Name: _____

Class: _____

Sydney Boys High School

2020

YEAR 11 YEARLY EXAMINATION

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used

- Write your name and class in the space provided

- Choose your answers carefully, no other paper will be provided

Total marks – 75

This paper has two parts, Part A and Part B

Part A – 20 marks
- Attempt Questions 1-20
- Allow about 35 minutes for this part

Part B – 55 marks
- Attempt Questions 21-36
- Allow about 1 hour and 25 minutes for this part

Section I – 20 marks

Attempt Questions 1-20

Allow about 35 minutes for this section

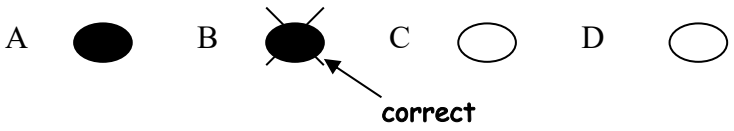
Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

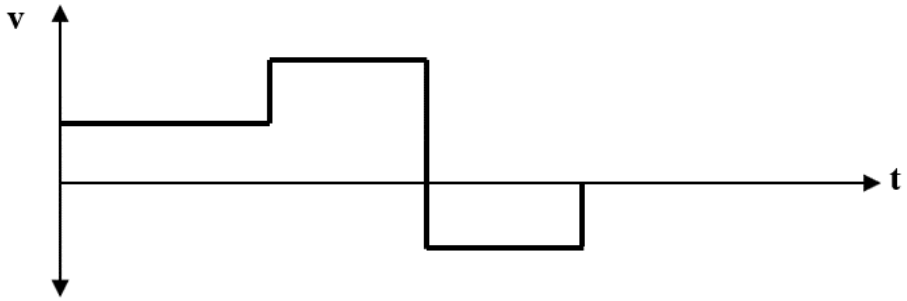
If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



CHOOSE THE MOST CORRECT ANSWER

1. The velocity of a vehicle, **v**, versus time, **t**, is shown below.



Which of the following statements most accurately applies to the vehicle's motion as plotted?

(A) The motion as plotted is not possible.

(B) The vehicle went as far backward as it went forward.

(C) The vehicle started from rest.

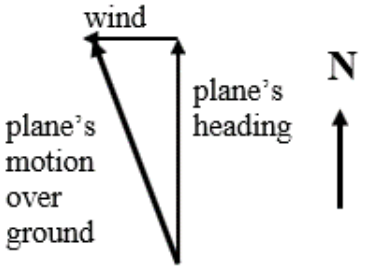
(D) The vehicle was never travelling with constant speed.

2. A plane can fly at 100 m s^{-1} through still air. The pilot wishes to travel due north. A wind of 20 m s^{-1} blows from the east.

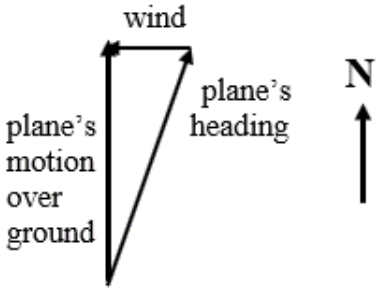
Which of the vector diagrams drawn by the pilot correctly represents this?

DIAGRAMS NOT TO SCALE

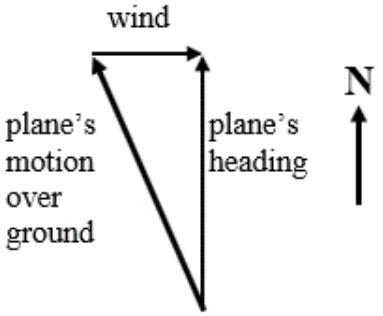
(A)



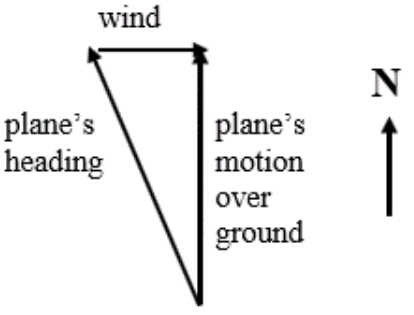
(B)



(C)



(D)



3. An object travelling in a straight line undergoes an acceleration of $5ms^{-2}$ for 6 seconds and reaches a velocity of 20 ms^{-1}. The initial velocity of the object was:

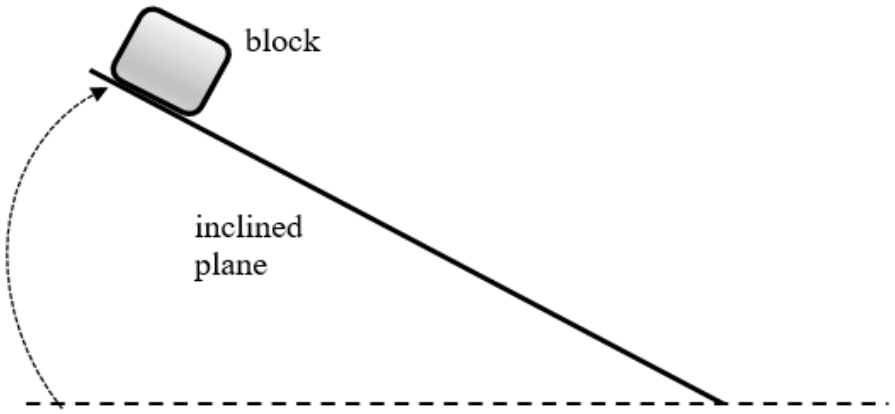
(A) + 10 ms^{-1}

(B) + 30 ms^{-1}

(C) - 10 ms^{-1}

(D) - 30 ms^{-1}

4. A block rests on an inclined plane, which is slowly tilted further to make it steeper until the block just begins to slide.



Which is the best description of the motion of the block after it begins to slide?

(A) the block stops again almost immediately

(B) the block begins to slide then stops again

(C) the block slides down the inclined plane with a constant speed

(D) the block accelerates

5. A person lifts a shopping bag with 5kg of groceries from the floor onto a kitchen benchtop. The work done by the person is approximately:

