Student Number.....

Hornsby Girls' High School

2020

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: 77

Section I — 20 marks

- Attempt Questions 1–20
- Allow about 30 minutes for this part

Section II — 57 marks

- Attempt All Questions
- Allow about 1 hour and 30 minutes for this part

Section 1 Multiple Choice - 1 mark each

20 marks
Attempt Questions 1–20
Allow about 30 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

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1. In the laboratory, white light can be split into its component colours: red, orange, yellow, green, blue, indigo and violet

What is this effect known as?

A. dispersion

B. resonance

C. superposition

D. Total internal reflection

2. A car travels 200 m North, then 40 m East.

The magnitude of the car's displacement (x) can be calculated using which of the following equations?

A. $\tan \theta = 200/40$.

B. 200 m N + 40 m E = x.

C. $x = (200)^2$ m N+ $(40)^2$ m E.

D. $x^2 = (200)^2$ m N + $(40)^2$ m E.

3. A radio wave has a frequency of 3.3×10^7 Hz.

What would its wavelength be closest to?

A. 7.0 m

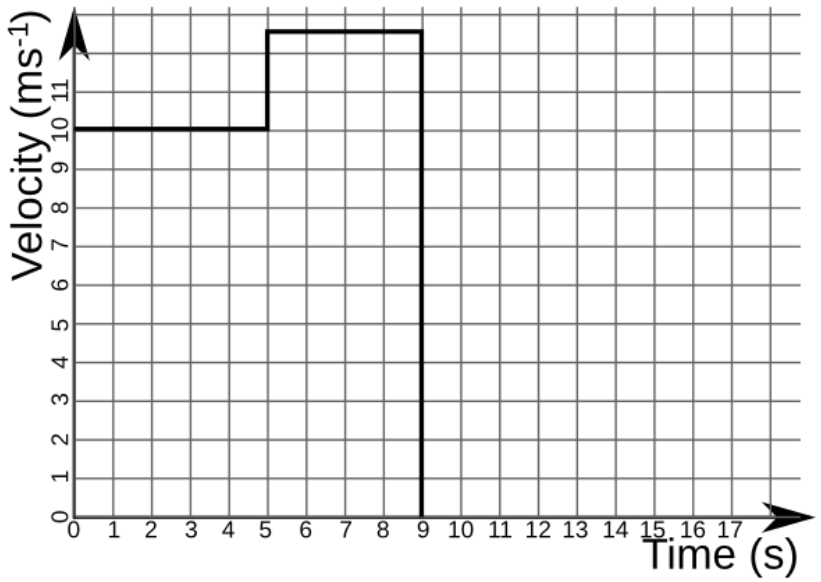
B. 9.0 m

C. 12 m

D. 14 m

Use the velocity graph below to answer Questions 4 and 5.

A river boat was recorded to have this motion.



4. What was the river boat's acceleration at time 3 s?

A. 0 ms^{-2}

B. 10 ms^{-2}

C. 30 ms^{-2}

D. 9.8 ms^{-2}

5. What was the displacement of the river boat at 9 s ?

A. 0 m

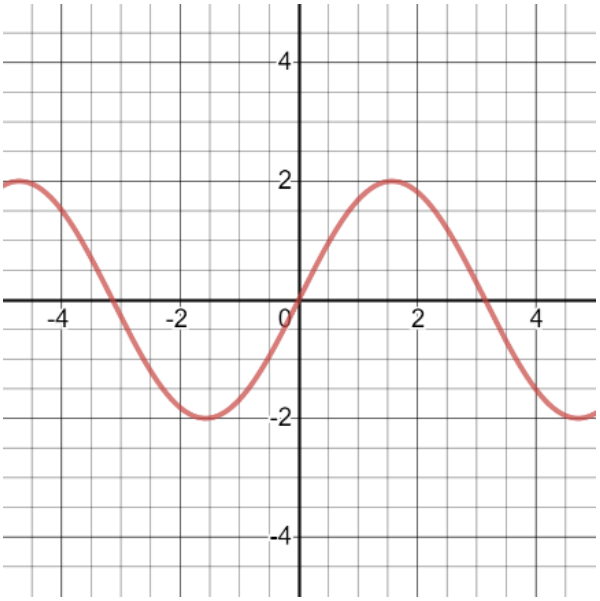
B. 12.5 m

C. 100 m

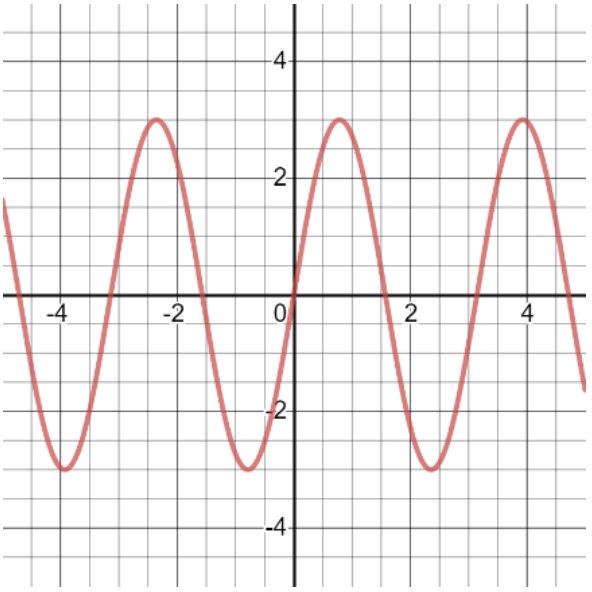
D. 112.5 m

Use Graph 1 and Graph II to answer question 6.

Graph I

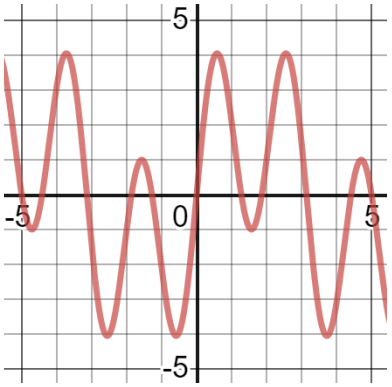


Graph II

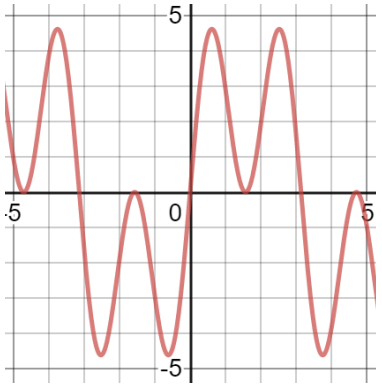


6. Which of the following graphs represents the superposition of graph I and graph II above?

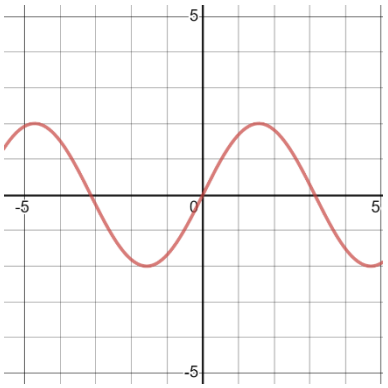
A.



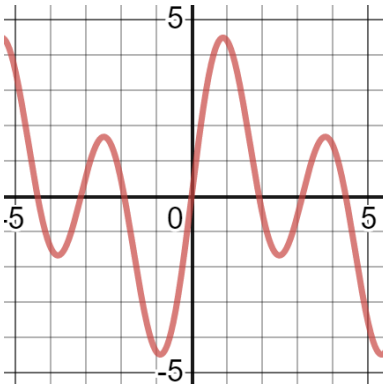
B.



C.



D.



7. The force on an object is measured as being 67 N.

Which pair below is closest to the *x* (horizontal) and *y* (vertical) components of the arrow's force?

	***x*-component (N)**	***y*-component (N)**
A.	32	62
B.	40	20
C.	60	30
D.	80	20

8. A mass of 250 kg is moving across a frictionless surface, with a constant velocity of 5 ms^{-1}.

What net force is needed to maintain this constant velocity?

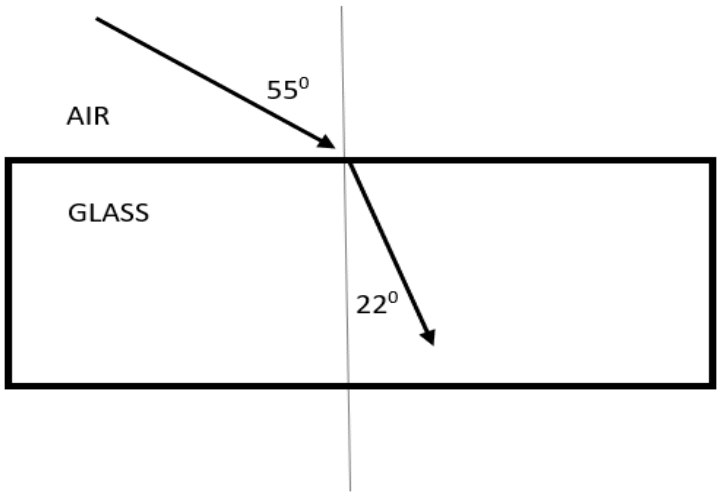
A. 0 N

B. 0.02 N

C. 50 N

D. 1250 N

9. The diagram shows light refracting in a glass prism. The incident angle is 55° and the refracted angle is 22°.



What is the refractive index of the glass?

A. 0.5

B. 2.2

C. 2.5

D. 4.5

10. Which of the following statements is correct?

A. Sound waves are longitudinal waves.

B. All slinky waves are transverse in nature.

C. Sound waves can travel through a vacuum.

D. The speed of light is 3×10^8 ms^{-1} in all situations.

11. A student predicts how much the light intensity will drop off over four metres from its orginal source.

What is the percentage of the original light intensity reaches four metres?

