

SAMPLE

CAMBRIDGE INTERNATIONAL AS & A LEVEL

PHYSICS  
(9702)

PAPER 4  
(A LEVEL)

WORKSHEET  
(QUANTUM PHYSICS)

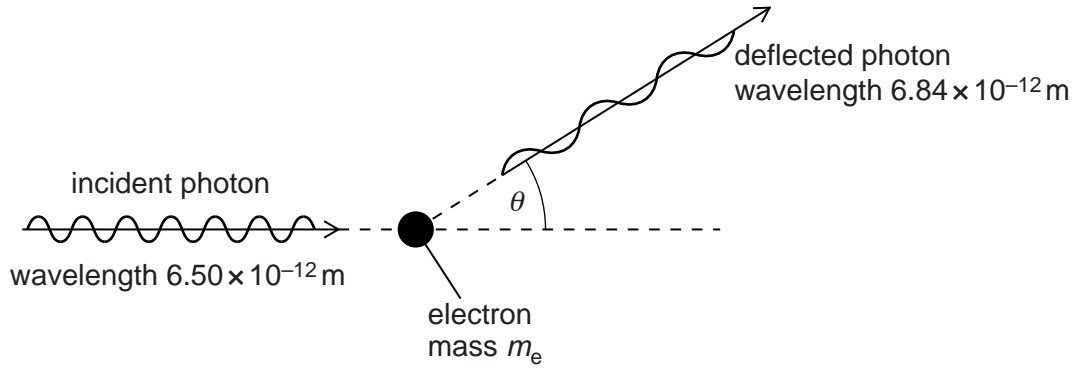


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SAMPLE

1

A photon of wavelength  $6.50 \times 10^{-12}$  m is incident on an isolated stationary electron, as illustrated in Fig. 8.1.



**Fig. 8.1**

The photon is deflected elastically by the electron of mass  $m_e$ . The wavelength of the deflected photon is  $6.84 \times 10^{-12}$  m.

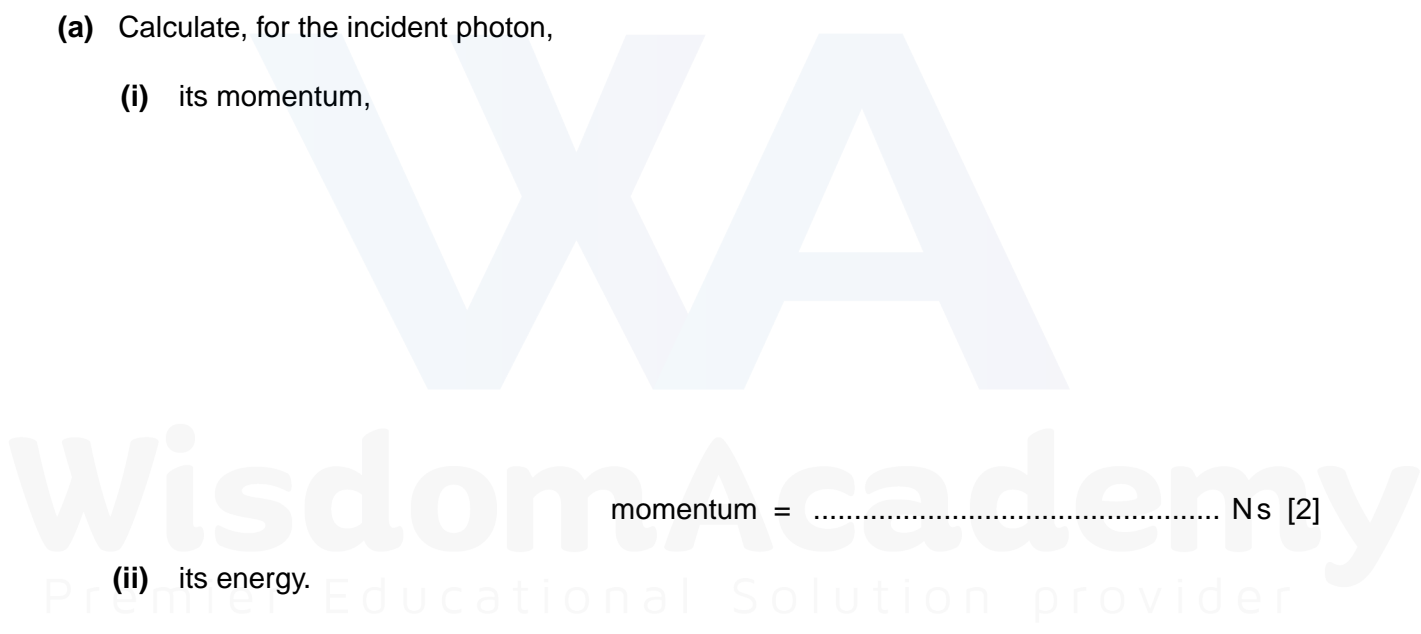
**(a)** Calculate, for the incident photon,