(A) 5 joules

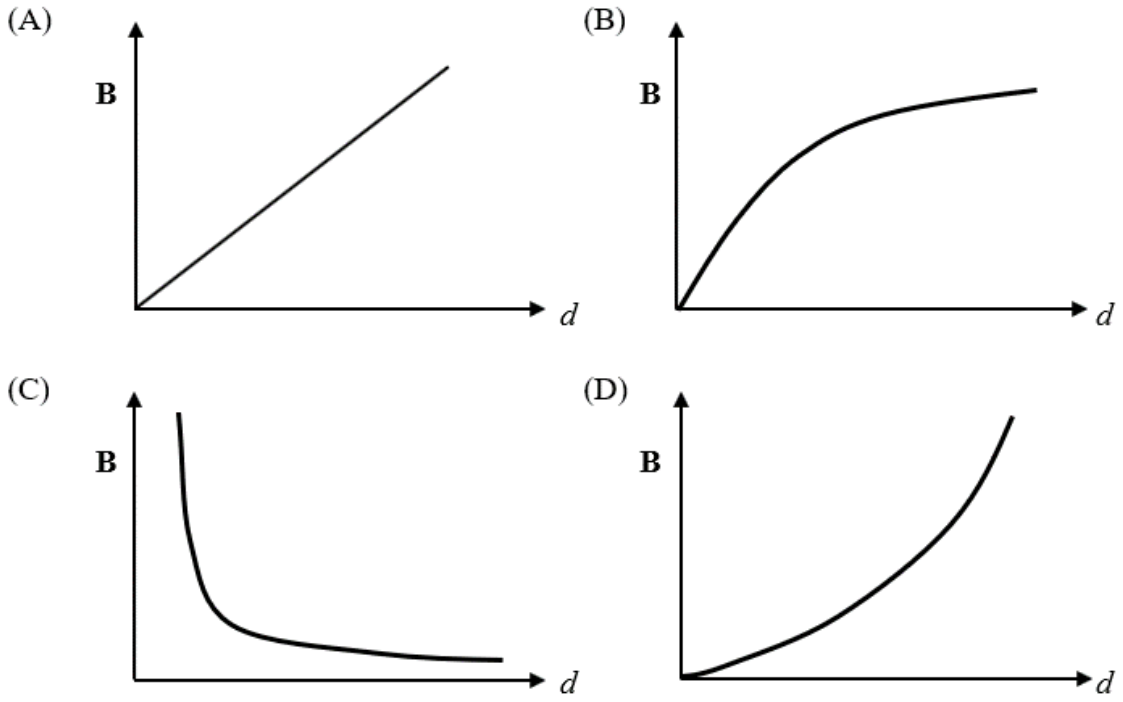
(B) 50 joules

(C) 500 joules

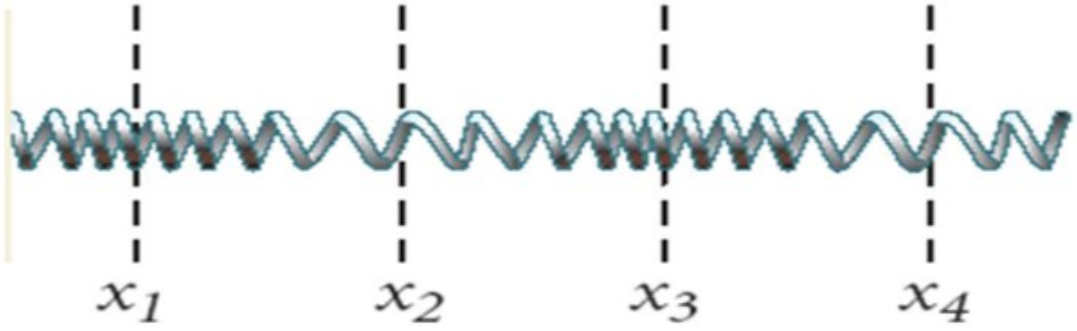
(D) 5000 joules

6. The strength of the magnetic field around a current-carrying wire was measured as the perpendicular distance from the wire was varied. The results were plotted on a graph.

Which graph of magnetic field strength versus perpendicular distance would best represent the expected results?



7. The textbook image below represents a longitudinal wave on a spring.



The wavelength for this longitudinal wave is the distance between positions:

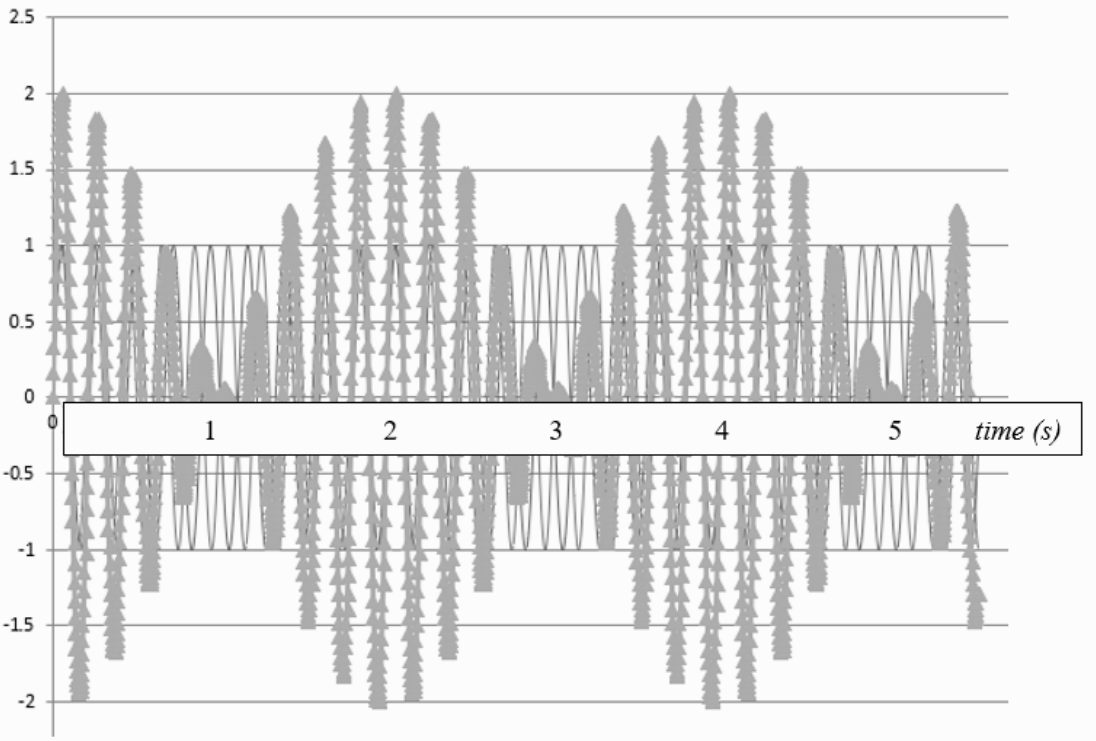
(A) X1 and X2

(B) X2 and X3

(C) X3 and X4

(D) X2 and X4

8. The resultant waveform when two sounds are played simultaneously is shown on the graph.



One source of sound is known to have a frequency of 400 Hz.

The frequency of the other source could be:

(A) either 399.5 Hz or 400.5 Hz

(B) either 399 Hz or 401 Hz

(C) either 398 Hz or 402 Hz

(D) 402 Hz

9. The pressurised liquid contents of a spray can are released. The escaping gas feels cold.

This is because:

(A) the gas turns back into a liquid when it hits your hand.

(B) the gas is moving quickly.

(C) of latent heat of vaporisation

(D) of latent heat of condensation.

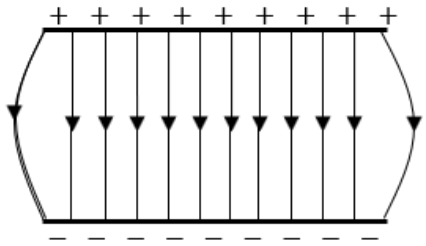
10. This image shows a property of water waves.

The name of the property and its cause is:

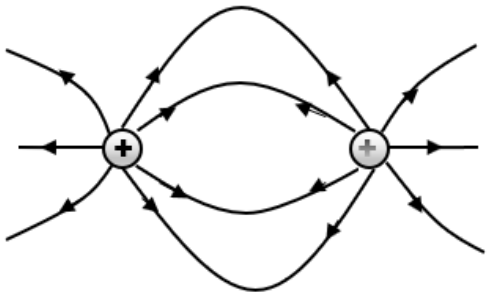
	Name of property	**Cause of property**
(A)	superposition	waves bending near an object
(B)	reflection	waves bouncing off the object
(C)	dispersion	bending around the edge of an object
(D)	refraction	change of speed of waves

11. Which of the following diagrams **correctly** represents the electric field given the arrangement of charges?

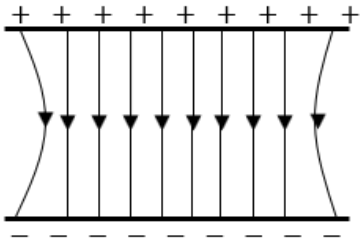
(A)



