Student Number.....

Hornsby Girls' High School

2019

YEAR 11
YEARLY
EXAMINATION

Physics Assessment Task 3

General Instructions

- Reading time – 5 minutes
- Working time – **2 hours**
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- A data sheet, formula sheet and Periodic Table are provided at the back of this paper
- For questions in Section II, show all relevant working in questions involving calculations

Total marks: 75

Section I — 15 marks

- Attempt Questions 1–15
- Allow about 20 minutes for this part

Section II — 60 marks

- Attempt All Questions
- Allow about 1 hour and 40 minutes for this part

Section 1 Multiple Choice - 1 mark each

1) A car travels 300 m north then turns and travels 400 m east.

What is the final displacement of the car?

(A) 700 m

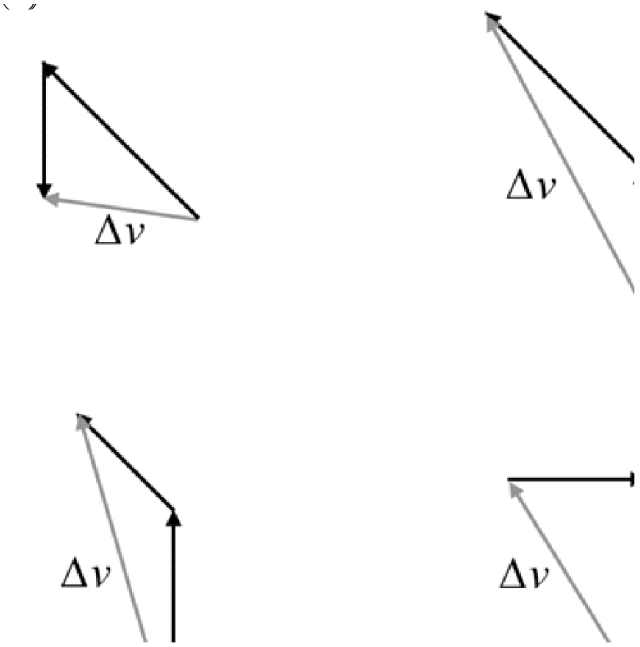
(B) 700 m bearing 053°

(C) 500 m bearing 037°

(D) 500 m bearing 053°

2) A plane was travelling due north when it encountered a cross wind from the west.

In order to maintain its current heading, it changed its bearing to NW and increased its speed. Which vector addition diagram below correctly identifies its change in velocity?



3) A pumpkin with a mass of 3.5 kg is dropped from a 20 m high window. Calculate the kinetic energy of the pumpkin when it is at a point ¾ of the way to the ground.

(A) 420 J

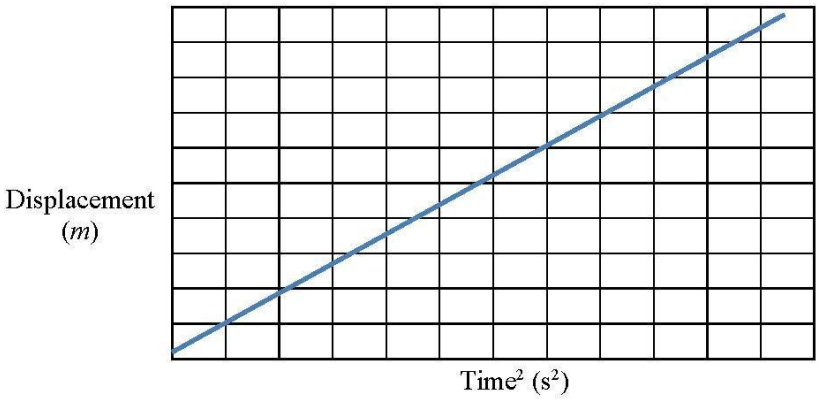
(B) 510 J

(C) 690 J

(D) 910 J

4) Students used a ball dropping experiment to determine the acceleration due to gravity. They timed how long it took a ball to reach the ground from different heights.

The graph below shows the line of best fit they produced. Note that the axes do not include their scales.



The students used the gradient (m) of the line of best fit to determine gravity (g).

Which equation would the students then use to determine their value for gravity from the gradient?

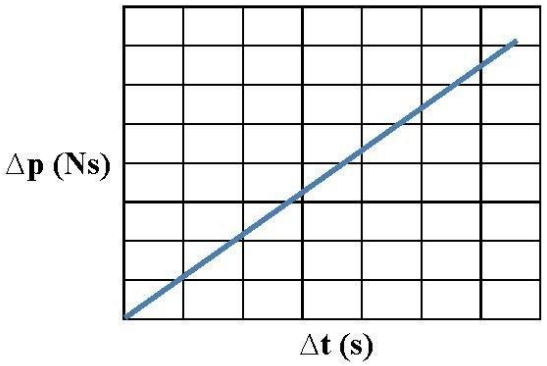
(A) g = 2m

(B) g = m

(C) g = $\frac{m}{2}$

(D) g = 4m

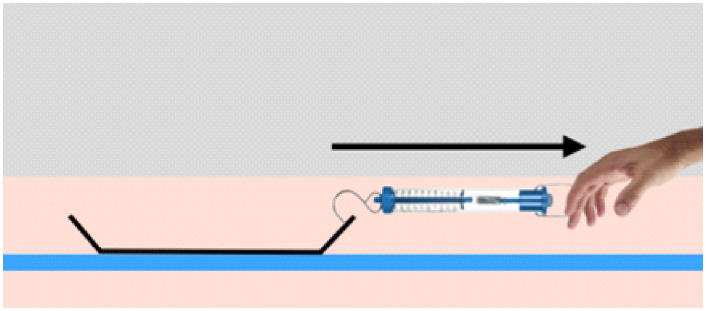
5) The graph below shows the change in momentum of a car as it accelerates.



What does the gradient of this graph represent?

(A) Force
(B) Impulse
(C) Velocity
(D) Acceleration

6) A student was investigating the kinetic coefficient of friction using the experimental setup shown below.



Which answer best describes why it would be necessary to pull the spring balance horizontally.

(A) If it was not pulled horizontally a consistent force would not be applied to the block.

(B) If it was not pulled horizontally the spring balance would only be measuring a component of the applied force.

(C) If it was not pulled horizontally the applied force would be a component of the force the spring balance was measuring.

(D) Pulling it horizontally ensures that the normal force remains consistent during the movement.

7) Two students are standing at different distances from a lamp. The first student measures an intensity of 25 lumens and the second student measures and intensity of 4 lumens.

What is the most likely respective distances of the students from the lamp?

(A) 2 m and 5 m

(B) 1 m and 3 m

(C) 3 m and 4 m

(D) 5 m and 8 m

8) A third harmonic frequency is being played on a pipe organ. Consider the pipe organ to be an air column closed at one end. If the speed of sound in the pipe is 343 m s^{-1} and the frequency is 243 Hz, what is the length of the pipe?

(A) 0.353 m

(B) 0.705 m

(C) 1.06 m

(D) 1.76 m

9) Which statement best defines our understanding of the temperature of a substance?

(A) Temperature is a measure of the internal heat energy of the matter.

(B) Temperature is a measure of the total heat capacity of the substance.

(C) Temperature is a measure of the average kinetic energy of the particles of matter.

(D) Temperature is the sum of the kinetic energy of the particles in the substance.

10) Which statement best describes the period of a wave?

(A) The value of the product of frequency and wavelength.

(B) A number of oscilliation of the source in one second.

(C) The number of waves that pass a given point in one second.

(D) The time taken for one complete wave to pass a given point.

11) The force between two electrostatically charged balls placed 50 cm apart is F.

What will be the new force between the balls if the charge on each ball is doubled, and the distance between them halved?

(A) F

(B) 8F

(C) 16F

(D) 32F

12) 3.5 mA passes through a resistor in 2.0 s.

How many electrons does this represents?

(A) 3.6×10^{18}

(B) 1.6×10^{-19}

(C) 1.7×10^{18}

(D) 4.4×10^{16}

13) When two identical resistors are placed in series they have a total resistance of 10 Ohms.

What would be their total resistance be when placed in parallel?

(A) 2.5 Ohms

(B) 5.0 Ohms

(C) 10 Ohms

(D) 20 Ohms

14) Which Law relates to the conservation of current around a circuit?

