Paper Two Extended Writing

Name: _____

Class: _____

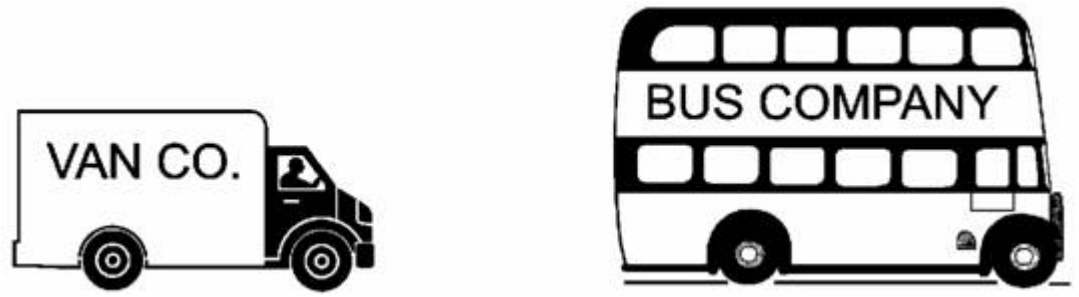
Date: _____

Time: **51 minutes**

Marks: **51 marks**

Comments:

1 **'SPEED KILLS' -** was the heading of an advertising campaign. The scientific reason for this is that energy is transferred from the vehicle to the person it knocks down.



(a) The bus and the van are travelling at the same speed. The bus is more likely to cause more harm to a person who is knocked down than the van would. Explain why.

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(2)

(b) A car and its passengers have a mass of 1200 kg. It is travelling at 12 m/s.

(i) Calculate the increase in kinetic energy when the car increases its speed to 18 m/s.

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

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Increase in kinetic energy = ...

(5)

(ii) Explain why the increase in kinetic energy is much greater than the increase in speed.

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(1)
(Total 8 marks)

2 The figure below shows a skateboarder jumping forwards off his skateboard.

The skateboard is stationary at the moment the skateboarder jumps.

(a) The skateboard moves backwards as the skateboarder jumps forwards.

Explain, using the idea of momentum, why the skateboard moves backwards.

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(3)

(b) The mass of the skateboard is 1.8 kg and the mass of the skateboarder is 42 kg.

Calculate the velocity at which the skateboard moves backwards if the skateboarder jumps forwards at a velocity of 0.3 m / s.

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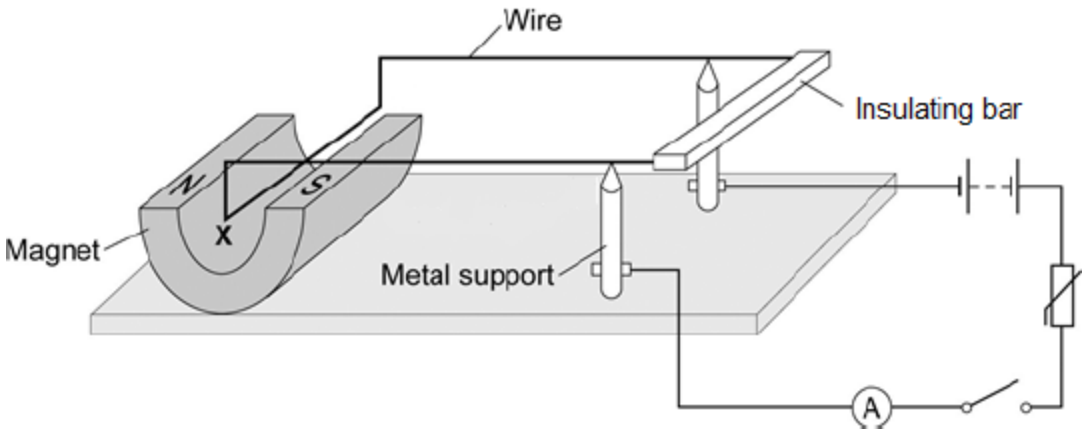
Velocity of skateboard = ... m / s

(3)
(Total 6 marks)

3 **Figure 1** shows a piece of apparatus called a current balance.

Figure 1



When the switch is closed, the part of the wire labelled **X** experiences a force and moves downwards.

(a) What is the name of the effect that causes the wire **X** to move downwards?

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(1)

(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

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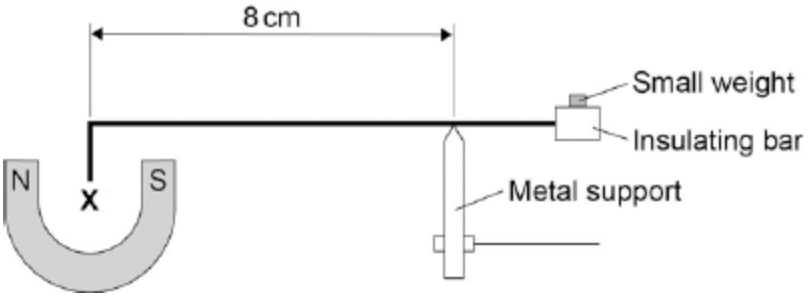
(1)

(c) **Figure 2** shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 2



The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

Give the unit.

