become a **black dwarf**.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 10 marks)

Q8.

The figure below shows some bumper cars.

Bumper cars are designed to withstand collisions at low speeds.

(a) During a collision between a bumper car and the barrier, the bumper car and barrier act as a closed system.

What is meant by a ‘closed system’?

(1)

(b) How does Newton’s Third Law of motion apply to the collision between the bumper car and the barrier?

(1)

(c) During the collision, the change in momentum of the bumper car is 700 kg m/s.

The time taken for the collision is 0.28 s.

Calculate the force on the bumper car during the collision.

Use the Physics Equations Sheet.

Force = _____ N

(2)

(d) The bumper car has a flexible bumper.

Explain how the flexible bumper reduces the risk of injury to the people in the bumper car during the collision.

(3)

(e) A bumper car moved with an initial constant velocity and then accelerated at 2.0 m/s^2.

While accelerating, the bumper car travelled a distance of 1.5 m.

The final velocity of the bumper car was 2.5 m/s.

Calculate the initial constant velocity of the bumper car.

Use the Physics Equations Sheet.

Initial constant velocity = _____ m/s

(3)

(Total 10 marks)

Q9.

Momentum is a vector quantity.

(a) How is a vector quantity different to a scalar quantity?

_____

_____

(1)

(b) Name another vector quantity.

_____

(1)

(c) Give the definition of momentum.

_____

_____

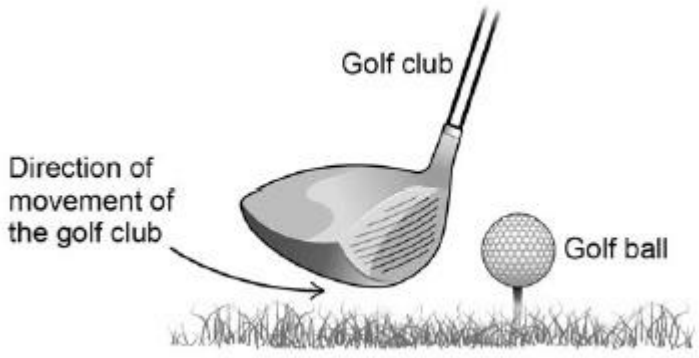
(1)

(d) What is the unit of momentum?

_____

(1)

(e) The image shows a golf club about to hit a stationary golf ball.



The golf club is in contact with the golf ball for 1.8 ms and exerts a force of 1500 N on the golf ball.

The mass of the golf ball is 0.045kg

Calculate the velocity of the golf ball as it leaves the golf club.

_____

_____

_____

_____

_____

Velocity = _____ m/s

(4)

(f) When hitting the golf ball the golfer swings the golf club to keep it in contact with the golf ball for as long as possible.

The force acting on the golf ball is constant during this time.

Explain the effect that the time of contact between the golf club and the golf ball has on the distance the golf ball travels.

(4)

(Total 12 marks)

Final Task

Write a 1000 word essay on a topic that interests you in physics. You may choose any subject you like, but you must cite (you may wish to use a website such as ‘citethisforme’) the information that you use.

This is an important task. If this work is completed to a high standard, we will use it as one of your assessed required practicals.

Q1.

(a) wavelength = Q

1

(b) $\text{amplitude} = \frac{R}{2}$

1

(c) radio waves

1

(d) s = 300 000 000 × 0.000009

1

s = 2700 (m)

1

(e) satellite communications
or
cooking /heating food
allow WiFi

1

[6]

Q2.

(a) ultraviolet travels at the same speed as visible light

1

(b) D

1

C

1

this order only

(c) A 400 – 315 = 85 (nm)
B 315 – 280 = 35 (nm)
C 280 – 100 = 180 (nm)
three calculations correct 2 marks
one or two calculations correct 1 mark

2

ultraviolet C (UVC)
mark dependent on all three calculations being made

1

(d) **Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content:

- ozone absorbs all of the UVC
- UVC is the most dangerous
- ozone absorbs nearly all (95%) of the UVB
- UVB has a medium risk
- ozone doesn't absorb any UVA
- ozone does not reduce risk from UVA
- UVA is the least dangerous
- the greater the ionising power the greater the absorption by ozone
- the greater the ionising power the greater the risk

- UV damages skin cells
- can lead to skin cancer
- can cause sunburn
- UV can damage eyes
- leads to problems with eyesight

(e) our eyes detect visible light

allow it would be dark all the time

allow specific effect ie plants couldn't grow

1

(f) transmitted

1

absorbed

1

this order only

[13]

Q3.

(a) Any **one** from:

- (medical) x-rays

  allow CT scans
- radiotherapy
- nuclear weapons (testing)

  allow nuclear fallout
- named nuclear disaster e.g. Chernobyl / Fukushima / Three Mile Island.

  ignore radioactive / nuclear waste

1

(b) uranium / plutonium

ignore any number given

allow thorium

1

(c) neutron absorbed by a uranium nucleus

1

nucleus splits into two parts

allow an atom splits into two parts if 1st marking point doesn't score

1

and (2/3) neutrons (are released)

1

and gamma rays (are emitted)

1

(d) lighter nuclei join to form heavier nuclei

allow specific examples

1

some of the mass (of the nuclei) is converted to energy (of radiation)

1

(e) activity decreases quickly

allow nuclei / waste will decay at a greater rate
ignore waste is radioactive for less time

1

risk of harm decreases quickly

allow burial site doesn't need to be monitored for as long
or
doesn't need to be buried underground for as long
or
may not need to be buried underground

1

[10]

Q4.