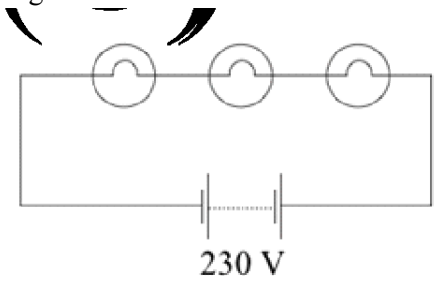
(A) Ampere's Law

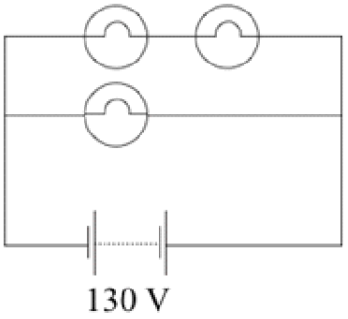
(B) Kirchhoff's Law

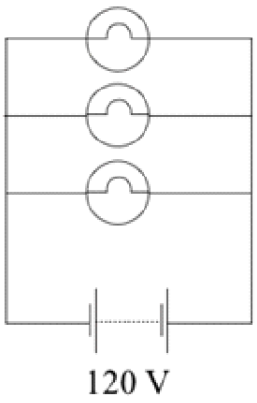
(C) Faraday's Law

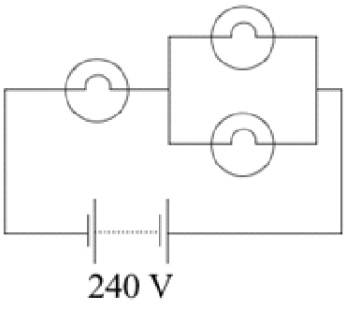
(D) Ohm's Law

15) Below are four circuits each containing three identical light bulbs. Which circuit below will have the brightest bulb?





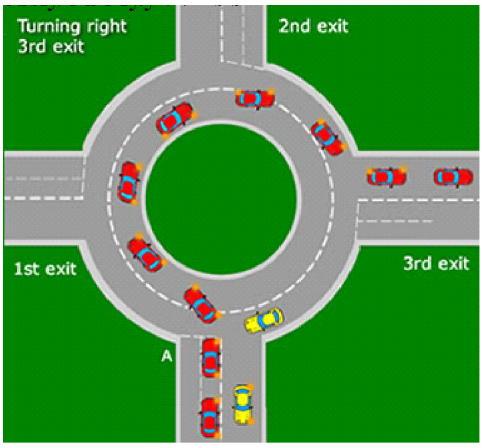




Section 2 Written Response

Question 16 (6 marks)

A car uses a roundabout to make a right hand turn as shown.



a) Construct a **scale vector diagram** to show the change in velocity of the car. **3**

b) The time between entering and exiting the roundabout was 11.7 s. Given the car has a mass of 1080 kg, what was the average force applied to the car? **2**

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c) What was the source of the force applied to the car? **1**

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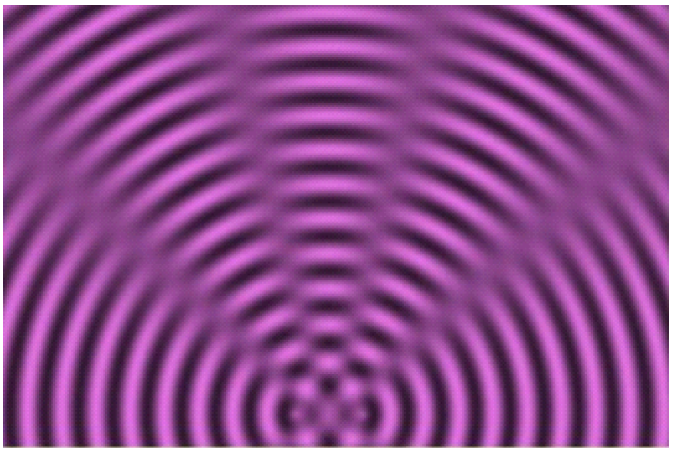
Question 17 (4 marks)

The diagram shows a snapshot of water waves produced by two oscillating sources marked by X. The sources oscillate in phase. The dark regions represent troughs and the light regions mark crests.

a) On the diagram, clearly mark a position in the water where the following occur:

i) constructive interference (use a letter **D**).

ii) destructive interference (use a letter **C**). **2**



c) Mark a position where waves from the two sources are meeting with a path difference of exactly half a wavelength. Label this position - **$\lambda/2$** **1**

d) How do you know that the frequency of the sources is constant? **1**

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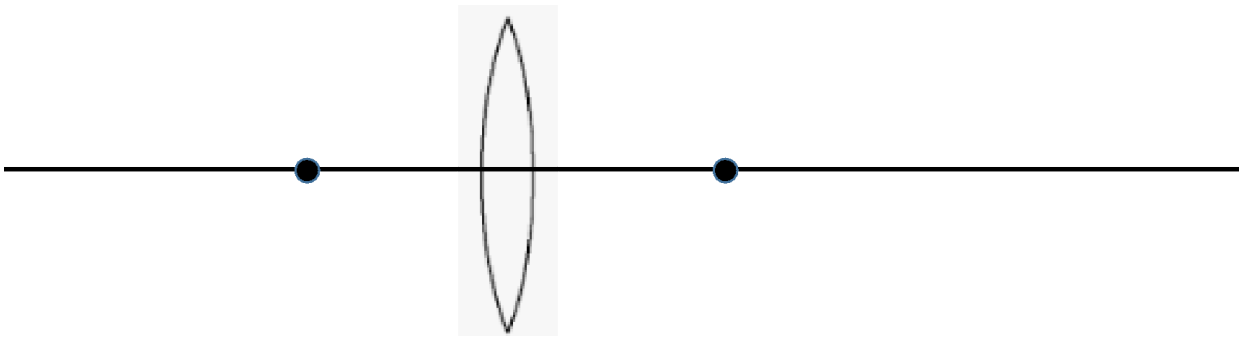
Question 18 (3 marks)

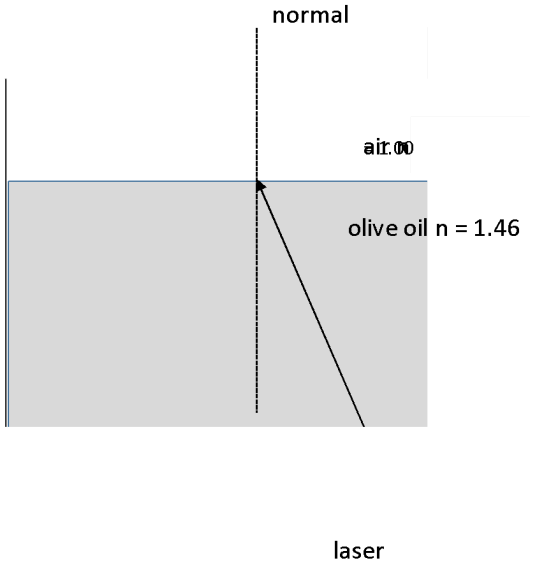
You need locate an object in a position so that a real and enlarged image is produced by the converging lens in the diagram.

Using a 2.0 cm upright arrow to represent the object, show where the object could be placed and where the resultant image would be formed. Use at least 2 rays to justify your answer.



Question 19 (5 marks)

A laser pointer was placed in a fish tank full of olive oil and the beam of light was directed at the surface at an angle as shown in the diagram.



At the surface some of the light is refracted and some is reflected.

a) On the diagram, draw the **reflected ray** and **refracted ray**. This must be done **accurately** according to the law of reflection and Snell's law. Show relevant calculations below. **3**

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b) Explain why the light will **not** be total internally reflected. **2**

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Question 20 (8 marks)

A plastic tube with a movable reflector was set up in class. A steady tone of 330 Hz was emitted by the phone. The reflector, initially next to the phone, was gradually moved away to the left.

a) At what length L was the **first** position of constructive interference located? **2**

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b) Is there a node or antinode at the reflector in this position? **1**

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c) This length was kept constant and the phone frequency was gradually increased until another loud sound was produced. What was this frequency? **2**

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d) Is this an example of resonance? Justify your answer. **3**

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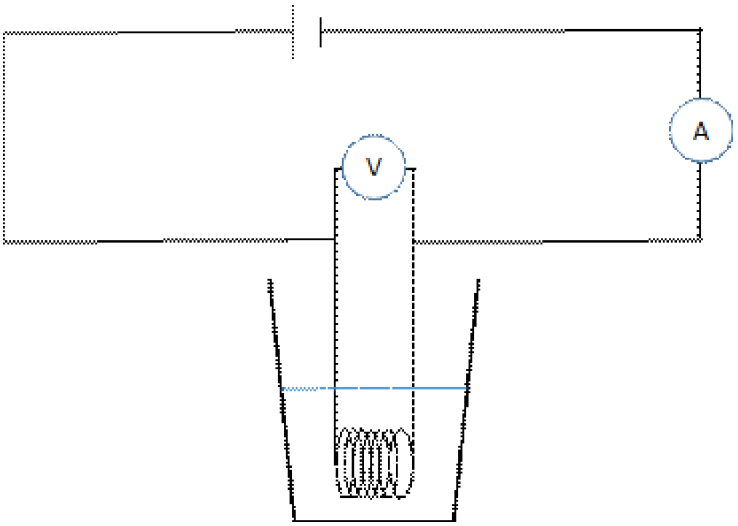
Question 21 (4 marks)

225 ml of water was placed in a foam coffee cup. A wire coil heater was placed in the water and allowed to stand for a while. The temperature of the water was then measured to be 17.5^0 C. The power supply was then switched on and a timer started. The voltage across the coil was 12.0 V and the current was 5.0 A.



