School of Mathematical Sciences

ESSENTIAL MATHEMATICS
EXAMINATION

Queen Mary
University of London

Duration: 2 hours. Calculators are NOT permitted.

To pass the exam, you need 12 correct answers.

Record each answer by ticking the corresponding box in the answer form.

1. Determine the number of primes lying between 110 and 130, end-points included

[a] 2 **[b]** 3 **[c]** 4 **[d]** 5 **[e]** not in the list

2. Compute the greatest common divisor of 30^2 and 168

[a] 4 **[b]** 6 **[c]** 12 **[d]** 36 **[e]** not in the list

3. Determine the fractional part of $\frac{1848}{39}$

[a] $\frac{16}{39}$ **[b]** $\frac{18}{39}$ **[c]** $-\frac{8}{13}$ **[d]** $\frac{5}{13}$ **[e]** not in the list

4. Evaluate

$$-\frac{7}{3}+\left[\left(\frac{17}{34}+\frac{1}{3}\right)\left(\frac{6}{5}\right)^{2}-\left(\frac{6}{5}-\frac{9}{12}\right)\left(\frac{4}{3}\right)\right]\div\frac{9}{5}$$

[a] $-\frac{28}{9}$ **[b]** $-\frac{94}{75}$ **[e]** not in the list

[c] -2 **[d]** $-\frac{4}{3}$

5. Estimate

$$x=\frac{40001}{20}\times\frac{1500}{2999}$$

[a] $10^2<x<10^3$ **[b]** $10^3<x<10^4$ **[e]** not in the list

[c] $10^4<x<10^5$ **[d]** $10^5<x<10^6$

6. Simplify

$$\left(\frac{x^2\,z^{-2}}{(1/y)^3}\right)\left(-\frac{y^2\,z}{x\,y^{-1}}\right)^{-3}$$

[a] $\frac{x^5}{z^5y^6}$ **[b]** $-\frac{x^5}{z^5y^{12}}$ **[e]** not in the list

[c] $-\frac{x^5}{z^5y^3}$ **[d]** $\frac{zy^{12}}{x}$

7. Compute the quotient of the following division

$$(x^4-4x+1)\div(x-2)$$

[a] $x^3-4x+12$ **[b]** x^3+2x^2 **[e]** not in the list

[c] x^3-2x^2 **[d]** x^3-2x^2+4x-4

8. When $x^2y + 2x^2 - 9y - 18$ is factored completely, one of the factors is

[a] $x + 3$ **[b]** $xy - 2x - 3y + 6$

[c] $xy - 2x + 3y - 6$ **[d]** $x^2 - 9$ **[e]** not in the list

9. Add and simplify

$$\frac{1}{y-3} - \frac{y+4}{2y^2-5y-3}$$

[a] $\dfrac{3y+5}{2y^2-5y-3}$ **[b]** $\dfrac{3y^2-4y-9}{(y-3)(2y^2-5y-3)}$

[c] $\dfrac{-y-3}{-2y^2+6y}$ **[d]** $\dfrac{1}{1+2y}$ **[e]** not in the list

10. Simplify

$$\left(\frac{x}{a} - \frac{1}{ax}\right)^2 \left(-x - \frac{1}{x}\right)^2 - \left(\frac{1}{x^4} - 2\right) \frac{1}{a^2}.$$

[a] $\dfrac{x^6 - 4x^4 + 8x^2 - 4}{a^2x^2}$ **[b]** $\dfrac{-4 + x^4}{a^2}$

[c] $\dfrac{x^4}{a^2}$ **[d]** $\dfrac{x^4 + 4}{a^2}$ **[e]** not in the list

11. Compute $f(-2z^3)$, where

$$f(x) = -x + \frac{1}{2}x^2 - \frac{1}{4}x^3$$

[a] $2z^6 + 2z^3 + 2z^5$ **[b]** $2z^6 - 2z^9 - 2z^3$

[c] $-2z^3 + z^6 - \dfrac{1}{2}z^9$ **[d]** $z^9 + 2z^3 + 2z^6$ **[e]** not in the list

12. Simplify, eliminating radicals at denominators

$$\frac{30}{\sqrt{75}} - \frac{1}{(\sqrt{3}-2)^2}$$

[a] $-7-2\sqrt{3}$ **[b]** $\dfrac{-1+14\sqrt{3}}{7}$ **[e]** not in the list

[c] $-\dfrac{1}{7}-2\sqrt{3}$ **[d]** $2\sqrt{3}-\dfrac{7+2\sqrt{3}}{37}$

13. Simplify

$$\frac{z^2}{\sqrt{z^2+z^4}}\sqrt{1-\frac{1}{z^4}}$$

[a] $\dfrac{1}{|z|}\dfrac{\sqrt{z^4-1}}{z^2+1}$ **[b]** $\sqrt{\dfrac{z^6-z^4}{(z^2+z^4)z^4}}$ **[e]** not in the list

[c] $\dfrac{1}{z}\dfrac{\sqrt{z^4-1}}{\sqrt{z^2+1}}$ **[d]** $\dfrac{\sqrt{z^2-1}}{|z|}$

14. The equation

$$\frac{8}{3x}+\frac{20}{2x+8}=\frac{6x}{x^2}$$

has, precisely

[a] three solutions **[b]** two irrational solutions **[e]** not in the list

[c] one integer solution **[d]** one non-integer solution

15. The equation $2\sqrt{y+4}=y+1$ has, precisely

[a] no real solution **[b]** a single solution **[e]** not in the list

[c] two integer solutions **[d]** no solution

End of examination paper