A. 50%

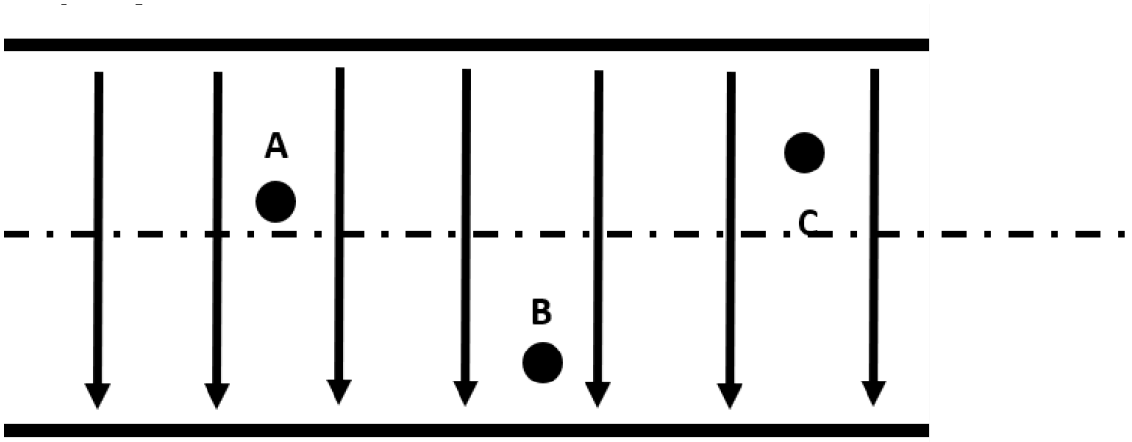
B. 25%

C. 12%

D. 6.25%

Use the information below to answer Question 12.

The diagram below shows an electric field between two parallel plates. Three charges (Charge A, B and C) were placed in the field on the midline. The position of each charge a short time later is shown.



12. What do the positions of the charges show?

A. Charge B is a positive charge

B. Charges A and C are identical charges

C. Charge B is approaching a positive plate

D. All charges are experiencing similar forces

13. Two light globes have the following electric ratings:

Light Globe Y: 12 V & 150 W

Light Globe Z: 240 V & 600 W

Identify the most correct conclusion a student can make from these ratings.

A. Light Globe Y uses less current to work

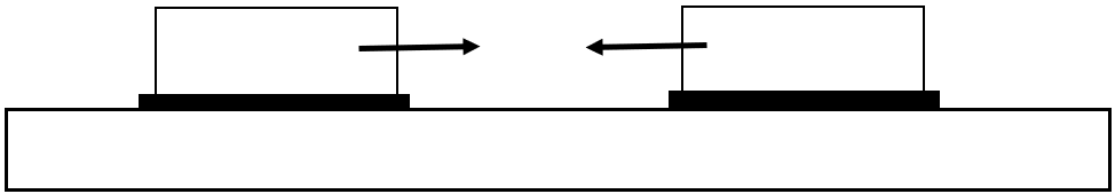
B. Light Globe Z has a greater resistance value

C. Both light globes use the same amout of energy in one minute

D. Light Globe Y will have a longer life span than Globe Z.

Use this information to Questions 14 and 15.

The diagram below is of a linear air track which is enabling the collision of two identical gliders, each with a mass of 20 g. The gliders are shown as they aproach each other with the same speed.



14. Which two identical physics qualities are shared by these two gliders?

A. Mass and velocity

B. Mass and impulse

C. Mass and momentum

D. Mass and kinetic energy

15. The two gliders stick together after the collision and move at 4.0 ms^{-1} right.

What is the magnitude of the final momentum?

A. 160 $kgms^{-1}$

B. 80 $kgms^{-1}$

C. 0.8 $kgms^{-1}$

D. 0.16 $kgms^{-1}$

16. A student constructs a 5000 turn solenoid which is 25 cm in length. She then passes a current of 40 A through it.

What is the strength of the magnetic field produced inside this solenoid?

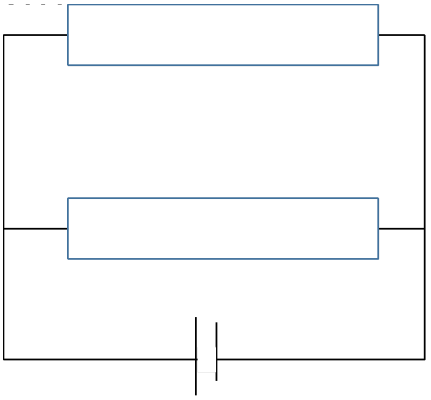
A. 0.01 T

B. 0.1 T

C. 1.0 T

D. 10 T

17. An electrical circuit (shown below) is constructed with a 8Ω resistor connected in parallel to a 16Ω resistor. This circuit is powered by 12V.



What is the total current flowing through the circuit?

A. 0.5 A

B. 2.3 A

C. 4.2 A

D. 10.5 A

18 Calculate the specific heat capacity of copper given that 2.34 kJ raises the temperature of 200 g of copper from 20°C to 50°C.

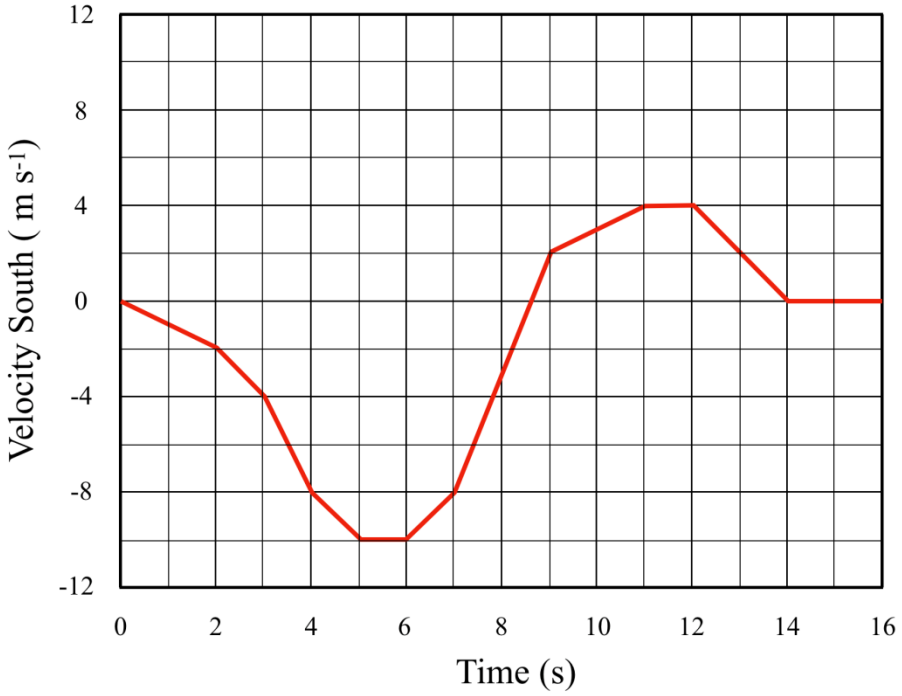
(A) 0.383 $JK^{-1}kg^{-1}$

(B) 13.8 $JK^{-1}kg^{-1}$

(C) 383 $JK^{-1}kg^{-1}$

(D) 13800 $JK^{-1}kg^{-1}$

19. Below is a velocity time graph of an object in motion.



cceleration only in the North

(B) 6-8 s

(C) 9-11 s

(D) 12-14 s

20 If a current of 8.0 amps is flowing through a conductor, how many coulombs of charge flow through the conductor in one hour?

(A) $2.2\times10^{-3}\,C$

(B) 8.0 C

(C) $4.8\times10^{2}\,C$

(D) $2.9\times10^{4}\,C$

End of section I

Section 2 – 55 marks
Attempt questions 21-31
Allow about 1 hour and 30 minutes for this part

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.

Question 21 (7 marks)

A student needed to determine the composition of an unknown material. They were given a list of various materials and their refractive index. They measured the angle of incidence and angle of refraction from air through this unknown material. Below are their results:

Angle of incidence˚	10	17	25	30	40
Angle of refraction˚	6	10	15	18	24

(a) Describe how a graph could be used to determine the refractive index of the material. **2**

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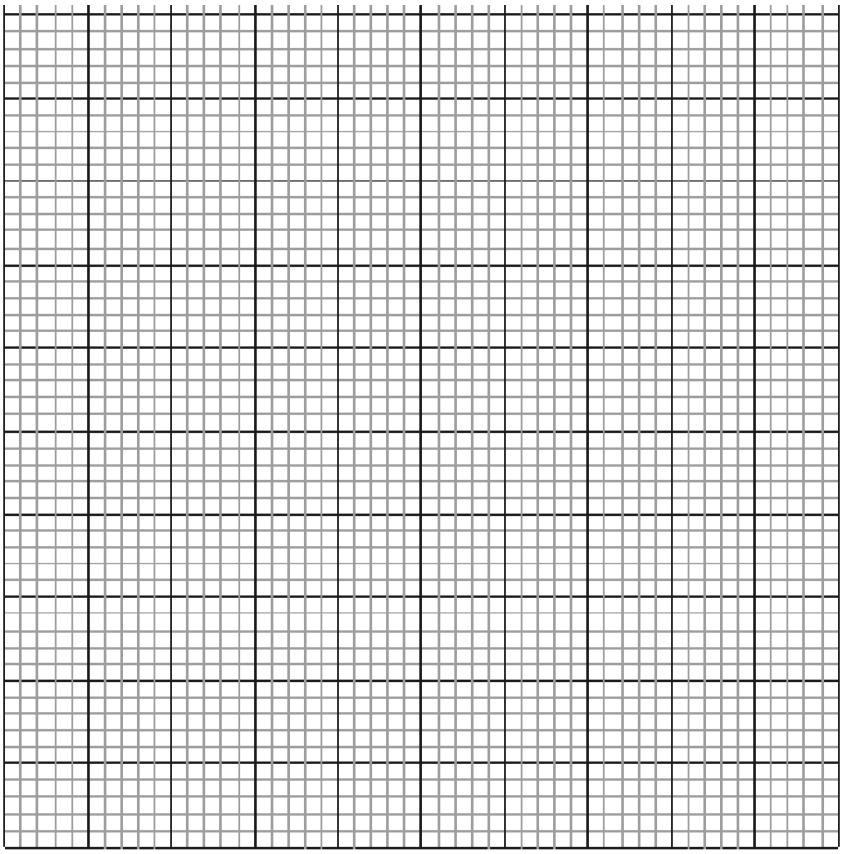
This grid can be used for working

Q21 continued on next page

(b) Using your strategy from (a) determine the refractive index of the unknown material. **4**



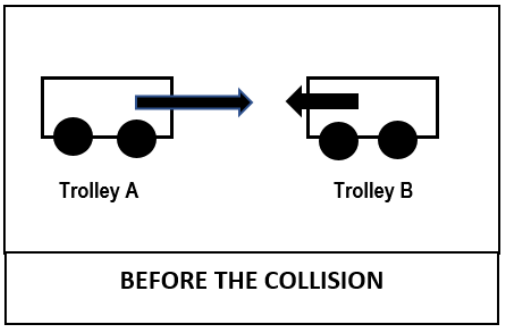
(c) Use the table to determine the identity of the unknown material. **1**

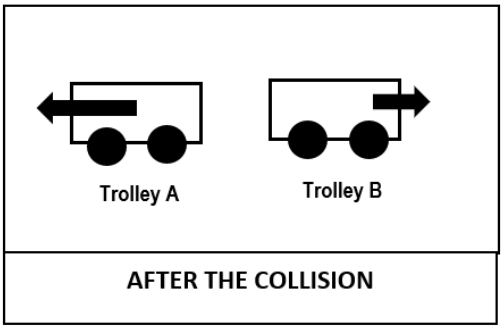
Material	Refractive Index
Diamond	2.42
Flint glass	1.65
Polycarbonate	1.58
Plexiglas	1.49
Ice	1.31

The unknown material is ……..