If no energy was lost to the surroundings, how long did it take to raise the temperature of the water to reach 55.0 ^{0} C?

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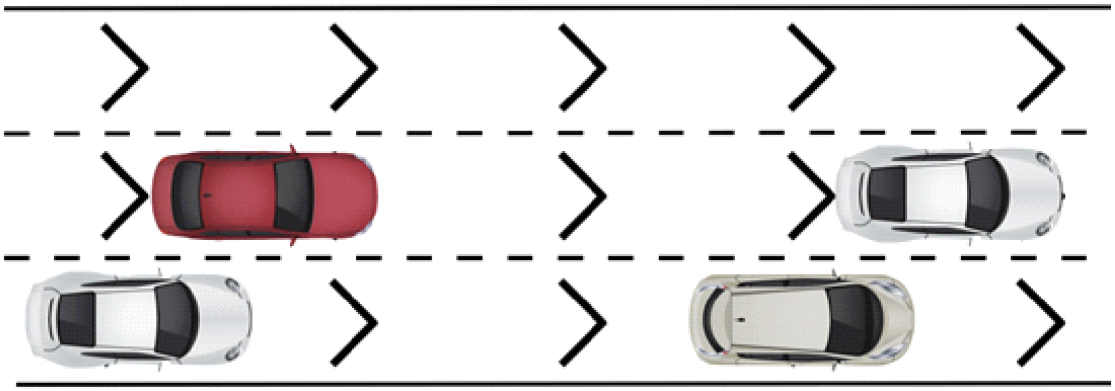
Extra writing paper – Question 16 -21. Clearly indicate what question is being answered on this sheet.

Question 22 (5 marks) **Student Number**_____

On a local highway, a safe driving initiative was put into effect to minimise tailgating (cars driving too close to the car in front). The road has chevrons painted on the lanes with uniform spaces in between, as shown in the diagram below. *note diagram is not drawn to scale.*



Drivers are urged to maintain a minimum distance of two chevron spaces between themselves and the driver in front.

a) Calculate the distance each chevron would need to be apart in order to create a 3.0 second gap between cars travelling at 110 km h^{-1}. **3**

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b) Brake reaction time is the amount of time that elapses between the recognition of an object or hazard in the roadway and the application of the brakes. A large study showed that the average brake reaction time for drivers is 2.3 s.

Does this support the idea of a 3.0 second gap between cars travelling at 110 km h^{-1}? Justify your answer. **2**

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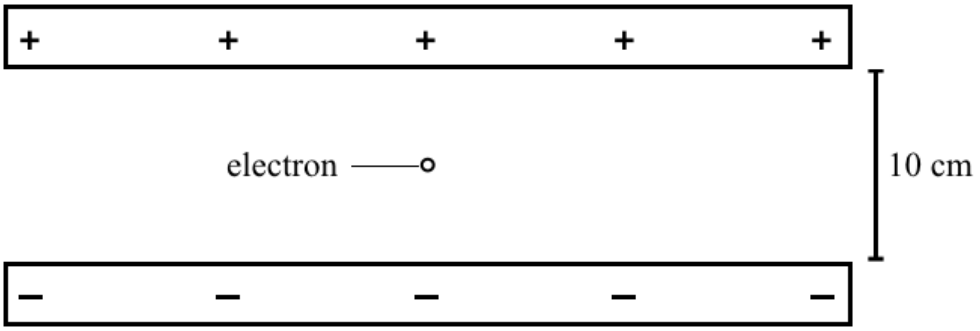
Question 23 (4 marks)

An electron is placed between two charged parallel plates as shown below. The potential difference between the plates is 215 V.



a) Calculate the force on the electron due to the electric field. **2**

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b) Ignoring any other forces, what would the acceleration of the electron be? **2**

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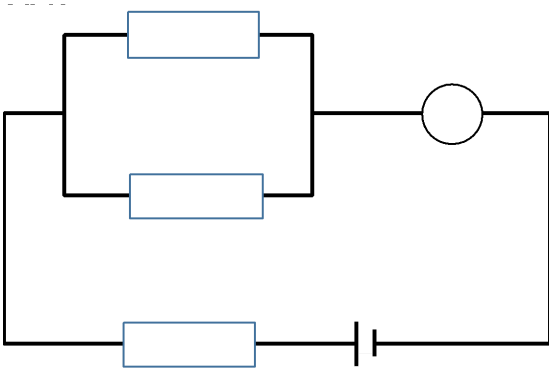
Question 24 (5 marks)

In the circuit modelled below, two thirds of the total circuit current travels through resistor R.



a) Calculate the total resistance of the circuit. **2**

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Calculate the current reading on the ammeter. **1**

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What is the voltage across the 30.0 Ω resistor? **2**

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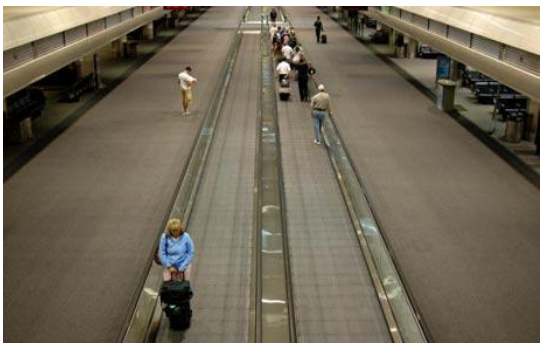
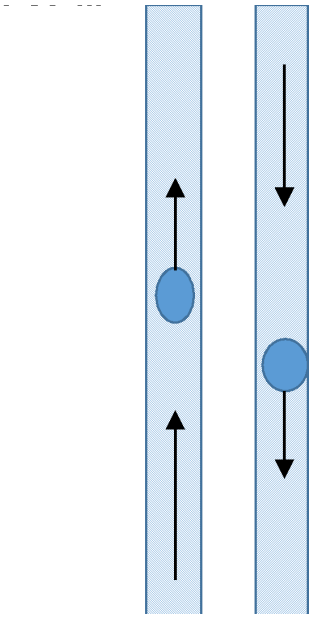
Question 25 (5 marks)



Moving walkways are used extensively in airports to move people around efficiently.

The digram is a top view of two walkways.



The walkway on the left travels north at 0.65 ms^{-1} relative to the ground, while the walkway on the right travels south at the same speed. Person A walks north at 1.7 ms^{-1} relative to the walkway as shown, while Person B walks on the south at 2.3 ms^{-1} relative to the walkway.

a) What is the velocity of Person A relative to the ground? **2**

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b) What is the velocity of Person B relative to Person A? **3**

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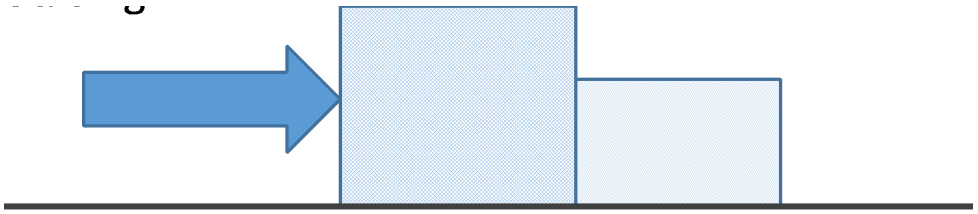
Question 26 (6 marks)

Two boxes, X and R are being pushed along a horizontal surface as shown. The boxes move at a constant speed. note $F_f = \mu F_N$



a) What is the coefficient of kinetic friction? **2**

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b) What force does X exert on R? **2**