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Magnetic flux density = ... Unit .....

(6)
(Total 8 marks)

4 Waves may be either longitudinal or transverse.

(a) Describe the difference between a longitudinal and a transverse wave.

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(2)

(b) Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

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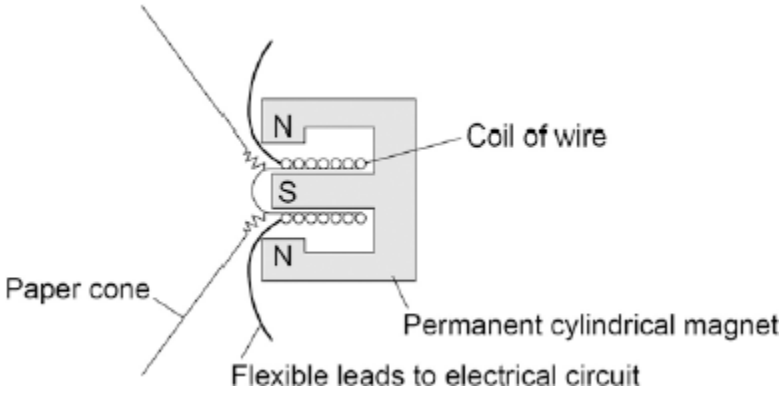
(1)

(c) The figure below shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.



Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

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(6)
(Total 9 marks)

5 (a) The Sun is at the stable stage of its life.

Explain, in terms of the forces acting on the Sun, what this means.

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(3)

(b) At the end of the stable stage of its life a star will change.

Describe and explain the changes that could take place.

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(6)
(Total 9 marks)

6 Explain, in as much detail as you can, the scientific evidence for the “big bang” theory of the origin of the Universe.

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(Total 5 marks)

7 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

There are two types of traditional transformer; step-up and step-down.

Describe the similarities and differences between a step-up transformer and a step-down transformer.

You should include details of:

- construction, including materials used
- the effect the transformer has on the input potential difference (p.d.).

You should **not** draw a diagram.

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Extra space .....

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(Total 6 marks)

Mark schemes

1

(a) the greater the mass / weight

1

then the greater the <u>kinetic energy</u>

accept the greater the momentum
accept greater mass / weight therefore greater force = 2

1

(b) (i)

<u>Note: this calculation requires candidates to show clearly how they work out their answer</u>

k.e. $\frac{1}{2}$ mv^2

accept evidence of equation

1

86 400 (J) at 12 m/s

accept ½ × 1200 × 12^2 ***or*** *86.4 KJ*

1

194 400 (J) at 18 m/s

accept ½ × 1200 × 18^2 ***or*** *194.4KJ*

1

increase in k.e. = 108 000
NB 10800 = 0 marks

N.B. if no working at all then max 3 for a correct numerical answer

1

joules **or J**

accept 108 kilojoules ***or*** *kJ*

1

(ii) explanation that ke $\propto$ v^2

1

[8]

2 (a) momentum before (jumping) = momentum after (jumping)

accept momentum (of the skateboard and skateboarder) is conserved

1

before (jumping) momentum of skateboard and skateboarder is zero

accept before (jumping) momentum of skateboard is zero

accept before (jumping) total momentum is zero

1

after (jumping) skateboarder has momentum (forwards) so skateboard must have (equal) momentum (backwards)

answers only in terms of equal and opposite forces are insufficient

1

(b) 7

*accept –7 for **3** marks*

*allow **2** marks for momentum of skateboarder equals 12.6*

or

0 = 42 × 0.3 + (1.8 × –v)

or

*allow **1** mark for stating use of conservation of momentum*

3

[6]

3 (a) motor effect

1

(b) increase the strength of the magnet

or

increase the current

1

(c) $4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$

1

$F = 6 \times 10^{-3}$ (N)

1

$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$

1

$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$

1

$B = 8 \times 10^{-2}$ or 0.08

1

*allow 8×10^{-2} **or** 0.08 with no working shown for **5** marks*

*a correct method with correct calculation using an incorrect value of F gains **3** marks*

Tesla

accept T

1

do not accept t

[8]

4 (a) in a longitudinal wave the oscillations / vibrations are parallel to the direction of energy transfer.

accept wave travel for energy transfer throughout

1

in a transverse wave the oscillations / vibrations are perpendicular to the direction of energy transfer.

1

(b) accept any sensible suggestion eg a vibrating drum skin does not move the air away to create a vacuum (around the drum)

1

(c) **Level 3 (5–6 marks):**
A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.

Level 2 (3–4 marks):
A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.

Level 1 (1–2 marks):
Some relevant points but fragmented with no logical structure.

0 marks:
No relevant content.