**(i)** its momentum,

momentum = ..... Ns [2]

**(ii)** its energy.

energy = ..... J [2]



(b) The angle  $\theta$  through which the photon is deflected is given by the expression

$$\Delta\lambda = \frac{h}{m_e c} (1 - \cos \theta)$$

where  $\Delta\lambda$  is the change in wavelength of the photon,  $h$  is the Planck constant and  $c$  is the speed of light in free space.

(i) Calculate the angle  $\theta$ .

$\theta = \dots\dots\dots^\circ$  [2]

(ii) Use energy considerations to suggest why  $\Delta\lambda$  must always be positive.

.....  
.....  
.....  
..... [3]

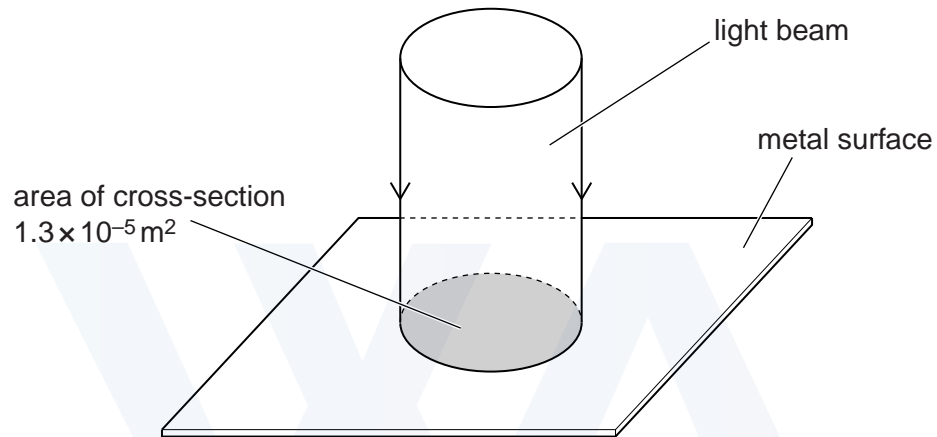
(a) State what is meant by a *photon*.

.....

.....

..... [2]

(b) A beam of light is incident normally on a metal surface, as illustrated in Fig. 8.1.



**Fig. 8.1**

The beam of light has cross-sectional area  $1.3 \times 10^{-5} \text{ m}^2$  and power  $2.7 \times 10^{-3} \text{ W}$ .  
The light has wavelength 570 nm.

The light energy is absorbed by the metal and no light is reflected.

(i) Show that a photon of this light has an energy of  $3.5 \times 10^{-19} \text{ J}$ .

