Week 6 Learning Check
Physics Higher

Name: _____

Class: _____

Date: _____

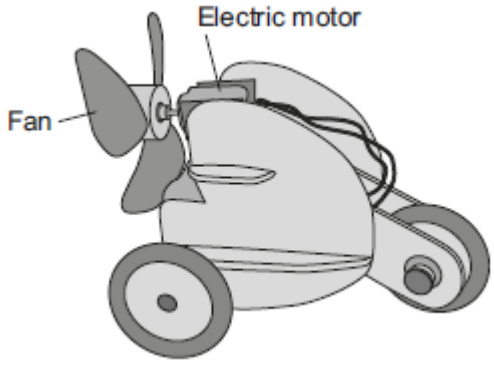
Time: **30 minutes**

Marks: **29 marks**

Comments:

Q1. The diagram shows an air-driven toy.

When the electric motor is switched on the fan rotates.
The fan pushes air backwards making the toy move forwards.



(a) (i) The toy has a mass of 0.15 kg and moves forward with a velocity of 0.08 m/s.

How is the momentum of the toy calculated?

Tick (✔) **one** box.

0.15 + 0.08 = 0.230 ☐

0.15 ÷ 0.08 = 1.875 ☐

0.15 × 0.08 = 0.012 ☐

(1)

(ii) What is the unit of momentum?

Tick (✔) **one** box.

kg m/s ☐ m/s^2 ☐ kg/m/s ☐

(1)

(iii) Use the correct answer from the box to complete the sentence.

less than	**equal to**	**more than**

The momentum of the air backwards is _____ the momentum of the toy forwards.

(1)

(b) The electric motor can rotate the fan at two different speeds.

Explain why the toy moves faster when the fan rotates at the higher of the two speeds.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q2.

The diagram shows a shuttlecock that is used for playing badminton.

The shuttlecock weighs very little.
When you drop it from a height of a few metres, it accelerates at first but soon reaches a steady speed.

Explain, as fully as you can:

(a) why the shuttlecock accelerates at first,

_____

_____

_____

(2)

(b) why the shuttlecock reaches a steady speed.

_____

_____

_____

_____

(3)

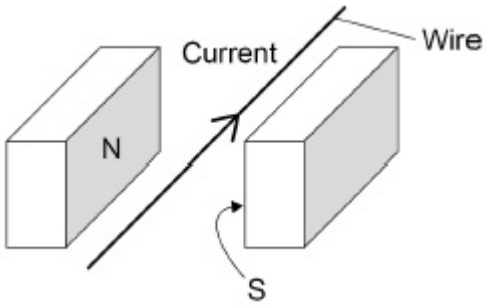
(Total 5 marks)

Q3.

Figure 1 shows a wire in a magnetic field.

The direction of the current in the wire is shown.

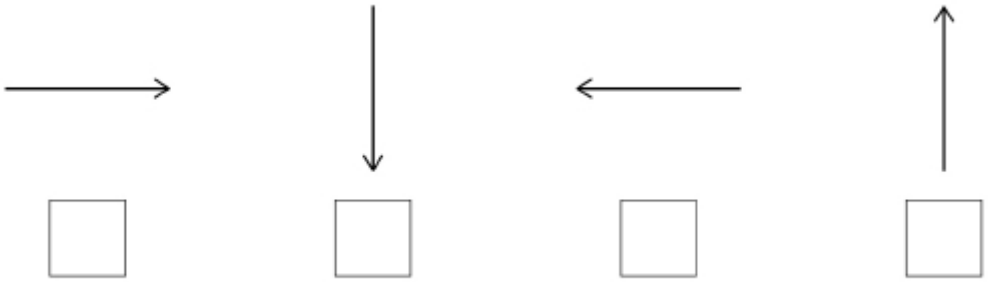
Figure 1



(a) There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

Tick (✓) **one** box.



(1)

(b) Give **two** ways that the direction of the force on the wire could be reversed.

1 _____

2 _____

(2)