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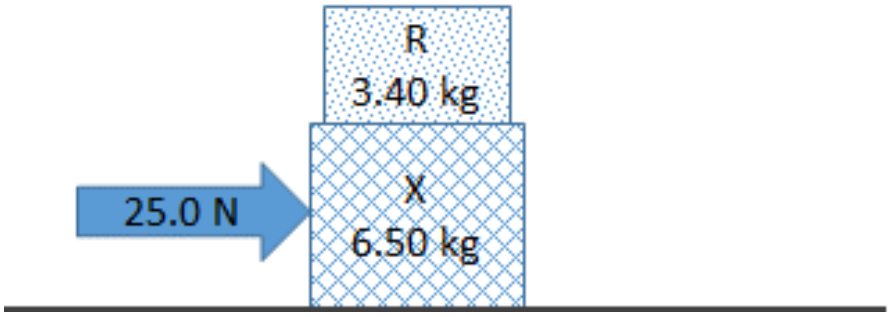
R is then placed on top of X. The applied force is increased to 25.0 N as shown.



c) Describe the resultant motion of this new set up. **2**

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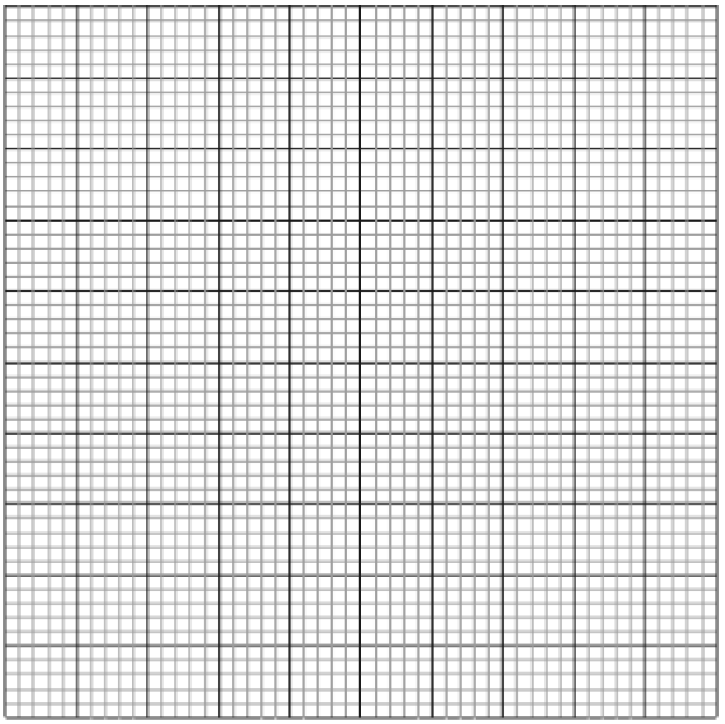
Question 27 (5 marks)

The current through a light globe was determined for different voltages. The results are shown in the table.

Voltage (V)	Current (A)
0	0
2.6	0.75
4.9	1.05
7.6	1.29
10.2	1.51
13.2	1.72
16.4	1.95

a) Plot a graph of the voltage vs current and draw a trend line. **3**



b) What does this graph tell you about the resistance of the light globe? **2**

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End of Exam

Extra writing paper – Question 22 -27 Clearly indicate what question is being answered on this sheet.

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Student Number.....

Hornsby Girls' High School

Answers

2019

YEAR 11
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Section I — 15 marks

- Attempt Questions 1–15
- Allow about 20 minutes for this part

Section II — 60 marks

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- Allow about 1 hour and 40 minutes for this part

Hornsby Girls High School
Year 11 Physics Yearly 2019

ANSWERS

Student Number | | | | | | | | | |

Section I
Multiple Choice Answer Sheet

Shade in the oval. If you make a change, clearly indicate which the correct answer is.

1.	A ○	B ○	C ○	D ●
2.	A ●	B ○	C ○	D ○
3.	A ○	B ●	C ○	D ○
4.	A ●	B ○	C ○	D ○
5.	A ●	B ○	C ○	D ○
6.	A ○	B ○	C ●	D ○
7.	A ●	B ○	C ○	D ○
8.	A ○	B ○	C ●	D ○
9.	A ○	B ○	C ●	D ○
10.	A ○	B ○	C ○	D ●
11.	A ○	B ○	C ●	D ○
12.	A ○	B ○	C ○	D ●
13.	A ●	B ○	C ○	D ○
14.	A ○	B ●	C ○	D ○
15.	A ○	B ○	C ○	D ●

Section 1 Multiple Choice - 1 mark each

1) A car travels 300 m north then turns and travels 400 m east.

What is the final displacement of the car?

(A) 700 m

(B) 700 m bearing 053°

(C) 500 m bearing 037°

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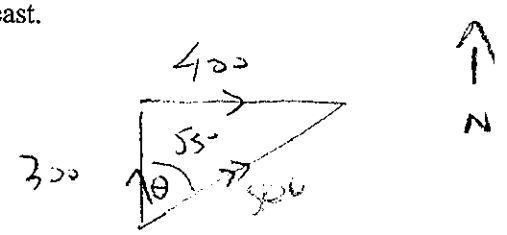
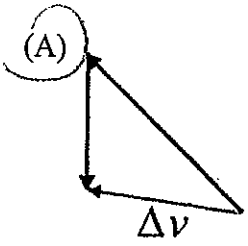


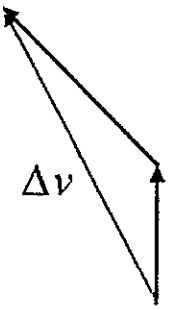
2) A plane was travelling due north when it encountered a cross wind from the west.

In order to maintain its current heading, it changed its bearing to NW and increased its speed. Which vector addition diagram below correctly identifies its change in velocity?

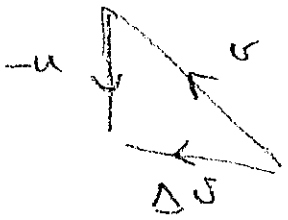
(A)



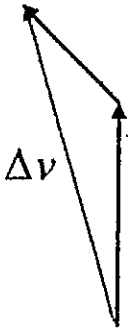
(B)



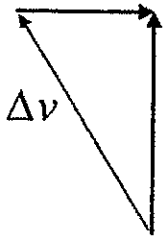
$\Delta v = v - u$



(C)



(D)



3) A pumpkin with a mass of 3.5 kg is dropped from a 20 m high window. Calculate the kinetic energy of the pumpkin when it is at a point ¾ of the way to the ground.

(A) 420 J

(B) 510 J

(C) 690 J

(D) 910 J

$\frac{1}{2}mv^2 = mg\Delta h$

$= 3.5 \times 9.4 \times 15$

$= 514$

$= 510 \text{ J}$ (2 sf)

$\Delta h = \frac{3}{4} \times 20$

$= 15 \text{ m}$

4) Students used a ball dropping experiment to determine the acceleration due to gravity. They timed how long it took a ball to reach the ground from different heights.

The graph below shows the line of best fit they produced. Note that the axes do not include their scales.

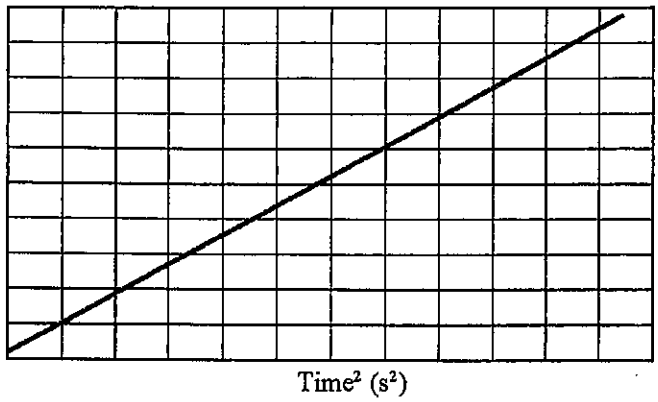
$s = ut + \frac{1}{2}at^2$

$s = \frac{1}{2}gt^2$

$\text{grad} = \frac{s}{t^2}$

$m = \frac{1}{2}g$

$g = 2m$



The students used the gradient (m) of the line of best fit to determine gravity (g).

Which equation would the students then use to determine their value for gravity from the gradient?

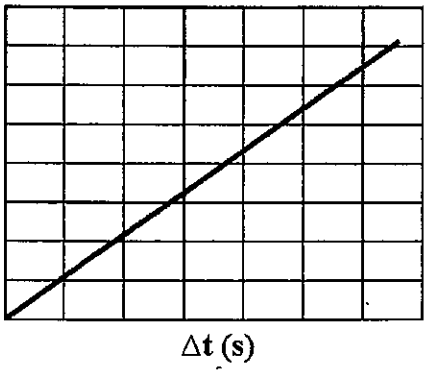
(A) $g = 2m$

(B) $g = m$

(C) $g = \frac{m}{2}$

(D) $g = 4m$

5) The graph below shows the change in momentum of a car as it accelerates.