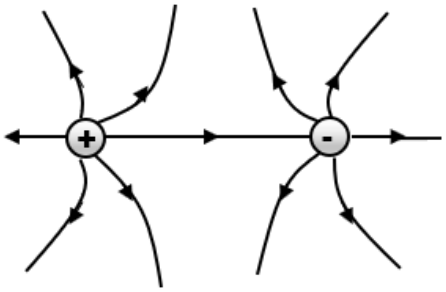
(B)



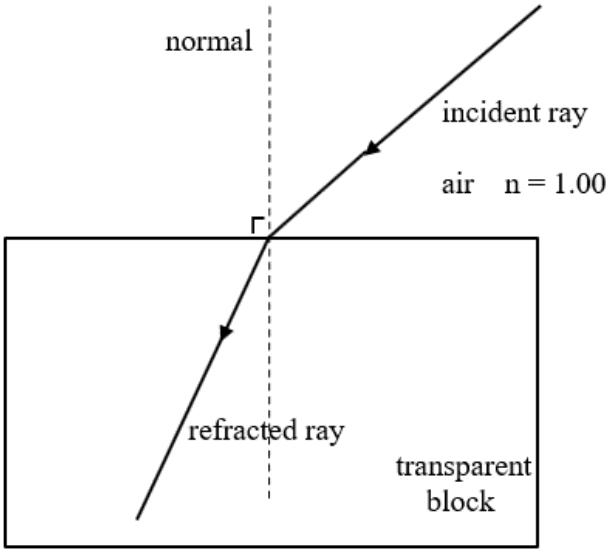
(C)



(D)



12. A ray of light enters a transparent block as shown.



Using the angles shown in the diagram, what is the refractive index of the block?

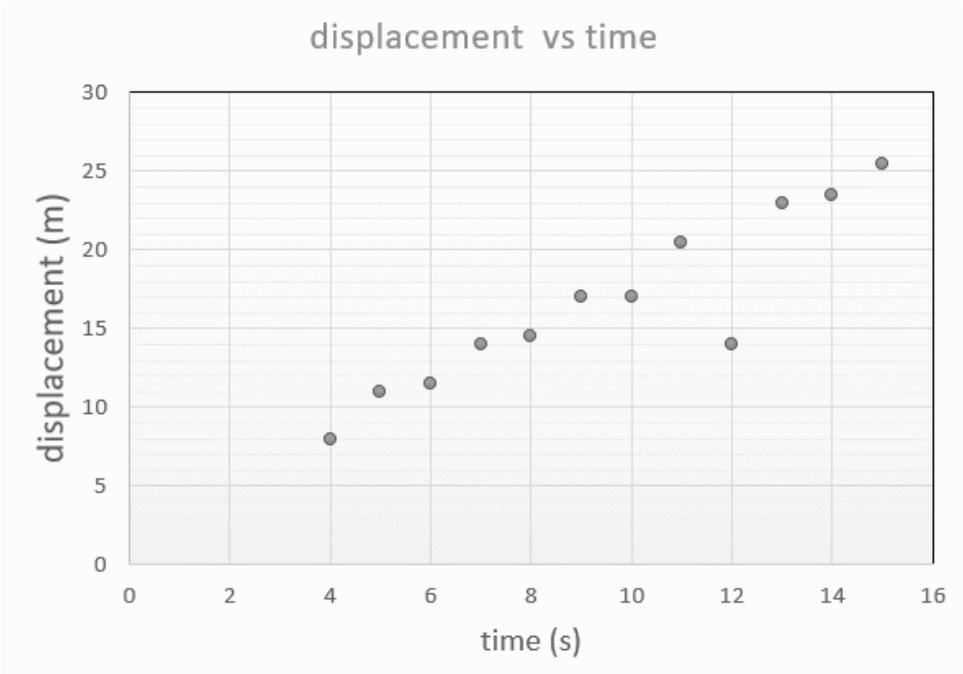
(A) 2.1

(B) 1.9

(C) 1.5

(D) 0.5

13. A student measured the displacement of a toy remote-controlled car every second for 15 seconds, but missed the first few readings. The results were plotted on the axes as shown.



The toy car's starting displacement and average speed was closest to:

	starting displacement (m)	**average speed (m s^{-1})**
(A)	1	0.67
(B)	5	1.5
(C)	5	0.67
(D)	1	1.5

14. Light with a frequency of 4.5 x 10^{14} Hz has a wavelength in air of what?

(A) 2.2 x 10^{-15}m

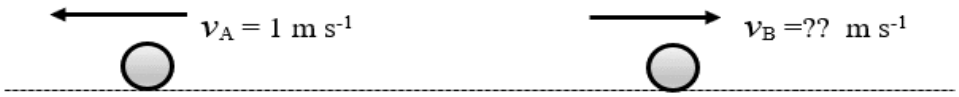
(B) 6.7 x 10^{-7}m

(C) 1.6 x 10^{6} m

(D) 1.35 x 10^{23}m

15. Two balls with equal masses are rolled along a horizontal frictionless surface so that they collide head-on, as shown.

After they collide, the balls' motion is recorded, as shown:



Which alternative gives the value of the final velocity of ball **B** and whether the collision can be classified as elastic or inelastic?

	v_B (m s^{-1})	elastic or inelastic
(A)	3	elastic
(B)	3	inelastic
(C)	5	elastic
(D)	7	inelastic

16. A DC power source set to 12.0 V is connected to a heating coil. The coil is immersed in 250 mL water in a beaker. The water is initially at 16.7 °C. A current of 3.5 A flows constantly through the heating coil for 4 minutes exactly, after which time the temperature of the water rises to 22.7 °C.

The efficiency of the heating coil in heating the water is closest to:

(A) 15%

(B) 62%

(C) 76%

(D) 84%

17. A decibel (dB) is a unit used for sound intensity. To calculate the difference in dB between two sound intensities the following formula is used:

$$dB = 10 \log_{10} \frac{I_2}{I_1}$$ where I = sound intensity in W m^{-2}.

A point source of sound has its intensity measured in W m^{-2} at a distance of 10 m away and again at 100 m.

The difference between the two intensities, in dB, is:

(A) 10

(B) 20

(C) 100

(D) 5

18. In which of the following situations would the dispersion of light **NOT** be observed?

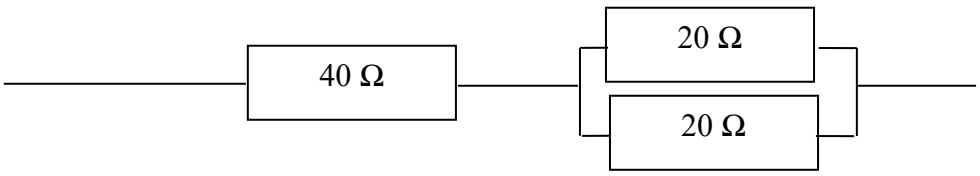
(A) When sunlight is used as the source of light.

(B) A monochromatic light source is used.

(C) The prism used is not made from pure glass.

(D) The light is refracted towards the same direction two times.