(ii) Calculate, for a time of 1.0 s,

1. the number of photons incident on the surface,

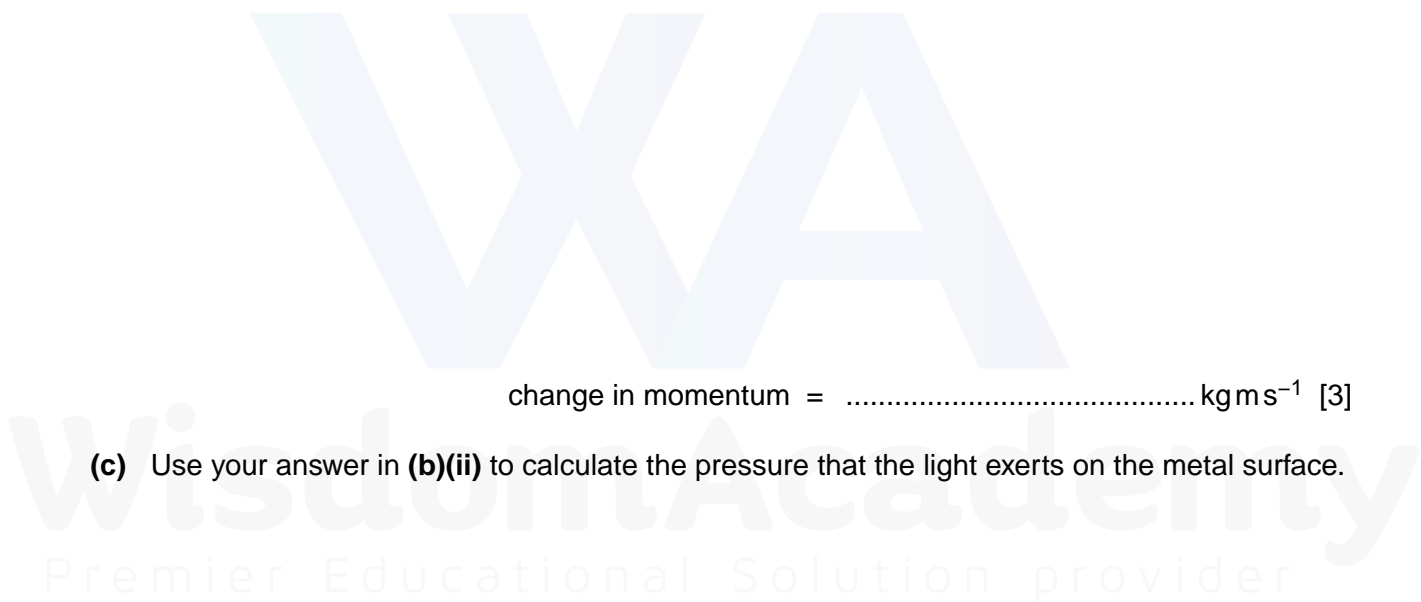
number = ..... [2]

2. the change in momentum of the photons.

change in momentum = ..... kgms<sup>-1</sup> [3]

(c) Use your answer in (b)(ii) to calculate the pressure that the light exerts on the metal surface.

pressure = ..... Pa [2]



For a particular metal surface, it is observed that there is a minimum frequency of light below which photoelectric emission does not occur. This observation provides evidence for a particulate nature of electromagnetic radiation.

(a) State three further observations from photoelectric emission that provide evidence for a particulate nature of electromagnetic radiation.

1. ....
2. ....
3. ....

[3]

(b) Some data for the variation with frequency  $f$  of the maximum kinetic energy  $E_{MAX}$  of electrons emitted from a metal surface are shown in Fig. 9.1.