$\text{gradient} = \frac{\Delta p}{\Delta t}$

$\Delta p = Ft$

$= \frac{Ft}{t} = F$

What does the gradient of this graph represent?

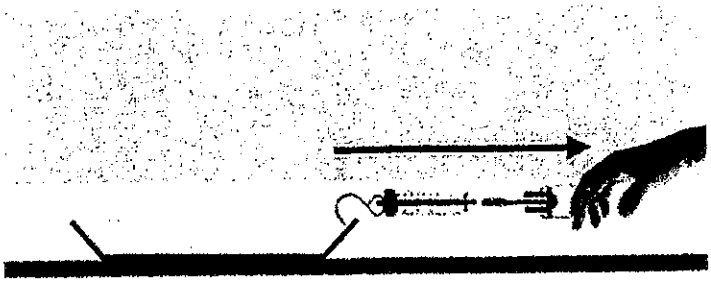
(A) Force

(B) Impulse

(C) Velocity

(D) Acceleration

6) A student was investigating the kinetic coefficient of friction using the experimental setup shown below.



Which answer best describes why it would be necessary to pull the spring balance horizontally.

(A) If it was not pulled horizontally a consistent force would not be applied to the block.

(B) If it was not pulled horizontally the spring balance would only be measuring a component of the applied force.

(C) If it was not pulled horizontally the applied force would be a component of the force the spring balance was measuring.

(D) Pulling it horizontally ensures that the normal force remains consistent during the movement.

7) Two students are standing at different distances from a lamp. The first student measures an intensity of 25 lumens and the second student measures and intensity of 4 lumens.

What is the most likely respective distances of the students from the lamp?

(A) 2 m and 5 m

(B) 1 m and 3 m

(C) 3 m and 4 m

(D) 5 m and 8 m

8) A third harmonic frequency is being played on a pipe organ. Consider the pipe organ to be an air column closed at one end. If the speed of sound in the pipe is 343 m s^{-1} and the frequency is 243 Hz, what is the length of the pipe?

(A) 0.353 m

(B) 0.705 m

(C) 1.06 m

(D) 1.76 m

9) Which statement best defines our understanding of the temperature of a substance? RECALL

(A) Temperature is a measure of the internal heat energy of the matter.

(B) Temperature is a measure of the total heat capacity of the substance.

(C) Temperature is a measure of the average kinetic energy of the particles of matter.

(D) Temperature is the sum of the kinetic energy of the particles in the substance.

by definition

10) Which statement best describes the period of a wave?

RECALL

by definition

(A) The value of the product of frequency and wavelength.

(B) A number of oscilliation of the source in one second.

(C) The number of waves that pass a given point in one second.

(D) The time taken for one complete wave to pass a given point.

11) The force between two electrostatically charged balls placed 50 cm apart is F.

What will be the new force between the balls if the charge on each ball is doubled, and the distance between them halved?

$F_1 \propto \frac{q_1 q_2}{r^2}$

$F_2 \propto \frac{2q_1 \, 2q_2}{\left(\frac{r}{2}\right)^2} = \frac{4q_1 q_2}{\frac{r^2}{4}} = 16 q_1 q_2$

(A) F

(B) 8F

(C) 16F

(D) 32F

12) 3.5 mA passes through a resistor in 2.0 s.

How many electrons does this represents?

$I = \frac{q}{t}$

$q = It$

$= 3.5 \times 10^{-3} \times 2.0$

$= 7 \times 10^{-3} A$

$e = 1.602 \times 10^{-19}$

$\frac{q}{e} =$ no of electrons

$= 4.4 \times 10^{16}$

(A) 3.6×10^{18}

(B) 1.6×10^{-19}

(C) 1.7×10^{18}

(D) 4.4×10^{16}

13) When two identical resistors are placed in series they have a total resistance of 10 Ohms.

What would be their total resistance be when placed in parallel? $R = 5$

(A) 2.5 Ohms
(B) 5.0 Ohms
(C) 10 Ohms
(D) 20 Ohms

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R} = \frac{1}{5} + \frac{1}{5}$

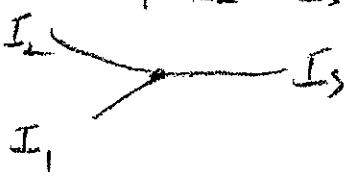
$\frac{1}{R} = \frac{2}{5}$

$R = 2.5 \Omega$

14) Which Law relates to the conservation of current around a circuit?

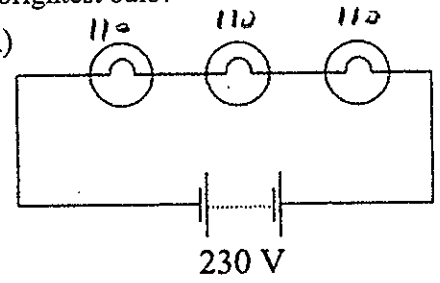
(A) Ampere's Law
(B) Kirchhoff's Law
(C) Faraday's Law
(D) Ohm's Law

Recall $I_1 + I_2 = I_3$

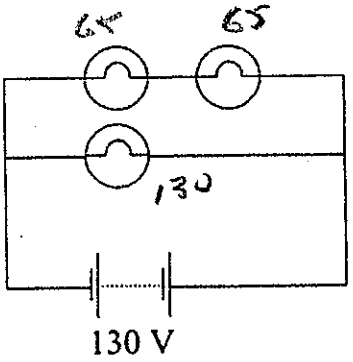


15) Below are four circuits each containing three identical light bulbs. Which circuit below will have the brightest bulb?

(A)

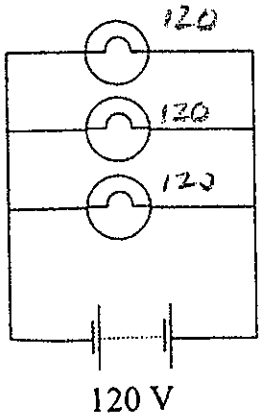


(B)

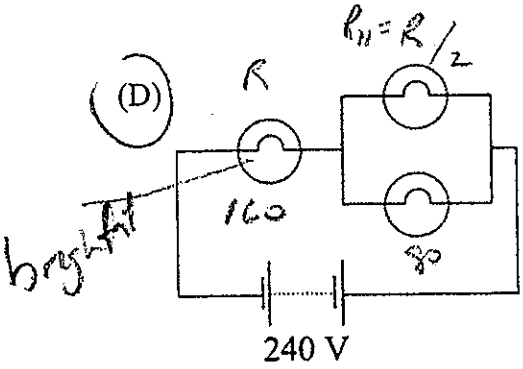


brightest = most power

(C)



(D)



bright

$P = \frac{V^2}{R}$

21

Section 2 Written Response

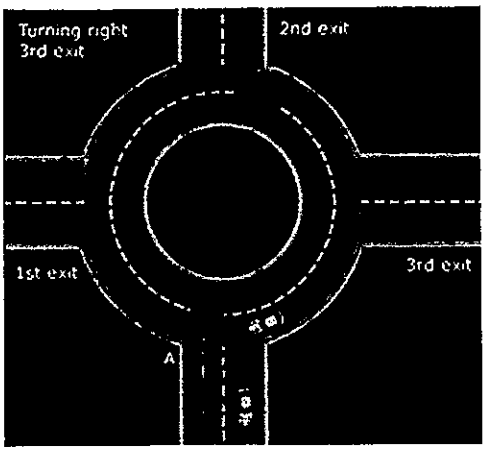
Question 16 (6 marks)

correct scale = 1 mark

$v - u$ = 1 mark

adds $v + u$ = 1½ mark

A car uses a roundabout to make a right hand turn as shown.