Question 22 (5 marks)

The diagrams and the data table below display the results of two identical trolleys which have collided in a laboratory. The velocities of the trolleys are measured by students immediately before and after the collision.





	Trolley A	Trolley B		Trolley A	Trolley B
Before Collision	u= 20 ms^{-1} m =1.25kg	u=10 ms^{-1} m =1.25kg	After Collision	V= 15ms^{-1} m =1.25kg	V= 5 ms^{-1} m =1.25kg

Use the diagrams and the data table above to analyse the collision and answer the following questions.

(a) Is momentum conserved in this collision? Justify your answer. **2**

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(b) Use calculations to show if the kinetic energy is conserved in the collsion. If it is not, explain where the energy has gone. **3**

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Question 23 (4 marks)

Kirchhoff's Laws : $\Sigma I = 0$ and $\Sigma V = 0$ are used to analyse circuits. Explain how these concepts are 4 ed to determine voltages and currents in a circuit.

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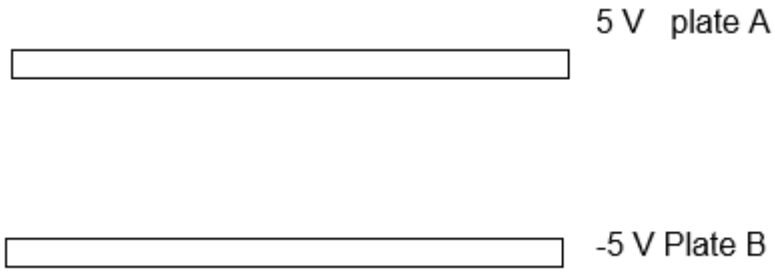
Question 24 (5 marks) A pair of parallel charged plates is shown below.



(a) On the diagram, draw the electric field lines between the plates **2**

b) Calculate the velocity of a proton that has moved through the field from plate A to Plate B **3**

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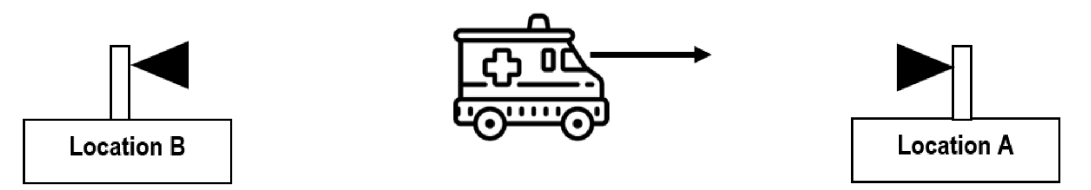
Question 25 (4 marks)

An ambulance is moving at a speed of 30 ms^{-1}. It is emitting a siren which has a frequency of 1750 Hz. A diagram of this event is shown below.



(a)What frequency would be detected by a stationary frequency probe positioned in Location A, in front of the ambulance? **2**

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(b) The same situation was performed under cold conditions where the speed of sound is 330ms^{-1}.

Would the frequency be higher or lower at Location A when compared to normal conditions? Justify your answer. **2**

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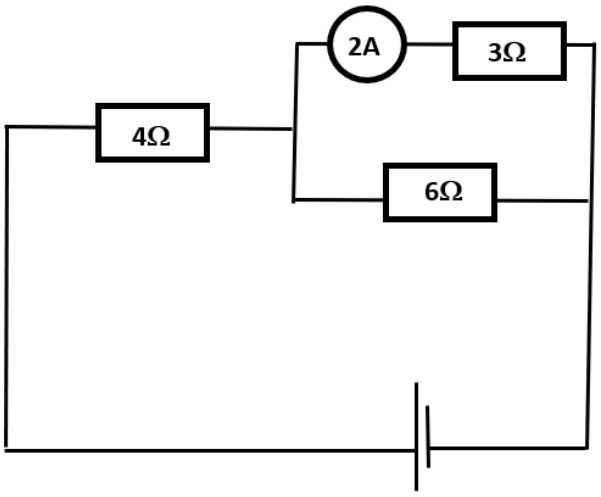
Question 26 (6 marks)

A student designs an electric circuit as shown.



(a) Calculate the total resistance in the circuit. **2**

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(b) Calculate the potential difference accross the 4Ω resistor. **2**

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(c) Calculate the energy used by the 3 Ω resistor if it was left on for 4.5 hrs. **2**

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Question 27 (8 marks)

Impulse is often a critical concept to investigate when analysing collisions.

(a) An experiment is performed to model what can occur in collisions. A 52 g egg was dropped from a distance of 8.0 m onto a cement floor.

Calculate the impulse experienced by the egg. **3**

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(b) Derive impulse using Newton's second law of motion. **2**

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(c) Explain how the concept of impulse has been applied to improve car safety by applying technologies which protect the occupants in an accident. **3**

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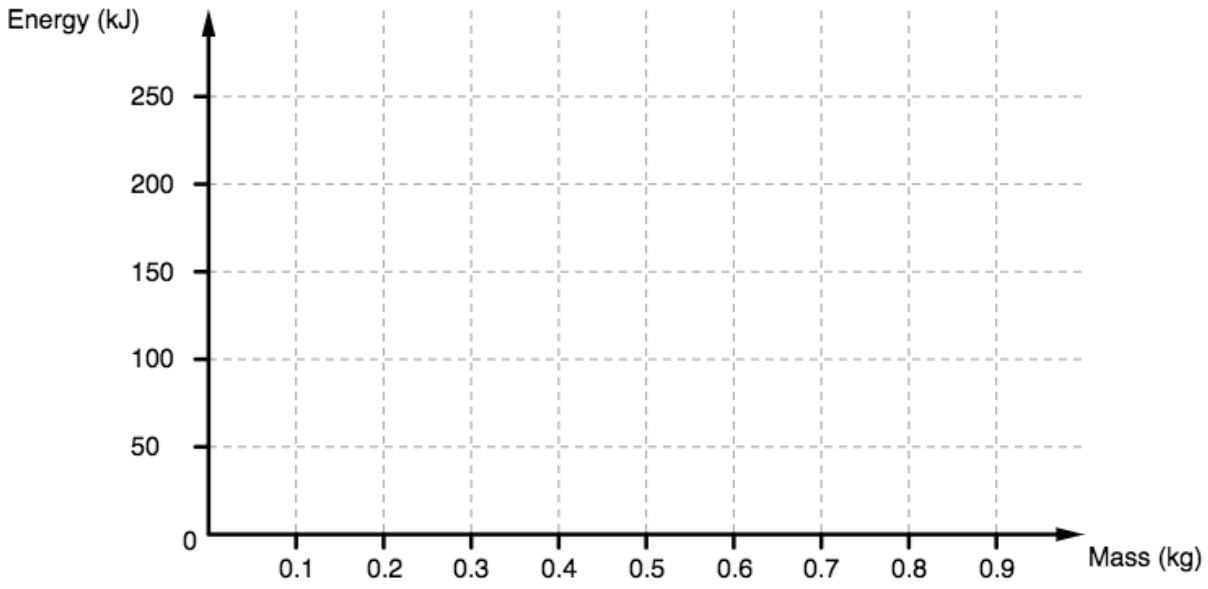
Question 28 (5 marks)
A student conducted an investigation to determine the latent heat of fusion of water.

She recorded her results in the table below:

Mass of Water Produced (kg)	Energy (kJ)
0.10	33
0.22	71
0.40	125
0.51	175
0.64	217

(a) Plot and graph the data onto the axes below. **2**



(b) **Use your graph** to determine the latent heat of fusion of water. **3**

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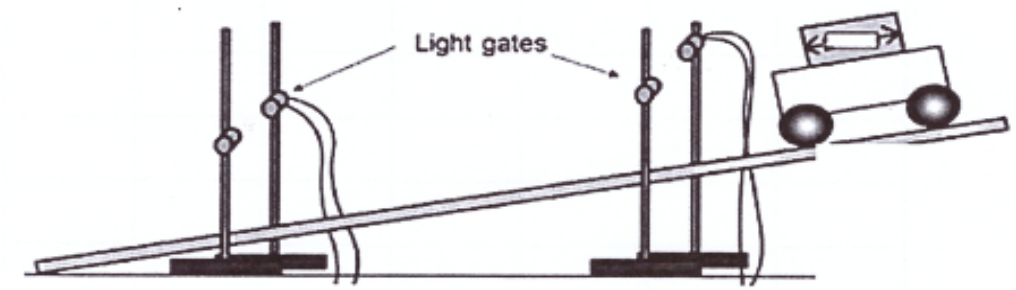
Question 29 (5 marks)

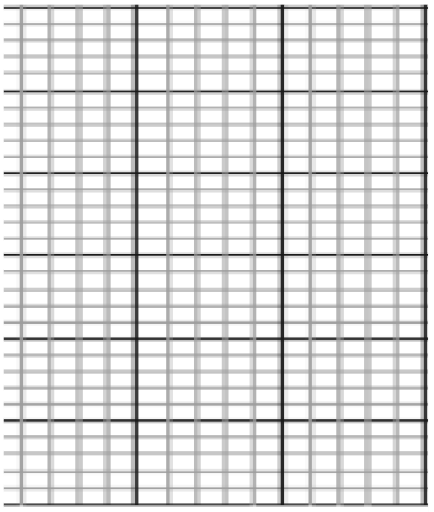
The table shows the results of an experiment involving a trolley rolling down a ramp from rest from different positions. The time was measured using timing gates and the times were squared. These are recorded in the table as shown.



The table shows the results for 6 runs down the slope.