19. Consider the resistors in the following diagram:



To have an equivalent resistance, the above arrangement of resistors could be replaced by a single resistor with a value of:

(A) 50 Ω

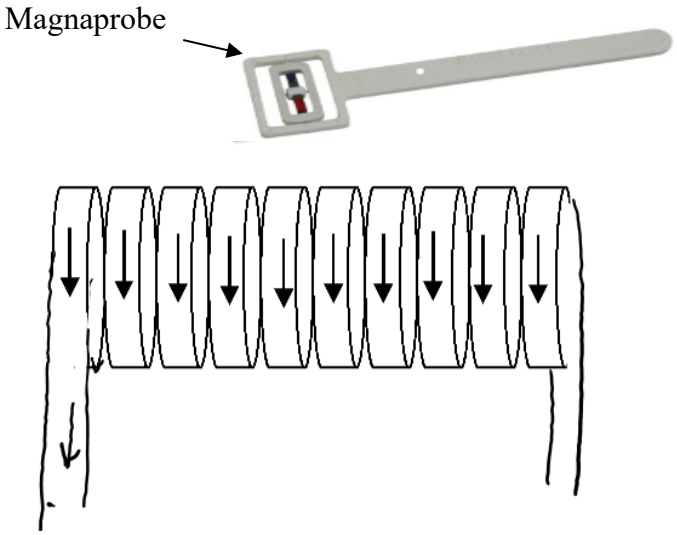
(B) 60 Ω

(C) 70 Ω

(D) 80 Ω

20. A student used a magnaprobe to test the magnetic field direction near a solenoid.

The magnaprobe has a small bar magnet that can swivel to align with a magnetic field.



When the solenoid is connected to a DC supply, the direction of the current in the solenoid is as shown by the arrows on the coils. Which of the following shows how the small magnet on the probe positioned above the solenoid as shown in the diagram, will align in the magnetic field of the solenoid?

(A) S  N

(B) N  S

(C) 

(D) 

2020

YEAR 11

EXAMINATION

Physics

Section II

Answer Booklet

55 marks

Attempt Questions 21 – 34

Allow about 1 hour and 25 minutes for this part

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Show all relevant working in questions involving calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which questions you are answering.

Marks

Question 21 (7 marks)

A train travels on a long straight track next to a road. The train is travelling at 90 km h^{-1} North while a car next to the train is travelling in the same direction at 60 km h^{-1}.

(a) Describe the motion of the train relative to the car. **2**

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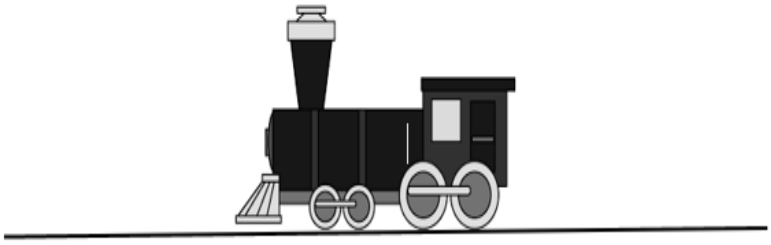
(b) Given that the train is travelling with a constant speed, add labelled arrows to the diagram to show the forces acting on the train. **2**



(c) What can be concluded about the net force, $\vec{F}_{NET}$, acting on the train? **1**

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(d) If the train started to decelerate at 2.0 m s^{-2}, what distance would it take to come to a complete stop? **2**

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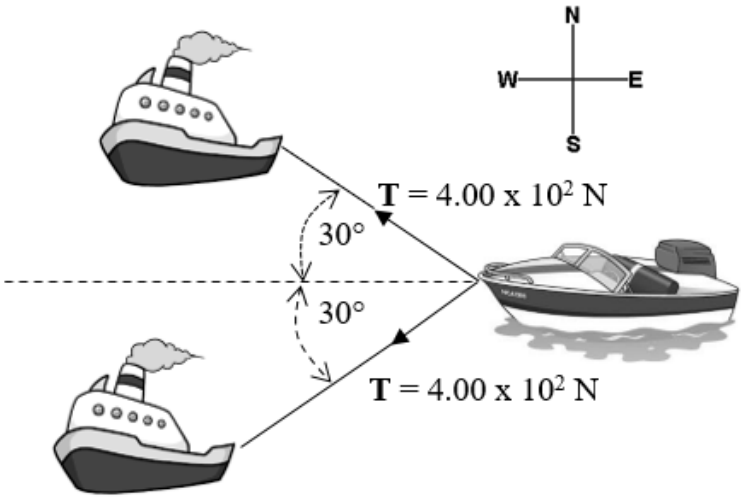
Marks

Question 22 (2 marks)

Using a diagram, show how a vehicle could complete a journey where the magnitude of its average velocity is only one-half of its average speed. **2**

Question 23 (3 marks)

Two boats are towing a third boat, as shown in the diagram.



The boat being towed is travelling at a constant velocity. The tension, **T**, in each tow rope is 4.00×10^2 N.

Find the drag force acting on the boat being towed. **3**

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Marks

Question 24 (4 marks)

(a) Given $\Delta \vec{p} = \vec{F}_{net} \Delta t$, show that $\Delta \vec{p} = m \Delta v$. **2**

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(b) A net force of 2.00 x 10^4 N acts on a spaceship with a mass of 1.00 x 10^4 kg for 80.0 seconds.

Find the change in the spaceship's speed. **2**

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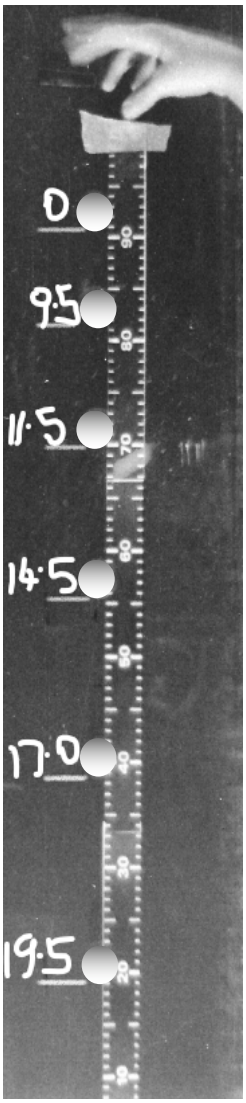
Question 25 (9 marks)

This multi-image photo of a ball falling, was taken in a darkened room by a group of students using a stroboscopic flash unit. The frequency of the flash unit was set to 20.0 Hz. The ball was dropped next to a centimetre scale. The distance in centimetres that the ball fell during each of 5 intervals between flashes was written on the image by one of the students.



Question 25 continues on the next page

Marks

Question 25 (continued)

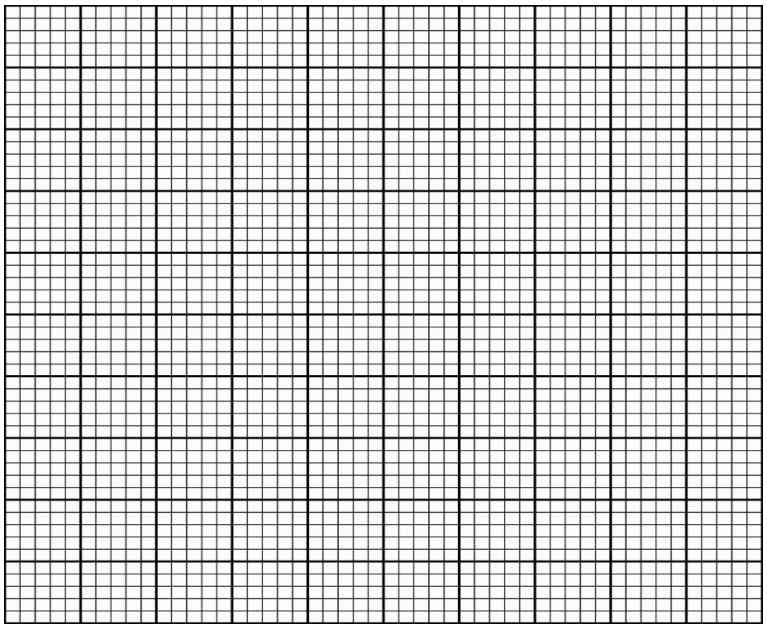
3

(a) Use the information provided, including details from the photo, and calculations of average velocity for each time interval to complete the table below for the falling ball experiment.