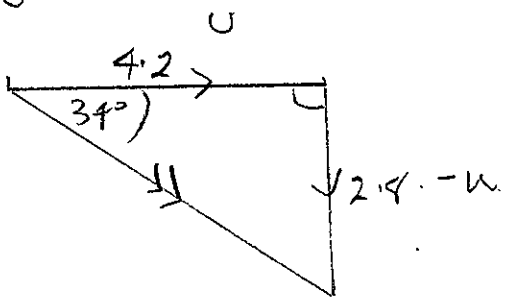
exit velocity 4.2 ms^{-1} east

entry velocity 2.8 ms^{-1} north

$-\frac{1}{2}$ for calculation not protractor

a) Construct a **scale vector diagram** to show the change in velocity of the car. **3**

$\Delta v = \vec{v} - \vec{u}$



b) The time between entering and exiting the roundabout was 11.7 s. Given the car has a mass of 1080 kg, what was the average force applied to the car? **2**

$F = ma = M\frac{v-u}{t}$

$= \frac{1080 \times 5.1}{11.7} = 470\ N$ 2 sig fig

c) What was the source of the force applied to the car? **1**

friction between tyres and road

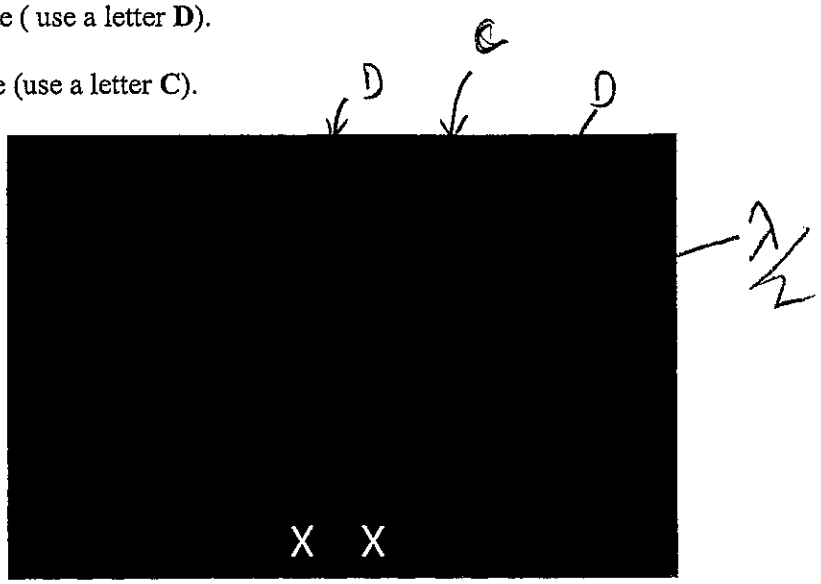
Question 17 (4 marks)

The diagram shows a snapshot of water waves produced by two oscillating sources marked by X. The sources oscillate in phase. The dark regions represent troughs and the light regions mark crests.

a) On the diagram, clearly mark a position in the water where the following occur:

i) constructive interference (use a letter **D**).

ii) destructive interference (use a letter **C**). **2**



c) Mark a position where waves from the two sources are meeting with a path difference of exactly half a wavelength. Label this position - **λ/2** **1**

d) How do you know that the frequency of the sources is constant? **1**

wavelength is constant

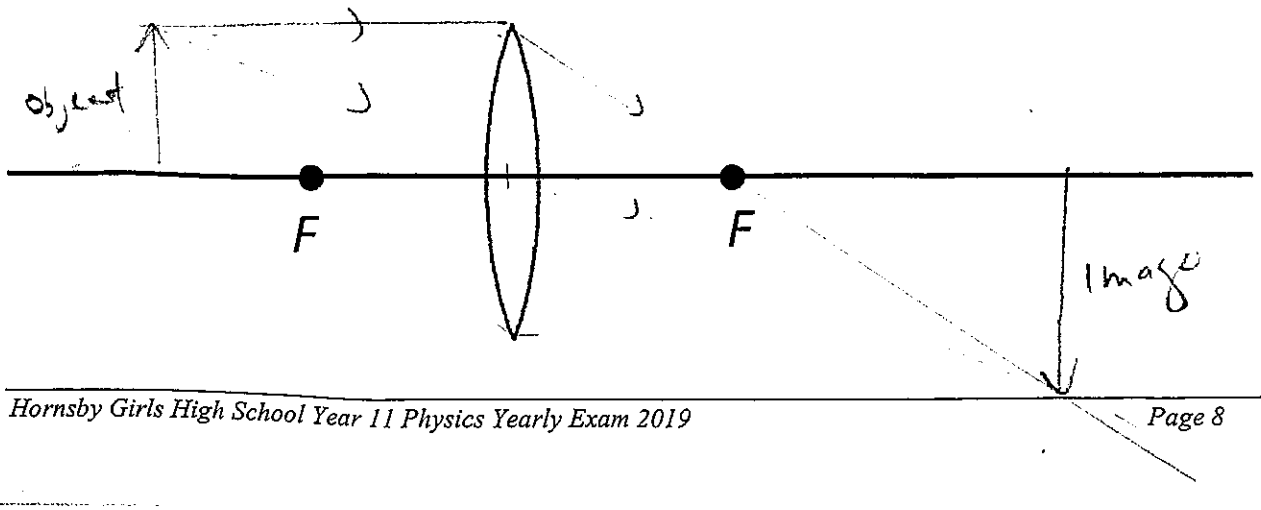
.....

.....

Question 18 (3 marks)

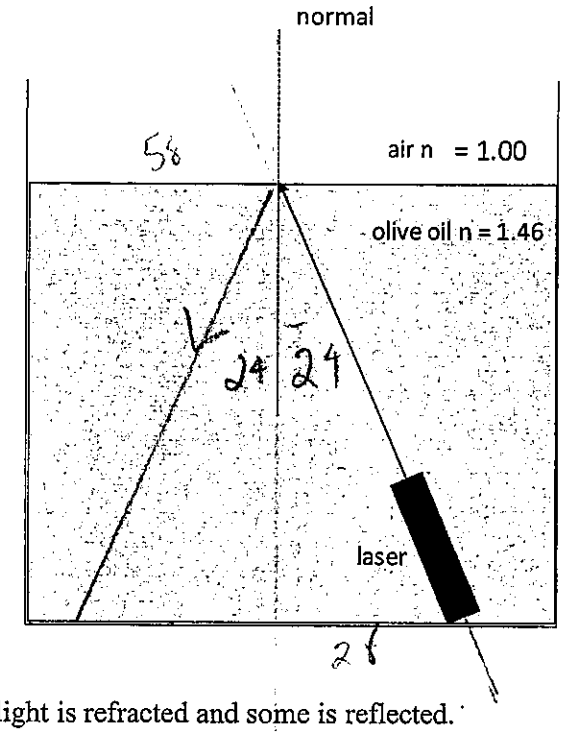
You need locate an object in a position so that a real and enlarged image is produced by the converging lens in the diagram.

Using a 2.0 cm upright arrow to represent the object, show where the object could be placed and where the resultant image would be formed. Use at least 2 rays to justify your answer.



Question 19 (5 marks)

A laser pointer was placed in a fish tank full of olive oil and the beam of light was directed at the surface at an angle as shown in the diagram.



At the surface some of the light is refracted and some is reflected.

a) On the diagram, draw the **reflected ray** and **refracted ray**. This must be done **accurately** according to the law of reflection and Snell's law. Show relevant calculations below. **3**

$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{1}{1.46}$ $i = 24°$

$r = \sin^{-1}(\sin 24 \times 1.46)$

$= 36.7°$

$= 37°$

b) Explain why the light will **not** be total internally reflected. **2**

the critical angle is

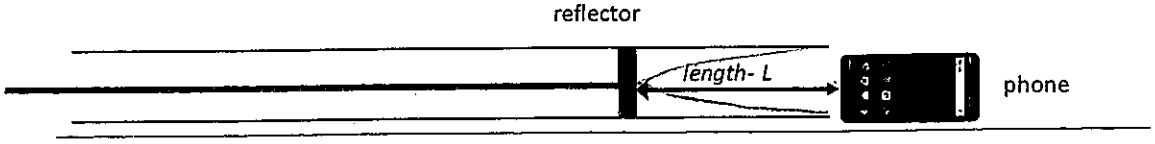
$\sin \theta_c = \frac{n_2}{n_1} = \frac{1}{1.46}$ $\theta_c = \sin^{-1}\left(\frac{1}{1.46}\right) = 43°$

The angle of incidence is less than 43°

∴ no TIR

Question 20 (8 marks)

A plastic tube with a movable reflector was set up in class. A steady tone of 330 Hz was emitted by the phone. The reflector, initially next to the phone, was gradually moved away to the left.



a) At what length L was the **first** position of constructive interference located? **2**

$L = \frac{\lambda}{4}$ $v = f\lambda$ $\lambda = \frac{v}{f} = \frac{340}{330} = 1.03$

$\lambda = \frac{1.03}{4} = 0.26\,m$

b) Is there a node or antinode at the reflector in this position? **1**

node

c) This length was kept constant and the phone frequency was gradually increased until another loud sound was produced. What was this frequency? **2**

$L = 0.26\,m$ $L = \frac{3}{4}\lambda$

$\lambda = \frac{4L}{3} = 0.34\,m$ $f = \frac{v}{\lambda} = \frac{340}{0.34} = 1000\,Hz$

d) Is this an example of resonance? Justify your answer. **3**

Yes. The air column has natural frequencies where standing waves form.