(c) The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

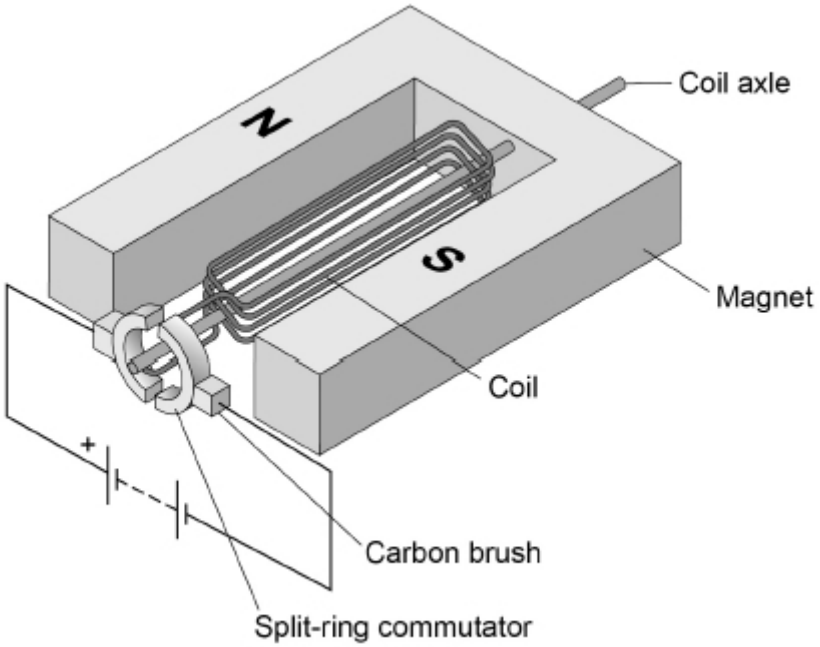
Use the Physics Equations Sheet.

Current = _____ A

(4)

(d) **Figure 2** shows a simple motor.

Figure 2



Explain why the coil rotates when there is a current in the coil.

(4)

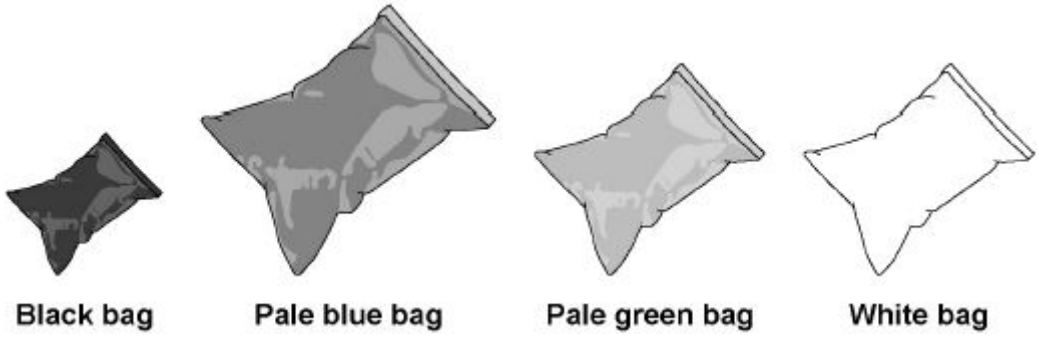
(Total 11 marks)

Q4.

A solar water bag can be used to heat water for an outdoor swimming pool.

A student wanted to find out if the colour of the solar water bag affects the temperature increase of the water inside the bag.

The diagram below shows some of the equipment used.



This is the method used.

1. Fill each bag with water.
2. Place the four bags on the ground outside.
3. After three hours, measure the temperature of the water inside each bag.
4. Repeat steps 1−3 on the next two days.

(a) Suggest three changes the student should make to this method to get valid results.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

The student repeated the investigation using an improved method.

The results obtained were valid.

The table below shows the results.

Colour of bag	**Temperature increase in °C**			
	Day 1	**Day 2**	**Day 3**	**Mean**
Black	44.0	31.4	43.4	39.6
Pale blue	38.5	23.6	38.1	33.4
Pale green	37.9	23.7	37.7	33.1
White	25.3	23.4	24.2	**X**

(b) The student used a thermometer to measure the temperature of the water inside each bag.

What was the resolution of the thermometer?

Resolution = _____ °C

(1)

(c) Suggest **one** reason why the temperatures increased less on Day 2 than on Day 1 and Day 3.

_____

_____

(1)

(d) Calculate the mean temperature increase for the white bag.

_____

_____

Mean temperature increase = _____ °C

(1)

(e) Which colour of bag would be best to use to heat water?

Give a reason for your answer.

Colour _____

Reason _____

_____

_____

_____

(2)

(Total 8 marks)

Q1.

(a) (i) $0.15 \times 0.08 = 0.012$

1

(ii) kg m/s

1

(iii) equal to

1

(b) momentum of the air increases
or
force backwards increases

accept air moves faster
accept momentum backwards increases
accept pushes more air back(wards)

1

so momentum of the toy must increase
or
the force forwards (on the toy) increases

accept momentum forwards must increase
it = toy

1

[5]

Q2.

(a) reference to

- weight / force of gravity / acting downwards
- unbalanced (by any upwards force)

for 1 mark each

2

(b) *ideas that* forces balance(d)

gains 1 mark

but
weight / force of gravity / downwards force balanced by friction / air resistance / drag / upwards force

gains 2 marks

latter increases with speed

(*accept* arrows or relevant length and direction if clearly labelled, as answers to parts (a) and (b))

for 1 further mark

3

[5]

Q3.