Time (s)	Displacement (m)	Velocity (av) (ms^{-1})

b) Construct a velocity verses time graph for the falling ball experiment.

4



(c) Use the velocity vs time graph to determine the acceleration of the ball in this experiment.

2

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Marks

Question 26 (4 marks)

An investigation was performed to find the frequency at which sound will resonate in a glass tube closed at one end.

(a) Write a procedure for this investigation which clearly identifies the source of the driving frequency. **2**

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(b) If the shortest length of tube was found to be 45.0 cm, calculate the driving frequency used in this investigation. **2**

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Question 27 (4 marks) **Marks**

(a) An aircraft is flying towards a stationary observer at 100 m s^{-1}.and is emitting a constant sound at frequency 1000Hz.

What frequency sound would a stationary observer hear as the plane was approaching? Take the speed of sound in air to be 340 ms^{-1}. **2**

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(b) The aircraft then passes directly overhead and flies away from the stationary observer.

Describe the effect of the aircraft passing overhead and moving away on the sound observed coming from the aircraft. **2**

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Marks

Question 28 (4 marks)

A convex lens is used in an investigation into the effects on the image produced when an object is placed beyond the focal length and closer than the focal length to the lens. The object used is a small source of light.

Use the diagrams provided below to draw ray diagrams and describe the nature of the image produced in each situation. **4**

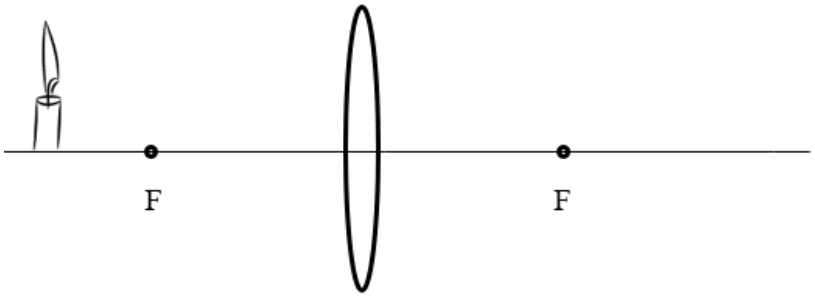

Image produced:

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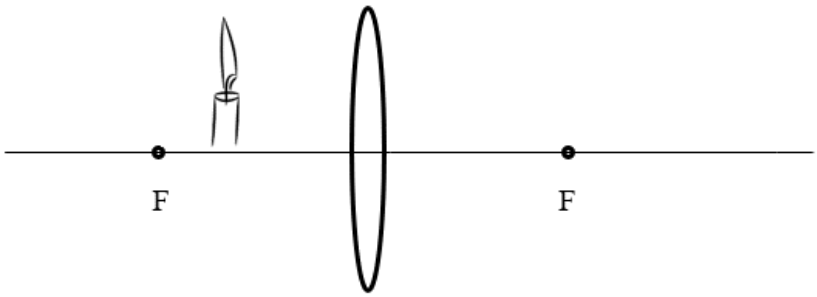

Image produced:

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Marks

Question 29 (5 marks)

A 100 g metal block is submerged in 100 mL of water in an insulated cup. Initially, the metal block's temperature is 40 °C, while the water is at 20 °C.

After several minutes, both the metal block and the water have reached a temperature of 24 °C.

(a) Explain why the final temperature reached is **not** 30 °C. **3**

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(b) Calculate the specific heat of the metal used in the metal block. **2**

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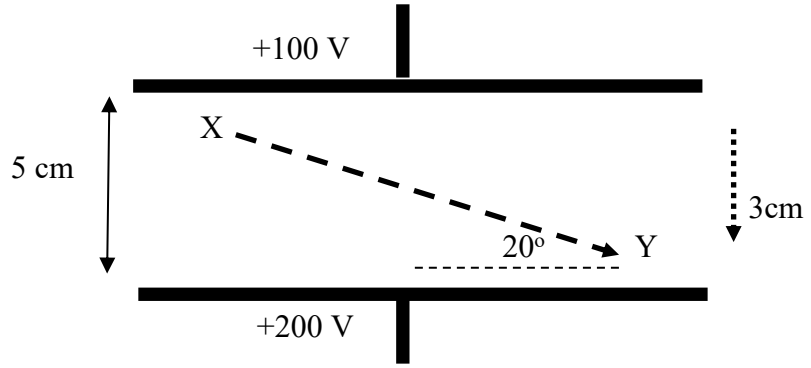
Marks

Question 30 (6 marks)

A small positively charged particle with charge 5.5 x 10^{-2} C is moved from position X to position Y between two parallel plates as shown below.



3

(a) Calculate the work done to move the charge from position X to position Y **2**

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(b) When the charged particle is released from position Y it accelerates. Describe the direction of the particle's acceleration **1**

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(c) If the particle experiences an acceleration of 2.75 x 10^{7} ms^{-2} when it is released from position Y, determine its mass. **3**

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Question 31 (4 marks) **Marks**

For any electric circuit, Kirchoff's voltage law states that $\Sigma V = 0$.

(a) Explain the concept of "potential difference" in relation to a component in an electric circuit. **2**

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(b) Explain why Kirchoff's voltage law is an example of the conservation of energy. **2**

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Marks

Question 32 (3 marks)

With the aid of diagrams, show the shape and direction of the magnetic field surrounding (i) current-carrying wires, and (ii) solenoids. **3**

Section II extra writing space.

If you use this space indicate clearly which question you are answering.

Section II extra writing space.

If you use this space indicate clearly which question you are answering.

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SBHS Marking Guidelines 2020

2020 Physics Year 11 (Preliminary) Examination.

Marking Guidelines and Model Answers.

Section I Multiple Choice

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	B	C	D	B	C	D	A	C	D	A	B	D	B	B	B	B	B	A	B

Section II

21.a.

Assuming north is positive:

$v_{1,2} = v_1 - v_2 \quad \Rightarrow \quad v_{t,p} = v_t - v_p = 90 - 60 = 30 = 30 \text{ km h}^{-1} \text{ N}$

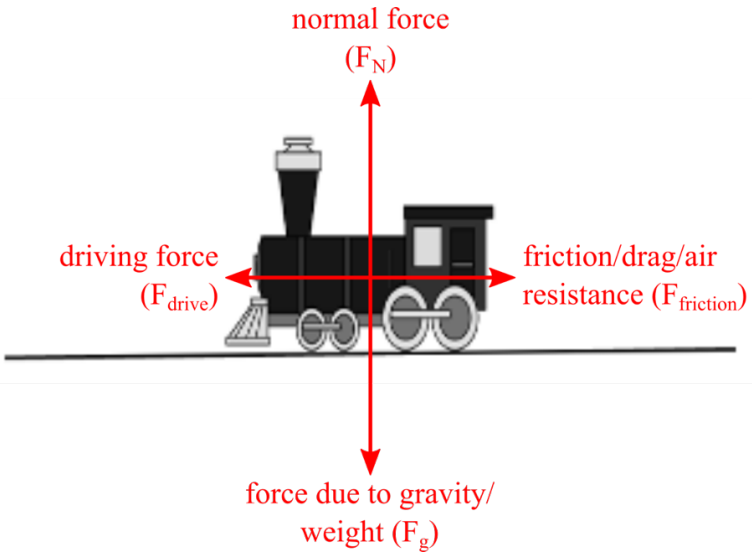
$30 \text{ km h}^{-1} = 10 \times \dfrac{1000}{60 \times 60} = 8.33 = 8 \text{ m s}^{-1} \text{ N}$ (to 1 s. f. due to $\underline{6}0 \text{ km h}^{-1}$ & $\underline{9}0 \text{ km h}^{-1}$)

✓ correct value & units

✓ correct compass direction

notes: * don't use recurring decimals – they imply infinite significant figures
* don't leave answers as fractions – they are considered incomplete calculations
* the question has a specific orientation mentioned (north), so use compass directions in your answer

21.b.