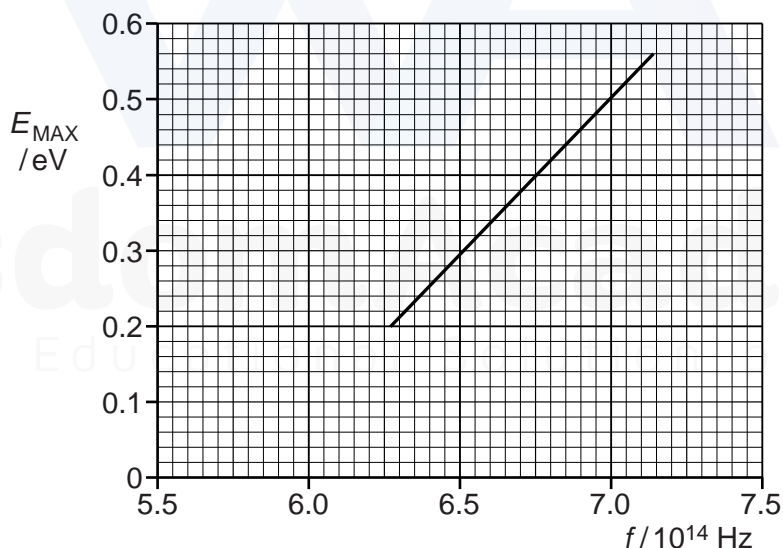


Fig. 9.1

(i) Explain why emitted electrons may have kinetic energy less than the maximum at any particular frequency.

- .....
- .....
- ..... [2]

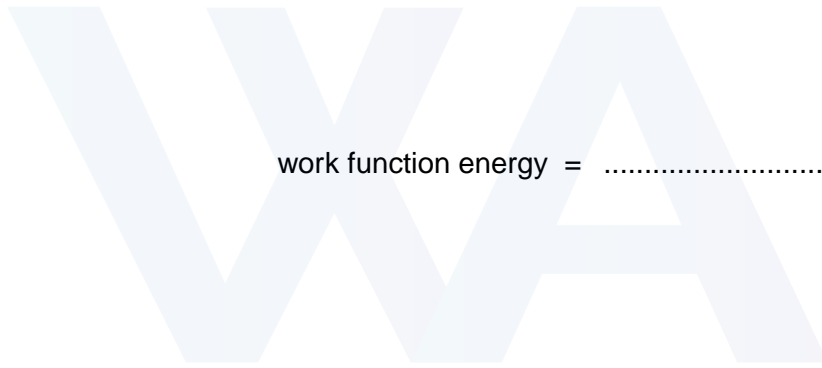
(ii) Use Fig.9.1 to determine

1. the threshold frequency,

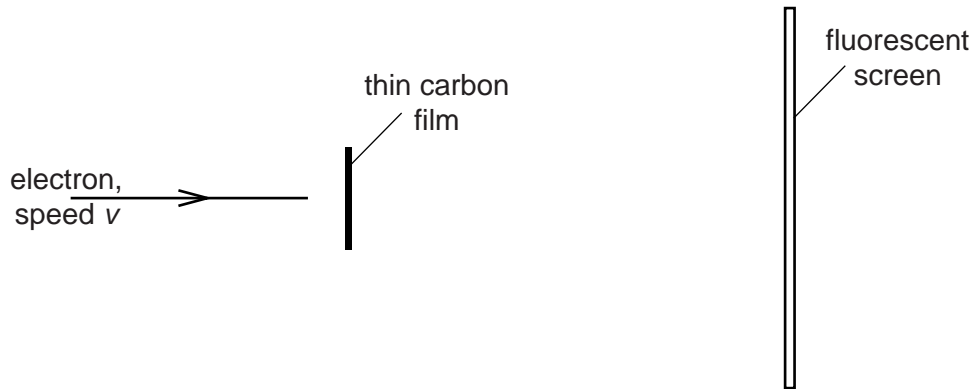
threshold frequency = ..... Hz [1]

2. the work function energy, in eV, of the metal surface.

work function energy = ..... eV [3]



Electrons, travelling at speed  $v$  in a vacuum, are incident on a very thin carbon film, as illustrated in Fig. 7.1.



**Fig. 7.1**

The emergent electrons are incident on a fluorescent screen. A series of concentric rings is observed on the screen.

- (a)** Suggest why the observed rings provide evidence for the wave nature of particles.

.....  
 .....  
 .....

..... [2]

- (b)** The initial speed of the electrons is increased. State and explain the effect, if any, on the radii of the rings observed on the screen.

.....  
 .....  
 .....