Distance between the light gates (cm)	(Time to roll down the ramp)^2 (s^2)
10	0.04
20	0.08
30	0.12
40	0.16
50	0.20
60	0.24

(a) Complete the graph of the results of this experiment using the axes below. **3**



(b) Use the graph and $s = ut + \frac{1}{2}at^2$ to determine the acceleration of the trolley down the incline. **2**

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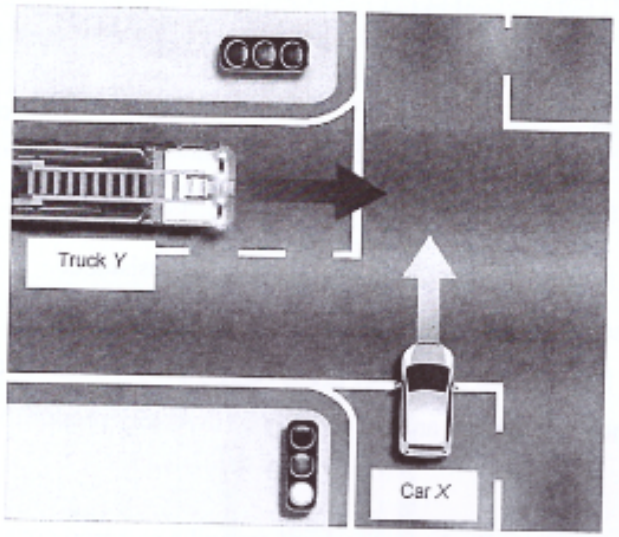
Question 30 (3 marks) **3**

The diagram shows car X and truck Y approaching an intersection

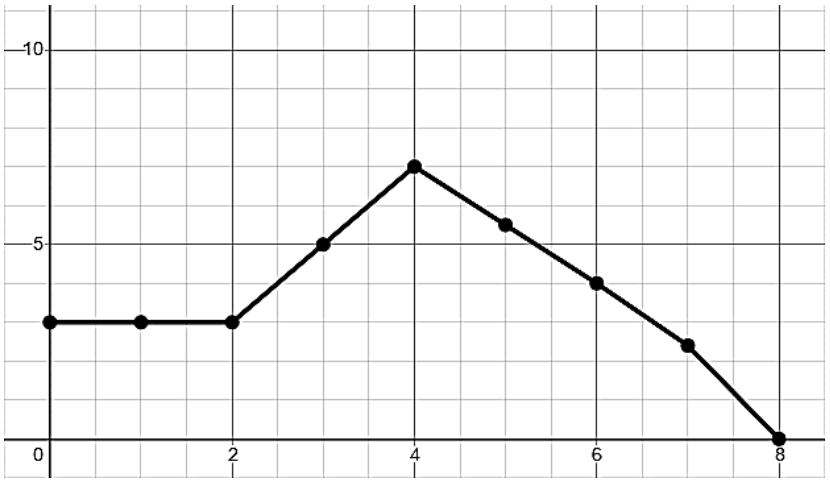


Car X approaches the intersection at 70 km/hr north and truck Y at 55 km/hr east.

Draw a vector diagram and calculate the velocity of car X relative to truck Y in the space below.

Question 31 (5 marks)

Wendy plotteed the graph below of a ball's motion during a practical in class. The graph is incomplete, but she recorded the vertical axis units in ms^{-1}.



Time (s)

(a) What type of graph did Wendy draw? **1**

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(b) What does Wendy's motion graph indicate between 2 to 4 sec? Quantify this value below. **2**

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(c) What is the ball's motion between 0 to 2 sec? **1**

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(d) What is the balls motion between 4 to 8 sec? **1**

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End of Exam

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

Student Number _____

Hornsby Girls High School

2020

Year 11 Physics

Section 1: Multiple Choice Answer Sheet

Shade in the oval. If you make a change, clearly indicate which the correct response 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 ◯
16.	A ◯	B ◯	C ◯	D ◯
17.	A ◯	B ◯	C ◯	D ◯
18.	A ◯	B ◯	C ◯	D ◯
19.	A ◯	B ◯	C ◯	D ◯

20. A ◯ B ◯ C ◯ D ◯

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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:
77/5

Section I — 20 marks

- Attempt Questions 1–20
- Allow about 30 minutes for this part

Section II — 57/55 marks

- Attempt All Questions
- Allow about 1 hour and 30 minutes for this part

Section 1 Multiple Choice - 1 mark each

20 marks
Attempt Questions 1–20
Allow about 30 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

---

1. In the laboratory, white light can be split into its component colours: red, orange, yellow, green, blue, indigo and violet

What is this effect known as?

(A) dispersion
B. resonance
C. superposition
D. Total internal reflection

2. A car travels 200 m North, then 40 m East.

The magnitude of the car's displacement (x) can be calculated using which of the following equations?

A. $\tan\theta = 200/40$.
B. 200 m N + 40 m E = x.
C. $x = (200)^2$ m N+ $(40)^2$ m E.
(D) $x^2 = (200)^2$ m N + $(40)^2$ m E.

$x^2 = y^2 + z^2$
$= (200m\ N)^2 + (40m\ E)^2$

3. A radio wave has a frequency of 3.3×10^7 Hz.

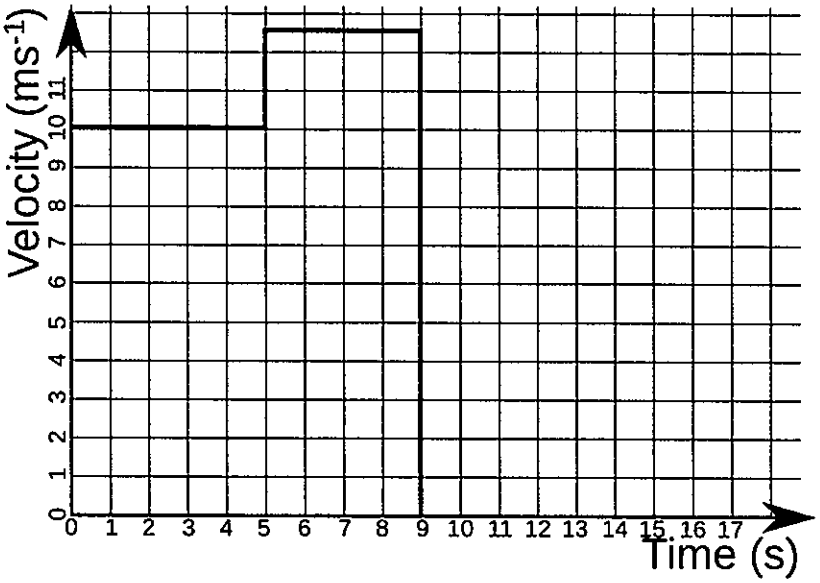
What would its wavelength be closest to?

A. 7.0 m
(B.) 9.0 m
C. 12 m
D. 14 m

$v = f\lambda$
$\lambda = \frac{v}{f} = \frac{3\times10^8}{3.3\times10^7} = 9.1m$

Use the velocity graph below to answer Questions 4 and 5.

A river boat was recorded to have this motion.



4. What was the river boat's acceleration at time 3 s?

(A) $0\ ms^{-2}$ = Vel Vs T = straight line = constant velocity

B. $10\ ms^{-2}$

C. $30\ ms^{-2}$

D. $9.8\ ms^{-2}$

5. What was the displacement of the river boat at 9 s ?

A. 0 m

B. 12.5 m

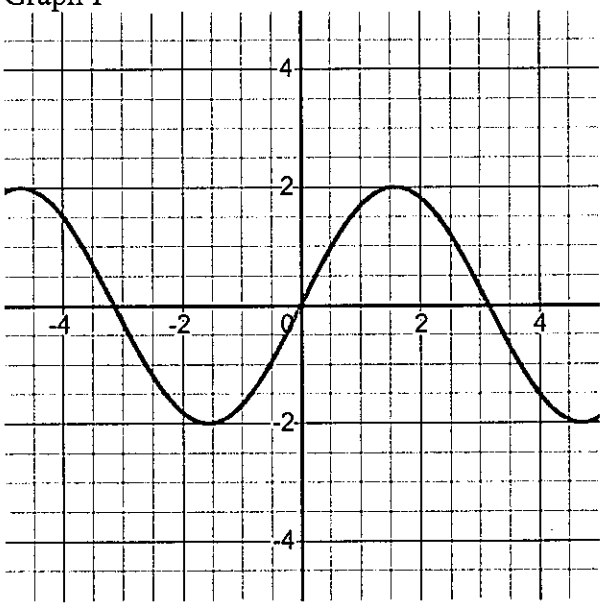
(C) 100 m

D. 112.5 m

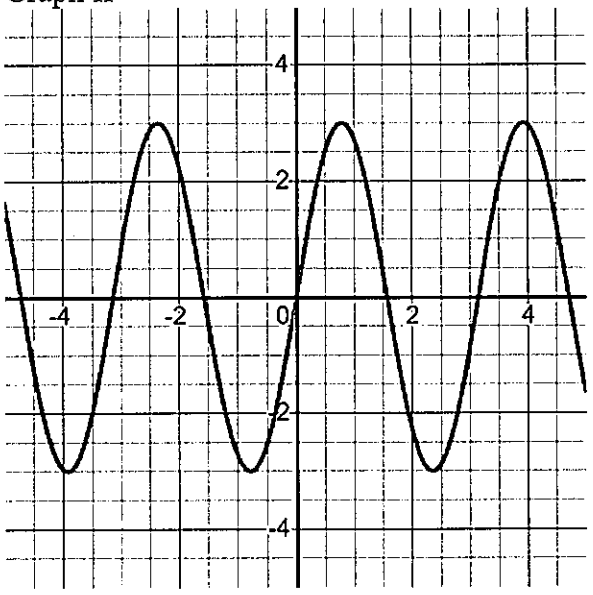
S = Area Under Curve
= 10 × 5 + 12.5 × 4
= 50 + 50
= 100 m

Use Graph 1 and Graph II to answer question 6.

Graph I

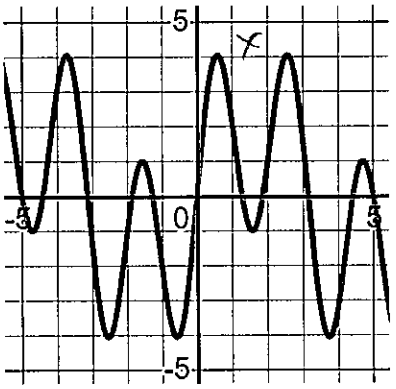


Graph II

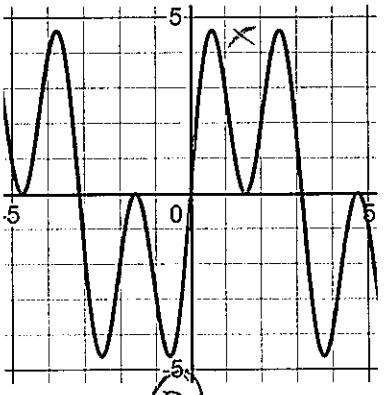


6. Which of the following graphs represents the superposition of graph I and graph II above?

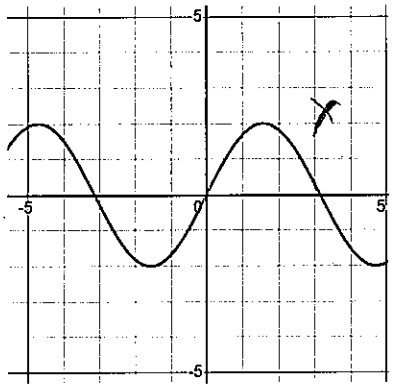
A.