✓ correctly labelled weight & normal forces (approximately equal length vectors)

✓ correctly labelled driving & friction forces (approximately equal length vectors)

notes: * "gravity" is not the force applied to the train – it is a *field* that *can* apply a force on a mass (just as a hand can apply a force, but is not considered a force itself)
* "mg" is not a force label (it is a formula to calculate weight … or it could be short for milligrams)
* "applied force" or "motion force" are too general – these terms can also apply to weight, or normal force, or driving force

21.c.

A constant speed means that the acceleration is zero. Therefore, since $\vec{F} = m\vec{a}$, $\vec{F}_{net} = 0$.

✓ correctly states $\vec{F}_{net} = 0$

21.d.

Assuming north is positive:

$$90 \text{ km h}^{-1} = 90 \times \frac{1000}{60 \times 60} = 25 \text{ m s}^{-1}$$

$$v^2 = u^2 + 2as$$

$$\Rightarrow s = \frac{v^2 - u^2}{2a} = \frac{0^2 - 25^2}{2 \times -2} = 156.25 \text{ m}$$

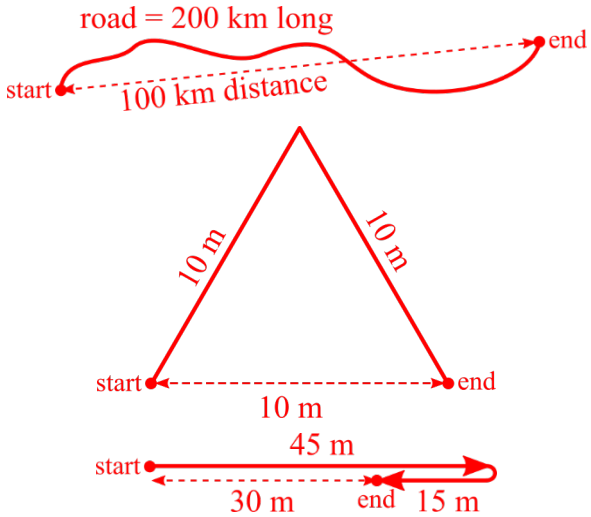
$$= 200 \text{ m (to 1 s. f. due to } \underline{9}0 \text{ km h}^{-1})$$

✓ correct equation with substitution

✓ correct distance & units

22.

Given that $v = \frac{s}{t}$ and $\vec{v} = \frac{\Delta\vec{s}}{\Delta t}$, a journey that has an average velocity half that of its average speed will have a displacement half that of the total distance travelled. Examples include:



✓ diagram has $\vec{v}_{ave} < v_{ave}$

✓ values show that $\vec{v}_{ave} = \frac{1}{2} v_{ave}$

23.

The total force of the two tug boats is to the west. Each boat has a force component west of:

$T_{west} = T\cos\theta = 4.00 \times 10^2 \times \cos 30 = 346.4$ N

Therefore, the total force pulling the third boat is $F_{pull} = 2 \times T_{west} = 2 \times 346.4 = 692.8\ N$.

Given that the third boat is travelling at a constant speed, the net force is zero and the drag force opposing the pulling force is 693 N east.

✓ correct calculation of T_{west}

✓ correct value & units for F_{pull}

✓ correct compass direction

notes: * the question provides a compass, so use compass directions in your answer
* significant figures are complicated by the cosine function (requires derivative analysis), so cannot be marked at high school level
* write answers in decimal format ($400\sqrt{3}$ is considered incomplete calculation)
* avoid using cosine rule – it usually ends badly!

24.a.

Since $\vec{F}_{net} = m\vec{a}_{ave}$, $\Delta\vec{p} = \vec{F}_{net}\Delta t = m\vec{a}_{ave}\Delta t$.

Since $\vec{a}_{ave} = \frac{\vec{v}-\vec{u}}{\Delta t}$, $\Delta\vec{p} = m\left(\frac{\vec{v}-\vec{u}}{\Delta t}\right)\Delta t = m(\vec{v}-\vec{u})$.

Since $\vec{v}-\vec{u} = \Delta\vec{v}, \Delta\vec{p} = m\Delta\vec{v}$.

✓ an appropriate step is shown

✓ all steps shown <u>clearly</u> & correctly

24.b.

From (a):

$\vec{F}_{net}\Delta t = m\Delta v$

$$\Rightarrow \Delta v = \frac{\vec{F}_{net}\Delta t}{m} = \frac{2.00 \times 10^4 \times 80.0}{1.00 \times 10^4} = 160 \text{ m s}^{-1}$$

$$= 1.60 \times 10^2 \text{ m s}^{-1}$$

✓ correct value & units

✓ correct significant figures (3)

notes: * when applying significant figures, don't write "≈" – it is <u>not</u> an approximation, it is stating the correct answer to the limit of accuracy available (indicated by the s.f.)
* only writing "160 m s^{-1}" is 2 significant figures (the zero is considered a placeholder) – you need to indicate that the zero is significant (e.g. by writing "160 m s^{-1} (to 3 s.f.)", "160. m s^{-1}")

25. (a)

A frequency of 20.0 Hz corresponds to a time interval of 0.0500 s.

Time (s)	Displacement (m)	Velocity (av) (ms^{-1})
0.0500	0.095 / 0.095	1.9
0.1000	0.115 / 0.210	2.30
0.1500	0.145 / 0.355	2.90
0.2000	0.170 / 0.525	3.40
0.2500	0.195 / 0.720	3.90

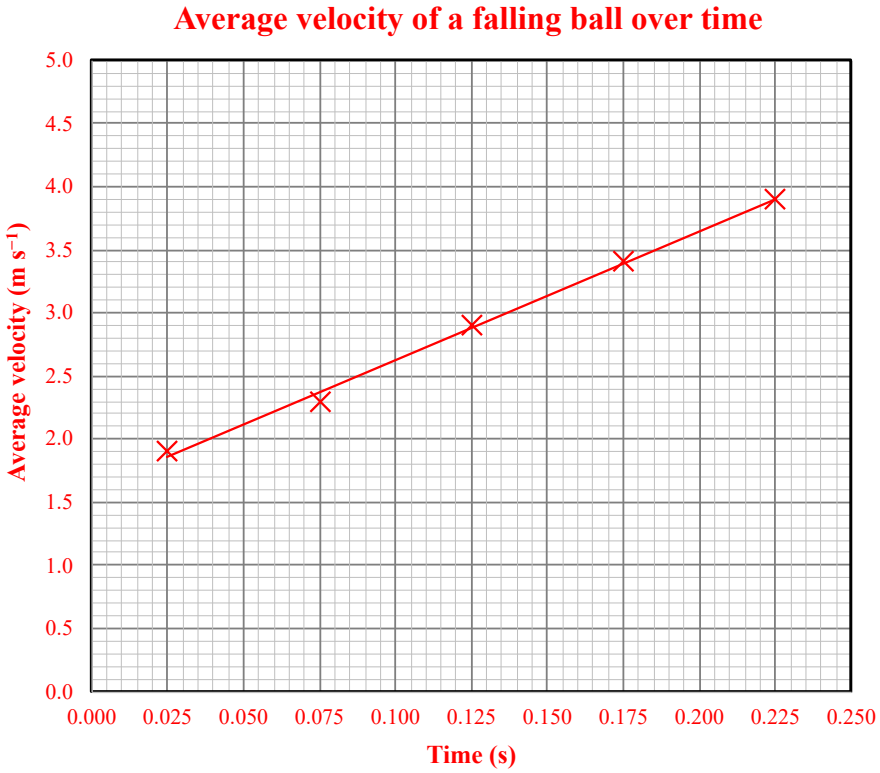
✓ time values at 0.05 s intervals with consistent significant figures or limit of reading

✓ correct displacement values (interval or total) with consistent limit of reading

✓ correct velocity values & no zero(es)

note: a row for $t = 0$ is not necessary … but, the velocity is not zero

25.(b)



✓ correctly arranged axes (time on x-axis)

✓ correctly labelled axes (variables as words & units as symbols)

✓ correctly plotted data with appropriate symbols

✓ appropriate LOBF & scale (use over ½ of each axis)

notes: * if you have 0,0 in the table, it also has to be plotted on the graph
* a good guide for a LOBF is to have about the same number of data points above & below the line (as well as ignoring any outlier(s), etc.)