..... [3]

- (c) A proton and an electron are each accelerated from rest through the same potential difference.  
Determine the ratio

$$\frac{\text{de Broglie wavelength of the proton}}{\text{de Broglie wavelength of the electron}}$$

ratio = ..... [4]



SAMPLE

CLASS TEST

Date : \_\_\_\_\_

Name : \_\_\_\_\_

Std : AS & A Level

Subject : Chemistry (9701)

Topic : Chemistry of Transition Elements (Paper 4)

Duration : 45 minutes

Max Marks : 25

Marks Obtained : \_\_\_\_\_



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SAMPLE

1 Carboplatin is a drug used to treat cancer. The drug includes the transition element platinum. Its formula is  $C_6H_{12}N_2O_4Pt$ .

(a) (i) Define the term *transition element*.

[1]

.....

.....

(ii) Predict how the melting point and density of platinum compare to the melting point and density of calcium.

[2]

.....

.....

(iii) The outer electrons in a platinum atom are in 5d and 6s orbitals, with the arrangement  $5d^96s^1$ .

Predict the arrangement of the outer electrons in the  $Pt^{2+}$  ion.

[1]

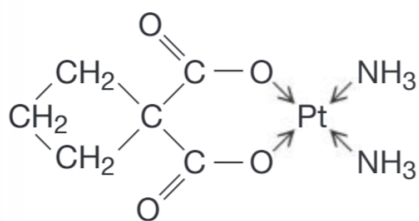
.....

.....

(iv) Sketch two d orbitals with different shapes.

[3]

(b) Carboplatin is a complex. Its structure is shown below. The complex has no overall charge.



(i) Write down the molecular formulae of the two different types of ligand in carboplatin, including their charge if appropriate.

[2]

.....

(ii) Deduce the charge on the platinum ion in carboplatin. Explain your deduction.

[2]

.....  
.....

(iii) Define the term *ligand*.

[1]

.....  
.....

(iv) For each ligand in part (iii), state whether it is monodentate, bidentate or polydentate.

[2]

.....  
.....

(v) Give the co-ordination number of platinum in carboplatin.

[1]

.....  
.....

(vi) Describe the shape of the carboplatin complex ion with respect to platinum.

[1]

.....

(c) Another cancer drug is cisplatin,  $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ .

(i) Draw and name the structures of cisplatin and transplatin.

[2]

(ii) Describe one difference and one similarity between cisplatin and carboplatin.

[2]

.....  
.....  
.....

(d) In the body, cisplatin forms  $\text{cis-}[\text{PtCl}(\text{NH}_3)_2(\text{H}_2\text{O})]^+$ . In cancer cells, the water ligand is displaced by bases in DNA.

(i) Predict the structure of  $\text{cis-}[\text{PtCl}(\text{NH}_3)_2(\text{H}_2\text{O})]^+$ .

[1]

(ii) Explain why the charge of  $\text{cis-}[\text{PtCl}(\text{NH}_3)_2(\text{H}_2\text{O})]^+$  is +1.

[1]

.....

**(iii)** Write an equilibrium expression for the formation of  $cis-[PtCl(NH_3)_2(H_2O)]^+$  as a result of ligand exchange.

[1]

.....

.....

**(iv)** Define the term *stability constant*.

[1]

.....

**(v)** Deduce an expression for the stability constant of the ligand substitution in **(iii)**.

[1]

*SAMPLE*

CAMBRIDGE INTERNATIONAL AS AND A LEVEL

BIOLOGY

(9700)

WORKSHEET

PAPER 1

CELL STRUCTURE

NUCLEIC ACIDS AND PROTEIN SYNTHESIS

TRANSPORT IN PLANTS



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*SAMPLE*

- 1 Which pair of organelles are surrounded by a double membrane?
- A centriole and ribosome  
 B chloroplast and nucleus  
 C Golgi body and mitochondrion  
 D lysosome and rough endoplasmic reticulum

[1]

- 2 Which of the following organelles does **not** contain DNA?