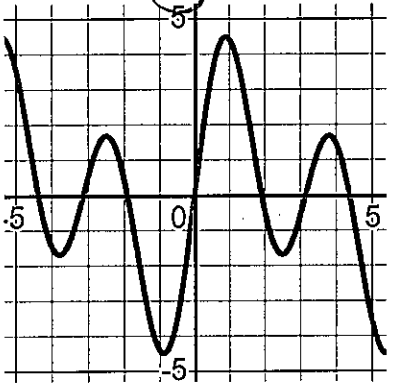
B.



C.



D.



7. The force on an object is measured as being 67 N.

Which pair below is closest to the x (horizontal) and y (vertical) components of the arrow's force?

	x-component (N)	y-component (N)
A.	32	62
B.	40	20
(C.)	60	30
D.	80	20

$R^2 = Y^2 + X^2$

$67^2 = 60^2 + 30^2$

$4489 = 3600 + 900$

$=$

8. A mass of 250 kg is moving across a frictionless surface, with a constant velocity of 5 ms^{-1}.

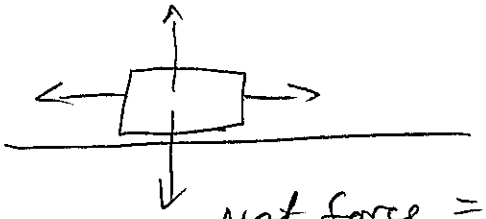
What net force is needed to maintain this constant velocity? = forces are in balance

(A.) 0 N

B. 0.02 N

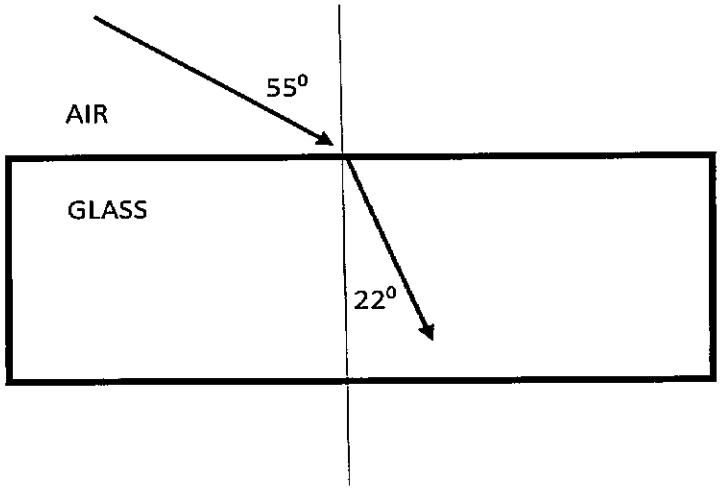
C. 50 N

D. 1250 N



Net force = 0.

9. The diagram shows light refracting in a glass prism. The incident angle is 55° and the refracted angle is 22°.



What is the refractive index of the glass?

$n = \frac{\sin i}{\sin r} = \frac{\sin 55}{\sin 22} = 2.2$

A. 0.5
B. 2.2
C. 2.5
D. 4.5

10. Which of the following statements is correct?

A. Sound waves are longitudinal waves.
B. All slinky waves are transverse in nature. can be longitudinal
C. Sound waves can travel through a vacuum. Can NOT
D. The speed of light is 3×10^8 ms^{-1} in all situations. only in a vacuum

11. A student predicts how much the light intensity will drop off over four metres from its orginal source.

What is the percentage of the original light intensity reaches four metres?

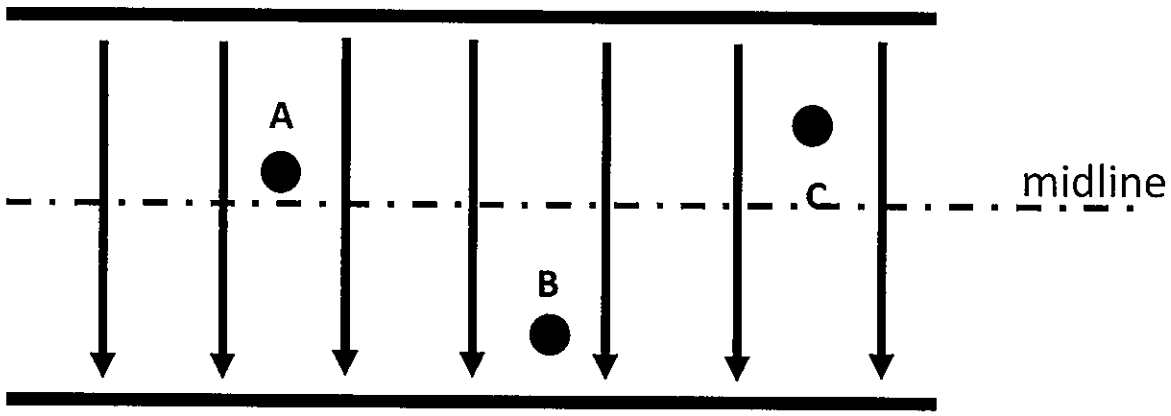
$I \propto \frac{1}{d^2}$

$1_m \rightarrow 2_m \rightarrow 3_m \rightarrow 4_m$
$I \quad \frac{1}{4} \quad \frac{1}{9} \quad \frac{1}{16}$
$= 0.0625$
$= 6.3\%$

A. 50%
B. 25%
C. 12%
D. 6.25%

Use the information below to answer Question 12.

The diagram below shows an electric field between two parallel plates. Three charges (Charge A, B and C) were placed in the field on the midline. The position of each charge a short time later is shown.



12. What do the positions of the charges show?

(A.) Charge B is a positive charge

~~B.~~ Charges A and C are identical charges — moving in opposite directions

~~C.~~ Charge B is approaching a positive plate — approaching -ve plate

~~D.~~ All charges are experiencing similar forces — not moving in similar directions

13. Two light globes have the following electric ratings:

$P = VI$

Light Globe Y: 12 V & 150 W $I = \frac{P}{V} = \frac{150}{12} = 12.5\,A$ $R = \frac{V}{I} = \frac{12}{12.5} = 0.96\,\Omega$ OR $R = \frac{V^2}{P} = \frac{144}{150} = 0.96\,\Omega$

Light Globe Z: 240 V & 600 W $I = \frac{P}{V} = \frac{600}{240} = 2.5\,A$ $R = \frac{V}{I} = \frac{240}{2.5} = 96\,\Omega$

Identify the most correct conclusion a student can make from these ratings.

A. Light Globe Y uses less current to work

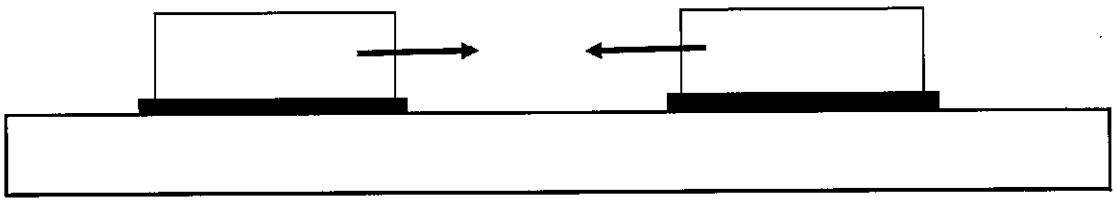
(B) Light Globe Z has a greater resistance value

C. Both light globes use the same amout of energy in one minute

D. Light Globe Y will have a longer life span than Globe Z.

Use this information to Questions 14 and 15.

The diagram below is of a linear air track which is enabling the collision of two identical gliders, each with a mass of 20 g. The gliders are shown as they aproach each other with the same speed.



14. Which two identical physics qualities are shared by these two gliders?

A. Mass and velocity — v in opposite direction
B. Mass and impulse — Δ in $p=mv$ is in " "
C. Mass and momentum $p=mv$ = " "
D. Mass and kinetic energy $=\frac{1}{2}mv^2$

15. The two gliders stick together after the collision and move at 4.0 ms^{-1} right.

What is the magnitude of the final momentum? $m = 2 \times 0.02$ kg

A. 160 $kgms^{-1}$
B. 80 $kgms^{-1}$
C. 0.8 $kgms^{-1}$
D. 0.16 $kgms^{-1}$

$p = mv$
$= 0.04 \times 4$
$= 0.16$ Ns or $kg\,ms^{-1}$

16. A student constructs a 5000 turn solenoid which is 25 cm in length. She then passes a current of 40 A through it.

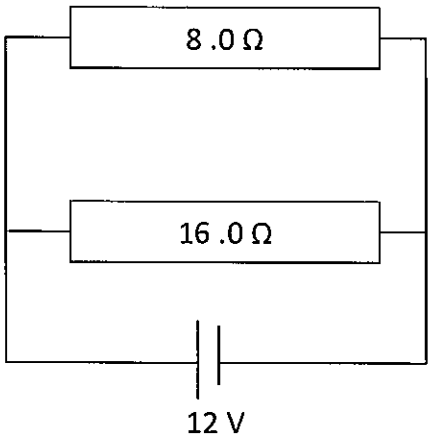
What is the strength of the magnetic field produced inside this solenoid?

A. 0.01 T
B. 0.1 T
C. 1.0 T
D. 10 T

$B = \frac{\mu_0 N I}{L} = \frac{1.25 \times 10^{-6} \times 5000 \times 40}{0.25}$

$= 1$ T

17. An electrical circuit (shown below) is constructed with a 8Ω resistor connected in parallel to a 16Ω resistor. This circuit is powered by 12V.



$V = IR$

$I_8 = \frac{V}{R} = \frac{12}{8} = 1.5\ A$

$I_{16} = \frac{V}{R} = \frac{12}{16} = 0.75\ A$

$I_T = I_1 + I_2$

$= 1.5 + 0.75$

$= 2.25\ A$

What is the total current flowing through the circuit?

A. 0.5 A

B. 2.3 A

C. 4.2 A

D. 10.5 A

18 Calculate the specific heat capacity of copper given that 2.34 kJ raises the temperature of 200 g of copper from 20°C to 50°C.