25 (c)

$$gradient = \frac{rise}{run} = \frac{\Delta v}{\Delta t} = a$$

$$\Rightarrow a = gradient = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3.8 - 1.9}{0.215 - 0.030} = 10.3 \text{ m s}^{-2}$$

$$= 1.0 \times 10^2 \text{ m s}^{-2} \text{ (to 2 s. f.)}$$

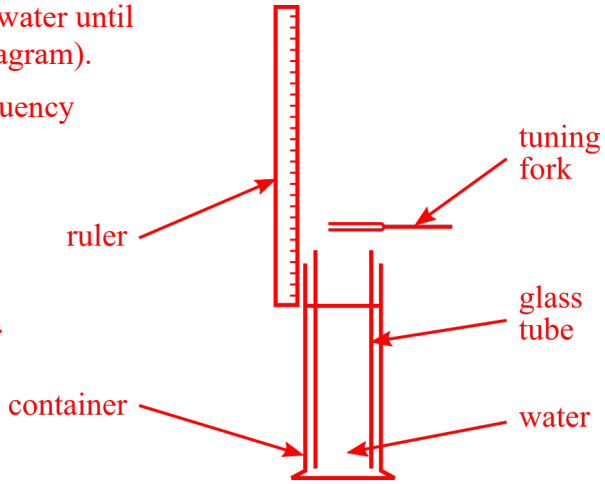
✓ gradient equation with substitution from LOBF

✓ correct value (±0.5) & units

note: significant figures from graphs are complicated by the combination of the magnitude of the numbers on the axes, as well as the limit of reading from the grid boxes (varies from graph to graph)

26.a.

1. Place an open glass tube into a container of water until it is almost fully submerged (as shown in diagram).
2. Strike and hold a tuning fork of a given frequency above the open end of the glass tube.
3. Raise the tube until the volume of the sound reaches a peak (the resonance point).
4. Use a ruler to measure the distance from the water level to the open end of the glass tube.



2 MARKS: valid procedure that is complete, sequential & clear

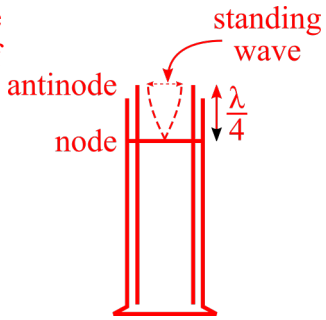
1 MARK: procedure is incomplete, not sequential or unclear

0 MARKS: procedure is invalid

notes: * methods must be point-form (e.g. numbered)
* a valid procedure requires either a fixed frequency of sound & changing length of tube OR a fixed length of tube & changing frequency of sound
  - moving frequency source inside fixed tube will not work
  - using different tuning forks or different length tubes is not valid
* resonance is achieved in air, not in glass – you won't see glass vibrate

26.b.

Given that the closed end must be a node (air particles cannot vibrate into the water) and the open end is an antinode, the shortest length of tube corresponds to a quarter of a wavelength.



$$\frac{\lambda}{4} = 0.450 \quad \Rightarrow \quad \lambda = 4 \times 0.450 = 1.80 \text{ m}$$

$$v = f\lambda \quad \Rightarrow \quad f = \frac{v}{\lambda} = \frac{340}{1.80} = 188.89 \text{ Hz}$$

$$= 190 \text{ Hz (to 2 s.f due to } \underline{340} \text{ m s}^{-1}\text{)}$$

✓ use of correct equation(s)

✓ correct frequency & units

27.a.

$$f' = f\frac{(v_{wave} + v_{observer})}{(v_{wave} - v_{source})} = 1000 \times \frac{(340 + 0)}{(340 - 100)} = 1417 \text{ Hz}$$

$= 1000$ Hz (to 1 s. f. due to $\underline{1}00$ m s^{-1} & $\underline{1}000$ Hz)

✓ use of correct equation

✓ correct frequency & units

note: this answer highlights the problem with giving answers to 1 significant figure – you lose a lot of detail (which is why you should *always* provide an answer to more significant figures before writing an answer to only 1 significant figure)

27.b.

As the aircraft passes overhead, the observed pitch will match the pitch of the sound produced by the aircraft, with a frequency of 1000 Hz. The sound would also be at the loudest volume observed.

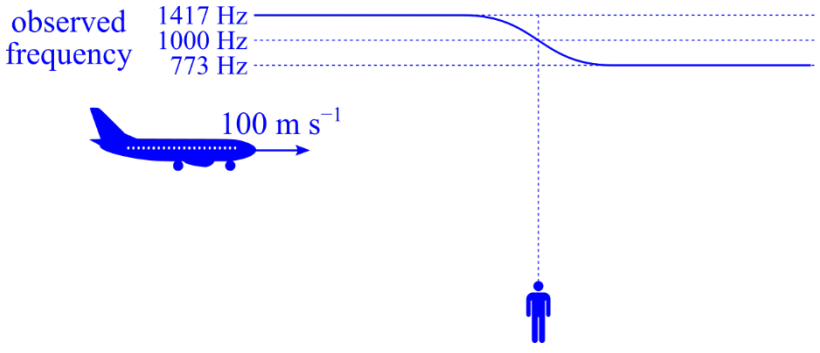
Assuming the aircraft maintains the same constant velocity as it moves away, the observed pitch will be lower, with a frequency of:

$$f' = f\frac{(v_{wave} + v_{observer})}{(v_{wave} - v_{source})} = 1000 \times \frac{(340 + 0)}{(340 + 100)} = 773 \text{ Hz}$$

In addition, the loudness will decrease over time.

✓ 1 MARK each for two correct observations of the sound

notes:
* this was a *describe* question, not an *explain* question – reasons for why pitch/ frequency decrease are irrelevant
* descriptions for the approaching aircraft were ignored (that was covered in previous question)
* "the sound will decrease" is not enough – what feature of the sound decreases?
* the Doppler effect is related to frequency/pitch <u>not</u> loudness/volume
* the frequency was not the highest as the aircraft passed overhead – the frequency changes (approximately) as shown below:



28.