- A chloroplast  
 B mitochondrion  
 C nucleus  
 D ribosome

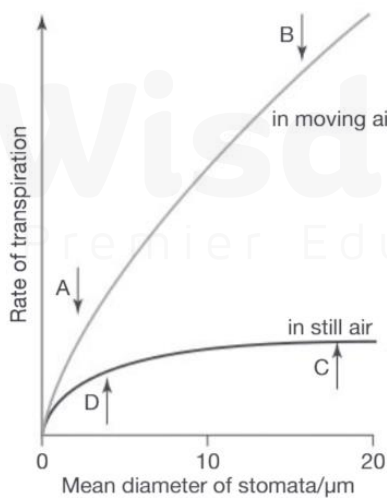
[1]

- 3 Where is the Casparian strip located in a plant?

- A endodermis in roots  
 B epidermis in leaves  
 C xylem in stems  
 D phloem in leaves

[1]

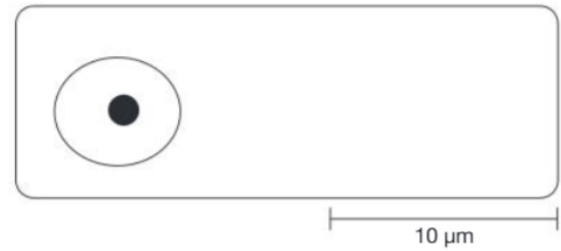
- 4 The graph shows the rate of transpiration of *Tradescantia zebrina* in still air and in moving air.



Which letter indicates the mean stomatal diameter that is not limiting the rate of transpiration?

[1]

- 5 The drawing shows an animal cell.



What is the diameter of the nucleolus?

- A 0.45 nm  
 B 4.5 μm  
 C 1.3 μm  
 D 1.3 mm

[1]

- 6 The following are structures found in cells.

- 1 Golgi body  
 2 lysosomes  
 3 nucleus  
 4 rough endoplasmic reticulum  
 5 smooth endoplasmic reticulum

Which structures are involved in the production of proteins in cells?

- A 1, 3 and 4;                      B 1, 3 and 5;  
 C 2 and 4;                          D 2, 4 and 5

[1]

- 7 Which describes a codon?

- A a part of DNA or mRNA which codes for a specific amino acid  
 B a part of DNA which codes for a particular polypeptide  
 C a part of mRNA that codes for three amino acids  
 D a part of a tRNA molecule that binds to mRNA

[1]

- 8 Plasmodesmata connect adjoining plant cells.  
What is the function of plasmodesmata?
- A allow substances to move between cells without crossing membranes
  - B hold the cell walls of adjoining cells together
  - C allow substances to move through cell surface membranes
  - D allow the formation of cell walls during cell division
- [1]

- 9 Cells can have 70S and 80S ribosomes and circular and linear forms of DNA.  
Which letter in the table below represents a prokaryote?

	70S	80S	circular DNA	linear DNA
A	✓	✓	✓	✓
B	✓	✓	✓	
C	✓		✓	
D		✓		✓

[1]

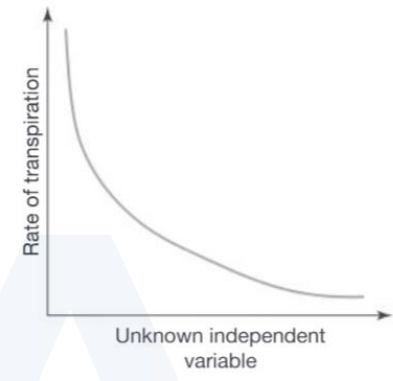
- 10 A student investigated the rate of transpiration.  
The mass of water lost over 24 hours was 620 g.  
The total surface area of the leaves was estimated as 16 m<sup>2</sup>.  
Which shows the rate of transpiration?
- A 0.8 gm<sup>-2</sup>h<sup>-1</sup>
  - B 1.6 gm<sup>-2</sup>h<sup>-1</sup>
  - C 26 gm<sup>-2</sup>h<sup>-1</sup>
  - D 39 gm<sup>-2</sup>h<sup>-1</sup>
- [1]

- 11 The table shows the water potentials of four plant tissues.