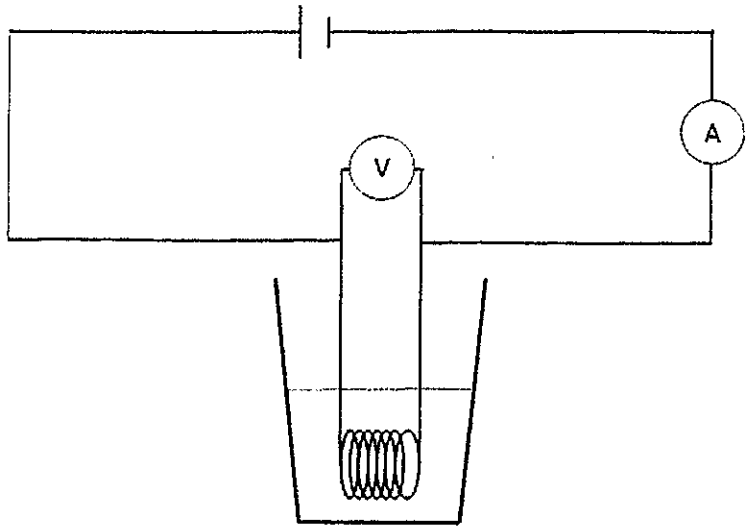
If a driving frequency is applied to cause a standing wave there will be an amplification of the vibration which is resonance

Yes = 1

just ✓ − weak + ½ − good + good = 2

Question 21 (4 marks)

225 ml of water was placed in a foam coffee cup. A wire coil heater was placed in the water and allowed to stand for a while. The temperature of the water was then measured to be 17.5° C. The power supply was then switched on and a timer started. The voltage across the coil was 12.0 V and the current was 5.0 A.



If no energy was lost to the surroundings, how long did it take to raise the temperature of the water to reach 55.0 ° C?

$Q = mc\Delta T$ $m = 225$ g $c = 4.18$ J g^{-1}

$\Delta T = 55.0 - 17.5 = 37.5$

$= 225 \times 4.18 \times 37.5$

$= 35268$ J

$P = IV = 12.0 \times 5.0 = 60$ W $P = \frac{E}{t}$ $t = \frac{E}{P}$

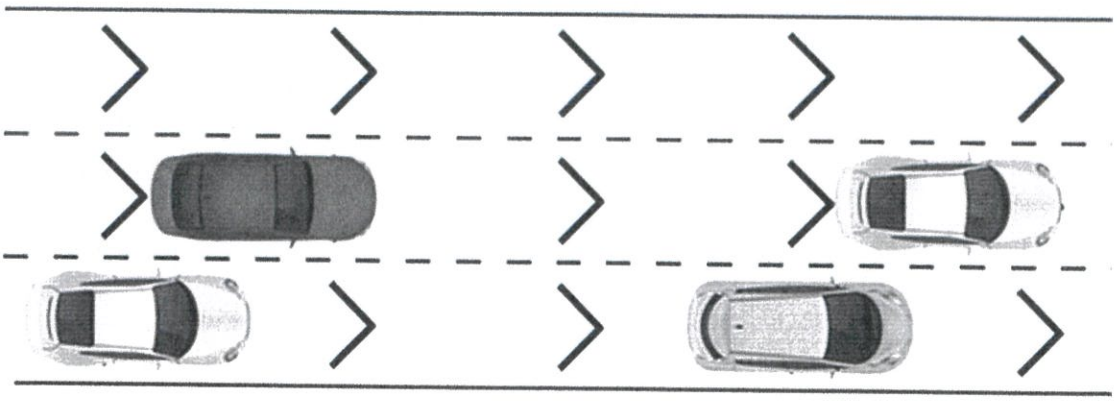
$= \frac{35268}{60}$

$= 588$ s

$= 590$ s

Question 22 (5 marks) **Student Number**_____

On a local highway, a safe driving initiative was put into effect to minimise tailgating (cars driving too close to the car in front). The road has chevrons painted on the lanes with uniform spaces in between, as shown in the diagram below. *note diagram is not drawn to scale.*



Drivers are urged to maintain a minimum distance of two chevron spaces between themselves and the driver in front.

a) Calculate the distance each chevron would need to be apart in order to create a 3.0 second gap between cars travelling at 110 km h^{-1}. **3**

$v = 110\ km\,h^{-1} = 30.6\ m\,s^{-1}$

$d = v.t = 3 \times 30.6 = 91.7\ m$

chevron space $= 91.7\ m / 2 = 45.8\ m$

b) Brake reaction time is the amount of time that elapses between the recognition of an object or hazard in the roadway and the application of the brakes. A large study showed that the average brake reaction time for drivers is 2.3 s.

Does this support the idea of a 3.0 second gap between cars travelling at 110 km h^{-1}? Justify your answer. **2**

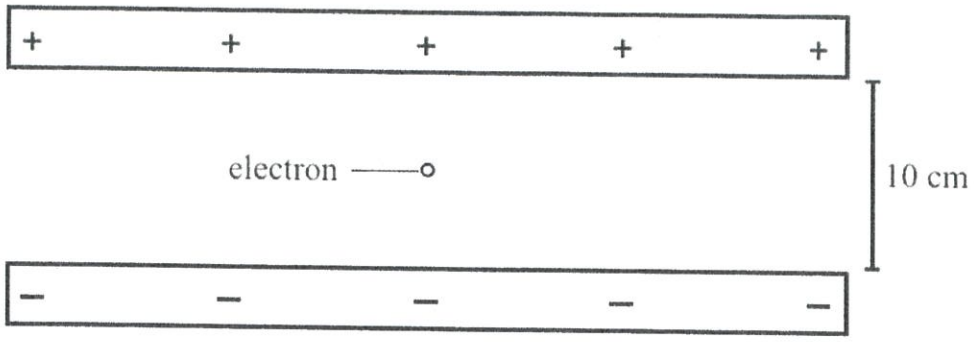
NO

- $d = 2.3 \times 30.6 = 70.3\ m$
- For a 3 sec gap, $d = 91.7\ m$
- Also consider braking distance!

Hence there is not enough space for a car to brake; the deceleration required is too high.

Question 23 (4 marks)

An electron is placed between two charged parallel plates as shown below. The potential difference between the plates is 215 V.



a) Calculate the force on the electron due to the electric field. **2**

$E = V/d = \frac{215}{0.1} = 2150\ V m^{-1}$

$F = qE = -1.602 \times 10^{-19} \times 2150$

$= 3.44 \times 10^{-16}\ N$ towards +ve plate

b) Ignoring any other forces, what would the acceleration of the electron be? **2**

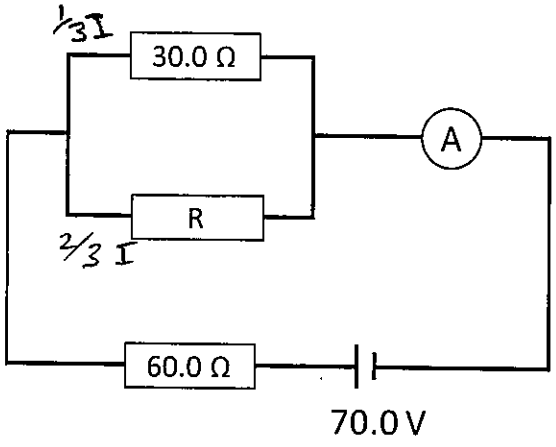
$F = ma$

$a = F/m = \frac{3.44 \times 10^{-16}\ N}{9.109 \times 10^{-31}}$

$= 3.78 \times 10^{14}\ ms^{-2}$ towards the +ve plate

Question 24 (5 marks)

In the circuit modelled below, two thirds of the total circuit current travels through resistor R.



a) Calculate the total resistance of the circuit. 2

R is 15 Ω since twice as much current flows through it c/f the 30 Ω resistor. 1

For parallel circuit $\frac{1}{R_T} = \frac{1}{15} + \frac{1}{30} = \frac{3}{30}$

$\therefore R_T = 10\ \Omega$ 1

Total resistance = 60 + 10 = 70.0 Ω (3 sf)