$\Delta T = 50^\circ - 20^\circ$

$= 30^\circ C$

(A) 0.383 $JK^{-1}kg^{-1}$

(B) 13.8 $JK^{-1}kg^{-1}$

(C) 383 $JK^{-1}kg^{-1}$

(D) 13800 $JK^{-1}kg^{-1}$

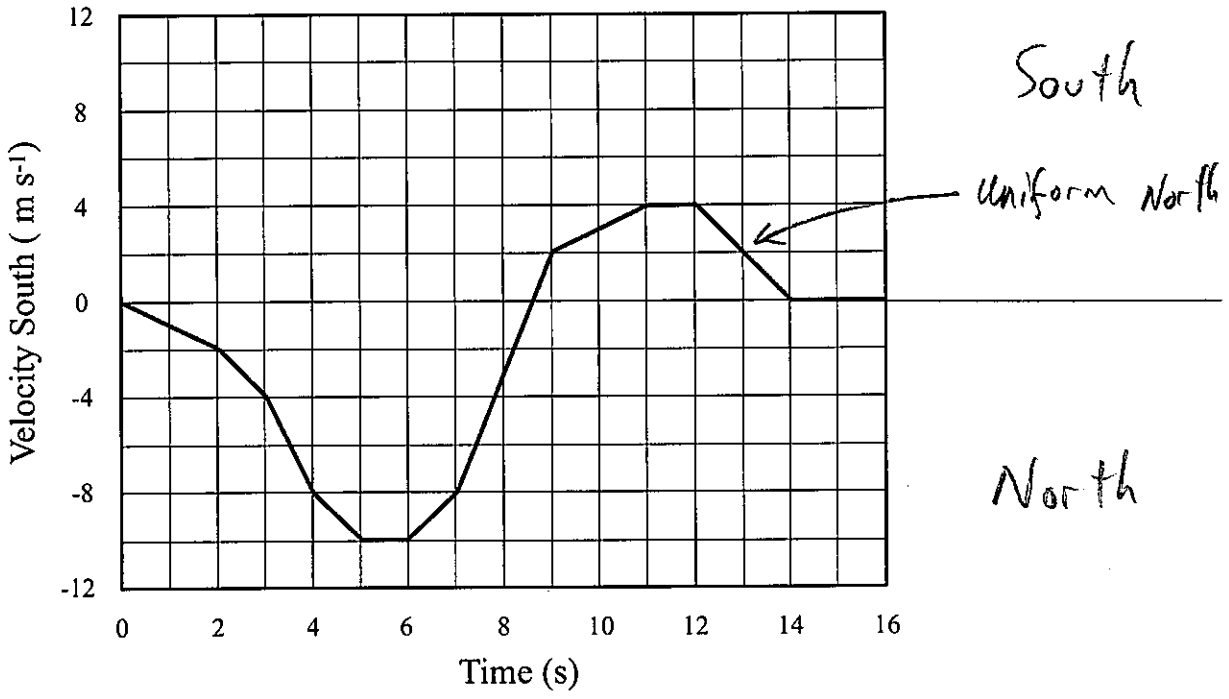
$Q = mc\Delta T$

$2.34 \times 10^3 = 0.2 \times c \times 30$

$c = \frac{2.34 \times 10^3}{0.2 \times 30}$

$= 390\ J\ kg^{-1}K^{-1}$

19. Below is a velocity time graph of an object in motion.



During which of the time intervals shown below was the acceleration only in the North direction?

(A) 4-7 s — acceleration, constant, deceleration

(B) 6-8 s — acc in South direction

(C) 9-11 s — " " " "

(D) 12-14 s

20 If a current of 8.0 amps is flowing through a conductor, how many coulombs of charge flow through the conductor in one hour?

(A) 2.2×10^{-3} C

(B) 8.0 C

(C) 4.8×10^{2} C

(D) 2.9×10^{4} C

$Q = I \times T$
$= 8 \times 60 \times 60$
$= 2.9 \times 10^{4}$ C

End of section I

Section 2 – 55 marks
Attempt questions 21-31
Allow about 1 hour and 30 minutes for this part

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.

Question 21 (7 marks)

A student needed to determine the composition of an unknown material. They were given a list of various materials and their refractive index. They measured the angle of incidence and angle of refraction from air through this unknown material. Below are their results:

Angle of incidence°	10	~~20~~ 17	25	30	40
Angle of refraction°	6	10	~~16~~ 15	18	24

(a) Describe how a graph could be used to determine the refractive index of the material. **2**

- graph sin i (vertical) Vs sin r (horizontal) 1 mark.
- gradient of graph = $\frac{\sin i}{\sin r}$ = n 1 mark

This grid can be used for working

θ_i	sin i	θ_r	sin r	n
10	0.17	6	0.10	1.66
17	0.29	10	0.17	1.68
23	0.42	15	0.26	1.63
30	0.5	18	0.31	1.62
40	0.64	24	0.41	1.58

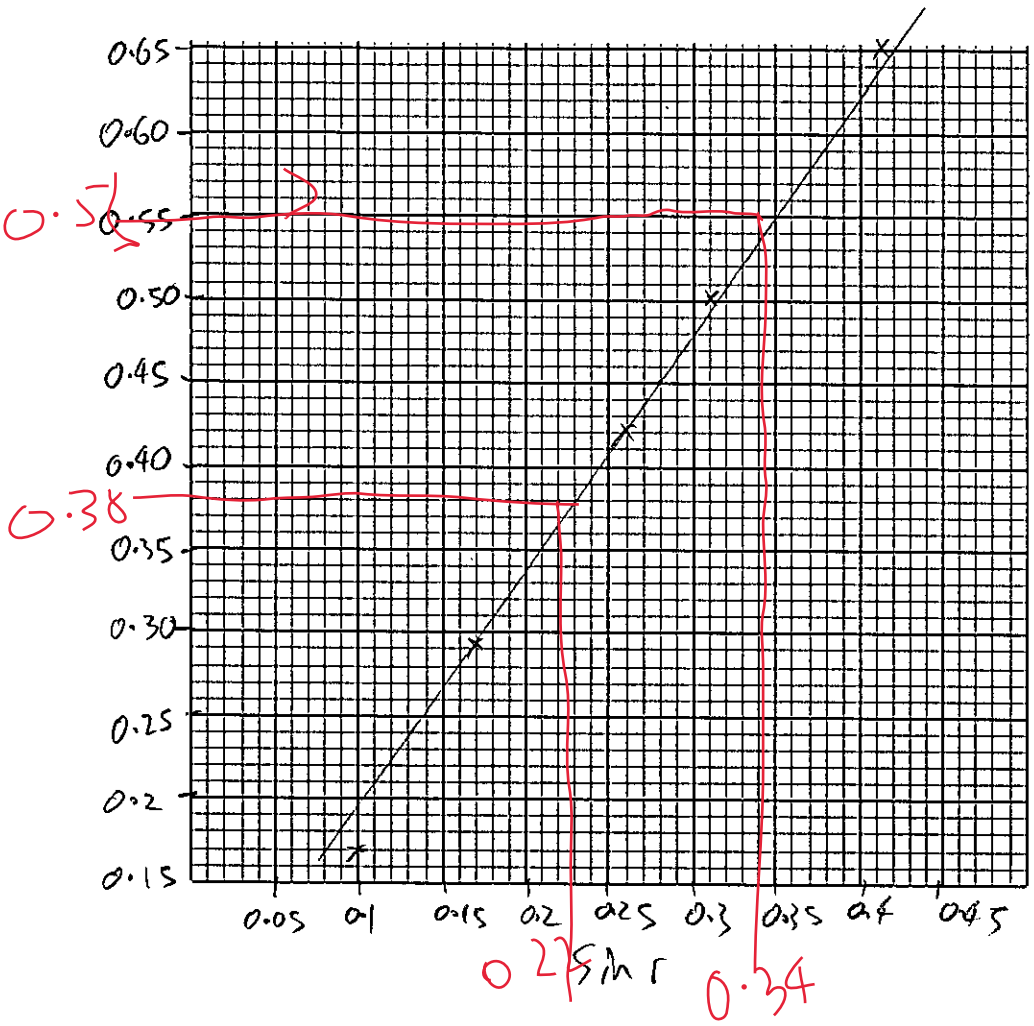
$n_{ave} = 1.63$

Q21 continued on next page

#Remove Space.

(b) Using your strategy from (a) determine the refractive index of the unknown material.

4



1 mark axis
1 " Scale
1 " points
1 " LBF

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{0.64 - 0.17}{0.41 - 0.1}$$

$$= \frac{0.47}{0.31}$$

$$= 1.55$$

(c) Use the table to determine the identity of the unknown material. **1**

Material	Refractive Index
Diamond	2.42
Flint glass	1.65
Polycarbonate	1.58
Plexiglas	1.49
Ice	1.31

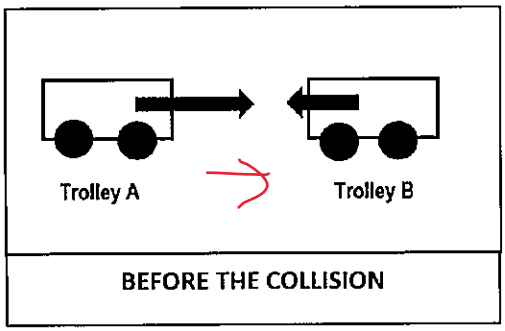
The unknown material is .....

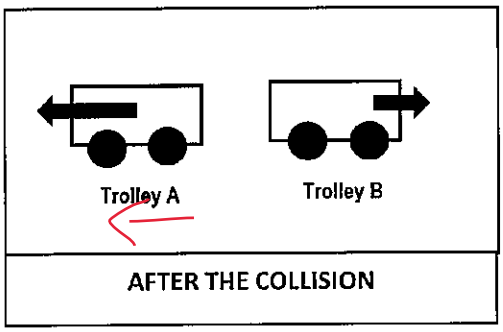
acceptable range from graph

Question 22 (5 marks)

The diagrams and the data table below display the results of two identical trolleys which have collided in a laboratory. The velocities of the trolleys are measured by students immediately before and after the collision.

Let → be +ve direction





	Trolley A	Trolley B		Trolley A	Trolley B
Before Collision	u= 20 ms^{-1} m =1.25kg	u=10 ms^{-1} m =1.25kg	After Collision	V= 15ms^{-1} m =1.25kg	V= 5 ms^{-1} m =1.25kg

Use the diagrams and the data table above to analyse the collision and answer the following questions.