Tissue	Water potential/MPa
A	-0.01
B	-1.07
C	-2.60
D	-3.67

Which tissue will show very little change in mass when immersed in distilled water? [1]

- 12 The graph shows the effect of an environmental factor on the rate of transpiration.



Which is the independent variable?

- A humidity
  - B light intensity
  - C temperature
  - D wind speed
- [1]
- 13 Companion cells in phloem tissue have carrier molecules that act as co-transporters.  
Which describes the action of this co-transporter mechanism?
- A moving glucose into the companion cell
  - B moving hydrogen out of the companion cell
  - C moving sodium out of the companion cell
  - D moving sucrose into the companion cell
- [1]

- 14 During transcription nucleotides are assembled along the template strand of DNA to form mRNA.

In a DNA molecule, the triplet CAG on the template strand codes for the amino acid valine.

What is the base sequence of the anticodon on the tRNA to which valine becomes attached?

- A CAG
- B CUG
- C GTC
- D GUC

[1]

- 15 The DNA codons for glutamic acid are GAA and GAG. Two DNA codons for valine are GTG and GTA. In sickle cell anaemia, valine is present in the sixth position in  $\beta$ -globin instead of glutamic acid.

Assuming that a single base pair substitution has occurred, what is the mRNA codon for the amino acid in the sixth position of  $\beta$ -globin in people with sickle cell anaemia?

- A CUC
- B CUT
- C GUG
- D GUU

[1]

- 16 A DNA molecule is replicated to form two molecules of DNA. Which statement about the polynucleotides of the newly replicated DNA molecule is correct?

- A both polynucleotides are made of newly polymerised nucleotides
- B both polynucleotides contain bases from the original molecule
- C one polynucleotide is new and the other was part of the original molecule
- D the base pairs are conserved and have new sugar-phosphate backbones

[1]

- 17 The proportion of guanine in a sample of DNA is 22%. What proportion of the bases are adenine?

- A 22%
- B 28%
- C 44%
- D 56%

[1]

SAMPLE

CAMBRIDGE INTERNATIONAL AS AND A LEVEL

MATHEMATICS

(9709)

WORKSHEET

(PAPER 6)

CONTINUOUS RANDOM VARIABLE



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SAMPLE







4 The continuous random variable  $X$  has p.d.f.  $f(x)$  where

$$f(x) = \begin{cases} 4x(1-x^2) & \text{for } 0 \leq x \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

Find

- (i) the mode
- (ii) the median.

5 The continuous random variable  $X$  has p.d.f.  $f(x)$  where

$$f(x) = \begin{cases} \frac{1}{8}x & \text{for } 0 \leq x \leq 4 \\ 0 & \text{otherwise.} \end{cases}$$

Find

- (i)  $E(X)$
- (ii)  $\text{Var}(X)$
- (iii) the median value of  $X$ .

6 The function  $f(x) = \begin{cases} k(3+x) & \text{for } 0 \leq x \leq 2 \\ 0 & \text{otherwise.} \end{cases}$

is the probability density function of the random variable  $X$ .

- (i) Show that  $k = \frac{1}{8}$ .
- (ii) Find the mean and variance of  $X$ .
- (iii) Find the probability that a randomly selected value of  $X$  lies between 1 and 2.