Calculate the current reading on the ammeter. 1

$V = IR \therefore I = V/R = 70/70$

$= 1.00$ A (3 s.f.) 1

What is the voltage across the 30.0 Ω resistor? 2

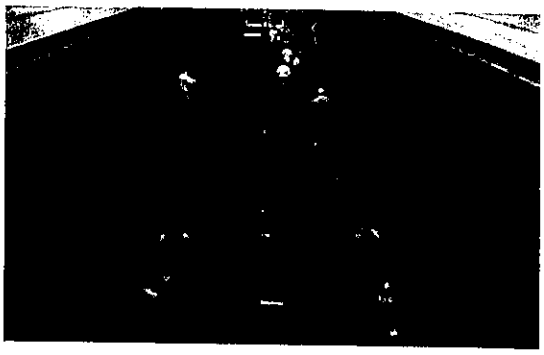
Effective resistance of branch = 10 Ω 1

$V = IR$

$= 1 \times 10$

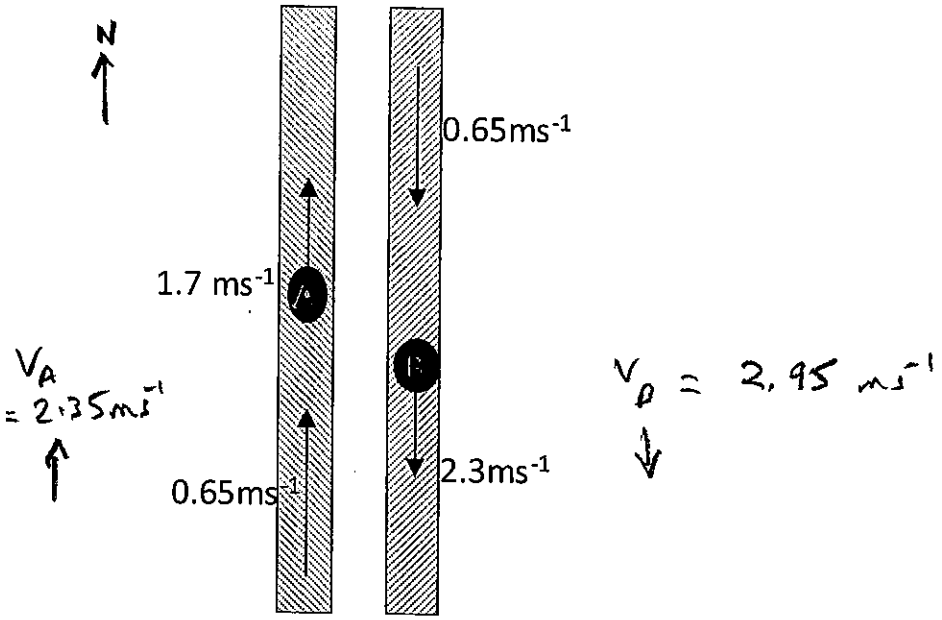
$V = 10.0$ V (3 s.f.) 1

Question 25 (5 marks)



Moving walkways are used extensively in airports to move people around efficiently.

The digram is a top view of two walkways.



The walkway on the left travels north at 0.65 ms^{-1} relative to the ground, while the walkway on the right travels south at the same speed. Person A walks north at 1.7 ms^{-1} relative to the walkway as shown, while Person B walks on the south at 2.3 ms^{-1} relative to the walkway.

a) What is the velocity of Person A relative to the ground? 2

$V_A = 1.7 + 0.65 = 2.35\ ms^{-1}$ north

1.7 ms-1

0.65 ms-1

b) What is the velocity of Person B relative to Person A? 3

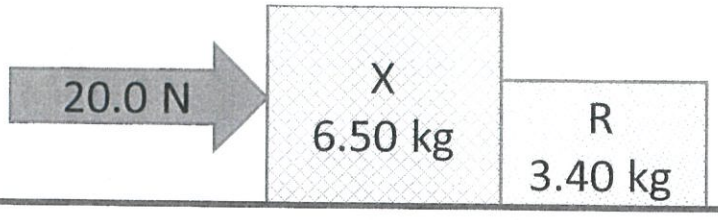
$V_{BA} = V_B - V_A$

$= 2.95 - -2.35\ ms^{-1}$

$= 5.3\ ms^{-1}$ south

Question 26 (6 marks)

Two boxes, X and R are being pushed along a horizontal surface as shown. The boxes move at a constant speed. note $F_f = \mu F_N$



a) What is the coefficient of kinetic friction? 2

$F_f = 20$ N left

$F_f = \mu F_N = \mu \times 9.8(6.50 + 3.40)$

$20 = 97.02\mu$

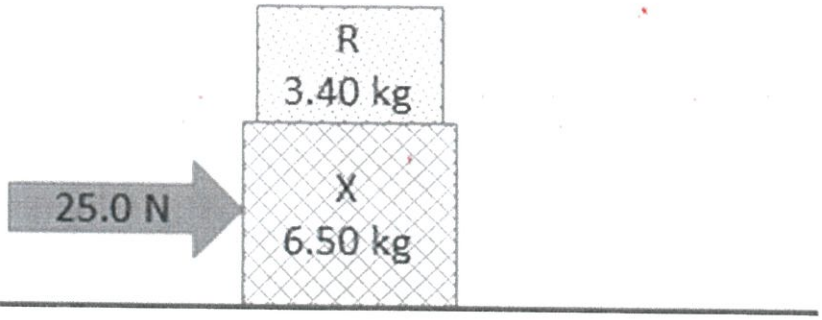
$\mu = 0.206$ (3 sf)

b) What force does X exert on R? 2

$F_{XR} = F_f$ where $F_f = 20 \times \frac{3.40}{9.90}$

$F_{XR} = 6.87$ N to the right

R is then placed on top of X. The applied force is increased to 25.0 N as shown.



c) Describe the resultant motion of this new set up. 2

As before $F_f = -20$ N

$F_{net} = 25 - 20 = 5$N to the right

The masses will accelerate to the right

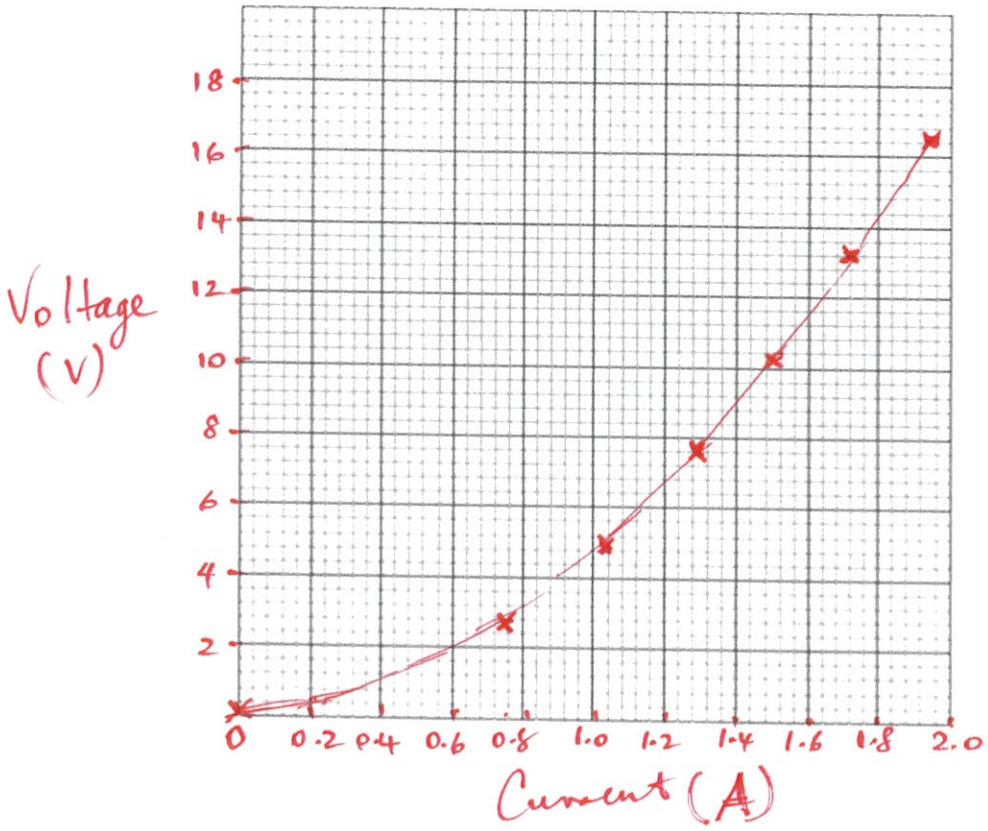
where $a = \frac{5}{9.9} = 0.505\ ms^{-2}$ →

Question 27 (5 marks)

The current through a light globe was determined for different voltages. The results are shown in the table.

Voltage (V)	Current (A)
0	0
2.6	0.75
4.9	1.05
7.6	1.29
10.2	1.51
13.2	1.72
16.4	1.95

a) Plot a graph of the voltage vs current and draw a trend line. **3**



b) What does this graph tell you about the resistance of the light globe? **2**

This is a non-ohmic resistor. The resistance increases as the voltage increases; as the temperature of the filament also increases.

End of Exam