(a) Is momentum conserved in this collision? Justify your answer. 2

$P_{Before} = P_{After}$ ∴ P is conserved

$m_A u_A + m_B u_B = m_A v + m_B v_B$

$1.25 \times 20 + -1.25 \times 10 = 1.25 \times 15 + 1.25 \times 5$ 1 mark for Calculation

$25 - 12.5 = -18.75 + 6.25$ 1 " " P is NOT conserved

$12.5\ Ns = -12.5\ Ns$

Right → ← Left

(b) Use calculations to show if the kinetic energy is conserved in the collsion. If it is not, explain where the energy has gone. 3

$K_{Before} = K_{After}$

$\frac{1}{2} m_A u^2 + \frac{1}{2} m_B u^2 = \frac{1}{2} m v^2 + \frac{1}{2} m_B v^2$

$\frac{1}{2} 1.25 \times 20^2 + \frac{1}{2} 1.25 \times 10^2 = \frac{1}{2} \times 1.25 \times 15^2 + \frac{1}{2} 1.25 \times 5^2$

$250 + 62.5 = 140.6 + 15.6$

$312.5\ J \neq 157\ J$

∴ K is NOT Conserved

K has gone into sound, heat in the collision ie other energies

1 mark for Calculation
1 " " NOT conserved
1 " " other energies

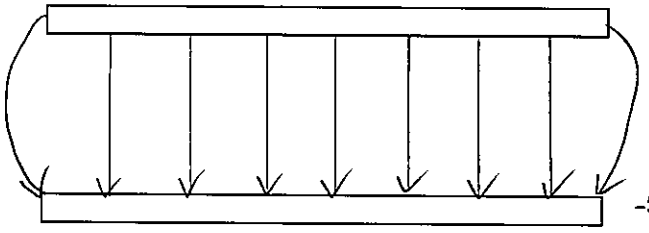
Question 23 (4 marks)

Kirchhoff's Laws : $\Sigma I = 0$ and $\Sigma V = 0$ are used to analyse circuits. Explain how these concepts are applied to determine voltages and currents in a circuit. **4**

$\Sigma I = 0$ is Kirchhoff's current law ie. current in a circuit is conserved. ie. current moving in a circuit cannot leave or enter ie is conserved. Eg. Parallel circuit current out = current into transformer but splits in branches $I_T = I_1 + I_2 + I_3$

$\Sigma V = 0$ is Kirchhoff's voltage law ie. voltage is conserved ie. voltage of transformer can divide amongest resistors Eg. Series circuit $V_T = V_1 + V_2 + V_3$

Question 24 (5 marks) A pair of parallel charged plates is shown below.



– 1 mark evenly spaced lines

– 1 mark for curved Field line at end.

(a) On the diagram, draw the electric field lines between the plates **2**

b) Calculate the velocity of a proton that has moved through the field from plate A to Plate B **3**

Given: $m_p = 1.673 \times 10^{-27}$ kg $V = 5V - -5V = 10V$ $q_p = 1.602 \times 10^{-19}$ C

use: $V = \frac{\Delta U}{q}$ $\therefore V \times q = \Delta U$ $\therefore \Delta U = 10 \times 1.602 \times 10^{-19} = 1.602 \times 10^{-18}$ J (1)

$\Delta U = K$ $\therefore 1.602 \times 10^{-19} = \frac{1}{2} m v^2$ ——— (1)

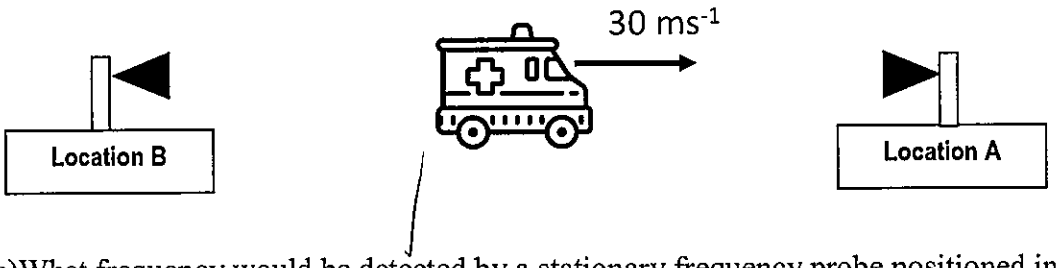
$$v = \sqrt{\frac{2 \times 1.602 \times 10^{-19}}{1.673 \times 10^{-27}}}$$

$= 43762$ ms^{-1}

$= 4.4 \times 10^{4}$ ms^{-1} (1)

Question 25 (4 marks)

An ambulance is moving at a speed of 30 ms^{-1}. It is emitting a siren which has a frequency of 1750 Hz. A diagram of this event is shown below.



(a)What frequency would be detected by a stationary frequency probe positioned in Location A, in front of the ambulance? **2**

given: $f = 1750\,Hz$ $V_{wave} = V_{sound} = 340\,ms^{-1}$ $V_{source} = 30\,ms^{-1}$

use: $f' = f\left(\frac{V_{wave} + V_{obs}}{V_{wave} - V_{source}}\right)$

$= 1750\left(\frac{340 + 0}{340 - 30}\right)$

$= 1750 \times \frac{340}{310}$

$= 1919.4\,Hz$

2 marks = cal^ + units
1 " = Incorrect substitution

(b) The same situation was performed under cold conditions where the speed of sound is 330ms^{-1}.

Would the frequency be higher or lower at Location A when compared to normal conditions? Justify your answer. **2**

$f = 1750\left(\frac{330 - 0}{330 - 30}\right)$

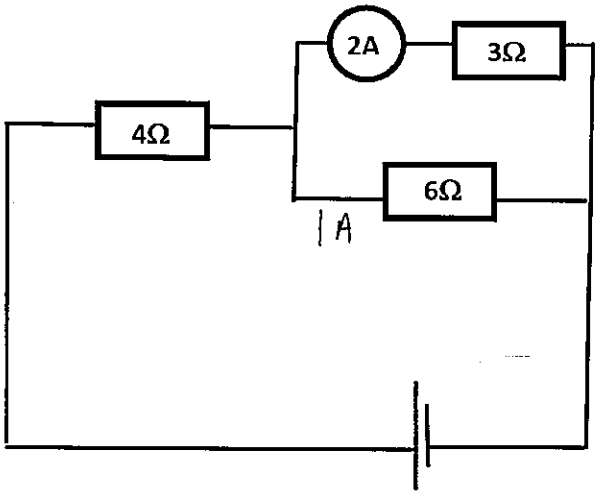
$= 1750 \times \frac{330}{300}$

$= 1925\,Hz$ = 1 mark cal^

$\therefore f$ would be higher = 1 mark $f\uparrow$

Question 26 (6 marks)

A student designs an electric circuit as shown.



(a) Calculate the total resistance in the circuit. **2**

$R_T = R_S + R_P \left(\frac{1}{3}+\frac{1}{6}=\frac{1}{2}=2\Omega\right)$

$= 4\Omega + \frac{1}{3} + \frac{1}{6}$

$= 4\Omega + 2\Omega$

$= 6\Omega$

(b) Calculate the potential difference ~~flowing~~ across through the 4Ω resistor. **2**

$V = IR = 3 \times 4 = 12\,V$ (4Ω) OR $V = IR = 2 \times 3 = 6\,V$ (3Ω)

$V_{6\Omega} = IR = 1 \times 6 = 6\,V$

$\therefore V_{\text{across } 4\Omega} = 6 + 6 = 12\,V$

(c) Calculate the energy used by the 3 Ω resistor if it was left on for 4.5 hrs. **2**

Given: $E = ?$ $R = 3\Omega$ $t = 4.5 \times 60 \times 60 = 16200$

use:

$E = VIt$ OR $P = VI = 6 \times 2 = 12\,W$ OR $q = It$

$= 6 \times 2 \times 16200$ $P = \frac{E}{t}$ $= 2 \times 16200$

$= 194400$ J or W $E = P \times t$ $= 32400$

$= 1.94 \times 10^5$ J $= 12 \times 16200$ $W = E = qV$

$= 194$ KJ or KW $= 194400$ J $= 194400$ J

1 watt = 1 $J\,s^{-1}$

1 kW = 1000 $J\,s^{-1}$

Question 27 (~~6~~ 8 marks)

Impulse is often a critical concept to investigate when analysing collisions.

(a) An experiment is performed to model what can occur in collisions. A 52 g egg was dropped from a distance of 8.0 m onto a cement floor.

Calculate the impulse experienced by the egg. **3**

Use: $I = \Delta p = mv - mu$ when: $m = 52g = 0.052kg$ $s = 8m$

1st $v^2 = u^2 + 2as$

$= 0 + 2 \times 9.8 \times 8$

$= 12.5 ms^{-1}$ — (1) Cal^ of V = 1

2nd $\Delta p = mv - mu$ Cal^ " I = 1

$= 0.052 \times 12.5 - 0$ Direction = 1

$= 0.65$ Ns up

(1) (1)

OR $I = F t$ $F = ma$

$= 0.5096 \times 1.28$ $= 0.052 \times 9.8$

$= 0.65$ Ns up $= 0.5096$ N

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

$\therefore t = \sqrt{\frac{2 \times s}{9.8}} = \sqrt{\frac{16}{9.8}} = 1.28$

(b) Derive impulse using Newton's second law of motion. **2**

$F = ma$ $a = \frac{\Delta v}{\Delta t}$ or $F = m\frac{\Delta v}{\Delta t}$

$= m \times \frac{\Delta v}{\Delta t}$ $Ft = mv - mu$

$Ft = mv - mu = I$ $I = mv - mu$

$\therefore I = Ft$

(c) Explain how the concept of impulse has been applied to improve car safety by applying technologies which protect the occupants in an accident. **3**

Air bags, seat belts, crumple zones ↑ collision time in impact ∴ ↑t decreases Forces on passengers.

ie. $I = Ft$ ∴ $F = \frac{I}{t}$ ↑t ↓F

- Force is inversely proportional to time

27

Question 31 (5 marks)