Indicative content

the current in the electrical circuit is varying

the current passes through the coil

the coil experiences a force (inwards or outwards)

reversing the current reverses the force

the size of the current affects the size of the force

the varying current causes the coil to vibrate

the (vibrating) coil causes the cone to vibrate

the vibrating cone causes the air molecules to move

the movement of the air molecules produces the pressure variations in the air needed for a sound wave

the air molecules bunch together forming compressions and spread apart forming rarefactions

6

[9]

5 (a) the Sun is subject to two balancing forces / 2 forces in equilibrium
the forces are: gravity making it contract **or** inward force due to gravity
and a force due to temperature / heat / energy / radiation pressure making it expand **or** outward force due to temperature / heat / energy / radiation pressure

for 1 mark each

3

(b) Read all the answer first. Stop after 6 marks.

hydrogen / fuel used up owtte the star will expand and become a red giant
it will contract under gravity become a white dwarf
it may explode and become a supernova throwing dust and gas into space
leaving a dense neutron star / black hole

(no mark for contradiction)
any six for 1 mark each

6

[9]

6

ideas that: galaxies show a red-shift

gains 1 mark

but more distant galaxies show bigger red-shift

gains 2 marks

galaxies moving away/Universe expanding

gains 1 mark

but more distant galaxies moving away faster

gains 2 marks

so all Universe once in one place

for 1 further mark
(only if the previous 2 marks are also gained)

[5]

7 Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant / correct content.

Level 1 (1–2 marks)
Either there is an attempt at a description of the construction of a transformer

or

a correct statement of the effect of one type of transformer on the input p.d.

Level 2 (3–4 marks)
There is a description of the construction of a transformer
and
a correct statement of the effect of one type of transformer on the input p.d.

Level 3 (5–6 marks)
There is a clear description of the construction of a transformer
and
there is a correct description of how transformers affect the input p.d.

details of construction:

extra information

a (laminated) core

core is made from a magnetic material / iron

2 coils

the coils are made from an electrical conductor / copper

the coils are covered in plastic / insulation

the coils are (usually) on opposite sides

step-up transformer has more turns on secondary coil than (its) primary (or vice versa)

step-down transformer has fewer turns on secondary coil than (its) primary (or vice versa)

effect on input p.d. :

step-up transformer, the output p.d. is greater (than the input p.d.)

accept voltage for p.d.

step-down transformer, the output p.d. is lower (than the input p.d.)

6

[6]

Examiner reports

1

(a) Most candidates recognised correctly that the bus was heavier but there were relatively few answers that referred to both mass and kinetic energy.

(b) Many candidates used the correct equation but only the most able could cope with the v^2 part of this. Weaker candidates subtracted 12 m/s from 18 m/s and then used the equation. Candidates who did not follow the instruction, 'Show clearly how you work out your answer', could not be credited with full marks even if the final answer was correct. In the final part, the majority of candidates failed to refer to v^2.

2

(a) A large proportion of the students scored zero on this question, many because of their failure to use the idea of momentum. The majority of these answers included reference to forces, commonly beginning 'every action has an equal and opposite reaction' etc. Some of the students picked up marks for stating that momentum is conserved or words to that effect and a smaller number picked up a mark for realising that the initial momentum was zero. Some students related the situation to an explosion but still struggled to score more than one mark. However, those who understood the situation were able to give clear answers gaining full marks.

(b) Over half of the students scored zero on this calculation. Many added the masses together before attempting to calculate any momentum, and there was a general lack of clear understanding. Very few of the students scored a mark for stating that momentum was conserved but some compensation marks were scored for finding the final momentum of the skateboarder.

5

In part (a) only the most able candidates were able to identify the two forces acting on the Sun correctly, though more of them realised that the forces are balanced. A number of candidates referred to the stability of the Solar System.

The answers to part (b) varied in quality form those where candidates were fortunate to pick up marks by mentioning 'red giant', 'white dwarf' etc. amongst a lot of mis-ordered or irrelevant information; to those which covered the whole range of possibilities in a well-structured order and could have gained ten marks if these had been available. For the really able candidates, or the candidate with a genuine interest in Astronomy, this must have been a satisfying way to end the examination.

6 Many weaker candidates produced answers relating to the origin of the solar system or of individual stars. Amongst creditworthy responses, the expansion of the Universe as indicated by galaxies moving away from each other was frequently mentioned but the fact that the speed of this movement increases with distance was mentioned much less frequently. It is the latter, proportional, relationship which implies that all the galaxies were once all at the same point. Some candidates correctly described observations of red-shifts as evidence for the above. In some scripts, however, the word “red-shift” was used in a way that indicated no understanding of the concept or of its significance.

7 This question also assessed the quality of written communication. The vast majority of students produced a level 1 answer worth 1 or 2 marks. Many students either did not attempt the question or discussed the use of transformers, rather than their construction. Those students who did score, many referred correctly to the number of turns on respective coils, but failed to carry this through to the effect on p.d. Many students referred to current, electricity, energy or power instead of or alongside p.d. often contradicting a correct statement. Many made no reference to the iron core, which limited their access to higher levels. There were a number of answers that described the iron core as a good conductor of electricity rather than mentioning its magnetic properties.