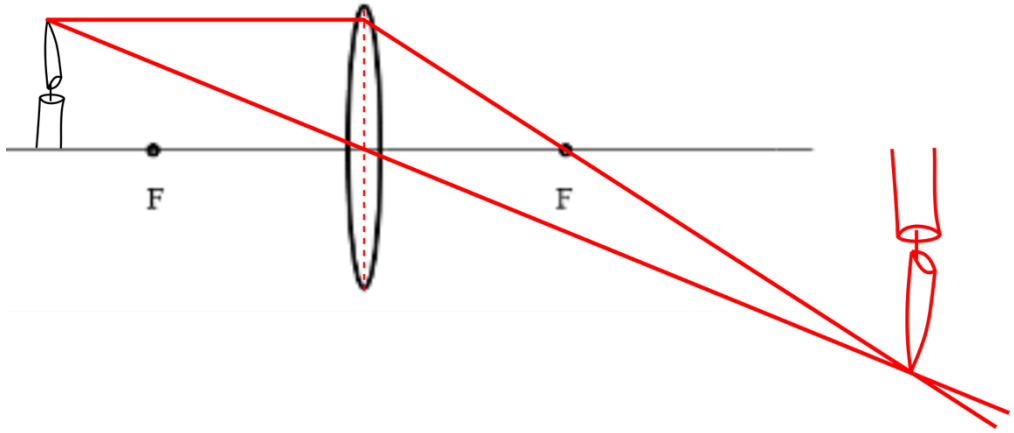


Image produced: magnified, inverted, real

✓ correct ray tracing

✓ correct description of image drawn

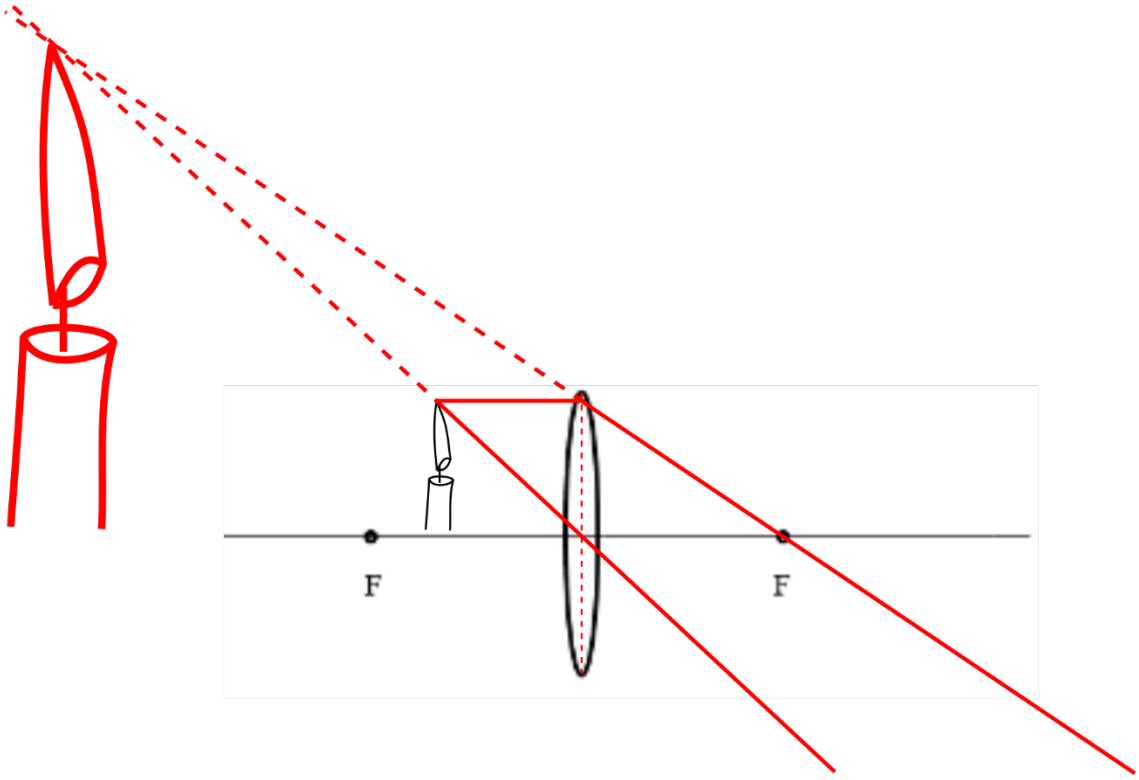


Image produced: magnified, upright, virtual

✓ correct ray tracing

✓ correct description of image drawn

29.a.

Marking Criteria	Marks
• Explains the difference in specific heat of metal and water	**1**
• Identifies that spec heat of water is greater than that of metal	**1**
• Explains why the difference in spec heat leads to the 24 degree temp.	**1**

The heat that flows from the metal block into the water when the block is immersed only heats the water by 4°C. It takes less heat energy transfer to change the temperature of the metal block compared to the water. The metal has a smaller specific heat, so despite the masses of the block and the water being equal, the final temperature of the two substances once thermal equilibrium has been reached is closer to the initial temperature of the water.

29.b.

Marking Criteria	Marks
• Correct equation line, substitution, , correct answer , correct units	**2**
• Missing one part of above	**1**

$$Q_{water} = -Q_{metal} \quad \text{with } \Delta T_{water} = 4K;\ \Delta T_{metal} = -16K$$
$$m_w c_w \Delta T_w = -m_m c_m \Delta T_m$$
$$c_m = \frac{-m_w c_w \Delta T_w}{m_m \Delta T_m}$$
$$c_m = \frac{-100 \times 4.18 \times 4}{100 \times -16}$$
$$= 1.05 \text{ J K}^{-1} g^{-1}$$

30 (a)

Criteria	Marks
• Determines the correct answer using V = 60 Volts	2
• Uses W=qV to determine a work value in joules	1

Sample answer
W = qV = 5.5 x 10^{-2} x **60** = 3.3 joules.

30 (b)

Criteria	Mark
• Answer implies that the particle will move directly upwards towards the top plate	1

Sample answer
The particle will accelerate vertically towards the top plate.

30 (c)

Criteria	Marks
• Correctly determines the mass of the object and correct units	3
• Determines E = V/d and Equates F = ma with F = Eq. Answer has correct units ALL WORKING MUST BE SHOWN.	2
• Determines E = V/d or Equates F = ma with F = Eq	1

Sample answer
F = ma
F = Eq + E = V/d → F = Vq/d = ma
m = Vq/da = (100 x 5.5 x 10^{-2})/ (0.05 x 2.75 x 10^{7}) = **4 x 10^{-6} kg**

31.a.

Marking Criteria	Marks
• Explains PD(Volts) equals joules of energy used per coulomb of charge moving through a component	**2**
• A partial explanation of potential difference **referring to energy**	**1**

Potential difference, measured in the unit of volts, is a measure of how many joules of energy are lost for each coulomb of charge passing through the component. (or gained if passing through a battery). A PD of 1 volt between two points means 1 J of energy is used to move each coulomb of charge between the points.

31.b.

Marking Criteria	Marks
• States LOCofE PLUS For any current loop the sum of PD(Energy/coulomb) lost through each component equals the PD(energy) gained through the battery. (nb. An understanding of the relationship between voltage and energy must be shown)	**2**
• A partial explanation linking voltage change to energy conversion	**1**

The total energy lost for each coulomb of charge passing through the components of the circuit is equal in magnitude to the electric potential energy gained when the same charge passes through the battery(or emf source). Ie. the energy lost as charge moves around a circuit = energy gained through the battery. Therefore the net energy change is zero. Energy is conserved.

32.

Marking Criteria- subtract 1 for each part missing	Marks
• Diagram done in pencil • Both current directions correctly labelled with I (straight wire and solenoid) • B field lines around solenoid shown with direction labelled • B field lines around straight conducting wire shown with direction labelled • B field lines form complete loops where possible and don't touch or cross • Direction of solenoid loops is clear *	**3**
• * this was an area most students can improve. eg make the front of the loop solid and the back dashed.	

Sample Answer