(a) uranium-235

accept any correct indication

1

(b) splits / breaks (into two smaller parts)

nucleus is separated is insufficient
*do **not** accept atom splits – on its own*

1

and (two / three) neutrons

1

(c) steam

correct order only

1

turbine

1

generator

1

[6]

Q5.

(a) (i) plutonium (239)

accept Pu / Thorium / MOX (mixed oxide)
*do **not** accept uranium-238 **or** hydrogen*

1

(ii) (energy) used to heat water and

1

produce (high pressure) steam

1

the steam drives a turbine (which turns a generator)

1

(b) Neutron(s) shown 'hitting' other U-235 nuclei
one uranium nucleus is sufficient

1

U-235 nuclei (splitting) producing 2 or more neutrons

1

(c) any **two** from:

- neutrons are absorbed (by boron / control rods)
- there are fewer neutrons
- chain reaction slows down / stops
accept fewer reactions occur

2

[8]

Q6.

(a) (i) (enough) dust and gas (from space) is pulled together
accept nebula for dust and gas
accept hydrogen for gas
accept gas on its own
dust on its own is insufficient
mention of air negates this mark

1

by:
gravitational attraction
or
gravitational forces
or
gravitaty
ignore any (correct) stages beyond this

1

(ii) joining of two (atomic) nuclei (to form a larger one)
do not accept atoms for nuclei

1

(iii) more sensitive astronomical instruments / telescopes
or
infrared telescopes developed

accept better technology

more knowledge is insufficient

1

(b) (i) (other) planets / solar systems

do not accept galaxy

moons is insufficient

1

(ii) provided evidence to support theory

accept proves the theory

1

(c) elements heavier than iron are formed only when a (massive) star explodes

accept materials for elements

accept supernova for star explodes

accept stars can only fuse elements up to (and including) iron

1

[7]

Q7.

(a) J

reason only scores if J is chosen

1

(only) stars (about) the same / smaller size / mass as the Sun become black dwarfs

accept smaller than the Sun

accept it is the smallest

accept (only) small stars become black dwarfs

1

(b) (i) become a supernova
or
it will explode

ignore subsequent correct stages

1

(ii) cannot take measurements needed
or
do not have the technology

*do **not** accept cannot measure mass*

1

(iii) advances in (measuring) techniques / technology / knowledge

1

(c) any **five** from:

ignore any information up to the end of the main sequence

Apply the list rule if more than 5 points are made

- star expands (to become)
- a red giant

red supergiant is incorrect

- heavier elements are formed (by fusion)

  elements heavier than iron are formed is incorrect
- star shrinks (to become)
- a white dwarf

  supernova, neutron star, black hole are incorrect
- star cools / fades
- star stops emitting energy / radiation

  star loses all energy is insufficient

5

[10]

Q8.

(a) the total amount of energy (of the bumper car and barrier) remains constant.
or
total momentum (of bumper car and barrier) before collision equals total momentum (of bumper car and barrier) after collision
or
the resultant external force acting (on the system) is zero

allow there are no external forces (acting on the system)

1

(b) the force of the car on the barrier is equal to the force of the barrier on the car and in the opposite direction

1

(c) $F = \frac{700}{0.28}$

1

F = 2 500 (N)

1

(d) increases the time taken for the collision to occur

allow increases contact time

*do **not** accept slows down time*

1

(so) the rate of change of momentum decreases

allow reduces acceleration / deceleration

1

reducing the force (on the people)

reduces impact is insufficient

1

(e) $2.5^2 - u^2 = 2 \times 2.0 \times 1.5$

1

$u^2 = 2.5^2 - (2 \times 2.0 \times 1.5)$

1

u = 0.50 (m/s)

allow 0.5 (m/s)

1

[10]

Q9.

(a) a vector has direction (a scalar does not)

1

(b) accept any vector quantities eg

- velocity
- force
- weight
- acceleration
- displacement

1

(c) mass × velocity

*do **not** accept speed for velocity*

*do **not** accept symbols*

1

(d) kilogram(s) metre per second

allow kg m/s

1

(e) 1.8 ms = 0.0018 s

*an answer of 60 (m/s) scores **4** marks*

1

$$1500 = \frac{0.045 \times v\,(-0.045 \times 0)}{0.0018}$$

1

$$v = \frac{1500 \times 0.0018}{0.045}$$

1

v = 60 (m/s)

*an answer of 60 000 scores **3** marks*

1

(g) longer the time of contact the greater the change of momentum

allow the converse

1

since the mass of the golf ball is constant

1

the velocity of the golf ball must increase

1

increasing the distance the golf ball travels

1

[12]