(a)

1

(b) reverse the direction of the current

1

reverse the direction of the magnetic field

1

(c)

*an answer of 4.0 (A) scores **4** marks*

B = 0.360 (T)

1

0.072 = 0.360 × I × 0.050

allow a correct substitution using an incorrectly / not converted value of B

1

$$I = \frac{0.072}{(0.360 \times 0.050)}$$

allow a correct rearrangement using an incorrectly / not converted value of B

1

I = 4.0 (A)

allow a correct calculation using an incorrectly / not converted value of B

1

(d) there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field

1

current is in opposite directions in each side of the coil

1

so forces act in opposite directions on either side of the coil

1

(the split ring ensures that) the current in the left / right side of the coil is always in the same direction

allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction

allow the current reverses each half rotation

1

[11]

Q4.

(a) any **three** from:

- same surface area of bag (exposed to sun)

  allow same sized bag

- same volume / mass of water

  allow same amount of water

- use same starting temperature of water

  allow measure temperature at the start

- place all bags out at the same time
- place all bags out in same area / conditions
- same thickness of material / bag
- same type of material (for each bag)
- use IR lamp in a lab

3

(b) 0.1 (°C)

1

(c) any **one** from:

- more cloudy
- less sunny

  ignore less Sun

- less sunlight
- cooler day

1

(d) 24.3 (°C)

1

(e) black

1

(it has the) greatest (temperature) rise

allow it is the best absorber of IR (radiation)
ignore best emitter of IR (radiation)

1

reason only scores if black is given

[8]

Q1.

(a) (i) This was well answered with most students making the correct choice to calculate the momentum.

(ii) Just under half of the students correctly identified the unit of momentum.

(iii) Surprisingly few students understood that the backward and forward momentum would be the same.

(b) Most students scored zero with very few scoring both marks. The main problem was students not identifying either the directions of forces or the increased magnitude of the forces. Those who mentioned momentum often neglected to identify if it was the air or the toy they were referring to or the fact that it had increased. The most common point that gained credit was the air moving quicker or more air being forced backwards by the fan. Many of the students simply repeated information from the stem of the question stating that the toy went faster.

Q3.

(a) A quarter of students were able to correctly determine the direction of the force on the wire.

(b) Over half of the students gained at least 1 mark on this question. Some students knew that changing the magnetic field in some way would have an effect. Some students used expressions such as ‘change the magnets’ or ‘move magnets over’ which were insufficiently specific to score the mark. A number incorrectly stated that increasing, decreasing or changing the field strength or current would have the effect of changing the direction of the force.

(c) A quarter of the students scored 0 marks on this question. Of those that did score marks, the vast majority scored 3 marks as few converted the flux density from mT to T to score full marks.

(d) Very few students scored full marks on this question. Three quarters of students scored 0 marks. Some students drew force arrows on the diagram, which enhanced their response. Less effective responses often scored mp1 and mp4. Common errors included mixing magnetism and charges attracting or repelling, discussing motion of either side of the coil rather than forces, or only discussing current and force on one side of the coil. Many students spent too long discussing the interaction of the magnetic fields so ran out of space for other points.

Q4.

Foundation

(a) Most students attempted to improve this method. Using the same size bags was the most common correct answer, followed by using the same volume of water. Many students gave answers to extend the investigation instead, such as suggesting using more colours.

The common answer of repeating for more time or on more days did not gain credit. 69% of students gained some credit.

(b) Resolution appears to be a concept that is not well understood, with 6% of students providing a correct answer. 22% of students did not attempt to answer this question.

(c) This was generally well understood, but all too often inaccuracy in expression resulted in the mark not being awarded.

(d) The mean value was correctly calculated by 67% of students.

(e) 87% of students concluded that it was black bag that would be best to use. However, approximately half of these students did not gain the mark for their reason. Those that did so usually referred to the greatest rise in temperature. A very common misconception is that the colour black 'attracts the Sun / heat'.

Higher

(a) 60% of students achieved two or more marks for this question. Answers such as, 'the size of the bag' and, 'the volume of water' were not uncommon, but do not answer the question. The most common correct answer seen was 'use the same size bag'.

(b) Resolution appears to be a concept that is not well understood with 31% giving a correct answer.

(c) The stem of the question requires an answer which is comparative, so 'it was a cold day' was not awarded the mark. 64% of students achieved the mark.

(d) This proved a successful question for 93% of students. However, poor formation of numerals meant that '4' could often easily be interpreted as '7' or '9'.

(e) Most students selected 'black bag' with reasons based on evidence or knowledge that black is the best absorber of heat. The statement based on evidence from Table 1 required an answer such as 'because it had the great**est** temperature rise'. A common misconception is that that black **attracts** heat and light.