**SAMPLE**

**CAMBRIDGE INTERNATIONAL AS AND A LEVEL**

**MATHEMATICS**

**(9709)**

**SURPRISE TEST**

**PAPER 1**

**(INTEGRATION)**

Date : \_\_\_\_\_

Name : \_\_\_\_\_

Max Marks : 45

Marks Obtained : \_\_\_\_\_

Duration : 1 Hour 30 Minutes

Remarks :

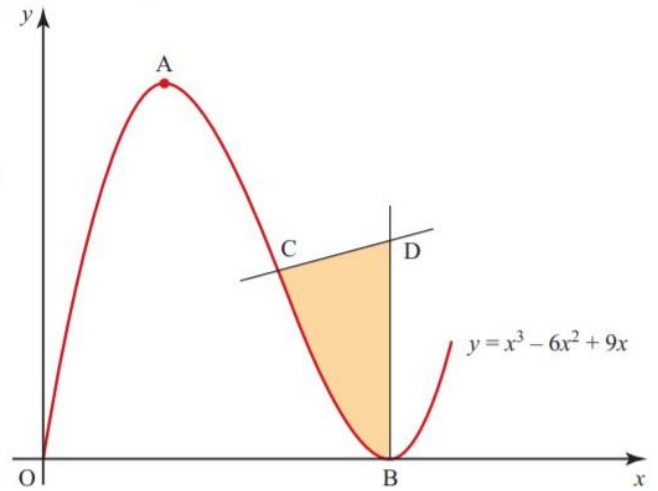
**SAMPLE**





- 4 The diagram shows the curve  $y = x^3 - 6x^2 + 9x$  for  $x \geq 0$ . The curve has a maximum point at A and a minimum point on the  $x$  axis at B. The normal to the curve at C(2, 2) meets the normal to the curve at B at the point D.

- (i) Find the co-ordinates of A and B.
- (ii) Find the equation of the normal to the curve at C.
- (iii) Find the area of the shaded region.



W A

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[9]



6 The graph shows the curve  $y = x^2 - 4$ . The region  $R$  is formed by the line  $y = 12$ , the  $x$  axis, the  $y$  axis and the curve  $y = x^2 - 4$  for positive values of  $x$ .

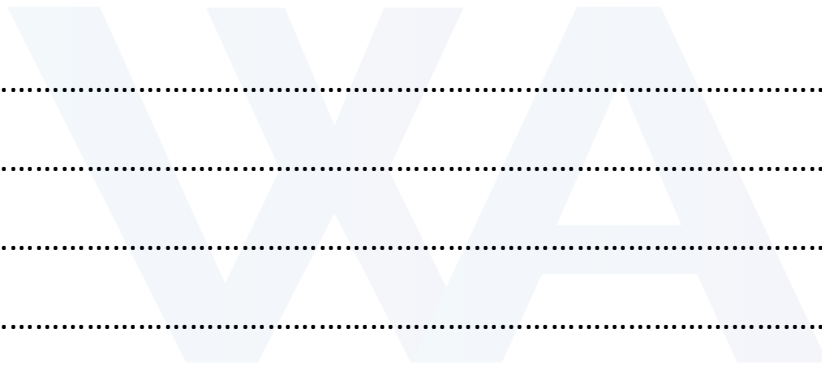
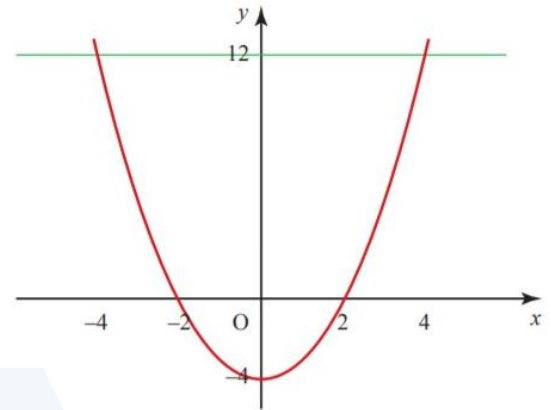
(i) Copy the sketch graph and shade the region  $R$ .

The inside of a vase is formed by rotating the region  $R$  through  $360^\circ$  about the  $y$  axis. Each unit of  $x$  and  $y$  represents 2 cm.

(ii) Write down an expression for the volume of revolution of the region  $R$  about the  $y$  axis.

(iii) Find the capacity of the vase in litres.

(iv) Show that when the vase is filled to  $\frac{5}{6}$  of its internal height it is three-quarters full.



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