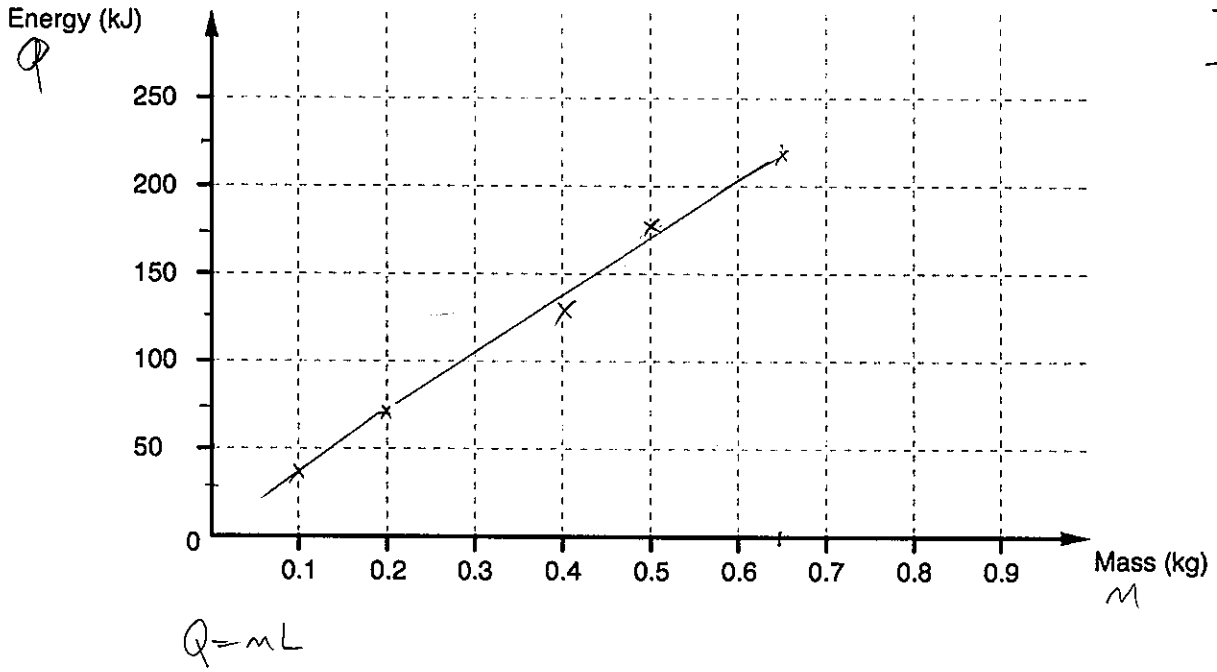
A student conducted an investigation to determine the latent heat of fusion of water.

She recorded her results in the table below:

Mass of Water Produced (kg)	Energy (kJ)
0.10	33
0.22	71
0.40	~~85~~ X 125
0.51	175
0.64	217

(a) Plot and graph the data onto the axes below. **2**

- points
- Line BF



Q = mL

(b) **Use your graph** to determine the latent heat of fusion of water. **3**

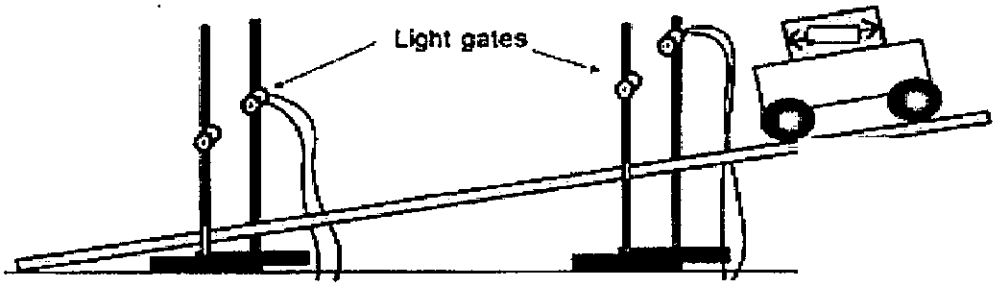
$\frac{Q}{m}$ = gradient = $\frac{\text{rise}}{\text{run}} = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{217 - 33}{0.64 - 0.1} = \frac{184}{0.54}$

$Q = mL$ $L = \frac{Q}{m}$ = Latent heat of Fusion = 340.7

Or $= \frac{71}{0.22} = 323$ kJ kg^{-1} ← range → = 341 kJ kg^{-1}

Question 29 (5 marks)

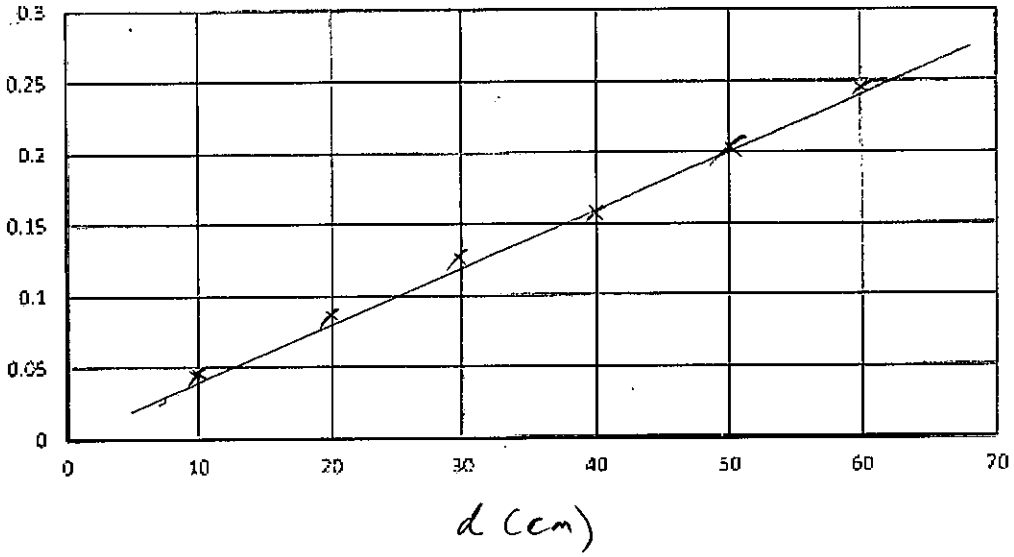
The table shows the results of an experiment involving a trolley rolling down a ramp from rest from different positions. The time was measured using timing gates and the times were squared. These are recorded in the table as shown.



The table shows the results for 6 runs down the slope.

Distance between light gates (cm)	*(Time to roll down slope)^2 (s^2)*
10	0.04
20	0.08
30	~~0.20~~ 0.12
40	0.16
50	0.20
60	0.24

(a) Complete the graph of the results of this experiment using the axes below. **3**



– axis label
– points
– LOF

(b) Using the information in your grap and $s = \underset{=0}{ut} + \frac{1}{2}at^2$ to determine the acceleration of the trolley down the incline. **2**

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

$\therefore a = \frac{2s}{t^2}$ = gradient^{-1} $= \frac{2 \times 40}{0.16} = \frac{40}{0.16} \times 2 = 250 \times 2 = 500$ cm/s^2

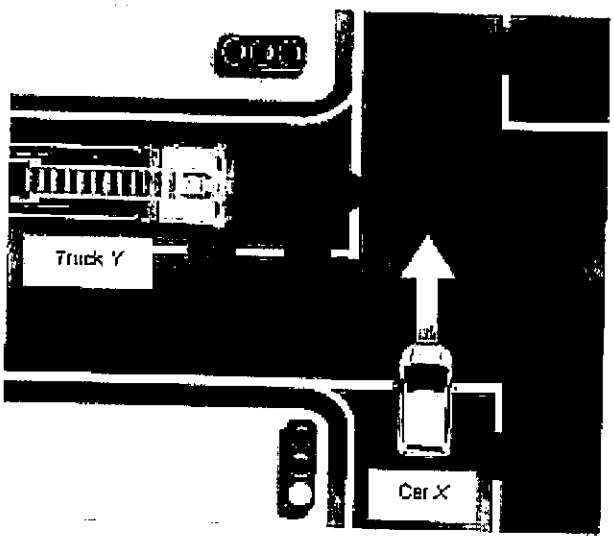
$= 5$ m/s^2

OR

gradient $= \frac{t^2}{s} = \frac{1}{a}$ $\therefore a = 2 \times$ gradient

Question 30 (3 marks) 3

The diagram below shows the motion of car X and truck Y approaching an intersection.



Car X approaches the intersection at 70 km/hr north and truck Y at 55 km/hr east.

Draw a vector diagram and calculate the velocity of car X relative to the truck below.

truck Y = 55 km west

R

Car X
70 km N

θ

car X relative truck Y

$V_{car\ X} = X_{North} - Y_{west}$ — ① mark For relative

$X_{North} + (-Y_{East=west})$

$R^2 = 55^2 + 70^2$

$= \sqrt{55^2 + 70^2}$

$= \sqrt{7925}$

① mark calculation $= 89$ km/hr

$\tan\theta = \frac{opp}{adj} = \frac{55}{70} = 38°9'$ ① mark for θ

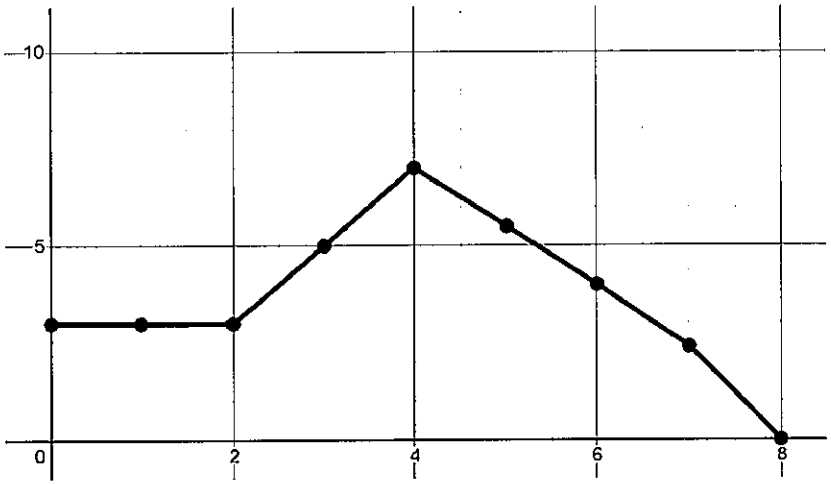
∴ Velocity of car X relative to car Y is 89 km/hr N 38° W.

24.7 ms^{-1}

✳ Mark Darker

Question 31 (5 marks)

Wendy plotteed the graph below of a ball's motion during a practical in class. The graph is incomplete, but she recorded the vertical axis units in ms^{-1}.



Time (s)

(a) What type of graph did Wendy draw? **1**

Velocity Vs Time

(b) What does Wendy's motion graph indicate between 2 to 4 sec? Quantify this value below. **2**

Acceleration $a = \text{gradient} = \frac{\text{rise}}{\text{run}} = \frac{7-3}{2} = \frac{4}{2} = 2\ ms^{-2}$

(c) What is the ball's motion between 0 to 2 sec? **1**

Constant velocity of $3\ ms^{-1}$

(d) What is the balls motion between 4 to 8 sec? **1**

decreasing velocity, slowing down, decerating

$\frac{V=0-7}{8-4} = -1.75\ ms^{-1}$

End of Exam